NIMAL HUSBANDRY AND FISHERIES
RESOURCES DEPARTMENT
GOVT. OF BIHAR

Training Manual

Hands-on Training

on

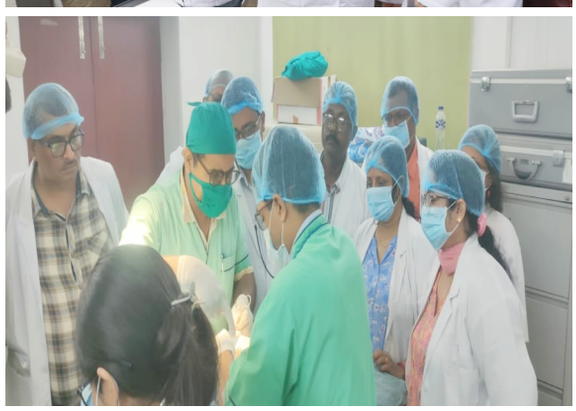
"Advanced Diagnostic and Therapeutic Techniques in Veterinary Practices"

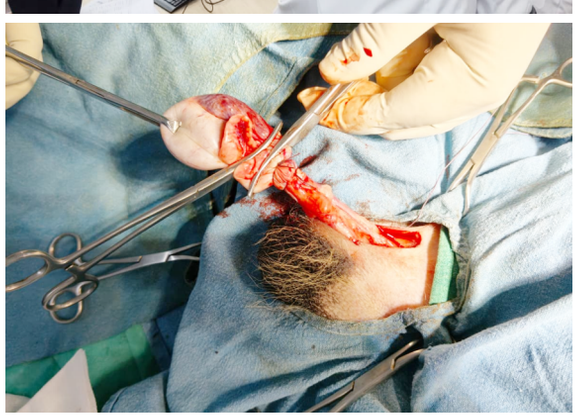
(22-26 September, 2025)

Directorate of Extension Education

Bihar Animal Sciences University, Patna-14


Laboratory Safety





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Sponsored by:

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Organized by:

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

Editor In-Chief
Dr. Nirmal Singh Dahiya
Director Extension Education, BASU, Patna

Editors
Dr. Mritunjay Kumar
Associate Professor
Department of Veterinary Medicine
Bihar Veterinary College
Bihar Animal Sciences University (BASU), Patna.

Dr. Y. S. Jadoun
Associate Professor & Head
Department of Diary Extension Education
Sanjay Gandhi Institute of Diary Technology (SGIDT)
Bihar Animal Sciences University (BASU), Patna.

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CORE TEAM MEMBERS OF THE TRAINING

Course Director
Dr. Nirmal Singh Dahiya
Director Extension Education, BASU, Patna

Course Convenors
Dr. Y. S. Jadoun
Associate Professor & Head
Department of Diary Extension Education
Sanjay Gandhi Institute of Diary Technology (SGIDT)
Bihar Animal Sciences University (BASU), Patna.

Dr. Mritunjay Kumar
Associate Professor
Department of Veterinary Medicine
Bihar Veterinary College
Bihar Animal Sciences University (BASU), Patna.

Course Coordinator
Dr. Saroj Kumar
Associate Professor & Head
Department of Veterinary & Animal Husbandry Extension Education
Bihar Veterinary College
Bihar Animal Sciences University (BASU), Patna.

Dr. Shyma K. P.
Associate Professor
Department of Veterinary Parasitology
Bihar Veterinary College
Bihar Animal Sciences University (BASU), Patna.

Course Co-coordinator
Dr. Puspendra Kumar Singh
Assistant Professor
Department of Veterinary & Animal Husbandry Extension Education
Bihar Veterinary College
Bihar Animal Sciences University (BASU), Patna.

बिहार पशु विज्ञान विश्वविद्यालय
बिहार पशु चिकित्सा महाविद्यालय प्रांगण, पटना–800014
BIHAR ANIMAL SCIENCES UNIVERSITY
BIHAR VETERINARY COLLEGE CAMPUS, PATNA-800014

डॉ0 इन्द्रजीत सिंह
कुलपति
Dr. Inderjeet Singh
Vice Chancellor

☎ 0612-2222221
+91-94728-64654
Email : vc-basu-bih@gov.in
vicechancellorbasu@gmail.com

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

बिहार पशु विज्ञान विश्वविद्यालय
BIHAR ANIMAL SCIENCES UNIVERSITY

BIHAR ANIMAL SCIENCES UNIVERSITY
BIHAR VETERINARY COLLEGE CAMPUS, PATNA- 800014
Directorate of Extension Education

Dr. Nirmal Singh Dahiya
Director Extension Education

Ph. No. : 0612-2227261 Email: deebasupatna@gmail.com

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

Mritunjay Kumar and Anil Kumar
Department of Veterinary Medicine
Bihar Veterinary College, Bihar Animal Sciences University (BASU), Patna-14

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

Body Water Distribution and Physiology

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

selection and volume replacement strategies for restoring physiological balance.

Indications for Fluid Therapy

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

Types and Classification of Dehydration

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

Isotonic Dehydration

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

Hypotonic Dehydration

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

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

Hypertonic Dehydration

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

Clinical Signs

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

Diagnostic Evaluation

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

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

Types of Fluids

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

A. Crystalloids

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

1.IsotonicCrystalloids

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

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

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

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

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

Dosage (dogs/cats/cattle)

Maintenance: 40–60 ml/kg/day

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

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

2. Hypotonic Crystalloids

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

3. Hypertonic Crystalloids

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

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

B. Colloids

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

1. Natural Colloids

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

2. Synthetic Colloids

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

Fluid Selection Based on Clinical Condition

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

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

Electrolyte-Based Fluid Modification

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

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

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

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

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

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

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

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

Routes of Administration

IV: Preferred (jugular, cephalic, saphenous)

Intraosseous: For neonates, rapid access

Intraperitoneal: For young animals (slow absorption)

Subcutaneous: Only for mild dehydration (avoid 5% dextrose)

Fluid Calculation and Therapy Plan

Formula:

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

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

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

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

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

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

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

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

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

Conclusion

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

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

References

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

Basic Principles of Radiography

Ramesh Tiwary
Department of Veterinary Surgery and Radiology, Bihar Veterinary College
Bihar Animal Sciences University (BASU), Patna-14

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

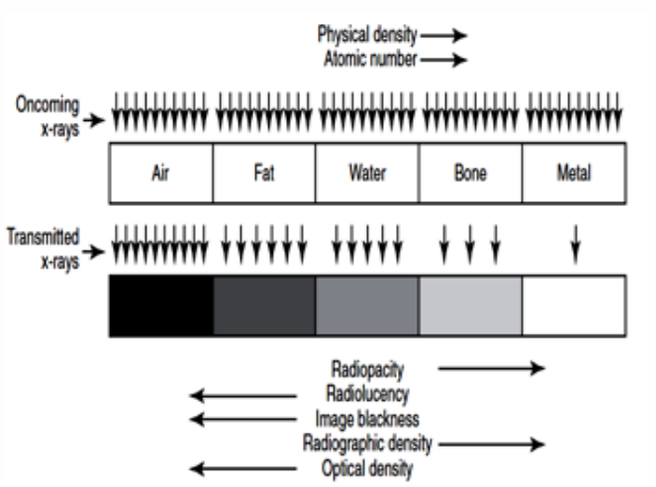
These are high voltage X-ray machines (300-1000 mA) and are generally used for large animal radiography. With these machines radiography of abdomen and chest is possible but these needs setting up of very high exposure factors.

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

Gyan Dev Singh
Veterinary Clinical Complex, Bihar Veterinary College
Bihar Animal Sciences University (BASU), Patna-14

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

Vivek Kumar Singh[1] and Pallav Shekhar [2]
[1]Veterinary Clinical Complex and [2]Department of Veterinary Medicine
Bihar Veterinary College, Bihar Animal Sciences University (BASU), Patna-14

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.

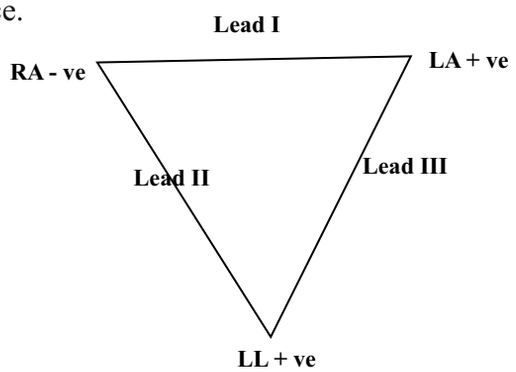


Fig.1. Diagrammatic representation of standard lead system.RA-right arm or right forelimb, LA- left arm or left forelimb, LL- left foot or left hind limb.

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.

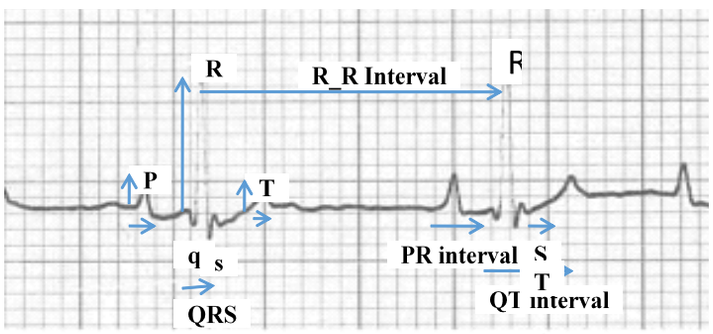


Fig.2. Measurement details of the amplitude and duration of different complexes and intervals in the electrocardiogram

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.

References

1. Bolton, G.R. 1975. Handbook of Canine Electrocardiography. W.B. Saunders Company.
2. Deepti, B.R., Yathiraj,S.,Ramesh,P.T., Rangnath, L. and Narayanaswamy, H.D.(2016). Diagnosis and Treatment of Congestive heart failure in canines. Diets/OSU Symposium for the Treatment of Small Animal Cardiology, Intas Polivet 17: 129-131.
3. Ettinger, S.J. and Suter, P.F.1970. The recognition of cardiac disease and congestive failure in dogs. Lead paper: National Symposium on "Innovative Techniques, Energing Issues and Advancement in Veterinary Medicine to Meet the Challenges: Present and Future" held at Veterinary College and research Institute, Trunelveli- 627358, Feb. 22-24,2007, pp 80-83.
4. Friedberg, C.K.1966. Diseases of Heart. 3rdedn. W.B.Saunders Company, Philadelphia
5. Guyton,A.C.1971. Text Book Of Medical Physiology.4thedn.W.B.Saunders Company,

Blood Transfusion in Farm and Companion Animals

Mritunjay Kumar and Anil Kumar
Department of Veterinary Medicine, Bihar Veterinary College,
Bihar Animal Sciences University (BASU), Patna-14

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:

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

Interpretation of Results Observation Interpretation No hemolysis or agglutination Compatible Agglutination present Incompatible Hemolysis in tube Incompatible

- **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.

References

1. Braz-Ruivo, L., & Divers, T. J. (2001). Transfusion medicine in ruminants. *Veterinary Clinics of North America: Food Animal Practice*, 17(3), 641–657.
2. George, J. W. (2001). Veterinary Laboratory Medicine: Interpretation and Diagnosis. *W.B. Saunders Company*.
3. Jain, N. C. (1993). Essentials of Veterinary Hematology. *Lea &Febiger*.
4. Tizard, I. R. (2013). Veterinary Immunology: An Introduction. *Elsevier Health Sciences*.
5. Smith, B. P. (2009). Large Animal Internal Medicine (4th Ed.). *Mosby Elsevier*.
6. Mohanty, D. N., & Panda, A. K. (2016). Principles and Practice of Large Animal Surgery and Medicine. *Kalyani Publishers*.

Method for Rectal Palpation of Bovine Reproductive Tract

C.S. Azad[1] and Dushyant Yadav[2]
[1]Department of Veterinary Gynaecology and Obstetrics/ [2]Livestock Farm Complex
Bihar Veterinary College, Bihar Animal Sciences University (BASU), Patna-14

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.

Uterine Torsion – An Emergency Reproductive Problem in Dairy Animals

Sumit Singhal and Alok Kumar
Department of Veterinary Gynaecology & Obstetrics
Bihar Veterinary College, Bihar Animal Sciences University (BASU), Patna-14

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

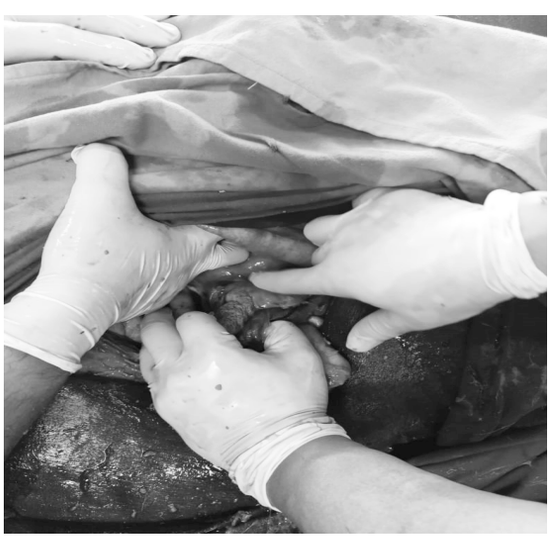
5. Diagnosis - Diagnosis is easy when the abnormal symptoms appear at time of parturition. Typical history of a case of uterine torsion will indicate that animal was about to calve, as exhibited by letdown of milk and relaxation of pelvic ligaments, but adequate time has passed and still there is neither 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.

Ultrasonography in Small Animals

Pallav Shekhar[1] and Vivek Kumar Singh[2]
[1]Department of Veterinary Medicine and [2]Veterinary Clinical Complex,
Bihar Veterinary College, Bihar Animal Sciences University (BASU), Patna-14

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

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

Principles of Ultrasonography

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

a) Reflected back to the transducer

b) Transmitteddeeper

c) Scattered/absorbed

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

Key principles include:

1. Acoustic Impedance:

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

2. Echo Generation:

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

3. Attenuation:

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

4. Resolution vs. Penetration:

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

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

5. Doppler Effect:

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

6. Real-Time Imaging:

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

Modes in Ultrasonography:

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

1. A-Mode (Amplitude Mode)

Description: Oldest and simplest form; displays echoes as vertical spikes on a graph.

Application: Rarely used in clinical practice today. Previously used for measuring fat or eye axial length.

2. B-Mode (Brightness Mode)

Description: Most commonly used mode in veterinary practice. It creates a two-dimensional grayscale image, where each echo is represented by a dot with brightness

corresponding to echo intensity.

Application: Abdominal organ evaluation, pregnancy diagnosis, thoracic structures, musculoskeletal assessments, etc.

3. M-Mode (Motion Mode)

Description: Captures motion of a single scan line over time, producing a wave-like graph.

Application: Primarily used in cardiology to assess heart wall and valve motion (e.g., in dogs with mitral valve disease or dilated cardiomyopathy).

4. Doppler Mode

Used to assess blood flow in vessels and heart. It includes several subtypes:

a) Color Doppler

I. Displays blood flow direction and velocity using color (red and blue).

II. Application: Evaluating blood flow in organs or heart.

b) Power Doppler

a) More sensitive than color Doppler; detects low-velocity flows but doesn't show direction.

b) Application: Detecting small or slow-flowing vessels (e.g., in tumors).

c) Pulsed-Wave Doppler

a) Measures flow velocity at a specific location.

b) Application: Quantifying blood flow through heart valves or vessels.

d) Continuous-Wave Doppler

a) Measures high-velocity flow continuously along a line.

b) Application: Useful in assessing severe valvular stenosis or regurgitation.

5. 3D and 4D Modes(Advanced)

a) 3D Mode: Provides volumetric imaging of structures.

b) 4D Mode: Real-time 3D imaging (moving 3D).

c) Application: Rare in routine veterinary practice; may be used in specialized reproductive or cardiac imaging.

Ultrasound Transducers and Their Applications:

Transducers, or probes, are essential components of an ultrasound machine. They generate and receive high-frequency sound waves. Different types of transducers are used based on

frequency, shape, and field of view, depending on the clinical application and body part being examined.

Types of Transducers Used in USG

1.Linear Transducer:

Frequency: High (7.5–15 MHz)

Shape: Flat, rectangular surface

Image: Rectangular field of view

Application:Superficial structures (e.g., tendons, lymph nodes)

Small animal abdomen (superficial organs in cats/small dogs)

Mammary gland, thyroid, skin masses

Vascular access and nerve blocks

2. Curvilinear (Convex) Transducer

Frequency: Medium (3.5–8 MHz)

Shape: Curved surface

Image: Sector-shaped field of view (wider than linear)

Application:

General abdominal examination in dogs and cats

Pregnancy diagnosis

Liver, kidney, spleen, urinary bladder

Deeper structures in medium to large dogs

3. Microconvex Transducer

Frequency: Medium to high (5–10 MHz)

Shape: Small curved footprint

Image: Small sector image

Application:

Ideal for cats and small breed dogs

Intercostal scanning (e.g., echocardiography)

Neonates and pediatric animals

Ocular and cranial imaging

4. Phased Array Transducer

Frequency: Low to medium (2–5 MHz)

Shape: Small square or circular face

Image: Sector (pie-shaped) field of view

Application:

Echocardiography in all breeds

Useful in tight spaces (e.g., between ribs)

Thoracic imaging

5. **Endocavitary / Endorectal Transducer**

Frequency: High (7–10 MHz)

Shape: Long, narrow probe

Image: Curved or linear

Application:

Rectal or vaginal scanning in small animals

Prostate gland evaluation

Reproductive tract in bitches and queens

Patient Preparation and Positioning of Dogs for Ultrasonography:

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

I. Patient Preparation

1. Fasting

Duration: 8–12 hours prior to abdominal ultrasound

Purpose: Reduces gas in the stomach and intestines, which can interfere with sound wave transmission and image quality.

Note: Fasting is not necessary for emergency cases.

2. Bladder Filling

A moderately full urinary bladder provides better evaluation of the bladder wall and adjacent organs.

Encourage the dog not to urinate for at least 2–3 hours before the exam if urinary tract evaluation is intended.

3. Hair Clipping

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

Common clipping sites:

Abdomen: From xiphoid to pubis and laterally to the flanks

Thorax (for cardiac scans): Over the left/right thoracic wall (4th to 6th intercostal space)

4. Coupling Gel

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

5. Sedation

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

II. Patient Positioning

The positioning depends on the organ system being evaluated:

1. Abdominal Ultrasonography

The most Common Position is dorsal recumbency(dog lies on back) using a V-trough or foam support. This allows access to entire abdomen, including liver, spleen, kidneys, intestines, and bladder.Alernatively, lateral recumbency(left or right side) can be used in fractious or uncomfortable animals.

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

3. Thoracic Ultrasonography: For this lateral or sternal recumbency depending on the region of interest can be done.

Application:For pleural effusion, lung consolidation, or mediastinal masses.

Methods of using probe in ultrasonography: In small animal ultrasonography, several probe manipulation techniques are used to obtain optimal images and thoroughly evaluate internal structures.

I. **Fanning:** It involves pivoting the probe on its fixed point in a sweeping motion to scan through an organ in multiple slices without changing the probe's location.

II. **Sliding:**It is the movement of the probe linearly across the skin surface to shift from one region to another.

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

IV. **Tilting (or heel-toe maneuver)**: It adjusts the angle of the probe by lifting or lowering one end, which helps in visualizing structures at different depths or angles.

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

Artifacts and their Applications in Ultrasonography (USG)

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

Common Ultrasound Artifacts and Their Applications

1**. Acoustic Shadowing**

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

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

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

2. Acoustic Enhancement (Posterior Enhancement)

Description: Increased echogenicity (brightness) behind fluid-filled structures.

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

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

3. Reverberation Artifact

Description: Multiple equally spaced bright lines appearing due to repeated reflections

between strong interfaces.

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

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

4. Mirror Image Artifact

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

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

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

5. Edge Shadowing

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

Cause: Refraction and scattering at curved surfaces.

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

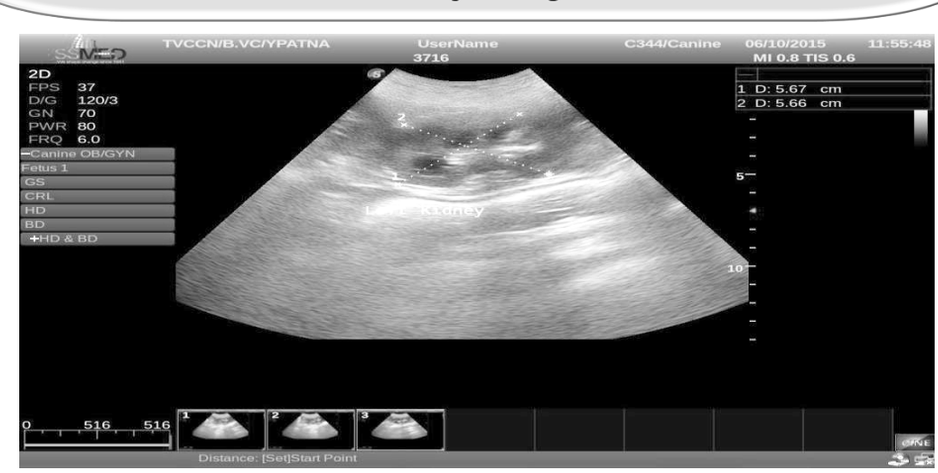
6. Comet Tail and Ring-Down Artifact

Description: Bright tapering lines extending from a source.

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

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

Fig : Figure showing texture, size and structure of normal kidney in dog



Pregnancy Diagnosis

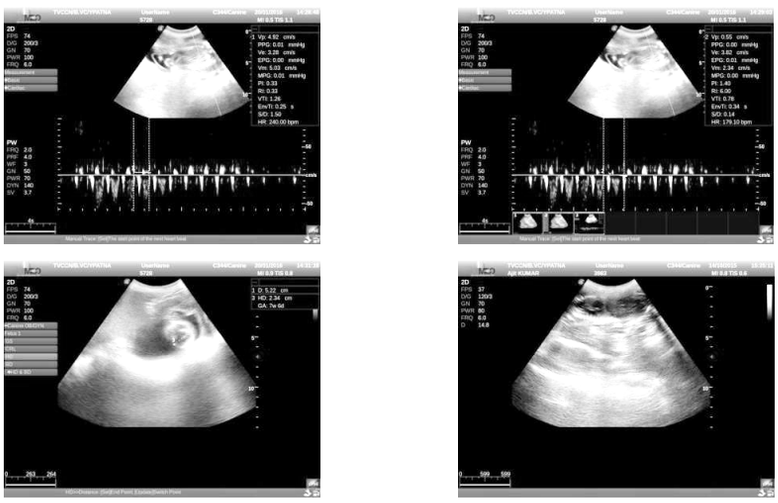


Fig 9: Urinary Bladder Calculus

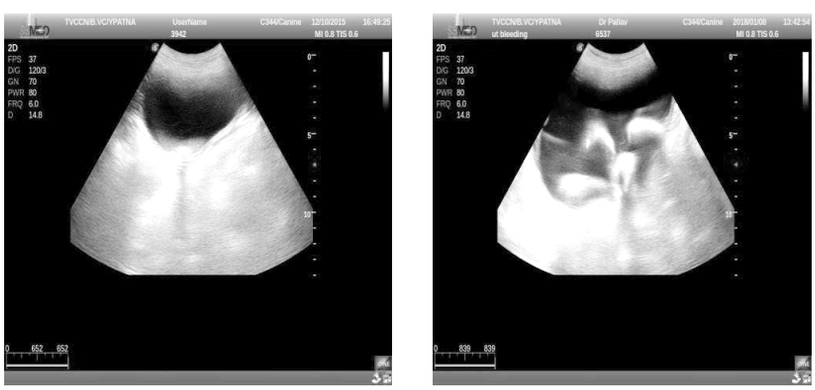


Fig: Sonogram Showing Nephrolith

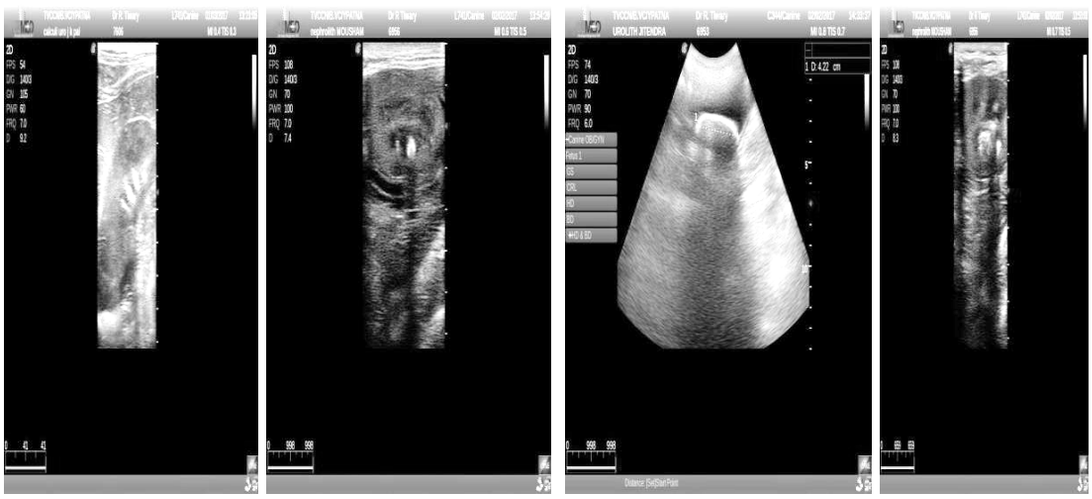


Fig : Sonogram showing Pyometra in Bithes

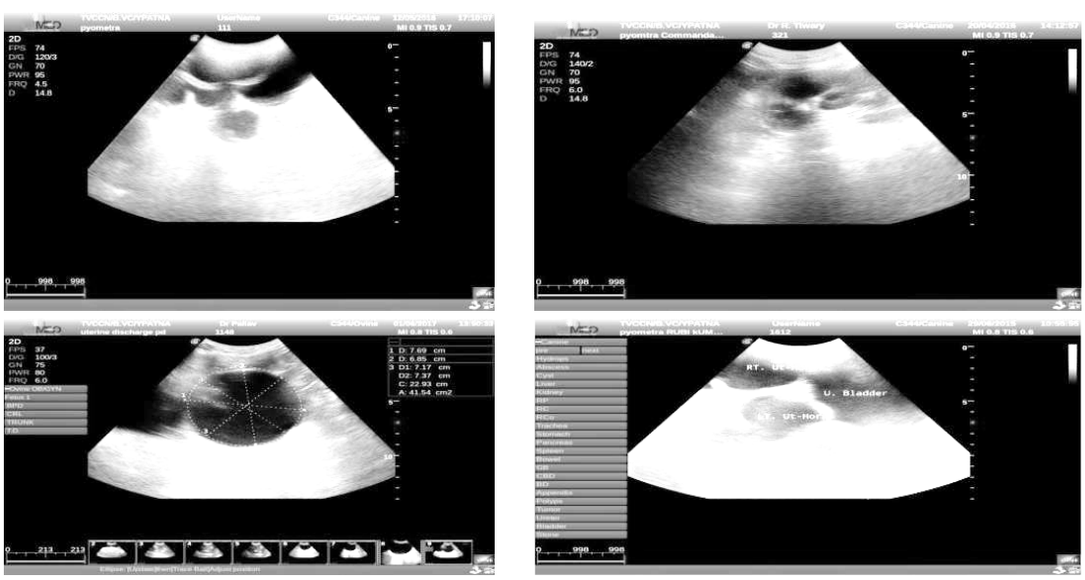


Fig: Sonogram showing LOSS of Corticomedullary Junction (Left and right kidney)

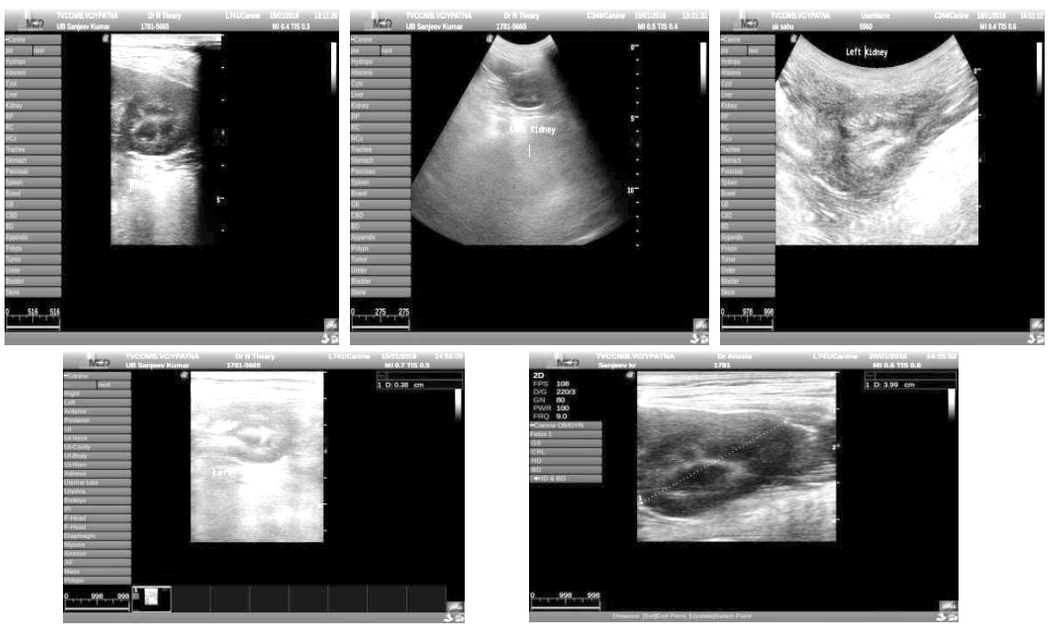


Fig: Sonogram showing Small oval and shrunken kidney with hyperechoic cortex

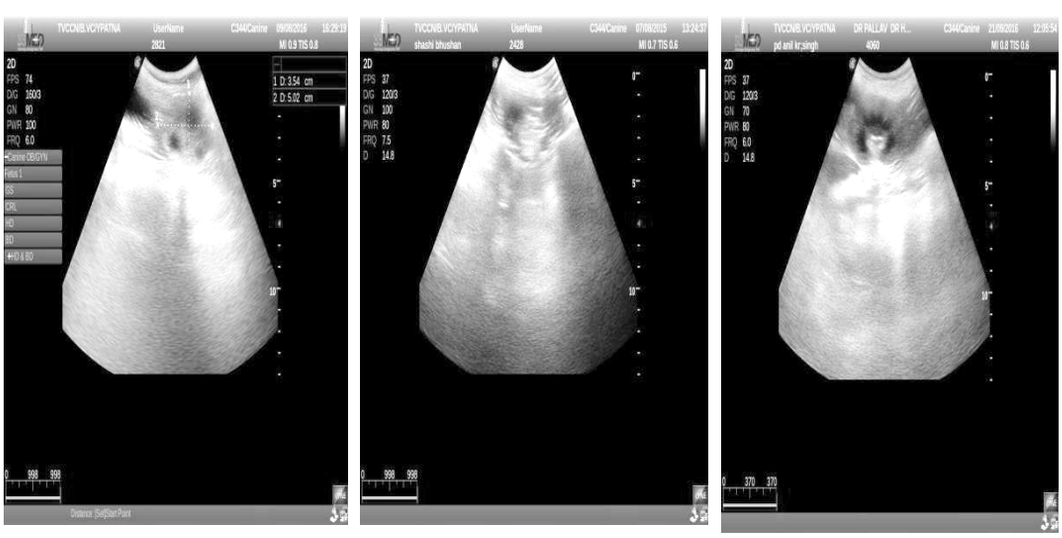
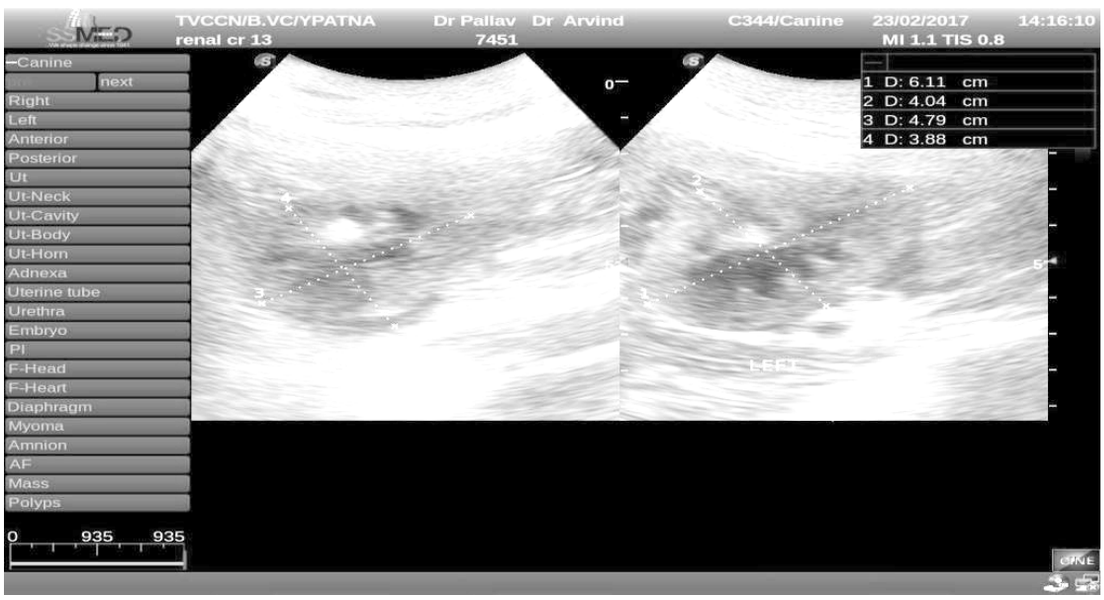


Fig :Sonogram of Left and Right Hyperechoic cortex Kidney with Creatinine 13mg/dl



Smart and Innovative Bandaging Techniques for Future of Wound Management in Veterinary Practice

Md. Moin Ansari
Department of Veterinary Surgery and Radiology, Bihar Veterinary College
Bihar Animal Sciences University (BASU), Patna-14

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

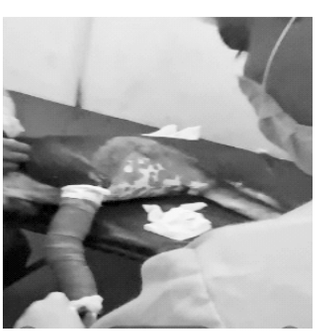
- Prepare the area: Wounds should be clipped wide to check for additional wounds or allow the placement of stay sutures for a tie-over bandage. The peri-wound area should be cleaned with chlorhexidine gluconate 4% diluted with 25 to 50 mL of saline. When appropriate, the wound should be lavage with sterile 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



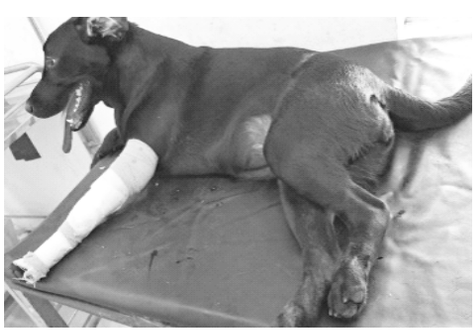


Fig. 3. Robert Jones Bandages

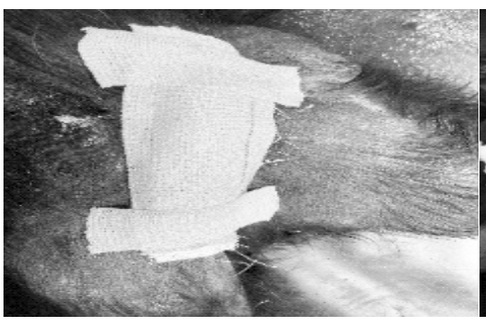


Fig. 4. Wound Bandage

Fig. 5. Tie-over bandage

Fig. 6. Use of Elizabethan collar

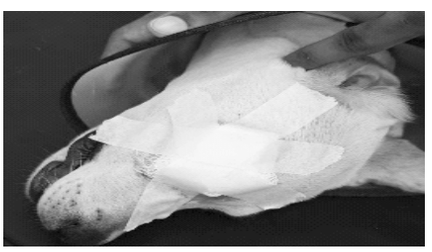


Fig. 7. Eye bandage in a dog

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

1. Anderson, D.M. 2009. Management of open wounds. In Williams J, Moores A, eds. BSAVA Manual of canine and feline wound management and reconstruction. 2nd ed. Quedgeley, Glouster, England: British Small Animal Veterinary Association. P.37.
2. Bohling, M.W. and Swaim, S. F. 2021. Bandaging and drainage techniques. In: Bojrab MJ, Waldron DR, Toombs JP, eds. *Current Techniques in Small Animal Surgery*. 5th ed. TetonNewMedia; pp.13-26.
3. Bojrab ,M.J. 1994. A handbook on veterinary wound management. Ashland, OH: KenVet Prof Vet Co.
4. Bojrab, M.J. 1982. Wound management. Mod Vet Pract. 63:867.
5. Campbell, B.G. 2006. Dressings, bandages, and splints for wound management in dogs and cats. *Vet Clin North Am*. 36: 759.
6. Grambow, C.B. 2015. Moist wound healing in dogs and cats: using MRDs to improve care. *Todays Vet Pract*. 5(4):32-42.
7. *Han, G. and Ceilley, R. 2017. Chronic Wound Healing: A Review of Current Management and Treatments. AdvTher. 34: 599–610.*
8. Hedlund, C.S. 2007. Surgery of the integumentary system. In: Fossum TW, ed. Small Animal Surgery. 3rd ed. Philadelphia: Saunders Elsevier, p.159.
9. Lux, C.N. 2021. Wound healing in animals: a review of physiology and clinical evaluation. *Vet Dermatol*. 33(1):91-102. doi: 10.1111/vde.13032.
10. Mehmood, N.*et al.* 2014. Applications of modern sensors and wireless technology in effective wound management. *J Biomed Mater Res B Appl Biomater*.102 (4): 885–95.
11. Palecek, E. *et al.* 2002. New approaches in the development of DNA sensors: hybridization and electrochemical detection of DNA and RNA at two different surfaces.
12. *Bioelectrochemistry* 56 (1-2): 85–90.
13. Swaim, S.F. 1997. Henderson RA. Small animal wound management. 2nd ed. Baltimore: Williams & Wilkins.

Diagnosis Approaches to Veterinary Parasitic Infections

Ajit Kumar and Pankaj Kumar
Department of Veterinary Parasitology, Bihar Veterinary College
Bihar Animal Sciences University (BASU), Patna-14

Parasitic infections cause severe morbidity and mortality in animals and thus affect the economy of livestock owners by decreasing the ability of the farmer to produce economically useful animal products. Parasitic infections adversely affect animal's health and threaten profitable animal production, thus affecting the economy of our country.

Parasites infection/infestation	**Economic losses due to parasitic infection or gain after parasitic treatment**	**References**
Helminthic infection	Increased 12 litre milk in 100 days after anthelmintic treatment	Sanyal *et al.* (1992)
Paramphistomosis	1.60 litre/day in cow and 1.31 litre in buffaloes after anthelmintic treatment	Kumar *et al.* (2007)
Helminthic infection	Increased milk production 04 -18 percent in cow after anthelmintic treatment	Das *et al.(*2017)
Tick and Tick - bornediseases (TTBDs)	13.9- 18.7 billion US $ losses in production annually in the world	De Castro (1997)
Tropical bovine theileriosis	800 million US $ losses in India	Devendra (1995)

Economic losses of farmers (due to decreased milk production, draught power capability and reproduction performance) can be minimized by controlling parasitic infections in animals.Appropriate control measures against parasitic infections is mainly dependedupon the detection of parasites.Diagnosis of parasites generally done on the basis of symptoms or detection of parasites or its stages from the materials collected from the herds and the flock by necropsy.

Samples to be required for the diagnosis of various parasites:

- Faeces
- Blood
- Nasal scraping
- Urine
- Lymph node biopsy
- Skin scraping
- Sputum

A. Faecal Examination:

Gastrointestinal parasites:

Helminths			Protozoa
Nematodes (round worms)	**Cestodes (Tapeworms)**	**Trematodes (Flukes)**	
Ancylostoma spp. (Hook worm), *Haemonchus contortus* (Barber pole worm) , *Toxocara vitulorum*(Ascaris of calf), *Strongylus* etc.	*Moniezia expansa, Moniezia benedeni, Taenia solium, Dipylidium caninum, Echinococcus granulosum* etc.	*Fasciola* spp. (liver fluke), Amphistomes, Schistosomes (blood flukes) etc.	*Entamoeba histolytica*, *Giardia* spp., *Balantidium coli*, *Eimeria* spp. (Coccidia), *Cryptosporidium* spp., *Toxoplasma gondii*etc.

Faecal Examination Methods:

To diagnose or detect the gastro intestinal parasites or it's eggs and other stages.

Materials/Equipment to be required for the diagnosis of Gastro-intestinal Parasites:-

- Specimen collecting vial
- Faeces
- Glass slide
- Tooth pick
- Cover slip
- Microscope
- Formalin (10 %)
- Ethyl alcohol
- Lugol's Iodine

- Camel hair brush

Collection of faeces:

Faecal samples should be collected from the rectum of the suspected animals because such samples give a more reliable picture of the infection. In large animals collection of faeces from the rectum can be done by hand without difficulty. Smaller animals such as lamb and dogs can be induced to defecate by inserting a moistened little finger into the rectum and gently massaging with a rotatory motion and then sample may be collected. For collection of samples use stoppered wide mouth bottles 20-30 ml capacity (for dispatching) or petridishes (for early examination). A sufficient amount of faces should be collected, specially of the herbivores, as their faces contain considerable amount of roughage. Care should be taken during the collection of faecal samples that they should not be intermixed with the animal's faeces.

Preservation of collected faecal samples:

Since eggs embryonate rapidly, the faeces should be stored in the refrigerator unless examination is carried out within a day. Some timesfaecal samples sent to laboratory examination for long Distances through the post, the addition of twice the volume of 10 % formal into the faeces will minimize development and hatching.

Examination of Faces:

(A) Gross examination of Faces:- Faces are examined in the first place for adult parasites, larval stages of insects(e.g. bots) and segments of tape worms.

(B) Microscopic examination:

(a) <u>Direct smear method</u>:- A small quantity of fresh faces is placed on a slide, mixed with a small droplets of water or normal saline with the help of needle evenly spread over the slide and coverslip is placed on the fluid and examined under low power microscope.

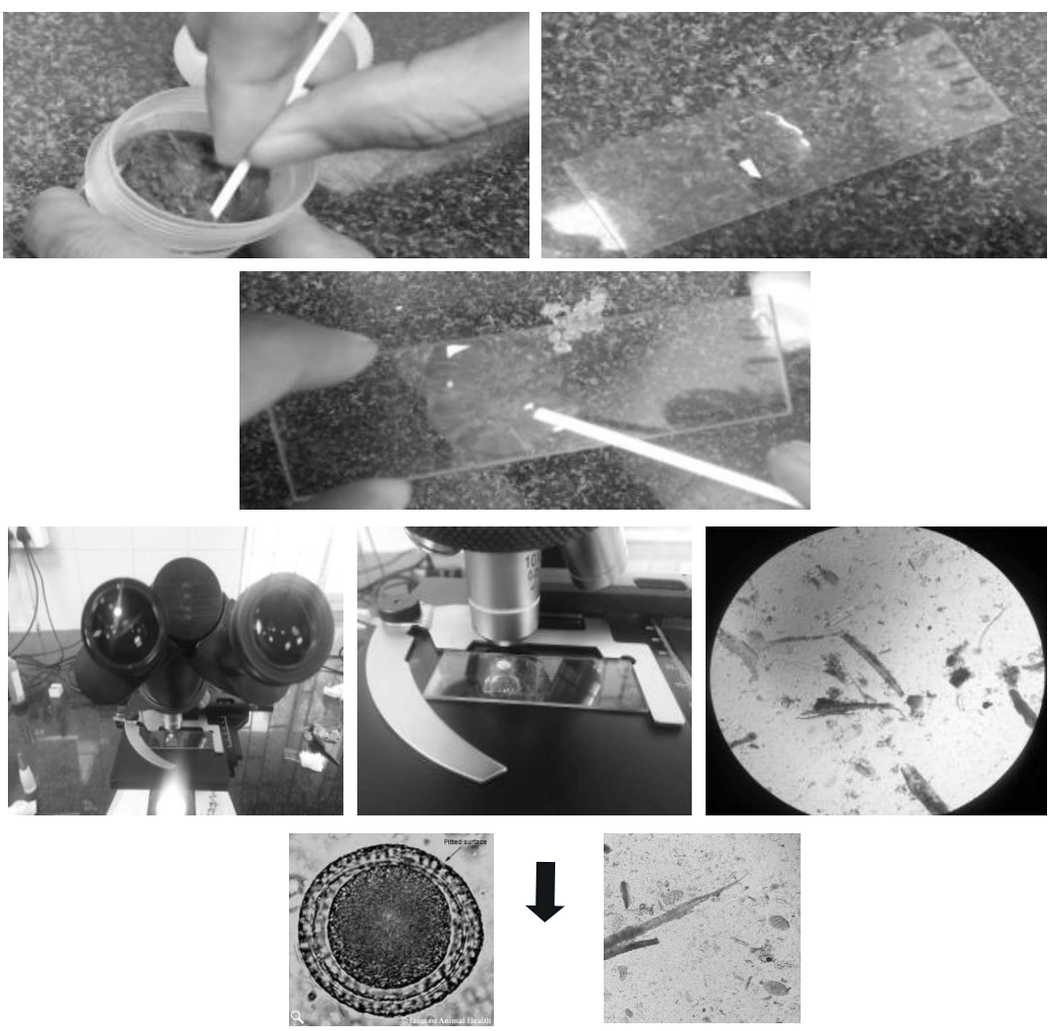
Advantages:

1. This is a simple technique and can be performed at field condition without any equipment.

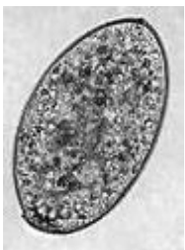
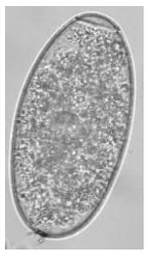
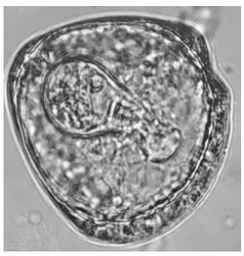
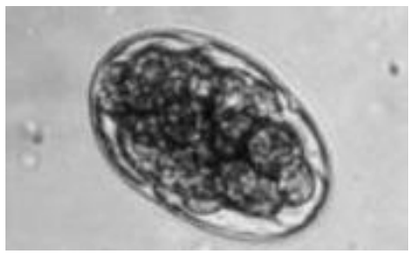
2. This is a quick test, so that large number of samples can be performed in a very short time.
3. This test is useful in the diagnosis of (i) heavy coccidian and helminthic infections and (ii) cestode and trematode eggs (mainly in birds).

Disadvantage:

1. This method is qualitative so severity of the infection can not be determined.
2. It is usually fails to detect low grade infection and is only suitable when the Concentration of parasitic stage is high.



Egg of *Toxocara vitulorum* Egg of *Haemonchus contortus*

Egg of *Fasciola* Egg of AmphistomeEgg of*Moniezia expansa*

Floatation Method:-

Requirements:

- Fresh or 10 % formalin or 70 % ethyl alcohol preserved faecal sample
- Microcsope
- Glass slide
- Cover slip
- Tooth pick
- Flat bottam test tube
- Dropper
- Saturated salt solution
- Water

Principle: When parasitic eggs or protozoan cysts are suspended in a liquid with a specific gravity higher than that of the eggs, the eggs will float up to the surface. Nematode and cestode eggs float in a liquid with a specific gravity of between 1: 10 and 1:20. Trematode, which are much heavier, require a specific gravity of 1.30 – 1.35.

Common saturated solution used in floatation technique;-

- Sodium Chloride (Specific gravity- 1.20)
- Sugar- Sucrose (Sp. Gr. – 1.12 – 1.30)
- Zinc sulphate- 30 % (Sp. Gr. – 1.18)
- Magnesium sulphate – 35 % (Sp. Gr. – 1.28)
- Sodium nitrate (Sp. Gr. – 1.36)

Procedure:

- About 2.0 g of faces are mixed with 10 – 20 ml of saturated common salt solution

(brine) in a small floatation tube.

- Fill the floatation tube upto the tip with solution.
- A clean coverslip or slide is slid sideways over the top of the tube.
- Left about 30 minutes by which time all the eggs would have floated up and touches the coverslip.
- Then coverslip or slide is gently lifted, inverted and examined the fluid film under low power of the microscope.
- This method is not suitable for eggs of trematodes or most cestodes but is useful for the majority of nematode eggs.

Zinc sulphate centrifugal technique;-

Procedure: -

- Faecal suspension is prepared by mixing one part of a faecal sample and 10 parts of luke warm water.
- About 10 cc. Of the suspension is strained through one layer of wet cheese cloth and filtrate are centrifuge for 2 or 3 times until the supernatant is clear.
- Then sediment is mixed with a saturated solution of Zinc sulphate in a centrifuge tube and then centrifuge for 1 or 2 minutes.
- Eggs will float to surface and then touch the coverslip with the surface of solution.
- Lift the coverslip gently and placed it on a clean slide and examined under a microscope.
- This method is suitable for the detection of eggs of cestodes, most of the nematode and oocyst of coccidian.

A. Blood Smear Examination:

For the diagnosis of haemoprotozoan parasites (*Trypanosma*, *Theileria*, *Babesia*, *Hepatozoon* etc.), microfilaria of *Dirofilarial immitis* (heart worm of dog), rickettsial organisms (*Anaplasma*, *Ehrlichia* etc.)

Preparation of blood smear:

Requirements:

- Glass slide
- 2% glacial acetic acid in ethyl alcohol
- Distilled water
- Anticoagulants
- Spirit

- Needle

Procedure:

Cleaning of slides:

The slides should be hard, non-fogging white glass with no sharp edges. For faecal examination, 25 x 75 mm (regular size) size is used. When making a preparation on a slide, it is most important that the slides should be absolutely grease free and clean. To make it absolutely grease-free the slides are soaked overnight in 2% glacial acetic acid in ethyl alcohol, washed in distilled water, dried and cleaned with dry muslin cloth before use.

Anticoagulants:

- Ethylene diamine tetra acetic acid : 1 mg of powder to 5 ml of blood.
- Heparin : 75 units for 10 ml. of blood.
- Sodium oxalate 20% : use @ 0.01 ml/ml of blood.
- Sodium citrate 25% : use @ 0.01 ml/ml of blood.

Collection of blood:

Small amount of blood for making smears may be taken from the ear vein of horse, cattle, sheep, goat, pig, rabbit and dog. When a blood sample from a bird is required, the vein near the elbow joint under the wing is punctured. The hairs from the area should be clipped and the part cleaned and disinfected with 70% alcohol or methylated spirit.

Thin blood smear:

The site of the vein is cleared with non-fluffy cotton and ethyl alcohol to remove the contaminants and the slide is dried. The vein is punctured using a clean needle.

A small drop of blood, less than a pin's head is placed in the middle, near one end of the slide.

The slide is held firmly between the middle finger and thumb of the left hand and another clean slide with straight and smooth edges (spreader slide), is placed on the centre of the examination slide. The lower edge of the spreader slide is held at an angle of 30 to 45 degrees and is drawn up to make contact with the drop of blood and wait until drop of blood flows both end of the spreader slide. Draw the spreader slide away from the blood drop with a smooth rapid movement. This action results in thin and even blood smear. The film is dried by waiving it in the air but rapid drying

under sunlight may cause artefacts. The examination slide in this position should be protected from fly, dust, moisture, etc. The identity with respect to its host etc. is recorded on the slide.

Points of a good blood film:

- The film should occupy about 1/3 of the length of the slide.
- The greater part of it should consist of a uniform single layer of blood cells.
- The edges of the film should be as unbroken as possible.
- The film should not be so thin to break the continuity of the film.

Wet blood film:

A wet blood film is used for the detection of living trypanosomes and microfilaria of filarial worms. Staining in this case is unnecessary because the movement of the trypanosomes make them apparent. The use of phase contrast microscope is especially useful for this purpose.

Procedure:

A drop of blood is placed on a clean slide. The blood is covered with a clean, dry coverslip. The film is then immediately examined under the microscope using the high power objective.

Lymph gland biopsy smear:

A lymph node smear is sometimes used in preference to a blood smear, for example during an investigation of theileriosis or even trypanosomiasis. Common lymph node used for biopsy is prescapular.

Procedure:

A suitable superficial lymph node is selected and palpated so that the site is fully known. The site is shaved and cleaned with the help of alcohol; punctured by a sterile hypodermic needle and the material is gradually drawn into a clean syringe. The collected lymph fluid is ejected on a clean slide and thick smear is drawn with the help of a spreader.

Fixation of slides:

Fixation helps to preserve the material used for the preparation and also enables it to withstand damage during subsequent staining. Otherwise, the smears would deteriorate, the cells may shrink or stretch due to osmosis or be digested by

their own cellular enzymes; the material may also be affected by bacteria or fungi such as moulds. Chemical fixatives like methyl alcohol is used to fix them.

- **Methyl alcohol:** This is suitable for blood films/smears. The slide is immersed in methanol for two minutes. If an aqueous stain is to be used, the slides must be dipped in water after fixation.

Procedure:

Staining:

A carefully stained preparation shows parts of structures well coloured with the dye and other parts faintly coloured. When two stains are used, either separately as in methylene blue and eosin or together as in Giemsa's staining, some parts will be coloured by one dye and other parts by the other e.g. the nuclei of protozoa stained by Giemsa appear red and the cytoplasm blue. Various types of stains and their staining methods are described below :

1. Leishman's stain :

This stain has a poor keeping quality in hot climate, so it is better to prepare a fresh stain from the powder every month or so.

Staining procedure:

Ten drops of Leishman's stain are poured on the slide, rocked gently, and allowed to act for one minute. Twenty drops of slightly alkaline (pH 7.2) distilled water is added to the slide and is mixed by rocking the slide gently. Ten to 20 minutes are allowed for staining. The slide is washed by stream of distilled water in horizontal position until the smear looks pink. Thereafter, the slide is kept in a vertical position so that it drains and dries. It can be examined under a microscope in oil immersion without a coverslip, however, zero number coverslips can be used if permanent mount is needed. Fixation is not required in Leishman's staining procedure because methyl alcohol is already mixed in Leishman's stain.

2. Giemsa's stain :

The stain introduced by Giemsa is a modification of a stain made by Romanowsky who mixed methylene blue and eosin so that three colours red, purple and blue were present in the stained slide. Giemsa's stain is a Romanowsky stain

containing methylene blue, eosin, methylene azure, glycerol and methyl alcohol. Nowadays the stain is normally obtained in a concentrated form and requires dilution before use.

Preparation of buffer :

i) KH_2PO_4 (Potassium dihydrogen orthphosphate) - 3.0 gm.

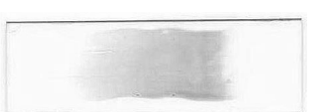
ii) $Na_2HPO_4\,12H_2O$ (Disodium hydrogen orthophosphate) - 15.0 gm.

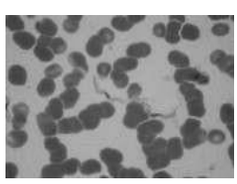
Add (i) to half the volume of water, dissolve, then add (ii) and make up to 5 litres, dissolve, mix well and check pH which should be 7.2 and if not, discard and make five litres afresh.

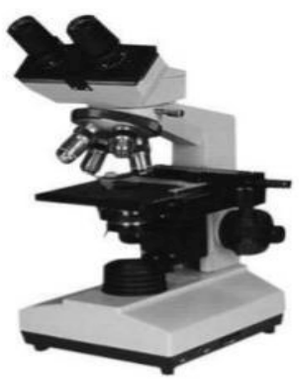
Staining procedure:

A thin smear is made, allowed to dry thoroughly and fixed in methyl alcohol for two minutes. The stain is diluted with buffer in a ratio of 1:9. The slides are then kept on a staining rack and sufficient diluted stain is poured to cover the smear. It is kept (covered with some tray etc. in summer to avoid evaporation) for 45 minutes. The slides are flooded with buffer/distilled water till the smear is just pink (usually for one minute). The slides are dried in the air and examined under the microscope under oil immersion

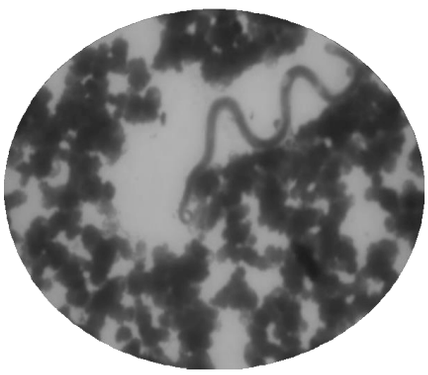
The artifacts are liable to camouflage the precision of the microscopic findings. To avoid this, the slides should be placed vertically in the copulin jar having the required stain or preferably stained on a horizontal rack, diluted and washed with a buffer in the same position. If the stain is poured off, the scum is liable to stick to the slide and forms artifacts.



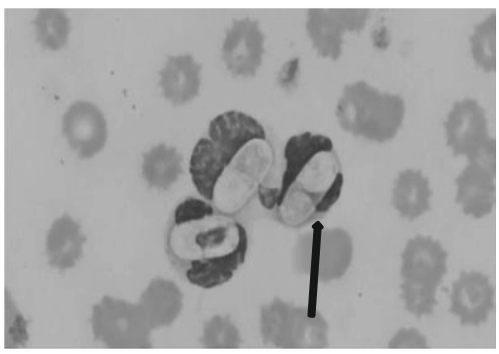




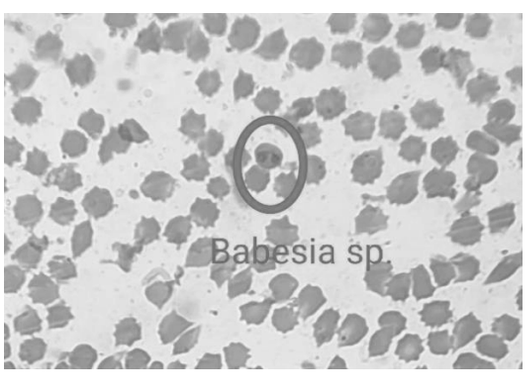
Trypanosoma



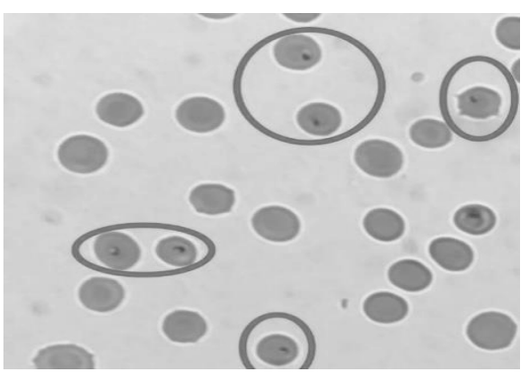
Microfilaria of *Dirofilarial immitis*



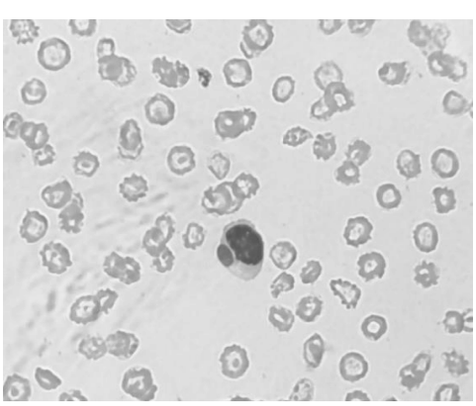
Hepatozoon canis inside neutrophil



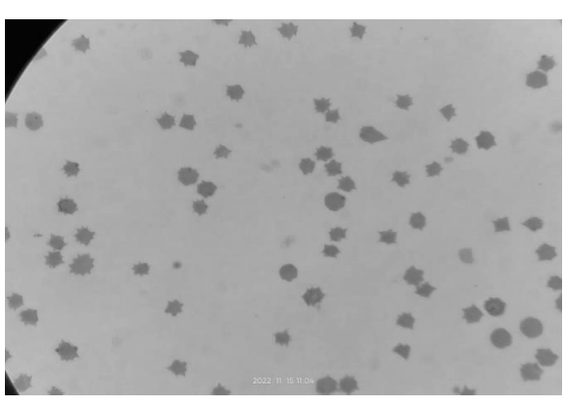
Babesia spp. inside RBCs



Theileria sp. inside RBCs



Ehrlichia spp.



Anaplasma marginal

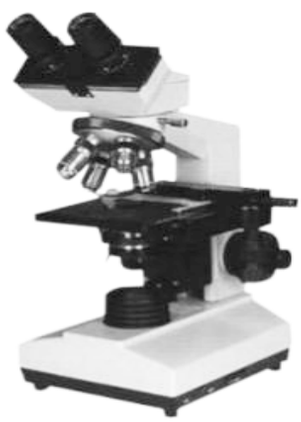
A. **Skin Scarping Method:**

- Used for the diagnosis of parasitic mites. Mites causing a disease in animals called mange. Mange includes alopecia, dermatitis etc.

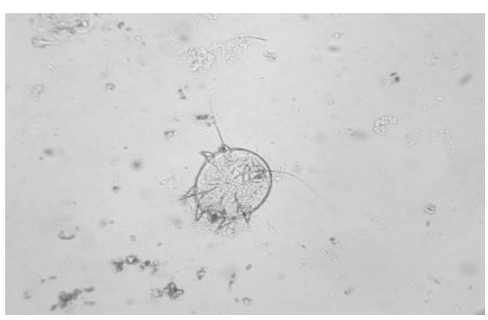
Procedure:

- Clip the hairs around lesion and scrap the edges of skin lesions with the help of a blunt scalpel or blade to extent that a little blood begins to ooze through the abrasions. Collect the scraping materials on a plane paper.
- Skin scrapings should be taken from moist part near the edge of the lesion avoiding the inclusion of large amount of dry crust, hair or wool. It is also desirable to take scrapings from more than one lesions.\
- Boil the scraping materials in 10 percent KOH to dissolve debris.
- After cooling pour the materials into centrifuge tube and centrifuge for 2 minutes at 2000 rpm.
- Take one drop of sediment on a glass slide , cover with cover slip and examine under low power (40X) of microscope for the presence of mites.

Hyperkeratosis of skin



Demodex mites



Notoedres mite

Primary Treatment of Orthopaedic Affection in Small Animals

Rajesh Kumar and Aakanksha
Department of Veterinary Surgery and Radiology, Bihar Veterinary College
Bihar Animal Sciences University (BASU), Patna-14

Primary treatment is the immediate help given to patients who are injured or suddenly become ill, typically performed within a limited range of skills. In small animals such as dogs and cats, primary treatment refers to the initial care provided to an injured or sick animal before professional veterinary assistance can be obtained. Similar to human medicine, primary treatment plays a crucial role in improving the prognosis and outcome for small animals during emergencies. The primary objectives of primary treatment are to preserve life, prevent suffering, and minimize further injury. It can mean the difference between life and death in critical situations. Whether caring for household pets, working animals, or wildlife, a swift and appropriate first aid response can significantly improve recovery chances and reduce the severity of injuries. For pet owners, veterinary professionals, and animal caregivers, the ability to provide immediate care in emergencies is not only beneficial but often vital.

Small animals, particularly pets like dogs, cats, rabbits, and guinea pigs, can encounter emergencies such as accidents, trauma, poisoning, choking, heatstroke, or respiratory distress. In these situations, the time between the onset of the problem and professional medical treatment is critical. While veterinary care is the definitive solution, first aid acts as a stabilizing bridge until the animal can be treated by a veterinarian. First aid can reduce complications, minimize pain and stress, and, in remote or rural areas without immediate veterinary access, it may be life-saving. Basic first aid for animals does not replace professional veterinary care but serves as a critical first step. Pet owners should familiarize themselves with first aid techniques, maintain a well-stocked first aid kit, know the location of the nearest veterinary hospital, and understand how to safely transport an animal in distress. Common emergencies include infectious and non-infectious diseases, wounds,

electrocution, and burns. In life-threatening situations, immediate action by the owner or an animal health worker is essential. Animal owners, caretakers, and veterinary staff should be trained in basic primary treatments techniques and have an emergency plan in place.

Fracture

A fracture refers to the breaking of a bone and cartilage. Fractures typically occur due to trauma, such as a fall, accident, or direct impact, though they can also be caused by underlying conditions that weaken the bones, such as osteoporosis or cancer.

There are two categories of fractures:

1. Closed (Simple) fracture

- The skin is intact and no wound exists anywhere near the fracture site.

2. Open (Compound) fracture

- The underlying skin over the fracture has been damaged or broken.
- The wound may result from bone protruding through the skin.
- The bone may not always be visible in the wound.

Primary treatments:

- Stop any bleeding by applying pressure to the wound with a sterile bandage or a clean piece of cloth.
- Avoid manipulating the fracture, as it causes pain and may worsen the injury
- Apply ice packs to limit swelling and help relieve pain until emergency personnel arrive.
- In open fractures, the wound flush thoroughly with clean water. Wound should be covered with sterile gauze dressing if possible. If this is not available, use a clean cloth or feminine pad applied over the opening and bone.
- Immobilize the injured area.
- Most fractures distal to the elbow (front limb) or stifle (hind limb) can be treated with temporary cooptation until definitive treatment can be performed.
- The cooptation must immobilize the joint above and below the fracture zone, otherwise, otherwise it may be detrimental.
- Cooptation or supportive bandages can temporarily immobilise the fractures,

minimise further soft tissue disruption from the fractured bones and improve patient comfort.

- The toes must be exposed at the distal end of the bandage to assess for foot swelling.
- Cage resting is also beneficial for pup and cat.
- Don't try to realign the bone, if not properly trained to splint. Some bones like femur and humerus cannot splinting
- If possible, the pet should be immobilized on a large board for transport.

Arthritis: -Arthritis means inflammation of the joint. It may be broadly classified into two

Types

DegenerativeJointDisease (DJD)

It is characterized by progressive deterioration of articular cartilage and eburnation of sub chondral bone, limping and new bone formation at joint surfaces and margins. The main cause is trauma and other pre disposing causes includes aging, nutritional deficiencies, congenital and malformation.

Clinical Signs: -

- Lameness
- Limited flexion
- Pain
- Enlargement of joint in chronic stages.
- In advance stage crepitus or palpation or movement.

Primary treatments:

- Reducing excess weight decreases stress on joints and improves mobility.
- Controlled, low-impact exercise (e.g., leash walks, swimming, hydrotherapy).
- Avoid high-impact activities (jumping, running on hard surfaces).
- Massage, passive range of motion, laser therapy, acupuncture.

- Cold hydrotherapy in acute stage to check the inflammatory process and to reduce oedema.
- Improves muscle tone and joint function.
- **Pentosan poly sulfate sodium**, poly sulfated glycos aminoglycans, glucosamine, and chondroitin supplements.
- **NSAIDs (Non-Steroidal Anti-Inflammatory Drugs):** First-line drug for pain and inflammation control (e.g., carprofen, meloxicam, deracoxib, firocoxib).
- **Adjunctive pain relief** like Gabapentin, amantadine, or tramadol (depending on severity).

Infectious arthritis

Infectious arthritis is characterized by inflammation of the syno vial membrane and articular surface due to infection.

Etiology:

- Haematous route is main cause of infection arthritis. Infectious arthritis usually associated septicaemia, suppurative mastitis, metritis, enteritis, pneumonia, endo carditic, myocarditis and diaphragmatic abscess. E. coli, staphylococcus, streptococci and salmonella are most commonly causing infectious arthritis.
- Peritrating trauma and intra-articular injection.

Clinical sign:

- Systemic sign like pyrexia, depression and anorexia.
- Local sign severe pain, lameness and distended joint.
- Reduce joint motion due to fibrous thickening of joint capsule.

Primary treatments:

- Reduce excess body weight to lessen joint stress.
- Regular, low-impact activity (walking, swimming) to maintain joint mobility

without overloading.

- Hydrotherapy, massage, and range-of-motion exercises to preserve muscle mass and joint flexibility.
- **NSAIDs (Non-Steroidal Anti-Inflammatory Drugs)**for pain and inflammation.
- **Chondroprotective agents** like glucosamine, chondroitin sulphate, omega-3 fatty acids, or injectable polysulfated glycosaminoglycans to support cartilage health.

Dislocation /luxation:

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 sublixation.

Clinical sign:

- Unnatural position of the limb, shortening a lengthening of limb)
- Inability to use the limb and immobility of joint.
- Inflammatory swelling notice daround the joint.
- There is excessive movement of joint in all direction when all the ligaments including capsular ligaments are ruptured)
- Pain is present in a dislocation.

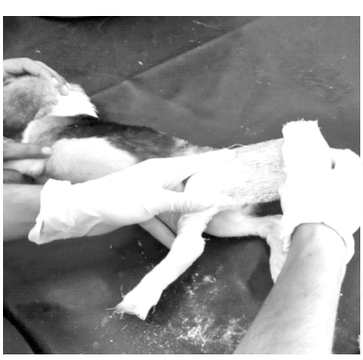
Differential diagnosis:

- The pain due to dislocation is constant, there is no period of pain as in fracture.
- The tenderness present in dislocation is less intense and more diffuse then fracture.
- In fracture, when the concerned extremities are moved there is crepitition, where as in dislocation there is rocking noise.
- A fracture when reduced recurs immediately unless properly supported. A dislocation once reduced has very little tendency to re-occur provided rest is given.

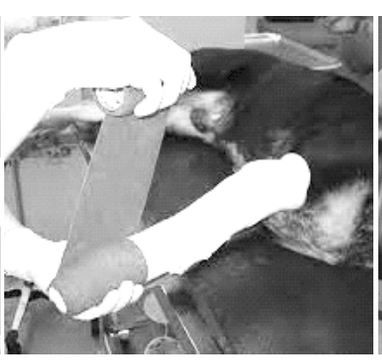
- The local symptoms of dislocation are noticed at the joint.
- In dislocation the limb is after fixed in particular posture and movement is generally restricted, but in fracture there is abnormal and free morality.

Primary treatments:

- Provide analgesia and sedation (sometimes general anesthesia) before manipulation.
- Stabilize the patient if in shock or trauma.
- Manual replacement of the joint into its normal position under anesthesia / sedation.
- Followed by immobilization (splint, bandage, Ehmer sling for hip, Velpeau sling for shoulder, etc.
- External coaptation (bandages/splints/slings) to maintain reduction for 2–3 weeks depending on joint and severity.



Bandaging of hind limb



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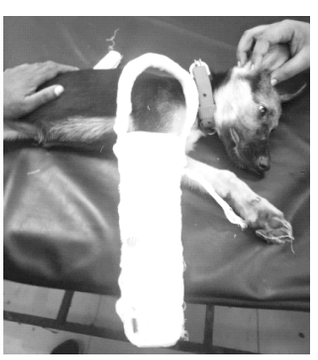

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Milk Fever in Dairy Cattle: A Comprehensive Mini Review

Sonam Bhatt and Bipin Kumar Singh
Department of Veterinary Medicine, Bihar Veterinary College
Bihar Animal Sciences University (BASU), Patna-14

Milk fever typically affects multiparous, high-producing dairy cows in the periparturient period, generally within 48 hours after calving but the danger period may extend upto10th day post-partum. It is also known as parturient paresis**.** It happens when the cow's body cannot keep up with the sudden demand for calcium needed for milk production. As a result, the calcium level in the blood drops, and the cow shows weakness or even collapses if not treated quickly. Disease is characterised by muscular weakness, recumbency and collapse.

Occurrence and distribution

- Milk fever usually appears within the first 2–3 days after calving, though sometimes it can occur just before or a little later.
- Older, heavy-milking cows are at greater risk.Mature dairy cows are most commonly affected in the 5-10-year age.
- Stressors: Starvation for 48 h also causes severe depression of serum calcium level and this may be of importance in the productionof hypocalcemic paresis in thisspecies at times other than in the postparturient period.
- Dietary calcium: Feeding more than100 g of calcium daily during the dry periodis associated with an increased incidenceof milk fever. A 500 kg cow requires onlyabout 31 g of calcium to meet daily maintenanceand fetal demands in late gestation
- Prepartum diets high in cations such assodium and potassium are associatedwith an increased incidence of milk fever,while diets high in anions, especiallychloride and sulfur, and are associated with adecrease in the incidence of the disease. Alkaline diets containing an excessiveconcentration of sodium and potassiumcan result in an increased incidence of thedisease.

Clinical Presentation

Clinical milk fever presents as depression, muscle weakness, sternal then lateral recumbency, cold extremities and, if untreated, coma and death. Animal is seen in sternal recumbency with a typical posture of lateral kink in the neck and head resting over the flank. Subnormal temperature, cod extremities, dilated pupil, relaxed anal sphincter, increase heart rate (80 per min), weak pulse and ruminal stasis are important findings in second stage of milk fever.In lateral stage, animal is almost comatose and lie in lateral recumbency.

Diagnosis

The history of recent calving and classical clinical sings are indicative of the disease. Diagnosis is clinical for overt cases (typical periparturientrecumbency and signs) and confirmed by measuring blood ionized or total calcium. Blood Ca thresholds vary by study, but values <2.0 mmol/L are commonly used to define subclinical hypocalcaemia. Total serum calcium levels are reduced tobelow 8 mg/dL (2.0 mmol/L), usually to below 5 mg (1.2 mmol/L) and sometimes to as low as 2 mg (0.5 mmol/L). Prolongedrecumbency results in ischemic muscle necrosis and increases in the serummuscle enzymes creatine phosphokinase (CPK) and aspartate aminotransferase (AST) or SGOT.

Treatment

Most cows with milk fevercan be treated successfully with 8-10 g of calcium (calcium borogluconate is 8.3% calcium). For cattle, 400-800 mL of a 25 % solution is the usual dose. Half of the calculated dose is administered slow intravenous route and remaining by subcutaneous route. Belching, muscle tremors over flank, sweating of muzzle, increase in intensity of heart sounds and defecation are the sings indicative of good response of calcium therapy.

Prevention & Herd Strategies

Effective prevention focuses on dry-period and transition management includes:

- Feeding of acidifying ration having negative DCAD: By formulating rations

with a negative DCAD, the diet becomes more acidic, which can help enhance calcium mobilization from the cow's body reserves and increase blood calcium levels during the transition period. Anionic salts are commonly used in acidifying rations to create a negative DCAD. Common anionic salts used include calcium chloride, magnesium chloride, ammonium chloride, and magnesium sulphate.

- Targeted postpartum calcium supplementation for high-risk cows/calcium gel dosing: Feeding low calcium rations just 2 weeks prior to calving lowers the risk of milk fever.The oral administration of easily absorbed calcium salts such as calcium chloride providing 40-50 g calcium per dose as a bolus, a gel, a paste or a liquid, given in 3-4 doses beginning 12-24 h before calving, to 24 h after calving will prevent a significant proportion of milk fever cases. The oral administration of one or two doses as a supplement to intravenous calcium borogluconate is also effective in reducing the incidence of relapses.
- Supplementation of Vitamin - D in transition period: Vitamin D supplementation before calving has been studied as a strategy to reduce the incidence of periparturient hypocalcaemia (milk fever). Adequate Vitamin D status ensures cows can mobilize calcium reserves more efficiently at calving. Traditional approaches have included parenteral administration of Vitamin D_3 (cholecalciferol) or its analogs 2–8 days before expected parturition. A single dose of 10 million IU of vitaminD3 1M given 2-8 days before parturition has been considered as optimal. A dose of 1 million units per 45 kg BW has given consistently better results.

Important Highlights

- Milk fever or periparturient hypocalcaemia is common within 48 hours of calving but can occur slightly earlier/later.
- Older, high-producing, multiparous cows are at highest risk; first-lactation cows are usually less affected.
- The great demand of calcium in early lactation to produce 10 liters of colostrum, cow losses 23 g of calcium in a single milking (2.3 g / L) which is about nine times more present in the plasma compartment.

- Clinical signs: weakness, sternal, lateral recumbency, cold extremities; subclinical cases show reduced feed intake and predisposition to other diseases.
- Calcium borogluconate (most common) is used for the treatment and administered IV.
- Usual dose of calcium carbonate is 8–12 g elemental calcium (≈500 mL of 23% calcium borogluconate) given slowly over 10–20 minutes.
- Oral Calcium Supplementation (calcium chloride) are used as adjuncts. Ii is very much effective when given immediately after calving (for prevention or mild cases) and as follow-up after IV therapy to maintain blood calcium. Earlier supplementation (within 12 hours of calving) is most effective
- Oral administration of ammonium chloride at a dose of 23–25 g daily during the three weeks preceding calving, gradually increased to about 100 g/day and divided into two doses at the time of parturition, has been shown to help prevent the occurrence of milk fever.
- Subclinical hypocalcaemia is common and economically important even when cows are not clinically recumbent and should be address it at herd level.

References

1. Akalu A. Status of parturient paresis (Hypocalcaemia and milk fever) on dairy farm in Addis Ababa City, Ethiopia. Eur. J Appl. Sci. 2017;9:6-10. Wilkens, M. R. et al. (2020).

2. DeGaris, P. J., & Lean, I. J. (2008). Milk fever in dairy cows: A review of pathophysiology and control principles. *The veterinary journal*, *176*(1), 58-69.

3. Aiello, S. E., & Moses, M. A. (Editors). *The Merck Veterinary Manual* (11th ed.). Merck & Co., Inc.; Wiley. 2016.

4. Frost, I. R., Seely, C. R., McCray, H. A., Callero, K. R., Seminara, J. A., Martinez, R. M., ... &McArt, J. A. A. (2024). Effect of postpartum calcium supplementation on serum calcium and parathyroid hormone concentrations in multiparous Holstein cows. *JDS communications*, *5*(3), 215-219.

5. Neill, D.M., Roche, J.R., McLachlan, B.P., Stockdale, C.R., 2002. Nutritional strategies for the prevention of hypocalcaemia at calving for dairy cows in pasture-based systems. Australian Journal of Agricultural Research 53, 755–770.

Estrus Synchronization and Breeding Management of Cattle with Emphasis on Artificial Insemination

Alok Kumar

Department of Veterinary Gynaecology and Obstetrics

Bihar Veterinary College, Bihar Animal Sciences University (BASU), Patna-14

Proper reproductive management is the foundation of profitable dairy and beef production systems. Even with advancements in farm practices, reproductive inefficiencies such as postpartum anestrus, silent estrus, and difficulties in heat detection continue to challenge productivity. Estrus synchronization in combination with artificial insemination (AI) provides a practical solution, enabling farmers to plan breeding programs, reduce reliance on visual heat detection, and utilize the genetic potential of superior bulls.

1. Estrus Synchronization

Cattle and buffaloes show differences in their reproductive physiology, which influences the success of synchronization strategies. In both species, the average length of the estrous cycle is around 21 days, though buffaloes show more variability, ranging from 18 to 24 days. The duration of estrus in cattle is usually 12 to 18 hours, while in buffaloes it can last from 6 to 30 hours, often being shorter and less visible. Ovulation occurs approximately 24 to 30 hours after the onset of estrus in both species. Unlike cattle, which are non-seasonal breeders, buffaloes exhibit marked seasonality, with better cyclicity during the winter months and poor expression of estrus during summer. Estrus signs are also clearer and more distinct in cattle, while buffaloes often exhibit silent or weak estrus, complicating detection.

Different synchronization protocols have been developed to overcome these challenges. Prostaglandin $F_2\alpha$ ($PGF_2\alpha$) protocols are widely used in cattle, where one or two injections induce luteolysis in animals with a functional corpus luteum. Buffaloes show less predictable responses, especially during summer, though a two-injection regime given 11 to 14 days apart improves outcomes. Progesterone or progestagen-based methods, using devices such as CIDR, PRID, or vaginal sponges,

mimic the luteal phase and trigger estrus after withdrawal, proving effective in postpartum cows and anestrus buffaloes. The Ovsynch protocol, involving sequential treatment with GnRH, $PGF_2\alpha$, and a second GnRH injection followed by fixed-time AI, has gained popularity in cattle. Buffaloes respond as well, though conception rates tend to be lower, prompting modifications such as Double-Ovsynch and Cosynch for better synchronization. Other protocols such as GPG (GnRH–$PGF_2\alpha$–GnRH) and GPE (GnRH–$PGF_2\alpha$–Estradiol) have shown effectiveness in managing silent estrus, particularly in buffaloes.

The success of synchronization depends on several factors. Body condition plays a vital role in both cattle and buffaloes, and poor nutrition increases the risk of anestrus. Postpartum intervals also vary between species, with cows usually cycling after 45 days, whereas buffaloes often require 60 to 90 days. Seasonal influences are minor in cattle but significant in buffaloes, which frequently experience summer anestrus. Heat stress further complicates reproductive efficiency by reducing estrus intensity in cattle and causing silent estrus and poor follicular growth in buffaloes.

2. Breeding Management in Cattle

Breeding management is a systematic approach aimed at maximizing fertility, genetic progress, and productivity in cattle. It encompasses estrus detection, mating practices, semen handling, pregnancy diagnosis, calving, and postpartum care. The main objectives are to achieve an optimal calving interval of about 12 to 13 months, ensure high conception rates, reduce reproductive problems such as anestrus and repeat breeding, and promote genetic improvement through AI. These measures together contribute to the sustainability and profitability of dairy farming.

A thorough understanding of reproductive physiology is central to successful management. Puberty in heifers generally occurs between 12 and 18 months, although body weight is considered a more accurate indicator than age, with indigenous breeds reaching puberty at 250 to 300 kg and crossbred cattle at 280 to 320 kg. The estrous cycle averages 21 days, with estrus lasting for 12 to 18 hours and ovulation occurring 24 to 30 hours later. The recommended time for insemination is during mid to late estrus, usually following the AM-PM rule, which advises

inseminating cows observed in heat in the morning by evening and those observed in the evening by the next morning.

Efficient estrus detection remains one of the most challenging aspects of breeding management. Observable signs include restlessness, frequent bellowing, standing to be mounted, clear stringy mucus discharge, swelling of the vulva, temporary reduction in milk yield, and increased urination. To enhance accuracy, modern farms often use heat detection aids such as activity monitors, pedometers, tail painting, detection cards, and teaser bulls.Cattle may be bred either naturally or by AI. Natural service is still common in rural areas, but it has drawbacks including disease transmission, inefficiency in large herds, and limited potential for genetic improvement. AI, on the other hand, provides numerous advantages by enabling the use of semen from proven sires stored in liquid nitrogen at –196 °C. It reduces the cost of maintaining bulls, helps in preventing reproductive disease transmission, and accelerates genetic progress, making it the preferred method in modern dairy farming.

The timing of first breeding is another important consideration. Heifers should ideally be bred at 15 to 18 months, once they have achieved the target body weight. Breeding too early leads to stunted growth, calving problems, and reduced productivity, while delayed breeding results in economic losses. Maintaining a calving interval of 12 to 13 months is essential, with the second or third postpartum estrus being the most suitable for breeding. Estrus synchronization methods such as Ovsynch, $PGF_2\alpha$ protocols, and CIDR devices are widely used to support fixed-time insemination, especially in larger herds where dependence on heat detection may be impractical.

Pregnancy diagnosis forms another critical component of breeding management. Rectal palpation, a reliable method, is generally accurate from 45 to 60 days of gestation. Ultrasonography allows earlier detection, as early as 25 to 28 days post-breeding, while progesterone assays provide an indirect method for pregnancy confirmation. Early and precise diagnosis enables timely rebreeding of non-pregnant cows, reducing reproductive losses.Nutrition and herd health play a significant role in reproductive performance. Balanced diets rich in energy, protein, minerals, and

vitamins are essential. Negative energy balance, especially in early lactation, often delays estrus or results in silent heats. Key minerals such as phosphorus, copper, zinc, and selenium, along with vitamins A, D, and E, are critical for fertility. Vaccination against reproductive diseases including brucellosis, IBR, BVD, and leptospirosis should be part of routine herd management.

Record-keeping is indispensable for evaluating breeding efficiency. Records should cover estrus detection, insemination dates, sire information, conception results, calving dates, and inter-service intervals. Important reproductive indicators include a conception rate of 40 to 50 percent under AI, 1.6 to 2 services per conception, a calving interval of 12 to 13 months, and an age at first calving of 24 to 30 months. Meeting these standards ensures profitable and sustainable dairy farming.

3. Artificial Insemination in Cattle

Artificial insemination is the most widely applied reproductive technology in cattle, and it has transformed both dairy and beef sectors globally. By allowing semen from genetically superior sires to be distributed across herds, AI has greatly improved milk yield, fertility, growth traits, and disease resistance. In India, AI is particularly valuable for small and marginal farmers as it provides an affordable means to enhance the productivity of native breeds.

The main objective of AI is to accelerate genetic progress by facilitating widespread use of elite sires. Additional goals include reducing the spread of venereal diseases, eliminating the costs of bull maintenance, enabling the integration of synchronization programs, and allowing semen to be stored and transported across long distances.

A clear understanding of the reproductive anatomy is essential for successful insemination. The female tract consists of the vulva, vagina, cervix, uterus, and ovaries, with the cervix containing four to five annular rings through which the insemination catheter must be carefully passed. Ovulation usually occurs 24 to 30 hours after standing estrus, making the correct timing of AI crucial.

The recto-vaginal technique is the most common method of AI. The cow is

restrained, and the vulva is thoroughly cleaned. Semen straws are thawed at 37 °C for 30 to 40 seconds before loading into the insemination gun. The gun is guided through the cervix with the aid of a hand inserted in the rectum, and semen is deposited into the uterine body just beyond the cervix.

Accurate timing significantly influences conception. The AM-PM rule is often followed, where cows in estrus in the morning are inseminated in the evening, and those detected in the evening are inseminated the next morning. In fixed-time AI protocols such as Ovsynch, insemination is performed at predetermined times following hormonal treatments, eliminating the need for heat detection.

AI offers numerous benefits compared to natural service. It allows rapid dissemination of superior genetics, increases productivity, minimizes disease risks, reduces the cost of keeping bulls, and provides the flexibility of long-term semen storage. It can also be combined with advanced technologies such as sexed semen and embryo transfer to further improve herd genetics and farm profitability.

Conclusion:

However, challenges remain in its widespread adoption. Estrus detection remains a major obstacle, particularly in high-producing cows and buffaloes that often show silent heat. The availability of trained technicians is limited in rural areas, and maintaining the cold chain of semen storage and transport is logistically demanding.

In addition, awareness and knowledge among farmers regarding AI practices are often inadequate, which reduces success rates.Looking to the future, innovations such as sex-sorted semen, genomic selection of sires, and precision livestock farming technologies hold great promise for improving AI outcomes. Automated estrus detection systems and hormonal monitoring devices may reduce reliance on visual heat detection, while combining AI with embryo transfer and in vitro fertilization is expected to open new avenues for genetic advancement in cattle.

Haematological and Urinary Biomarkers: Tools for Early Disease Detection

Deepak Kumar and Vishal Kumar Sinha

Department of Veterinary Pathology

Bihar Veterinary College, Bihar Animal Sciences University (BASU), Patna-14

Urine analysis and haematological testing are two of the most fundamental diagnostic tools in clinical laboratory science. Together, they provide a comprehensive overview of a patient's physiological and pathological status, often serving as the first line of investigation in routine health screenings and targeted diagnostic evaluations.

Urine analysis (urinalysis) is a non-invasive, cost-effective and easily repeatable diagnostic procedure used to assess the chemical composition, physical characteristics and microscopic content of urine. It plays a vital role in the diagnosis and monitoring of renal diseases, urinary tract infections (UTIs), metabolic disorders such as diabetes mellitus and systemic conditions like preeclampsia or liver dysfunction. The three primary components of urinalysis are physical, chemical and microscopic examination that collectively aid in identifying a wide spectrum of clinical conditions with high sensitivity and specificity when interpreted accurately (Bishop *et al*., 2018).

Haematology on the other hand deals with the study of blood and its components including red blood cells (RBCs), white blood cells (WBCs), platelets, haemoglobin (Hb) and haematocrit (HCT). A complete blood count (CBC) is one of the most frequently ordered laboratory tests, essential for diagnosing anaemia, infections, haematological malignancies, bleeding disorders, and bone marrow dysfunction (Rodak *et al*., 2020). Modern haematology also incorporates advanced technologies like automated analysers and flow cytometry to ensure precision, reproducibility and speed.

With the advent of automation and increasingly sophisticated analysers both urinalysis and haematological investigations have become more accurate and efficient. However, despite technological advancements, the importance of manual

verification and critical interpretation by trained laboratory personnel remains paramount.

2. Haematology

2.1 Overview

Haematology is the branch of clinical pathology that focuses on the study of blood, bloodforming organs and blood related disorders. It involves both quantitative and qualitative analysis of blood components like red blood cells (RBCs), white blood cells (WBCs) and platelets as well as haemoglobin concentration and haematocrit levels. These investigations are fundamental to diagnosing a wide range of medical conditions including anaemia, infections, coagulopathies, hematologic malignancies (leukaemia) and bone marrow dysfunctions (Rodak *et al*., 2020; Henry, 2021).

2.2 Complete Blood Count (CBC)

The Complete Blood Count (CBC) is one of the most commonly requested diagnostic tests in clinical practice. It provides a comprehensive snapshot of the patient's haematological status by measuring the following parameters:

- Haemoglobin (Hb): Reflects the oxygen-carrying capacity of blood.
- Haematocrit (Hct): Indicates the percentage of blood volume occupied by RBCs.
  [Haematocrit (Hct)= (Volume of RBCs/Total Blood Volume) ×100]
- Red Blood Cell (RBC) Count: Measures the number of erythrocytes per microliter of blood.
- Red Cell Indices:
  - Mean Corpuscular Volume (MCV): Average size of RBCs.
  - Mean Corpuscular Haemoglobin (MCH): Average haemoglobin content per RBC.
  - Mean Corpuscular Haemoglobin Concentration (MCHC): Concentration of haemoglobin in a given volume of RBCs.
- White Blood Cell (WBC) Count and Differential: Total number of leukocytes with breakdown into neutrophils, lymphocytes, monocytes, eosinophils and

shape (spherocytes, schistocytes, sickle cells) and colour (hypochromia indicating iron deficiency).

- White Blood Cells (WBCs): Abnormal forms, such as blasts (indicative of acute leukaemia) or atypical lymphocytes (seen in viral infections) can be detected.
- Platelets: Assessed for number, size and clumping. Giant platelets may be seen in myeloproliferative disorders or Bernard-Soulier syndrome (Bain, 2019).

Peripheral smear analysis is especially crucial when CBC results are flagged for abnormal findings.

2.4 Haematology Analysers

Modern automated haematology analysers have revolutionized routine blood analysis by providing rapid and reliable results using several advanced principles:

- Electrical Impedance (Coulter Principle): Counts and sizes cells based on changes in electrical resistance as cells pass through a small aperture.
- Flow Cytometry: Utilizes laser light scattering to distinguish cells by size and internal complexity (granularity) useful for WBC differentials.
- Cytochemical Staining and Fluorescent Dyes: Used in advanced analysers for improved WBC classification, including detection of immature cells or blasts.

Automated systems significantly reduce manual workload and improve precision but manual verification is still required for pathological samples or unexpected results (Rodak *et al*., 2020).

2.5 Common Haematological Disorders

Anaemia

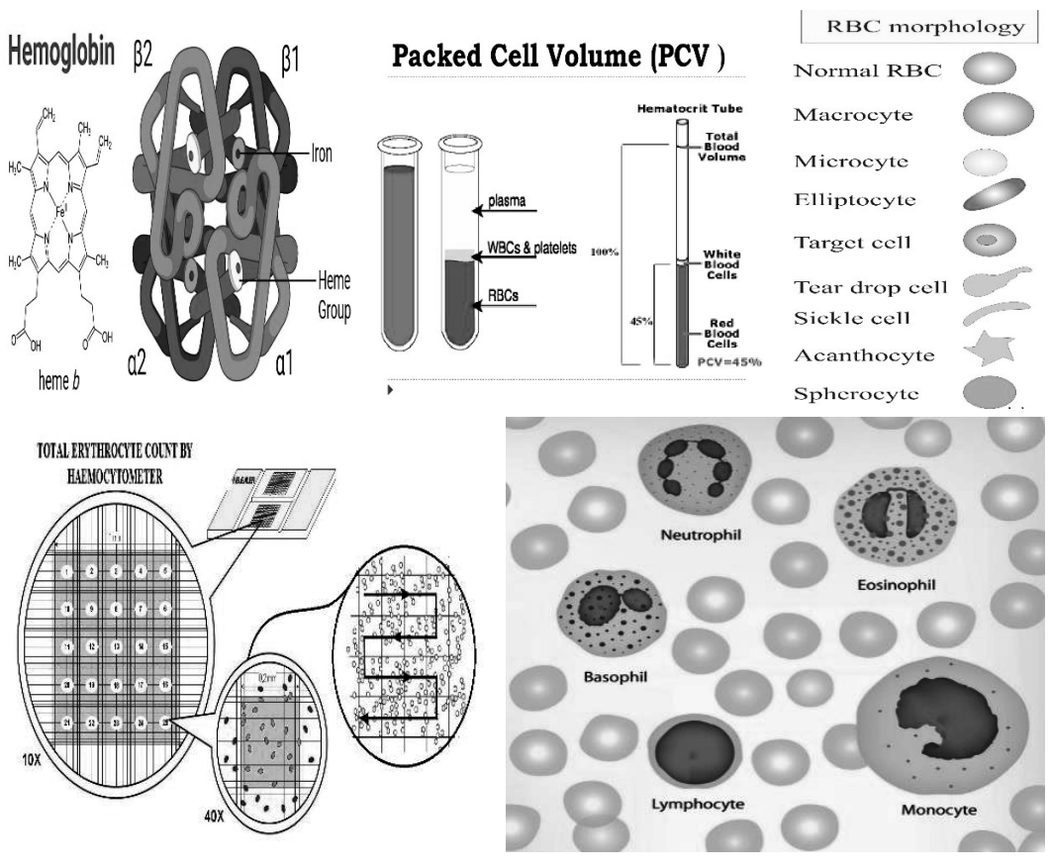
Characterized by reduced haemoglobin or haematocrit, anaemia is classified based on RBC indices:

- Microcytic, hypochromic anaemia: Often due to iron deficiency or thalassemia.

basophils.

- Platelet Count: Essential for assessing clotting potential and evaluating bleeding disorders.

CBC results guide the diagnosis and monitoring of conditions like anaemia, infection, thrombocytopenia and leukaemia (McKenzie and Williams, 2014).



2.3 Peripheral Blood Smear Examination

While automated analysers provide numerical data, manual examination of a stained peripheral blood smear remains critical for assessing cell morphology. A Romanowsky-type stain (Wright or Leishman) is typically used for microscopic analysis.

- Red Blood Cells (RBCs): Evaluated for size (microcytic or macrocytic),

- Normocytic anaemia: May result from acute blood loss or chronic disease.
- Macrocytic anaemia: Associated with vitamin B12 or folate deficiency.

Leucocytosis and Leukopenia

- Leucocytosis (↑ WBC): Commonly seen in bacterial infections, inflammation or leukaemia.
- Leukopenia (↓ WBC): May occur in viral infections, chemotherapy or bone marrow suppression.

Thrombocytopenia

A low platelet count can lead to bleeding complications. Causes include:

- Bone marrow failure (e.g., aplastic anaemia)
- Drug-induced suppression(NSAID)
- Immune-mediated destruction (Tick borne diseases like theileriosis, babesiosis etc)
- Disseminated Intravascular Coagulation (DIC)

These conditions are typically identified through CBC abnormalities, confirmed by smear findings and further tests like bone marrow biopsy if needed (Henry, 2021).

Parameter / Test	**Normal Range / Appearance**	**Clinical Significance / Interpretation in Animals**
Haemoglobin (Hb)	Cattle: 8–15 g/dL	↓ Hb → anemia (blood loss, hemolysis, chronic disease); ↑ Hb → dehydration or polycythemia
Haematocrit (Hct / PCV)	Cattle: 24–46%	↓ Hct → anemia; ↑ Hct → hemoconcentration due to dehydration
RBC Count	Cattle: 5 –10 $\times 10^6/\mu L$	↓ RBC → anemia; ↑ RBC → polycythemia or dehydration
Mean Corpuscular Volume (MCV)	40–60 fL (cattle)	↓ MCV → microcytic anaemia (iron deficiency); ↑ MCV → macrocytic anaemia (B12/folate deficiency)
Mean Corpuscular Haemoglobin (MCH)	11-17pg(cattle)	↓ MCH → hypochromic anaemia; ↑ MCH → macrocytic or regenerative anaemia
Mean Corpuscular Hemoglobin Concentration (MCHC)	30–36 g/dL	↓ MCHC → hypochromia (iron deficiency, chronic disease); ↑ MCHC → spherocytosis

Parameter / Test	Normal Range / Appearance	Clinical Significance / Interpretation in Animals
Total WBC Count	Cattle: 4 –12 $\times 10^3/\mu L$	↑ WBC (leucocytosis) → bacterial infection, inflammation, leukaemia; ↓ WBC (leukopenia) → viral infection, chemotherapy, bone marrow suppression
Neutrophils	15-33%	↑ Neutrophils → bacterial infection, stress; ↓Neutrophils → viral infection, immunosuppression
Lymphocytes	62-63%	↑ Lymphocytes → chronic infection, immune stimulation; ↓ Lymphocytes → stress, corticosteroid effect
Monocytes	2–10%	↑ Monocytes → chronic inflammation, tissue necrosis; ↓ Monocytes → rarely significant
Eosinophils	0-9%	↑ Eosinophils → parasitic infections, hypersensitivity reactions; ↓ Eosinophils → stress or corticosteroids
Basophils	0-1%	↑ Basophils → rare; associated with allergic responses, parasitism
Platelet Count	100–800 $\times 10^3/\mu L$ (cattle)	↓ Platelets (thrombocytopenia) → bleeding disorders, bone marrow failure, drug -induced, immune -mediated (theileriosis, babesiosis), DIC; ↑ Platelets → inflammation or reactive thrombocytosis
Peripheral Smear RBC Morphology	Uniform, biconcave (cattle)	Microcytosis → iron deficiency; Macrocytosis → B12/folate deficiency; Hypochromia → iron deficiency;

Disorder	Key CBC / Smear Findings	Associated Diseases
Anaemia	↓ Hb, ↓ Hct, ↓ RBC; RBC morphology changes	Iron deficiency, chronic disease, acute blood loss, B12/folate deficiency, haemoparasites (Theileria, Babesia)
Leucocytosis	↑ WBC (neutrophilia, lymphocytosis)	Bacterial infections, inflammation, leukaemia
Leukopenia	↓ WBC	Viral infections, bone marrow suppression, chemotherapy
Thrombocytopenia	↓ Platelet count, giant platelets or clumping	Bone marrow failure, drug-induced (NSAIDs), immune-mediated destruction (tick-borne diseases), DIC
Haemoparasitic Infection (Babesiosis/Theileriosis)	Anaemia, thrombocytopenia, leukopenia or leucocytosis; parasites seen in RBCs on smear	Babesia spp., Theileria spp. in cattle
Polycythemia/ Haemoconcentration	↑ RBC, ↑ Hb, ↑ Hct	Dehydration, splenic contraction, hypoxia adaptation

3. Urine Analysis

3.1 Overview

Urine analysis or urinalysis is one of the most frequently requested laboratory investigations. It is a non-invasive, simple and cost-effective method to obtain valuable diagnostic information. Urinalysis can detect a wide range of disorders including urinary tract infections (UTIs), kidney diseases, metabolic conditions (like diabetes mellitus) and dehydration.

Urine analysis is typically divided into three components:

a. Physical examination – assesses observable characteristics like colour and clarity.
b. Chemical examination – detects specific analytes using reagent test strips.
c. Microscopic examination – identifies cells, casts, crystals and microorganisms.

3.2 Types of Urine Samples

The accuracy of urine analysis greatly depends on proper sample collection. Common types include:

Sample Type	Purpose
Random urine	Most common, convenient for routine analysis.
First morning urine	Ideal for detecting proteins and pregnancy testing due to concentration.
Midstream clean - catch	Reduces contamination, preferred for culture.
24-hour urine	For quantitative chemical analysis (e.g., creatinine clearance, protein excretion).

Note: Samples should be tested within 2 hours of collection or refrigerated to avoid bacterial overgrowth and degradation of analytes.

3.3 Physical Examination of Urine

a. Colour- Normal urine colour ranges from pale yellow to amber due to the presence of urochrome pigment. Deviations may suggest pathology:

Colour	Possible Cause
Dark yellow	Dehydration
Red or pink	Haematuria, beet ingestion, porphyria
Brown/tea-coloured	Liver disease (bilirubin, myoglobin)
Milky	Chyluria, pyuria (pus), phosphaturia

b. Clarity (Turbidity)- Normal urine should be clear. Cloudiness may result from:

- Crystals (urates, phosphates)
- White blood cells (infection)
- Epithelial cells
- Bacteria

c. Odour

Though not routinely reported, unusual odours can provide clues:

- Fruity smell: Ketones in diabetic ketoacidosis
- Ammonia: Bacterial decomposition
- Foul: Possible UTI

3.4 Chemical Examination of Urine

Chemical testing is performed using reagent strips (dipsticks) impregnated with chemicals that change colour based on the presence or concentration of specific analytes.

Test	Normal Result	Clinical Significance
pH	4.5–8.0	Acidic in high-protein diet; alkaline in infection
Specific Gravity	1.005–1.030	Measures urine concentration; low in diabetes insipidus
Protein	Negative	Positive in glomerular disease, nephrotic syndrome
Glucose	Negative	Positive in diabetes mellitus or renal glycosuria; may indicate stress hyperglycemia in cattle.
Ketones	Negative	Positive in starvation, ketosis (common in dairy cows postpartum) or diabetic ketoacidosis (rare in cattle).
Bilirubin	Negative	Positive in liver disease, obstruction
Urobilinogen	0.2–1.0 mg/dL	Increased in haemolysis, decreased in obstruction
Blood	Negative	Positive in haematuria, haemoglobinuria, or myoglobinuria
Nitrites	Negative	Positive suggests gram-negative bacterial infection
Leukocyte Esterase	Negative	Positive in UTI (WBC presence)

3.5 Microscopic Examination of Urine

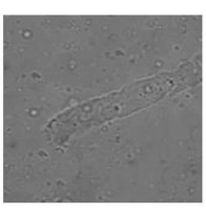
Performed on centrifuged urine sediment, microscopic examination identifies formed elements that may not be detected by dipstick tests.

a. Cells

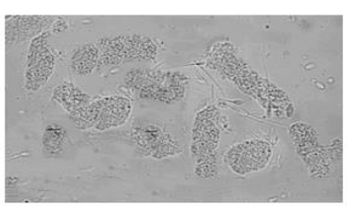
Cell Type	Significance
RBCs	Haematuria from stones, trauma, infection, glomerulonephritis
WBCs	Infections, especially UTIs
Epithelial cells	Few squamous cells are normal; renal tubular cells suggest tubular damage

b. Casts- Casts are cylindrical structures formed in the renal tubules indicating kidney involvement.

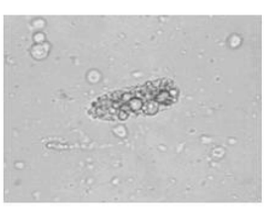
Cast Type	Clinical Indication
Hyaline	Normal in small numbers; seen in dehydration or exercise
RBC casts	Glomerulonephritis
WBC casts	Pyelonephritis
Granular casts	Tubular damage, chronic kidney disease
Waxy casts	Advanced renal disease
Fatty casts	Nephrotic syndrome



Hyaline cast

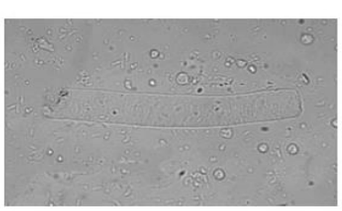


Granular cast



Fatty cast

Cellular cast



Waxy cast

c. Crystals- Most crystals are pH-dependent and may be normal or pathologic.

Crystal	pH	Clinical Context
Calcium oxalate	Acidic/neutral	Common finding; may contribute to formation of urinary stones (urolithiasis) in cattle, sheep, and dogs.
Uric acid	Acidic	Rare in cattle; seen in gout or secondary to rapid tissue breakdown (tumor lysis) in small animals.
Triple phosphate	Alkaline	UTI with urea-splitting bacteria
Cystine	Acidic	Cystinuria (inherited disorder)

d. Microorganisms

Organism	Clinical Context / Significance in Animals
Bacteria	Presence may indicate urinary tract infection (UTI) or sample contamination. Common pathogens in cattle include *E. coli*, *Corynebacteriumrenale* and *Proteus* spp.
Yeasts (e.g., Candida spp.)	Rare in cattle; may occur in immunocompromised animals or following prolonged antibiotic therapy. In small animals, *Candida* infections are more common in diabetic or immunosuppressed pets.
Parasites	Urinary parasites are uncommon in cattle. In certain regions, *Trichomonas foetus* can cause reproductive tract infection (venereal disease), occasionally appearing in urine; *Schistosoma* spp. is mainly relevant in endemic areas affecting livestock or other animals.

3.6 Automation in Urinalysis

Modern laboratories often use automated urine analysers which improve throughput and standardization.

- Chemical analysis: Performed using reflectance photometry.
- Microscopy: Some advanced systems use digital imaging and AI to identify cells and crystals.

3.7 Clinical Applications of Urinalysis

Urinalysis supports the diagnosis of multiple conditions:

Clinical Finding	Interpretation / Animal Disease
Proteinuria with RBC casts	Indicates glomerulonephritis or severe renal damage in cattle or small animals.
Positive nitrites, leukocyte esterase, WBCs	Suggests urinary tract infection (UTI); common pathogens in cattle include *E. coli* and *Corynebacteriumrenale*.
Glucose and ketones in urine	Indicates uncontrolled diabetes mellitus (rare in adult cattle) or ketosis in dairy cows.
Haematuria without casts	Suggests urinary stones, trauma or lower UTI; common in male ruminants prone to urolithiasis.
Alkaline pH with triple phosphate crystals	Suggests infection with urea-splitting bacteria such as *Proteus* spp.; may lead to struvite stone formation.

Conclusion

Urine analysis and haematology are fundamental components of clinical laboratory diagnostics, providing critical information for the detection, diagnosis and monitoring of various diseases. Urine analysis is a simple, non-invasive and cost-effective test that evaluates physical characteristics (colour and clarity), chemical properties (pH, glucose, protein and ketones) and microscopic elements (cells, casts and crystals) in urine. It plays a vital role in identifying renal disorders, urinary tract infections, metabolic conditions and systemic diseases. While automated urine analysers have improved efficiency and accuracy, manual microscopy remains essential for confirming abnormal findings. Haematology on the other hand focuses on the study of blood and its cellular components. The complete blood count (CBC) is a widely used test that measures parameters such as haemoglobin, haematocrit, red and white blood cell counts and platelet levels. These values help in diagnosing anaemia, infections, leukaemia and clotting disorders. Peripheral blood smear examination adds further value by allowing visual assessment of blood cell morphology which is crucial for detecting abnormalities that may not be picked up by automated systems. Modern haematology analysers which use techniques like

electrical impedance and flow cytometry offers rapid and precise analysis though manual review and clinical correlation remain important for accurate interpretation. Together, urine analysis and haematology form the backbone of routine laboratory testing and are indispensable for effective patient care and disease management.

References

1. Bain B. J. (2019). *Blood Cells: A Practical Guide* (5th edn.). Wiley-Blackwell.
2. Bishop M. L., Fody E. P. and Schoeff L. E. (2018). *Clinical Chemistry: Techniques, Principles, Correlations* (8th edn.). Wolters Kluwer.
3. Henry J. B. (2021). *Henry's Clinical Diagnosis and Management by Laboratory Methods* (24th edn.). Elsevier.
4. McKenzie S. B. and Williams J. L. (2014). *Clinical Laboratory Hematology* (3rd edn.). Pearson.
5. McPherson R. A. and Pincus M. R. (2021). *Henry's Clinical Diagnosis and Management by Laboratory Methods* (24th edn.). Elsevier.
6. Rodak B. F., Carr J. H. and Muensterer P. M. (2020). *Hematology: Clinical Principles and Applications* (6th edn.). Elsevier.

Collection, Preservation and Dispatch of Materials for Laboratory Diagnosis

Sanjiv Kumar[1] and Himalaya Bhardwaj[2]
[1]Department of Veterinary Pathology/ [2]Veterinary Biochemistry
Bihar Veterinary College, Bihar Animal Sciences University (BASU), Patna-14

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^{o}C.

Materials to be collected in some common diseases of Animals:

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.

BASU

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एडवांस ट्रेनिंग कोर्स ऑन इम्पोर्टेंट वेटरनरी क्लिनिकल प्रोसीजर अवधि: 3 सप्ताह, प्रवेश क्षमता: 6

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

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