Training Manual

Hands-on Training

on

"Advanced Diagnostic and Therapeutic Techniques in Veterinary Practices"

(08-12 September, 2025)

Directorate of Extension Education

Bihar Animal Sciences University, Patna-14


EMINENT PARASITOLO

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Sponsored by:

ANIMAL HUSBANDRY AND FISHERIES
RESOURCES DEPARTMENT
GOVT. OF BIHAR

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Message

It gives me great pride to present this training manual titled; *Hands-on Training on Advanced Diagnostic and Therapeutic Techniques in Veterinary Practices*, prepared for the Veterinary Officers of Bihar. This manual embodies the university's ongoing commitment to strengthening the field-level capacity of veterinary professionals by equipping them with practical skills that align with the dynamic needs of animal health and production systems.

The livestock sector is central to ensuring nutritional security and sustaining rural livelihoods in Bihar. In recent years, rapid developments in diagnostics, therapeutics, and disease management have transformed veterinary practices. It is therefore essential that our Veterinary Officers are equipped with updated knowledge, advanced techniques, and modern tools to effectively address field challenges and deliver quality services to farmers.

This manual has been thoughtfully developed by experienced faculty members and subject experts of Bihar Animal Sciences University to provide both structured training and practical reference material. I am confident that this initiative will enhance the clinical competence of our veterinary officers and contribute significantly to improving livestock health and productivity in the state.

I convey my sincere appreciation to the organizing team, contributors, and resource persons for their dedicated efforts in preparing this valuable resource. I extend my best wishes to all participants for a fruitful and enriching learning experience.

Dr. Inderjeet Singh
Vice Chancellor, BASU, Patna

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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. Nirmal Singh Dahiya
DEE, BASU, Patna

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

Y.S. Jadoun, Nirmal Singh Dahiya and A.K. Thakur
Directorate of Extension Education (DEE)
Bihar Animal Sciences University (BASU), Patna-14

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:

- Vaccination
- 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.

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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.

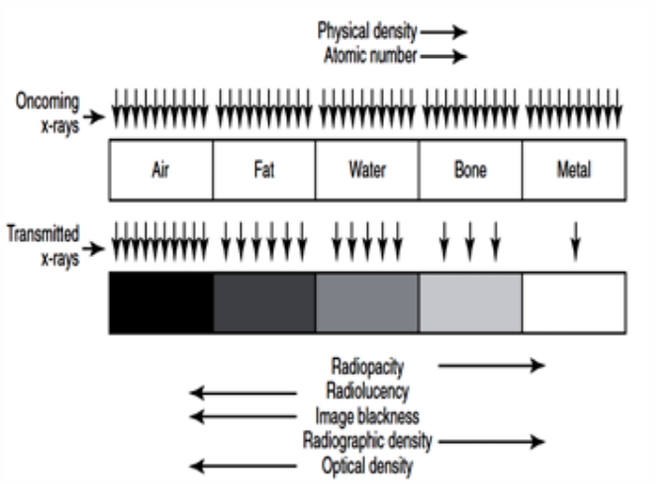
X-ray machines
Variety of X-ray machines are now a days available in veterinary field. They can be of following types.

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.

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.

2. 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

C. Based on Origin

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-Based Guide

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 Patterns

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

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

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.

Basics of ECG in Canine and Feline

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Electrocardiography (ECG) is a non-invasive diagnostic tool widely employed in veterinary cardiology to evaluate heart rate, rhythm, electrical conduction, and, to some extent, chamber size. In dogs and cats, ECG plays an important role in the diagnosis of arrhythmias, conduction disturbances, and systemic effects of cardiac and non-cardiac diseases. While echocardiography provides detailed anatomical and functional insights, ECG remains unmatched in the evaluation of cardiac rhythm abnormalities and conduction defects.

What is an Electrocardiograph, Electrocardiography, and Electrocardiogram?
Electrocardiograph: The machine/device used to record the electrical activity of the heart.

Electrocardiography: The process of obtaining the electrocardiogram.

Electrocardiogram (ECG/EKG): The graphical representation of the electrical activity of the heart, plotting depolarization and repolarization events of the atria and ventricles against time.

Historical Background
The development of ECG traces back to Harvey (1616), who described circulation, and Waller (1887), who first recorded electrical activity of the human heart. Einthoven (1895) introduced the nomenclature P, Q, R, S, and T and developed the string galvanometer, earning the Nobel Prize in 1924. Veterinary applications began in the early 20th century, with Waller (1909) recording canine heart activity and Norr (1922) using ECG clinically in dogs.

Principle of ECG

- The ECG records voltage changes generated during the depolarization and repolarization of cardiac muscle fibers.
- P wave: Atrial depolarization
- QRS complex: Ventricular depolarization
- T wave: Ventricular repolarization
- Each cardiac cycle produces a series of these waves, segments, and intervals, which reflect the electrical conduction pathway of the heart.

The Conduction System of the Heart

The canine and feline hearts, electrically, are considered in two units: atria and ventricles. The impulse originates at the sinoatrial (SA) node, travels via internodal fibers to the atrioventricular (AV) node, then passes through the bundle of His, right and left bundle branches, and Purkinje fibers to activate the ventricular myocardium.

- P wave represents atrial depolarization.
- PR interval reflects atrioventricular conduction delay.
- QRS complex shows ventricular depolarization.
- ST segment and T wave represent ventricular repolarization.

Equipment and Paper

- **Electrocardiograph machine:** Voltage meter with amplifiers and recording system.
- **Electrodes:** Standard four limb electrodes (RA, LA, RL, LL) and additional precordial (chest) leads.
- **Paper:** Graph paper with 1 mm squares; at 25 mm/s, each small square equals 0.04 sec (horizontal) and 0.1 mV (vertical).

Lead Systems

- Bipolar standard leads (I, II, III) – record potential differences between two limbs.
- Augmented unipolar leads (aVR, aVL, aVF) – compare electrical potential at one limb with the sum of the others.
- Chest leads (V leads) – provide transverse plane views (commonly V10 in dogs and cats).
- Bailey's hexaxial system – combines standard and augmented leads, most used in

small animal practice.

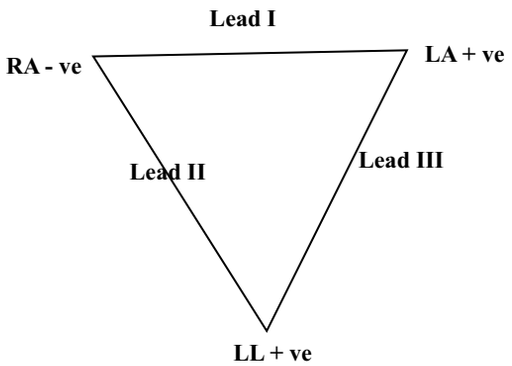

Fig.1. Diagrammatic representation of standard lead system.RA-right arm or right forelimb, LA- left arm or left forelimb, LL- left foot or left hind limb.

Recording Technique

For recording an electrocardiogram in dogs and cats, the animal is generally positioned in right lateral recumbency on a table covered with a non-conductive surface to avoid electrical interference. Electrodes are attached close to the elbows and stifles after clipping the hair if necessary, and the contact points are moistened with electrocardiographic gel or alcohol to ensure proper conduction. Most patients can be adequately restrained manually, although in nervous or uncooperative animal's mild sedation with agents such as diazepam or acepromazine may be administered without significantly altering cardiac function. The ECG is usually recorded at a paper speed of either 25 or 50 mm per second, with the sensitivity commonly set so that 10 millimeters correspond to 1 millivolt of electrical activity, which allows for accurate measurement and interpretation of the complexes.

Common Artifacts

- Artifacts may interfere with ECG interpretation:
- Electrical interference (improper grounding, fluorescent lights).
- Muscle tremor/panting/purring.
- Wandering baseline (respiration, movement).
- Electrode misplacement (may reverse polarity).

Systematic Interpretation of ECG

- Heart rate calculation (lead II is most common).
- Rhythm analysis (sinus rhythm vs. arrhythmias).

- Waveform and interval measurement (P, PR, QRS, ST, T, QT, RR).
- Mean electrical axis determination (normal canine MEA: +40° to +100°).
- Comparison with normal reference values.

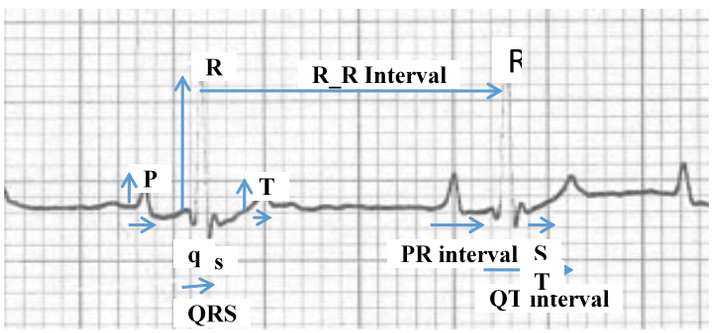

Fig.2. Measurement details of the amplitude and duration of different complexes and intervals in the electrocardiogram

Normal ECG in Dogs and Cats

Dogs:

- HR: 70–160 bpm (small breeds higher, puppies up to 220 bpm).
- P wave: 0.15–0.4 mV, 0.02–0.04 sec.
- QRS: 0.03–0.05 sec.
- T wave: 0.15–0.5 mV.
- PR interval: 0.08–0.12 sec.
- QT interval: 0.11–0.23 sec.

Cats:

- Heart Rate (HR) 140 – 220 beats/min (often higher in clinic due to stress, up to 240 bpm)
- P wave amplitude ≤ 0.2 mV
- P wave duration 0.02 – 0.04 sec
- PR interval 0.05 – 0.09 sec
- QRS duration 0.04 – 0.06 sec
- QRS amplitude (R wave) ≤ 0.9 mV (usually smaller than in dogs)
- T wave amplitude ≤ 0.3 mV (may be positive, negative, or biphasic; quite variable in cats)
- QT interval 0.12 – 0.18 sec (rate-dependent; shorter with tachycardia)

When to Use ECG

Electrocardiography should be considered an important diagnostic tool in both dogs and cats whenever there is a suspicion of cardiac or systemic involvement affecting the heart. It is particularly useful in patients where arrhythmias are detected during routine auscultation, as it helps to confirm the type and significance of the rhythm disturbance. Likewise, animals presenting with episodes of syncope, unexplained collapse, or seizures benefit from ECG evaluation to rule out cardiac causes. Respiratory signs such as dyspnea, persistent coughing, or the detection of heart murmurs also warrant electrocardiographic examination, since these may be secondary to underlying cardiac dysfunction. Beyond cardiopulmonary conditions, ECG has value in cases of trauma, shock, or electrocution where myocardial injury or rhythm disturbances may occur. It is equally relevant in systemic illnesses such as renal and endocrine disorders, as well as in patients with electrolyte imbalances that can alter cardiac conduction. Finally, ECG is recommended as part of routine pre-anesthetic screening to assess baseline cardiac status and minimize anesthetic risk.

Clinical Significance

Arrhythmias: ECG is the only definitive diagnostic tool.

Chamber enlargement: Tall P wave (RA enlargement), broad P wave (LA enlargement), tall R wave (LV enlargement), deep S wave (RV enlargement).

Conduction blocks: Prolonged PR interval (1st degree AV block), wide QRS complexes (bundle branch blocks).

Electrolyte disturbances: Hyperkalemia (tented T waves), hypokalemia (biphasic T waves).

Other findings: ST elevation/depression, QT interval changes.

Limitations

Although electrocardiography is a valuable diagnostic tool in small animal practice, it does have certain limitations that must be kept in mind during interpretation. It cannot provide information about structural abnormalities such as valvular disease, myocardial wall thickness, or the presence of obstructive lesions within the heart or great vessels. Furthermore, normal variations associated with breed differences and body conformation often complicate the interpretation of ECG tracings, making it difficult to establish universal reference values. Most importantly, a normal electrocardiogram does not necessarily rule out the presence of heart disease, since many structural or functional abnormalities may exist without producing detectable electrical changes on the ECG.

Conclusion

Electrocardiography is a fundamental diagnostic technique in small animal cardiology. While limited in detecting structural heart disease, it is indispensable for the evaluation of arrhythmias, conduction abnormalities, and certain systemic effects on the heart. A systematic approach to recording and interpretation, coupled with knowledge of normal canine and feline values, enhances diagnostic accuracy and guides therapeutic decisions.

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Serum Biochemical Analysis in Veterinary Medicine: Interpretation and Clinical Significance for Systemic Diseases

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Serum biochemical analysis is a cornerstone of veterinary diagnosis. It provides objective data on organ function, metabolic status, and systemic health. Proper interpretation requires correlating laboratory findings with clinical signs, history, and species-specific norms. Serum analysis encompasses a wide range of parameters, including liver enzymes, kidney function markers, electrolytes, and proteins. Veterinarians use these results to diagnose disease, monitor treatment progress, and assess the overall health status of various animal species. The interpretation of serum biochemistry results requires a thorough understanding of normal reference ranges, which can vary significantly between species, breeds, and even individual animals.

1. General Principles of Serum Analysis

- **Sample Collection**: Use plain vacutainer tubes (without any anti coagulants added), avoid haemolysis, process promptly.
- **Reference Ranges**: Always species-specific; **what is normal for cattle may be abnormal in dogs**.
- **Interpretation**: Never rely on a single parameter; look for patterns and trends.
- **Clinical Correlation**: Lab data supports but does not replace physical examination and history.

Serum analysis results can be influenced by factors such as age, sex, reproductive status, and environmental conditions, necessitating careful interpretation within the context of each individual case. The accuracy and reliability of serum analysis depend heavily on proper sample handling and laboratory techniques. Quality control measures, including regular calibration of equipment and participation in external proficiency testing programs, are essential for maintaining the integrity of results. Veterinarians often collaborate with clinical pathologists to interpret challenging cases and stay updated on emerging diagnostic markers and their clinical significance across different species.

2. Serum Chemistry Parameters and Their Diagnostic Value

A. Hepatic Function:

These liver function tests provide valuable insights into hepatic health and disease processes. ALT and AST are particularly useful for detecting hepatocellular damage, with ALT being more specific to liver injury in small animals. ALP and GGT are important markers for cholestatic conditions and biliary tract disorders, while bilirubin levels help differentiate various causes of jaundice. Bile acid testing is considered the most reliable method for evaluating overall liver function, as it assesses the liver's ability to uptake, conjugate, and excrete bile acids. This test is especially useful in cases where other liver enzymes may be within normal ranges but hepatic dysfunction is suspected.

- **ALT (Alanine aminotransferase)**: Specific for hepatocellular injury (dogs, cats). Not useful in large animals.
- **AST (Aspartate aminotransferase)**: Present in liver and muscle; increases with hepatocellular or muscular damage.
- **ALP (Alkaline phosphatase)**: Elevates with cholestasis, corticosteroid induction, bone activity (young animals).
- **GGT (Gamma-glutamyl transferase)**: Sensitive indicator of biliary disease, colostrum absorption in neonates.
- **Bilirubin (total, direct, indirect)**: Jaundice differentiation (pre-hepatic, hepatic, post-hepatic).
- **Bile acids**: Gold standard for liver function assessment.

Interpretation Example:

- **ALT ↑, Bilirubin normal** → Hepatocellular injury without cholestasis.
- **ALP ↑, GGT ↑, Bilirubin ↑** → Cholestasis or bile duct obstruction.

B. Renal Function:

Renal function tests provide valuable insights into kidney health and can help identify various kidney disorders. In addition to urea, creatinine, SDMA, and electrolytes, other important markers include phosphorus and calcium levels, which can be elevated in chronic kidney disease. Urinalysis, including urine specific gravity and protein-to-creatinine ratio, is also crucial for a comprehensive evaluation of renal function. The interpretation of renal function tests requires consideration of multiple factors, including the patient's age, breed, and overall health status. Serial measurements over time can be particularly useful in monitoring disease progression and treatment efficacy. In some cases, advanced imaging techniques or renal biopsies may be necessary to confirm a diagnosis or determine the underlying cause of kidney dysfunction. The use of novel biomarkers, such as symmetric dimethylarginine

(SDMA), has shown promise in detecting early stages of kidney disease before traditional markers become elevated.

- **Urea (BUN)**: Increases with decreased renal clearance, high-protein diet, GI bleeding.
- **Creatinine**: More specific for renal filtration; less influenced by diet.
- **SDMA (Symmetric dimethylarginine)**: Early marker of kidney dysfunction (dogs, cats).
- **Electrolytes**: Sodium, potassium, chloride changes common in renal disease.

Interpretation Example:

- **BUN ↑, Creatinine ↑, Isosthenuria** → Chronic renal failure.
- **BUN ↑ only** → GI bleed or high-protein meal.

C. Muscle Disorders:

It's important to note that while CK and AST are valuable indicators of muscle injury, a comprehensive approach considering clinical signs, physical examination findings, and other laboratory parameters is essential for accurate diagnosis and appropriate treatment planning.

- **CK (Creatine kinase)**: Highly specific for muscle injury, rises rapidly after trauma or myopathy.
- **AST**: Also elevated but less specific (shared with liver).

D. Pancreatic Function:

- **Amylase, Lipase**: Unreliable in most species; nonspecific.
- **PLI (Pancreatic lipase immunoreactivity)**: Gold standard for pancreatitis in dogs/cats.
- **TLI (Trypsin-like immunoreactivity)**: Test for exocrine pancreatic insufficiency.

In assessing pancreatic function, traditional markers like amylase and lipase have limitations in veterinary medicine due to their lack of specificity. However, species-specific tests such as PLI for pancreatitis diagnosis in dogs and cats, and TLI for detecting exocrine pancreatic insufficiency, have significantly improved the accuracy of pancreatic function assessment in veterinary patients.

E. Protein Metabolism:

The assessment of protein metabolism provides valuable insights into overall health and specific disease processes in veterinary patients. Alterations in total protein, albumin, and globulin levels can indicate a wide range of conditions, from dehydration and malnutrition to chronic inflammation and neoplasia. The albumin-to-globulin (A/G) ratio is particularly useful in differentiating between various

pathological states, with a low ratio often suggesting underlying inflammatory, infectious, or immune-mediated disorders.

- **Total protein**: Reflects hydration, inflammation, or chronic disease.
- **Albumin**: Decreases with liver failure, protein-losing enteropathy/nephropathy, malnutrition.
- **Globulins**: Increased in chronic inflammation, immune stimulation, neoplasia (multiple myeloma).
- **A/G ratio**: Low ratio suggests inflammation, infection, or immune-mediated disease.

F. Electrolytes and Acid–Base Balance:

Bicarbonate levels play a crucial role in maintaining acid-base balance, with alterations indicating metabolic acidosis or alkalosis. Magnesium, though often overlooked, is an essential electrolyte involved in numerous physiological processes, and its imbalance can lead to neuromuscular and cardiac abnormalities. Anion gap calculations can provide additional information about acid-base disturbances, helping to differentiate between various metabolic acidoses. Monitoring trends in electrolyte levels over time can be more informative than single measurements, particularly in critically ill patients or those undergoing fluid therapy.

- **Sodium (Na)**: Hyponatremia in diarrhea, renal loss, Addison's disease.
- **Potassium (K)**: Hyperkalemia in renal failure, hypoadrenocorticism; hypokalemia in vomiting, diuretics.
- **Chloride (Cl)**: Changes with acid-base imbalance.
- **Calcium & Phosphorus**:
    - Hypercalcemia: Neoplasia, renal failure, vitamin D toxicity.
    - Hypocalcemia: Milk fever, eclampsia, hypoalbuminemia.

3. Interpretation of Systemic Diseases

Hepatic Disease

- **Acute hepatocellular damage**: ALT, AST ↑
- **Chronic liver disease**: Low albumin, high globulin, high bile acids
- **Cholestasis**: ALP, GGT, bilirubin ↑

Renal Disease

- **Acute renal failure**: Rapid ↑ creatinine & BUN, hyperkalemia, metabolic acidosis
- **Chronic kidney disease**: Progressive ↑ BUN & creatinine, hypocalcemia, hyperphosphatemia, anemia

Endocrine Disorders

- **Diabetes mellitus**: Hyperglycemia, glucosuria, hyperlipidemia

- **Hypothyroidism**: Hypercholesterolemia, mild anemia, sometimes ↑ CK
- **Hyperthyroidism (cats)**: Hyperglycemia, ↑ ALT, ALP, possible azotemia
- **Hypoadrenocorticism (Addison's)**: Hyponatremia, hyperkalemia, Na/K ratio < 27

Musculoskeletal Disorders

- **Myopathy**: CK, AST ↑
- **Rhabdomyolysis in horses**: Marked CK, AST ↑, myoglobinuria

4. Patterns for Quick Clinical Use

Parameter	↑ Indicates	↓ Indicates
ALT	Hepatic injury	–
AST	Liver/muscle damage	–
ALP	Cholestasis, bone activity	–
GGT	Biliary disease	–
BUN	Renal failure, GI bleed	Liver failure, low protein diet
Creatinine	Renal disease	Low muscle mass
Albumin	–	Liver disease, PLE, PLN
Globulins	Inflammation, neoplasia	Immunodeficiency
Ca	Neoplasia, renal failure	Milk fever, hypoalbuminemia
K	Renal failure, Addison's	Vomiting, diuretics

5. Practical Tips for Veterinarians

1. Always interpret results with **species-specific ranges**.
2. Consider **age, diet, hydration, and stress** before labeling abnormal.
3. Use **trends over time** rather than single values for chronic diseases.
4. Pair serum analysis with **urinalysis** for complete renal assessment.
5. In systemic diseases, look for **multi-parameter patterns** instead of isolated markers.

Conclusion

Serum analysis is a key diagnostic tool in veterinary medicine, but its value depends on accurate clinical interpretation. Effective use requires consideration of species-specific reference ranges, patient factors, and the interplay of multiple biochemical markers. Recognizing patterns within these results improves diagnostic accuracy for conditions such as hepatic, renal, endocrine, and musculoskeletal disorders. A holistic, context-based approach enhances treatment decisions and supports better patient outcomes.

Diagnosis and Management of Common Reproductive Disorders in Large and Small Ruminants

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Reproductive efficiency is a critical component of livestock productivity, directly impacting the economic viability of animal husbandry. In both large ruminants (such as cattle and buffaloes) and small ruminants (such as sheep and goats), reproductive disorders are a significant cause of decreased fertility, extended calving intervals, and economic loss. This article provides a comprehensive overview of the diagnosis and management of common reproductive disorders affecting large and small ruminants.

Common Reproductive Disorders in Large Ruminants

I. Anestrus

Anestrus refers to the absence of estrus behavior and ovarian cyclicity in mature female cattle, buffaloes leading to failure to exhibit estrus over an extended period (usually more than 45 days postpartum).

Etiology:

1. Nutritional Deficiencies: Inadequate energy, protein, or mineral intake (especially selenium, phosphorus, and vitamin A) can impair ovarian function.
2. Poor Body Condition: Low body weight and condition score (below 2.5 on a 5-point scale).
3. Postpartum Anestrus: Delay in the resumption of ovarian activity after calving due to uterine involution or poor metabolic state.
4. Stress: Environmental factors like extreme temperatures, poor housing, and transport stress.
5. Endocrine Disorders: Hypothyroidism or pituitary insufficiency.
6. Subclinical Uterine Infections: Metritis or endometritis delaying the return to

cyclicity.

Diagnosis:

1. History: Absence of estrus for >45 days, previous breeding details, and postpartum interval.
2. Clinical Examination: Physical assessment of body condition and reproductive tract via rectal palpation.
3. Ultrasonography: Visualization of ovarian structures to assess follicular development or detect cysts.
4. Hormonal Assays:
    - Low serum progesterone (<1 ng/ml) suggests inactive ovaries.
    - LH and FSH levels for pituitary function.
5. Vaginal Cytology: To rule out infections.

Management:

1. Nutritional Correction: Balanced energy and protein diet, mineral supplementation (Se, Vit A, E).
2. Hormonal Therapy:
    - GnRH analogs (e.g., Buserelin) to stimulate LH release and follicular growth.
    - Progesterone-releasing devices (CIDR) to induce estrus.
    - PMSG or hCG to promote follicular development.
3. Treatment of Underlying Diseases:
    - Antibiotic therapy for subclinical uterine infections.
    - Manual removal of retained fetal membranes if present.
4. Management Practices:
    - Minimize stress and ensure proper housing.
    - Implement heat detection protocols and proper insemination timing.

II. Repeat Breeding Syndrome (RBS)

Repeat Breeding Syndrome is defined as the failure of a fertile female ruminant (cattle, buffalo, sheep, or goat) to conceive despite having been exposed to fertile males or receiving artificial insemination (AI) during multiple (at least three) consecutive estrous cycles under apparently normal conditions.

Etiology:

1. Infectious Causes:

a) Subclinical Endometritis/Metritis: Inflammation of the uterine lining without obvious clinical signs impairs the uterine environment, preventing embryo implantation.

b) Viral and Bacterial Infections:

- *Bovine Herpesvirus* 1 (BHV-1)
- *Brucella abortus*
- *Mycoplasma spp*
- *Chlamydia spp*
- *Toxoplasma gondii* (small ruminants)

2. Non-Infectious Causes:

a) Hormonal Imbalances:

- Luteal insufficiency.
- Anovulatory cycles.

b) Ovarian Dysfunction:

- Follicular cysts.
- Poor follicular development.

c) Genetic Factors:

- Heritable defects in the reproductive system.

3. Semen and Sire Factors:

a) Low semen quality: low motility, abnormal morphology, or low sperm concentration.

b) Inappropriate semen handling or AI technique.

4. Management and Environmental Factors:

a) Poor heat detection accuracy leading to improper insemination timing.

b) Inadequate nutrition (energy, protein, and mineral deficiencies).

c) Stress (heat stress, poor housing, transportation).

d) Poor hygiene during insemination.

Diagnosis:

1. History and Clinical Examination

- Detailed history of breeding attempts.
- Physical examination of body condition and general health.
- History of postpartum interval, previous reproductive performance.

2. Ultrasonography

- Evaluate ovarian structures (follicles, corpus luteum, cysts).
- Assess uterine contents for signs of inflammation or abnormalities.

3. Hormonal Assays

- Serum progesterone measurement: To assess luteal function.
- LH and FSH levels: To evaluate pituitary-ovarian axis function.

4. Uterine Cytology and Culture

- Uterine swab collected for cytological examination and microbial culture to detect subclinical endometritis or other infections.
- Culture and sensitivity testing to guide appropriate antibiotic therapy.

5. Semen Analysis

- Microscopic evaluation of semen for motility, morphology, viability, and concentration.
- Assessment of AI technique and semen storage.

6. Laparoscopy (in some cases)

- Direct visual inspection of reproductive organs for abnormalities.

Management:

1. Treatment of Underlying Infections

- Intrauterine antibiotic infusion based on culture sensitivity (commonly used antibiotics: cephalosporins, oxytetracycline, or gentamicin).
- Systemic antibiotics if generalized infection is suspected.
- Anti-inflammatory agents and uterine lavage when appropriate.

2. Hormonal Therapy

- GnRH analogs (Buserelin, Deslorelin) to stimulate ovulation.
- Prostaglandin F2α to induce luteolysis in cases of persistent corpus luteum.
- Progesterone supplementation (CIDR devices) to support luteal phase.

3. Nutritional Management

- Correct energy, protein, and mineral deficiencies (especially selenium, iodine, and vitamins A and E).
- Body condition scoring and adjusting feed accordingly.

4. Management Practices

- Improve estrus detection protocols (use of teaser animals, heat detection aids).
- Proper insemination timing based on heat signs or ovulation predictors.
- Ensure correct AI technique and semen handling.
- Maintain proper hygiene during insemination to reduce contamination risk.

5. Genetic and Sire Evaluation

- Avoid breeding from animals with hereditary defects.
- Evaluate sire fertility by conducting a breeding soundness examination (BSE).

6. Stress Reduction

- Provide proper housing with adequate ventilation and space.
- Minimize handling and transport stress.
- Manage environmental temperatures and humidity.

Prevention:

1. Ensure balanced nutrition, with mineral and vitamin supplementation as required.
2. Regular reproductive health checks postpartum.
3. Vaccination against reproductive pathogens (e.g., *Brucella abortus*, IBR).
4. Good hygiene practices during AI or natural mating.
5. Proper heat detection methods: visual observation, activity monitors, or pedometers.
6. AI training for technicians to ensure proper technique.
7. Use of estrus synchronization programs in large herds to control breeding seasons.

III. Metritis

Metritis is defined as an acute postpartum uterine infection involving the

entire uterine wall, often accompanied by systemic signs such as fever, anorexia, and depression. It differs from endometritis, which is limited to inflammation of the uterine lining without systemic involvement.

Etiology:

1. Bacterial Infection

- *Escherichia coli* – The most common primary invader.
- *Trueperella pyogenes* – Frequently involved in severe infections.
- *Fusobacterium necrophorum* – Secondary invader.
- *Bacteroides spp.*
- *Streptococcus spp.*

2. Predisposing Factors

- **Retained Fetal Membranes (RFM)** – Failure to expel the placenta creates an ideal environment for bacterial proliferation.
- **Dystocia** – Difficult or prolonged parturition leading to uterine trauma.
- **Poor Hygiene** – Unclean calving environments increase bacterial exposure.
- **Nutritional Deficiencies** – Low selenium and vitamin A can impair uterine immunity.
- **Immunosuppression** – Periparturient period is characterized by transient immunosuppression.

Clinical Signs:

- Enlarged, tender uterus detectable by rectal palpation.
- Foul-smelling, reddish-brown vaginal discharge.
- Fever (>39.5°C).
- Depression, anorexia, and dehydration.
- Decreased milk production.
- In severe cases, signs of systemic illness, such as tachycardia or hypothermia.

Diagnosis:

1. **Clinical Examination:**
   - **Rectal Palpation**: Enlarged, flaccid uterus with watery or purulent

contents.

- **Vaginal Examination**: Observation of abnormal, fetid discharge.

2. Ultrasonography

- Visualization of uterine contents: fluid accumulation, echogenic debris, thickened uterine walls.

3. Laboratory Tests

- **Uterine Swabs**: Collected for bacterial culture and sensitivity testing.
- **Blood Tests**:
    i. Leukocytosis with neutrophilia.
    ii. Elevated acute-phase proteins (e.g., haptoglobin).
    iii. Hypocalcemia may be associated.

4. Differential Diagnosis

- Distinguish from puerperal metritis, endometritis, and pyometra by presence of systemic signs and uterine wall involvement.

Management:

1. Medical Treatment:

a) Antibiotic Therapy

- Systemic antibiotics based on culture and sensitivity:
    i. Oxytetracycline.
    ii. Penicillin-streptomycin combinations.
    iii. Third-generation cephalosporins.
- Intrauterine antibiotics (if culture sensitivity allows): cephapirin or tetracycline infusions.

b) Supportive Therapy

- Anti-inflammatory drugs: Flunixin meglumine or phenylbutazone to reduce inflammation and improve comfort.
- Fluid therapy: To correct dehydration and electrolyte imbalance.
- Calcium supplementation: Particularly in hypocalcemic animals.

2. Manual Removal of Retained Fetal Membranes (RFM)

- Only recommended if the membranes are easily detachable and not forcefully removed to prevent uterine damage.

- Avoid aggressive manual removal.

3. Hormonal Therapy

- Prostaglandin F2α (PGF2α) administration to promote uterine involution by inducing luteolysis and uterine contractions.

4. Nutritional Support

- Correct mineral and vitamin deficiencies (especially selenium and vitamin A).
- Ensure adequate energy and protein intake to support immune function.

7. Prevention

- Maintain proper calving hygiene: Clean, dry, and well-managed calving pens.
- Monitor and ensure proper nutrition during the peri-parturient period.
- Early removal of retained placenta by natural means or gentle manual assistance.
- Prevent dystocia by selecting appropriate breeding pairs.
- Implement vaccination protocols where applicable (e.g., against *Leptospira*).

Blood Transfusion in Farm and Companion animals

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Blood transfusion therapy in veterinary medicine has advanced significantly, particularly for large animals like cattle. Although not as commonly performed as in small animals, blood transfusion in farm animals (cattle, buffaloes, sheep, goats, and horses) can be a life-saving intervention under critical conditions such as hemorrhage, severe anemia, or blood loss from parasitic infections. Despite its therapeutic potential, the procedure must be conducted with a thorough understanding of bovine blood groups, immune responses, and appropriate handling practices to ensure clinical success and minimize adverse reactions.

Indications of Blood Transfusion in Cattle

Blood transfusion is primarily indicated when the oxygen-carrying capacity of the blood is compromised. Common conditions that necessitate transfusion in cattle include:

1. **Severe hemorrhage**: Due to trauma, surgery, gastrointestinal bleeding, or obstetric complications.
2. **Anemia**: Often associated with parasitic infestations like *Babesia*, *Theileria*, or *Anaplasma*; also seen in cases of chronic disease or immune-mediated hemolysis.
3. **Hypovolemia with anemia**: Where rapid volume expansion with red blood cells is needed.
4. **Neonatal Isoerythrolysis**: Incompatibility between dam's antibodies in colostrum and the calf's red cells.
5. **Surgical support**: In major procedures involving significant blood loss.
6. **Toxemia or septicemia**: With hemolysis or capillary leak syndrome leading to anemia.

According to Braz-Ruivo and Divers (2001), a transfusion is typically warranted when the packed cell volume (PCV) falls below 12%, or if the total hemoglobin is under 5 g/dL, especially if the animal exhibits clinical signs like tachycardia, pale mucous membranes, weakness, or collapse.

Procedure of Blood Transfusion in Cattle

1. Selection of Donor

An ideal donor should:

- ❖ Be healthy, disease-free (particularly free from hemoparasitic infections).
- ❖ Be of similar breed and preferably the same herd.
- ❖ Have a PCV > 30%.
- ❖ Be vaccinated and dewormed.
- ❖ Be negative for bovine viral diarrhea (BVD) and leukosis virus.

Adult bovines can safely donate 10–15 mL/kg body weight of blood, which amounts to approximately 4–6 liters in a 500 kg cow.

2. Collection of Blood

- ❖
- ❖ Use aseptic technique.
- ❖ Collect blood from the jugular vein into a sterile blood collection bag containing anticoagulant (citrate-phosphate-dextrose-adenine, CPDA, or acid citrate dextrose, ACD).
- ❖ Monitor for clotting or hemolysis.
- ❖ Blood should be used fresh (within 4 hours) or stored at 4°C for up to 21–28 days depending on anticoagulant used.

3. Recipient Preparation

- ❖ Assess PCV, total protein, and vital signs.
- ❖ Establish IV access (usually jugular vein).

Fig. 1. Collected blood in CPDA

- ❖ Ensure the animal is calm and restrained.
- ❖ Check crossmatch if available (especially in repeat transfusions).

4. Administration

- Start with a slow rate of transfusion (0.1 mL/kg/hr) for the first 15–30 minutes while monitoring for any adverse reaction.

  Volume Required (L)= Body Weight (Kg) x Blood Volume (ml/Kg)x (Desired PCV –Actual PCV)

  Volume to transfuse (L)= (Desired PCV−Recipient PCV)×Body Weight (kg)×Blood Volume (mL/kg)

  Donor PCV
- If no reaction occurs, the rate can be increased up to 10–20 mL/kg/hr.
- Total transfusion volume is usually 10–20 mL/kg depending on severity of anemia.

Table 1. Standard Blood Volume in Animals (total amount of blood circulating in the body, typically expressed as mL per kg of body weight).

Species	Blood Volume (ml/Kg)
Cattle	65-70 ml/kg
Buffalo	65-70 ml/kg
Horse	70-75 ml/kg
Sheep	60-70 ml/kg
Goat	60-70 ml/kg
Pig	60-70 ml/kg
Dog	80-90 ml/kg

Bovine Blood Groups

Cattle have a highly complex blood group system. There are 11 recognized blood group systems in bovines: A, B, C, F, J, L, M, R, S, T, and Z. Among these, the **B and J systems are the most clinically relevant**.

1. B System

- Most polymorphic, with over 60 different antigens.
- Responsible for most antigenic differences and incompatibility.
- Difficult to match completely due to variability.

2. J System

- Unique in that the J antigen is not inherited but acquired from serum lipoproteins.
- Animals negative for J antigen are more likely to develop antibodies upon transfusion.

➢ **Buffaloes**: Similar to cattle but less studied; incompatibility is rare in the first transfusion.

➢ **Sheep**: Seven blood group systems; crossmatching is recommended, especially in valuable animals.

- **Goats**: Few antigens; transfusions generally safe with first-time donors.
- **Pigs**: 16 blood group systems; high risk of reactions if not crossmatched.
- **Horses**: Have 8 blood group systems (A, C, D, K, P, Q, U, and T); the Aa and Qa antigens are most immunogenic. Cross matching is highly recommended.

Due to this variability, routine crossmatching is not widely practiced in field conditions, but it becomes crucial in repeat transfusions or in valuable animals.

Crossmatching Procedure

Materials Required

- ✓ Sterile syringes and needles
- ✓ Anticoagulated blood (preferably with EDTA or citrate)
- ✓ Centrifuge and test tubes
- ✓ Saline (0.9% NaCl)
- ✓ Water bath or incubator (37°C)
- ✓ Microscope or agglutination viewing card (optional)

Step-by-Step Procedure

Step 1: Collect Samples

- Collect 5–10 mL of whole blood from both donor and recipient into anticoagulant tubes (EDTA or citrate).
- Label tubes clearly as donor and recipient.

Step 2: Preparation of RBC Suspension

- Centrifuge both blood samples at 1500–2000 rpm for 5–10 minutes to separate plasma and packed RBCs.
- Remove plasma from each and keep it in clean, labeled tubes.
- Wash the packed RBCs three times with 0.9% saline.
- Add saline, mix gently, centrifuge, and discard supernatant.
- Prepare a 2–5% suspension of washed RBCs in saline.

Step 3: Perform Crossmatches

a. Major Crossmatch

To perform a major crossmatch in cattle, begin by mixing two drops of recipient plasma with one drop of donor red blood cell (RBC) suspension (typically a 2–5% saline-washed suspension of packed RBCs) in a clean test tube. Gently mix the contents and incubate the mixture at 37°C for 15 to 30 minutes to allow any potential antigen-antibody reaction to occur. After incubation, centrifuge the tube at 1000 to 1500 revolutions per minute (rpm) for 1 to 2 minutes to separate the cells from the plasma. Carefully examine the supernatant and sediment. The presence of hemolysis (indicated by a pink to red coloration of the supernatant) or agglutination (clumping of RBCs) suggests an incompatible reaction between the donor's red cells and the

recipient's plasma antibodies. These changes can be observed either visually or under a microscope. A clear supernatant and uniformly dispersed red cells indicate a compatible crossmatch, and transfusion may proceed safely**.**

b. Minor Crossmatch

- Mix:
  - 2 drops of donor plasma
  - 1 drop of recipient RBC suspension
- Incubate and examine as in the major crossmatch.

Optional Controls:

- Autocontrols: Mix recipient's own plasma and RBCs (to rule out autoagglutination).
- Saline control: Mix recipient plasma with saline (to rule out non-specific agglutination).

Interpretation of ResultsObservationInterpretation No hemolysis or agglutinationCompatibleAgglutination presentIncompatibleHemolysis in tubeIncompatible

- **Compatible crossmatch:** Safe to proceed with transfusion.
- **Incompatible:** Avoid transfusion or consider alternative donor.
- Even weak agglutination should be considered significant.

Limitations of Crossmatching in Cattle

- ❖ Does not identify specific blood group antigens.
- ❖ May miss low-titer antibodies that can still cause delayed reactions.
- ❖ Requires centrifuge and incubator, which may not be available in field settings.
- ❖ In field situations, a simple slide agglutination test can be a quick alternative:

Field Adapted Slide Agglutination Test (Simplified Method)

Materials:

- Clean microscope slide
- Capillary blood (from donor and recipient)
- Saline solution
- Mixing stick or pipette tip

Procedure:

1. Place 1 drop of recipient plasma and 1 drop of donor whole blood (with RBCs) on the slide.
2. Mix gently and observe for clumping/agglutination.
3. Agglutination = Incompatible.

In conclusion, crossmatching is a vital safeguard, especially for repeat transfusions,

young calves, or valuable breeding stock. It is a relatively simple technique that can prevent serious and sometimes fatal transfusion reactions. Even under field conditions, simplified agglutination tests can offer critical insight into donor-recipient compatibility and should be employed wherever feasible.

Clinical Significance of Blood Transfusion

Transfusion provides immediate support to critically ill animals. Benefits include:

- Restoration of oxygen-carrying capacity.
- Improved perfusion and reduced lactate accumulation.
- Stabilization of heart rate and respiratory rate.
- Support for surgical patients or those with hemolytic crisis.

However, improper technique or incompatibility can cause more harm than benefit. Transfusion remains a valuable emergency tool, particularly in tertiary veterinary hospitals or organized dairy units.

Adverse Reactions to Blood Transfusion

Transfusion reactions are generally classified into **immunologic** and **non-immunologic** types.

1. Immunologic Reactions

- ✓ **Acute hemolytic reaction**: Due to incompatible transfusion; rare but fatal.
- ✓ **Febrile non-hemolytic reaction**: Most common; presents with fever, tachycardia, restlessness.
- ✓ **Urticaria and anaphylaxis**: Rare; seen more in hypersensitive individuals.

2. Non-Immunologic Reactions

- ✓ **Bacterial contamination**: Due to poor asepsis; may cause sepsis.
- ✓ **Iron overload**: Seen in multiple transfusions.
- ✓ **Hypocalcemia**: Due to citrate toxicity, especially with rapid transfusion.
- ✓ **Volume overload**: In young or compromised animals.

Management of reactions includes stopping transfusion, administering antihistamines (e.g., diphenhydramine), corticosteroids, and supportive care.

Precautions During Blood Transfusion

1. **Proper donor selection**: Screen for diseases and compatibility.
2. **Use sterile techniques**: Avoid contamination during collection and administration.
3. **Avoid rapid transfusion initially**: Start slow to monitor reaction.
4. **Observe the recipient**: Monitor temperature, pulse, respiration, mucous membrane color.
5. **Avoid mixing drugs with blood**: Incompatibility can cause hemolysis.
6. **Use within 4 hours if not refrigerated**: Stored blood should be used within

expiry.

7. **Avoid repeated transfusion without crossmatching**: Sensitization can occur.

Limitations and Field Considerations

In rural or field conditions, blood transfusion is challenging due to limited access to blood typing, storage facilities, or sterile equipment. In such scenarios, fresh whole blood transfusion using aseptic techniques and donor from the same herd may be the only viable option.Veterinarians must rely on clinical signs and basic hematology (PCV, hemoglobin) to make decisions. Education and awareness among dairy farmers and paramedics about the potential and procedure of transfusion can improve its usage in rural practice.

Conclusion

Blood transfusion in cattle is a potentially life-saving but underutilized procedure. Understanding the indications, procedural steps, and risks associated with transfusion is critical for its successful application. Although bovine blood group complexity poses a challenge, careful donor selection, proper administration, and monitoring can reduce adverse reactions. It is an essential skill in modern bovine clinical practice, particularly in managing anemia, hemorrhage, and critical medical conditions.

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Practical Approaches to Clinical Sample Collection, Faecal Examination and Blood Smear Preparation

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Proper collection, handling, and examination of clinical samples are critical for the accurate diagnosis of parasitic and microbial infections. This chapter provides an overview of key procedures for clinical and faecal sample collection, smear preparation, and result interpretation

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 andparasites** 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., Wuchereriabancrofti, 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.

Smart Bandaging Techniques in Animals: Future of Wound Management

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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. 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. Wound healing technologies constitute a major commercial enterprise, with the market for products involved in wound closure exceeding $15 billion and the market for skin scar prevention accounting for another $12 billion. The ideal wound care technology would: 1) create a moist, clean, and warm environment, 2) protect the wound bed from mechanical trauma and bacterial infiltrations, 3) modulate exudates level, 4) allow for gas exchange, 5) promote thermal insulation, 6) be non-toxic and non-allergenic, and 7) deliver therapeutic compounds essential for healing with optimal temporal profile. Despite advances in wound healing technologies, there is still a need for devices that can provide diagnostic information, combat infection, and effectively heal chronic wounds by intervening in dysfunctional healing processes. Such systems could revolutionize the wound care practice and have profound effects on therapeutic outcomes. Smart systems, which allow for sensing, responding, reporting, or a combination of such functions, can address many of the challenges associated with wound healing, particularly for chronic wounds, and may allow for better wound management, improving clinical outcomes by means such as detecting infections in a timely

manner or providing alerts for patients. Sensors can be combined with active drug delivery systems to autonomously respond to potential infection or hyper-inflammation. These integrated systems, which are summarized in the following sections, also have the potential to reduce healthcare costs for patients, hospitals, and insurance providers. Current wound dressings are mainly designed to keep the injury site sealed and protected. Some of them release drugs or compounds that can prevent infection and help with faster healing. A key limitation of these dressings is their inability to provide information about the healing status and the conditions of the wound environment with regards to its pH, bacterial loading, tissue oxygenation, and the level of inflammation. Sensors in the wound environment can provide important information that would expedite the decision making process in wound care. In addition, they can decrease the frequent changing of the wound dressing.

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 exudates 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 exudates. The gauze is applied dry, and it absorbs the exudates, 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 exudates, 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

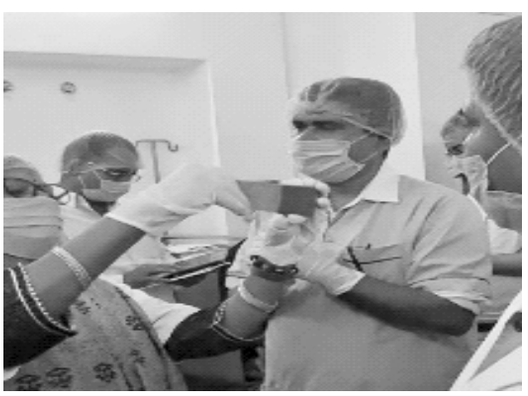

Fig. 2. Demonstration of Vetrap

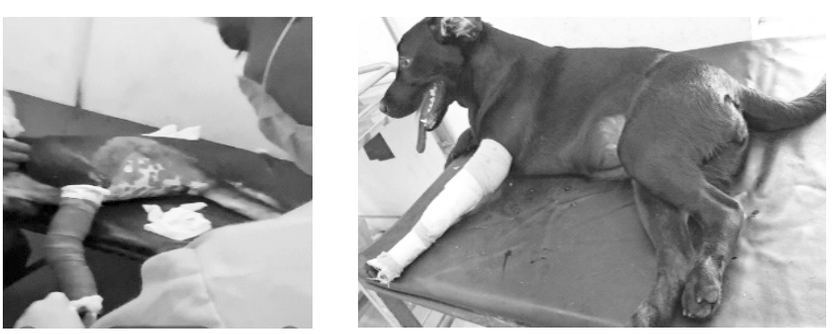

Fig. 3. Robert Jones Bandages

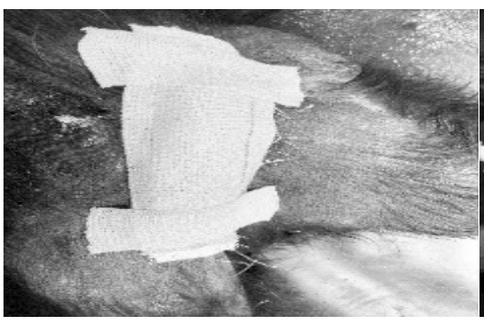

Fig. 4. Wound Bandage

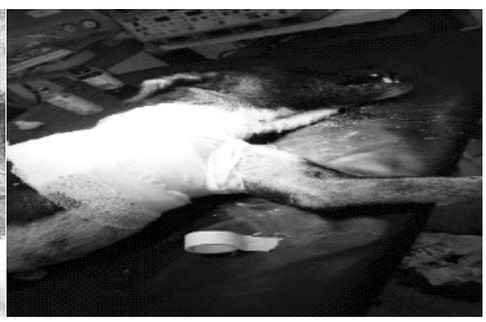

Fig. 5. Tie-over bandage

Fig. 6. Use of Elizabethan collar

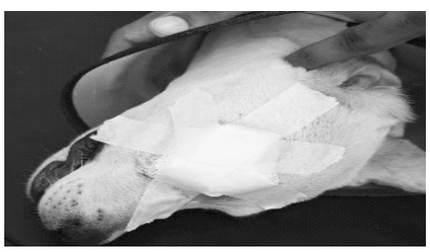

Fig. 7. Eye bandage in a dog

Fig. 8. Ear bandage in a dog

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.

✓ **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%.
- 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).

Conclusion:

The emergence of automated bandages and telemedicine is expected to change veterinary clinical practice especially in remote areas. In the field of wound management, more automated dressings that can sense and deliver therapeutics automatically or semi-automatically would significantly improve a patient's comfort and reduce the wound complications. There are also significant benefits in reduction of healthcare cost and time of hospitalization.

Suggested Readings

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Method for Rectal Palpation of Bovine Reproductive Tract

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Rectal Palpation: It is the procedure that enable to palpation reproductive tract of and animals that will help to access the normal and abnormal condition of internal genital organs.

Objective-

- To examine the genital organs.
- To access the normal/abnormal (pathological) condition of reproductive organs.
- To detect the pregnancy and its duration along with normal & abnormal pregnancy.
- To detect the uterine involution, phase of oestrous cycle and estrus phase etc.

Materials required:

1. Disposable full hand gloves.
2. Apron or gown.
3. Gumboots.
4. Lubricants like paraffin.
5. Animal crate etc.

Procedure:

- Take the history of animals like previous calving record, diseases record like metritis, pyometra etc., esrtrous cycle length, esrtus phase record etc.
- Restrained the animal in the trevis to avoid injury to the examiner as well as animals
- Insert your lubricated hand should be gently in the form of a cone into the rectum.
- Remove the faecal material by back racking avoiding the air insertion/ballooning and leads to its consequent distension making.
- The distension is eliminated by grasping the most posteriorly located contracted fold of rectum and expressing the air by gentle backward movement of the fold or by stimulating peristalsis by pinching the rectal wall which will help in evacuation of air.
- Examine the cervix, body of uterus, both uterine hors and ovaries in a very

gentle manner.

Examination of various reproductive organs:

A) Vagina- examine the vaginal area for any tumor, pneumovagina etc.

B) Cervix-It is recognized as a firm, cylindrical somewhat nodular structure located on the mid line of pelvic floor. This is the landmark of rectal palpation in the cattle and buffalo. It can be palpated by placing the finger beneath and thumb on its top, grasping its cranial part and pulling it back. It has three parts-

- External os of cervix
- External os of cervix
- Body of cervix – it has 3-4 annular rings/folds in case of cattle and buffalo. Bending of the body of cervix leads to kinked cervix.

C) Uterus-Uterus can be retracted by locating the ventral intercornual ligament. Hooking the ligament with the middle finger and gently pulling the entire uterus in to the pelvis. The two uterine horns should be reflected dorsally such that the base of each horn is directed at the examiner. The Size, muscular tone and contents of the uterus is then assessed.

Extent of Tonocity, Coiling and ability to return back at its normal position after lifting with fingers is reflect the stage of oestrous cycle/estus phase. Enlarged horns indicates the Pregnancy, Pyometra, Hydrometra, Mucometra, recent calving etc. Pathology of pregnancy can also be easily detected by rectal papation.

D) Ovaries- it is suspended approx. 5 cm laterally from the ovarian end of the uterine horns. Ovaries as the distinct oval or round masses on either side of the uterus, suspended on the edge of broad ligament. The ovary should be cradled between the middle and index finger so that its surface can be explored with thumb.

Following structures are palpated on the surface of ovaries by rectal palpation-

I. Follicle-fluid filled fluctuations structures

II. Corpus Luteum- hard consistency like liver and distinct feeling

i) Corpus luteum haemorrhagicum-Soft crepitating blood clot like structure (not easy to detect)

ii) Corpus luteum spurium and Verum-Liver like consistency, with or without papillae (crown like projection) above the surface of ovary. It may be embedded inside the ovaries.

iii) Corpus luteum albicans very small, firm and smooth.

Pathological Condition of ovary-

- Cyst (Follicular/Luteal)
- Smooth ovaries
- Tumor
- Hypo/hypertrophy of ovaries.
- Morphological abnormalities like sickle shape ovary etc.

E) Oviduct and ovarian bursa: Oviduct is not very easy to palpate. It is a cord like structure. The ovarian bursa is palpated by locating the mesovarium medial or lateral to the site of attachment of the ovary. All fingers are bent and slided underneath the mesovarium into the ovarian bursa. Oviduct detected clinically when there is enlargement of diameter of oviduct.

Precautions:

- ✓ The nails should be trimmed.
- ✓ Rings and wrist watch should be worn on examining hand.
- ✓ The protective clothing, gumboots and disposable plastic arm sleeves/glove should be worn.
- ✓ The gloved hand should be well lubricated with a non-irritating lubricant.
- ✓ Frequent removal of hand from the rectum during the process of removing the faecal material should be avoided.

Collection, Preservation and Dispatch of Materials for Laboratory Diagnosis

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For proper diagnosis other than clinical examination and collection of relevant history, proper idea of collection of materials for laboratory test is must.

Instruments/ other Items needed for Collection of Specimens:

- Surgical instruments- scissors, forceps, sharp/blade holders with BP knife.
- Gloves
- Pasteur pipettes with rubber bulbs.
- Bottle and vials- screw capped/Mc Cartany bottles with rubber stoppers.
- Microscopic slides.
- Sterilized swab on strong bamboo sticks.
- Syringes-glass/disposable 5-10 ml size, needles 16 to 20 SWG
- Scaling and labelling tape rolls
- Packing boxes
- Sterilized absorbent/non-absorbent cotton
- Polythene bags
- Protective garments- Aprons, gum boots and face mask.

General Considerations for Collection of Specimens:

1. Specimen collected should be accompanied with full history and relevant clinical data indicating the probable clinical diagnosis viz. clinical symptoms, duration of illness, species affected probable diagnosis and information regarding recent or current chemotherapy.
2. In case of a disease outbreak the materials form 5-6 animals should be collected at the height of body temperature clinical signs.
3. When sero-diagnosis is desired always paired sera samples should be collected: one sample at the time of start of disease and another after recovery (3-4 weeks) from the disease.
4. All biological specimens should be transported on ice as soon as possible to the laboratory.
5. When death is recorded, post mortem examination should be conducted at the

earliest to avoid putrification.

6. Materials collected for most of the diseases should be kept at 4°C if there is a delay in dispatch. Materials for biological examination should not be kept at subzero temperature (-20° C) while for virus isolation it can be stored at -20°C to -80°C.
7. Detailed post-mortem report should be dispatched with the morbid materials in 10% formalin. The morbid materials should be sent without preservative in sterile containers over ice.
8. The transport media used specially for virological examination of the morbid materials are 50% phosphate buffered glycerine, phosphate buffer saline (pH 7.3-7.4) and Hank's balanced salt solution.
9. In case of non-availability of transport media it is always desirable to collect tissues in sterile containers sealed and transported on ice.
10. Screw capped cylindrical bottle known as universal container is recommended for most types of specimens including pus, blood, sputum, faeces and urine. They are sterilized by autoclaving with caps loosely screwed on after sterilization, the caps are tightened.
11. Swabs suitable for taking specimens of exudates from the throat nostril, ear, skin, wounds and other accessible lesions may be made in the lab. The tube with the swab should be sterilized in the autoclave.
12. When virus disease is suspected, antibiotics (Penicillin 1000 IU/ml and streptomycin 10 mg/ml) may be used in the transport media.

Preservatives

1. Anticoagulants for blood

a. *Heparin* 5-6 IU/ml of blood.

b. *EDTA* - 1-2 mg/ml of blood.

c. *K /Na Oxalates*-2 mg/ml of blood.

d. K and Ammonium oxalate mixture-1ml/10 ml. of blood.

Blood is transported in chilled condition, but never frozen. Antibiotics may be added where bacterial isolation is not required

2. Transport media / preservatives:

a. ***50% phosphate buffered glycerine (pH 7.4)***

First prepare M/25 phosphate saline (pH 7.4-7.6) as follows:

Sodium chloride	8.5g
Di-sodium hydrogen phosphate	6.110g
Potassium dihydrogen phosphate	6.110g
Distilled water	1000 ml

Add equal volume of sterile neutral glycerine M/25 phosphate buffer saline (pH 7.4-

7.6) to prepare 50% phosphate buffered glycerine (pH 7.4). Add 0.1 ml of 1% phenol red solution to 100ml of that solution so as to give a final concentration of phenol red to 0.001 %. The solution when sterile should have reddish tinge. Yellow colour indicates contamination. Each vial must contain 10 ml for collection of tissues.

b. ***Hank's Balanced Salt Solution (HBSS)***

HBSS dry powder	1 vial
Distilled water	1000 ml

Dissolve the powder and add 0.5 g gelatin powder. Sterilize at 15lbs pressure for 30 minutes. Cool and add sterile sodium bicarbonate to make pH 7.4 and antibiotics (Penicillin 1000IU/ml, Streptomycin 10 mg/ml). Store in 3 ml quantity in vials at 4°C for collection of swabs and fluid for virus isolation.

c. ***10% formal saline***

Sodium chloride	8.5 g
Formalin (40%)	100 ml
Deionized water	900 ml

d. ***Merthiolate and sodium azide solution***

0.001% concentration of either of the two is good preservative for serum used for serological tests, but not for serum used for neutralization test. Use antibiotics when serum neutralization test is required.

e. **Phosphate *buffer saline, pH 7.2***

Sodium chloride	8.5 g
Di-sodium hydrogen phosphate	0.56 g
Potassium dihydrogen phosphate	0.14 g

Collection procedures in different cases:

1. Bacteriological examination (five to six animals should be investigated)

Conditions- Aseptic conditions using sterilized instruments (scalpel, scissors, forceps, Pasteur pipettes, syringe, needles) after scaring the surface with a hot iron or spatula

Containers- sterilized (wide mouthed) bottles, tubes, cotton swab.

Preservative- refrigeration at 4º C from collection till received at laboratory using ice or dry ice. Should not be kept at sub zero temperature i.e. -20 º C.

2. Virological studies:

Conditions and Containers- As above.

Preservative-As above. Antibiotics viz. penicillin 1000 units and streptomycin 10 mg/ml may be used in transport media. Alternatively the samples can be collected in

5 to 10 times volumes of sterile 50% buffered glycerine solution. The sample can be stored at -20 to -80˚ C.

3. Immunological studies: (Paired sera samples) one at start of disease and other at recovery.
Conditions- Aseptic conditions using sterilized instruments after scaring the surface with a hot iron or spatula.
Containers - As above.
Preservative- Serum after separation with merthiolate (1: 10000). The sample can be stored at -20 to -80˚ C.

4. Histopathological examination:
Conditions- Aseptic conditions not required.
Containers- Clean wide mouth bottles.
Preservative- 10% formalin.

5. Chemical/toxicological examination (large pieces of visceral organs, blood samples, stomach contents and urinary bladder):
Conditions- Aseptic conditions not required.
Containers- Clean wide mouth bottles.
Preservative- Refrigerated condition with ice.

6. Parasitological examination: Ectoparasites (ticks, fleas, lices& mites)
Conditions- Aseptic conditions not required
Containers- clean wide mouth bottle.
Preservative- 70% alcohol

Collection during P.M. for Isolation of bacteria
During Post mortem bacteriological examination sometimes becomes necessary. It needs a fair knowledge from where and how to collect the samples and then proceed for isolation of bacteria. Here are the some descriptions usually needed during post mortem for bacteriological examination.

- **a.** Heart blood is collected in sterile Pasteur pipette directly from the heart puncture at the time of P.M., but it is advised to sterilize the heart surface before puncturing with a hot spatula to avoid contamination. However, blood can also be collected by venipuncture in some cases. The collected blood is inoculated on solid media like McConkey's or Blood agar. The blood drop is placed at one point

in plate and then spread by using bacteriological loop by streaking method.

- **b.** Tissues and organs are collected in sterile Petri dishes from dead body at P.M. examination. The tissue surface is sterilized by touching with hot spatula or knife; then the surface is cut with sterile knife. The freshly cut surface is touched with solid media on plate which is further spread by loop. Alternatively, by using loop, some material from freshly cut surface is inoculated in plate or broth. In some cases the tissues are as such inoculated in broth and organisms are allowed to grow. After broth culture, these are inoculated on plate for isolation and characterization.
- **c**. Swabs (pus, fecal, nasal, vaginal etc.) are directly inoculated on solid media, if freshly collected. If the swabs are to be transported after collection, these should be kept in nutrient broth/normal saline/P.B.S. etc. so that these do not dry up. Then it is incubated in broth and further inoculated on agar plates.
- **d.** After inoculation, the agar plates or broth tubes are incubated at 37˚C for 24 hrs. if no colony is observed, it should be further incubated for 72 hrs. before being declared negative. The culture plates are carefully examined for the presence of colony of bacteria. The colony characteristics provide a guideline in identification. Its shape, size, colour, margin, elevation, consistency etc. should be noted for identification.
- **e.** For pure isolation and identification it is advised that from the culture from agar plates, a single colony is further inoculated on nutrient agar for further identification. The routine staining done for differentiation of bacteria is by Gram Staining Technique**.**

Dispatch of material

- During dispatch of pathological material the mouth of containers should be sealed with molten paraffin or wax.
- All containers should be labeled carefully and correctly.
- Materials should be packed tightly, so it does not move during transit.
- All parcels should be conspicuously marked 'Fragile with care'.
- For microbiological examination transport in screw capped water tight bottle is preferred over dry ice.
- For viral examination McCartney bottles with metallic screw cap and rubber lining are suitable and sent on ice packed box.
- The preserved samples are required immediate dispatch to lab on the day of collection by a special messenger.
- If delay in transit is expected it should be stored in a freeze at 4°C.

Materials to be collected in some common diseases of Animals:

Diseases	Materials to be collected
Haemorrhagic Septicaemia	Sick animals- Fixed smears from blood and throat swelling Dead animals- smear from heart, blood and liver. Heart blood,lymph node and spleen on ice.
Anthrax	Flame fixed blood smears of cattle and sheep. From subcutaneous swe lling in horses, swine and dogs. Swabs of blood from ear vein from dead animals. Small piece from tip of ear in saline.
Black Quarter	Impression smears from the affected muscle tissue: exudates from lesions: pieces of affected muscles on ice.
Brucellosis	Paired serum, blood and abnormal contents of aborted foetus: placenta with 2-3 cotyledons; vaginal swabs in PBS.
Johne's disease	Rectal pinch smears, bowl washings (at least 10 g preserved in 10% formalin). In dead animals terminal portion of ileo -caecal valve, mesenteric lymph gland in 10% formal saline.
Glanders	Exudate from skin and lung lesions in vial on ice. Impression smears from exudates duly fixed.
Tuberculosis	Cough material in sterile container from live animal; sample of milk in sterile container; suspected lesions in 10 % formal saline (dead animal): smears from lesions fixed by heat and lymph glands or lung lesions in sterile container for isolation in 50% buffered glycerine.
Leptospirosis	Blood serum: pieces of liver and kidney in 10% fo rmalin (in dead animals) and milk or urine in vials by adding 1 drop of formalin per 20 ml.
Salmonellosis	Intestinal swab: heart blood: bile in sterile container on ice.
Actinomycosis & Actinobacillosis	Smears from pus lesions: pus in vial on ice: formalin preserved materials from lesions (affected muscle).
Listeriosis	Aborted fetus brain, placenta: all internal organs in 10% formalin on ice.
Rinderpest/PPR/ Bovine Viral Diarrhoea	Live animals – 10 ml or more blood at the height of body temperature in anticoagulant: rectal swab in PBS on ice. Dead animals- prescapular lymph nodes, spleen on ice and lung, liver spleen, tonsil etc. in 10% formalin
Foot and Mouth Disease	Vesicular fluid from unruptured oral vesicles and curetted epithelium from fresh lesio ns: oropharyngeal fluid in 50% Phosphate buffered glycerine preferably on ice: about 10 ml blood at height of body temp. in EDTA/heparin. Dead animal- heart pieces on ice.
Rabies	Half portion of brain, salivary gland in 50% phosphate buffered glycerine and rest half portion of brain in 10% formalin. Alternative and preferable small pieces from hippocampus and brain (cerebellum, medulla, cerebrum, spinal cord) in 50% buffered glycerine and 10% formalin separately

Diseases	Materials to be collected
Pox	Scrab in sterile container on ice: scab in 50% buffered glycerine: skin lesions in 10 % formalin separately.
Swine Fever	Heparinised 20 ml blood on ice from live animal: heart blood, pieces of spleen, lymphnode, pancreas in 50% buffered glycerine saline: pieces of brain, lung, intestines, ileocaesal region and kidney in 10% formalin from dead animal.
Blue tongue/ African Horse Sickness/ Arbo viruses	Blood at the height of body temperature in heparin (5-10 units/ml) or EDTA: paired sera. From dead animals collect spleen, lymph nodes (5-10g) on ice.
Canine Distemper	Pieces of lung, UB, liver, trachea, stomach wall and brain in 10% formal saline: impression smear from liver.
Equine influenza	Nasal swab in PBS or Hanks on ice: paired serum.
Infectious Canine Hepatitis	Liver, gall bladder and kidney in 10 5 formal saline. Impression smears from liver fixed in methanol. Spleen and liver in sterile containers on ice.
Canine parvovirus	Rectal swab in PBS: pieces of intestines, heart on ice : all internal organs in 10% formalin.

Uterine Torsion – An Emergency Reproductive Problem in Dairy Animals

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Reproductive efficiency is a key determinant of dairy herd profitability. Among obstetrical disorders, uterine torsion holds a unique significance, being one of the most common causes of dystocia in cattle and buffaloes. Reported incidence varies from 2–12% of all calving cases in cows and up to 60–80% of dystocia cases in buffaloes in certain regions and incidence of cases is increasing also in Bihar. The condition often presents suddenly during the terminal stage of pregnancy or at the onset of labor, leading to severe complications for both dam and fetus.

Due to its high prevalence in buffaloes, uterine torsion can be described as a "buffalo disease" in Indian veterinary obstetrics. Its multifactorial etiology, diagnostic challenges, and complex therapeutic decisions make it a crucial subject for veterinary practitioners and clinicians. Beyond immediate obstetrical management, uterine torsion significantly affects future fertility, uterine health, milk production, and survival rates.

This article provides an in-depth, holistic analysis of uterine torsion in bovines with emphasis on etiology, clinical features, diagnostic strategies, therapeutic interventions, preventive measures, and long-term implications.

2. Anatomy and Pathophysiology Relevant to Uterine Torsion

Understanding the anatomical and physiological background is essential to appreciate the mechanism for the occurrence of torsion. To understand, the bovine uterus is bicornuate with a long cervix, suspended by broad ligaments in the abdominal cavity. During advanced pregnancy, the gravid uterine horn extends into the abdominal cavity and becomes relatively heavy, with its weight predominantly resting on the conical apex of uterine horn towards the ventral abdominal wall. Also, the broad ligaments are oriented obliquely, providing stability but allowing mobility of uterus to great extent compared to any other species. Furthermore, in buffaloes, the broad ligaments are relatively weaker and positioned more ventrally, predisposing them to torsion.

Pathophysiology:

- Uterine torsion occurs when the gravid uterus rotates along its longitudinal axis beyond 45°.

- Rotation may occur in either clockwise (right) or anticlockwise (left) direction.
- Torsion obstructs the cervical canal, impeding parturition
- Vascular supply is compromised, leading to congestion, ischemia, necrosis, and fetal death if uncorrected.

3. Etiology and Predisposing Factor:

Uterine torsion is multifactorial, influenced by anatomical, physiological, environmental, and managemental factors.

3.1 Species-specific Predisposition

- **Buffaloes**: Higher incidence due to pendulous abdomen, weaker abdominal muscles, and ventrally located broad ligaments
- **Cows**: Relatively lower incidence, but torsion remains a significant cause of dystocia also in cattle

3.2 Parity and Gestation Stage

- Most cases occur during **late gestation** or at the onset of parturition
- Pluriparous animals are more susceptible due to uterine laxity

3.3 Anatomical and Physiological Factors

- Asymmetrical uterine weight distribution
- Weak abdominal muscles (especially in buffaloes)
- High fetal fluid volume (hydroallantois)
- Excessive fetal movements

3.4 Environmental and Managemental Factors

- Slippery or uneven flooring → sudden slips and falls
- Transport of pregnant animals in late gestation
- Improper handling or sudden movement

3.5 Other Factors

- Inadequate exercise during late pregnancy
- Genetic predisposition (reported but not fully established)

4. Clinical Presentation – clinically the affected animal may be presented with

various symptoms depending upon the severity, duration of uterine torsion and condition of fetus, however, these signs and symptoms can be seen as -

4.1 General Signs

- Restlessness, abdominal discomfort – may exhibit frequent sitting and standing behaviour
- Colic-like signs (pawing, kicking abdomen)
- Severe stress, shaking body, panting, breathing with open mouth and extended tongue
- Reduced feed and water intake

4.2 Obstetrical Signs

- **Failure to deliver calf despite uterine contractions.**
- Vaginal examination reveals **spiral folds** in the vaginal wall indicating torsion direction.
- In complete torsion, the cervix remains closed, preventing fetal expulsion.

4.3 Degree of Torsion

- **Mild (≤90°):** May self-correct or reduce in degree wherein the fetus could be expelled out with external assistance
- **Moderate (90–180°):** Usually requires correction
- **Severe (>180°):** Obstructs blood flow, fetal distress, maternal toxemia

4.4 Side and Site of Uterine Torsion -

Side: depending upon the side of rotation of longitudinal axis the rotation may be either clockwise (right) or anticlockwise (left) direction

Site: depending upon the location of twisting cranial or caudal to cervix it can be either pre-cervical or post-cervical

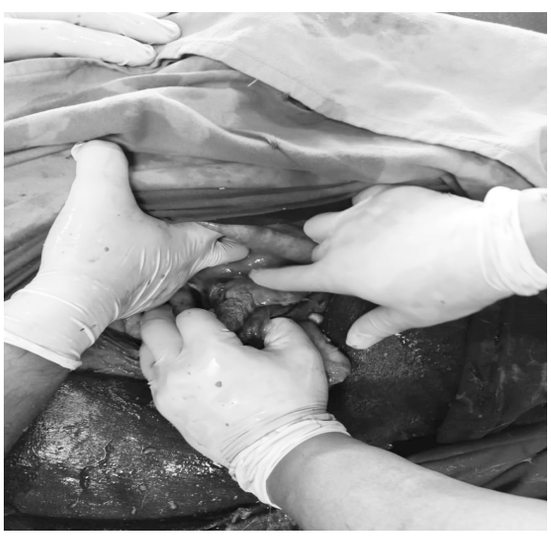
5. Diagnosis - Diagnosis is easy when the abnormal symptoms appear at time of parturition. Typical history of a case of uterine torsion will indicate that animal was about to calve, as exhibited by letdown of milk and relaxation of pelvic ligaments, but adequate time has passed and still there is neither the rupture of fetal water bags nor the appearance of fetus from vulvar lips. In spite of that, dam is suffering from

tachycardia, tachypnoea, restlessness (frequently gets up and down), and severe abdominal pain (due to stretching of the broad ligament) as manifested by kicking of the abdomen with her hind legs. With the increase in degree of torsion (>270°), the stretch receptors present in the vagina are stimulated and lead to severe abdominal straining. Step wise clinical diagnosis for the affected cases is as -

- **External signs** of uterine torsion like displacement of upper commissure of vulva towards inward, left or right, vulvar edema due to compression of the vaginal veins and lymphatic drainage, and a slight depression of lumbo-sacral vertebrae are not the consistent features
- **Vaginal examination:** *Post-cervical uterine torsion:* Post-cervical torsions can be easily diagnosed by vaginal examination. About 66–96% torsions are post-cervical in which the twist of rotated uterus extends caudal to the cervix and involves the anterior vagina in rotation. During vaginal examination, if post-cervical torsion is <180°, then the spiral folds or twists are present in the vaginal wall along an accessible cervix. When post-cervical torsion reaches more than one revolution (>180°), then only vaginal folds are palpable and cervix is not accessible. In these vaginal folds, if the fingers go to the left side and the hand to right side then torsion is of right side; however the side of torsion needs confirmation by rectal examination.
- **Rectal palpation** - Accurate determination of the direction of torsion through rectal examination is necessary prior to making attempts at correction, as detorsion in the wrong direction will worsen the problem. Stretching and displacement of broad ligaments indicate the torsion direction.

6. Treatment Approaches - The technique to be selected for detorsion of uterus in bovines varies with expertise of veterinarian, stage of pregnancy, severity of torsion as well as condition of dam, uterus and fetus. The most commonly used techniques are per-vaginal rotation of fetus, rolling of dam and caesarean section. Prior to undergo with any of the above treatment the administration of tocolytic drugs will block smooth uterine muscle contraction thereby can induce uterine relaxation which will help in better assessment of the direction of torsion, easier passage of hand through the vaginal folds, easier rotation of fetus through the vagina and easy distortion of the uterus.

- **Per-vaginal rotation of fetus** - is possible only in mild degrees of torsion ($\leq 90^0$) where the obstetricians hand can touch the fetus and sufficient fluids are present in the uterus along with live fetus. The fetus is grasped by a bony prominence such as elbow, sternum or thigh and swing to opposite side of torsion for distortion. If the manipulation is successful, the torsion will disappear and the vaginal folds will regain normal shape and the fetus can be delivered with little difficulty. The success rate is high if dam is standing, case is fresh, the cervix is sufficiently dilated to grasp the fetus and the fetus is alive.
- **Rolling of animal and Schaffer's Method** - utilizes the principle of rolling the animal around its uterus while the uterus remains static. It is one of the oldest and simple methods to relieve uterine torsion in buffaloes. The animal must be rolled preferably on grass with its head lower than the rear quarters. Vicious animals must be given a sedative. The animal is laid down in lateral decumbency on the same side to which the torsion is directed. The two hind legs are tied together with a rope. Both the fore legs are also tied together using a separate rope. The animal is rolled suddenly in the same direction as the torsion of the uterus to the other side. The rapidly rotating body of the buffalo overtakes the more slowly rotating gravid uterus. After the animal has been rolled to 180° her body must be brought back to the original position slowly so that she can be rolled once again. Followed by each rolling the progress of distortion must be check by per-vaginal examination.



Surgical Correction (Caesarean Section) – it is indicated when torsion is

severe, prolonged, or uncorrectable by rolling. It provides direct access to fetus, higher chances of calf survival.

- **Post-delivery supportive therapy –** the individual case must be looked for dehydration, ruminal functions & toxemia and accordingly the treatment can include fluid therapy eg. NSS, DNS etc.; antibiotics & NSAIDs to prevent infection and shock; rumenotorics to maintain digestion; Ca, oxytocin, P therapy to stimulate uterine contractions and prevent ROP like conditions; other supportive may include metabolites, multi-vitamins, energy supplements etc.

7. Prognosis

- **Good prognosis** if treated early (<6 hours).
- **Poor prognosis** if delayed (>12–24 hours), especially in buffaloes.
- Fetal survival: 60–70% if corrected early, <20% in delayed or severe torsion.
- Maternal complications: retained placenta, metritis, delayed involution are common post-treatment complications.

8. Prevention

8.1 Managemental Measures

- Avoid slippery floors and sudden animal movement of pregnant animal.
- Provide adequate exercise to pregnant animals.
- Avoid unnecessary transport during late pregnancy.

8.2 Nutritional Support

- Balanced rations with energy, protein, and minerals must be provided.
- Proper body condition scoring must be maintained to avoid obesity or emaciation.

8.3 Breeding and Genetic Aspects

- Selection against familial predisposition is recommended.
- Calving ease traits must be encouraged

8.4 Monitoring in Late Pregnancy

- Buffaloes in final trimester must be kept under close observation.
- Early veterinary intervention are required at first signs of calving

difficulty.

Uterine torsion represents one of the most critical obstetrical emergencies in bovine practice, particularly in buffaloes. Its multifactorial etiology requires a holistic understanding of anatomical, physiological, environmental, and managemental factors. Prompt and accurate diagnosis followed by timely corrective intervention is essential to save both dam and calf. Preventive strategies through improved management, nutrition, and monitoring in late pregnancy can significantly reduce incidence. With advances in diagnostic imaging, surgical techniques, and herd health management, outcomes of uterine torsion cases are expected to improve, ensuring better reproductive performance and economic returns in dairy farming.

Surgical Management of soft tissue infection in Canines

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Intestinal obstruction occurs when the movement of intestinal contents is blocked, preventing them from progressing further through the intestine. In dogs and cats, one of the primary causes of obstruction is the presence of foreign bodies in the intestines. The obstruction can be either partial or complete, depending on the size of the foreign object (Papazoglou*et al.,* 2003). In small animal, intestinal obstruction, presenting with a range of clinical signs that vary based on the location, severity, and duration of the obstruction (Aronson et al., 2000; Papazoglou et al., 2003). Gastrointestinal obstruction leads to disruptions in fluid balance, acid-base levels, and serum electrolyte concentrations due to hypersecretion and fluid sequestration in the gastrointestinal tract. These disturbances are worsened by vomiting and reduced fluid and nutrient intake (Boag*et al.,* 2005). Ingestion is considered the primary method through which foreign bodies enter the intestines of small animals (Hunt et al., 2004). Diagnosis is made through clinical signs, radiography, and ultrasonography.

Clinical sign:

- Vomiting
- Gagging or retching:
- Lethargy
- Drooling
- Loss of appetite
- Diarrhea
- Straining to poop
- Restlessness
- Painful abdomen
- Prayer position
- Bloating

Diagnosis is made through clinical signs, radiography, and ultrasonography.

Treatments:

Stabilization

Before any specific treatment, stabilizing the dog is essential.

- **Intravenous fluids**: To correct dehydration, electrolyte imbalances, and acid-base disturbances.
- **Pain management**: Analgesics may be administered to manage discomfort.
- **Anti-emetics**: Medications to control vomiting.

Surgical Treatment

Enterotomy:

Perform laparotomy at the mid ventral or chosen site. The laparotomy wound is retracted and intestinal coils are examined to locate the foreign body by drawing the coils between the fingers. the affected segment of intestine is exteriorized and isolated by packing with surgical towels and is clamped before and behind with bowel clamps. A full thickness longitudinal incision is made on the free (anti-mesenteric) border in healthy tissue proximal to the obstruction. the obstruction is removed and the opening is closed by Cushing's sutures or by continuous Lembert's sutures. Size 3/0 medium chromic catgut with atraumatic needle is suitable for intestinal sutures. the towels are removed after cleaning the bowel surface with saline solution. the laparotomy wound is closed after returning the bowel into abdominal cavity.

Resection and Anastomosis:

In severe cases where part of the intestine is damaged or necrotic, that portion may need to be removed. The healthy ends of the intestine are then reconnected (anastomosis).

Intussusception in Dogs

It is a condition where a segment of the intestine telescopes into an adjacent section, leading to intestinal obstruction. It is one of the common cause of mechanical obstruction of intestine in dogs (Singh *et al.,* 2015). Puppies and kittens have a significantly higher incidence of intussusception compared to adult animals (Applewhite *et al.,* 2002; Atray*et al.,* 2012; Ghashghaii*et al.,* 2017). Intussusceptions in young animals are considered idiopathic, however various

predisposing factors may contribute to its occurrence. These factors include intestinal parasitism, linear foreign bodies (such as bones and plastic toys), parvoviral enteritis leading to intestinal hypo- or hypermotility, non-specific gastroenteritis, intraluminal masses, prior abdominal surgery, hypertrophied lymphoid nodules, and granulomatosis resulting from inflammatory conditions (Guilford and Strombeck, 1996; Rallis et al., 2000; Rewerts and Cohn, 2000; Patsikas*et al.,* 2003, 2008; Schwandt, 2008; Allenspach, 2010; Gelberg, 2012). If intussusception remain prolonged, the trapped tissue can become ischemic, devitalized and necrosed. Therefore, it is a medical emergency that requires prompt diagnosis and treatment.

Clinical Signs:

- Persistent or recurring vomiting
- Diarrhea (often with blood)
- Abdominal pain (e.g., whining, stretching, guarding)
- Lethargy and weakness
- Weight loss in chronic cases
- Dehydration

Diagnosis:

Physical Exam: Abdominal palpation may reveal a mass, suggesting obstruction.
Ultrasound: The most effective diagnostic tool, revealing the characteristic telescoping of the intestine.
Radiographs: May show site of obstruction but are less specific.
Contrast Studies: Sometimes used if ultrasound results are inconclusive.
Treatment:

Emergency Surgery:

Procedure: A laparotomy is performed to locate and manually reduce the intussusception. If the affected part of the intestine is non-viable (due to necrosis), it may require resection and anastomosis (removal of the damaged part and reconnection of healthy ends).
Gastropexy: In some cases, part of the intestine may be anchored to prevent recurrence.
Postoperative Care:

- Fluid therapy
- Antibiotic and analgesic agent.

Gastric Foreign Body

Dogs are naturally curious and often engage in playing with and consuming non-food items, which can lead to gastric foreign body syndrome (Tripathi*et al.,* 2010). These objects are easily swallowed, becoming lodged in the stomach, and can result in complications such as ulceration, malnutrition, dehydration, and potentially death (Chiang and Chou, 2005). Common clinical signs include persistent vomiting, partial or complete anorexia, weight loss, and lethargy (Uma Rani *et al.,* 2010). Puppies are more prone to gastric foreign bodies due to their indiscriminate and excessive eating habits (Fossum, 2007). The progression and severity of the condition depend on the location of the obstruction and whether it is partial or complete.

Clinical sign:

- Vomiting
- Loss of appetite
- Abdominal pain
- Diarrhea
- Dehydration
- Lethargy

Diagnosis: Based on clinical sign and plane radiographs or contrast radiograph.

Treatment:

Endoscopic Removal: Typically, effective if the object is reachable.

Procedure: Performed under anaesthesia with an endoscope to retrieve the foreign body.

Gastrotomy: Used for larger, rough, or inaccessible objects.

Surgical technique:

The surgical site is aseptically prepared for the procedure. A midline incision is made to perform a laparotomy. The stomach is gently exteriorized through the laparotomy opening and isolated using sterile surgical towels. The foreign body within the stomach wall is localized and enclosed within a pouch, which may be clamped distally with bowel clamps if required. An incision, either longitudinal or transverse depending on the foreign body's size is made along the pouch, taking care to preserve gastric vessels as much as possible. The foreign body is carefully removed, and any protruding mucosa at the incision site is trimmed flush with the wound edges. The incision is then closed with a layer of Cushing sutures, followed by an overlying continuous Lembert suture for reinforcement. The stomach surface is thoroughly rinsed with sterile saline before being repositioned in its normal

anatomical location, and the packing towels are removed. Finally, the laparotomy wound is closed in standard fashion.

Postoperative Care*:*

- Broad spectrum antibiotic for seven days
- Analgesic agent for 3 days
- Monitor for signs of infection (peritonitis), and reintroduce food slowly after 48 hours.

Gastric Bleeding

Diagnosis: Endoscopy is preferred; surgery may be necessary if other methods fail.

Treatment:

Medical Management:

- Fluid Therapy: Stabilization (e.g., Lactated Ringer's solution 5-10 mL/kg/hr IV).
- Acid Suppression: Proton pump inhibitors (e.g., Omeprazole) and H2 receptor antagonists (e.g., Ranitidine).
- Mucosal Protection: Synthetic prostaglandins (e.g., Misoprostol).

Surgical Intervention: Required for uncontrolled bleeding or perforation.

- Procedure: Inspect the stomach, remove ulcers, or perform a gastrectomy.

Postoperative Care*:*

- Broad spectrum antibiotic for seven days
- Analgesic agent for 3 days
- Monitor for signs of infection (peritonitis), and reintroduce food slowly after 48 hours.

Gastric Dilatation and Volvulus (GDV)

Gastric dilatation and volvulus (GDV) is a life threatening condition, characterized by abnormal gastric distension with gastric gasses and its rotation along its mesenteric axis (Bhatia *et al.,* 2010). This condition can occur in many species including man, but more frequent in dogs (Glickman *et al.,* 2000). Vascular compromise resulting in gastric necrosis followed by shock and death may occur in this condition (Guilford, 1996).The mortality of GDV is reported up to 68% in earlier studies (Mackenzie *et al.,* 2010), where as in recent reports up to 26.8% (Green *et al.,* 2011).

Clinical Signs

- Restlessness or pacing

- Non-productive vomiting or retching
- Excessive salivation (ptyalism)
- Abdominal distension
- Weakness
- Collapse in severe cases

Diagnosis

Clinical Sign and abdominal radiography, particularly the right lateral projection, is diagnostic for GDV

Management:

- Supportive care for patient stabilization
- Surgical correction

After induction of general anaesthesia, the dog is positioned in dorsal recumbency, and the abdomen is aseptically prepared for surgery. A cranial midventral laparotomy is performed to access the stomach. Gastric decompression is most commonly achieved via gastrotomy but can also be accomplished by passage of an orogastric tube. Once decompressed, the stomach and spleen are carefully examined for signs of ischemia. Devitalized portions of the gastric wall are resected, and splenectomy is performed if splenic vascular compromise is present. Extensive gastric necrosis, particularly involving the cardia, is associated with a poor prognosis. Anatomical repositioning of the stomach is essential to prevent recurrence of gastric dilatation–volvulus (GDV). In some cases, spontaneous repositioning may occur following decompression. To minimize the risk of recurrence, a gastropexy is performed, most commonly using either the **Belt-Loop** or **Circumcostal** technique.

Belt-Loop Gastropexy

This method involves creating a seromuscular antral flap anchored around a segment of transversus abdominis muscle.

- A horseshoe-shaped incision is made in the serosal layer of the gastric antrum, based at the greater curvature.
- The seromuscular layer is isolated by gently separating the mucosa from the full-thickness wall using thumb and index finger, then incised with scissors.
- The antral flap is dissected free of submucosa, the stomach returned to its normal position, and the flap aligned with the transversus abdominis.
- Two longitudinal incisions are made in the transversus muscle fibers, and

the intervening muscle segment undermined.

- The gastric flap ("belt") is passed through the transversus muscle tunnel ("loop") and sutured to itself with 2-0 monofilament absorbable sutures in a simple interrupted pattern.

Circumcostal Gastropexy

- Place stay sutures approximately 4 cm apart on the ventral pyloric antrum.
- Create an "I"-shaped seromuscular incision, about two-thirds the length of the antrum, parallel to its long axis.
- Elevate two seromuscular flaps (3 cm × 1–1.5 cm) without penetrating submucosa or mucosa.
- Expose one of the last four right costal arches by sharply incising and reflecting muscle over ~5 cm at the costochondral junction. **Caution:** The diaphragm is close; avoid pneumothorax.
- Pass the flap around the exposed costal arch and suture to the opposing flap using simple interrupted 2-0 synthetic absorbable sutures.

Postoperative Management

- Withhold food and water for 48 hours after surgery; maintain hydration using polyionic isotonic crystalloid fluids at 60 mL/kg/day.
- If vomiting persists, continue withholding oral intake and adjust fluid therapy accordingly.
- After 24 hours without vomiting, reintroduce food gradually over 2–3 days, starting with a liquid diet, progressing to soft/baby food, and finally returning to the regular diet.
- Continue antibiotic therapy for 7–10 days postoperatively.
- Provide analgesic therapy for a minimum of three days.

Surgical Management of Orthopedic Affection and Emergency Condition

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Orthopedic Surgeries

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 remodeling. 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.

Emergency Surgeries

Emergency surgical situations in veterinary medicine require rapid diagnosis, critical decision-making, and prompt intervention. It involves procedures performed to address life-threatening conditions such as trauma, hemorrhage, obstruction, torsion, and perforation affecting vital organs. Managing surgical

emergencies effectively enhances patient outcomes and minimizes mortality.

Principles of Veterinary Emergency Surgery

Veterinary emergency surgery refers to immediate surgical interventions required to save the life of an animal, relieve severe pain, or prevent irreversible organ damage. These procedures involve small animals (dogs, cats), large animals (cattle, horses), and exotic species. Indications for emergency surgery include severe trauma (vehicular accidents, falls, bites), internal haemorrhage, gastrointestinal obstruction or perforation, acute abdominal pain (acute abdomen), diaphragmatic hernia, torsion or volvulus of organs, urogenital emergencies (pyometra, obstructed urolithiasis), dystocia and uterine rupture, thoracic injuries with pneumothorax or hemothorax etc. Goal of emergency surgery is to stabilize the patient, address the primary pathology, minimize pain and distress, prevent systemic deterioration (e.g., sepsis, shock) and to preserve or restore the normal physiological function.

Initial Patient Assessment and Stabilization

Triage and Prioritization: Triage involves sorting patients based on the urgency of their condition. Categories:

- Red (Critical): Immediate life-saving intervention needed
- Yellow (Urgent): Severe but not immediately life-threatening
- Green (Delayed): Non-urgent cases
- Black: Moribund or deceased

ABCDE Approach

- A – Airway: Ensure a patent airway
- B – Breathing: Evaluate respiratory rate and pattern; administer oxygen
- C – Circulation: Check pulse, mucous membrane color, CRT; start IV fluids
- D – Disability: Assess neurological status
- E – Exposure: Examine entire body for injuries

Stabilization protocols including oxygen therapy, intravenous fluid resuscitation, analgesia and sedation, blood transfusion (if needed), correction of acid-base and electrolyte imbalances and antibiotics (broad-spectrum until culture results) are important.

Surgical Techniques in Emergencies

Asepsis and Instrumentation

Quick yet thorough preparation is essential. Surgeon can use sterile disposable kits if time is limited. The common incision techniques include midline laparotomy (most common), flank approach (ruminants) or paracostal incision (renal or adrenal access). For suturing and closure, use absorbable sutures for internal structures and non-absorbable for skin. For tension-bearing closures consider tension-relieving patterns (e.g., vertical mattress).

Anesthesia

Pre-anesthetic stabilization is critical. Use short-acting, reversible agents and monitor vital parameters continuously. The recommended protocols include premedication with opioids (morphine, methadone), induction with propofol or alfaxalone, maintenance with isoflurane or sevoflurane, and, supportive care with fluids, temperature regulation, oxygen etc. It requires additional monitoring of ECG, BP, spO_2, $ETCO_2$ and to assess the depth of anesthesia and reflexes.

Common Emergency Surgical Conditions

Species-specific emergency surgeries in small animals (dogs and cats) include GDV, dystocia, urinary obstruction, trauma etc. These conditions are often associated with high survival with prompt diagnosis and intervention. In large animals, cattle are mostly affected with uterine torsion correction, left displaced abomasum (LDA) surgery and rumenotomy for foreign body (hardware disease). The horses are mainly associated with emergency surgical procedure of colic surgery (large colon volvulus, strangulating lipoma), cesarean section (rare) or fracture fixation (limited by cost and recovery issues). Surgical options for exotic and wild animals depend on species physiology requiring individualized care. They often require sedation in traps or transport cages.

Gastrointestinal Emergencies

Gastric Dilatation-Volvulus (GDV)

- Species: Dogs (deep-chested breeds)
- Signs: Abdominal distension, retching, shock
- Surgical Intervention: Gastropexy and derotation
- Prognosis: Good with early intervention

Intestinal Obstruction

- Causes: Foreign body, intussusception, tumors
- Signs: Vomiting, anorexia, dehydration
- Treatment: Enterotomy or resection and anastomosis

Rectal or Anal Prolapse

- Management: Manual reduction, purse-string suture, resection if necrotic

Thoracic Emergencies

Diaphragmatic Hernia

- Cause: Trauma
- Diagnosis: Radiography
- Surgery: Midline laparotomy and hernia repair

Pneumothorax / Hemothorax

- Procedure: Thoracocentesis, chest tube placement, surgical repair if persistent

Urogenital Emergencies

Pyometra

- Common in: Intact female dogs
- Treatment: Emergency ovariohysterectomy
- Signs: Vaginal discharge, lethargy, PU/PD

Urethral Obstruction

- Common in: Male cats and dogs
- Procedure: Perineal urethrostomy or catheterization
- Complication: Hyperkalemia, azotemia

Cesarean Section

- Indications: Dystocia, fetal distress, uterine inertia
- Anesthetic precautions: Minimize fetal depression

Trauma-related Emergencies

Wound Management

- Principles: Debridement, lavage, closure

- Types: Clean, contaminated, infected

Fracture Repair

- Stabilize patient first
- Surgical options: Internal/external fixation

Splenic Rupture

- Surgical Removal: Splenectomy
- Monitor for hemorrhage and anemia

Postoperative Management

Intensive care is to monitor for hemorrhage, infection or dehiscence, provide analgesia (opioids, NSAIDs) and fluid therapy to maintain hydration and perfusion. Nutritional support (enteral if possible) post surgically enhances the recovery. Common complications in the post-operative period may be related to hypovolemia or shock, surgical site infection (SSI), seroma or hematoma formation, ileus or delayed gastric emptying etc. Reoperation may be required in some cases.

Ethical and Legal Considerations

Obtain informed consent from the owner explaining risks, benefits, costs, and prognosis. Euthanasia can be recommended in hopeless cases or extreme suffering. Owner communication is key with humane protocols must be followed.

Canine Demodicosis: A Big Challenge for Pets

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Skin problems are common in the small animals which constitutes approximately 25% morbidity in small animal (Grant and Thoday., 1994). Since the first description of *Demodex mites* in 1842 by the French dermatologist Gustav Simon, more than 140 known species or subspecies have been described. This is parasitizing hair follicles or sebaceous glands in mammals (Zhoa et al., 2012).

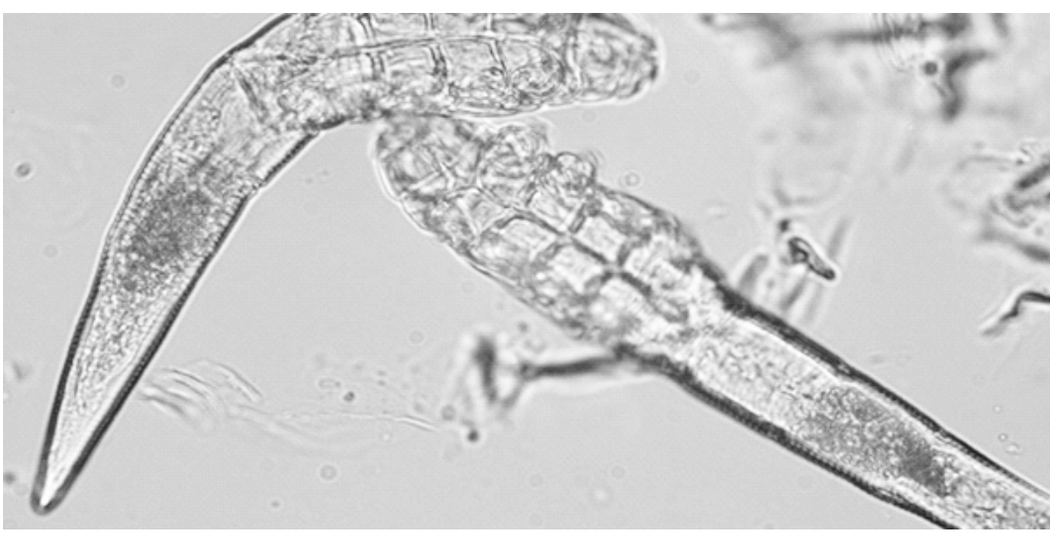

Fig. Demodicosisis in canines

Demodicosisis is an inflammatory parasitic disease of dogs which is also known as demodectic mange, red mange and follicular mange. Demodicosis is characterized by the presence of larger than normal numbers of demodectic mites (Miller *et al*., 2013). Three types of *Demodex* mites have been described in dogs as following;

1) *D. canis*
2) *D. injai*

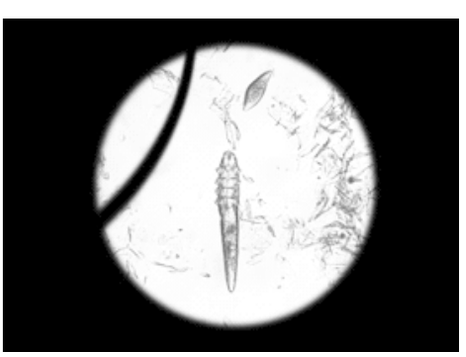

Fig. Demodectic mites

3) *D. cornei*

Demodicosis can be classified as localized and generalized, with a juvenile and adult onset (Grotel, 2006).

Demodex mite is the normal cutaneous micro fauna in most of the healthy dogs (Ravera et al., 2013). The disease is thought to be the consequences of immunodeficiency that allows its proliferation (Singh and Dimri, 2014). Some of the most important factors known to included are;

Breeds (Plant *et al.,* 2011)

Breeding line and age (Ghubash, 2006)

Genetics,

Nutritional status

Oxidative stress (Dimri *et al.,* 2008)

Parasite induced T cells misbalance (Singh *et al.,* 2010)

Parasite induced apoptosis of immune cells (Singh *et al.,* 2011)

Length of hair coat

Stage of estrus cycle

Parturition

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most important factors known to included are;
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Parasite induced apoptosis of immune cells (Singh *et al.,* 2011)
Length of hair coat
Stage of estrus cycle
Parturition
Endoparasitism
Debilitating diseases etc.

Clinical Findings: Demodecosis is characterized by erythema, alopecia, edema, seborrhoea, pyoderma and pruritus which occur generally on the face, trunk and legs of the dogs. During the progression of disease, the mites enter and colonise into the hair follicles and multiply in to thousands causing alopecia and redness of skin.

Diagnosis:

Skin scraping-Collection of skin scrapings

In this methods spatula or scalpel blade andmineral oil is required. Select the most active lesion particularly periphery of lesion. Clean the lesion with spirit. Take a scalpel and dip its blade in mineral oil that is liquid paraffin. Press the lesion between thumb and index finger. Hold the scalpel blade with thumb and finger firmly and scrape the skin deeply. The skin is scraped deep enough to produce capillary bleeding.Collect the scrapings in petridish/watch glass.

Methods: Direct Method:

Place a small pinch of skin scraping on glass slide. Add 1-2 drops of 10% KOH solution. Apply mild heat to slide for few seconds and wait for 15-30 minutes. Put a cover slip and examine under low power of microscope

Sedimentation Method:

Take sufficient quantity of skin scrapings in a test tube. Add 5 ml of 10% KOH solution. Keep it overnight or boil it till the solution becomes syrupy. Centrifuge for 2 minutes at 1000 rpm. Examine a drop of sediment under low power of microscope

Trichography: In this method plucked hair samples are examined under the microscope to identify the demodex mites because the mites are remain attached to the hair shaft. The mineral oil is used to prepare the sample. This test is not as reliable

as skin scraping.It is useful in the area of skin which is difficult to squeeze or scrape.

Punch biopsy: This method is used when the routine methods like skin scraping is insufficient specially in the region where mites are located deep in the hair follicle. If the skin scraping is negative but index of suspicion of demodicosis is high. A small circular full thickened section of skin is collected by punch instruments. The use of local anesthetics and cleaning the areas of sample collection is an important step. Histologically the biopsy sample is examined for the presence of demodex mites.

Acetate tape preparations:

Acetate tape can be used to detect the superficial canine mite *D. cornei.* Repeatedly press a piece of acetate tape to the skin and fur. Then lay the tape flat on a glass slide for microscopic examination. Lower the condenser on the microscope and decrease the light to increase the contrast in the microscope field is beneficial. Evaluate the entire tape sample by using 4X or 10X microscope objectives.

Exudative samples:

In case of demodecosis with concurrent deep pyoderma the exudative sample may be taken directly into the glass slide and can be examined under microscope.

Otic swabs:

Demodectic otitic externa is viewed by taking the sample from the ear with the help of cotton swab and after putting the sample on the glass slide to examine under microscope under oil immersion.

Scanning electron microscope (SEM):

Used to examine demodectic mites for its morphological details (Jing et al.,2005).

Histopathology studies:

In very chronic cases histopathological test of skin biopsy is reliable (Mondal ,1983). Hyperplasia, hyperkeratosis, acanthosis, folliculitis, furunculosis, parakeratosis, perifolliculitis can be detected.

More recently, **polarised-light dermoscopy** has been applied successfully to human patients(Segal et al., 2010).

Haematological studies:

The average Hb concentration may be lower than the normal. Decrease TEC and PCV may also be possible due to decreased erytheropoiesis and reduced life span of erythrocytes (Dimiri et al.,2000). The average TLC value can be high due to inflammatory reaction. The DLC examination reveals lymphopenia, neutrophilia, eosinophilia. Lymphopenia is due to stressful condition or T- cell suppression due to blastogenesis factor present in the sera of the

demodectic dog (Dhume et al.,2000; Singh et al., 2011).

Histochemical studies:

Succinic Dehydrogenase Enzyme (SDH):

The activity of SDH enzyme in healthy skin is marked in the cells of epidermis and adnexa of the skin along with wall of the blood vessels. The affected skin shows sparse or mild activity of the Enzyme. Due to which shining of the skin may affected (Muller et al., 2011).

Alkaline Phosphatasse Enzyme (ALKP):

The healthy skin shows mild to negligible activity of this enzyme. Affected skin shows moderate to intense activity of the enzyme, mainly in the cell of the sebaceous gland, hair follicle and epidermis (Mueller et al., 2011).

Biochemical Studies:

Blood glucose, serum total protein, cholesterol, acetyl cholinesterase should be conducted.

Other laboratory test: Urine analysis, Hyper-adrenocorticism test and Mineral estimation.

Rapid Molecular Diagnostic Tests:

The development of rapid assays based on sero-diagnosis or molecular tests is required. Demodex-specific antigens which react with antibodies in the serum of infested pigs have been identified. An immunodiagnostic assay is feasible (Yang et al., 2004). The immune-histological assessment reveal that MHC class II expression in the skin of dogs suffering for demodicosis is elevated (Huisingaa et al., 2007). The evaluation of cytokine messenger RNA expression suggests that the IL-5 might be a useful marker of the clinical course in demodicosis (Tani et al., 2002).

Species identification can be done by the use of PCR.

Treatment:

Treatment of canine generalized demodicosis is multimodal. To maximize the potential for successful treatment in addition to effective acaricidal therapy treatment of concurrent bacterial skin infection, internal parasitism and underlying systemic disease is necessary (Mueller *et al*.,2010).

Canine demodicosis treatment includes mainly, amitraz, ivermectin, milbemicin oxime, moxidectin, doramectin (Mueller.,2004; Dimri *et al*., 2009). If a patient dose not responds to the initial miticide, one should switch to another treatment option. In addition to various medical treatments it is beneficial to recommend; good control of endo-parasites, a balanced, high-quality diet and avoidance of immunosuppressive

treatments.

Amitraz:

Amitraz has been approved for the treatment of canine generalized demodicosis in many countries for decades. It has been shown to be an effective treatment option in many studies (Mueller., 2004).

Mechanism of action:

It inhibits prostaglandin synthesis. Interacts with the octopamine receptors of the central nervous system and inhibits monoamine oxidases.

Yohimbine (Yobine, Ben Venue Laboratories) is the antidote for amitraz, and can be used if side effects are excessive. Atipamesole (50µg/kg intramuscularly) can reverse the signs of toxicosis within 10 minutes (Hugnet *et al., 2001).*

The recommended concentration varies from 0.025 to 0.06%, with a frequency of once weekly to every 2 weeks (Mueller RS.,2004). Amitraz plus inactivated parapoxvirus ovis in the treatment of canine generalised demodicosis isalso effective (amitraz 3ml + 1 lit. water conc) is given along with 2 ml of iPPVO injected subcutaneously (Pekmezci *et al* ., 2014).

Amitraz causing sudden death in Chihuahuas, so it should be avoided in this breed. This medication should also be avoided in pregnant and lactating bitches and in puppies less than 12 weeks of age (Craig *et al*., 2003).

Macrocyclic lactones: Macrocyclic lactones include-Avermectins, ivermectin, doramectin, Milbemycins, milbemicin oxime and moxidectin.

Mechanism of action:

This class of drugs selectively binds to glutamate-gated and gamma aminobutyric acid (GABA)-gated chloride cannels in the mite's nervous system. Resulting in cell hyper polarization, mite paralysis and finally death.

Ivermectin: For generalized demodicosis, the injectable form of ivermectin should be given. Signs of ivermectin toxicosis can occur irrespective to any breed but are most common in ivermectin sensitive breeds such as collies and other herding breeds (Hopper *et al.,* 2002). The main side effects of this medication are neurological, and include changes in pupil size, behavior, ataxia, seizures, coma, and death.A subpopulation of certain herding breeds have homozygous mutations in their MDR1 genes that results in the production of abnormal P-glycoprotein proteins pumps in their blood brain barrier (Mealey KL., 2006). In ivermectin-sensitive dogs, one report recommended initially dosing ivermectin at 50 µg/kg/day and then incrementally increasing the dose by 50µg/kg during the first days of treatment until the target dose is achieved (Mueller and Bettenay., *1999).*

There is no safe specific antidote for ivermectin toxicosis.There are some reports of using picrotoxin to treat ivermectin toxicosis.

The use of ivermectin should be avoided in heartworm positive dogs, as animals with a high microfilaria load can have adverse reactions (Boothe DM., 2001). The efficacy of ivermectin–metronidazole combinedtherapy in the treatment of Demodex folliculorum is good (Salem *et al.,* 2013).

It has been proposed that metronidazole may acton the mite via one or more of its active metabolites formed in vivo (Schmadel *et al*., 1990).

Milbemycin oxime: Oral milbemycin oxime is recommended at a dose rate of 1.5 to 2mg/kg/ day, although the dose ranges of 0.5 to 3.1 mg/kg/day have been used.(Holm., *2003).*Ivermectin-sensitive breeds generally tolerate milbemycin oxime (Tranquilli *et al., 199).*Milbemycin, even though related to ivermectin, appears to be safer and associated with fewer side effects, even in ivermectin sensitive breeds.Although anecdotal reports exist of some collies being sensitive to this drug when used at higher dosages(Lacey *et all., 2011).*

Neurological side effects have been noted when used at a dose greater than 2.5 mg/kg day. The major limitation of this drug is expense.

Moxidectin and Doramectin: Moxidectin given orally at 400µg/kg/day may be effective in treating generalized demodicosis *(*Maderson PFA., 2003). Moxidectin can be used at a lower dose and then gradually increased to 400µg/kg/day similar to ivermectin (Wagner and Wendlberger, 2000). Doramectin is another avermectin, can be used at 600µg/kg/week subcutaneous injection (Dimri *et al.,* 2009; Johnston., 2003).This drug should not be used in ivermectin sensitive breeds of dogs.

A combination product containing imidacloprid and moxidectin had been used in Australia since 2004.

Some other treatment approaches

A recently published study showed that treatment with selamectin at a dose of 24–48 mg/ kg p.o.once weekly or twice monthly had a low success rate in canine generalized demodicosis (Schnabl *et al.,* 2010). Canine generalized demodicosis can treated with varying doses of a 2.5% oxidectin + 10% imidacloprid spot-on and oral ivermectin (Paterson *et al.,* 2014).

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नामांकन नोटिस

बिहार पशु विज्ञान विश्वविद्यालय, पटना के अधीन बिहार पशु चिकित्सा महाविद्यालय,पटना एवं संजय गाँधी गव्य प्रौद्योगिकी संस्थान, पटना में शैक्षणिक सत्र 2025–2026 में नये पाठ्यक्रम शुरू किए जा रहा है, नामांकन हेतु विवरणी निम्नवत् है:–

बिहार पशु चिकित्सा महाविद्यालय, पटना

कोर्स का नाम	अवधि
बी.एस.सी. (पोल्ट्री प्रोडक्शन)	3 वर्ष (6 सेमेस्टर)

पैरा वेटरनरी साइंसेज

कोर्स का नाम	अवधि
डिप्लोमा इन वेटरनरी एंड लाइवस्टॉक डेवलपमेंट (डी.वी.एल.डी.)	2 वर्ष (4 सेमेस्टर)
डिप्लोमा इन वेटरनरी लेबोरेटरी टेक्नोलॉजी (डी. वी. एल. टी.)	2 वर्ष (4 सेमेस्टर)
सर्टिफिकेट कोर्स इन आर्टिफिशियल इन्सेमिनेशन	3 माह

पोस्ट ग्रेजुएट डिप्लोमा

ऑनलाईन – वेटरनरी होम्योपैथी, एथ्नोवेटरनरी मेडिसिन, वन हेल्थ, ऑफलाईन – बोवाइन क्लिनिकल प्रैक्टिस, कैनाइन एंड फेलाइन क्लिनिकल प्रैक्टिस ।
एडवांस ट्रेनिंग कोर्स ऑन इम्पोर्टेंट वेटरनरी क्लिनिकल प्रोसीजर अवधि: 3 सप्ताह, प्रवेश क्षमता: 6

सर्टिफिकेट कोर्स

वेटरनरी फॉरेंसिक साइंस, सीमन हैंडलिंग एवं आर्टिफिशियल इन्सेमिनेशन, मॉलिक्यूलर डायग्नोसिस ऑफ इन्फेक्शस डिजीजेस, वेटरनरी डायग्नॉस्टिक इमेजिंग, एम्ब्रायो ट्रांसफर टेक्नोलॉजी (आईवीएफ) इन बोवाइन।

ऑनलाइन पाठ्यक्रम

फीड एवं फॉडर टेक्नोलॉजी पर ऑनलाइन शार्ट कोर्स
प्रसार एवं उद्यमिता विकास पर ऑनलाइन शार्ट कोर्स

संजय गाँधी गव्य प्रौद्योगिकी संस्थान, पटना

कोर्स का नाम	अवधि
बी.टेक. (एफ.टी.)	4 वर्ष (8 सेमेस्टर)

प्रवेश क्षमता, अवधि एवं सभी कोर्स की विस्तृत जानकारी हेतु विश्वविद्यालय की वेबसाइट www. basu.org.in पर अपलोड किए गए विवरण पुस्तिका को देखें।

Hands-on Training on "Advanced Diagnostic and Therapeutic Techniques in Veterinary Practices"
(08 to 12 September, 2025)

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- **YouTube:** https://youtube.com/@basupatna

Directorate of Extension Education
Bihar Animal Sciences University, Patna-14