Training Manual

Hands-on Training

on

"Advanced Diagnostic and Therapeutic Techniques in Veterinary Practices"

(21-25 July, 2025)

Directorate of Extension Education

Bihar Animal Sciences University, Patna-14

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Sponsored by:

ANIMAL HUSBANDRY AND FISHERIES
RESOURCES DEPARTMENT
GOVT. OF BIHAR

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Message

It gives me immense pleasure to present this training manual entitled **Hands-on Training on "Advanced Diagnostic and Therapeutic Techniques in Veterinary Practices"** prepared for the veterinary officers of Bihar. This manual is a part of the university's ongoing commitment to strengthening the field-level capacities of veterinary professionals through skill-based, practical training aligned with the current demands of animal health and production systems.

There has been significant advancements in recent years, particularly in the domains of diagnostics, therapeutics, and disease management. The livestock sector in Bihar plays a crucial role in ensuring nutritional security and rural livelihoods. Therefore, it is imperative that our veterinary officers are well-equipped with the latest techniques, tools, and approaches in clinical diagnosis and treatment. This training program is specifically designed to provide **hands-on exposure to advanced diagnostic procedures, clinical interpretation, therapeutic interventions, and critical care protocols** relevant to field conditions.

This manual will serve as both a **training guide and a practical reference**, enabling officers to enhance their professional competence and offer improved veterinary services to farmers. The content has been thoughtfully curated by experienced faculty members and domain experts of Bihar Animal Sciences University, keeping in mind the real-world challenges faced in rural veterinary practice.

I extend my sincere appreciation to the organizing team, resource persons, and contributors who have worked diligently to develop this valuable resource. I am confident that the training, along with this manual, will significantly enhance the clinical acumen of our veterinary officers and contribute meaningfully to the health and productivity of livestock in Bihar.

I wish all the participants a fruitful and enriching training experience.

Dr. Umesh Singh
DEE, BASU, Patna

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Extension Services and Programs of the Directorate of Extension Education, BASU, Patna

Y.S. Jadoun, Umesh Singh and A.K. Thakur
Directorate of Extension Education (DEE)
Bihar Animal Sciences University (BASU), Patna

The **Directorate of Extension Education (DEE)** at **Bihar Animal Sciences University (BASU), Patna**, serves as a vital bridge connecting cutting-edge research and innovations developed within the university to the practical needs of farmers across Bihar. Its core mandate is to facilitate the **transfer of scientific knowledge and proven technologies** related to animal husbandry and veterinary sciences directly to livestock owners, rural youth, and other stakeholders involved in the livestock sector.

To fulfil this mission, the directorate undertakes a wide array of **farmer-centric extension activities**, including **capacity-building programs, on-farm demonstrations, village adoption models, mobile veterinary services, BASU Krishi Gyan Vahan, awareness campaigns, and digital outreach initiatives**. These programs are designed to promote best practices in areas such as **livestock health management, breeding, nutrition, fodder production, disease prevention**, and **value-added animal products**.

By engaging with farmers through both physical and digital platforms, the Directorate ensures that the latest innovations and scientific interventions reach the grassroots level, thereby contributing to improved productivity, better animal welfare, and enhanced rural livelihoods. The major extension activities carried out by the Directorate of Extension Education are outlined below.

Farmer Training Programs

Conducts regular **on-campus and off-campus trainings** for farmers, livestock keepers, veterinary officers, dairy field officers, livestock assistants, and rural youth. Such as:

- Dairy farming and milk processing
- Diagnostic and therapeutic techniques in veterinary practices
- Goat and poultry farming
- Fodder production and silage making
- Clean milk production

- Animal health and vaccination

Field-Level Demonstrations and Farmer Interface

a) FLDs and OFTs

Frontline Demonstrations (FLDs) and On-Farm Trials (OFTs) to evaluate and popularize livestock technologies across farming systems.

b) Demonstration Units at KVK, Jamui

The Directorate of Extension Education (DEE), Bihar Animal Sciences University (BASU), Patna, has taken a significant step towards strengthening practical agricultural education and skill development by establishing multiple demonstration units at the newly established Krishi Vigyan Kendra (KVK) in Jamui. These include dedicated units f**or goat, poultry, pig, and cattle rearing, offering vital hands-on training and experiential learning** opportunities to farmers, students, and extension workers.

In addition to livestock units, DEE has also developed essential infrastructure to support comprehensive agricultural extension activities. A nursery demonstration unit has been set up to promote horticultural practices and plant propagation techniques. Two functional borewells have been installed to ensure a reliable water supply for farm operations and irrigation needs. Furthermore, a farm implement shed has been constructed to house agricultural tools and machinery, enabling mechanized demonstrations and equipment familiarization.

To provide continuous support and advisory services to the farming community, a **Kisan Paramarsh Kendra (Farmers' Advisory Center)** has been established. This center serves as a hub for information dissemination, farmer-scientist interactions, and on-the-spot solutions to agricultural challenges. Moreover, a seed production unit has been initiated to facilitate the production and distribution of quality seeds, contributing to improved crop productivity and sustainability in the region.

These developments at KVK Jamui underscore BASU's commitment to integrated, field-livestock based agricultural education and its vision of empowering rural communities through science-led integrated farming practices.

c) New KVK at Jamui

Directorate of Extension Education (DEE) at **Bihar Animal Sciences University**

(BASU), Patna is instrumental in establishing a new KVK, extending the university's presence and outreach in tribal and underdeveloped regions.

Animal Health and Awareness Camps: Organizes **free veterinary health camps** in remote and rural areas.

Services include:

- Deworming
- Disease diagnosis and treatment
- Infertility and reproductive disorder treatments

Also conducts awareness campaigns on zoonotic diseases and hygienic livestock practices.

Farmer-Scientist Interaction Programs: Arranges interactive sessions between university experts and local farmers.

Aims to:

- Solve field-level livestock problems
- Collect feedback for research and extension improvements
- Promote collaborative learning and experience sharing

Collaboration and Networking

Directorate of Extension Education, Bihar Animal Sciences University (BASU), Patna have strong collaboration, linkages and networking with

- BAMETI
- Animal and Fisheries Resources Department (AFRD), Bihar
- NABARD
- COMFED
- JEEViKA
- Bihar Livestock Development Agency (BLDA)
- ICAR-RCER & ICAR-ATARI
- National Commission for Women (NCW), New Delhi
- Dairy Development Department, Bihar

These linkages have facilitated joint training programs, funding, innovation dissemination, and field demonstrations.

Information, Education, and Communication (IEC) Activities

Publication and Distribution of Extension Literature

- Publishes leaflets, booklets, manuals, and newsletters in regional languages for easy understanding.
- Topics include disease management, fodder production, breeding techniques, and value-added dairy products.

Audio-Visual Aids

- Produces educational videos and slide presentations on animal husbandry practices.
- Broadcasts programs through Doordarshan, All India Radio, and local cable networks.

Use of ICT Tools

- Provides information through mobile apps, SMS services, and WhatsApp groups.
- Maintains an online knowledge updates on livestock management at University website

Organization of Exhibitions, Fairs, and Events;

Livestock and Agriculture Fairs (Pashu Melas)

- Hosts exhibitions to showcase latest technologies, breeds, and innovations.
- Offers platform for farmers to interact with scientists and companies.

World Veterinary Day, World Milk Day, and Other Celebrations

- Organizes events to spread awareness on livestock health, nutrition, and productivity.
- Involves school children, farmers, and stakeholders for community participation.

Participation in State/National Exhibitions

- Represents BASU in regional and national agri expos and fairs.
- Demonstrates university innovations and farmer success stories.

Flagship Programs and Initiatives Directorate of Extension Education

Directorate of Extension Education (DEE) at **Bihar Animal Sciences University (BASU), Patna**, implemented numerous innovative extension programs aimed at bridging the gap between research and client system of livestock farmers of the state.

a) Cattle Expo-2023

Organized Bihar's landmark Cattle Expo, promoting livestock technologies, breed improvement, and farmer-scientist interaction.

b) Pashupalan Darshika – Hindi Magazine

To strengthen knowledge dissemination among livestock farmers and rural communities, a Hindi magazine titled **'Pashupalan Darshika'** has been launched as a **quarterly** publication. This magazine is specifically designed to cater to the informational needs of Bihar's rural population, with a focus on promoting best practices in animal husbandry, veterinary care, livestock management, and allied agricultural activities.

'Pashupalan Darshika' serves as an accessible and practical resource, offering expert insights, success stories, seasonal advisories, and scientific recommendations in a language that is both familiar and easy to understand for farmers. The publication aims to bridge the gap between research institutions and the grassroots level by translating technical knowledge into actionable guidance. By empowering farmers with up-to-date and relevant information, the magazine contributes significantly to improving livestock productivity, health, and income generation in rural Bihar.

This initiative reflects a broader commitment to inclusive extension services and the use of regional languages as a medium to enhance outreach and impact across farming communities.

c) e-Kisan Samadhan

A digital initiative leveraging WhatsApp groups for quick advisory delivery, real-time interaction with farmers, and dissemination of weather, disease alerts.

e-Kisan Samadhan is a digital extension initiative launched by the **Directorate of Extension Education, Bihar Animal Sciences University (BASU), Patna**, designed to provide real-time, science-based livestock advisory services to farmers through modern communication tools. The program primarily operates through **WhatsApp groups**, making it easily accessible even to farmers in remote and rural areas. It leverages **live interactive webinars**, expert-led audio-visual sessions, and

regular **video uploads** on dedicated platforms to disseminate practical knowledge related to **animal health care, nutrition, breeding, disease prevention, and scientific livestock management**.

Through this initiative, farmers receive timely solutions to their field-level challenges directly from veterinary and animal husbandry experts. The platform also facilitates two-way communication, allowing farmers to ask questions, share field observations, and adopt improved practices based on expert feedback. By combining digital technology with expert outreach, **e-Kisan Samadhan** plays a vital role in **empowering livestock farmers and rural youth**, enhancing productivity, and promoting sustainable livestock-based livelihoods. It stands as a model for **inclusive, ICT-driven agricultural extension**, effectively bridging the gap between research institutions and grassroots communities.

d) BASU Krishi Gyan Vahan: A Mobile Knowledge Dissemination Initiative

Directorate of Extension Education (DEE), Bihar Animal Sciences University (BASU), Patna has started a unique initiative **"Krishi Gyan Vahan"**, under 4th Krishi Road Map, Govt. of Bihar, a mobile extension, and outreach service aimed at bridging the knowledge gap between researchers, extension personnel, and farmers across Bihar. This initiative plays a crucial role in technology dissemination, awareness creation, and capacity building among livestock and crop farmers, particularly in remote and underserved regions.

The **Krishi Gyan Vahan** is a well-equipped vehicle carrying:

- Audio-visual aids (TV, PA system, projector)
- Training materials, leaflets, and brochures
- Models and samples for demonstration
- Veterinary medicines and diagnostic kits

Teams comprising **BASU scientists**, **veterinary officers**, and **subject matter specialists (SMSs)** from **KVKs** accompany the van during field visits. The Vahan follows a pre-determined schedule covering different blocks and panchayats, in collaboration with the **AFRD**, **KVKs and ATMA**, and other allied departments.

e) Village Adoption Program

Adopted Dariyapur Village of Naubatpur block Patna under a participatory rural extension model focused on dairy and poultry development, with the objective of transforming it into a model village. The initiative aimed at holistic livestock

development, creating a cascading impact in nearby areas by enhancing income levels and generating employment opportunities.

Conclusion

The Directorate of Extension Education at Bihar Animal Sciences University (BASU), Patna, serves as a pivotal force in advancing the university's outreach mission. It plays a crucial role in bridging the gap between scientific research and grassroots application by effectively disseminating knowledge and best practices to farming communities across Bihar. Through a multifaceted approach that includes farmer training programs, awareness campaigns, on-field demonstrations, and collaborative initiatives with governmental and non-governmental organizations, the directorate has made substantial contributions to enhancing the productivity, profitability, and sustainability of livestock farming in the region.

By aligning its activities with emerging technologies and the evolving needs of rural stakeholders, the directorate remains committed to promoting innovation and resilience in the livestock sector. Its dynamic and adaptive strategies not only empower farmers with practical skills and scientific knowledge but also foster a culture of continuous learning and self-reliance.

Principles and Practice of Fluid Therapy in Veterinary Medicine

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Fluid therapy forms a cornerstone of veterinary clinical practice, serving as a life-saving intervention in a wide range of conditions. It is indispensable for restoring and maintaining fluid balance, correcting acid-base and electrolyte imbalances, supporting adequate tissue perfusion, and acting as a medium for delivering medications. In clinical settings, animals often present with varying degrees of dehydration or fluid shifts resulting from trauma, surgical interventions, gastrointestinal disturbances, renal dysfunction, or systemic infections. These conditions can lead to compromised circulation, shock, or multi-organ dysfunction if not managed promptly. Timely and accurate fluid administration—tailored to the type and extent of the fluid loss—is critical in stabilizing patients, improving prognosis, and expediting recovery. Whether employed in emergency resuscitation, perioperative care, or chronic disease management, fluid therapy remains one of the most frequently employed and effective tools in veterinary medicine.

Body Water Distribution and Physiology

Water is the most abundant component in an animal's body, accounting for approximately 60% of total body weight. This total body water is distributed between two primary compartments: intracellular fluid (ICF) and extracellular fluid (ECF). About two-thirds of the total water resides within cells (ICF), where it is essential for maintaining cellular metabolism and biochemical functions. The remaining one-third is located in the ECF, which is further subdivided into the interstitial fluid (three-fourths of ECF) and intravascular fluid or plasma (one-fourth of ECF). This division is critical because the fluid in the intravascular space directly influences blood volume and pressure, while the interstitial fluid serves as the medium through which nutrients, waste products, and gases are exchanged between the blood and cells. Fluid movement between these compartments occurs freely due to the permeability of cell and capillary membranes to water. However, the movement is primarily governed by osmotic gradients created by solute concentrations, particularly electrolytes and plasma proteins. Osmotic pressure and hydrostatic pressure are key forces that regulate fluid exchange, ensuring equilibrium across compartments. Understanding this distribution is crucial in veterinary fluid therapy, as it guides appropriate fluid

selection and volume replacement strategies for restoring physiological balance.

Indications for Fluid Therapy

- Correction of dehydration and hypovolemia
- Management of acid-base and electrolyte imbalances
- Supportive therapy for renal dysfunction
- Drug delivery via constant-rate infusions (CRI)
- Maintenance during perioperative periods
- Inducing diuresis in cases of toxicosis

Types and Classification of Dehydration

Dehydration refers to the loss of body water along with essential electrolytes, resulting in an imbalance in the fluid compartments of the body. It is a common clinical condition encountered in veterinary practice, often secondary to gastrointestinal diseases, renal dysfunction, or systemic illness. Based on the relative loss of water and electrolytes, dehydration is broadly classified into three types: isotonic, hypotonic, and hypertonic. Each type has distinct pathophysiological features and requires tailored fluid therapy for effective correction.

Isotonic Dehydration

This is the most encountered form of dehydration in animals. It involves a proportional loss of water and electrolytes, primarily sodium and chloride, resulting in no significant change in plasma osmolality. Common causes include vomiting, diarrhea, polyuria, and hemorrhage. Because the osmotic balance between intracellular and extracellular compartments remains unchanged, water does not shift significantly between them. However, the loss of extracellular fluid (ECF) volume can compromise perfusion, leading to signs such as decreased skin turgor, prolonged capillary refill time (CRT), dry mucous membranes, and tachycardia. Isotonic crystalloid solutions like Lactated Ringer's Solution or Normal Saline are typically used to correct this type of dehydration.

Hypotonic Dehydration

In hypotonic dehydration, the loss of electrolytes, especially sodium, exceeds the loss of water. This results in decreased plasma osmolality, leading to a net movement of water from the extracellular space into the intracellular space, causing cellular swelling. This condition is commonly seen in cases of secretory diarrhea caused by pathogens like Escherichia coli or Salmonella, as well as in conditions such as pyloric stenosis and gastric dilatation-volvulus. Clinical signs may include lethargy, muscle

weakness, and in severe cases, neurological manifestations due to cerebral edema. Treatment involves administering isotonic or mildly hypertonic fluids, often supplemented with sodium, to restore osmotic balance and correct the deficit.

Hypertonic Dehydration

This type results from a greater loss of water than electrolytes, causing increased plasma osmolality. Water shifts from the intracellular to the extracellular space in an attempt to restore osmotic balance, leading to cellular dehydration. Conditions such as diabetes insipidus, inadequate water intake, and excessive panting or fever commonly cause hypertonic dehydration. Affected animals may exhibit marked thirst, dry mucous membranes, and signs of neurological dysfunction like ataxia and seizures. Rapid correction with hypotonic fluids should be avoided due to the risk of cerebral edema; instead, gradual rehydration using isotonic or slightly hypotonic solutions is preferred.

Clinical Signs

Recognizing the clinical signs of dehydration is critical for timely diagnosis and appropriate fluid therapy. Dehydration in animals is assessed by estimating the percentage of total body water lost, with severity ranging from mild and subclinical to life-threatening. When dehydration is less than 5%, clinical signs are often absent or very subtle, making it difficult to detect without laboratory testing. At 5–6%, signs such as tacky (sticky) mucous membranes and a slight delay in skin tenting may be observed, indicating mild dehydration. Moderate dehydration (7–8%) is characterized by more obvious clinical signs, including dry mucous membranes, sunken eyes, prolonged capillary refill time (CRT of 2–3 seconds), and decreased skin elasticity. In severe cases (10–12%), signs include markedly sunken eyes, cold extremities, CRT exceeding 3 seconds, severe skin tenting, and signs of circulatory collapse or early shock. Dehydration exceeding 12–15% is critical and often results in hypovolemic shock, collapse, and death if not immediately corrected. Consistent evaluation of mucous membrane moisture, CRT, skin turgor, eye position, and general demeanor is essential in assessing dehydration severity and guiding fluid therapy.

Diagnostic Evaluation

- Laboratory values aid in diagnosing and grading dehydration:
- PCV & Total Protein: Increased in dehydration
- Serum electrolytes: Guide specific replacement therapy
- BUN/Creatinine: Elevated in pre-renal azotemia

- USG (Urine SG): >1.030 suggests renal response to dehydration

Types of Fluids

Fluid therapy in veterinary medicine relies on two major categories of fluids: crystalloids and colloids. The choice depends on the type and severity of dehydration, the underlying disease condition, and the therapeutic goal, whether it is volume expansion, maintenance, or correction of electrolyte or acid-base imbalances.

A. Crystalloids

Crystalloids are water-based solutions containing small molecules such as electrolytes and sugars that can easily cross capillary membranes. They are the most used fluids in veterinary practice due to their affordability and broad applicability.

1.IsotonicCrystalloids

These solutions have osmolality similar to plasma and are ideal for rehydration, electrolyte correction, and general fluid replacement.

0.9% Normal Saline (NaCl): Sodium-rich; lacks potassium and calcium. Used in cases of vomiting, diarrhea, and metabolic alkalosis.

Lactated Ringer's Solution (LRS): Contains sodium, potassium, calcium, chloride, and lactate (a buffer). Suitable for treating metabolic acidosis and general fluid loss.

Ringer's Solution: Similar to LRS but without lactate; preferred in large animals that are prone to alkalosis.

Normosol-R and Plasmalyte: Balanced electrolyte solutions; good for perioperative and critical care patients.

Dosage (dogs/cats/cattle)

Maintenance: 40–60 ml/kg/day

Replacement: Depends on % dehydration (e.g., 10% dehydration in a 25 kg dog = 2500 ml over 24 hrs)

Shock Dose: Dogs – up to 90 ml/kg/hr; Cats – 50–60 ml/kg/hr

2. Hypotonic Crystalloids

5% Dextrose in Water (D5W): Provides free water, not suitable for volume expansion. Used to manage hypoglycemia, especially in neonates or septic patients.

3. Hypertonic Crystalloids

3–7.5% Hypertonic Saline: Draws fluid from interstitial and intracellular compartments into the vascular space. Rapidly improves blood pressure in cases of hypovolemic or endotoxic shock.

Dosage: 4–5 ml/kg IV over 5–10 minutes (dogs, cattle); must be followed by isotonic crystalloids to maintain fluid balance.

B. Colloids

Colloids are fluids containing large molecules that remain within the vascular compartment, making them ideal for maintaining oncotic pressure and plasma volume in hypoproteinemic or hypotensive animals.

1. Natural Colloids

Whole Blood: Used in hemorrhagic shock or severe anemia.
Plasma: Corrects hypoproteinemia and coagulopathies.
Packed RBCs: Indicated in anemic but normovolemic animals.
Dosage:
Whole Blood: 10–20 ml/kg IV
Plasma: 10–15 ml/kg IV
Packed RBCs: 1 unit/10–20 kg body weight

2. Synthetic Colloids

Hetastarch (e.g., Vetplasma), Dextrans: Effective in maintaining blood pressure during shock and severe hypoalbuminemia. They provide rapid plasma volume expansion and are often used in combination with crystalloids.
Dosage
Dogs: 5–10 ml/kg IV over 15–30 minutes
Cattle: 8–10 ml/kg IV
Small animals: 10–20 ml/kg/day, adjusted based on CVP and hydration status
In all cases, fluid therapy must be carefully monitored to prevent complications like fluid overload, pulmonary edema, or electrolyte disturbances. Regular reassessment of clinical and laboratory parameters is vital for ensuring safe and effective treatment. Choosing the appropriate fluid type is a critical step in effective fluid therapy, as it directly impacts the correction of underlying physiological disturbances. The decision should be based on a thorough clinical assessment of the animal, supported by laboratory data. Several factors must be considered, including the type and extent of fluid loss, electrolyte imbalances, acid-base status, and the specific pathophysiology of the disease involved.

Fluid Selection Based on Clinical Condition

The nature of fluid loss, whether isotonic, hypotonic, or hypertonic—plays a central role in fluid selection. For isotonic dehydration, isotonic crystalloids such as Lactated Ringer's Solution (LRS) or Normal Saline (0.9% NaCl) are typically used. In cases of

acidosis, LRS is preferred due to its lactate content, which serves as a buffer and is converted into bicarbonate by the liver. Conversely, in patients with metabolic alkalosis, Ringer's Solution (which lacks lactate) is more suitable, particularly in large animals prone to alkalosis. Hypertonic saline is used in emergency situations such as shock to rapidly expand plasma volume, but it must be followed by isotonic fluids to prevent rebound dehydration.

Electrolyte-Based Fluid Modification

Electrolyte supplementation is often necessary to tailor the fluid therapy to the patient's needs.

Potassium (K): Hypokalemia is defined as serum K levels below 3.5 mEq/L and is commonly associated with prolonged anorexia, diarrhea, or diuretic use. Potassium chloride can be added to fluids cautiously (not exceeding 0.5 mEq/kg/hr) to correct the deficit.

Bicarbonate (HCO): Indicated in metabolic acidosis, often seen in severe diarrhea or renal failure. The bicarbonate requirement is calculated using the base deficit **formula:**

HCO needed (mEq) = Base Deficit × 0.3 × Body Weight (kg).

Overcorrection should be avoided as it may lead to alkalosis and neurologic complications.

Dextrose: Used in cases of hypoglycemia, liver disease, sepsis, or neonatal weakness. A 5% dextrose solution can maintain normoglycemia, while 50% dextrose diluted appropriately is used for acute correction.

Calcium (Ca^{2}): Hypocalcemia may occur in parturient paresis or sepsis. Calcium gluconate is commonly administered slowly IV while monitoring cardiac function.

Appropriate fluid selection and supplementation not only restore fluid balance but also correct metabolic derangements, support organ function, and improve clinical outcomes. Regular monitoring of clinical signs, urine output, and laboratory values is essential for adjusting the therapy accordingly.

Routes of Administration

IV: Preferred (jugular, cephalic, saphenous)
Intraosseous: For neonates, rapid access
Intraperitoneal: For young animals (slow absorption)
Subcutaneous: Only for mild dehydration (avoid 5% dextrose)

Fluid Calculation and Therapy Plan

Formula:

Fluid required (ml) = {Body weight (g) × % dehydration} + Estimated ongoing

losses + Maintenance
Maintenance requirement:
{(BW in kg × 30) + 70} ml/day
Example:
25 kg dog, 10% dehydrated = 25000 g × 0.10 = 2500 ml (deficit)
Fluid distribution:
Total Body Water (TBW) loss = 2500 ml
ECF (⅓ of TBW) = ~833 ml
IVF (¼ of ECF) = ~208 ml

Fluid Infusion Rates and Monitoring
Shock Rate (dog): Up to 90 ml/kg/hr with close CVP monitoring
General Protocol:
- 1st hr: 13-14 ml/kg/hr
- 2nd hr: 10 ml/kg/hr
- 3rd hr: 5 ml/kg/hr
- 4th hr onward: 2 ml/kg/hr

Monitor:
- Daily weight
- Lung sounds (for overload)
- CRT, urine output, CVP

Signs of Overhydration:
- Serous nasal discharge
- Crackles, restlessness
- Drop in PCV/TP, increased BP

Fluid Therapy in Specific Conditions
Fluid therapy plays a vital role in the management of various disease-specific conditions in animals by restoring and maintaining circulatory volume, correcting electrolyte and acid-base imbalances, and supporting organ function. In conditions such as shock, diarrhea, vomiting, ketosis, and renal dysfunction, timely and tailored fluid administration can be lifesaving. The type, volume, and rate of fluids must be carefully chosen based on the pathophysiology of the disease, species involved, and clinical status of the patient. Accurate fluid therapy not only improves recovery and survival rates but also enhances the effectiveness of concurrent treatments.

This table summarizes fluid therapy recommendations across various disease conditions in dogs, cats, and cattle, including appropriate fluid types and dose rates. It

is designed to aid clinical decision-making in common scenarios.

Condition	Species	Fluid Choice	Dose Rate	Notes
Ketosis	Cattle	5–10% Dextrose IV + oral propylene glycol	500–1000 ml IV over 30–60 min daily	Common post-partum; combine with energy sources
	Dogs/Cats	0.9% NaCl → 0.45% NaCl + 2.5–5% Dextrose	10–20 ml/kg/hr	For diabetic ketoacidosis (DKA)
Vomiting	Dogs/Cats	LRS or 0.9% NaCl + KCl	Maintenance + deficits + ongoing loss	Monitor electrolytes, esp. K
	Cattle	0.9% NaCl ± KCl ± Calcium	40–80 ml/kg IV	Often metabolic alkalosis due to reflux
Diarrhea	Dogs/Cats	LRS + KCl ± bicarbonate	Based on % dehydration + losses	Commonly causes metabolic acidosis
	Calves	Oral fluids (mild), IV isotonic bicarbonate or LRS + glucose	80–100 ml/kg IV over 4–6 hr	Assess acidosis; add glucose for energy
Cerebral Edema	Dogs/Cats	Hypertonic saline (3%) or Mannitol	4–5 ml/kg hypertonic saline or 1–2 g/kg Mannitol IV	Avoid hypotonic fluids (e.g., D5W)
Meningitis	Dogs/Cats	Isotonic crystalloids (LRS, Normosol-R)	40–60 ml/kg/day (maintenance)	Monitor neurologic status
	Calves	LRS + glucose + antibiotics	60–100 ml/kg IV over 6–8 hr	Supportive + antimicrobial therapy
Fever	Dogs/Cats	LRS or Plasmalyte	Maintenance + 10–20% extra per °C rise	Compensate for insensible fluid loss
	Cattle	Ringer's or Normal saline	Add 4.5–5 L/day per 1°F (0.55°C) temp increase	Adjust total fluid intake accordingly
Jaundice	Dogs/Cats	LRS or 0.9% NaCl (avoid lactate in severe liver dysfunction)	Maintenance rate (40–60 ml/kg/day)	Supportive; monitor liver enzymes and hydration
Hepatitis	Dogs/Cats	0.9% NaCl ± glucose ± potassium	Maintenance + correction of deficits	Avoid lactate-containing fluids in severe hepatic disease
Renal Failure (Acute)	Dogs/Cats	0.9% NaCl, Plasmalyte, Normosol-R	60–90 ml/kg/day or based on urine output	Monitor BUN, creatinine, and electrolytes closely
Renal Failure (Chronic)	Dogs/Cats	Subcutaneous LRS or Normosol-R	10–20 ml/kg/day SC	Used for long-term maintenance at home
Ascites	Dogs/Cats	0.9% NaCl ± colloids (Hetastarch)	Maintenance only, avoid aggressive boluses	Cautious use to prevent worsening effusion
Congestive Heart Failure	Dogs/Cats	Restricted fluids, low sodium (¼ strength saline)	2–4 ml/kg/hr IV or < maintenance	Monitor for pulmonary edema; avoid overload
Anemia	Dogs/Cats	Whole blood or packed RBCs	10–20 ml/kg IV over 1–2 hrs	Corrects oxygen-carrying capacity in severe cases
Pancreatitis	Dogs/Cats	LRS or Normosol-R + KCl	Maintenance + ongoing loss (60–90 ml/kg/day)	Avoid fatty emulsions; correct electrolyte losses

Conclusion

Fluid therapy is an indispensable tool in veterinary clinical practice, providing critical support in a wide range of disease conditions—from dehydration, shock, and renal failure to systemic infections, hepatic dysfunction, and cardiac disorders. Its

effectiveness lies in the accurate assessment of fluid deficits, electrolyte imbalances, and the underlying pathophysiology of the disease. Tailoring fluid type, volume, and administration route to the specific needs of each patient-whether a calf with diarrhea, a cat with renal disease, or a dog with pancreatitis-ensures optimal therapeutic outcomes. Close monitoring during therapy, including hydration status, urine output, cardiovascular and respiratory parameters, is essential to prevent complications such as fluid overload or electrolyte disturbances. Mastery of fluid therapy principles significantly improves survival, accelerates recovery, and enhances the overall standard of veterinary care.

References

1. Allen, D.G., and Holm, J.L. (2003). "Shock and Fluid Resuscitation." *Veterinary Clinics of North America: Small Animal Practice*, 33(6): 1107–1129. Elsevier.
2. Constable, P.D., Hinchcliff, K.W., Done, S.H., and Grünberg, W. (2017). *Veterinary Medicine: A Textbook of the Diseases of Cattle, Horses, Sheep, Pigs and Goats.* 11th ed. Saunders Elsevier.
3. DiBartola, S. P. (2012). *Fluid Therapy in Small Animal Practice* (3rd ed.). St. Louis, MO: Elsevier Health Sciences.
4. Gough, A., and Murphy, K. (2018). *Differential Diagnosis in Small Animal Medicine.* 3rd ed. Wiley-Blackwell.
5. Guyton, A.C., and Hall, J.E. (2016). *Textbook of Medical Physiology.* 13th ed. Elsevier Saunders.
6. Nelson, R.W., and Couto, C.G. (2019). *Small Animal Internal Medicine.* 6th ed. Elsevier.
7. Plumb, D.C. (2018). *Plumb's Veterinary Drug Handbook.* 9th ed. Wiley-Blackwell.
8. Sarma, K., Chethan, G.E., Kumar, M., Das, G., Sarvanan, M., Rajesh, J.B., & Thakur, N. (2023). *A Textbook of General and Systemic Veterinary Medicine.* 1st ed. New Delhi Publishers.
9. Singh, A., and Sirohi, A. (2016). *Veterinary Clinical Practice Manual.* ICAR – Indian Council of Agricultural Research.
10. Thrall, M.A., Weiser, G., Allison, R.W., and Campbell, T.W. (2012). *Veterinary Hematology and Clinical Chemistry.* 2nd ed. Wiley-Blackwell.
11. Willard, M.D., and Tvedten, H. *Small Animal Clinical Diagnosis by Laboratory Methods.*

Transfusion Medicine in Veterinary Practice: Indications, Protocols, and Complications

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Blood transfusion is a vital therapeutic procedure in veterinary medicine, essential for both large and small animal practice. It involves transferring whole blood or specific blood components from a donor to a recipient to restore blood volume, enhance oxygen delivery, and correct hemostatic disorders. With advancements in species-specific blood typing, compatibility testing, and component therapy, the scope of transfusion medicine has significantly expanded. In ruminants such as cattle, sheep, and goats, transfusions are primarily indicated in cases of acute hemorrhage or severe parasitic anemia. In contrast, in companion animals like dogs and cats, transfusion therapy is more commonly employed and encompasses a broader range of indications, including immune-mediated and coagulopathic disorders.

Blood Group System

Blood groups are determined by specific antigens present on the surface of red blood cells (RBCs). Each species exhibits unique and complex blood group systems. Understanding these systems is crucial to avoid hemolytic reactions during transfusion.

(i) Cattle

Possess 11 recognized blood group systems: A, B, C, F, J, L, M, R, S, T, Z, and U. The B system is the most complex and clinically significant, with numerous alleles leading to high antigenic diversity. True blood typing is challenging in cattle so cross-matching is often used in practice.

(ii) Sheep and Goats

Multiple blood group systems similar to cattle, though fewer alleles. Clinical relevance in transfusion is less well defined compared to bovines.

(iii) Dogs

In dogs over 12 Dog Erythrocyte Antigen (DEA) systems have been identified, in which DEA 1.1 is the most clinically important for transfusion compatibility. Dogs do not have naturally occurring alloantibodies, so the first transfusion (if DEA 1.1 status is unknown) is often tolerated, but subsequent transfusions require cross-

matching or typing.

(iv) Cats

There are three major blood types in cats: A, B, and AB. Type A is most common worldwide, while Type B is more prevalent in some breeds (e.g., British Shorthair). Cats possess naturally occurring alloantibodies, so even the first transfusion must be blood type-matched to avoid fatal reactions.

Clinical Indications for Blood Transfusion in Veterinary Practice

Blood transfusions are indicated in a variety of clinical conditions. In cattle, sheep, and goats, the primary indications include acute blood loss due to trauma or surgery, parasitic anemia (e.g., Haemonchosis), and coagulopathies. In small animals, indications extend to immune-mediated hemolytic anemia (IMHA), rodenticide poisoning, thrombocytopenia, disseminated intravascular coagulation (DIC), and hypoalbuminemia. Fresh whole blood, packed red blood cells (pRBCs), plasma, and platelet-rich plasma are used according to the specific need of the patient.

Requirement for safe transfusion

Blood transfusion requires appropriate materials for safe collection, storage, and administration:

(i) Blood bags with anticoagulants (e.g., CPDA)
(ii) Blood administration sets with filters (BT set)
(iii) Sterile syringes and needles
(iv) Centrifuge for component separation
(v) Cross-matching and typing kits
(vi) Refrigerators and freezers for storage

Selection of donor

Ideal blood donors should be clinically healthy, appropriately vaccinated, and free from infectious diseases. In cattle and small ruminants, donors are typically selected from the same herd to minimize disease transmission risk. A bovine donor can safely donate up to 10–15 mL/kg of body weight. For companion animals, dogs weighing more than 25 kg and cats over 4.5 kg are generally considered suitable donors. Comprehensive screening is essential—dogs should be tested for *Babesiosis*, *Anaplasmosis*, and *Ehrlichiosis*, while cats must be negative for FeLV and FIV. Recipient animals should undergo thorough clinical evaluation, including packed cell volume (PCV), physical examination, and hemodynamic assessment, to confirm the necessity of transfusion.

Pre-Transfusion Compatibility Assessment (Cross-Match Procedures)

Cross-matching is an essential laboratory procedure conducted prior to blood transfusion to confirm compatibility between donor and recipient. Its primary purpose is to prevent potentially life-threatening immunologic reactions resulting from blood group incompatibility. This test identifies naturally occurring or acquired antibodies that can trigger hemolysis or agglutination of red blood cells (RBCs), ensuring safer transfusion outcomes.

Types of Cross-Match

Major Cross-Match:

- Involves testing the recipient's serum (containing antibodies) against the donor's red blood cells.
- Detects antibodies in the recipient that could destroy donor RBCs, making it the most critical component of compatibility testing.
- Mandatory in all species, particularly in cats and in dogs with a history of previous transfusions.

Minor Cross-Match:

- Involves testing the donor's serum against the recipient's red blood cells.
- Detects antibodies in the donor's plasma that could react with the recipient's RBCs.
- Considered less critical in dogs, as donor plasma is typically diluted or removed when packed red blood cells are used.

Materials Required

- Fresh blood samples from **donor** and **recipient**:
    - **EDTA tube** (for RBCs)
    - **Plain tube** (for serum)
- Centrifuge
- Microscope slides and cover slips
- Normal saline (0.9% NaCl)
- Test tubes (preferably labeled)
- Water bath (37°C)
- Light microscope
- Pipettes or droppers

Detailed Procedure for Cross-Matching

1. Sample Preparation

Collect 2–3 mL of blood from both donor and recipient:

- **Serum Preparation:** Centrifuge clotted blood samples at **1500 rpm for 10 minutes** to obtain serum.
- **RBC Preparation:** From EDTA blood, wash red blood cells **3–4 times** with normal saline, centrifuging each time at **1500 rpm for 2–3 minutes**.
- After the final wash, prepare a **2–5% RBC suspension** in normal saline.

Major Cross-Match

- Mix **2 drops of recipient serum** with **1 drop of donor RBC suspension**
- Incubate at 37°C for 15–30 minutes.
- Examine:
    - **Macroscopically** for hemolysis or agglutination.
    - **Microscopically** under 10x or 40x for RBC clumping (agglutination).

Minor Cross-Match

- Mix **2 drops of donor serum** with **1 drop of recipient RBC suspension**
- Follow same incubation and examination steps as above.

Control Tubes (Optional but Recommended)

- To validate results and rule out nonspecific reactions:
    - **Auto-control:** Mix recipient serum with recipient RBCs.
    - **Saline control:** Mix saline with RBC suspension (ensures no spontaneous agglutination).

Interpretation of ResultsFindingInterpretationAction Absence of hemolysis or agglutinationCompatibleSafe to transfuseHemolysis or agglutination in majorIncompatibleDo **not** use donor**Important Species-Specific Notes**

Cats:

- Have naturally occurring alloantibodies.
- Cross-matching is mandatory, even for the first transfusion.

Dogs:

- First transfusion is generally safe without cross-matching, provided the donor and recipient are healthy and have no transfusion history.
- Cross-match required for any subsequent transfusions or when history is unknown.

Ruminants:

- May tolerate the first mismatched transfusion, but cross-matching is strongly recommended—especially for valuable animals or when repeat transfusions are planned.

Procedure of Blood Collection and Transfusion

Blood is collected aseptically from the jugular vein using anticoagulant-containing blood collection bags. It should be gently agitated during collection. For transfusion, blood is warmed to room temperature and administered intravenously via a filter. The rate starts at 0.5–1 mL/kg/hr for the first 15 minutes to monitor for reactions, then increased up to 10 mL/kg/hr. Total transfusion volume should not exceed 20 mL/kg per session and be completed within four hours.

Benefits of Transfusion

Transfusion provides immediate physiological benefits:

- Restores oxygen-carrying capacity (RBCs)
- Replenishes clotting factors (plasma)
- Corrects thrombocytopenia (PRP)
- Maintains oncotic pressure (albumin)

In ruminants, it significantly improves survival in periparturient hemorrhage and parasitic anemia. In small animals, targeted component therapy reduces the risk of volume overload and improves clinical outcomes in IMHA, DIC, and surgical interventions.

Adverse Reactions and Their Management

Adverse transfusion reactions include:

- Hemolytic reactions: due to mismatched blood
- Febrile non-hemolytic reactions
- Allergic reactions: urticaria, vomiting
- Anaphylaxis
- Infectious disease transmission
- Hypocalcemia due to citrate toxicity

To avoid these, use typed and cross-matched blood, start transfusions slowly, monitor continuously, and use appropriate filters. Corticosteroids or antihistamines may be pre-administered in at-risk patients.

Conclusion

Blood transfusion and component therapy play a critical role in modern veterinary care for both companion animals and livestock. The success of these procedures relies on species-specific understanding, proper donor and recipient selection, and vigilant monitoring throughout the process. With advancements in transfusion medicine and improved access to diagnostic tools, veterinarians can now implement

safer, more effective protocols—significantly improving patient survival and clinical outcomes.

References

1. **Guyton AC, Hall JE.** (2020). *Textbook of Medical Physiology,* 14th ed.
2. **Jain NC.** (1993). *Essentials of Veterinary Hematology.*
3. **Nelson RW, Couto CG.** (2019). *Small Animal Internal Medicine,* 6th ed.
4. **Plumb DC.** (2018). *Plumb's Veterinary Drug Handbook,* 9th ed.
5. **Schalm OW, Jain NC, Carroll EJ.** (1975). *Veterinary Hematology,* 3rd ed.
6. **Stockham SL, Scott MA.** (2008). *Fundamentals of Veterinary Clinical Pathology.*
7. **Thrall MA et al.** (2012). *Veterinary Hematology and Clinical Chemistry.*
8. **Tizard IR.** (2021). *Veterinary Immunology,* 11th ed.
9. **Wardrop KJ.** (2004). Transfusion medicine in small animals. *Vet Clin North Am Small Anim Pract*

Bandaging techniques in animals

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Bandaging is the process of applying a bandage to an injury or a part of the body. This is often done to hold a dressing in place, provide support, or control bleeding. Additionally, bandaging can be used to secure a splint or provide compression. Patients owner visit veterinary clinics with various types of wounds, including those caused by road traffic accidents, bite injuries, surgical site infections, and chronic draining tracts. Managing wounds can be challenging and frustrating, especially when faced with multidrug-resistant organisms or other underlying health issues. While the physiology of wounds can be complex, most can be effectively managed in general practice settings. The type and location of the wound will influence treatment recommendations and determine whether a bandage is necessary. Bandages are usually made of cloth or other materials and come in various forms, including roller bandages and triangular bandages. Bandaging techniques in animals involve applying layers of material to protect wounds, provide support, or prevent further injury. Proper bandaging is crucial for healing and preventing complications, and should be done by a veterinarian or trained professional. Important aspects of bandaging include wound preparation, choosing the right materials, applying the layers correctly, and securing the bandage. It's essential to monitor for any complications. Bandages should be changed regularly as advised by your veterinarian, particularly if they become wet, soiled, or show any signs of infection. Proper bandage care and topical treatments can enhance wound healing. Wounds can be treated in various ways; thus, it is essential to select the appropriate treatment based on the wound's location and healing stage.

Purpose of Bandaging:

Bandaging techniques in animals are essential for wound management, stabilization of injuries, and overall patient comfort.

- **Securing dressings:** Bandages are crucial for holding dressings (which are applied directly to the wound) in place over wounds.
- **Controlling bleeding:** Applying pressure with a bandage can help control haemorrhage from a wound.
- **Providing support:** Bandages can immobilize or support an injured limb or joint,

preventing further injury.

- **Securing splints:** Bandages are used to hold splints in place, which are used to immobilize fractures or dislocations.

Layers of a bandage:

Primary (contact) layer: The first layer of the bandage is the primary or contact layer. This layer should be placed sterilely. Wet-to-dry and dry-to-dry gauze dressings are older techniques used to clean a wound. For wounds in the initial phases of healing, wet-to-dry bandages can be used. Wet-to-dry bandages provide nonspecific mechanical debridement when they are removed; therefore, they should be avoided in wounds that have a healthy granulation bed. Wet-to-dry bandages consist of saline-soaked gauze, lactated Ringers solution, or 0.05% chlorhexidine diacetate solution is used to wet the gauze before placing it on a wound with viscous exudate or necrotic material. However, the current standard is moist wound healing. Moist wound healing allows excessive exudate to be removed with appropriate topical therapy and provides moisture to the wound. Regardless of bandage type used, the wound should not be excessively wet or dry. Exudates are diluted and absorbed into the secondary bandage layer. The fluid evaporates, the bandage dries and adheres to the wound. Bandage removal results in removal of adherent necrotic tissue and debris. Because this removal may be painful, moistening the gauze with warm 2% lidocaine may make removal more comfortable for the animal. On cats, warm saline is used to moisten the gauze. Dry-to-dry gauze bandages are used to clean wounds that have a low viscosity exudate. The gauze is applied dry, and it absorbs the exudate, which evaporates.

Secondary (absorbent/padding) layer: The secondary layer of Robert Jones (RJ) bandage consists of cast padding and conform gauze, which can absorb any exudate that escapes the primary layer. Cast padding should begin at the distal portion of the limb and work proximally. Cast padding cannot be put on too tight as it will rip, but it should be placed without wrinkles to avoid creating bandage sores. Each layer should at least overlap 50% with the previous layer. The purpose of the layer is to absorbs wound exudate, provides cushioning, and helps maintain a moist wound environment for healing.

Tertiary (outer) layer: The tertiary layer of RJ bandage is self-adherent bandaging tape (e.g., Vetrap, 3M etc.), which provides compression and contains the bandage. Tape can also be placed too tightly; therefore, it is crucial to ensure that appropriate

tension is applied.3 Depending on the location of the wound, it is important to leave toes exposed so that owners can monitor for bandage slippage or swelling of the toes. Elastic tape (e.g., Elasticon, Johnson & Johnson) can be placed to prevent scuffing of the bandage, but it is optional and should not be placed directly on the skin to avoid causing irritation. Bandages should be changed if strikethrough is noted or if they slip after placement. The purpose of the layer is to secures the bandage, provides protection from the environment, and can offer additional support or compression.

Principles of bandaging: General technique for limb bandaging

Prepare the area: Wounds should be clipped wide to check for additional wounds or allow the placement of stay sutures for a tie-over bandage. The peri-wound area should be cleaned with chlorhexidine gluconate 4% diluted with 25 to 50 mL of saline. When appropriate, the wound should be lavage with sterile saline using a high-pressure lavage system. Larger volumes of lavage should be used in contaminated wounds. Aerobic and anaerobic culture specimens of the wound should be taken to determine the appropriate antimicrobial therapy, but they should be taken after lavage has been performed. Debridement can be performed with Metzenbaum scissors or a surgical blade when indicated.
Apply stirrups (optional): These are strips of tape placed longitudinally to help prevent the bandage from slipping down the limb.

Apply the primary layer: Cover the wound with a suitable dressing.

Apply the secondary layer: Wrap the limb with padding (e.g., cast padding or cotton) from distal to proximal (towards the body), overlapping by 50%.

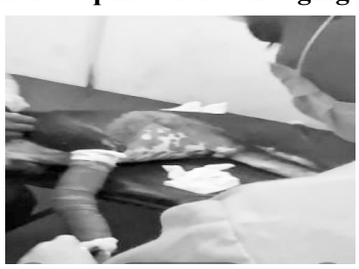
Apply the tertiary layer: Wrap the cohesive bandage (Vetrap or similar) in the same direction, overlapping by 50%, ensuring it's snug but not too tight.

Check the tension: Ensure you can fit two fingers comfortably under the top of the bandage.

Leave toes exposed: If possible, leave the middle two toes visible to monitor for swelling.

Fig. 1. Materials required for bandaging

Fig. 2. Demonstration of Vetrap



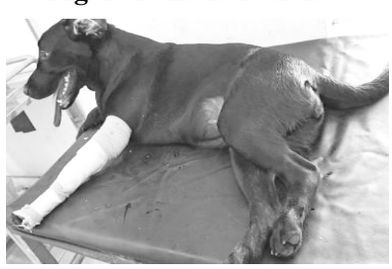


Fig. 3. Robert Jones Bandages

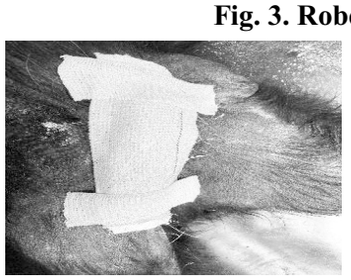


Fig. 4. Wound Bandage

Fig. 5. Tie -over bandage

Fig. 6. Eye bandage in a dog

Fig. 7. Ear bandage in a dog

Fig. 8. Use of Elizabethan collar

Robert Jones: used for severe limb injuries, involving a thick layer of padding for immobilization and compression. Step by Step Robert Jones Bandage are:

- Clip a large area surrounding the wound to expose the wound edges and to check for any additional wounds.
- Clean the peri-wound area with dilute chlorhexidine and lavage with saline to remove debris.
- Dry the surrounding area with gauze.
- Choose an appropriate topical therapy/primary layer and apply in a sterile fashion.
- Apply cast padding.
- Apply conform gauze.
- Apply bandage tape.
- Apply elastic tape.

Tie-over bandage: versatile bandage that can be applied to various locations on the body using sutures to secure it. Step by Step Tie-over bandage are:

- Clip a wider area (up to 3 cm) surrounding the wound. A wider area is important for tie-over bandages to allow for the stay sutures.
- Clean the peri-wound area with dilute chlorhexidine and lavage with saline to remove debris.
- Dry the surrounding area with gauze.
- Place stay sutures close enough to the wound to keep the bandage on but far enough from the wound in case of tissue necrosis (roughly 2–3 cm).
- Choose an antimicrobial/primary layer and apply in a sterile fashion.
- Apply lap sponges into the wound bed in a sterile fashion.
- Cover lap sponges with the covering from the lap sponges or drapes.
- Place umbilical tape through the stay sutures to secure the bandage.

Paw bandage: requires special attention to padding between the toes and ensuring the bandage doesn't restrict circulation to the paw.

Splinting: incorporating a splint within the bandage layers can provide additional immobilization for fractures.

Velpeau sling: is applied in order to prevent the dog from weight bearing on that forelimb and to immobilize the shoulder joint, for a period of time. Like most slings, it should not be left on for more than 7-10 days.

Ehmer sling: is a specialized bandage used in dogs to stabilize the hip joint after injuries like luxation (dislocation) or certain fractures. It keeps the hind limb flexed, internally rotated, and prevents weight-bearing, promoting healing and

preventing further injury.

Take-Home Message:

- Robert Jones (RJ) bandages should be placed distal to proximal on a patient's limb.
- When placing bandage layers, make sure that each layer overlaps the previous layer at least by 50%.
- RJ bandages are better for wounds on the limbs, while tie-over bandages can be placed in most locations.
- When placing cast padding, ensure that it is free of wrinkles, which can lead to bandage sores.
- Cast padding cannot be put on too tight.
- Monitor for complications like swelling above or below the bandage, skin irritation, or changes in the wound's appearance.
- Prevent the animal from interfering with the bandage, potentially using an Elizabethan collar (e-collar).

Suggested Readings

Anderson, D.M. 2009. Management of open wounds. In Williams J, Moores A, eds. BSAVA Manual of canine and feline wound management and reconstruction. 2nd ed. Quedgeley, Glouster, England: British Small Animal Veterinary Association. P.37.

Bohling, M.W. and Swaim, S. F. 2021. Bandaging and drainage techniques. In: Bojrab MJ, Waldron DR, Toombs JP, eds. *Current Techniques in Small Animal Surgery*. 5th ed. Teton NewMedia; pp.13-26.

Bojrab ,M.J. 1994. A handbook on veterinary wound management. Ashland, OH: KenVet Prof Vet Co.

Bojrab, M.J. 1982. Wound management. Mod Vet Pract. 63:867.

Campbell, B.G. 2006. Dressings, bandages, and splints for wound management in dogs and cats. *Vet Clin North Am*. 36: 759.

Grambow, C.B. 2015. Moist wound healing in dogs and cats: using MRDs to improve care. *Todays Vet Pract*. 5(4):32-42.

Hedlund, C.S. 2007. Surgery of the integumentary system. In: Fossum TW, ed. Small Animal Surgery. 3rd ed. Philadelphia: Saunders Elsevier, p.159.

Lux, C.N. 2021. Wound healing in animals: a review of physiology and clinical evaluation. *Vet Dermatol*. 33(1):91-102. doi:10.1111/vde.13032

Swaim, S.F. 1997. Henderson RA. Small animal wound management. 2nd ed. Baltimore: Williams & Wilkins.

Embryo Transfer Technology (IVF) in Bovine

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Sustainable Livestock Production is only way to feed the growing human population and supplement the One Health Approach. Reproductive Biotechnology is a key in the generation of an adequate food supply, it has a potential to increases the production performance of the animals, increases the reproductive efficiency, increases the rates of genetic improvement, Production of targeted disease free animals in future etc.

Common Reproductive Biotechnology

- Artificial insemination (AI)
- Synchronization
- Multiple Ovulation Embryo transfer (MOET)
- *In-vitro* fertilization (IVF)
- Cloning
- Transgenesis
- Sperm Sexing etc.

Among these Reproductive Biotechnology Embryo Transfer Technology is the best way to enhance the productivity of animals.

History of Embryo Transfer & IVF in INDIA

- First ETT project- NDDB in 1987- central ET laboratory- Sabarmati Ashram Gaushala (SAG), Bidaj
- First OPU-IVF in Buffalo- "Saubhagya"- was produced at GBPUA&T, Pantnagar, Uttarakhand, 2008
- First OPU-IVF in aged Sahiwal cattle done at National Dairy Research Institute (NDRI), Karnal, 2012 and produce Sahiwal calf "HOLI"
- First ETT calf of Bihar- "Nandini"-Bihar Veterinary College, BASU, Patna (01 Aug, 2021)
- First IVF Calf in Bihar – "Tanuja"- Bihar Veterinary College, BASU, Patna (17 Jan, 2024).

Embryo Transfer Technology

It works in two ways-

1. Multiple Ovulation Embryo Transfer (ETT*)
2. Ovum Pick Up-In-Vitro Fertilization and Embryo Transfer (OPU-IVF-ET)

Multiple Ovulation Embryo Transfer (ETT*)

- MOET is the technique in which multiple eggs are fertilized in an animal and then embryo is collected (in –vivo) and transferred in synchronized recipients. Currently MOET have a major impact on livestock improvement program in developed and developing countries.

Protocol of MOET is summarized below-

Donor

↓

Synchronization/ natural heat

↓

Super-ovulatory protocols (FSH) & A.I.

↓

Flushing of uterine horns

↓

Searching, grading & loading of embryos in ET straw

↓

Transfer of collected embryos in synchronized recipients

First MOET Calf of Bihar

Nandini- 01.08.2021

भ्रूण प्रत्यारोपण से सूबे में पहली बार बछिया का जन्म

बिहार पशु विज्ञान विवि की ईटीटी व आईवीएफ प्रयोगशाला में हुआ सफल परीक्षण

atul chaturvedi and 9 others liked a Tweet you were tagged in

विश्वविद्यालय के ईटीटी एवं आईवीएफ प्रयोगशाला में पहली बार गाय के बाछी का जन्म हुआ। यह पूरे बिहार के लिए गौरव की बात है। वर्ष 2019 में भारत सरकार की महत्वाकांक्षी परियोजना राष्ट्रीय गोकुल...

Ovum Pick Up-In-Vitro Fertilization and Embryo Transfer (OPU-IVF-ET)

In this technique oocytes were aspirated from the live animals subsequently fertilized with desired semen and grow into the lab for a definite time interval and then transferred into the synchronized recipient animals.

Comparison Between MOET V/s IVF-ET

Characters	MOET	IVF
Process performed (mainly)	*In-vivo*	*In-vitro*
Collection	Embryos	Oocytes
Media requirement	Flushing media, Embryo holding media, Transfer media	Oocyte recovery media, IVM ,IVF, IVC and Embryo holding media etc
Economical to farmer	Low	High
Trangenesis	Rare	Frequent
Hormone requirement	Superovulation required FSH	Not required at all
Calves yield	8-10 / Year	20-25 / Year
Frozen Embryo pregnancy rate	Higher	Low
Recovery of Viable Embryos	average 5 viable embryos/ session thus 25 embryos/ yr from a donor (5 cycles/ yr)	average 3 viable embryos/ session thus 51 embryos/ yr from a donor (17 cycles/ yr)

Steps in Bovine IVF-ET

Protocol of IVF

OPU of Selected Donor (Stimulated/non-stimulated)

↓

Washing of OPU content

↓

Searching & Grading of oocytes

↓

Transfer of A, B & C Grade oocytes in IVM media for maturation

↓

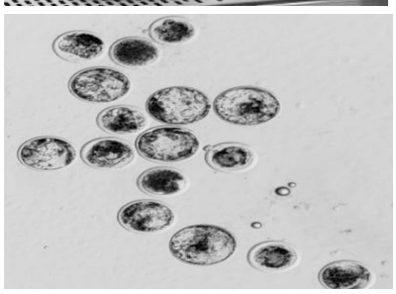
Fertilization of matured oocytes in IVF media along with capacitated sperm for fertilization

↓

Transfer of fertilized potential zygote under IVC media for 6-7 days

↓

Grading of embryos, transfer in to recipients/ cryo-preservation



1. Selection of Donors

- Animal should be docile
- High genetic merit
- No genital abnormalities
- Normal cyclic cow with Good oocyte pool
- With BCS 2.5- 3.5 (ideal)
- MSP - >3500 for indigenous cow
- Well response of hormone
- Aged b/w 4-8 Years

2. Selection of Recipients

- Animal should be docile
- Cervix should be patent and uterus should be normal with Normal cyclic
- With BCS 2.5- 3.5 (ideal)
- Well response of hormone
- Aged b/w- 4-8Years
- Either should be other breed or same breed

3. Synchronization of Recipients & Donor

• GnRH Based-

- Ovsynch
- Heatsynch
- Ovsynch-Plus
- Doublesynch
- Estradoublesynch
- Selectsynch
- Cosynch
- Hybrid synch, etc.,

• PG based Protocols

- Single PG-
- Double PG

• P4 Based Protocols

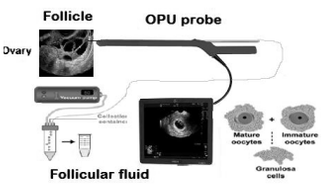
- PRID
- CIDR

4. Ovum Pick-up from Donors

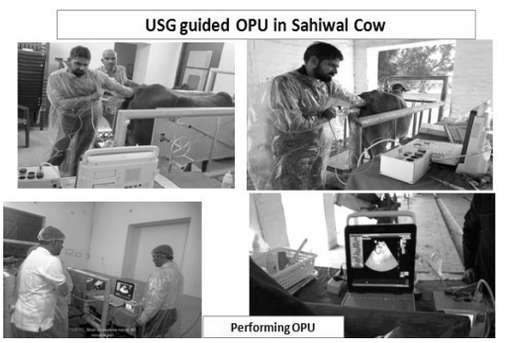
Trans-vaginal Ultrasound Guided Oocytes Retrieval from donor animals- using the trans-vaginal USG probe connected with aspiration lines and 18 G/20 G ovum

pickup needle through a needle guide we aspirate the visible follicles using the USG monitor. Aspirated content will further go for washing and search of oocytes.

B. Washing and filtration of the OPU content – washing and filtration of collected OPU content will be done in the pertidish (60/100 mm) using the oocytes filter (pore size less than 75 micron).

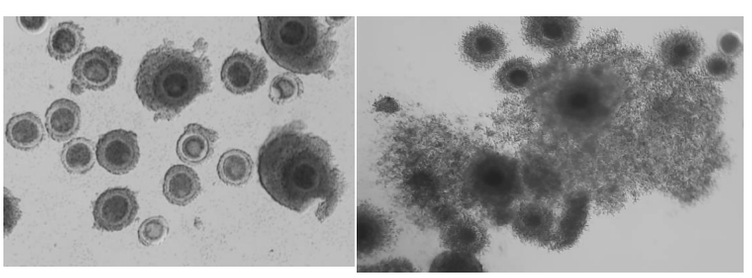


Ovarian follicular aspiration



5. Searching, washing and grading of oocytes in filtered OPU content- searching of oocytes will be done under stero-zoom microscope and subsequent washing in wash media is done, further grading of aspirated oocytes will done for the further process.

6. *In-vitro* maturation of immature oocytes – selected oocytes will be put for the maturation in TCM199 medium based maturation media in the controlled environment (under CO_2/Tri-gas incubator) at the set temperature (approx 38.5^0C for 22- 24 hrs).

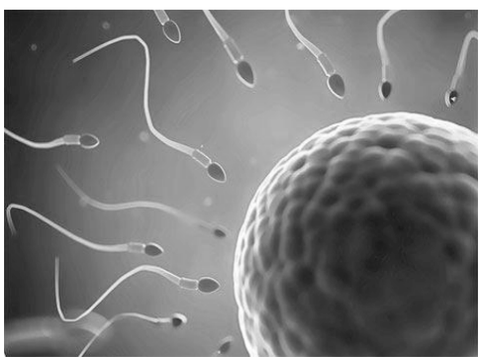

Oocytes before maturation

Oocytes after maturation

7. *In-vitro* fertilization of matured oocytes-

a. Washing of matured oocytes- matured oocytes will be washed in the pre-

incubated IVF media and then transfer into IVF media.

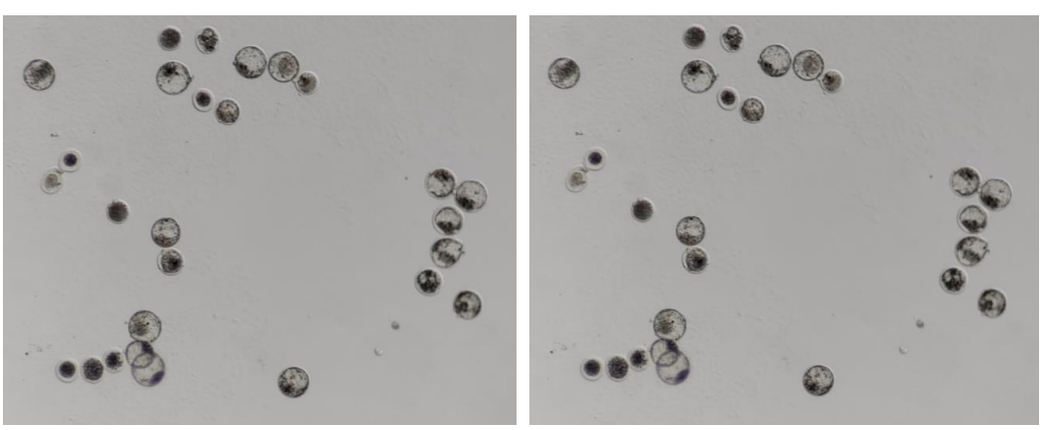


b. Sperm preparation- in parallel to washing of matured oocytes, desired semen samples should be prepare via using the ***Percoll Density Gradient*** method/**swim up technique** and centrifugation for pellet formation for maximum live spermatozoa. Subsequently this pellet is again centrifuge in IVF media to acclimatize the sperm and to enhance the capacitation process of spermatozoa.

c. Fertilization of mature oocytes– desired concentration of processed semen will be added in the prewashed matured oocyte in the IVF media and kept for 18-20 hrs for effective fertilization process at same temperature/time/ gas concentration as used for maturation.

8. ***In-vitro*** **culture of fertilized oocytes (potential zygote)-** Fertilized oocytes will be washed and denude subsequently transfer in to the culture media and kept for approx. seven (07) days at same temperature/time/ gas concentration as used for maturation.

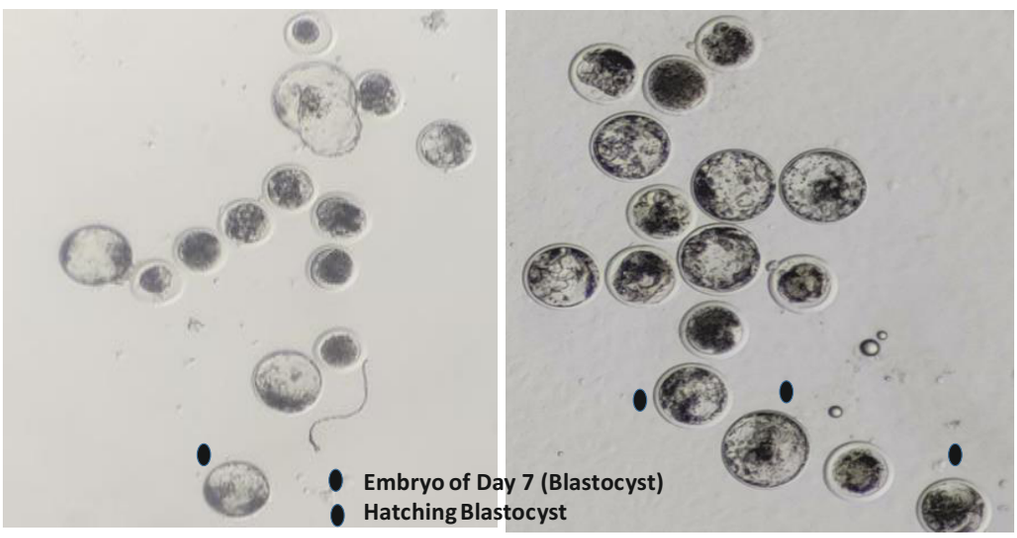
9. Evaluation and Grading of the Embryos – On day 6 or day 7 embryo will be evaluated for the their stage, quality, viability etc.



Day-7 Embryos

10. Embryo transfer– on the day 07, embryos (Blastocyst) will be transferred in the pre-synchronized recipients at the tip of epsilateral horn. (on the side of C.L.)

Grading of embryos at Day



11. Embryo preservation

a. Slow freezining of embryo (Direct Method)- embryos can be stored at -196^{0}C via using specific protocols and software based embryo freezer.

b. Vitrification (In-Direct method) – in this method embryos will be vitrified over the vitrification straw and directly pluge into the liquid nitrogen. Before transfer the process of de-vitrification is necessary.

12. Conclusion- At present IVF- based Embryo Transfer Technique is the best way of upliftment of germ-plasm of livestock. High media cost and limited expert manpower is main constraint of this technology. However the production of indigenous low cost media is under process and training for the manpower will certainly boom this technology in future.

Blood and Serum analysis for systemic disease detection

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Blood and serum analyses are essential diagnostic tools widely used in veterinary medicine to evaluate an animal's systemic health. These tests provide vital information about the physiological and pathological status of organs such as the liver, kidneys, pancreas, and hematopoietic system. By analyzing the cellular and biochemical constituents of blood and serum, clinicians can detect abnormalities at an early stage, monitor the progression of diseases, assess the response to therapy, and establish prognosis.

Comprehensive hematological and biochemical profiling plays a crucial role in diagnosing conditions such as anemia, infections, metabolic disorders, hepatic insufficiency, renal failure, and endocrine disturbances. When used in combination with clinical examination and imaging, blood and serum analyses improve diagnostic accuracy and guide effective treatment strategies in both companion and farm animals.

Objectives

- To familiarize with hematological and biochemical parameters.
- To interpret results for systemic disease diagnosis.

Serum Separation and Storage

- Allow blood in plain tubes to clot at room temperature for 20–30 minutes.
- Centrifuge at 2000–3000 rpm for 10 minutes.
- Transfer serum using a clean micropipette into sterile cryovials.
- Store at 4°C for short-term (up to 24 hrs) or -20°C for long-term storage.

Types of Blood Collection Tubes and Their Uses

Tube Type	Color	Additive	Use
EDTA	Lavender	Ethylenediaminetetraacetic acid	CBC, DLC
Plain	Red	None	Serum collection for biochemistry
Heparin	Green	Heparin	Plasma biochemistry, electrolyte tests
Fluoride Oxalate	Grey	Sodium fluoride & potassium oxalate	Glucose estimation
Citrate	Blue	Sodium citrate	Coagulation profile

Biochemical serum analysis is a vital diagnostic approach in veterinary and

medical practice. It involves the quantitative measurement of various metabolites, enzymes, and electrolytes present in the serum (the liquid portion of blood after clotting). This analysis provides critical information about the functional status of different organs and metabolic systems in the body.

Key Importance

Organ Function Evaluation

Serum analysis is essential for evaluating the functional integrity of vital organs, such as:

Liver (via ALT, AST, ALP, bilirubin)
Kidneys (via urea, creatinine, electrolytes)
Pancreas (via amylase, lipase)
Heart (via CK-MB, troponins)

Early Detection of Systemic Diseases

Many diseases, including hepatic failure, renal insufficiency, and endocrine disorders, present with non-specific symptoms initially. Serum biochemistry helps in their early detection before clinical signs become evident.

Monitoring Disease Progression and Treatment Response

Repeated serum analyses allow clinicians to track disease progression or remission, as well as evaluate the effectiveness of ongoing treatment protocols.

Assessment of Electrolyte and Acid-Base Balance

Electrolytes like sodium, potassium, chloride, and bicarbonate are crucial in maintaining homeostasis. Disturbances can indicate dehydration, acidosis, alkalosis, or endocrine disorders such as Addison's disease.

Nutritional and Metabolic Insights

Hypoproteinemia, hyperlipidemia, or abnormal glucose levels provide clues about malnutrition, lipid metabolism disorders, or endocrine diseases like diabetes mellitus.

Pre-surgical and General Health Screening

Serum biochemistry is routinely performed in health check-ups and before anesthesia to identify hidden abnormalities and minimize surgical risks.

Different tests and its clinical significance

A. Liver Function Tests (LFT)

ALT (Alanine aminotransferase)

- Marker of hepatocellular injury (especially liver-specific in dogs).
- ↑ in hepatitis, toxic liver damage, and hepatic neoplasia.

AST (Aspartate aminotransferase)

- ↑ in liver, cardiac, or skeletal muscle damage.
- Helps differentiate hepatic vs muscular causes when combined with CK levels.

ALP (Alkaline phosphatase)

- ↑ in cholestasis, hepatic neoplasia, or corticosteroid excess (Cushing's disease).
- Also elevated in bone disorders and growing animals.

Total Bilirubin

- ↑ in hemolysis, cholestasis, or liver dysfunction.
- Helps differentiate pre-hepatic, hepatic, and post-hepatic jaundice.

Albumin

- ↓ in chronic liver disease, protein-losing nephropathy/enteropathy, or malnutrition.
- Reflects hepatic synthetic function.

B. Kidney Function Tests (KFT)

- BUN (Blood Urea Nitrogen)
- ↑ in renal failure, dehydration, high-protein diet, or GI hemorrhage.
- ↓ in liver failure or low protein intake.

Creatinine

- ↑ indicates reduced glomerular filtration rate (GFR); useful for diagnosing chronic kidney disease (CKD).
- More specific for renal function than BUN.

Uric Acid

- ↑ in renal dysfunction, urate metabolism disorders, or portosystemic shunts.

- Useful in birds, reptiles, and Dalmatians (urate uroliths).

C. Pancreatic Enzymes

Amylase

- ↑ in acute pancreatitis, but also in renal insufficiency (due to decreased clearance).
- Not highly specific—interpret with lipase.

Lipase

- ↑ in pancreatic inflammation, pancreatic insufficiency, or renal disease.
- More specific than amylase for canine pancreatitis.

D. Electrolytes

Sodium (Na^+)

- ↓ in Addison's disease, renal failure, diarrhea, or vomiting.
- ↑ in dehydration or diabetes insipidus.

Potassium (K^+)

- ↓ in vomiting, diarrhea, or diuretic use.
- ↑ in renal failure, urinary obstruction, or hypoadrenocorticism.

Chloride (Cl^-)

- Imbalance reflects acid-base disturbances (e.g., metabolic alkalosis in vomiting, acidosis in diarrhea).
- ↓ in gastric outflow obstruction.

Calcium & Phosphorus

- ↑ Calcium in hyperparathyroidism, neoplasia, or renal failure.
- ↓ Calcium in eclampsia, pancreatitis, or hypoparathyroidism.
- ↑ Phosphorus in CKD, bone lysis; ↓ in hyperparathyroidism.

E. Protein and Lipid Profile

Total Protein

- ↑ in dehydration, chronic inflammation, or neoplasia.
- ↓ in liver disease, renal protein loss, or GI protein loss.

Albumin

- ↓ in chronic liver disease, nephrotic syndrome, or malabsorption.
- Globulin
- ↑ in chronic infections, immune stimulation, or multiple myeloma.
- Altered A:G ratio is diagnostically significant.

Cholesterol

- ↑ in hypothyroidism, Cushing's, diabetes mellitus, or nephrotic syndrome.
- ↓ in liver failure or malabsorption.

Triglycerides

- ↑ in diabetes mellitus, hypothyroidism, pancreatitis, and postprandial state.
- Useful in diagnosing lipemia or metabolic disorders.

Serum Biochemical Analysis Reference Ranges

Parameter	Dog	Cat	Horse	Cattle	Pig	Sheep	Goat	Rabbit
Total Protein (g/dL)	5.5–7.5	5.9–8.0	5.5–7.9	6.7–7.5	7.9–8.9	6.0–7.9	6.4–7.0	5.4–7.5
Albumin (g/dL)	2.6–4.0	2.5–3.9	2.6–3.8	3.0–3.5	1.9–3.9	2.4–3.0	2.7–3.9	2.7–5.0
Globulin (g/dL)	2.5–4.5	2.8–5.1	2.9–4.1	3.5–4.0	5.3–6.4	3.5–5.7	2.7–4.1	1.5–2.7
ALT (U/L)	10–100	20–107	5–20	15–40	6–19	45–80	6–14	10.9–95.1
AST (U/L)	15–66	10–100	160–300	60–125	32–84	60–280	167–513	35–130
ALP (U/L)	20–150	15–62	70–270	40–150	93–387	12–96	41–92	27–160
Bilirubin - Total (mg/dL)	0.1–0.6	0.1–0.4	0.1–0.5	0.1–0.5	0–1.0	0.1–0.5	0–0.1	0–0.7
BUN (mg/dL)	7–25	10–30	10–25	10–30	10–30	8–20	10–20	20–45
Creatinine (mg/dL)	0.5–1.8	1.0–2.1	1.2–2.0	1.0–2.0	1.0–2.7	1.2–1.9	1.0–1.8	0.5–2.5
Glucose (mg/dL)	75–120	70–150	75–120	40–60	85–150	50–80	50–75	75–155
Calcium (mg/dL)	8.7–11.5	8.2–10.8	11.0–13.0	8.5–10.0	7.1–11.6	11.5–12.8	8.9–11.7	11–14
Phosphorus (mg/dL)	2.5–6.8	3.0–6.0	2.8–4.7	5.0–7.5	5.3–9.6	5.0–7.3	4.2–9.1	4.0–6.5

Interpretation of Findings in Systemic Diseases

Condition	Indicative Parameters
Anemia	↓ RBC, ↓ Hb, ↓ PCV
Leukemia	↑ TLC, abnormal DLC
Liver Disease	↑ ALT, ↑ AST, ↓ Albumin
Kidney Disease	↑ BUN, ↑ Creatinine, ↑ Phosphorus
Diabetes Mellitus	↑ Glucose, ↑ Cholesterol, ↓ Potassium
Pancreatitis	↑ Amylase, ↑ Lipase

Basic Principles of Radiography

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Radiography is a commonly used diagnostic tool in veterinary practice. X-ray images (radiographs) allow radiologists and other specialists to examine the body for injury or disease. Not only used for bones, radiographs also provide examination of the heart, lungs, and abdominal organs. Radiography is often the first line of diagnostic imaging with which a radiologist can either make a diagnosis, or direct the need for further imaging. It is quick, painless, and economical tools of diagnostic imaging.

X-ray machines

Variety of X-ray machines are now a days available in veterinary field. They can be of following types.

Mobile/Portable X-ray machines

These are low voltage x-ray machines (70-150 mA) and are used for making radiographs of extremities of animals i.e. bones below carpus or tarsus joints. Commonly used in veterinary field and are portable ones.

Ceiling suspension X-ray machines

These are high voltage X-ray machines (300-1000 mA) and are generally used for large animal radiography. With these machines radiography of abdomen and chest is possible but these needs setting up of very high exposure factors.

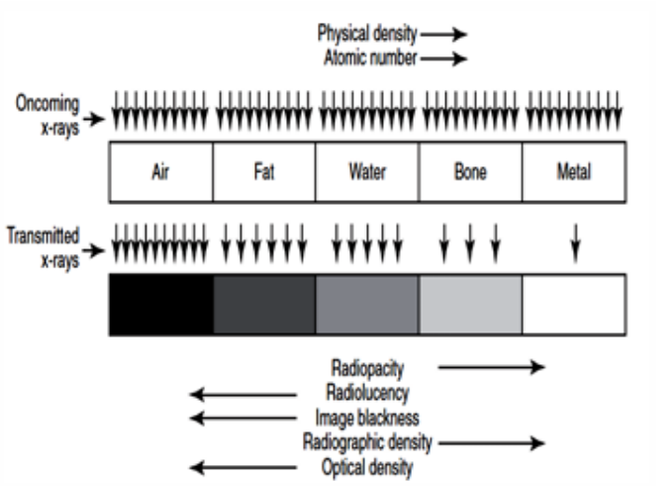
Moving Grid X-ray machines

They are generally used for radiography of dogs, cats and small ruminants.

Radiographic Density

Radiographic density is the measure of the degree of blackness on a processed film and is directly related to the number of X rays reaching the film. More the number of X-rays that reach the film, blacker it is i.e. higher is the radiographic density. Radiographic density is inversely proportional to the subject density as denser the

object more it absorb s X-rays so that less photons reach the film. Main densities which can be appreciated on a radiograph are i) metal, mineral and bone, ii) fluid (soft tissue), iii) fat, and iv) gas



Interpreting Abdominal Radiographs

Some important radiographic features of disorders involving various structures are described below.

Diaphragm

The diaphragm should be evaluated for its integrity. In case of diaphragmatic hernia, the abdominal viscera can be visualized in the thoracic cavity across the diaphragm.

Liver and Gall Bladder

Diffuse

Hepatomegaly in dogs may be evaluated by assessing the axis of the stomach. In most dogs, the long axis of stomach is parallel to the rib cage on lateral view. Generalized enlargement of the liver produces characteristic displacement of the pylorus and pyloric antrum caudally, dorsally, and to the left. In many instances the enlarged caudoventral edge of the abnormal liver can be seen as it projects beyond the costal margin.

Spleen

On a lateral radiograph the tail of spleen in dogs is seen in the ventral abdomen dorsal to the falciform fat and caudal to the stomach at about the level of the umbilicus. It is less commonly seen on lateral radiographs of cats. Spleen should be considered enlarged if its edges are round and displaces adjacent viscera.

Stomach

Normal canine stomach lies transversely across the abdomen with the fundus located on the left side of the midline on VD radiograph and in a cranio-dorsal position on lateral radiograph. Pyloric antrum is located to the right of midline on VD view and ventrally on the lateral view.Acute Gastric Dilation and Volvulus (GDV) can be easily diagnosed on a lateral projection with classical radiographic feature of compartmentalization of stomach or "double bubble appearance" which can be appreciated on lateral and VD views.

Small Intestine

Normalserosal margins should be smooth and are most easily seen adjacent to the abdominal wall, where there is less superimposition of other structures. Young and emaciated animals have poor serosal definition owing to lack of intra-abdominalfat.Normal small bowel diameter should not exceed the height of the central part of the body of a lumbar vertebra or the diameter of the SI in dogs should not be more than 1.6 times the height of the center of the 5th lumbar vertebra.

Cecum

Cecum is located to the right of midline at the level of L2 and L3 on the VD radiographs, with a characteristic gas distended 'C' shape, spiral or comma shape.

Colon

The ascending, transverse and descending colon can be easily identified on the VD projections. Megacolon is diagnosed of the diameter of colon exceeds the length of L7 vertebra.

Urinary Bladder

The commonest abnormality identified in the bladder on plain radiographs are radiopaque calculi. The prostate lies immediately caudal to the neck of the bladder. In young dogs the prostate is located within the pelvic canal. As the dog ages the

prostate will tend to be located further cranially. The same cranial displacement also occurs with enlargement of the prostate. The most reliable assessment of the dimensions of the prostate are the transverse diameter should be no greater than 75% of the distance from the ventral surface of the sacrum to the floor of the pelvis.

Kidney

In the dog the normal size of kidney is 2.5-3.5 times the length of the second lumbar vertebra. In cats it is 2-3 times the size of L2. Focal increases in sizes or changes of shape of the kidney are typically associated with either abscess or a neoplastic process.

Reproductive Tract

Enlargement of the uterus is associated with either pregnancy or pyometra. The radiographic differentiation of early pregnancy and pyometra can be difficult. The presence of mineralized fetal parts is the most helpful radiographic sign in determining pregnancy. Mineralization of the fetal skeleton begins at approximately forty to forty five days and is not complete until immediately prior to the term. Fetal death leads to putrefaction and presence of gas in fetus and uterus (visible after 24 hours of death). In pyometra the enlargement of the uterus can become very extensive.

Interpretation of thoracic radiographs

At least three well-positioned orthogonal radiographic views i.e left lateral, right lateral and a DV or VD view are essential for complete evaluation of the thoracic structures. Most radiologists describe radiographic changes within the lung tissue on the basis of lung patterns. There are 4 major categories of lung pattern - these correspond to the component of the pulmonary tissue that is altered. The 4 major categories are:

Interstitial Lung Patterns

The interstitial lung pattern may be nodular or military. In Miliary interstitial pattern there are fine dotted (bread mould) pattern in the lungs (e.g. Blastomycosis). The nodular lung pattern may be structured or unstructured. Structured nodular pattern shows increased nodular densities having distinct, well-defined margins (e.g., neoplasia, chronic granulomas).

Alveolar Lung Pattern

The alveolar pattern may be localized or diffused. May involve a single lung lobe (Lobar sign) or multiple lung lobes. Characteristic findings may include air bronchograms, loss of cardiac silhouette and silhouetting of the pulmonary vasculature and Patchy, poorly defined, increased densities with fluffy, indistinct margins which tend to coalesce.

Bronchial Lung Pattern

The bronchial lung pattern is defined by increased visualization of the bronchi walls. Increased bronchial visualization may be present because of bronchial wall calcification, bronchial wall thickening or the accumulation of peribronchial infiltrates. The bronchial walls seen side-on are linear and parallel. For this reason, the side-on bronchi are commonly referred to as "tram-lines" or "train-tracks". The end-on bronchi appear as circular structures with a radiolucent centre and referred to as "doughnuts".

Vascular Lung Pattern

A vascular pattern is present when the amount of blood in the larger arterial or venous branches is increased or decreased. This causes the vessels to change in size, shape and direction. On a VD/DV view the caudal pulmonary vessels are compared to the 9th rib at the point where they cross this rib. In normal animals the vessels should never be of greater width than the rib. On a Lateral view the cranial pulmonary artery and veins are compared with each other and should be of equal width. Any alteration is indicative of disease process. The width of the vessels on this view should not be greater than the width of proximal third of the 4th rib.

Radiographic assessment of the heart

On lateral radiograph (Right lateral or Left lateral) of the canine thorax, the heart is oriented at approximately 45 degree angle, is situated between the 3rd-8th thoracic vertebrae, and occupies about 3 intercostal spaces. In general a rule of thumb states that a normal cardiac silhouette in the dog usually ranges from 2.5 to 3.5 times the width of intercostal spaces. However this also may not be true in the cases. The vertebral heart scale (VHS) is a method for cardiac measurement that compares the dimensions of the cardiac silhouette with the length of thoracic vertebral bodies. The generic normal range is 8.7-10.7. VHS measurements tend to increase in dogs with cardiac disease. In cats the VHS critical limit is set at 8.5.

Ultrasonography in Small Animals

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Ultrasonography is a non-invasive diagnostic imaging technique that uses high-frequency sound waves to visualize internal body structures in real-time. In small animal practice, especially for dogs and cats, ultrasonography has become an indispensable tool for clinicians due to its safety, repeatability, and ability to provide detailed anatomical and functional information.The application of ultrasonography in companion animals began gaining popularity in the late 20th century, paralleling advancements in veterinary diagnostic imaging. It is now routinely used for evaluating abdominal organs, thoracic structures (in the absence of air interference), musculoskeletal conditions, and even guiding minimally invasive procedures such as biopsies and fluid aspirations.Ultrasound is particularly valuable in detecting conditions such as pyometra, renal diseases, hepatic abnormalities, splenic tumors, urinary tract obstructions, gastrointestinal disturbances, and pregnancy diagnosis. Echocardiography, a specialized form of ultrasonography, plays a critical role in diagnosing and monitoring cardiac diseases in dogs and cats.

Unlike radiography, ultrasonography does not involve ionizing radiation, making it safer for repeated use, including in pregnant animals. The development of portable and high-resolution ultrasound machines has further expanded its accessibility in first-opinion practices and emergency settings.As technology continues to evolve, ultrasonography is increasingly being integrated with other modalities such as Doppler imaging and contrast-enhanced studies, enhancing its diagnostic capabilities in veterinary medicine.

Principles of Ultrasonography

Ultrasonography is based on the principle of sound wave reflection. It uses high-frequency sound waves (ultrasound), typically between 2 to 15 MHz, which are emitted by a transducer (probe). These sound waves penetrate the body and interact with different tissues. Depending on the density and composition of the tissue, the sound waves are:

a) Reflected back to the transducer
b) Transmitteddeeper
c) Scattered/absorbed

The transducer receives the returning echoes, and the ultrasound machine processes these signals to create a real-time image of internal structures.

Key principles include

1. Acoustic Impedance

Each tissue has a unique acoustic impedance (resistance to sound wave transmission). The greater the difference in impedance between two tissues, the stronger the reflected echo.

2. Echo Generation

Tissues that reflect many sound waves appear hyperechoic (bright), while those that reflect few appear hypoechoic (dark). Fluid-filled structures (e.g., bladder, cysts) are typically anechoic (black) because sound waves pass through them without reflection.

3. Attenuation

As sound waves travel through tissue, their intensity diminishes due to absorption and scattering. This is called attenuation, and it increases with depth and frequency.

4. Resolution vs. Penetration

High-frequency probes (7–15 MHz) provide better resolution but less penetration—ideal for superficial structures.

Low-frequency probes (2–5 MHz) offer deeper penetration with lower resolution—used for large dogs or deep abdominal organs.

5. Doppler Effect

Doppler ultrasonography utilizes the frequency shift of echoes from moving blood cells to assess blood flow direction and velocity, crucial in cardiovascular evaluation.

6. Real-Time Imaging

The ultrasound machine updates images continuously, allowing dynamic assessment of organ movement, peristalsis, heart function, and fetal viability.

Modes in Ultrasonography

Ultrasonography operates in several modes, each suited for specific diagnostic purposes.

1. A-Mode (Amplitude Mode)

Description: Oldest and simplest form; displays echoes as vertical spikes on a graph.
Application: Rarely used in clinical practice today. Previously used for measuring fat

or eye axial length.

2. B-Mode (Brightness Mode)
Description: Most commonly used mode in veterinary practice. It creates a two-dimensional grayscale image, where each echo is represented by a dot with brightness corresponding to echo intensity.
Application: Abdominal organ evaluation, pregnancy diagnosis, thoracic structures, musculoskeletal assessments, etc.

3. M-Mode (Motion Mode)
Description: Captures motion of a single scan line over time, producing a wave-like graph.
Application: Primarily used in cardiology to assess heart wall and valve motion (e.g., in dogs with mitral valve disease or dilated cardiomyopathy).

4. Doppler Mode
Used to assess blood flow in vessels and heart. It includes several subtypes:
a) Color Doppler
I. Displays blood flow direction and velocity using color (red and blue).
II. Application: Evaluating blood flow in organs or heart.
b) Power Doppler
a) More sensitive than color Doppler; detects low-velocity flows but doesn't show direction.
b) Application: Detecting small or slow-flowing vessels (e.g., in tumors).
c) Pulsed-Wave Doppler
a) Measures flow velocity at a specific location.
b) Application: Quantifying blood flow through heart valves or vessels.
d) Continuous-Wave Doppler
a) Measures high-velocity flow continuously along a line.
b) Application: Useful in assessing severe valvular stenosis or regurgitation.

5. 3D and 4D Modes(Advanced)
a) 3D Mode: Provides volumetric imaging of structures.
b) 4D Mode: Real-time 3D imaging (moving 3D).
c) Application: Rare in routine veterinary practice; may be used in specialized reproductive or cardiac imaging.

Ultrasound Transducers and Their Applications:
Transducers, or probes, are essential components of an ultrasound machine. They

generate and receive high-frequency sound waves. Different types of transducers are used based on frequency, shape, and field of view, depending on the clinical application and body part being examined.

Types of Transducers Used in USG

1. Linear Transducer

Frequency: High (7.5–15 MHz)
Shape: Flat, rectangular surface
Image: Rectangular field of view
Application
Superficial structures (e.g., tendons, lymph nodes)
Small animal abdomen (superficial organs in cats/small dogs)
Mammary gland, thyroid, skin masses
Vascular access and nerve blocks

2. Curvilinear (Convex) Transducer

Frequency: Medium (3.5–8 MHz)
Shape: Curved surface
Image: Sector-shaped field of view (wider than linear)
Application
General abdominal examination in dogs and cats
Pregnancy diagnosis
Liver, kidney, spleen, urinary bladder
Deeper structures in medium to large dogs

3. Microconvex Transducer

Frequency: Medium to high (5–10 MHz)
Shape: Small curved footprint
Image: Small sector image
Application
Ideal for cats and small breed dogs
Intercostal scanning (e.g., echocardiography)
Neonates and pediatric animals
Ocular and cranial imaging

4. Phased Array Transducer

Frequency: Low to medium (2–5 MHz)
Shape: Small square or circular face
Image: Sector (pie-shaped) field of view

Application:
Echocardiography in all breeds
Useful in tight spaces (e.g., between ribs)
Thoracic imaging

5. Endocavitary / Endorectal Transducer
Frequency: High (7–10 MHz)
Shape: Long, narrow probe
Image: Curved or linear
Application
Rectal or vaginal scanning in small animals
Prostate gland evaluation
Reproductive tract in bitches and queens

Patient Preparation and Positioning of Dogs for Ultrasonography
Proper patient preparation and correct positioning are essential for obtaining high-quality and diagnostic ultrasound images. This ensures minimal artifacts, better organ visualization, and accurate interpretation.

I. Patient Preparation
1. Fasting
Duration
8–12 hours prior to abdominal ultrasound
Purpose
Reduces gas in the stomach and intestines, which can interfere with sound wave transmission and image quality.
Note: Fasting is not necessary for emergency cases.

2. Bladder Filling
A moderately full urinary bladder provides better evaluation of the bladder wall and adjacent organs.
Encourage the dog not to urinate for at least 2–3 hours before the exam if urinary tract evaluation is intended.

3. Hair Clipping
The area to be scanned should be liberally clipped to ensure proper contact of the transducer with the skin.

Common clipping sites:

Abdomen: From xiphoid to pubis and laterally to the flanks
Thorax (for cardiac scans): Over the left/right thoracic wall (4th to 6th intercostal space)

4. Coupling Gel
Ultrasound gel can be applied to eliminate air between the transducer and the skin surface for optimal sound wave transmission.

5. Sedation
Usually not required, but mild sedation (e.g., with butorphanol or acepromazine) may be used in anxious, aggressive, or non-cooperative dogs, especially for prolonged or painful evaluations.

II. Patient Positioning
The positioning depends on the organ system being evaluated
1. Abdominal Ultrasonography
The most Common Position is dorsal recumbency (dog lies on back) using a V-trough or foam support. This allows access to entire abdomen, including liver, spleen, kidneys, intestines, and bladder.Alernatively, lateral recumbency(left or right side) can be used in fractious or uncomfortable animals.

2. Echocardiography (Cardiac Ultrasound)
For echocardiography right or left lateral recumbency can be done. Left lateral is commonly used for right parasternal view (standard in veterinary cardiology).A soft table or cut-out "echocardiography table" can be used for probe access from beneath.

3. Thoracic Ultrasonography
For this lateral or sternal recumbency depending on the region of interest can be done.
Application
For pleural effusion, lung consolidation, or mediastinal masses.

Methods of using probe in ultrasonography
In small animal ultrasonography, several probe manipulation techniques are used to obtain optimal images and thoroughly evaluate internal structures.
I. Fanning: It involves pivoting the probe on its fixed point in a sweeping motion to scan through an organ in multiple slices without changing the probe's location.
II. Sliding: It is the movement of the probe linearly across the skin surface to shift from one region to another.

III. Rotating: It means turning the probe clockwise or counterclockwise to change the scanning plane, such as from longitudinal to transverse.

IV. Tilting (or heel-toe maneuver)

It adjusts the angle of the probe by lifting or lowering one end, which helps in visualizing structures at different depths or angles.

V. Rolling

It refers to a gentle rotation along the long axis of the probe to refine image alignment. These techniques are essential for comprehensive and dynamic assessment of organs in dogs and cats, ensuring accurate diagnosis.

Artifacts and their Applications in Ultrasonography (USG)

Artifacts in ultrasonography are image distortions or errors that occur due to the interaction of ultrasound waves with tissues and interfaces in ways not anticipated by standard assumptions. While some artifacts may obscure diagnostic detail, others can be useful in identifying specific conditions or structures. Understanding them is crucial for accurate interpretation.

Common Ultrasound Artifacts and Their Applications

1. Acoustic Shadowing

Description

It appears as a dark band (shadow) distal to a highly reflective or absorptive structure.

Cause

Sound waves are blocked or absorbed (e.g., by bone, calculi).

Application

It is useful in detecting urinary calculi, bone, or gas. Presence of shadow confirms the density of the object.

2. Acoustic Enhancement (Posterior Enhancement)

Description

Increased echogenicity (brightness) behind fluid-filled structures.

Cause

Sound waves pass easily through fluid, leading to stronger echoes from deeper tissues.

Application

It helps to identify cysts, urinary bladder, gallbladder, and uterine fluid in pregnancy.

3. Reverberation Artifact

Description

Multiple equally spaced bright lines appearing due to repeated reflections between strong interfaces.

Cause

Occurs between the probe and a highly reflective surface (e.g., gas or metal).

Application: It Indicates the presence of gas(as in intestines or pneumothorax) or foreign metallic objects.

4. Mirror Image Artifact

Description

A duplicate image of an organ appears on the other side of a strong reflector.

Cause

Sound waves reflect off a curved surface like the diaphragm before returning.

Application

It is seen in hepatic imaging, may help identify diaphragmatic hernias.

5. Edge Shadowing

Description

Dark lines appearing at the edges of round or curved structures.

Cause

Refraction and scattering at curved surfaces.

Application

It is commonly observed in kidneys, gallbladder, urinary bladder, and can help confirm shape and border.

6. Comet Tail and Ring-Down Artifact

Description

Bright tapering lines extending from a source.

Cause

Reverberation in very small, closely spaced structures or air bubbles.

Application

It is seen in gas pockets, helps in diagnosing emphysematous conditions, intestinal gas, or abscesses with gas.

Urine Analysis: Physical and Chemical Examination with Clinical Correlation

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Urine analysis, also called as Urinalysis is one of the oldest laboratory practices in the practices of medicine. Also called as Urine R & M (Routine and Microscopy). Urinalysis refers to the physical, chemical, and microscopic examination of urine. In veterinary practice, it is an indispensable diagnostic tool used to assess kidney function, detect metabolic or systemic diseases (like diabetes mellitus or hepatic dysfunction), and evaluate urinary tract infections or urolithiasis.

Unlike many other diagnostic tests that require invasive procedures or expensive equipment, urinalysis is:

- Non-invasive, requiring only urine collection without causing distress or harm to the animal.
- Cost-effective, making it ideal for routine health checks and initial screening in field or clinical settings.
- Broadly informative, as the urine reflects both local pathology (e.g., urinary tract infection, glomerulonephritis) and systemic abnormalities (e.g., ketonuria in ketosis, bilirubinuria in liver disease).

Urine composition is influenced by various physiological and pathological conditions, making urinalysis a sensitive indicator of homeostatic imbalances. The timely interpretation of urine findings—such as changes in colour, clarity, specific gravity, or presence of abnormal constituents (proteins, glucose, ketones, cells, casts, or crystals), can lead to early detection of diseases and help monitor therapeutic outcomes. Furthermore, because the kidneys filter and excrete metabolic waste products, urinalysis can act as a window into the animal's internal metabolic processes, especially in ruminants, companion animals, and equines. When combined with haematological and serum biochemical tests, urinalysis greatly enhances diagnostic accuracy and clinical decision-making.

Methods of Urine Collection in Animals

(i) Container

A neat and clean glass vials or disposable opaque plastic container should be used, if, the specimen is not to be examined soon after collection, as sunlight will cause

degradation of bilirubin and urobilinogen in less than an hour. Catheterization into a sterile container is mandatory for urine to be used for bacterial culture and sensitivity testing.

(ii) Time of Collection

1. An early morning sample should preferably be used.
2. Avoid collecting the first part of urine as it will contain cellular debris, cells and exudates flushed from the urethra, prepuce and genital tract.

(iii) Time of analysis:

A fresh sample is preferred. If urine is allowed to stand for several hours at room temperature then the bacteria of urethra may cause urea splitting which results in loss of usefulness of urine for diagnostic purpose.

(iv) Preservation:

1. Urine preserved by refrigeration (4°) is suitable for examination for 2 to 3 hours.
2. Freezing and damaged cells slightly increase specific gravity and may interfere with the tests.
3. Preservation by chemicals can stand for several hours but it may interfere in some chemical test.
(i) 1drop formalin in 30 ml urine.
(ii) 1 part of 5% phenol to 9-part urine.

Proper sample collection is crucial to prevent contamination and ensure accurate results.

Collection Methods:

Method	Description	Preferred Species	Remarks
Free catch (voided)	Urine is caught midstream during spontaneous urination	Dogs, cats, large animals	Easy, but prone to contamination
Manual expression	Bladder is palpated and expressed manually	Small animals, sedated animals	Risk of trauma or bladder rupture
Catheterization	Sterile catheter inserted into the urethra to collect urine	Dogs, male cats	Can introduce infection; use aseptic technique
Cystocentesis	Percutaneous needle aspiration of urine from bladder	Dogs, cats	Best for culture; avoid if coagulopathy or distended bladder

Physical Examination of Urine

The first step in urinalysis includes observing color, clarity, volume, odor, and specific gravity (SG).

Volume

The urine can be collected by so many methods among these the urine bag method and owner's reporting method are simpler and easier. The amount of urine excreted depends upon the weight and size of animal, diet, fluid intake, temperature, climate and exercise.

Specific gravity

The specific gravity indicates the relative proportion of dissolved components to the total volume of urine. Reflects the kidney's concentrating ability and hydration status. It also reflects the relative degree of concentration or dilution of the urine sample. Concentrated urine has a high specific gravity while diluted urine has a low specific gravity.

Colour

The pale yellow colour of urine is because of the presence of Urochrome pigment. The concentrated urine may be amber colour while diluted urine may be colorless. Large intake of green fodder turn the normal colour of urine to pale or deep yellow depending upon the intake of green. The colour of urine changes in many pathological conditions due to the presence of pigments that do not occur in normal urine.

Reaction (pH)

The pH is measuring the hydrogen Ion concentration in the urine. The pH of animals' urine depends on the diet. Vegetable diets- results in alkaline urine while high protein diets results in acidic urine. Therefore herbivores have alkaline urine and carnivores have acidic urine and omnivores either have alkaline or acidic.

Odor

Sweet or fruity indicates ketonuria; foul smell suggests bacterial infection.

Reference Ranges of Urine Specific Gravity (USG)

Species	Normal USG Range
Dog	1.015 – 1.045
Cat	1.020 – 1.050
Cattle	1.025 – 1.045
Horse	1.020 – 1.050

Chemical examination of Urine:

Most commonly using commercial reagent strips (dipsticks), which offer a rapid, semi-quantitative assessment of key urinary constituents. Parameters typically evaluated include:

• **pH**, which provides insight into acid–base status and dietary influence

• **protein**, where persistent proteinuria may indicate glomerular damage or inflammation

• **glucose**, whose presence is most often associated with hyperglycemia due to diabetes mellitus or stress-induced glucosuria (especially in cats)

• **ketones**, which are produced during enhanced lipid metabolism and are commonly observed in starvation, diabetic ketoacidosis, or bovine ketosis.

Additionally, detection of blood (which may reflect hematuria, hemoglobinuria, or myoglobinuria), bilirubin (suggesting hepatic dysfunction or bile duct obstruction), and urobilinogen (a marker of hemolysis or liver disease) provide valuable diagnostic clues.

These chemical tests, when interpreted alongside physical findings and microscopic examination, allow for a comprehensive understanding of urinary tract and systemic health.

Key Chemical Parameters and Interpretations using reagent strips/dipsticks

Test	Normal	Interpretation
pH	Carnivores: 5.5–7.5; Herbivores: 7.5–8.5	Acidic: acidosis, starvation; Alkaline: UTI, postprandial effect
Protein	Negative–Trace	Proteinuria may indicate glomerular disease, inflammation, or hematuria
Glucose	Negative	Glycosuria suggests diabetes mellitus or stress (cats)
Ketones	Negative	Positive in starvation, diabetic ketoacidosis
Blood	Negative	Positive in hematuria, hemoglobinuria, myoglobinuria
Bilirubin	Negative–Trace (dogs)	High values = hepatobiliary disease or hemolysis
Urobilinogen	Trace	Absent in obstruction; increased in hemolysis

Biochemical Tests for Urine Analysis in Animals

Test Name	Procedure	Positive Result	Possible Clinical Indications
Benedict's Test (Reducing Sugars)	Mix 5 ml Benedict's reagent with 0.5 ml urine, boil for 2 minutes, then cool	Green to brick red precipitate depending on sugar concentration	Diabetes mellitus, renal glycosuria, Fanconi syndrome
Heat Coagulation Test (Protein)	Heat upper part of urine in test tube; add few drops of acetic acid	White turbidity or coagulum in heated portion	Proteinuria, glomerulonephritis, pyelonephritis
Heller's Ring Test (Albumin)	Carefully add nitric acid at bottom of test tube, tilt slightly, layer urine over acid	White ring at junction of acid and urine	Albuminuria, nephrotic syndrome
Rothera's Test (Ketone Bodies)	Saturate urine with ammonium sulfate, add 2 drops sodium nitroprusside, then ammonia	Purple ring at interface	Diabetic ketoacidosis, starvation, pregnancy toxemia (in ruminants)
Gmelin's Test (Bile Pigments)	Layer urine over nitric acid in test tube	Green or rainbow-colored ring at interface	Hepatitis, liver cirrhosis, biliary obstruction
Benzidine Test (Blood)	Mix benzidine with glacial acetic acid and hydrogen peroxide, then add urine	Blue or green color	Hematuria, hemoglobinuria, urinary tract injury/infection
Hay's Test (Bile Salts)	Sprinkle sulfur on urine in a beaker	Sulfur sinks to bottom	Obstructive jaundice, liver disease
Sulphosalicylic Acid Test	Add 3–5 drops of sulphosalicylic acid to 1 ml of urine	Turbidity	Proteinuria, renal disease
Ehrlich's Test (Urobilinogen)	Add few drops of Ehrlich's reagent to 1 ml urine	Pink to red color	Hemolytic anemia, liver disease
Litmus Paper Test (pH)	Dip litmus paper into fresh urine sample	Red (acidic), blue (alkaline)	Acidosis, alkalosis, dietary influence, UTI

Microscopic Sediment Examination

Microscopy of the urine sediment reveals formed elements that provide insight into renal and urinary tract pathology.

Procedure

- Centrifuge 5–10 mL of urine at 1500–2000 rpm for 5 minutes.
- Discard supernatant; resuspend sediment in 0.5 mL of urine.
- Transfer a drop onto a slide and examine under 10x and 40x objectives.

Common Findings

Element	Interpretation
Red Blood Cells (RBCs)	Trauma, hematuria, urolithiasis, cystitis
White Blood Cells (WBCs)	Infection or inflammation
Epithelial Cells	Squamous: contamination; Transitional: UTI; Renal: nephritis
Casts	Cylindrical structures from renal tub ules; indicate tubular damage
Crystals	Vary with pH: Struvite (alkaline), Calcium oxalate (acidic)
Microorganisms	Bacteria: UTI; Yeast: rare, often contamination

Do's and Don'ts in Urinalysis

Do's:

- Use fresh, clean, and properly labeled containers to avoid contamination or misidentification.
- Collect urine using appropriate techniques depending on the diagnostic purpose (e.g., cystocentesis for urine culture).
- Examine the urine sample within 30–60 minutes of collection to prevent degradation. If delayed, refrigerate at 4°C.
- Mix the sample gently before performing dipstick analysis or microscopy to ensure uniform distribution of sediment and solutes.
- Record and interpret results systematically in correlation with the animal's clinical signs and history.

Don'ts:

- Do not delay analysis for more than an hour without refrigeration, as it leads to bacterial growth and decomposition of analytes.
- Do not use contaminated or previously used containers, as this can alter chemical and microscopic findings.
- Do not shake the urine sample vigorously, as it may cause hemolysis and false microscopic findings.
- Do not expose reagent strips to moisture, heat, or light, as these factors can degrade the chemical pads and cause inaccurate readings.
- Do not discard abnormal findings without correlation, as even mild abnormalities may indicate early disease states.

Basics of Veterinary Hematology: Parameters and Clinical Significance

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Introduction

Haematology is the branch of clinical pathology that focuses on the study of blood, its cellular components (red blood cells, white blood cells, and platelets), and associated parameters such as hemoglobin concentration, hematocrit, and indices related to red blood cells.

One of the most critical and commonly performed haematological investigations is the **Complete Blood Count (CBC)**. This test provides quantitative and qualitative data about the blood cells and is invaluable in detecting and monitoring numerous pathological conditions.

A **CBC** plays a pivotal role in the diagnosis and monitoring of:

Anemia–Characterized by decreased red blood cell count, hemoglobin, or hematocrit; CBC helps in differentiating between regenerative and non-regenerative types.

Infections – Alterations in total leukocyte count and differential leukocyte count can indicate bacterial, viral, or parasitic infections.

Leukemia and other hematopoietic neoplasms – Abnormal proliferation of white blood cells is typically reflected in marked leukocytosis or the presence of immature or atypical cells.

Inflammatory conditions – Changes in neutrophils, monocytes, and acute phase responses can be tracked.

Hemostatic or bleeding disorders – Platelet count and morphology are crucial in diagnosing conditions like thrombocytopenia or platelet function disorders.

Blood Collection in Veterinary Practice

Proper blood collection and handling are crucial for obtaining reliable hematological and biochemical results. The procedure varies slightly depending on the animal

species, but the core principles remain the same.

Materials Required

Sterile syringe and needle or vacutainer system
Alcohol swabs/antiseptic solution
Cotton and adhesive tape

Sites of Blood Collection (Species-wise)

Species	Preferred Collection Sites
Dog/Cat	Jugular vein, cephalic vein, lateral saphenous vein
Horse	Jugular vein
Cattle	Jugular vein, coccygeal (tail) vein
Sheep/Goat	Jugular vein
Pig	Ear vein, anterior vena cava
Rabbit	Marginal ear vein, central ear artery
Poultry	Wing vein (brachial), jugular vein

Types of Blood Collection Tubes and Their Uses

Tube type	Colour code	Anticoagulant	Purpose
EDTA tube	Lavender/Purple	Ethylenediaminetetraacetic acid	Hematology: CBC, blood smear
Plain/Clot activator	Red or Yellow	None or clot activator gel	Biochemistry (serum), serology
Heparin tube	Green	Lithium or sodium heparin	Plasma biochemistry, blood gases
Fluoride Oxalate tube	Grey	Sodium fluoride + potassium oxalate	Glucose and lactate estimation
Citrate tube	Light Blue	Sodium citrate	Coagulation profile
Trace element tube	Royal Blue	Varies (no additive or heparin)	Trace minerals (e.g., zinc, copper) analysis
ESR tube	Black	Sodium citrate	Erythrocyte sedimentation rate (ESR)

Complete Blood Count (CBC)

CBC is a routine hematological test that provides valuable information about the cellular components of blood and helps in the diagnosis of anemia, infections, inflammation, and other systemic conditions.

Parameters Include

Red Blood Cell (RBC) Count: Indicates the number of erythrocytes per microliter of blood; used to assess anemia or polycythemia.

Hemoglobin (Hb): Reflects the oxygen-carrying capacity of blood; low levels are indicative of anemia.

Packed Cell Volume (PCV): Also known as hematocrit; represents the percentage

of blood volume occupied by RBCs.

Mean Corpuscular Volume (MCV): Measures the average size of individual red blood cells.

> Helps classify anemia as microcytic, normocytic, or macrocytic.

Mean Corpuscular Hemoglobin (MCH): Indicates the average amount of hemoglobin per RBC.

Mean Corpuscular Hemoglobin Concentration (MCHC): Reflects the average concentration of hemoglobin in a given volume of packed RBCs.

Total Leukocyte Count (TLC): Measures the total number of white blood cells, useful in detecting infections, inflammation, or leukemias.

Differential Leukocyte Count (DLC): Determines the percentage of different types of WBCs (neutrophils, lymphocytes, monocytes, eosinophils, basophils), aiding in disease diagnosis.

Platelet Count: Assesses the number of thrombocytes involved in clotting; abnormalities may indicate bleeding disorders or bone marrow dysfunction.

Hematology (Complete Blood Count) Reference Ranges in Different species

Parameter	Dog	Cat	Cow	Horse	Pig	Sheep	Goat	Rabbit
PCV (%)	35–57	30–45	24–46	27–43	32–50	27–45	22–38	30–50
Hemoglobin (g/dL)	11.9–18.9	9.8–15.4	8–15	10.1–16.1	10–16	9–15	8–12	8–15
RBCs (×10 ^{6}/μL)	4.95–7.87	5.0–10.0	5.0–10.0	6.0–10.4	5–8	9–15	8–18	4–7
MCV (fL)	66–77	39–55	40–60	37–49	50–68	28–40	16–25	58–67
MCH (pg)	21.0–26.2	13–17	11–17	13.7–18.2	17–21	8–12	5.2–8	17.1–23.5
MCHC (g/dL)	32.0–36.3	30–36	30–36	35.3–39.3	30–34	31–34	30–36	29–37
Platelets (×10^{3}/μL)	211–621	300–800	100–800	117–256	200–500	800–1,100	300–600	250–650
WBCs (×10^{3}/μL)	5.0–14.1	5.5–19.5	4.0–12.0	5.6–12.1	11–22	4–8	4–13	6–12
Neutrophils (%)	58–85	45–64	15–33	52–70	28–47	10–50	30–48	20–60
Lymphocytes (%)	8–21	27–36	45–75	21–42	39–62	40–55	50–70	30–85
Lymphocytes (×10^{3}/μL)	0.4–2.9	1.5–7.0	2.5–7.5	1.2–5.1	3.8–16.5	2–9	2–9	1.6–10.6
Monocytes (%)	2–10	0–5	0–8	0–6	2–10	0–6	0–4	1–4
Monocytes (×10^{3}/μL)	0.1–1.4	0–0.9	0–0.9	0–0.7	0–1	0–0.75	0–0.55	0.05–0.5
Eosinophils (%)	0–9	0–4	0–20	0–7	0.5–11	0–10	1–8	1–4
Eosinophils (×10^{3}/μL)	0–1.3	0–0.8	0–2.4	0–0.8	0–1.5	0–1	0.05–0.65	0.05–0.5
Basophils (%)	0–1	0–1	0–2	0–2	0–2	0–3	0–1	1-5
Basophils (×10^{3}/μL)	0–0.14	0–0.2	0–0.2	0–0.3	0–0.5	0–0.3	0–0.12	0.05–0.9
Plasma Proteins (g/dL)	6.0–7.5	6.0–7.5	6.0–8.0	6.0–8.5	6–8	6–7.5	6–7.5	5.4–8.3
Plasma Fibrinogen (mg/dL)	150–300	150–300	100–600	100–500	200–400	100–500	100–400	200–400

Differential Leukocyte Count (DLC)

Definition

Differential Leukocyte Count is the percentage representation of various types of white blood cells (WBCs) observed under a microscope after staining a blood smear, typically using Romanowsky stains (e.g., Giemsa, Wright). It helps assess immune response and identify infections, inflammations, and hematological abnormalities.

Normal Ranges in Dogs (Approximate) and Clinical Significance

Cell Type	Normal %	Function	↑ Increased In	↓ Decreased In
Neutrophils	60–70%	First-line defense via phagocytosis; acute inflammation	Bacterial infections, stress leukogram, corticosteroid response, inflammation, tissue necrosis	Viral infections, bone marrow suppression, overwhelming sepsis
Lymphocytes	12–30%	Adaptive immunity; antibody production (B-cells), cellular immunity (T-cells)	Chronic infections, immune-mediated diseases, lymphocytic leukemia	Stress leukogram, corticosteroid therapy, immunodeficiency
Monocytes	3–9%	Phagocytosis of pathogens and cellular debris; antigen presentation	Chronic inflammation, granulomatous disease, monocytic leukemia	Rare; severe marrow suppression or overwhelming infection
Eosinophils	2–10%	Defense against parasites; modulate allergic responses	Parasitic infestations, hypersensitivity reactions, eosinophilic gastroenteritis	Corticosteroid therapy, stress response
Basophils	<1%	Mediate hypersensitivity; release histamine and heparin	Allergic reactions, parasitic diseases, certain neoplasms (e.g., mast cell tumor)	Often insignificant; glucocorticoid therapy

Blood Smear Preparation and Staining

Procedure

Place a drop of blood on a slide ~1 cm from the end.

Using a spreader slide at a 30–45° angle, spread the blood evenly.

Air dry and fix with methanol for 2–3 minutes.

Stain with Giemsa or Wright's stain for 20–30 minutes.

Examine under oil immersion.

Discussion and Demonstration on Common Surgical Procedures

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Fracture

A complete or incomplete break in the continuity of bone or cartilage or both is called fracture. These are mainly related to extrinsic factors of various types of direct or indirect trauma and the forces that may act on a bone or intrinsic factors like muscle contraction, pathological fracture or repeated stress. The symptoms include deformity, loss of function, abnormal mobility, pain and crepitus. During fracture repair recognition, reduction (closed/open), retention and rehabilitation should be considered. Direct or primary bone healing occurs without callus formation. Indirect or secondary bone healing occurs with a callus precursor stage including stage of haematoma, callus formation and stage of remodelling. However, complications like delayed union, non-union or mal-union may also occur.

External coaptation

External coaptation is defined as limb splinting that aid in stability & support of soft tissue and hard tissue. It serves as temporary support, first aid, secondary support after surgical intervention or primarily support and stabilization of fracture fragments. Minimum displaced fracture is suitable for EC. Reduction of fracture fragments must be achieve before application. Proper joint alignment is necessary to avoid malunion. Failure of align the major bone fragment with respect of joint can lead to malunion. Splint, bandage or cast should be applied so that the limb is maintained in a neutral standing position**.** Joint above and below must be immobilized. Most conventional splint and cast are adequate for fracture below and elbow and stifle joint. Selecting appropriate EC should be on the basis of patient and environment factor. If severe soft tissue inflammation is expected a temporary well-padded splint is beneficial.

***Robert Jone bandages*:** Bandage extend from toe to mid humerus or mid femur and provide temporary support of fracture or dislocation at or below the elbow or stifle joint. A tape stirrup is applied to medial and lateral surface of leg. A roll of cotton is wrapped loosely to give padding and compressed with elastic gauze to provide

stiffness & compression. Stirrup are inverted & bandage is covered with elastic tape.

Light or modified Robert jone bandage: less cotton padding is used. It is not suitable for temporary support but used after internal fixation to reduce swelling of the soft joint.

Reinforced Robert Jone bandage: rigid material is applied to enhance immobilization of joint in light or modified Robert jone bandage.

Plaster of paris: Roll of muslin stiffen with dextrose or starch impregnated with hemi hydrated Ca- phosphate can be easily and accurately moulded to contour of the limb. After reduction and application of antiseptic powder (boric acid/ sulphate powder), one or two layer of roll bandage are placed followed by uniform rolling of cotton and reapplication of bandage. Pop is immersed in water until bubbling or air stop & squeezed to remove excess water & rolled over bandage. It is left for few minute for solidification. Plaster or bandage should be applied spirally from top to bottom or vice versa. Turn of plaster bandage should overalp 50% with previous turn of its width. Each layer should be smoothened with hand provide good bound with preceding layer. At joint plaster applied in the figure of eight fashion to prevent break of plaster or prevent slipping. After final application of cast surface should be rubbed with hand to provide smooth and hard coating. However, it is heavy, has slow setting time, causes uneven pressure, so interfere with the circulation & may cause swelling.

Fiber glass cast: It is light weight, harden quickly. Application is similar of POP cast.

Velpeau Sling: Commonly used for immobilization of shouldher joint. It primary or help the stabilization of shouldher luxation, bicipital bursitis, minor fracture of scapula & humerus. It maintains the carpus, elbow & shoulder into flexed position & prevent weight bearing in the forelimb.

Ehmer sling: Used to prevent weight bearing of the pelvic limb & maintain limited degree of hip rotation & abduction of limb.

Hobbles: Circumferential tape strip constructed to allow weight bearing & walking to the hind limb, but prevent abduction of the limb at different levels.

Internal fixation technique

Intramedullary pinning: Pin can be placed either by closed or open method. During open reduction strict aseptic condition should be maintained. Frequent irrigation with warm saline or ringer solution help in removal micro-organism & debris & also promote healing. After exposure of fracture side pin is inserted either in normograde or retrograde manner. Bone is anatomically reduced & pin is driven upto metaphysis of distal fragments.

Cross pinning: applied for fracture closed to joint. The fracture fragments are exposed & brought into apposition & cross pinning is performed.

Orthopaedic wire: In full circlage wiring a 360 degree circumferential wire is placed around a bone at the fracture site. Its use is generally restricted to the long oblique diaphyseal fracture of bone, where the length the fracture is greater than twice of diameter of bone at fracture site, for interfragmentry compression. If the length of fracture is less than twice of the diameter shearing force will be produced which will disrupt the fracture. In hemicerclage wire is placed through the bone rather than around the fracture fragments of bone.

Tension band wires: Applied to convert distractive force into compression force at the tension side of the fracture. It is indicated mainly for avulsion fracture like greater trochanter of femur, tibial tuberosity, patella etc when a fragments is distracted from its original position by the pull of muscle or tendon or ligament.

Bone plating: It is internal splint that hold fracture fragment of bone together. Bone plate are attached with bone by the screw. Dynamic compression plate is providing fine bone contact between fracture fragment. It provides absolute stability & allow primary bone healing. The screw hole is oval & so head slide down the slope to lower end of hole, when it is tightening. In limited contact plate under surface contact plate under surface of the plate is scalloped, so that area of plate that make contact with bone is reduced. Reconstruction plate is V shaped plate contoured in all direction, mainly used in maxilla, mandible & pelvis**.**

External Skeletal Fixation

Used for stabilization of bone fragment with percutaneous pin held together with an external frame. Advantage of ESF include early return to function of affected limb with excellent mechanical properties, ability to adjust the frame after bone fixation, avoidance of surgical trauma, so as to preserve the local blood flow at the fracture site, avoidance of infection associated with implant, preservation of bone stimulatory protein that exude into the fracture site at the time of initial injury & provision of natural healing, easy implant removal and preservation of joint range motion.

ESF is applied under regional or general anaesthesia. After site preparation for aseptic surgery, proposed site of pin insertion is marked. A proper size of pin diameter is selected for ESF application. A small hole is predrilled at the chosen site and pin is inserted with slow speed. It is important to continuously flush with saline water while drilling pin at the insertion site. Pins are inserted in far-near-near far pattern. The pins generally placed no closer than three times diameter or half of the diameter of the bone from joints & fracture edges. Central pin should not contact fracture edge to avoid the interference with callus formation. Pin diameter no longer than 20% to 30% of the diameter of bone. The ESF can be linear or circular. With circular ESF technique, frame consist of ring connected with threaded rods. The frame is fixed to bone with tensioned small diameter wires.

Dislocation

Dislocation is defined as complete displacement of articular ends of bones when there is only a slight change in relationship of articular surface of bones is called partial dislocation or subluxation. The pain due to dislocation is constant, the tenderness is less intense and more diffuse. In dislocation there is rocking noise. A dislocation once reduced has very little tendency to re-occur provided rest is given.

Soft Tissue Surgeries

1. Castration

Indications: Neutering may be used in an attempt to treat certain forms of aggression, such as inter-male aggression. In older dogs, the operation may be performed to treat testicular tumours and some prostate gland conditions. It is also used to control hormonal (testosterone-dependent) diseases such as perianal adenomas.

Site of operation:

1. Pre-scrotal site: 3 cm long incision on the midline in front of the scrotum.

2. Scrotal site

Anaesthetic techniques: General anaesthesia

Control: Dorsal recumbency

Surgical Procedure:

One testes is pushed forward (in case of pre-scrotal incision) or toward (in case of scrotal incision) and is held in position by left index finger and thumb and about 2-3 cm long incision is made in the skin.

The testicle is continuously pushed outwards and gentle incisions are made in the subcutaneous fascia till shiny white tunica vaginalis is visible.

The testicle is now squeezed out and can be removed by any of the following methods:

Open method: An incision is given in the tunica vaginalis longitudinally over the spermatic cord. The anterior and posterior bundles of spermatic cord are identified. The testicular artery and vein are ligated with a non-absorbable suture proximal to the pampiniform plexuses. One end of the ligature is left long and held with artery forceps. The ductus deferens may be ligated separately and cut with a scissors. Artery forceps is now placed distal to the ligature in testicular vessels and the cord is cut between then. The testicle is now removed out along with artery forceps. The haemorrhage is checked carefully and only then the ligature end is cut short and the stump is allowed to recede in vaginal ring.

Close method: No incision is given in tunica vaginalis. It is ligated as such closed to the vaginal ring and is transected taking similar care for any haemorrhage as described in open method. The contra lateral testicle may be similarly removed after pushing it through the same incision (by making an additional incision in scrotal septum) or by making another incision in the contra lateral sac of scrotum or in case of pre-scrotal incision by incising only the contra lateral spermatic fascia. In cases of prescrotal incision, the skin wound is closed routinely, however in cases of scrotal incisions, these may be left open.

Post-operative care**:** Routine ASD and antibiotic therapy and prevention of self-mutilation.

2. Ovariohysterectomy

Indications: birth control programme**,** neoplasm involving ovary and uterus**,** ovarian cyst**,** uterine diseases (pyometra, metritis, chronic endometrial hyperplasia, prolapse)**,** minimize the risk of mammary gland tumors**,** vaginal edema**,** prevention

of hormonal changes that interferes with therapy for dermatitis, diabetes or epilepsy etc. are the indications of performing OHE in a bitch.

Site of operation: Ventral midline abdominal incision starting from the point of umbilicus backward over a length of 6 to 8 cm

Age and time: Best performed either before puberty or during anestrus. Six to eight months of age is generally considered best. Surgery may be most hazardous during estrus or pregnancy and in old obese females. Most suitable time to spay an adult bitch is three to four months after estrus. After whelping the operation should be done about six to eight weeks, as soon as the puppies have weaned and lactation has ceased.

Control and anaesthesia: The animal is controlled in dorsal recumbency under general anaesthesia.

Surgical procedure:

- A 8-10 cm long incision is given on midline from umbilicus and extending caudally. Skin, subcutaneous tissue, linea alba and peritoneum are incised to enter the abdominal cavity.
- An index finger is passed to locate the uterine horns. The uterus and ovaries are recognized and grasped with sterile gauge.
- The ovary is grasped between thumb and index finger and withdrawn for ligation. Application of artery forceps helps in efficient ligation.
- Chromic catgut is used to place a ligature over ovarian pedicle. The attachment between ovary and ligature is severed. Hemorrhage should be checked carefully.
- Similar procedure is followed to remove other ovary.
- The body of uterus is removed from abdomen after severing broad ligament. Uterine vessels are ligated. Then uterus is severed after placing double transfixing ligature.
- Uterine stump is checked carefully for hemorrhage. Abdominal incision is closed as usual.

Post-operative care: The site of operation should be checked for swelling or discharge. Course of antibiotics should be given. Antiseptic dressing is done daily. Restrict exercise for two weeks. Skin sutures are removed after 8-10 days of operation or after complete healing.

3. Aural Haematoma

Indications: Haematoma of the ear flap

Surgical Anatomy: External ear consists of the auricle (pinner, flap, leather) and external ear canal that extends to the tympanic membrane. The auricle is supported by auricular cartilage, which is covered with skin on both sides. It is pierced by many foramina which permits the passage of numerous vessels from great auricular artery. Haematoma usually forms on the concave surface of ear but can occur on convex surface or on both sides.

Anaesthetic Technique and Control: The animal is controlled in lateral recumbency keeping the affected ear upwards after proper premedication and general anesthesia.

Surgical Procedure:

- There are many surgical techniques for operating ear flap haematoma. Best results are obtained if surgery is performed 10 to 14 days after formation of the haematoma.
- Many surgical incisions like longitudinal, 'S' shape and criss cross for removal of an aural haematoma have been practiced. The 'S' shape incision is general preferred since it covers more surface area of the aural haematoma.
- The ear canal should be properly plugged with cotton prior to operation.
- The haematoma is removed, and cavity is flushed with saline to remove fibrin debris.
- Mattress sutures are placed parallel to the skin incision by using non-absorbable suture material size 20 or 30. In case of large haematoma, two or three rows of sutures 5 to 10 mm in width and 5 to 10 mm apart in each row may be placed.
- The sutures should penetrate the full thickness of the ear flap and tied on the convex surface of the ear. The edges of the incision are not brought into opposition, but the sutures are placed so that the incision remains open, a gap of 4 to 5 mm is considered best to acquire drainage. The number of sutures should be sufficient to obliterate the dead space.

Post-operative Management:

- After treating haematoma, ear canal is cleaned, and proper medication should be applied.
- Change the dressing as needed, usually every 3 days and keep the animal sedated.

- The ear should be usually bandaged.
- Sutures are removed on 7th to 10th post-operative day.

4. Rumenotomy

Indications: Rumenotomy can be performed to remove foreign bodies from the rumen, to treat acute ruminal acidosis and bloat, to treat oesophageal obstruction and some forms of choke, traumatic reticuloperitonitis, vagal indigestion, gastrointestinal obstructions and traumatic injuries to the rumen wall.

Anesthesia and control: Para vertebral or local infiltration analgesia.

Surgical technique:

- Rumenotomy is performed through a left para lumbar incision in standing animal.
- The abdominal muscles and parietal peritoneum are traversed by a direct incision corresponding to the skin incision.
- Following systematic exploration of the peritoneal cavity it is necessary to anchor the rumen to the incision to avoid contamination of the abdominal musculature and peritoneum during the rumenotomy procedure.
- For fixing the rumen Weingarth's frame method is used
- Short incision is made on the rumen and extended enough to permit easy access by hand into the rumen and reticulum.
- The rumen contents are evacuated without contaminating the peritoneal cavity by proper packing.
- The reticulum can also be examined by stretching the hand through the large rumen reticular orifice and the oesophageal groove.
- The row of continuous inversion sutures either Connell or Cushing by using No. 2 or No.3 chromic catgut.
- A second layer of sutures may be placed with Lambert continuous suture and muscle layers are closed with mattress followed by continuous sutures.
- The skin incision is closed by vertical mattress or simple opposition sutures.

5. Gastrotomy in dogs

Indications: Removal of foreign body, gastric dilatation volvulus syndrome, ulcers, neoplasm and other intervention in the stomach and to collect biopsies for diagnostic purposes.

Surgical technique:

- A ventral midline abdominal incision from the xiphoid to pubis has to be made.

- Inspect the entire abdominal contents.
- Isolate the stomach from remaining abdominal contents with moistened laparotomy sponges, for reducing the chance of contamination.
- Stay sutures can be placed to assist in manipulation of the stomach and to prevent spillage of gastric contents.
- Select a hypo-vascular area on the ventral aspect of the stomach for making the incision. It should be between the greater and lesser curvatures.
- The incision should be away from the pylorus.
- First make a stab incision into the gastric lumen with a scalpel, and then extend the incision with metzenbaum scissors.
- Suction can be used to aspirate gastric contents to avoid spillage.
- 2 – 0 or 3 – 0 absorbable suture material is used to close the stomach in a two-layer inserting sero-muscular pattern.
- In the first layer, serosa, muscularis and submucosa is included by inverting cushing suture. Then with a lambert or Cushing pattern that incorporates serosal and muscularis layers.
- To reduce the post-operative bleeding, as an alternative we can close the mucosa in a simple continuous suture pattern as a separate layers.
- Substitute sterile instruments and gloves for those contaminated by gastric contents.
- If gastrotomy is performed for removal of foreign body, be sure to check the entire intestinal tract for additional material that could cause an intestinal obstruction.

6. **Cystotomy in dog**

Indications: Bladder stones, urethral obstructions, abnormal ureters, bladder tumours, blood clots or in case of ruptures or trauma**.** A cystotomy can be used to obtain a biopsy sample of the urinary bladder.

Site of operation: Caudal ventral mid-line incision in females and paramedic in males.

Surgical anatomy: Urinary bladder lies on the ventral abdominal floor cranial to the pubis. Neck of the bladder lies in the pelvic cavity and is the only part not covered by the peritoneum. Two lateral ligaments one on each side and a single ventral median ligament keep the bladder in position. The ureters open on the dorso-caudal aspect of bladder.

***Anaesthetic technique*:** General anaesthesia
Control: Dorsal recumbency
Surgical procedure:

- After performing laparotomy, the urinary bladder is exteriorized and the abdominal wound is packed with moistened surgical towels or drapes.
- A stay suture on the apex of bladder involving only up to submucosa or muscularis is applies to facilitate the manipulation.
- The 2-3 cm long cystotomy incision is made on the dorsal aspect of bladder between the major blood vessels and away from the ureters (in case of cystic neoplasm, the incision has been given around the neoplasm).
- The urine is removed by suction and calculi are removed with forceps (or with a smooth edged gall bladder spoon)
- In case of males, a catheter is passed from the external urethral opening by an assistant and the calculi, if any, is back flushed into bladder from where these are removed.
- In case of females, the catheter is passed from the bladder into the urethra and flushed until all urethral calculi are removed and the catheter can be passed freely.
- The cystotomy incision is then closed in 2 to 3 layers using swaged-on atraumatic needle with 3-0 to 4-0 absorbable suture material.
- The first layer of horizontal mattress is used to close mucosa and the subsequent layer/s is/are applied by continuous inversion sutures (Cushing/ Lambert) to close remaining layers.
- The stay suture is removed and the laparotomy incision is closed routinely.

7. Enterotomy

Indications

1. To remove foreign bodies, perform a biopsy, or expose the bowel to pass a catheter.
2. Removing ischemic, necrotic, neoplastic, or fungal-infected segments of bowel.
3. Irreducible intussusceptions are also managed**.**

Surgical technique

- After the celiotomy incision, the diseased or desired intestinal segment is isolated from the abdomen by packing with towels or laparotomy sponges.
- Gently milk the intestinal contents from the lumen of the identified intestinal segment.
- Occlude the lumen at both end of the isolated segment by noncrushing intestinal

forceps

- Make a full thickness stab incision into the intestinal lumen on the antimesenteric border.
- After the correction of pathology, close incision with partial thickness inversion or apposition sutures.
- Apply gentle digital pressure and observe for leakage between sutures or through needle holes.
- Lavage the isolated intestine and entire abdomen if contamination have occurred.
- Omentum can be placed over the suture line (omentalisation) before closing the abdomen, to facilitate healing.
- Replace contaminated instruments and gloves before closing the abdomen.

Surgical Patient Preparation and Hospital Asepsis

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Surgical Patient Preparation

Veterinary pre-surgical preparations involve a comprehensive approach to ensure patient safety and optimal surgical outcomes. This includes thorough patient assessment, appropriate fasting protocols, and administration of necessary pre-medications. Surgical aseptic techniques are crucial in preventing infections and complications, encompassing proper hygiene, sterile gowning and gloving, and maintaining a sterile surgical field throughout the procedure. Proper patient positioning and surgical site preparation are critical components of preoperative procedures, necessitating strict adherence to established protocols. This process commences with the careful positioning of the patient to ensure optimal access to the surgical site while maintaining their comfort and safety. Precise hair clipping in the surgical area is conducted to minimize contamination risk, followed by thorough cleaning and disinfection using approved antiseptic solutions. These steps are essential in reducing the risk of surgical site infections and promoting optimal healing.

The selection and use of appropriate surgical instruments and materials are vital for ensuring successful surgical outcomes. Surgeons must meticulously select instruments that are well-maintained, sterile, and suitable for the specific procedure being performed. Sutures are chosen based on their tensile strength, absorption properties, and tissue reactivity, considering the type of tissue being repaired and the expected healing time. In cases where implants are required, factors such as biocompatibility, durability, and potential for integration with the patient's tissues must be considered. The proper handling and placement of these materials during surgery significantly influence the overall success of the procedure.

Postoperative care and monitoring are equally important aspects of the surgical process, playing a crucial role in patient recovery and the prevention of complications. Pain management is a key component of postoperative care, involving the administration of appropriate analgesics and the implementation of non-pharmacological pain relief strategies. Wound care is another critical aspect, encompassing regular dressing changes, monitoring for signs of infection, and ensuring proper healing. Close observation of the patient's vital signs, fluid balance,

and overall condition is essential for the early detection of any potential complications. This vigilant monitoring allows for prompt intervention if issues such as infection, bleeding, or adverse reactions to medications arise. Furthermore, postoperative care extends beyond the immediate recovery period, often involving rehabilitation programs, dietary adjustments, and lifestyle modifications to support the patient's long-term recovery and optimize the surgical outcome.

Patient education is also a crucial component, ensuring that individuals understand their role in the recovery process and can recognize signs that may warrant medical attention. By implementing comprehensive pre-surgical preparations, utilizing appropriate surgical techniques and materials, and providing thorough postoperative care, healthcare professionals can significantly enhance patient outcomes and promote faster, more effective recovery.

The integration of advanced technologies in veterinary surgery has revolutionized the field, offering enhanced precision and improved patient outcomes. These technological advancements include minimally invasive surgical techniques, such as laparoscopy and endoscopy, which reduce surgical trauma and accelerate recovery times. Additionally, the use of imaging technologies like CT scans and MRI for surgical planning has greatly improved the accuracy of diagnoses and the effectiveness of surgical interventions. The integration of advanced imaging technologies, such as 3D modelling and virtual reality, has further enhanced the capabilities of RI in preoperative planning. Surgeons can now visualize complex anatomical structures and simulate procedures before entering the operating room, leading to more precise and personalized surgical approaches. This increased level of preparation not only reduces the risk of complications but also shortens recovery times for patients, ultimately improving overall healthcare outcomes.

Aseptic Techniques

Infection is one of the most potentially devastating and challenging complications of surgery, which may occur during surgery or at any time during hospitalization. All possible measures should be taken to reduce the risk of *iatrogenic infection*.

Asepsis is defined as the absence of microorganisms that cause disease, which should be applied to the entire hospital to control the pathogens and to protect both the patient and hospital staff (Aseptic techniques, medical asepsis, clean techniques).

Sterile is defined as being free of all living microorganisms. Sterile technique are more appropriate for the operating room (OR) setting, and applies to work performed in a sterile field. The higher level of protection in a sterile field is critical because the

natural defences of the patient are breached by surgical incision, puncture, or introduction of instruments into the vascular system. For example, arthrocentesis performed under sterile technique might require the use of sterile gloves, a sterile patient preparation kit, and a small drape, whereas the same procedure performed using clean or aseptic technique would require only nonsterile gloves and an alcohol wipe.

Transmission of Microorganisms may occur due to contaminated instruments and the environment, but the hospital staff is the most likely means of transmission. The specific means of transmission from staff to patient include airborne, droplet, and contact. Airborne and droplet types of transmission is less common in veterinary hospitals because of the low incidence of reverse zoonosis. Contact from another patient or from an environmental source, is the most common method. During surgery, contact from the patient's normal sources of bacteria such as the skin or nasopharynx may transmit infection to the surgical wound.

Sources of contamination may be divided into animal sources and inanimate sources. Animal sources include the skin and hair, the nasopharynx, and other orifices such as the vulva or anus. Inanimate sources include fomites and air. One cubic foot of air contains thousands of particles, which can increase to more than 1 million particles during a lengthy surgical procedure, because of traffic into and out of the room and other air currents that develop, and may cause 80% to 90% of microbial contamination of a surgical wound.

PRINCIPLES OF HOSPITAL ASEPSIS

Minimization of infection in a surgery practice involves applying principles of aseptic technique throughout the hospital. Goals are to minimize sources of contamination and to block transmission of microorganisms.

- Regular hand washing by hospital staff
- Use of nonsterile or sterile gloves when handling likely sources of pathogens, including high-risk patients (e.g., patients with known infection or wounds), equipment (e.g., contaminated sponges), and hospital surfaces
- Cleaning or disposal of equipment between patients
- Containment of contaminated supplies and equipment
- Proper storage of equipment
- Regular equipment cleaning protocols
- Proper handling of soiled laundry

- Scheduled cleaning of hospital surfaces
- Proper maintenance of hospital heating, ventilation, and air conditioning systems
- Minimizing unnecessary traffic
- Isolation of patients with known pathogenic microorganisms

Sterile Technique

All surgical procedures are ideally performed under sterile conditions to prevent the transmission of microorganisms into the body during surgery or other invasive procedures.

Surgical team members should remain within the sterile area, movement in the operating room (OR) by all personnel is kept to a minimum; only necessary personnel should enter the operating room as movement in the OR and outside of the sterile area may encourage turbulent airflow, resulting in cross-contamination.

- Talking is kept to a minimum as it releases moisture droplets laden with bacteria.
- Non-scrubbed personnel should not reach over sterile fields as dust, lint, or other vehicles of bacterial contamination may fall on the sterile field.
- Scrubbed team members should face each other and the sterile field at all times as the back is not considered sterile even if wearing a wraparound gown.
- Equipment used during surgery must be sterilized, and scrubbed personnel should handle only sterile items; non-scrubbed personnel handle only nonsterile items as non-scrubbed personnel and unsterile instruments may be a source of cross-contamination. If the sterility of an item is questioned, it is considered contaminated.
- Sterile tables are sterile only at table height. Items hanging over the table edge are considered nonsterile because they are out of the surgeon's vision. If the surgical team begins the surgery seated, they should remain seated until the surgery has been completed. The surgical field is sterile only from table height to the chest; movement from sitting to standing during surgery may promote cross-contamination.
- Sterile drapes are used to create a sterile field Drapes covering instrument tables or the patient should be moisture proof as moisture carries bacteria from a nonsterile surface to a sterile surface (strike-through contamination). Sterile items within a damaged or wet wrapper are considered contaminated.
- If a sterile object touches the sealing edge of the pouch that holds it during opening, it is considered contaminated. Once opened, sealed edges of pouches are not sterile.
- Hands may not be folded into the axillary region; rather, they are clasped in front

of the body above the waist. The axillary region of the gown is not considered sterile. Gowns are sterile from mid-chest to waist and from gloved hand to 2 inches above the elbow.

- All items introduced onto a sterile field should be opened, dispensed, and transferred by methods that maintain sterility and integrity; the sterile field should be maintained and monitored constantly.
- Surgical staff should be trained to recognize when they have broken technique and should know how to remedy the situation.

Fundamentals of Veterinary Surgery

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Veterinary surgery is an integral component of veterinary science which includes knowledge, skills, and techniques required to diagnose, treat, and manage surgical disorders in animals. It demands understanding of basic surgical principles, applied anatomy, aseptic techniques, anaesthetic protocols, surgical instrumentation, operative procedures, and postoperative care. It requires not only technical knowledge but also sound clinical judgment and ethical considerations to ensure optimal outcomes for the animal patient.

Historical Perspective

Veterinary surgery has evolved from rudimentary procedures to highly specialized interventions due to advances in anatomical knowledge, anaesthesia, antisepsis, diagnostic tools, and surgical technology. Early veterinary practices were primarily limited to external injuries, castrations, and minor wound care, but advancements have made orthopaedic surgeries, soft tissue reconstruction, minimally invasive techniques, and microsurgery as routinely performed operative procedures in the clinical set up.

Scope of Veterinary Surgery

The scope of veterinary surgery includes routine procedures (castration, spaying, dehorning), emergency interventions (GDV, dystocia), orthopaedic and neurologic procedures (fracture repair, spinal surgery), oncologic surgery (tumour excision), ophthalmic and dental surgeries, laparoscopic and endoscopic surgeries as well as reconstructive and plastic surgeries. Veterinary surgeons play a crucial role not only in the treatment but also in research, public health, food safety, and animal welfare.

Basic Principles of Surgery

The basic principles of surgery are based on the popular "Tenets of Halstead". Halsted's original principles were developed during an era when surgical infections were rampant and mortality was high. By introducing meticulous surgical technique and infection control, Halsted dramatically improved outcomes. The seven classic

tenets of Halsted are gentle handling of tissues, meticulous haemostasis, preservation of blood supply, strict aseptic technique, minimum tension on tissues, accurate tissue apposition and obliteration of dead space. Later refinements added aspects like appropriate use of sutures, appropriate timing of surgery, and minimally invasive techniques, though the original seven form the core of surgical discipline.

Gentle Handling of Tissues: Tissue trauma during surgery initiates a cascade of inflammatory responses that may lead to oedema, necrosis, delayed healing, and increased infection risk. Example, in bowel surgery, excessive manipulation may lead to ileus or perforation or in orthopaedic procedures, muscle handling affects limb function postoperatively. Gentle handling preserves cellular viability and reduces complications. In veterinary surgery, animals cannot articulate pain or discomfort, therefore, it becomes even more critical to minimize intraoperative trauma. This includes using atraumatic instruments (e.g., DeBakey forceps), avoiding excessive stretching or crushing of tissues, using moist sponges to handle delicate organs like intestines or uterus and frequent saline irrigation to prevent drying of exposed tissues. Gentle handling not only promotes faster healing but also enhances patient comfort and reduces hospitalization time.

Meticulous Haemostasis: Haemostasis refers to the control of bleeding during and after surgery. Excessive blood loss impairs visibility, increases the risk of hematoma and infection, and contributes to shock. Veterinarians often deal with species where blood volume is small relative to body size (e.g., cats, birds, rodents), therefore, even minor haemorrhage can be life-threatening. Example, during ovariohysterectomy in dogs or cats, improper ligation of the ovarian pedicle can lead to severe intra-abdominal bleeding or in large ruminants, bleeding during horn or testicular removal must be carefully managed to prevent anaemia or death. Techniques include pressure application with gauze, haemostatic clamps (mosquito, Kelly), electrocautery or ligatures (absorbable sutures), topical haemostatics like gelatin sponges, bone wax or tourniquets in limb surgeries (used judiciously). Veterinarians must anticipate bleeding risks and plan interventions proactively.

Preservation of Blood Supply: Tissues need oxygen and nutrients to heal. Disrupting the blood supply during dissection can lead to ischemia, necrosis, delayed healing, and infection. Understanding vascular anatomy is critical. Veterinary surgeons must learn how to identify and preserve major arterial and venous pathways, use blunt dissection to avoid vessel transection, and choose incisions and

closures that do not compromise perfusion. Example, in skin flap surgeries, a random pattern flap must maintain a reliable blood supply from the base or during bowel resections, preserving the mesenteric vasculature is essential to avoid ischemic necrosis. In horses and dogs, skin is loosely attached and prone to devascularisation. Hence, undermining or tension must be minimized.

Strict Aseptic Technique: Asepsis is the complete absence of microorganisms in the surgical field. The principle is vital in preventing postoperative infections, sepsis, and death. The application of aseptic techniques in veterinary practice must account for multiple species with different skin flora. The fundamentals remain the same including sterilization of instruments using autoclaves or chemical agents, surgical scrubbing and gloving techniques, proper draping and attire and minimal conversation and traffic in the operating room. Example, in orthopaedic surgeries like TPLO in dogs, aseptic failure can lead to implant-associated infections or in caesarean sections in ruminants, improper site preparation can lead to peritonitis and loss of dam and foetus. Veterinarians must treat every surgery as an opportunity to uphold high standards of sterility.

Minimum Tension on Tissues: Excessive tension causes tissue ischemia, dehiscence, and delayed healing. Animals with thick or mobile skin (dogs, horses) are susceptible to wound gaping. To avoid this, use tension-relieving suture techniques (e.g., vertical mattress, walking sutures), utilize skin flaps or grafts in large wounds, avoid excessive suture tightening and ensure that closure layers match tissue planes accurately. Example, in abdominal surgeries, tight closures can lead to fascial dehiscence or incisional hernia and over-tightening sutures may lead to strangulated tissues and necrosis. Veterinary surgeons must develop the judgment to balance security and slack.

Accurate Tissue Apposition: The tissues should be sutured back in their original anatomical positions to facilitate rapid healing and restore function. It is sometimes challenging due to fur, muscle mass, and movement. Key practices include layered closure (muscle, fascia, sub cutis, skin), choosing appropriate needle and suture size, inverting or everting sutures based on tissue type and avoiding excessive gaping or overlapping. Example, in gastrointestinal surgery, mucosa must be correctly apposed to prevent leakage. In muscle surgeries, realigning fibre direction prevents contracture and dysfunction. Incorrect apposition may lead to sinus formation, infection, or loss of organ function.

Obliteration of Dead Space: Dead space allows fluid accumulation (seroma, hematoma), delays healing, and predisposes to infection. Veterinarians must be particularly careful in areas like axillae, groin, and flank. Techniques to manage dead space include layered closure to bring tissues together, use of drains (Penrose, closed suction), compression bandages and walking sutures to reduce space. Example after mastectomy in dogs, dead space can lead to massive seroma formation. In large wound repairs in horses, improper management may result in abscesses or wound breakdown. Eliminating dead space also improves cosmetic and functional outcomes.

Other modern considerations based on Halstedian principles include appropriate use of suture materials and use of minimally invasive techniques. Suture materials must be based on tissue type (fast or slow healing), species sensitivity and infection risk. Sutures should be absorbable for internal tissues (e.g., catgut, Vicryl), non-absorbable for skin (e.g., nylon) and should be appropriate in tensile strength and diameter. Though not in Halsted's era, modern adaptations of his tenets support laparoscopy and arthroscopy causing minimal tissue trauma, reduced pain and recovery time with fewer infections and adhesion, aligning well with Halsted's principles of precision and gentle handling. Incorporating these tenets into every stage ensures consistency, quality, and ethical standards in practice. The Halstedian tenets serve as the bedrock of safe, ethical, and effective surgery. As veterinary medicine continues to advance, these time-tested fundamentals remain as relevant and powerful as ever.

Classification of Surgical Procedures

Veterinary surgical procedures can be classified in various ways, depending on the urgency of intervention, purpose of surgery, anatomical region involved, nature of the procedure, and species or size of the animal.

Classification Based on Urgency

Elective Surgeries: Elective surgeries are non-urgent procedures that are planned in advance. These surgeries are usually preventive or cosmetic, or they aim to improve an animal's quality of life. Elective surgeries are typically performed when the animal is in optimal health and after appropriate preoperative planning. It allows for better preoperative assessment, less anaesthetic and surgical risk. Example, ovariohysterectomy (spaying), orchiectomy (castration/neutering), dewclaw removal in puppies, cosmetic dehorning in young calves, removal of benign skin masses etc.

Emergency Surgeries: Emergency surgeries are unplanned, life-saving

interventions that must be conducted immediately or within a short timeframe. These surgeries address life-threatening conditions, and delays can result in death or irreversible damage. It has high-pressure decision-making, often performed with incomplete preoperative preparation and require prompt diagnosis and intervention. Example, caesarean section in obstructive dystocia, gastric dilatation-volvulus (GDV) in dogs, traumatic diaphragmatic hernia, intestinal volvulus or torsion, laceration repair with active haemorrhage etc.

Classification Based on Purpose

Exploratory/Diagnostic Surgery: Diagnostic surgeries are conducted to determine the cause or extent of a disease when non-invasive diagnostics are inconclusive. These are often exploratory or involve biopsies. They are vital in cancer diagnosis, chronic illnesses and are often combined with therapeutic procedures. Example, exploratory laparotomy for chronic vomiting, lymph node excision for histopathology, liver or kidney biopsy, arthrotomy to explore joint disease etc.

Therapeutic Surgery: Therapeutic surgeries are performed to treat an existing condition. These are the most common type of surgeries and range from simple to highly complex interventions. Example, tumour excision, intestinal resection and anastomosis, hernia repair. limb amputation for osteosarcoma, fracture repair with internal fixation etc.

Reconstructive Surgery: These surgeries are aimed at restoring anatomical function and appearance, often following trauma, tumour removal, or congenital defects. Example, skin grafts for burn or wound coverage, cleft palate repair, reconstructive surgery following mastectomy, correction of entropion or ectropion in eyelids etc.

Classification Based on Anatomical Region or System

Soft Tissue Surgery: Soft tissue surgery includes procedures involving non-skeletal structures, primarily internal organs, skin, and body cavities.

- Abdominal surgery – Spaying, cystotomy, enterotomy
- Thoracic surgery – Lung lobectomy, PDA correction
- Dermal/subcutaneous – Tumour excision, wound management
- Head and neck surgery – Ear canal ablation, salivary gland excision

Orthopaedic Surgery: Orthopaedic surgeries deal with bones, joints, and

associated structures like ligaments and tendons. It may require radiographic imaging or implants and surgical tools specific to orthopaedics. Example, fracture repair (internal/external fixation), cruciate ligament repair (TPLO, extracapsular), hip replacement, arthrodesis etc.

Neurological Surgery: Neurosurgery includes procedures on the brain, spinal cord, and peripheral nerves. Example, hemilaminectomy for intervertebral disc disease (IVDD)

Ophthalmic Surgery: This category involves surgeries of the eyes and adnexa. Example, enucleation, entropion/ectropion correction, cherry eye correction, corneal ulcer repair, intraocular lens implantation etc.

Dental and Maxillofacial Surgery: It involves teeth, jawbones, and associated structures. Example, tooth extraction, mandibulectomy, maxillary fracture repair, oral tumour excision etc.

Classification Based on Level of Contamination

Clean Surgery: No infection or inflammation; no entry into the gastrointestinal, respiratory, or genitourinary tracts. Example, elective orthopaedic procedures, skin tumour removal, spay in non-pregnant female etc.

Clean-Contaminated Surgery: Controlled entry into tracts with no spillage or significant contamination. Example, enterotomy without leakage, elective cystotomy, tracheal surgery etc.

Contaminated Surgery: Open wounds, traumatic injuries, or surgery with spillage from GI or urinary tract. Example, penetrating abdominal injury, bowel rupture, abscess drainage etc.

Dirty/Infected Surgery: Obvious infection present at surgical site. Example, pyometra, septic peritonitis, gangrenous limb amputation etc.

The classification by contamination level helps determine infection risk and appropriate use of perioperative antibiotics.

Classification Based on Invasiveness

Open Surgery: Involves large incisions, visualization of internal structures, and direct tissue manipulation. Example, traditional laparotomy, hernia repair,

orthopaedic plating etc.

Minimally Invasive Surgery: Uses endoscopic instruments and small incisions; involves less pain and quicker recovery. The advantage includes reduced blood loss, shorter hospitalization and lower infection rates. Example, laparoscopic spay, arthroscopy, thoracoscopy etc.

Classification Based on Surgical Technique

Excisional Surgery: Involves removal of tissues or structures. Example, tumour removal, limb amputation, mastectomy etc.

Incisional Surgery: Involves cutting into a tissue without removing it. Example, incisional biopsy, arthrotomy, celiotomy etc.

Anastomotic Surgery: Reconnection of two hollow structures. Example, intestinal resection and anastomosis, ureteral reimplantation etc.

Reconstructive Surgery: Used to restore function and form. Example, skin grafts, tendon repair, flap creation etc.

Classification of surgical procedures serves as a foundation for surgical decision-making, helps in standardizing care, and facilitates effective communication. Being well-versed whether the surgery is elective or emergent, soft tissue or orthopaedic, minimally invasive or open ensures that resources are optimally allocated, safe and effective surgical care are executed and ethical considerations are respected.

Preoperative Considerations

Patient Evaluation: A thorough clinical evaluation is crucial for surgical planning. This includes history and physical examination, blood work (CBC, serum biochemistry), imaging (radiography, ultrasonography), ECG in high-risk patients etc.

Informed Consent: The owner should be briefed about the surgical procedure, potential risks, alternatives, prognosis, and costs. Written consent should be obtained.

Fasting and Hydration: Patients are fasted for 8–12 hours prior to general anaesthesia to minimize risk of aspiration. Water may be withheld for 2–4 hours.

Surgical Instruments and Sterilization

Veterinary surgical instruments are designed for precise and safe manipulation of tissues. They are categorized as:

- Cutting Instruments: Scalpels, scissors
- Clamping Instruments: Haemostats
- Tissue Holding: Allis, Babcock forceps
- Retractors: Gelpi, Weitlaner, self-retaining
- Needle Holders: Mayo-Hegar, Olsen-Hegar

Sterilization techniques include:

- Autoclaving (Steam sterilization): Most common and effective
- Chemical sterilization: Glutaraldehyde
- Ethylene oxide gas: For heat-sensitive instruments
- Plasma sterilization: Advanced, for endoscopes

Anesthesia and Analgesia

Successful surgical outcomes depend on appropriate anesthesia and pain management.

General Anesthesia

Injectables: Ketamine, propofol, alfaxalone
Inhalants: Isoflurane, sevoflurane

Local and Regional Anaesthesia

- Nerve blocks (e.g., brachial plexus block)
- Epidural anaesthesia (for caudal procedures)
- Topical anaesthesia (e.g., lidocaine gel)

Analgesia

- NSAIDs (carprofen, meloxicam)
- Opioids (morphine, buprenorphine)
- Adjuncts like ketamine, gabapentin

Surgical Techniques and Incisions

- Midline abdominal incision: Spaying, cystotomy
- Flank approach: Ruminant surgeries
- Lateral thoracotomy: Thoracic procedures

- Dorsal approach to spine: Hemilaminectomy

Suture Materials and Techniques
Suture types:
Absorbable: Catgut, vicryl, polydioxanone
Non-absorbable: Nylon, silk, polypropylene

Suture patterns:
Interrupted: Simple, cruciate
Continuous: Simple, Ford interlocking
Specialized: Mattress (horizontal/vertical), purse-string

Postoperative Care and Monitoring
Pain Control: Monitoring for signs of pain (vocalization, restlessness, tachycardia) and administering analgesics accordingly.
Wound Care: Daily cleaning, bandage changes, and checking for swelling, discharge, dehiscence, infection etc.
Fluid Therapy and Nutrition: Maintain hydration with IV fluids as needed. Early return to feeding is encouraged to promote gut motility.
Monitoring Vital Parameters: Temperature, pulse, respiration, mucous membrane colour, and capillary refill time must be regularly assessed.

Complications in Veterinary Surgery
Despite best practices, surgical complications may occur. Common issues include
Wound Infection: Often due to poor asepsis or immunocompromised status. Managed with debridement and antibiotics.
Haemorrhage: May occur intraoperatively or postoperatively. Requires haemostasis or transfusion.
Dehiscence: Wound breakdown due to tension or infection. Requires resuturing.
Seroma and Hematoma: Fluid accumulation managed conservatively or by aspiration.
Anaesthetic Complications: Hypoventilation, hypotension, arrhythmias, and aspiration are major risks requiring immediate correction.

Ketosis in Dairy Cattle

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Ketosis is a disease of paramount importance in dairy cattle. It mostly occurs in early lactation and is characterized by partial anorexia and depression. Rarely, it occurs in late gestation. In addition to inappetence, signs of nervous dysfunction, including pica, abnormal licking, incoordination and abnormal gait, bellowing and aggression, are occasionally seen. This is worldwide in distribution but is most common where dairy cows are bred and managed for high production.

Etiology

- When large amounts of body fat are utilised as an energy source to support production, fat is sometimes mobilised faster than the liver can properly metabolise it. If this situation occurs, ketone production exceeds ketone utilisation by the cow, and ketosis results.
- There are three ketone bodies that can be formed during energy production – acetate, acetoacetate and beta-hydroxybutyrate (BHB). Nutritional or metabolic insult in high yielding cows in early lactation results in negative energy balance.
- Animals in 4 -10 weeks post-partum, peak milk yield and decreased dry mater intake are prone for ketosis.
- Failure to provide sufficient glucose when the animals are subjected to heavier demands on their resource of glucose and glycogen, than can be met by their digestive and metabolic activity.
- Dysfunction of adrenal gland. Stress of parturition, lactation and stress of malnutrition leads to decreased ACTH activity.
- Composition of ration - ensilage (high in butyric acid) are more ketogenic than hay.
- There is difference in ketogenicity between feeds. eg. High protein diets produces more butyric acid.
- Factors those decrease energy supply, increase demand for glucose and increase utilization of body fat will lead to ketosis.
- Starvation decrease propionic acid resulting in excessive utilization of fat.

- Abnormal ruminal conditions may play an important part in the production of clinical ketosis.
- Hepatic insufficiency - primary or secondary . Hypoglycemia results in mobilization of fat & its deposition in liver - perpetuation of hepatic insufficiency.

Ketosis is of two types –

- Primary ketosis is caused by
- Ketosis of heavily fed high producing cows
- Inheritance may be there
- Tendency to reoccur in individual animals is probably due to variation in digestive capacity or metabolic efficiency
- Excessive feeding of ensilage
- Inadequate exercise
- Over fatness at calving time
- Inadequate energy intake during early lactation
- Specific dietary deficiency of cobalt (essential for metabolising propionic acid), phosphorous and vitamin B_{12}
- Secondary ketosis is caused by
- Reduction in appetite
- Abomasal displacement
- Traumatic reticulitis
- Metritis
- Mastitis

Epidemiology

- In the dairy cow, the mismatch between input and output usually occurs in the first few weeks of lactation, because the cow is not able to eat enough to match the energy lost in the milk.
- Ketosis in cows is mostly sporadic

Regardless of specific etiology bovine ketosis is
Most common during 1st month of lactation

- Less common during 2nd month of lactation
- Occasionally during late pregnancy
- Higher frequency in 20 - 30 days of calving
- Low prevalence at 1st calving

- Peak prevalence at 4th calving

Clinical findings

Wasting form

- Gradual but moderate decrease in appetite and decreased milk yield over 2-4 days
- First refuse grains, ensilage but continue to eat hay.
- Loss of body weight is rapid due to off-feed
- Woody appearance (due to loss of cutaneous elasticity and subcutaneous fat)
- Faeces firm and dry
- Cow moderately depressed
- Disinclined to move
- Normal temperature, pulse and respiratory rates.
- Rate and amplitude of ruminal movements normal and may be decreased in prolonged cases
- Ketone odour from mouth, breath and milk

Nervous form

- Suddenly appear Bizarre, delirium, walking in circles, straddling or crossing of legs, head pushing or leaning onto stanchion, apparent blindness, aimless movements, wandering, vigorous licking of the skin and inanimate objects
- Depraved appetite
- Chewing movements with salivation
- Hyperaesthetic- bellowing on pinching or stroking
- Moderate tremor and tetany
- Staggering gait.
- Nervous sign usually occur in short episodes which last for 1 or 2 hrs and may recur at intervals of about 8 to 12 hrs
- Affected cows may injure themselves during the nervous episodes

Diagnosis of ketosis

History with reference to time of calving, feeding program

- Biochemical examination reveals hypoglycemia, ketonemia and ketonuria
- The gold standard test for ketosis is the blood BHB level
- In cases of sub clinical ketosis: Ketonemia with absence of clinical signs
- Differentiate secondary ketonuria due to
- TRP,

- Bovine pyelonephritis,
- Indigestion,
- Abomasal displacement,
- Metritis and
- Mastitis.
- Nervous form of ketosis should be differentiated from Listeriosis and Rabies.
- Field test (Rothera's reaction) : Milk and urine can be tested. It measures only Aceto acetic acid.
- ß hydroxybutyric acid – no reaction
- Acetone - very little reaction
- Primary ketosis - strong colour
- Secondary ketosis - moderate reaction
- Cowside urine tests for ketosis: Urine acetoacetate can be evaluated quantitatively by nitroprusside tablets (Acetest, Bayer Corp. Diagnostics Division,
- Elkhart, IN). This test has excellent sensitivity but poor specificity (Nielen et al., 1994; Carrier et al.,2004; Oetzel, 2004).
- Cowside milk tests for ketosis: The most promising cowside milk ketone test used is a semi-quantitative milk BHB test strip manufactured by Sanwa Kagaku Kenkyusho Co., Ltd. (Nagoya, Japan). This test strip is marketed under various names (KetoTest, Ketolac BHB, and Sanketo paper) in different parts of the world.

Clinical Pathology of Ketosis

Metabolite	Level when diseased	Normal
Blood sugar	20 -40mg%	50 -55mg%
Blood Ketones	20 -100mg%	10mg%
Ketone in Urine	80 -130 mg/dl or more	5 -70 mg/dl
Milk ketones	Average 40m g/dl	3 mg/dl

Treatment

- 25 % glucose 1000-1500 ml I/V
- Propylene glycol or glycerine @ 225 mg / day for 2 days then 110 mg / day for 2 days.
- Corticosteroids have the ability to break down protein in muscles to produce glucose, which immediately replenishes the depressed blood glucose levels.

- When using corticosteroids, it is important to supply an adequate amount of glucose either as a high carbohydrate diet and/or propylene glycol drenches to prevent excessive breakdown of muscle protein
- Sodium propionate 110 -225 mg/ day, but shows very slow response.
- Lactates: Ca or sodium lactate 1 kg initially, later ½ kg / day for 7 days or
- Sodium acetate 110-500 g/day.
- Ammonium lactate 200g/day for 5 days.
- Anabolic steroids: Effective treatment for pregnancy toxemia of cows. Trenbolone acetate @ 60mg to 100 mg as single injection.
- Chloral hydrate- Initially, 30 g orally , later 7 g bid for several days as drench in molasses or water. It breaks the starch in the rumen and stimulates production and absorption of glucose. Also, selectively influence rumen fermentation to produce more of sodium propionate.
- Vitamin B_{12} and cobalt - for the activation of coenzyme A.
- Cysteamine (precursor of co-enzyme A)- 750 mg i/v
- Sodium fumerate (precursor of co-enzyme A) 3 doses at 1-3 days interval.
- Provide adequate food and water.
- Monensin sodium enhances the propionate production in the rumen. Dose 25mg/day in grain feed mix.

Control

- Should not be starved or over fat at calving.
- Adequate calorie intake at early lactation.
- 4 weeks prior to calving: silage or hay or pasture maintenance + 1 Kg concentrate/ day; gradually increase to 5 kg concentrate/day at calving.
- After calving, increase concentrate as production increases i.e. 3 kg hay/ 100 kg b.wt. or 9 kg ensilage/ 100kg b.wt. as maintenance + 1 kg concentrate /3 kg milk produced.
- Protein should not exceed 16-18 %.
- Exercise is must in intensive rearing.
- Ration should contain Co, P and I_2.
- Avoid wet ensilage or mouldy hay or dusty hay (as they have increased levels of butyrate).
- Prophylactic feeding of sodium propionate @ 110g daily for 6 weeks.
- Propylene glycol @ 350 ml / day for 10 days after serving or 6% of concentrate ration for 2 months.

General Management

- Manipulation of ration to produce more of propionate in the rumen (ration of finely ground roughage, cooked grain, cod liver oil with certain unsaturated fatty acid are anti ketogenic and produces less of milk fat thereby reducing energy loss).
- Blood glucose estimation at 2-6 weeks of lactation(< 35 mg % needs attention). Regular tests for ketone in urine are to be done from 2nd week.
- Estimation of β hydroxy-butyrate levels in early lactation.
- Palatable feeds and frequent feeding.
- 1/3rd of total D.M consumption through good quality roughage helps to maintain appetite.

Reference

- Constable P.D., Hinchcliff K.W., Done S.H. and Grunberg W. (2017). Veterinary Medicine: A textbook of the diseases of cattle, horses, sheep, pigs and goats.11th Edn. Pp 1708-1716. Elsevier.

Collection of Clinical Samples, Faecal Examination and Blood Smear Preparation

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Accurate diagnosis of parasitic and microbial infections depends on the proper collection, handling, and examination of clinical samples. This chapter outlines the essential procedures for collecting clinical and faecal samples, preparing smears, and interpreting results.

Collection of Clinical Samples

The quality of laboratory results greatly depends on how well clinical samples are collected and handled. Always use clean, sterile containers and label them with the patient's identification, date, and type of sample. Samples should be collected before starting any treatment, and transported to the laboratory as soon as possible.

For faecal sample collection, use a clean, dry container. A fresh sample (ideally within 1-2 hours of collection) is ideal. In the absence of immediate examination, samples can be preserved in 10% formalin or other suitable preservatives. Rectal swabs may be used if fresh stool is not available. Avoid contamination with urine, soil, or water.

Blood samples are critical for the diagnosis of blood-borne infections, serological testing, and hematology. The site of venipuncture depends on the species. Common venipuncture sites include the jugular vein (in cattle, sheep, goats, horses), the coccygeal vein (in cattle), and the ear or saphenous vein (in pigs and dogs).

Before collection, the site should be cleaned with 70% alcohol. A sterile needle and syringe or vacuum blood collection system should be used. Blood should be collected into appropriate tubes: EDTA tubes for hematological examination and plain tubes for serum collection. Always ensure proper mixing of blood with anticoagulant to prevent clotting and label the samples correctly.

Faecal Examination

Faecal examination helps in detecting parasitic infections by identifying eggs, larvae, cysts, and other developmental stages of parasites. There are two main approaches: qualitative and quantitative examination.

Qualitative Faecal Examination

Qualitative methods are used to detect the presence or absence of parasitic elements in the faeces.

Direct Smear: A small quantity of faeces is mixed with saline or iodine on a microscope slide and examined under low and high power. It helps detect motile protozoa and eggs.

Procedure:

- Place a drop of saline on a clean slide.
- Using a stick, mix a small amount of faeces (size of a match head) into the drop.
- Spread to make a thin smear.
- Optional: Add a drop of iodine to another slide for contrast (kills motile organisms but highlights cysts).
- Place a coverslip.
- Examine under low and high power objectives.

Floatation Method: This technique uses a saturated salt or sugar solution, in which lighter parasite eggs float to the surface and adhere to a coverslip. It is ideal for detecting nematode and cestode eggs.

Procedure:

- Mix about 2 g of faeces with 10–15 ml of floatation fluid.
- Strain the mixture into a test tube using gauze or a tea strainer.
- Fill the tube until a convex meniscus form at the top.
- Gently place a coverslip over the meniscus.
- Let it stand for 10–15 minutes.
- Carefully lift the coverslip and place it on a slide.
- Examine under microscope.

Sedimentation Method: Used for detecting heavier eggs, such as those of trematodes. Faeces are mixed with water and centrifuged; the sediment is examined under a microscope.

- Mix about 2 g of faeces with water thoroughly.
- Strain through gauze into a centrifuge tube.
- Centrifuge at 1500 rpm for 2–3 minutes.
- Discard supernatant carefully.
- Resuspend the sediment in water and repeat once if necessary.
- Place a drop of sediment on a slide, cover with coverslip.

- Examine under microscope

Quantitative Faecal Examination

Quantitative methods estimate the number of eggs per gram (EPG) of faeces, which helps in determining the severity of infection.

McMaster Technique: A measured amount of faeces is mixed with a known volume of floatation solution, strained, and filled into a McMaster counting chamber. Eggs are counted under a microscope, and EPG is calculated using a formula.

Procedure:

- Weigh 2 g of faeces into a container.
- Add 28 ml of floatation solution (gives 30 ml total).
- Mix thoroughly to form a uniform suspension.
- Strain the mixture through a fine sieve into a clean container.
- Fill the McMaster chamber with the filtered solution using a pipette.
- Allow to stand for 5 minutes to let eggs float to the top.
- Examine under low power.
- Count eggs in both chambers and multiply total by 50 to calculate EPG.

Stoll's Dilution Technique: Used for highly concentrated samples. It involves dilution of faeces, centrifugation, and examination of sediment.

Procedure:

- Weigh 0.1 g of faeces into a container.
- Add 10 ml of distilled water and mix well.
- Take 1 ml of this suspension and place it in a centrifuge tube.
- Centrifuge at 1500 rpm for 2–3 minutes.
- Discard the supernatant.
- Place a drop of sediment on a slide, cover with coverslip.
- Count the number of eggs and calculate EPG based on dilution.

Blood Smear Preparation

Smear preparation is essential for identifying protozoa and blood parasites. Blood smears help in detecting hemoparasites like *Babesia*, *Trypanosoma*, and *Anaplasma*.

Thin Smear: A small drop of sample (faeces, blood, or body fluid) is spread evenly on a clean slide using a second slide at an angle. The smear is air-dried and fixed with methanol before staining.

Procedure:

- Prick ear vein or tail vein using sterile needle/lancet.
- Place a small drop of blood near one end of a slide.
- Using another slide at a 30–45° angle, spread the blood into a thin smear.
- Air dry completely.
- Fix the smear by dipping in methanol for 1 minute.
- Allow to dry and stain with Giemsa (diluted 1:10) for 30 minutes.
- Rinse with buffer or distilled water and air dry.
- Examine under oil immersion (100× objective).

Thick Smear: A larger drop is spread into a thick area without fixation. It is stained directly and is useful for concentrating parasites, especially in blood samples.

Procedure:

- Place a large drop of blood at the center of a slide.
- Spread to form a circular area (~1–2 cm in diameter).
- Allow to air dry completely (do not fix with methanol).
- Stain directly with diluted Giemsa (1:10) for 30–45 minutes.
- During staining with diluted Giemsa, the hypotonic environment lyses red blood cells — this is the laking process**.**
- Laking clears the hemoglobin from the smear, leaving only white blood cells and parasites visible against a clearer background.
- Rinse, air dry, and examine under microscope.

Wet Blood film

The wet blood film (also called wet mount of blood) is a rapid method for the detection of motile blood parasites, particularly microfilariae (e.g., Wuchereria bancrofti, Brugia spp.), and some trypanosomes. It is useful for observing living, motile parasites in fresh, unfixed blood. Wet mounts should be examined within 10–15 minutes of preparation, before the blood dries or the parasites lose motility. Because no staining is done, fine details and small parasites may be missed compared to stained smears. This method is not suitable for detecting intracellular parasites**.**

Procedure:

- Place one drop of fresh blood in the center of a clean glass slide.
- If needed, add 1 drop of normal saline to slightly dilute the blood for easier visualization.

- Gently place a coverslip over the drop to avoid trapping air bubbles.
- Immediately examine the slide under the low power (10×) and high power (40×) objectives.
- Do not stain or fix the sample — observe live, motile organisms directly.
- Look for actively moving microfilariae, trypanosomes, or other visible blood parasites.

A Guide to Common Gynaecological Operations in Dogs and Bitches

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Neuter (Castration)

One of the most common surgical procedures performed in a male dog is neuter, known medically as orchiectomy or castration.

Advantages: Following are the advantages of castration:

1. It minimizes roaming
2. It minimizing aggressive behaviour
3. It prevents male dogs from impregnating female and hence is an effective method of pet population control
4. It prevents most prostrate problem

Pre-Operative consideration:

Following pre-operative consideration should be taken inti account while performing castration

1. Animal undergoing gonadectomy should have a through physical examination.
2. Conventional age of neutering is 4-9 years
3. A preoperative fast of 8 hrs is adequate
4. If necessary, 5% dextrose can be given intravenously at the rate of 4 ml/kg per hours before the surgical procedure.

Surgical technique:

The procedure begins with a pre scrotal skin incision on the medium septum. After cutting the skin, the testes are squeezed to the skin incision.

Following skin and Tunica dartos, the incision is given on Tunica vaginalis to expose the spermatic chord. The avascular end is cut with scissor

And the vascular end is ligated with catgut No. 1-0 followed by trans fixation of ligature. The spermatic cord is cut below the ligature. Similar procedure is performed on the second testicle. Lastly, the skin is closed with simple interrupted suture pattern using nylon. Remove the suture in about weeks' time.

Post- Operative complications: Certain complications arise owing to castration as

mentioned below.

1. If recovery is prolonged, hypoglycaemia should be suspected and the animal's blood glucose concentration should be monitored.
2. The animal can be wrapped in warm towels to combat hypothermia.
3. Premature removal of suture is a common complication.

Transmissible Venereal Tumour in Dogs

Canine transmissible venereal tumour is a naturally occurring tumour transmitted from animal to animal during copulation by viable tumour cells and is also called as transmissible venereal tumour, canine transmissible venereal sarcoma, sticky tumour that mainly affects external genitalia and occasionally the internal genitalia. TVT has been recorded all over the world and is most common in subtropical to tropical areas. A large stray dog population and uncontrolled sexual behaviour appear to be one reasons for high incidence of TVT. In India incidence of TVT in dogs is reported to range from 23-43%. TVT is seldom or no more detected in north America, Mainly due to the population control of stray animals, the preventive pre-breeding examination and the effective treatment of clinical cases. The tumour is seen most commonly in sexually active male and female dogs (2-8 years of age) allowed to roam freely. Female are infected more often than male.

Etiopathology

The origin of this tumour has been extensively studied. The most common mode of transmission is during mating, where tumor cells are transferred from the affected genitalia of one dog to the mucosa of another. Although a viral cause has been postulated but not verified, recent research confirms that the tumour is clonal in origin, and the development of this tumour requires transmitting the neoplastic cells from one dog to another. Presently, the consensus view is that TVT arise from allogenic cellular transplant and that the abnormal cells of the neoplasm are the vectors of transmission. The exfoliation and transplantation of neoplastic cells during physical contact provide the main mode of transmission onto genital mucosa and also onto nasal or oral mucosa during mating or licking of affected genitalia, respectively. The implantation of the tumour is facilitated by the presence of any mucosal lesion or by the loss of mucosal integrity.

Clinical Signs and symptoms

The common clinical signs observed include a serosanguineous or pure haemorrhagic vaginal or preputial discharge, protrusion of the neoplastic lesions and deformation of the external genitalia. TVT s are single to multiple, pink-red, nodular,

papillary multilobulated, cauliflower-shaped or pedunculated lesions that very greatly in size and can exceed up to 15 cm diameter when progress deeper inti the mucosa. Neoplasm are relatively firm but fragile. The superficial part is commonly ulcerated and inflamed and breeds.

In female dogs the neoplastic lesions are usually located at vestibule, often at the junction of the vestibule and the vagina perhaps due to high pressure exerted on this area during matting. It protrudes from the vulva.

In the male dogs the tumour is usually located on the caudal part (Bulbus landis) and Less often on the shaft (Pars longa glandis) or the tip of the glans penis and occasionally on the prepuce. The serosnaguinous or haemorrhagic discharge may be confused with oestrus, Urethritis or cystitis in the male with prostatitis. The tumour can cause mechanical obstruction to the flow of urine, dystocia in whelping female and phimosis and paraphimosis in the male. The general health of the affected dogs is not impaired unless the tumour become necrotic and infected or occlude the urethral orifice or metastasised.

Microscopic characteristic

Aspirates from TVTs are highly cellular and often bloody. Cytological examination revels the typical round to slightly polyhedral cells. The most prominent cytological feature of TVTs is presence of distinct, clear, cytoplasmic vacuoles.

Diagnosis

Definitive diagnosis is based on physical examination and cytological finding typical of TVT in exfoliate cells obtained by swab, fine needle aspiration or imprints of the tumours.

Treatment

Surgery, radiotherapy, immunotherapy, and chemotherapy have been applied for treatment of TVT. Surgery has been used extensively for the treatment of small, localized TVT, although the recurrence rate was high as 50-68% in cases of large invasive tumours. The tumours cells transplanted into the surgical wound during operation is source reoccurrence. The use of electrocautery makes the operation easier and a little more effective. However, it is still far from being suggested as the first choice.

Chemotherapy has been shown to be the most effective and practical therapy. Antimitotic agents, such as cyclophosphamide, methotrexate, vincristine are the chemotherapeutic drugs for treating TVT, Vincristine sulphate being the most frequently used drug.

Vincristine is administered weekly at a dose of 0.025 mg/Kg, I/V. The involution of the lesions is gradual, although noticeable and significant at the beginning of the treatment. The complete remission usually takes 2 to 8 injections and occurs in more than 90% of the treated cases.

Temporary side effects are partial anorexia, mild depression, fever and volition are reported in less than 20% of the treated dogs.

Prognosis

The prognosis for TVTs is very good. Less than 5% of TVTs metastasize to other sites. Vincristine sulphate is the treatment of choice with majority of dogs being cured. Even in the case of the metastasis the cure rate for TVTs is over 90%.

Control

Control of TVT is difficult because stray dogs serve as a reservoir. Dog owners and breeder should carefully examine all male and female before mating and should also prevent mingling of valued dogs with stray.

Pyometra in Dogs

What is pyometra?

Pyometra is a serious and potentially life-threatening infection of the uterus that causes it to fill with bacteria and pus. Many dogs with a pyometra have vaginal discharge and may feel very sick with a poor appetite, lethargy, vomiting and sometimes increased thirst or urination. This infectious and inflammatory disorder of the uterus typically occurring in adult, intact bitches during or immediately after the luteal phase of the estrous cycle. The clinical signs of pyometra are often nonspecific and vary among patients depending on the chronicity of the disease and the patency of the cervical canal. Early recognition, diagnosis, and treatment of pyometra are necessary to achieve a successful outcome. The condition must be treated quickly and aggressively.

How Does Pyometra in Dogs Happen?

Unneutered female dogs that still have reproductive organs are more likely to get pyometra, especially when they are over age 6.

The chances of developing pyometra are higher when your unneutered dog is out of heat. During this time, the dog goes through hormonal changes. When the heat period is over, most dogs return to normal. But, some may develop an infection or pyometra in their uterus.

As the infection grows, the uterus gets filled with pus. If not treated on time, the

pus can cause blood poisoning, peritonitis, kidney failure, or even death.
Pyometra can be 'open' or 'closed.' In an open pyometra, the uterus' entry remains open, and you can see pus or blood coming out of your dog's vulva.
In closed pyometra, the uterus is shut, and you can't see the discharge. This condition is more dangerous as the uterus can burst
In rare cases, a dog who has already been neutered may also develop a particular type of pyometra called a stump pyometra. It happens when a small uterus stump remains inside the dog and gets infected.

What Causes Pyometra in Dogs?

The primary cause of pyometra in dogs is hormonal change during each heat cycle. The cycle changes the uterus and makes it thicker with tissues to support pregnancy. When these changes keep happening, the uterus can change permanently and have excess tissue.

The transformation of the uterus makes it more vulnerable to infection. It also weakens the uterus' ability to fight off any infectious bacteria.

Pyometra commonly happens due to the E. coli vacterium, mostly a few weeks after the female dog completes the heat period.
Progesterone-based drugs can also cause pyometra due to the changes they make in the uterus. Dogs already taking hormone therapy for treating conditions of the reproductive system must be monitored for pyometra.

What Are the Signs of Pyometra in Dogs?

The symptoms of pyometra in dogs usually start after four to eight weeks of a heat period. The common ones include:

- An increased urge for water
- Nausea or vomiting
- A discharge from the vulva (pus)
- Bloated tummy
- Frequent panting
- Fatigue
- Appetite changes
- Increased urination

Diagnosis

Your veterinarian will diagnose a pyometra based on physical exam findings, such as vaginal discharge and a history of a recent heat cycle. Your veterinarian may also use any of the following tests to confirm a diagnosis:

- Ultrasound or X-rays to identify an enlarged, fluid-filled uterus
- Blood work
- Urine sample
- Vaginal cytology

Treatment

A pyometra is a medical emergency that requires prompt treatment. The mainstay of treatment includes:

- IV fluids
- Antibiotics
- Ovariohysterectomy

Pyometra is best treated with surgery to remove the ovaries and uterus (spay). The surgery for a pyometra is often more complicated than a spay for a normal, healthy dog. Some dogs may require more intensive care and monitoring for signs of sepsis, dehydration, shock, anemia and more.

Medical management involves injections of the hormone prostaglandin, fluids and antibiotics. However, it is rarely considered and generally discouraged except for specific cases, such as a young, valuable breeding dog. It is not a viable option for a critically ill dog or one with a closed pyometra. Medical management takes several days before showing improvement, and some may not improve at all and may ultimately require surgery. Additionally, medical management has many side effects, including panting, drooling, diarrhea, vomiting and even the potential rupture of the uterus, which could be life-threatening.

Outcome

Untreated pyometra can be deadly from overwhelming infection and sepsis. However, most patients have a good prognosis when diagnosed and treated with surgery early. Dogs that develop sepsis or have a ruptured uterus often have a worse prognosis. Dogs that are treated medically often experience a recurrence of infection.

Prevention

Pyometra is entirely preventable if a dog is spayed before the development of infection in the uterus. A spay to remove the ovaries and uterus is recommended to prevent pyometra. If a dog is intended for breeding, they should be bred at the appropriate age to minimize their risk of developing a pyometra. Having your dog spayed while young and healthy is safer and less costly than waiting for an emergency pyometra spay.

Ovariohysterectomy (OH)

One of the most common surgical procedures performed on dogs is spay, also known medically as am ovariohysterectomy (removal of Ovary and the uterus)

The most frequent indication for OH is the elective sterilization. It is the treatment of choice for most uterine disease including pyometra, localized or diffused cystic endometrial hyperplasia, uterine rupture and neoplasia. In addition, it may be justifiable adjuvant therapy for mammary neoplasia and hence preventing the female dogs from getting mammary tumour later in life

Contra-Indications: No important contraindications for this techniques have been described. However, some limitations include the need for multiple assistant for deranged biochemistry.

Procedures

The dog will need to be fasting (no food or water) the night before surgery and the day of surgery. Prior to anaesthesia, the dog blood will be tested to ensure her organs are functioning properly.

- The procedure takes about 45 minutes to an hour to perform in most cases, including the needed time for preparation and anaesthesia. In older or large-breed dogs the procedure can take longer and may require two surgeons.
- A pre-aesthetic, pain medication, and antibiotic are administered by injection to the dog.
- The dog will be feeling drowsy from the pre-anaesthetic/sedative, but mask gas anaesthesia will likely follow to allow the dog to rest comfortably.
- The anesthetized patient is placed on the surgical table in dorsal recumbence (on the back). The hind legs are tied cranially for stabilization purpose
- The patient will have the hair clipped close to the skin in a section from the xyphoid to the pubis. The freshly clipped area will then be scrubbed for surgery.
- A sterile drape is placed over the surgical site of dog, creating a sterile field. The drape is clamped in place and an opening is made in the drape, just above the focus point of the surgery.
- An incision is made using a scalpel blade, typically created over the midline just caudal to the umbilicus. The incision will pass through the subcutaneous tissues, fat and eventually, the peritoneal cavity.
- The organs of the female reproductive tract are identified and the major blood vessels supplying the ovaries and the uterus are ligated (tied off). This must be

done before these organs can be removed. Sutures (stitches) that dissolve over time are used to tie off the blood vessels and also to close the uterus above the cervix. Sometime, surgical staples are used in place of sutures.

- The uterus is located using a hook. The uterine horn will be gently pulled through the incision opening and Kelly forceps will be used to grasp the reproductive organ.
- The uterus is dissected and tied off with 0 or 2-0 monofilament absorbent sutures. Several sutures will be placed to ensure closure.
- The excess tissues from the pedicle are removed and inspected for bleeding. If no bleeding is present, the uterine pedicle is placed back into the peritoneal cavity.
- The surgical opening, including all layers of the abdominal wall, will be sutured with monofilament absorbent sutures. The outer layer of skin is closed with skin glue, sutures, or surgical staples; these sutures and staples need to be removed in about 10 to 14 days.
- Dogs need to be kept quiet in the post-operative period to encourage healing and help prevent complications. Most dogs can resume normal activity 5-10 days after surgery. Until then, leash walks, lots of rest, and no swimming, bathing, or running is advised. Elizabethan collars (E-collars) or alternatives to the E-collar used to prevent your dog from being able to lick at her incision are often recommended.

Reference

- Das U and Das AK. 2000. Review of canine transmissible venereal sarcoma. Veterinary Research communication 24: 545-556.
- Gandotra VK, Chauhan FS and Sharma RD. 1993. Occurrence of canine transmissible venereal tumour and evaluation of two treatments. Indian Vet. J.70: 854-857
- Murgia C, Pritchard JK, Kim SY, Fassati A and Weiss RA.2006. Clonal Origin and evolution of a transmissible cancer. Cell 126 (3): 477-487.
- Robbins MA, Mullen HS. 1994.n bloc Ovariohysterectomy as a treatment of dystocia in dogs and Cats. Vet. Surg 23, 48-52.
- Pearson H. 1973. The complication of ovariohysterectomy in the bitch. J small Anim Pract 14,257.

Effective Strategies for Managing Repeat Breeding in Dairy Cattle

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An animal's ability to reproduce is one of the key essentials in a dairy herd. Dairy farmers gain maximum profit if their herd provides one calf crop per year. A robust reproduction and production critically contribute to the profitability of the dairy enterprise. The perfect scenario for an individual dairy animal is to become pregnant within 90 days of calving, however this is usually not achieved. Most of the time cows suffer from repeat breeding while the buffaloes suffer from anoestrous. Repeat breeding is responsible for long service period and inert- calving interval thereby causing low milk and calf production resulting into greater economic loss to dairy industry. Repeat breeding has many predisposing factors, the predominant one are hormonal aberration and infections. Hormonal intervention can be used to improve oestrous detection and to increase pregnancy rates of dairy animals. Incidence of endometeritis in both cows and buffaloes is very high. Abnormal parturition, puperal complication, inseminations with unsterilized equipment and infected seen lead to uterine infection that develops into endometritis and eventually repeat breeding.

Repeat breeder cows are the bane of any dairy enterprise and one of the major causes of economic loss.

What is a repeat breeder cow?

- A cow that has regular oestrous cycle
- The cow does not possess or exhibit any palpable clinical abnormalities
- The dairy animal does not have any uncharacteristic vaginal discharge
- Is usually less than 10 years' age
- The cow has calved once and has failed to conceive despite at least three or more consecutive inseminations. These animals will regularly come to heat but not conceive despite matting / Artificial Insemination

Hormonal aberrations:

Various hormonal aberrations leading to poor conception rate and their interventions are described below.

Prolong duration of oestrous:

About 29-50% repeat breeding crossbred cattle display prolong oestrous period (37-60h vs 24-36h) that is associated with low conception rate (30% vs70%; Dadarwal *et al*.2005; Singh *et al*. 2009).

Treatment protocol for prolonged oestrus exhibiting repeat breeding cattle:

- Multiple inseminations or irrational hormonal interventions were able to conceive only partially equal to 19% of prolonged oestrus exhibiting cattle.
- Termination of luteal phase between days 7 to 9 post- Ovulation, normalized plasma progesterone and the duration of subsequent oestrus. The recorded pregnancy rate was 46% compared to nil in untreated cattle (Singh *et al*. 2006)
- Administration of GnRH (20µg Buserelin acetate) on the day of insemination leads to 34% pregnancy rate. An additional treatment with GnRH on day 12 post-insemination lead to 52% pregnancy rate in comparisons to 17% in untreated repeat breeder with prolonged oestrus
- Mid-luteal phase (Day 12 post-ovulation) GnRH treatment normalized post –treatment oestrus duration, improved luteal profile and conception rate (Honparkhe *et al.*2008).
- In fatty cattle, restricted feeding of concentrate, grain feeds and green fodder for two months reduced the length of oestrus period in 50% cattle. This treatment lead conception rate to 65% (Singh *et al*. 2009a)
- Treatment with controlled internal drug release (CIDR) for 7 days along with GnRH administration improved conception rate in prolonged oestrus exhibiting cattle.

Cystic ovarian disease (COD): These are defined as follicles with 2-2.5 cm diameter that are present on one or both ovaries and persist for at least 10 days in the absence of any active luteal tissue. Follicular cysts are uniformly an-echogenic with a thin wall, while luteal cyst have thicker wall (>3mm) that is visible as an echogenic rim. Higher incidence (30%) of COF is observed in crossbred cattle compared to indigenous cattle**.**

Cystic follicle can develop due to a dysfunction of the hypothalamic-pituitary-ovarian axis at either of the level, Viz. (a) GnRH or LH pulse frequency /amplitude is altered from the hypothalamus or pituitary, respectively. (b) pre-ovulatory LH surge is absent, insufficient or delayed and (d) altered feedback mechanism of estrogens on the hypothalamus -puitatry can result in an aberrant GnRH release. Suprabasal progesterone during estrus and stress due to higher milk yield are also considered to

be the predisposing factor of cyst formation. Treatment of COF with GnRH alone or in combination with PGF2alpha was successful to induce conception in 35-55% crossbred cattle (Singh *et al* 2008).

Antiluteolytic measures to reduce early embryonic mortality

One of the major factors influencing reproductive efficiency of dairy animals is embryonic mortality, which is referred to losses occurring before day 45 of gestation. Early embryonic mortality (EEM: animals return to estrus within 25 days after fertilization) could range from 20-44 percent and late embryonic mortality (Losses occur between days 25-45 of gestation) could range from 8-17 %. EEM has been attributed as a predominant cause for repeat breeding in dairy animals, through a list of factors including genetic predisposition, nutrition, age, climate insemination time, semen quality, infectious agents and endocrine imbalance particularly of progesterone and estrogen. Luteal deficiency is one of the predisposing factors causing EEM. The methods to supress luteolytic mechanism during post - insemination critical period (d 15-17) through various approaches is a possible strategy for improving conception rate in dairy animals. The remedial measures are given below.

- GnRH administration on the day of oestrus: Administration of GnRH/hCG just prior to or at the time of AI, causes ovulation. In addition, these injections increase the development of CL and hence peripheral progesterone and increased pregnancy rate in repeat breeding cows
- GnRH/hCG administration on day 5 of oestrous cycle: Administration of GnRH/hCG on days 5 or 6 after oestrous altered follicular dynamics, induced luteal tissue development, and increased plasma progesterone resulting in 45% increase in pregnancy rate
- GnRH/hCG administration between days 11-15 of oestrous cycle: following day 12 treatment with hCG/GnRH, an accessory ovulation was reported and causes prolongation of life span of CL and had 10-12% higher pregnancy rate

Infectious causes of repeat breeding

Endo metritis is often self-limiting with recovery occurring after subsequent oestrous cycles. If UDM (Uterine defence Mechanism) is impaired or weakened, bacteria may colonise the uterus and lead to development of uterine infection and endometritis. The component of UDM include phagocytosis, Immunoglobulin, mucus, secretion and normality of epithelium. There are several factors which affect UDM viz. number of neutrophil in the uterine fluid and their ability to phagocytose

bacteria, species and quantity of bacteria, type and other bacterial enzyme in the uterine lumen. Thus an effective treatment is one which increases the uterine defences and excludes bacterial infections. So Paisley *et al.* 1986 recommended that the ideal therapy for uterine infections should eliminate the bacteria from uterus, but should not inhibit the normal UDM and should not cause further adulteration of milk or meat for human consumption.

Current therapies

In general, the current therapies of endometritis and uterine infection can be classified into six major types.

1. Antibiotic: these have been widely used as treatment of uterine infections. Success of these treatments varies from beneficial to no benefit to recommendation against their use. When using penicillin, it inactivated through bacterial production of the enzyme penicillinase. In case of tetracycline, the need of large systemic dose to get tissue concentration against *A. pyogenes* could be toxic to the animal. The anaerobic environment of uterus makes aminoglycoside group of antibiotics (gentamicin, kanamycin, streptomycin and neomycin) ineffective because they require oxygen for their activity. These antibiotics also inhibit phagocytosis. This suppression of leukocyte activity is further increased if the bacteria were resistant to the applied antibiotic. In endometritis, the absorption of many drugs is diminished, due to which therapeutic level in the deeper layers of the uterus and other part of genital tract are not likely to be achieved. The poor response to intrauterine treatment is likely due to:

- Drugs used for retention of foetal membrane (ROFM) do not accelerate the loosening process in the placentomes and in fact, may delay it.
- Intrauterine manipulation (manual removal, antibacterial infusion etc.) are traumatizing and inhibit the phagocytosis that is necessary for placental detachment and clearance of infection.
- Intrauterine infusion of sulphonamides as a therapy has also been reported. Appreciable concentrations of sulpha drug can be detected in milk even 24 hrs after administration. Bacterial activity of sulphonamides, aminoglycosides and nitofurazone is greatly reduced in an environment containing blood, pus, necrotic tissues, products of leukocytes and tissue damage.

2. Antiseptics: Weak or dilute lugol's iodine solution has been reported to be an effective treatment of endometris. It has been recommended that routinely used

antiseptics adversely affect the uterine natural defence mechanism against infection.

3. Hormonal Therapy:

(a) Oestrogen: It improves the UDM of reproductive tract by increasing the blood circulation, leukocytic infiltration to the uterus, uterine contractions and mucus flow and phagocytosis. Small dosage (5 or 6 mg) of oestradiol benzoate i/m during early post-partum period (after 6 Days) are reliable treatment of cows with or without retention of foetal membranes. However, long-acting oestrogen and stillbestrol have been associated with more severe infections of oviducts and myometrium, development of cystic ovaries and depressed fertility from unknown causes (Paisley et al., 1986).

(b) Oxytocin: Oxytocin also increase phagocytosis. This effect can be seen up to 8 days' post-partum if involution has been delayed.

(c) Prostaglandin F_2 alpha: PGF_2 alpha and its analogues have been used as treatment of endometritis in cows. Paisley *et al*. (1986) recommended that the rationale of using PG for Post-Partum uterine infection include: Luteolysis and decreased progesterone inhibition of UDM, increased oestrogen induced UDM, increased myometrium contractions and expulsion of lochia and other contents from the uterus, and stimulated phagocytosis by uterine leukocytes. It was concluded that repeated administration of PGF_2 alpha on day 10 of cycle for six successive cycles resulted in a normal response of oestrus without development of cystic ovaries, which made if superior to estrogenic as a treatment of endometritis. Advantages of systemic use of antibiotic include easier administration, less risk of introducing new infection and causing injury to endometrium, depressing phagocytic activity and no loss antibiotics with uterine contraction. However, large dose of drug is required to achieve the optimum level of drug in the uterine lumen.

(d) Ovsynch Protocol: A protocol involving GnRH, prostaglandin F2α, and GnRH again, followed by TAI, has been shown to increase conception rates in repeat breeders.

4. Nutritional Management: Proper nutrition, including mineral supplementation and avoidance of overfeeding or mouldy feed, is essential for reproductive health.

5. Improving Oestrus Detection: Accurate and timely detection of estrus (heat) is

crucial for successful insemination.

6. Immunomodulatory: It is obvious from most of the reports that parenteral and intrauterine treatment with various antibacterial drugs gave inconsistent results. High cost of treatment, compulsory milk disposal, development of resistance to antibiotic, inhibition of UDF all led to find an alternative therapy for the treatment of uterine infection. So the people are trying to use substances which cause activation of UDM. These substances are

***E. Coli* Lipopolysaccharide (*E. Coli* Endotoxins, *E. Coli* LPS):** *E. coli* LPS and bacteria free filtrate of streptococci infusin to uterus effectively increased the influx of PMN into uterus by chemotaxis. Chemotaxis of PMN's to uterine lumen has been reported to play an important role in the pathogenesis and resolution of endometritis.

Serum, Plasma and Hyper immune serum: 50-100 ml of autologous plasma for 3 days can be given in the uterus. Intrauterine infusion of immunomodulatory have several disadvantage like:

- Loss of one oestrous cycle
- Inadvertent administration of infectious organism in the uterus.
- Failure to respond in severe cases of endometritis and pyometra

References

- Dadarwal D, SinghJagir, Honparkhe M, Cheede G S and Kang R.S. 2005. Investigation on repeat breeding cross-bred cattle with history of prolonged oestrus. Indian journal of animal Science 75(8):922-924.
- Singh-Jagir, dadarwal D, Honparkhe M, Dhaliwal GS and Ghuman SPS. (2009). Prolonged estrus in repeat breeding cross-bred cows: incidence, hormonal profile and ovarian dynamic. Project report to ICAR, Delhi
- Honparkhe M, Singh Jagir, Dadarwal D, Ghuman SPS, Dhaliwal GS and Kumar Ajeet.2008. Middle luteal phase GnRH treatment of repeat breeder cattle exhibiting prolonged estrus: Effect on subsequent oestrus, luteal profile and conception rate. Indian Veterinary Journal. 87:351-354
- Paisley, L.G., Mickoelson, W.D., Anderson, B.P(1986). Mechanism and therapy for retained fetal memebrane and uterine infections of cows: a review. Theriogenology.25: 353-381.

Management of Common Conditions in Animals

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Gastroenteritis Management in Animal

Frequent bowel evacuation of abnormal, soft or liquid feces in amount, consistency & frequency is known as diarrhea. Inflammation of intestinal mucosa resulting diarrhea and sometimes dysentery, abdominal pain occasionally and varying degree of dehydration & acid -base imbalance depending on the cause of the lesions and its severity and locations. e.g. Enterogenic E. coli associated diarrhea causing large net increase of fluids in to the lumen of the gut with very minor structural changes in the intestinal mucosa.

Gastroenteritis

In many cases gastritis and enteritis occurs together known as gastroenteritis. Thus in enteritis there are alterations in the intestinal secretory and absorptive mechanisms and the diarrhea is a major clinical finding due to malabsorption in the intestinal tract.

Etiology

Disease severity varying on account of its causative agents. Causative agents are bacteria, viruses, fungi, protozoa, helminths, chemicals & toxins. Diarrhea in newborn piglets and calves arises due to deficient in colostral immunoglobulins. Enteric Salmonellosis is commonly precipitated by the stressors of transportation or deprivation of feed and water. Dietary causes can be included as hypersensitivity, Intolerance, rapid dietary change and poor quality or spoiled food.

Among infectious causes bacterial (Salmonella, Clostidium, E.Coli, Campylobacter, Yersinia, etc.), viral (Parvo, Corona, Distemper, Canine adenovirus (ICH), Reovirus and Enterovirus (SVD)), fungal (Histoplasma capsulate), parasitic (Helminths, Toxocara, Taenia, Uncinaria (hook worm), Trichuris), protozoal (Isospora, Cryptosporidium and Giardia) and algae (Prototheca (clourless algae) are important cause of the gastroenteritis. Besides these, neoplasia, toxins of heavy metal, antibiotics and NSAIDS, metabolic cause of hypoadrenocorticism and anatomic causes of intussusceptions, obstruction and volvulus can be responsible for

the disease.

Pathogenesis

Normal Intestinal absorption- In normal condition a large quantity of fluid enters the small intestine from the saliva, stomach, pancreas, liver and intestinal mucosa. The fluid and its electrolytes and other nutrients must be absorbed, mainly by the small intestines. Large quantities of fluid move in to the large intestine for digestion and absorption. The brush border member of the villous epithelial cells is of paramount importance for the absorption of water, electrolytes and nutrients. The enteric nervous system is a critical component for the mechanism regulating fluid secretion in the normal intestine and key element in the pathophysiology of diarrhoea. Neural reflex pathways increase epithelial fluid secretion in response to several enteric pathogens as Salmonella spp., Cryptosporidium parvum, Rotavirus and C. difficile. The enteric nervous system also has an important role in epithelial secretion triggered by products of activated leukocytes during inflammation. Any dysfunction of the intestines results in failure of adequate absorption and diarrhea but depending on the pathogens. Intestinal malabsorption results at least four different mechanisms.

1. **Osmotic diarrhea:** flow of solvent from less concentration to high concentrated solution.
2. **Exudative diarrhea:** Slow escape of liquid containing protein & White cells through the walls of intact blood vessels due to inflammation.
3. **Secretory diarrhea :** Due to excessive secretion of fluids in to stool caused by frequent bowel movement
4. **Dysmotility diarrhea:** – Diarrhoea can be possible by hyper or hypo motility of intestine lead to malabsorption or bacterial overgrowth.

Clinical Findings

Major clinical findings are diarrhea, dehydration, severe abdominal pain, septicemia, toxemia with fever. Its severity depends on the causative agent, the age and species of the animals and the stage of the disease.

I. Acute Enteritis: Feces are soft or fluid with unpleasant odor may contain blood (dysentery), hematochezia or melena (black tarry feces) fibrinous casts and mucous obvious foreign material such as sand etc. The color may be other than normal but generally pale yellow due to dilution of brown bile pigments. Straining may occur, and may be followed by rectal prolapse when the lesions are present in the colon and rectum. Intussusceptions may occur when the enteritis involves the small intestine.

Septicemia toxemia and fever are common in the infectious enteritis. Dehydration is usually evident by 10-12 hours following the onset of acute enteritis and clinically obvious by 18-24 hours.

Fig 1. Hemorrhagic Diarrhoea

The passage of intestinal gas also occurs in horses with acute and chronic diarrhea.

Peripheral circulatory collapse occurs commonly in acute and per acute cases there may be tachycardia or bradycardia and arrhythmia depending on the degree of acidosis and electrolyte imbalance.

Intestinal sounds in enteritis: Auscultation of abdomen reveals sounds of increased peristalsis and fluid rushing sounds in the early stages of acute enteritis. Later may be paralytic ileus and absence of peristaltic sounds with only fluid and gas tinkling sounds. The abdomen may be distended in early stages because of distention of intestines and grunt in later stage when fluid has been passed out in the feces. Pain may be on palpation of the abdomen in young animals.

II. Chronic enteritis: Feces are usually soft and homogenous in consistency contain considerable mucus and usually without grossly abnormal odor. Progressive weight loss and emaciation is common. Animal drink and absorb the sufficient water to maintain the dehydration but there are laboratory evidence of dehydration and electrolyte loss. In parasitic enteritis and abomasitis there may be hyponatremia and subcutaneous edema.

Diagnosis: Examination of feces to determine the presence of causative bacteria, helminth, protozoa, Viruses and chemical agents, leukocytes and epithelial cells.

4. Intestinal protectants and absorbents: Kaolin and pectin mixtures are used to coat the intestinal mucosa inhibit secretions and increase the bulk of the feces in animals with enteritis

5. Antidiarrhoeal drugs: Anticholinergic drugs and opiates are available to decrease intestinal motility. The Anticholinergic drugs block the action of acetylcholine on smooth muscle and glands this results in decreased gastric secretion and emptying and a reduction on both segmental and propulsive movement of intestines.

6. The opiates function by producing an increase in segmentation while reducing propulsive movements in intestine. The net effect is an increase in resistance to passage of intestinal contents and more complete absorption of both water and nutrients occurs with decrease in the frequency of defecation.

7. Antisecretory drugs: Hyper secretory activity of enterotoxin produced by bacteria like E. coli. Loperamide hydrochloride orally given to calves can delay the onset of diarrhea by inhibition of fluid secretion. Chlorpromazine, opiates, atropine and prostaglandin inhibitors are antisecretory drugs. NDAIDs may retard recovery of ischemic injured intestine and are contraindicated.

Control:

1. Reduce infection pressure by controlling population density.

2. Adequate colostrums intake to neonates to ensure adequate nonspecific resistance and maintain adequate nutritional status.

3. Vaccinate for those disease which have effective vaccine.

4. Minimize the managemental and environmental stressors.

5. Monitor morbidity and mortality and ensure that a diagnosis is obtained to control for newly introduced diseases on to herd.

Management of Anaemia in Animals

Anemia is defined as an absolute decrease in red cell mass as measured by reduced RBC count, reduced hemoglobin concentration and reduced PCV under normal circumstances. It can develop from loss, destruction, or lack of production of RBC. This whole phenomenon upset the homeostasis of blood circulation which leads to insufficiency in oxygen delivery to the vital organ and peripheral tissue.

The function of RBC is to carry oxygen to the tissue, which is done by carrier molecule hemoglobin. Hemoglobin is constituted by 4 heme and 4 globulins (2 alpha

Intestinal tissue samples: Necropsies on selected early untreated cases of acute diarrhea to know the enteropathogens by gross and histopathological examination of the intestinal mucosa.

Hematology and serum biochemical test: Reveal the changes in the hemogram and serum biochemistry which is helpful to diagnose and differentiate the disease.

Treatment

1. Removal of causative agent- Specific treatment is usually directed at intestinal helminthiasis with anthelmintics, antiprotozoal drugs against coccidiosis, and antimicrobial agents like antibiotics. There are no specific treatments available for the viral interitides in farm animals.

2. Alteration of diet: If the cause of the diarrhea is dietary in origin the feed should be changed until the animal is fully recovered.

3. Fluids and electrolyte therapy: Necessary for restoration of the body fluids to normal volume, effective osmolality and acid base balance. The quality and quantity of fluid required are depends upon the characteristics of dehydration and acid-base-electrolyte imbalance. The determination of PCV, TSP, plasma bicarbonate, blood pH, serum electrolytes and hemogram with history and clinical findings would provide the information for the selection of fluid.

If severe acidosis present, hypertonic (5%) solution of bicarbonate should be given intravenously at the rate of 5-7ml/kg body wt. at speed of about 100ml/min. The initial hydration therapy should be given over the first 4-6 hours by continuous intravenous infusion, followed by maintenance of therapy for the next 20-24 hours or for the duration of the diarrhea if severe, @ 100-150ml/kg BW/24h.

Fig. 2. Management of diarrhoea in dog

and 2 beta). Iron is added in last step by the enzyme ferrochelatase. Interference in normal production of heme or globin leads to anemia. The causes may be Cu and Iron deficiency and lead poisoning.

On the basis of response of bone marrow anemia can be classified as;

1. Regenerative anemia: Anemia due to hemorrhage or haemolysis is usually regenerative. Blood loss can be internal or external. Hemorrhagic anemia can be possible during surgery and trauma, disseminated coagulopathy, gastrointestinal cause like hook worm, ulceration and neoplasia. There is multiple cause of hemolytic anemia, among which antibody mediated, toxin or drug induced, parasite induced caused by microangiopathy and congenital cause of hemolysis are important. In regenerative anemia the bone marrow responds appropriately to the decreased red cell mass by increasing RBC production and releasing reticulocytes.

2. Non-regenerative anemia: The cause of non-regenerative anemia may be intra-marrow or extra-marrow. Failure of erythropoiesis is major cause of non-regenrative anemia, happens either by primary or secondary failure. In primary failure of erythropoiesis there is impairment in production of RBC in bone marrow due to abnormality in erythropoietic cells. Secondary failure of erythropoiesis may caused by bone marrow disorders, defects in hemoglobin synthesis, defects in nuclear maturation or deficiency in erythropoietin. In non-regenerative anemia bone marrow responds inadequately to the increased need of RBC

In consequences of anemia the oxygen carrying capacity of blood is decreased lead to improper tissue oxygenation, development of clinical signs and the compensatory mechanism to overcome the anemia is started.

Clinical Signs: Animal shows weakness, lethargy, intolerance in exercise, pallor mucous membrane, jaundice, tachycardia and tachypnoea.

Diagnosis: Before, the managemental approach to the anemic animal age should be considered. In young animal congenital disease, worm load and iron deficiency may be considered. In middle aged animal immune mediated defects are important whereas, in old aged animal malignancy may be major cause for the anemia. The important step for diagnosis of anemia are the observation of clinical signs, estimation of CBC, reticulocyte, erythrocytic indices, study of RBC morphology and platelet count in which Hb and PCV measurement are important. Besides this Coomb's test, Direct immunofluroscent Flow Cytometry and Auto-agglutination test are remarkable for the diagnosis of anemia.

Biochemical profile like, increased alkaline phosphatase and SGPT indicating about liver damage, similarly hypoproteinemia reveals about the hemorrhage. The reduced level of vitamin B12 and serum folate suggests nutritional deficiency and blood loss.

Faecal occult blood test gives information about the upper gastrointestinal bleeding if the feces colour is black and tarry.

Bone marrow evaluation is necessary to confirm pancytopenia, leucopenia, thrombocytopenia, non-regenerative anemia and atypical cells in circulation.

The assay of prothrombin time (PT), activated partial thromboplastin time (APTT) reveals the status of platelets.

Treatment

Immunosuppressive therapy with glucocorticoids @ 0.5 to 1.0 mg/kg body weight can be used specially in autoimmune mediated hemolytic anemia. Antimetabolites, azathioprine, cyclophosphamide and danazol can also be used in immune mediated destruction of RBC. Supportive treatment can be used as per the requirement, especially fluid therapy, gastric protectants, anticoagulants like heparin and warferin. Intravenous immunoglobin and erythropoietin are used to prevent the AIHA and enhance the blood level. Vitamin B12, Iron and copper supplements are useful as supportive therapy of anemia. Vitamin K, desmopressin, epinephrine and norepinephrine and astringents are used as hemostatics in hemolytic anemia.

Surgical Management of GID

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Coenurosis is a parasitic disease of the central nervous system. It is uncommon, but seen in certain geographical areas particularly in Asian country. It is caused by a tapeworm (cestode) called ***Taenia multiceps*** (*T. multiceps*), which lives relatively benignly in the definitive canine host (including dogs, foxes, jackals and coyote) but causes significant disease in the intermediate host, where the larval stage of the tapeworm migrates to the brain and spinal cord and matures into a fluid –filled cyst. Sheep are the main intermediate host but there have been rare cases reported in cattle, pigs, deer, horses and humans.

Cerebral coenurosis is an important disease affecting sheep and goat which causes significant economic losses in their production. Cerebral coenurosis is caused by larval stage of *Taenia* Gid (Coenurosis) is a disease of the central nervous system in Goats, caused by *Coenurus cerebralis,* the larval stage of *Taenia multiceps*, a tapeworm, which infests the small intestine of carnivores. In 80–90% of cases, the cyst is located in one cerebral hemisphere, whilst in 5–10% of cases, it is localised in the cerebellum; rarely it involves two sites in the brain of the affected animal.

Coenurus cerebralis **is the larval form of** ***Taenia multiceps*** which is seen in the small intestines of carnivores. Infection occurs as a result of the oral intake of eggs spreading via fecal dumps of those animals by intermediate hosts. The disease is known as gid or sturdy which primarily localises in the central nervous system of sheep and goats mostly, but can also seen in camels, deer, pigs, horses, however, rarely in cattle and humans. Most of the cysts are located in the cerebral hemispheres and spinal cord, while rarely invading the subcutaneous and intramuscular tissues along with other organS. Symptoms vary depending on the cyst's location, size and compression the brain. While C. cerebralis initially causes purulent meningoencephalitis, later as the cyst grows, it leads to central nervous system symptoms resulting in death .Most of the characteristic clinical findings are observed 2-8 months after the intake of pathogen. Infected animals manifest circling, head tilt

towards the side of the cyst location, in coordinated and uncontrolled movements, ataxia, failure to hold the head straight, blindness, teeth grinding, salivation, paresis, convulsions.

With history of anorexia, bleating, head pressing against the wall and circling movement . Palpation of the occipital bone between the two horns lead to bleating.The real prevalence of coenurosis is difficult to assess, because farmers and vets often diagnose the disease and send the animal for slaughter without confirmation or report. A large proportion of infected lambs may also be sold fat before clinical signs have developed

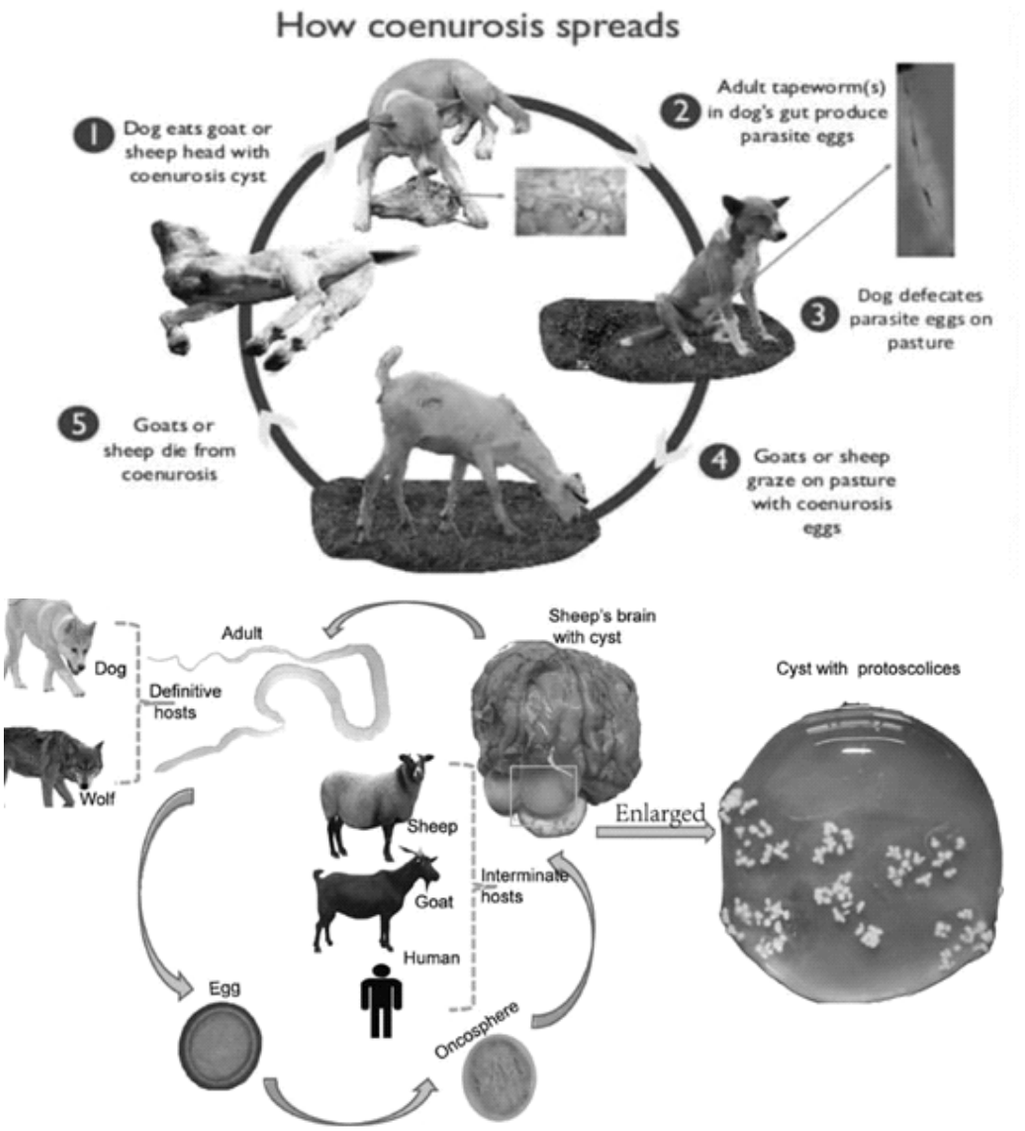
Dogs and other canines such as foxes, coyotes and jackals are the definitive hosts of the tapeworm Taenia multiceps. Canine hosts shed tapeworm eggs in their faeces which contaminates the pasture for the intermediate host to ingest. T. multiceps infection on a farm is significant as it confirms an unbroken sheep and dog life cycle, which in turn implies the existence of more important tapeworms such as Echinococcus granulosus. This dog / sheep tapeworm usually infects sheep and forms cysts in the lungs and liver, which if consumed by humans will cause a very serious disease that is very difficult to treat. Surgery is the only option.

The life cycle of *Taenia multiceps*:

1. The intermediate host is infected through ingestion of T. multiceps eggs
2. Each egg contains an onchosphere which hatches and is activated in the small intestine.
3. The onchosphere penetrates the mucosa and is carried via the blood stream to the brain or spinal cord. In goats the cysts can form in subcutaneous and muscular sites as well as the brain and spinal cord.
4. The onchosphere develops into a metacestode larval stage called Coenurosis cerebralis.
5. The Coenurosis cerebralis matures into a thin-walled fluid-filled cyst about 5cm in diameter.

.6. The life cycle is complete when the canine eats the raw infected brain, spinal cord or offal contaminated by the fluid from the ruptured cyst. The scolex (head of the tapeworm) embeds itself into the wall of the small intestine where it begins to grow, and shed new eggs.

Usually the Coenurosis cerebralis cyst persists for the life of the intermediate host.



Clinical Signs of Coenurosis

The clinical signs of the coenurosis develop when the central nervous system (CNS) of the goat/sheep is invaded by the cystic larval stage, or metacestode of the tapeworm.

Coenurosis can occur in both an acute and a chronic disease form. Acute coenurosis occurs during the migratory phase of the disease, usually about 10 days after the ingestion of large numbers of tapeworm eggs. Young lambs aged 6-8 weeks are most

likely to show signs of acute disease. The signs are associated with an inflammatory and allergic reaction. There is transient pyrexia, and relatively mild neurological signs such as listlessness and a slight head aversion. Occasionally the signs are more severe and the animal may develop encephalitis, convulse and die within 4 – 5 days.

Acute disease is an important differential diagnosis for **Cerebrocortical necrosis (CCN)**.

Chronic coenurosis typically occurs in sheep of 16-18 months of age. The time taken for the larvae to hatch, migrate and grow large enough to present nervous dysfunction varies from 2 to 6 months. The earliest signs are often behavioural, with the affected animal tending to stand apart from the flock and react slowly to external stimuli. As the cyst grows, the clinical signs progress to depression, unilateral blindness, circling, altered head position, incoordination, paralysis and recumbency. Unless treated surgically, the animal.

Surgical Technique

The animal is controlled manually with an assistant on lateral recumbency by keeping the affected side upper. The operative area is clipped, shaved and soaked with Tr. of iodine. Soon after sterilization the operative site is blocked by 2% lidocaine hydrochloride, a local analgesic A crosswise incision is given to make four flaps each of which is detached from the subcutaneous tissue by blunt dissection. Bleeding is checked by applying thumb pressure or gauge pressure. The subcutaneous tissue and the thin bone are scrapped then a hole is made sufficiently large enough with the help of a tissue forceps (Toothed forceps) to remove the cyst. A probe is gently introduced a bit and circling is done so that cyst can come out easily. Whenever cyst is found to come out the goat is allowed to jerk its head and move. Then the cyst is slowly removed by holding it with dry cotton and finger. Utmost care is taken not to allow the cyst to rupture and pour the fluid into the brain. Sometimes it is needed to wrap with thin cotton around the tip of the forceps. Before suturing the skin sulphanilamide powder is applied over the wounds. The flaps are sutured by interrupted pattern with nylon. A benzoin seal is then applied over the wound. In the weak and emaciated animals 5% dextrose saline (500 ml) is administered continuously into the jugular vein during operation.

Postoperative care

A combined antibiotic containing procaine penicillin 0.1 million units, benzathine penicillin 0.3 million units, streptomycin sulphate 0.5 gm (plus 5 ml distilled water) is used intra-muscularly @ 2 ml/10 kg body weight daily for 7 days. Intravenous saline is indicated until animals start eating again after surgery. It is advised to keep the animal in a clean house and not allowed to rub its head. Suture is removed after 7-9 days.

Effects of age, sex and seasons on the occurrence of gid disease:

The disease predominantly occurred between 1-2 years of age. The females (especially pregnant) are more vulnerable to the disease than male. The disease predominantly occurred in rainy season than in the other season of the year.

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Zoonotic Importance of Cerebral Coenurosis

Coenurus cerbrallis in human beings diagnosed for the first time in 1913 in Paris, when a man presented symptoms of CNS nerve degeneration. He had convulsions and trouble speaking/ understanding speech. During his autopsy, two coenuri were found in his brain.

Coenurosis is a relatively rare zoonotic disease of humans, caused by the larval stage of a dog tape worm Taenia(Multiceps) multiceps. Human infection occurs if eggs are accidentally ingested as result of poor personal hygiene after being shed in the faces of the dog.

After ingestion of the eggs, larvae hatch, penetrate the intestinal wall and migrate to various tissues, where they develop in to large, cystic larvae. Symptoms are secondary to the presence of a cyst in a vital structure. Patients with coenurosis present with headache and papille edema. The cysts have been responsible for epilepsy, hemiplegia, monoplegia and cerebral ataxia. When the spinal cord is affected there may be spastic paraplesia, lymphadenopathy, fever and malaise can occur, raising the suspicion of lymphoma.

The cerebral form of coenurosis in human is the most serious one. Several years may pass between infection and the appearance of symptoms and the symptoms varies with the neuroanatomical localization of the Coenurus: cerebral coenurosis is manifested by signs of intracranial hypertension and the disease is very difficult to distinguish clinically from neurocysticercosis or cerebral hydatidosis. Symptoms that may be observed consist of headache, vomiting, paraplegia, hemiplegia, aphasia and epileptic form of seizures. Papilledema is a sign of increased intracranial pressure. The Coenurus can also develop in the vitreous humor and may affect the retina and choroid. The degree of damage to vision depends on the size of the Coenurus and the extent of the choroido retinal lesion. The prognosis for coenurosis of the nervous tissue is always serious and the only treatment is surgery, although recently, the testing of treatment with praziquantel or albendazole has begun . There are more than 100 reports of human infection with these metacestodes. The cerebral coenurosis create hygiene after being shed in the faces of the dog.

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Suture and Suturing Techniques in Veterinary Practice

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Definition of Suturing

Suturing is the process of **approximating tissues using sterile thread-like materials (sutures)** to facilitate healing and restore anatomical continuity after injury or surgery.

Objectives of Suturing

- Achieve **hemostasis**
- Promote **primary wound healing**
- Minimize **infection and inflammation**
- Maintain **tissue strength and function**
- Provide **aesthetic closure** where necessary

Factors Affecting Suturing

Characteristic	Description
Biocompatibility	Non-toxic, non-carcinogenic, minimal tissue reaction
Tensile Strength	Adequate strength to hold tissues until healing occurs
Knot Security	Holds knots firmly without slipping or untying
Handling Properties	Easy to pass through tissue, flexible, minimal memory
Minimal Tissue Reaction	Should not provoke inflammation or hypersensitivity
Predictable Absorption	For absorbable sutures –known rate of degradation aligned with healing
Sterilizable	Must be capable of sterilization without degradation
Economical & Available	Cost-effective and easily accessible in field or clinic

Characteristics of an Ideal Suture Material

An ideal suture should:

Factor	Influence on Suturing Outcome
Wound Type & Location	Determines suture technique and material; e.g., facial wounds require finer sutures
Tension on Wound Edges	Excess tension causes dehiscence or necrosis; must select tension-bearing suture patterns
Tissue Type	Fragile tissues (e.g., liver, bladder) need atraumatic needles and fine sutures
Patient Factors	Age, nutrition, systemic diseases (e.g., diabetes) affect healing capacity
Suture Technique Used	Interrupted vs. continuous; everting vs. inverting affects tissue apposition
Sterility & Aseptic Conditions	Poor asepsis can lead to infection, dehiscence
Skill of the Surgeon	Proper needle angle, depth, and knot technique are crucial for success

TYPES OF SUTURE MATERIAL

Classification of Suture Materials

A. Based on Absorbability

Type	Characteristics	Examples
Absorbable	Broken down and absorbed by the body over time via enzymatic or hydrolytic action	Catgut, Vicryl, Dexon, PDS
Non-Absorbable	Permanently retained unless removed; used where long-term support is needed	Silk, Nylon, Prolene, Stainless steel

B. Absorbability:

Type	Characteristics	Examples
Monofilament	Single strand; less tissue drag; resists infection	Nylon, Prolene, PDS
	Multiple fibers twisted or braided; better handling, more tissue reaction	Silk, Vicryl, Dexon

2. Absorbable Suture Materials

A. Catgut (Plain & Chromic)

Origin: Natural (sheep intestine)

Absorption: Enzymatic (complete in 7–10 days for plain; 21–28 days for chromic)

Uses: Ligation, subcutaneous closure

Disadvantage: High tissue reaction, unpredictable strength loss

B. **Polyglactin 910 (Vicryl)**

Type: Synthetic, braided

Absorption: By hydrolysis, complete in 56–70 days

Advantages: Predictable strength loss, minimal tissue reaction

Uses: General soft tissue approximation, including muscle and subcutis

C. **Polyglycolic Acid (Dexon)**

Type: Synthetic, braided

Absorption: Hydrolytic, ~90 days

Uses: Similar to Vicryl; useful in intestinal and bladder surgeries

D. Polydioxanone (PDS)

Type: Synthetic, monofilament

Absorption: 180+ days (slow)

Uses: Fascia, tendons, long-term support tissues

Advantages: Strong, low tissue reaction

3. Non-Absorbable Suture Materials

A. **Silk**

Type: Natural, braided

Tissue Reaction: High

Use: Cardiovascular, ophthalmic, ligatures

Disadvantage: Can act as a nidus for infection

B. Nylon (Ethilon, Dermalon)

Type: Synthetic, monofilament

Properties: High tensile strength, minimal reaction

Uses: Skin closure, orthopedic repairs

C. Polypropylene (Prolene)

Type: Synthetic, monofilament

Properties: Inert, excellent tensile strength

Uses: Cardiovascular, skin, plastic surgeries

D. Polyester (Dacron, Mersilene)

Type: Synthetic, braided or coated

Use: Tendon repair, orthopedic surgeries

Caution: May saw through tissue

E. Stainless Steel

Type: Monofilament or twisted

Use: Orthopedic surgery, sternum closure, herniorrhaphy

Advantages: Maximum strength, inert

Drawbacks: Poor handling, kinks easily

4. Suture Size System

USP Size Diameter (approx.)	Common Use
0 – 2 Large size	Tendons, ligaments, large vessels
2-0 to 4-0 Medium	Skin, fascia, subcutis
5-0 to 7-0 Fine	Ophthalmic, microvascular

5. Suture Material Selection

Tissue Type	Recommended Suture
Skin	Nylon, Prolene (non-absorbable)
Subcutis	Vicryl, Dexon (absorbable)
Muscle	Vicryl, PDS
Bladder/Intestine	Vicryl, PDS (rapidly absorbable)
Fascia	PDS, Prolene (high tensile, delayed absorbable)
Tendon	Prolene, Polyester, Stainless steel

DIFFERENT TYPES OF SURGICAL KNOTS

1. Definition of Surgical Knot

A **surgical knot** is a method of securing suture material during or after wound closure to maintain **tissue approximation**, hemostasis, and stability.

2. Essential Qualities of a Good Surgical Knot

Secure and firm

Minimal tissue trauma

Easy to tie and adjust

Resistant to slippage

Does not loosen with tension

3. Common Types of Surgical Knots

Knot Type	Description	Application
Simple Knot	A single half-hitch; insecure if used alone	Starting point; must be followed by more throws
Square Knot	Two opposite half-hitches (right over left, then left over right)	Most commonly used in surgery
Surgeon's Knot	First throw is a double half-hitch, second is a single (e.g., double overhand)	Provides more friction; used under tension
Granny Knot	Two identical half-hitches (e.g., right over right)	Tends to slip; not recommended for final knots
Sliding Knot	Knot can be tightened by pulling ends	Used in laparoscopy, deep tissue where tight space
Ligature Knot	Secure ligation of blood vessels or pedicles; square or surgeon's variant	Hemostasis in vascular or organ ligation
Miller's Knot	Friction knot with a locking loop; secure on large pedicles	Common in large animal ovariectomy
Aberdeen Knot	Self-locking finishing knot for continuous sutures	Quick closure of continuous sutures

4. General Rules for Knot Security

Use **at least 3 throws** for monofilament and **4–5 for multifilament** sutures.

Avoid excessive tension that may cause **tissue necrosis** or **suture breakage**.

Ensure **flat, even knot placement** to minimize irritation and slippage.

Wetting synthetic sutures improves **knot tying** and **grip**.

SUTURE PATTERNS

1. Classification of Suture Patterns

A. Based on Tissue Effect

Type	Effect on Tissue Edges	Purpose
Appositional	Brings tissue edges edge-to-edge	Ideal for skin, fascia, intestine
Everting	Rolls tissue edges outward	Used in skin or tension-bearing areas
Inverting	Rolls tissue edges inward	Used in hollow organs to reduce leakage
Special	Combines functions or used in specific situations	Deep layers, cosmetic closure

2. Appositional Suture Patterns

Pattern	Type	Use
Simple Interrupted	Interrupted	Skin, muscle, fascia
Simple Continuous	Continuous	Skin, subcutaneous, intestines
Cruciate	Interrupted	Skin closure in large animals
Ford Interlocking	Continuous	Skin in large animals, better strength
Subcuticular/Intracutaneous	Continuous	Cosmetic skin closure

3. Everting Suture Patterns

Pattern	Type	Use
Vertical Mattress	Interrupted	Skin under tension; strong eversion
Horizontal Mattress	Interrupted	Skin, especially in areas of high tension
Near-Far-Far-Near	Interrupted	Deep wounds, high tension

4. Inverting Suture

Pattern	Type	Use
Lembert	Interrupted/Cont.	Intestinal and hollow viscera closure
Cushing	Continuous	Serosa and submucosa of hollow organs
Connell	Continuous	Full-thickness hollow organ closure (caution)
Halsted	Interrupted	Intestinal, layered closure
Parker Kerr	Continuous	Used to invert stump of hollow organs

5. Special Suture Patterns

Pattern	Purpose
Purse String	Circular tightening – anus, stomach, catheter sites
Stent Suture	Distributes pressure – used with drains
Chinese Finger Trap	Secures tubes like catheters or drains
Locking Loop	Used in tendon repair
Bunnell/Mayo Mattress	Deep tendon or ligament repair

6. General Tips for Pattern Selection

Use **appositional patterns** for skin, muscle, and fascia.

Use **inverting patterns** for **viscera (intestine, bladder, uterus)** to minimize leakage.

Everting patterns are best where **tension** is present and in **skin closures**.

Interrupted sutures allow precise tension control and security.

Continuous sutures are faster and provide better sealing but less secure if one part fails.

Clinical Tip: Always match suture pattern with **tissue type, healing capacity**, and **functional need** of the surgical site.

Examine the Reproductive Health using Ultrasonography

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1. Introduction

Dairy production sectors depend significantly on efficient bovine reproductive health. While traditional per-rectal palpation remains widely practiced, it provides limited dynamic insight. In contrast, ultrasonography delivers immediate, dynamic images of ovarian and uterine anatomy, enabling earlier, safer, and more accurate diagnosis than possible with palpation alone. Introduced in the late 20th century, reproductive ultrasonography quickly became indispensable in bovine medicine, from tracking follicular waves and luteal development to early pregnancy assessments, fetal sexing, and diagnosing ovarian pathologies. Moreover, it plays an essential role in postpartum uterine involution, cystic ovarian disease management, and guiding invasive procedures like follicular aspiration. Adopting ultrasonography in dairy herds enhances reproductive outcomes, reduces calving intervals, and improves herd fertility in modern livestock systems. When combined with therapeutic or assisted reproductive technologies, its clinical impact deepens further.

2. Principles of Ultrasonography

Ultrasonography utilizes high-frequency sound waves (2–15 MHz) generated by piezoelectric crystals. These sound waves are emitted by a transducer and reflected back from tissue interfaces, producing real-time two-dimensional (B-mode) images. The nature of the echo depends on tissue density, fluid content, and structural homogeneity. The principle components include:

- **Acoustic Impedance**: Determines the reflection of ultrasound waves at tissue boundaries.
- **Attenuation**: Reduction of wave intensity with tissue depth; important for probe selection.
- **Resolution**: Higher frequency = better resolution, lower penetration; lower frequency = deeper penetration.

Transducers used in bovine reproductive work are typically linear or convex rectal probes with a frequency of 5–7.5 MHz.

3. Equipment and Setup

3.1 Ultrasound Machine:

- Portable real-time B-mode scanner
- Rectal linear/convex probe
- Power source or battery-operated unit

3.2 Accessories:

- Shoulder-length gloves
- Lubricants
- Ultrasound gel
- Protective sheath for probe

3.3 Pre-scan Preparation:

- Restrain animal in travis
- Tie tail and evacuate rectum
- Lubricate probe and hand
- Calibrate depth and gain on ultrasound unit

4. Ultrasonographic Technique in Bovine Reproduction

4.1 Transrectal Scanning Procedure

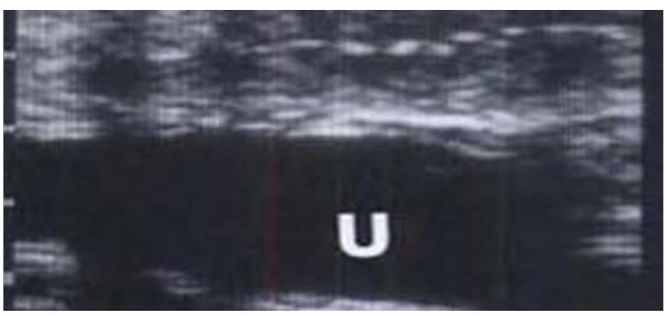
- Introduce gloved and lubricated arm per rectum
- Locate urinary bladder, cervix, uterus, and ovaries by palpation
- Gently place the probe dorsally against the target organ
- Adjust machine settings for optimal visualization

4.2 Identification of Reproductive Structures

Urinary Bladder:

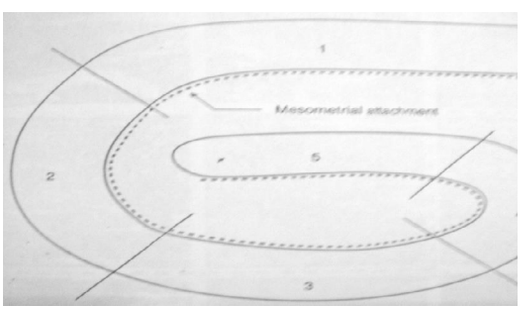
- Although not the part of reproductive organ

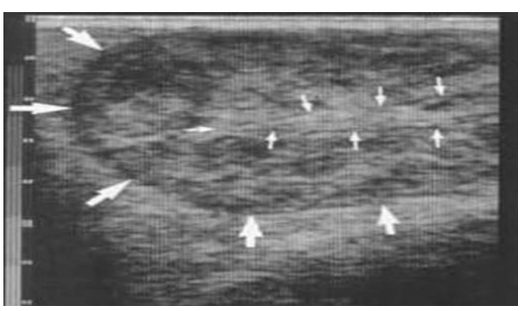
- Due to its easy visibility act as landmark during sonography of reproductive organs



Uterus:

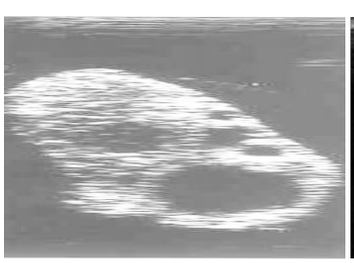
- Non-pregnant: tubular, uniform echogenic wall
- Pregnant: fluid-filled horn with hypoechoic content



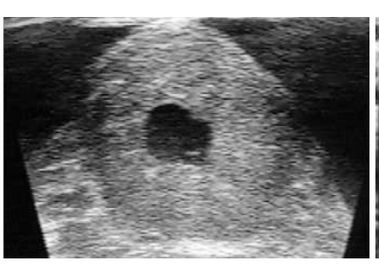


Ovaries:

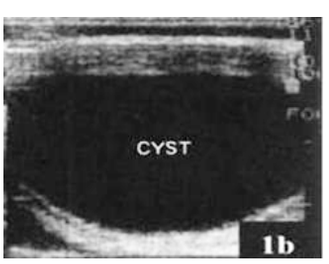
- Follicles: Anechoic (black), round, 3–20 mm
- CL: Mixed echogenicity; central cavity in early luteal phase
- Cysts: Thin-walled, large (>25 mm), anechoic or hypoechoic



Follicles- Black

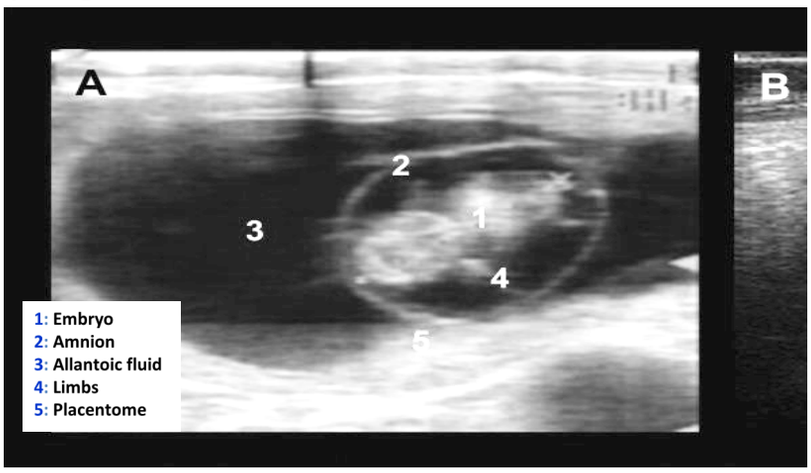


Mature CL with Central cavity



Follicular Cyst

Pregnancy Diagnosis:

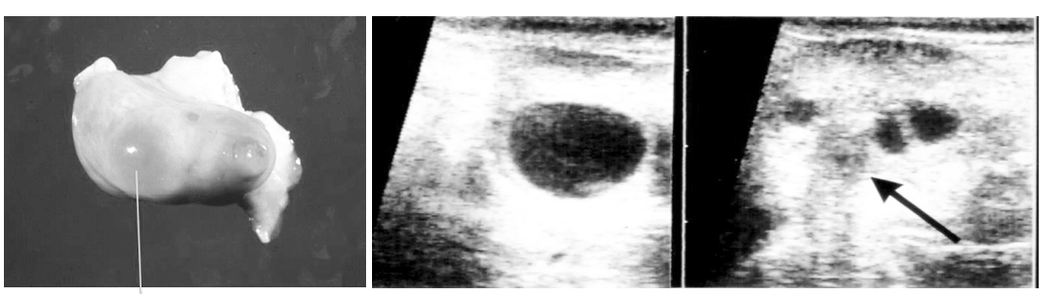


- Day 25: Anechoic embryonic vesicle
- Day 30–35: Embryo with heartbeat
- Day 45–60: Limb buds and placentomes visible

5. Main Field Applications of USG in Large Animal Reproductive Management

5.1 Estrus Detection and Synchronization Monitoring

- Follicular growth can be monitored, size of about 15-16 mm in absence of CL indicate the preovulatory follicle. Uterine tone and turgidity indicated by presence of vascularity are also seen during estrus.
- Confirmation of ovulation – absence of preovulatory follicle in second consecutive sonography at 12-24 h interval.

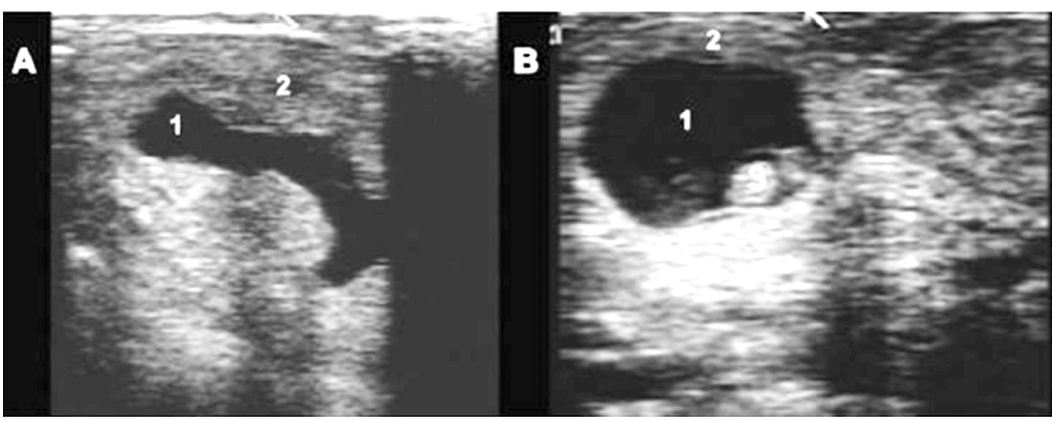


Pre-ovulatory follicle | Pre-ovulatory follicle | 12 hours later, Ovulation has occurred

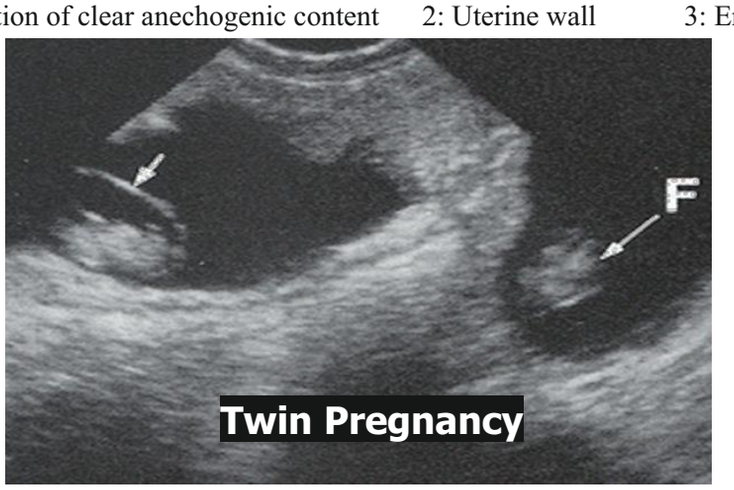
5.2 Early Pregnancy Diagnosis

- Accurate from Day 25–28 post-AI
- Heartbeat, limb movement, crown-rump length measurement
- Differentiation from pseudopregnancy, mucometra
- Detecting twins

Differential diagnosis of mucometra (A) & early pregnancy (B)
(7.5 MHz; depth 5 cm)

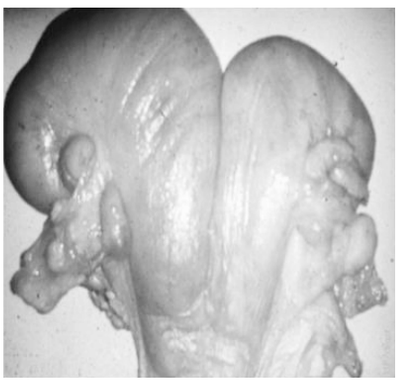
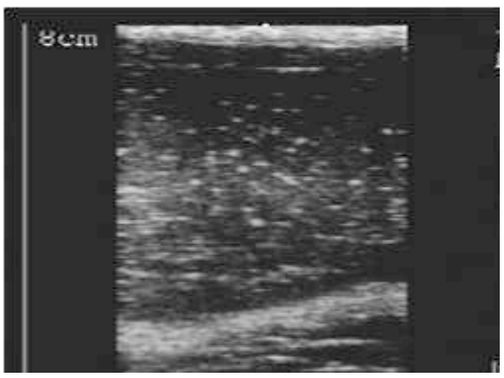


1: Accumulation of clear anechogenic content 2: Uterine wall 3: Embryo



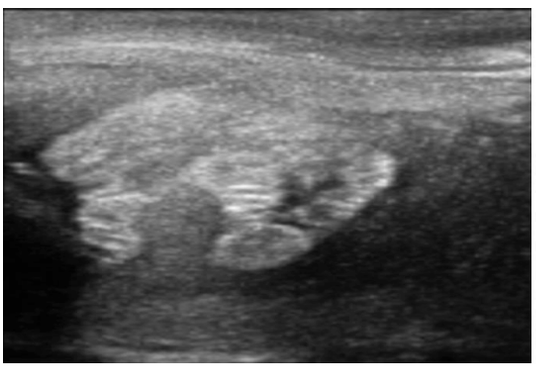
5.3 Diagnosis of Reproductive Pathologies

- Pyometra: Echogenic fluid with debris in uterine lumen
- Mucometra/Hydrometra: Anechoic fluid without debris

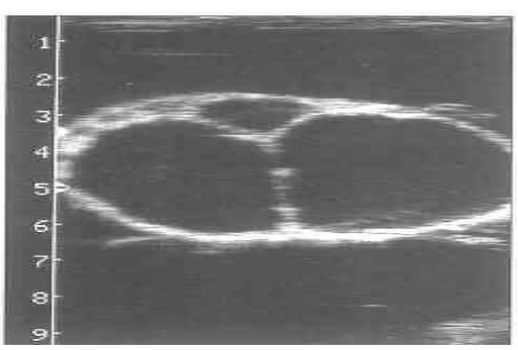
Pyometra

- Mummified fetus
- Fetal ascites

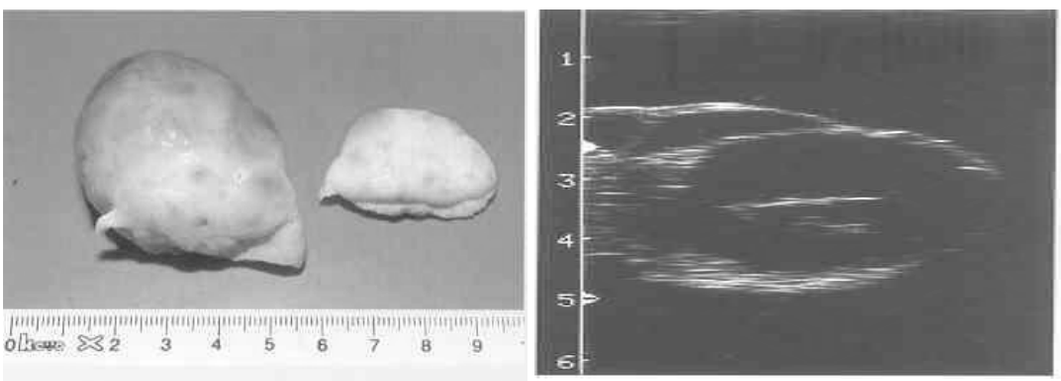



Mummified fetus Ascitic fetus

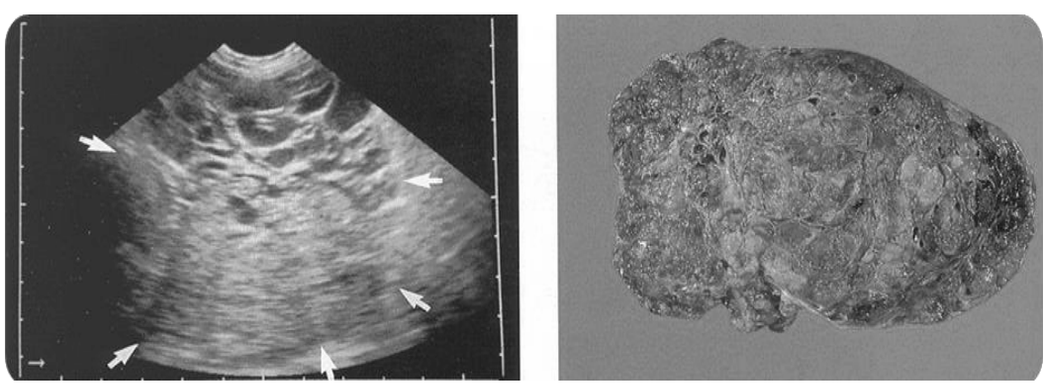
- Ovarian cysts: Persistent large follicles or luteal cysts
- Ovarian tumour

Follicular Cyst



Luteal Cyst



Ovarian Tumour

Advantages of Ultrasonography in Reproductive Practice

- Non-invasive and animal-friendly
- Early and accurate diagnosis
- Real-time functional assessment
- Improves reproductive efficiency and reduces calving interval

Limitations and Constraints

- High initial cost of equipment
- Operator-dependent interpretation
- Requires skilled personnel and training
- Limited field utility in extreme weather or remote areas

Recent Advances

- **Color Doppler Ultrasonography**: Assesses blood flow to CL, uterus, and fetus
- **3D Ultrasound**: Advanced structural evaluation
- **Automated follicular tracking**: AI-based interpretation

Recommendations for Clinical Practice and Training

- Incorporate ultrasonography into standard reproductive examination protocol
- Participate in hands-on training on USG
- Integrate with herd health and fertility monitoring programs

Conclusion

Ultrasonography has transformed reproductive diagnostics in bovines by delivering enhanced precision, safety, and procedural efficiency. Its versatility spans estrus detection, early pregnancy confirmation, and identification of genital or fetal abnormalities. These applications are now integral to routine herd reproductive programs. Research shows that B-mode imaging enables detection of viable embryos by 28–30 days post-insemination, with earlier functional assessment now possible through color Doppler evaluation of corpus luteum vascularization. With adequate training and investment in mobile ultrasound technology, practitioners can apply ultrasonography effectively in field settings, significantly enhancing fertility management in dairy herds. Looking ahead, innovations—including Doppler imaging to assess luteal and uterine blood flow**,** AI-powered image analysis for automated diagnostics, and compact, robust portable devices are expanding accessibility and accuracy, ushering in a new era of precision veterinary reproductive care.

Suggested References -

Ahuja, A. K., Singhal, S., Singh, R., & Deshmukh, S. (2020). Ultrasonographic and pathological findings of grade III cervico vaginal prolapse in a pregnant buffalo. *Indian Journal of Animal Research*, *54*(6), 790-793.

Gawai M, Kumar B, Mehrotra S, Chandra P, Kohli K, Donadkar M, Yadav V, Yadav BK, Warghat C, Kharayat N, Yadav D, Singhal S, Chouhan VS, Singh SK and Khan MH (2024) Impact of antral follicle count on follicular–luteal characteristics, superovulatory response, and embryo quality in Sahiwal cows. *Front. Vet. Sci.* 11:1494065. doi: 10.3389/fvets.2024.1494065

Imtiyaz, N., Brar, P. S., Singh, N., Singh, H., Singhal, S., & Malik, V. S. (2020). Relationship of antral follicle count, plasma Estradiol and progesterone levels with super ovulatory response and embryo production in Sahiwal cows. *Int J Curr Microbiol*

App Sci, *9*, 352-9.

Prasad, S., Singh, B., Singhal, S., Khan, F. A., Prasad, J. K., & Gupta, H. P. (2013). Production of the first viable ovum pick–up and in vitro embryo produced (OPU–IVEP) buffalo calf in India. *Asian Pacific Journal of Reproduction*, *2*(2), 163-165

Ravi, S.K., Prasad, S., Singh, B., Prasad, J.K. and Singhal, S. (2011). Hormonal profile in superovulated buffaloes following ablation of dominant follicle. The Indian Veterinary Journal. 93(07): 19-21.

Singh N, Dhaliwal G.S., Malik V.S., Singhal S., Honparkhe M and Brar P.S. 2016. Effect of Aspiration Pressure on Recovery and Quality of Oocyte following Ovum Pick-up in Buffaloes. *Indian Vet. J.,* 93 (10): 37 – 40.

Singh N, Singhal S, Malik V S, Singh H, Kumar A and Brar P S. 2018. Establishment of pregnancy from Sahiwal embryo in surrogate cross-bred cattle. *The Haryana Veterinarian* 57(1):99-100.

Singh S, Prasad S, Gupta HP, Singhal S, Gupta AK, Kumar A. 2012. Isolation and characterization of oviduct-specific glycoproteins from ampulla and isthmus parts of cyclic and acyclic buffalo for studying differential microenvironment. *Appl Biochem Biotechnol.* 166(7): 1814–30. https://doi.org/10.1007/s12010-012-9599-6. Epub 2012 Feb 19. PMID: 22350939.

Singh, M., Honparkhe, M., Kumar, A., & Singhal, S. (2018). Comparison of metabolites in the follicular fluid of bovine preovulatory and cystic ovarian follicles using nuclear magnetic resonance. *Indian Journal of Animal Sciences*, *88*(3), 290-294.

Singh, M., Honparkhe, M., Kumar, A., & Singhal, S. G. S. (2017). Comparative efficacy of cystic ovarian follicle ablation and CIDR based Ovsynch in dairy cattle. *International Journal of Livestock Research*, *7*(5), 175-182.

Singhal S, Singh N, Malik V S, Kumar A and Brar P S. 2017. A preliminary study on superstimulatory response using low dose FSH and subsequent embryo transfer in Sahiwal cattle during summer season. The Indian Journal of Animal Reproduction 38(2): 37–39.

Singhal, S., Prasad, S., Singh, H., Shukla, M., & Prasad, J. K. (2021). Effects of Pre-Treatment with GnRH on the Efficiency of Superstimulatory Protocol in Water Buffalo (Bubalus bubalis). *Iranian Journal of Applied Animal Science*, *11*(2), 305-310.

Singhal, S., Prasad, S., Verma, R., Gupta, H. P., & Prasad, J. K. (2021). Superovulatory response and progesterone profile in Murrah buffaloes (Bubalus bubalis) pretreated with GnRH agonist. *Indian Journal of Animal Research*, *55*(7), 763-766.

Singhal, S., Singh, N., Singh, H., Malik, V. S., & Brar, P. S. (2020). Curtailing the conventional dose of Folltropin-V for superstimulation and embryo recovery in Sahiwal cattle (Bos indicus). *The Indian Journal of Animal Sciences*, *90*(11), 1471-1475.

Taru Sharma, G., Nath, A., Prasad, S., Singhal, S., Chandra, V., & Saikumar, G. (2020). Expression pattern of GLUT 1, 5, 8 and citrate synthase transcripts in buffalo (Bubalus bubalis) preimplantation embryos produced in vitro and derived in vivo. *Reproduction in Domestic Animals*, *55*(10), 1362-1370.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