



Vol. 42 (No. 1 & 2), June & December, 2020



# Vet Alumnius

ISSN 2319-5762

## In this issue

- Functional anatomy of udder
- Anthelmintic resistance
- Lightning safety of livestock
- Fracture management in bovines
- Postsurgical dehiscence in small animals

Chief Editor  
Dr. Ashwani Kumar

Editor  
Dr. Ashwani Kumar Singh

An official organ of the Alumni Association, College of Veterinary Science,  
Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana

Since 2015 all published issues of  
the 'Vet Alumnus' are available as OPEN ACCESS (PDF)  
on <https://www.gadvasu.in/page/vet-alumnus>

Printed at Foil Printers, 2051, Gobind Nagar, Civil Lines, Ludhiana-141001, Punjab, India and published on the behalf of the Alumni Association of the College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana -141004, Punjab, India

## CONTENTS

GADVASU veterinary hospital management software – An overview <i>Raj Sukhbir Singh</i>	1
Ethnoveterinary practices: An age-old medicine in bovine care <i>Hansmeet Kour, Tarundeep Singh and Gurpreet Kaur</i>	8
Functional anatomy of udder in various species of animals <i>Samikshya Sarangi and Neelam Bansal</i>	16
Significance of starch in dairy cattle nutrition <i>Digvijay Singh, JS Hundal, Amit Sharma and Udeybir Singh</i>	22
Anthelmintic resistance and its management in gastrointestinal nematodes of small ruminants <i>Paramjit Kaur</i>	27
Bacterial cause of abortion and infertility in cattle <i>Pallvi Slathia and Deepti Narang</i>	34
Clinico-pathological alterations in postparturient hemoglobinuria <i>Priyanka, Mandeep Kaur, Nittin Dev Singh and Geeta Devi</i>	39
Canine lymphoma - An overview <i>Mohanapriya Thangaraj, Vishal Mahajan and Leishangthem Geeta Devi</i>	43
Lightning safety of livestock <i>Biswadeep Jena and Mehak Mahant</i>	49
Postsurgical laparotomy wound dehiscence in small animals <i>Aseem Goyal, Vikas Garg, Ashwani Kumar</i>	54
Sertoli cell tumour in dogs <i>Nikita Gupta, Vandana Sangwan and Arun Anand</i>	60
Technique of external coaptation for the management of metacarpal and metatarsal fracture in bovines <i>Akashdeep Singh Hundal and Vandana Sangwan</i>	63
Tele-extension in GADVASU <i>R K Sharma and Amandeep Singh</i>	69

---

## EXECUTIVE COMMITTEE

---

### ALUMNI ASSOCIATION

College of Veterinary Science (Ludhiana)  
Guru Angad Dev Veterinary & Animal Sciences University

Founder President	Late Dr. Balwant Singh
President	Dr. Sarvpreet Singh Ghuman
Vice-President	Dr. Swaran Singh Randhawa
Secretary	Dr. Navdeep Singh
Joint-Secretary	Dr. J.S. Hundal
Treasurer	Dr. Rajnish Sharma
Co-Treasurer	Dr. Randhir Singh
Chief Editor	Dr. Ashwani Kumar
Editor	Dr. Ashwani Kumar Singh

---

## EXECUTIVE MEMBERS

---

Dr. Gurcharan Singh Dhaliwal	Dr. Ravinder Singh
Dr. Gurinder Singh Walia	Dr. Mandeep Singh
Dr. Kewal Arora	Dr. Tejbir Singh Randhawa
Dr. P.S. Walia	Dr. Kanwar Anoop S. Kaler
Dr. Amrik Singh	Dr. Darshan Das
Dr. Sham Singh	Dr. Gagandeep Kaushal
Dr. Ranjeev Bali	Dr. Gurdev Singh
Dr. Parvinder Kaur Lubana	Dr. Amarpreet Singh Pannu
Dr. Rana Preet Gill	Dr. Gurdit Singh
Dr. Daljeet Singh Dhani	Dr. Raj Sukhbir Singh
	Dr. Navdeep Singh Ratta

## **GADVASU VETERINARY HOSPITAL MANAGEMENT SOFTWARE – AN OVERVIEW**

**Raj Sukhbir Singh**

Department of Teaching Veterinary Clinical Complex,  
College of Veterinary Science (Ludhiana),

Guru Angad Dev Veterinary and Animal Sciences University, Punjab-141004, India

Corresponding author E-mail: rsbs\_66@rediffmail.com

### **Abstract**

*Digitalization of the records is an important activity for efficient management of the hospitals, both in human and veterinary medicine. Today, with the benefits of advanced information technology, there is a need to develop systems to computerize clinical records of veterinary patients, and further, its sharing with the agencies involved in disease surveillance activities for the betterment and health of all species. Teaching Veterinary Hospital at Guru Angad Dev Veterinary & Animal Sciences University being one of the leading veterinary institutes in India needs a system for computerization of the clinical case record so that a large volume of clinical information can be easily assessed for monitoring and surveillance of animal diseases. Department of Biotechnology, Government of India has recently awarded a research project “Establishment of Teaching Veterinary Hospital Database Management System” under “DBT – GADAVSU Canine Research Centre and Networks”. This article discussed the designing and construction of hospital database management system and its utility in management of hospital.*

**Keywords:** *Veterinary, clinical record, hospital management software*

### **Introduction**

A complete and systematic recording of clinical data is the key to deliver appropriate veterinary healthcare facilities as well as management of hospital in a better way. Digital records of veterinary patient data provide a practical way for locating, accessing and retrieving important clinical information. Analysis of computer-based clinical records can be used in patient care, health-system management, health-services planning, billing and government reporting. In addition, digital records of patient data could also facilitate new interfaces between care and research environments, leading to great improvements in the scope and efficiency of clinical research. Almost every veterinary hospital and clinic in western countries are equipped with veterinary software, such as Avimark, cornerstone and ezyVet, that are designed for recording each and every aspect of owner and patient-related information in a quick and systematic way. These web-based software enable veterinary practitioners to electronically record history and clinical examination findings, diagnosis, plan treatment, track patients' medical information, book appointments and manage administrative operations such as billing. In India, such veterinary based hospital

management software are not routinely used in most of the veterinary clinics in India. The reason for this might be either unawareness among the veterinary practitioners regarding the software or due to high initial and running cost of such software. Veterinary hospital at GADVASU with an annual ODP of more than 30, 000 cases, provide primary and specialized veterinary health care facilities for both small and large animal patients. A huge amount of clinical information generated in the hospital can be a possible source of understanding various aspect of disease processes such as most common species and breeds presented and associated medical problems. Recently, Department of Teaching Veterinary Clinical Complex, under a project funded by Department of Biotechnology, has developed a web-based Veterinary Hospital Management (VHM) software. The VHM software has been developed with the aim to computerize all the information related with animals presented at the GADVASU veterinary hospital i.e. registration process of owners and their animals at registration counter, reason for which animal is presented (history, clinical examination, diagnosis and treatment made), providing computerized reports (laboratory and radiology), doing computerized billing and having an quick overview about the number and type of animals presented and most common type and pattern of disease occurrence.

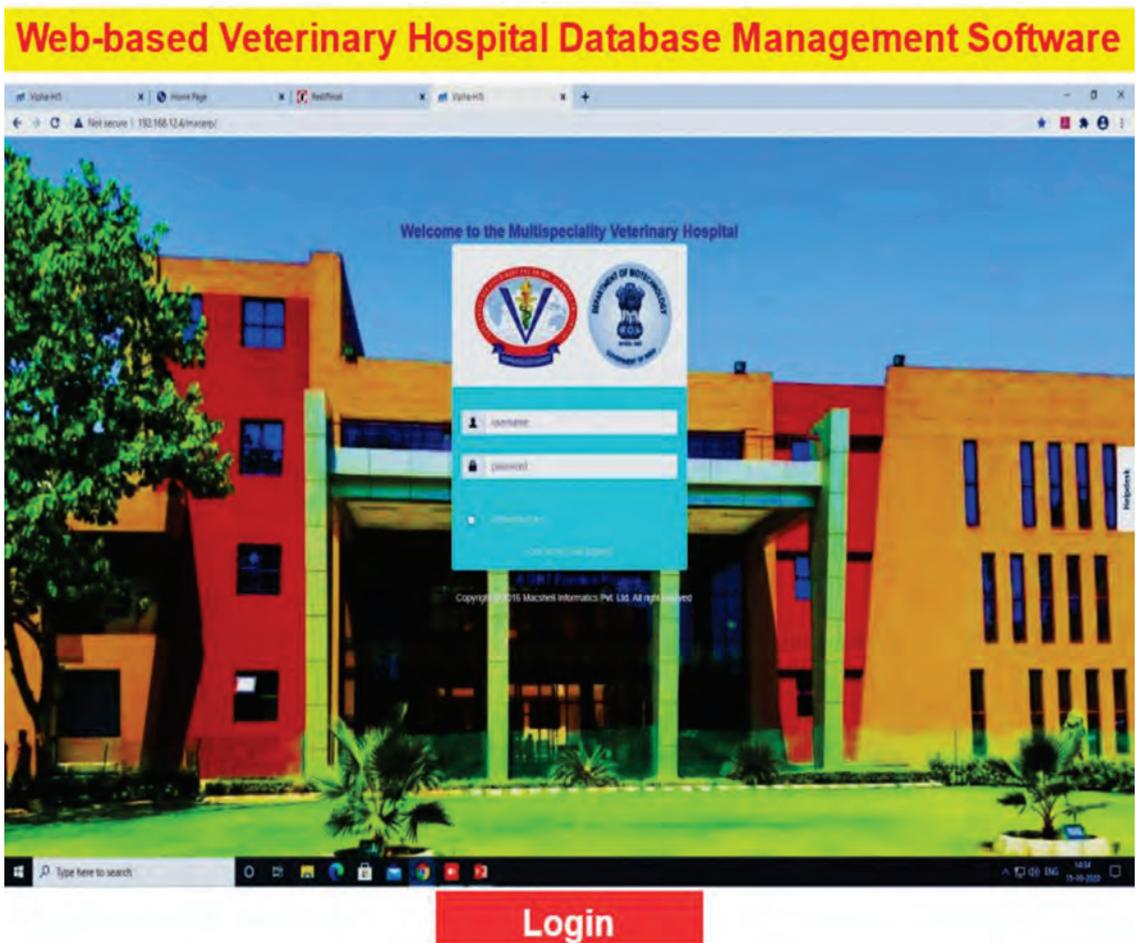
Templates for reporting of results of various tests related to clinical laboratory (such as haematology, serum biochemistry, urine analysis, faecal examination) and radiology (such as X-ray and ultrasound) have been developed and incorporated into the software. Working data including States, cities, tehsils and villages, breeds, species, faculty names and departments associated with the hospital, reference values of various diagnostic tests, list of medicines/drugs, diagnosis list, etc. have been added. A dedicated server room for handling and storage of hospital data has been established. The software is operational in different sections of the hospital such as registration counter, billing section, O.P.Ds, clinical laboratory, radiology unit.

#### **Some of the modules of GADVASU-VHM software:**

- *Dashboard*
- *Registration and Bar Code generation: Owner & Animal*
- *Billing: Consultancy, Laboratory, Radiology, Service/Procedure*
- *Consultant: Department workbench, Vaccination & Deworming, Animal Health Record & Prescription (Electronic Medical Record)*
- *Laboratory: Pathology, Biochemistry, Microbiology, Toxicology, Public Health, Animal nutrition*
- *Radiology: X-ray, Ultrasound, Echo, Endoscopy, ECG*
- *Operation Theatre: OT schedule, OT entry*

- *Admin Panel*: Include masters (Service, Doctor/Staff, State/City, User, Breed, Species, Lab values, Diagnosis, Vaccination, EMR, Anaesthesia), Service charge Setup, Consultancy charge setup, Utility (role management, user setup)
- *Reports*
- *Inventory*: Medicine list generator
- *Management information system* for quick visualization and analysis of hospital data
- *Helpdesk*: Change password, backup, logout

Here are some screen-shoots of GADVASU-VHM software:



**Dashboard**

**Registration counter**

**Bar code generation**

**Laser capturing of Bar Code**

Hospital staff using software

**Reporting**

Investigation	Value	Units	Specimen Type	Reference Interval
WBC	15.0	gms		10 - 16
Platelet	13.0	gms		8000 - 12000
Relative Neutrophil Count	82	%		60 - 77
Relative Lymphocyte Count	14	%		12 - 30
Relative Monocyte Count	6	%		3 - 10
Relative Eosinophil Count	58	%		2 - 10
Relative Basophil Count	0	%		0 - 1
Relative Neutrophil Count	5870	%		3000 - 7000
Relative Lymphocyte Count	2070	%		1000 - 4000
Relative Monocyte Count	8	%		100 - 200
Relative Eosinophil Count	692	%		100 - 200
Relative Basophil Count	0	%		10 - 100

Lab technician using software in laboratory

**Operation Theater Schedule**

Schedule:  Date: 20/02/2020  
 Start Time: 08:00:00  
 End Time: 12:00:00  
 Operation Theater: 3rd Surgery (2) LPH

Owner Reg No: 0102020  
 Start City: Ludhiana  
 Species: Dog  
 Breed: Afghan Hound  
 Age: 10  
 Sex: Male

Client Name: Suman Singh  
 Phone No: 9416633333  
 Age: 10  
 Sex: Male

**MULTISPECIALITY VETERINARY HOSPITAL LUDHIANA**  
 Ludhiana  
 Guru Angad Dev Veterinary & Animal Sciences University, Ludhiana  
 ਗੁਰੂ ਅੰਗਦ ਦੇਵ ਵੈਟਰਨਰੀ ਅਤੇ ਜੀਵਨ ਵਿਗਿਆਨ ਯੂਨੀਵਰਸਿਟੀ, ਲੁਧਿਆਣਾ

Report No: 12345  
 Patient No: 1010101010  
 Owner Name: Harpreet Singh  
 Owner Reg No: 1010101010  
 Animal Name: 1010101010  
 Animal Reg No: 1010101010  
 Species: Dog  
 Breed: Afghan Hound

Report No: 12345  
 Report Date: 10/10/2020  
 Ref Doctor: Dr. Harpreet Singh  
 Ref Department: Radiology  
 Procedure Name: Digital X-Ray (Chest)  
 Performing Doctor: Dr. Harpreet Singh  
 Area: Radiology  
 View: Lateral & VD

**Department of Surgery & Radiology**  
**X-Ray Report**  
 Report No.:  
 Area: Radiology Region  
 View: Left Lateral

**Findings:**

- The diaphragmatic line is clearly remarkable.
- There is no evidence of pneumonia.
- There is no evidence of pleural effusion.
- Mild increase in vascular markings seen in the caudo-dorsal lung lobes.

**Impression:**  
 Normal thorax and diaphragmatic line.

**Radiologist using software in radiology unit**

**Reporting**

**Analysis of registered owners & animals**

**MULTISPECIALITY VETERINARY HOSPITAL LUDHIANA**  
 Ludhiana  
 Guru Angad Dev Veterinary & Animal Sciences University, Ludhiana  
 ਗੁਰੂ ਅੰਗਦ ਦੇਵ ਵੈਟਰਨਰੀ ਅਤੇ ਜੀਵਨ ਵਿਗਿਆਨ ਯੂਨੀਵਰਸਿਟੀ, ਲੁਧਿਆਣਾ

**OWNERS REGISTERED**

ID	Name	Date of Birth	Sex	Breed	Status
1	Harpreet Singh	10/10/2020	Male	Human	Active
2	Harpreet Singh	10/10/2020	Male	Human	Active
3	Harpreet Singh	10/10/2020	Male	Human	Active
4	Harpreet Singh	10/10/2020	Male	Human	Active
5	Harpreet Singh	10/10/2020	Male	Human	Active
6	Harpreet Singh	10/10/2020	Male	Human	Active
7	Harpreet Singh	10/10/2020	Male	Human	Active
8	Harpreet Singh	10/10/2020	Male	Human	Active
9	Harpreet Singh	10/10/2020	Male	Human	Active
10	Harpreet Singh	10/10/2020	Male	Human	Active

**ANIMAL WITH INFORMATION**

ID	Name	Date of Birth	Sex	Breed	Status
1	Harpreet Singh	10/10/2020	Male	Human	Active
2	Harpreet Singh	10/10/2020	Male	Human	Active
3	Harpreet Singh	10/10/2020	Male	Human	Active
4	Harpreet Singh	10/10/2020	Male	Human	Active
5	Harpreet Singh	10/10/2020	Male	Human	Active
6	Harpreet Singh	10/10/2020	Male	Human	Active
7	Harpreet Singh	10/10/2020	Male	Human	Active
8	Harpreet Singh	10/10/2020	Male	Human	Active
9	Harpreet Singh	10/10/2020	Male	Human	Active
10	Harpreet Singh	10/10/2020	Male	Human	Active

**Benefits/features of GADVASU-VHM software:**

1. A web-based user-friendly VHM software that is easy to use by everyone from the complete computer novice to the IT savvy.
2. Most of the information is on the home page (dashboard). You can navigate to different parts of the program from the same page with a few clicks.
3. Quick and easy owner and animal registration process.
4. Photo of the presenting animal can be uploaded at the time of registration.
5. A sticker containing information about the owner and animal can be printed and pasted on the registration card and owner's slip.
6. A SMS containing registration number can be sent to the owner at registered mobile number.
7. There are many modules for easy operations and management e.g., vaccination and deworming page, electronic medical record page, laboratory, imaging, OT, inventory, admin page, etc.
8. Under electronic medical record page, entries related with presenting history, physical and clinical examination findings, lab tests advised, diagnosis made, treatment plan and owner's instructions can be made.
9. There is facility to upload/attach any document (photo, video, pdf file or word file) to the patient record for future reference of the clinician.
10. Patient's past medical history and treatments prescribed can be accessed in future.
11. The lab and radiology reports come directly to the patient record. These reports can be printed from anywhere in the clinics. The lab reports are also sent at owner's registered mobile number.
12. Electronic billing and Invoice creation facility
13. Clinician can access VHM software from any computer with attached with university intranet.
14. Reports (excel and graphical format) during any selected period can be generated for administration/management purpose. Examples included: Animals (Overall, breed-wise, species-wise, gender-wise, area-wise) registered report, disease or diagnosis report, lab test report, radiology report, income generated report, etc.

**Further scope of the software**

In future, VHM software at GADVASU will become a good source of clinical information which can be explored for animal disease surveillance and monitoring activities. Probably, the software will help in assessment of the animal health status,

monitoring of disease trends, recommendation of priorities and evaluation of the effectiveness of the disease control measures.

Following points can be explored:

- Disease categorization:
  - Analysis of most common reasons for veterinary visits and, accordingly categorization of animal diseases.
- Identification of potential risk factors and patterns of disease occurrence:
  - Potential host and demographic risk factors associated with the occurrence of most commonly presented diseases.
- Trends in disease occurrence pattern over a given time period.
- Disease forecasting:
  - Review of health database to identify its utility to forecast most commonly presented diseases
- Owner awareness through:
  - Health alerts for animals: Vaccination, deworming, tick control and nutrition, annual health screen in pets
  - Creation of educational material such as pamphlets, brochures, booklets
- Animal health data sharing with government animal husbandry agencies for prioritization of disease management programmes.

## ETHNOVETERINARY PRACTICES: AN AGE-OLD MEDICINE IN BOVINE CARE

**Hansmeet Kour\*, Tarundeep Singh and Gurpreet Kaur**

Department of Veterinary Microbiology, College of Veterinary Science (Ludhiana),  
Guru Angad Dev Veterinary and Animal Sciences University, Punjab-141004, India

\*Corresponding author E-mail: seren smile11@gmail.com

### Abstract

*Ethno-veterinary medicine is based on traditional beliefs, knowledge, indigenous methods and practices of healing and managing livestock, and includes the use of traditional remedies such as traditional surgical techniques, traditional immunization, and the use of herbal medicines for curing various veterinary diseases. These herbal medicines will fill a gap caused by increasing costs, drug resistance, and side effects of modern pharmaceuticals like drug residuals in milk and meat products. These medications offer a variety of biological effects, such as antioxidant, anti-inflammatory, and antibacterial qualities, and can be utilized as a supplement to or replacement for modern medicine, particularly in locations where medicinal and other facilities are scarce. The extinction of these methods will have an adverse impact on not only poor villagers and their animals, but also on our culture, legacy, and biodiversity.*

**Keywords:** *Ethno-veterinary practices, Traditional remedies, Herbal medicines, Bovines.*

### Introduction

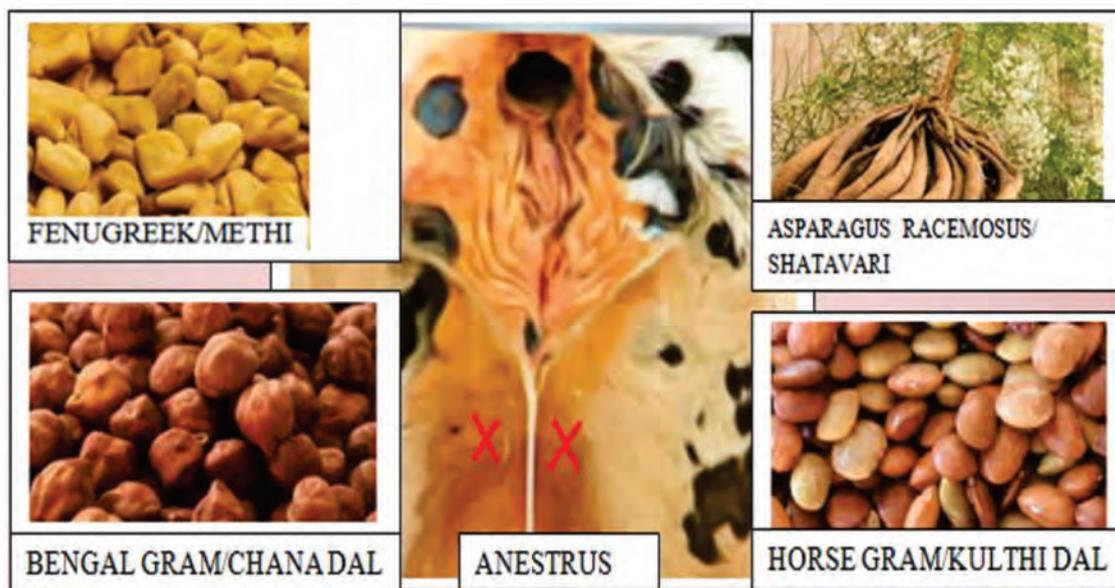
Ethnoveterinary Research and Development with its introduction highlighted folk-based knowledge, beliefs, techniques, and skills related to animal health and production. According to the World Health Organization, nearly 80% of people in developing countries rely heavily on indigenous practices to control and treat various diseases that affect both humans and animals (SriBalaji & Chakravarthi, 2010).

The majority of the rural and tribal population of India is directly or indirectly dependent on agricultural practices and livestock farming for earning a living. Marginal farmers and livestock rearers rarely manage to visit veterinary clinical facilities for addressing their animal health issues. Due to the high cost of modern medicines, different geographical barriers, and the lack of proper communication systems, farmers have preferred using old traditional ways to heal their animals. Ethnoveterinary treatments are readily available, simple to manufacture, and administer, and they come at little or no expense to the farmer. Ethnoveterinary medicine differs not only from region to region but also among and within communities. Depending upon the terrain and diversity of an area, different ethnoveterinary practices are being performed.

## Ethnoveterinary practices used in the treatment of different bovine ailments

### 1. Anestrus (Sarswat, & Purohit, 2020)

Ingredient	Quantity to be fed	Function
Fenugreek/Methi seed	1g/kg body weight	Enhance reproductive performance by stimulating the oviduct through their active ingredients such as saponins and alkaloids and due to higher amounts of major minerals (iron, calcium, and phosphorus) and trace minerals (copper manganese, and zinc).
Asparagus racemosus/ Shatavari root powder	100-200 mg/kg for 90 days postpartum	Estrogenic property to stimulate ovarian function, uterine tonicity property for early uterine involution and consequently early initiation of the estrous cycle, antioxytotic action on uterus which helps in conception or condition associated with hypermotility of the uterus as in threatened abortion, immunomodulator, antioxidant and anti-stress agent.
Germinated Bengal gram or Horse gram	200 gm orally for 7 days	Improves reproductive performance and helps in the initiation of estrus.



**2. Retention of placenta** (Sarswat, & Purohit, 2020)

Ingredients and Quantity to be fed	Mode of application
2 kg pearl millet grain+ 100g of methi seeds+50 g of asalio+25 g of suva+ 500 g of jaggery boiled in water for one hour	Orally
Chickpea flour (1 kg) mixed with buttermilk (chach)	Orally
Crushed <i>Moringa stenopetala</i> bark (0.5 kg) + 1 litre of warm water, Sieved and administered as a drench @ 1 litre for a cow, 0.5 litre for a sheep or goat) every 2 hours until the placenta is discharged	Drenching
250 gm sesame plants ( <i>Sesamum indicum</i> ) leaves pounded with 1litre of water	Drenching
Crushed 200 gm Bada goksur ( <i>Peadiium murex</i> ) plant soaked in 1 litre of water	Drenching
Balanites aegyptica Del. fresh leaves soaked in water with leaves of T. indica for about one day	Orally
Hibiscus sabdariffa Linn Apical part of plant	Orally
Ficus thonningii Blume Fresh leaves	Orally
S. bicolor, Linn. Moench Apical part of plant	Orally
Wood ash powder	Rub ash powder around vagina



Asalio/halim seed



Suva seed/Dill seed



Retention of placenta



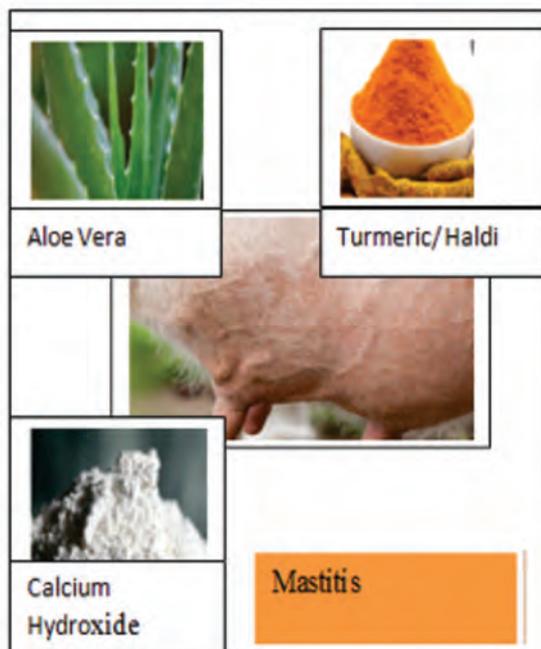
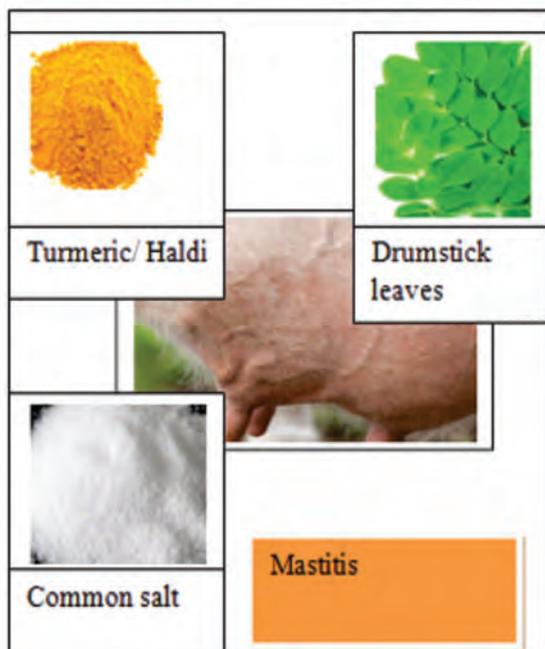
Pearl millet/Bajra



Fenugreek/Methi

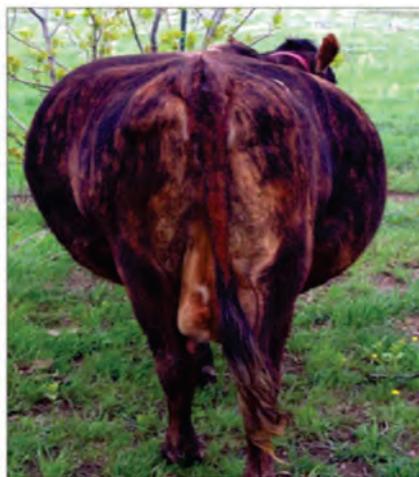
### 3. Mastitis/ Thanela rog

Plant/Ingredient	Part used/Mode of application
Aloe vera leaves, Curcuma longa rhizome (Haldi) and Calcium hydroxide (chuna) paste (Balakrishnan <i>et al</i> , 2017)	Remove milk from all quarters and wash udder with lukewarm water. Apply the paste to the affected udder 10 times daily for a week.
Benachu kallu+ Desi butter+ Betel leaf (Piper betle) paste and Sambrani (Benzoin resin) smoke to fumigate (Mooventhan <i>et al</i> , 2016)	Apply paste on affected udder followed by Sambrani (Benzoin resin) smoke fumigation for 5 – 10 minutes twice a week.
Turmeric rhizome powder (Curcuma longa) + Drumstick leaves (Moringa oleifera) +Common salt (Sodium chloride) (Mooventhan <i>et al</i> , 2016)	Blend Turmeric rhizome powder with Drumstick leaves paste for 30 minutes and add salt. The mixture is applied thrice a week
Lyonia ovalifolia (Anyar-Ericaceae) (Phondani <i>et al</i> , 2010)	Bark of Lyonia ovalifolia is ground to powder and mixed with ash of Quercus leucotricophora and its smoke is used.



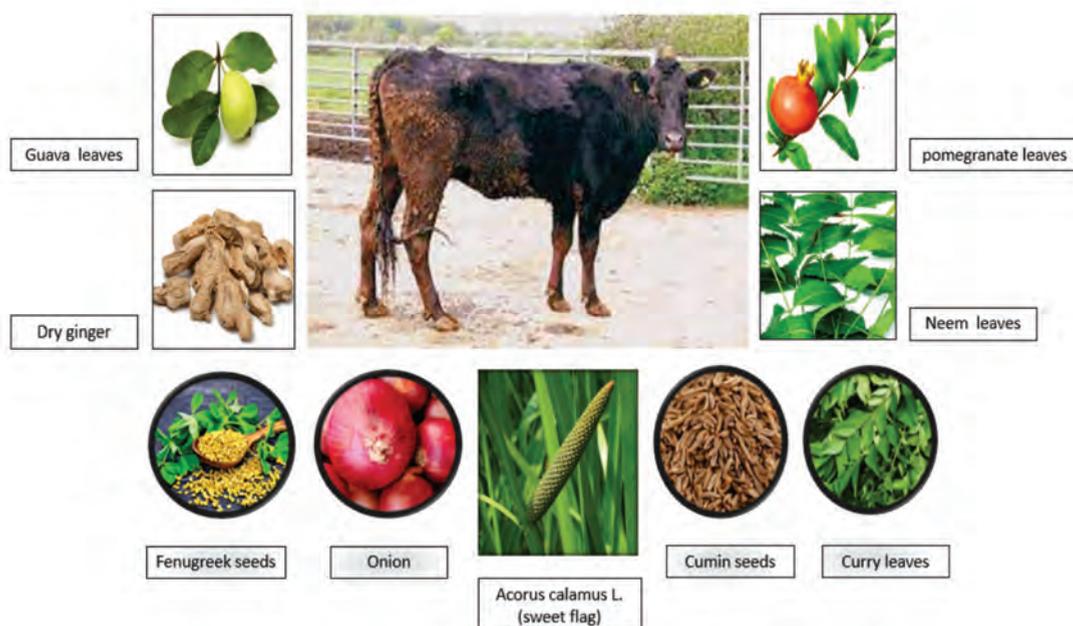
#### 4. Bloat/ Tympany

Ingredients	Quantity	Preparation	Application
Castor oil ( <i>Ricinus communis</i> ) Lukewarm water (Vivekanandan, 2022)	200 ml 200ml	Mixed by shaking	Oral administration every 4-6 hours
Common salt (sodium chloride) Wood ash (Khateeb <i>et al</i> , 2015)	60g 100g	Mixed	Fed twice a day
Beetle leaves (paan) Ginger (adrak) Black pepper Garlic (lahsun) Rock salt (Vivekanandan, n.d.)	10 in no. 20 gm 10 gm 10 gm 50gm	Pound and mix well in lukewarm water	Oral administration at 6 hours interval
Angelica glauca Edgew (chora, choru, chouria) roots (Khateeb <i>et al</i> , 2015)	300gm	Grind and mix in water	Drench twice a day



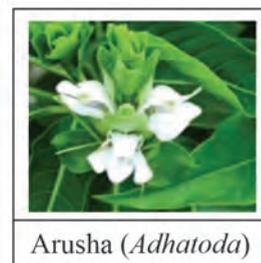
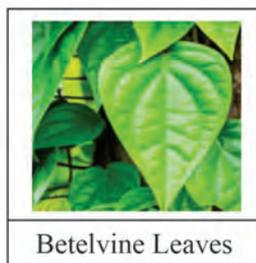
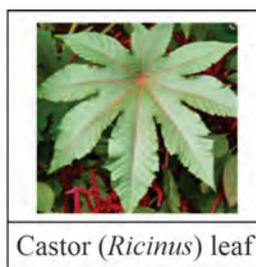
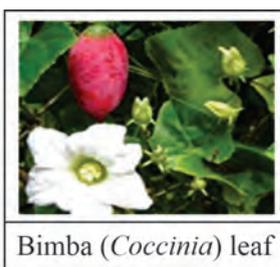
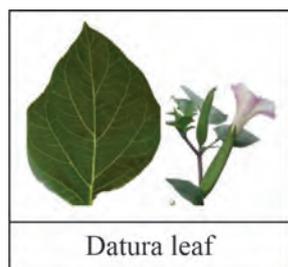
### 5. Diarrhoea

Ingredients	Quantity	Preparation	Application
Tender leaves of Pomegranate (Anar), Guava (amrud), Indian lilac (Neem) Dried ginger Jaggery (Vivekanandan,2022)	One handful of leaves 50gm 100gm	Grind and make three bolus	One bolus at a time, thrice daily
Fenugreek(methi) seeds Onion (pyaaz) Garlic (lahsun) Cumin seeds (jeera) Turmeric (Haladi) Curry leaves (Kari patta) Poppy seeds (khas khas) Black Pepper (kali mirch) Jaggery (gud) Asafoetida (heeng)	10gm 1 in no. 1 pearl 10gm 10gm 1 handful 5gm 10gm 100gm 5gm	Dry fry cumin seeds, asafoetida, poppy seeds, and fenugreek seeds Grind the fried seeds and mix with the rest of the ingredients to make a paste Roll the paste into small balls	Oral administration, once daily
Acorus calamus L. (sweet flag)(Khateeb <i>et al</i> , 2015)	Whole plant	Grind	Feed 100 gm twice a day, for 2 days



**6. Miscellaneous ailments** (Vivekanandan, 2022)

<b>Ailment</b>	<b>Ingredients</b>	<b>Method</b>	<b>Application</b>
Traumatic wounds and maggot infestation	Coconut oil 250 ml, Datura leaf extract 250ml and Copper sulfate 2.5gm	Boil datura leaf extract in coconut oil for 1 hour and add copper sulfate to it.	Directly on wound
Eye injuries	Leaves of Bimba ( <i>Coccinia grandis</i> ) and Castor ( <i>Ricinus communis</i> )	Crush, mix with a pinch of salt, and extract Juice	Few drops in the eyes
Ectoparasites	20 gms each of Garlic, Tulsi, Neem leaves, Seethapal Seeds, Turmeric, and Neem oil	Grind and boil in neem oil	Directly applied over the body
Poisonous bite	10 gm each of betel vine Leaves (paan), tulsi, pepper, dried ginger	Grind and boil in warm water	Administer orally and add a few drops to the eyes
Respiratory tract infections	100 gm leaves of Tulsi ( <i>Ocimum sanctum</i> ) and arusha ( <i>Adhatoda vasica</i> ), 50 gm ginger, 10 gm pepper and 100 gmjaggery	Boil all the ingredients in 1 liter of water	Administer 100 – 250 ml of the decoction 2-3 times daily.



## References

- Balakrishnan, M. N., Punniamurthy, N., Mekala, P., Ramakrishnan, N., & Kumar, S. K. (2017). Ethno-veterinary formulation for treatment of bovine mastitis. *Journal of Veterinary Sciences*, 18(S1), 377-382.
- Ethnoveterinary Formulations for Important Ailments in Bovines*. (n.d.). Vikaspedia.In. Retrieved April 1, 2022, from <https://vikaspedia.in/agriculture/livestock/general-management-practices-of-livestock/ethnoveterinary-formulations-for-important-ailments-in-bovines>
- Khateeb, A. M., Khandi, S. A., Kumar, P., Bhadwal, M. S., & Jeelani, R. (2015). Ethno-veterinary practices used for the treatment of animal diseases in Doda district, Jammu & Kashmir. *Indian Journal of Traditional Knowledge*, 14(2), 306-312.
- Mishra, D. (2013). Cattle wounds and ethnoveterinary medicine: A study in Polasara block, Ganjam district, Orissa, India.
- Mooventhan, P., Manimaran, A., Kumar, R. S., Selvan, A. S., & Prakash, M. A. (2016). Indigenous ethnoveterinary medicinal practices for management of mastitis in dairy cattle. *Indian Journal of Animal Research*, 50(1), 137-139.
- Phondani, P. C., Maikhuri, R. K., & Kala, C. P. (2010). Ethnoveterinary uses of medicinal plants among traditional herbal healers in Alaknanda catchment of Uttarakhand, India. *African Journal of Traditional, Complementary and Alternative Medicines*, 7(3).
- Sarswat, C. S., & Purohit, G. N. (2020). Use of ethno-veterinary medicine for therapy of reproductive disorders in cattle. *J Entomol Zool Stud*, 8, 1006-16.
- SriBalaji, N., & Chakravarthi, V. P. (2010). Ethnoveterinary practices in India-A review. *Veterinary world*, 3(12), 549.
- Vivekanandan, P. (2022). *Ethnoveterinary Practices*. Sustainable Agriculture & Environment Voluntary Action (SEVA). Retrieved April 1, 2022, from <http://sevango.in/herbal-treatment-for-animals-english/>

## FUNCTIONAL ANATOMY OF UDDER IN VARIOUS SPECIES OF ANIMALS

Samikshya Sarangi and Neelam Bansal\*

Department of Veterinary Anatomy, College of Veterinary Science (Ludhiana),  
Guru Angad Dev Veterinary and Animal Sciences University, Punjab-141004, India

\*Corresponding author E-mail: bansal.neelam@rediffmail.com

### Abstract

*The mammary glands are modified sudoriferous (sweat) glands located outside the abdominal cavity and are grouped together to form an udder in some species. The shape of udder depends on the maturity, functional status as well as on the individual and breed characteristics. The number and shape of teats varies depending upon the species and breed. Histologically gland is covered by a fibroelastic capsule and comprises of milk secreting unit known as alveoli which are drained by ductular channels. The teat consists of a teat cistern and a streak canal. Species specific variation is seen in the number of teat sinus and streak canal per teat. Presence of streak canal explains the primary protective mechanism against microbial entry into the mammary gland. The mammary glands, particularly in milch animals, are prone to traumatic injury, infection and other diseases, knowledge of basic anatomy can be useful in understanding the extent of tissue damage, pathophysiology and assuring right approach in treating and restoring the functional state of the udder and teat.*

**Keywords:** Applied anatomy, mastitis, teat, udder,

### Introduction

The mammary gland is an organ unique to the animals of class Mammalia. Mammals get their name from the word “mammary”. Mammary gland is the largest exocrine gland in the animal body with its function of milk synthesis, secretion, and involution to prepare the gland for subsequent lactation (Rowson *et al.*, 2012). The anatomical knowledge of mammary gland at different stages is desirable, to understand the background information in the physiology, pathology, surgery, medicine, livestock production and management and genetics. Since the mammary glands are very prone to traumatic injury, infection and other diseases, the basic anatomy play a crucial role in understanding the extent of tissue damage and help in assuring right approach in treating and restoring the functional state of the udder and teat.

### External Structures

The mammary glands are modified sudoriferous (sweat) glands and are located outside the abdominal cavity. The mammary glands in some species are grouped together in a structure called the udder (Dyce *et al.*, 2010).

**Udder:** In cows, the udder is covered by thin, easily movable skin which has thin hair except teat that is totally hairless. An even, hemispherical udder is present in mare, ewe and cow whereas a more sac – like udder is seen in doe. The appearance of the udder varies greatly, depending on maturity and functional status. Individual and breed specific variations also affect the shape of udder.

These variations are more prominently observed in buffaloes. The different shapes of udder in buffalo are bowl, globular, pendulous and goaty. Some studies showed bowl shaped udder yields more milk which might be due to forward and backward extension of the udder quarters (Prasad *et al.*, 2010). The occurrence of trough shaped udder is more in Indian cows, whereas the crossbred cows mostly have pendulous type of udder (Susanta *et al.*, 2013).

The gland is divided into smaller fore quarters and larger rear quarters. The udder is composed of right and left halves, divided by median suspensory ligament also known as longitudinal intermammary groove. Each half is further divided into two separate quarters by less prominent thin membranes (Pandey *et al.*, 2018). All the four quarters are independent of each other thus preventing spread of infection from one quarter to another.

**Mammary Gland:** The gland, in domestic animals, consists of variable number of milk glandular units called mammary complexes. The hemispherical glandular mammary complexes terminates at papilla-like appendage present ventrally known as the teat. A single mammary complex is present in the human beings, horse and small ruminants; however, the cow has two, cat has four, the dog has four or five and in the pigs six to eight mammary complexes are found (Dyce *et al.*, 2010).

The shape, position and size of the mammary gland differ from species to species owing to the presence of number of mammary complexes. The mammary glands are located in the inguinal region in cattle, sheep, goat and horses whereas in primates and elephant the glands are placed in the thoracic region. In case of pigs, rodents and carnivores, the mammary glands spread along the ventral surface of the thoracic and the abdominal region (Dyce *et al.*, 2010).

**Teat:** The teats are cylindrical or conical in shape, elastic and serve as the exit for milk from each gland. There are four functional teats in cattle, two in sheep, goat and horse, eight to ten in carnivores and ten to eighteen in swine. Each teat has one streak canal draining a separate gland in cow, ewe and doe whereas the mare has two to four and in sow there are two to three streak canals per teat, with each canal draining different secretory regions. The number of streak canals in rodents, carnivores, and primates ranges from 10 to 20 per teat.

The origin, shape and covering skin of teats show species variation. The teats

originate abruptly in cow, sow, ewe and bitch whereas in mare and doe, these originate more gradually from the body of the mammary gland. Further, the teats of cow, buffalo and sow are devoid of hair whereas in mare, ewe and doe sparse covering of hair is present.

The teats of cow are craniolaterally oriented, cylindrical, peg-like appendages with rounded tips. The cylindrical shape teats are more prone to mastitis. The craniolateral orientation is remarkable when the teat cisterns are full of milk.

The shape of teats in buffaloes varies greatly within species and also within breeds which can be classified as conical, bottle, pear, cylindrical and funnel although the cylindrical teats are more frequently observed than other shapes.

### **Internal Structures**

**Udder:** The ligaments and tissues which help in suspension of the udder from body plays crucial role in lactation. This apparatus comprises of various elements imparting different functions (Fig. 1) namely:

1. Suspensory system
  - a. Skin
  - b. Superficial fascia
  - c. Coarse areolar tissue
2. Lateral suspensory ligament
  - a. Superficial
  - b. Deep
3. Median suspensory ligament

**1. Suspensory system:** The skin and superficial fascia covers the udder and provide very little suspensory support to udder. The coarse areolar tissue attaches the dorsal surface of the front quarters to the abdominal wall and it helps in keeping the fore quarters in proximity of the body wall, though it too does not provide any major support to the udder. But it is of importance during evaluation of conformation in dairy cows.

**2. Lateral Suspensory Ligament:** The lateral suspensory ligament originates from the subpelvic tendon and is further divided into superficial and deep layers.

- a) The superficial lateral suspensory ligament with fibrous and few elastic tissue stretches cranioventrally from the pubic region towards the udder and wraps the udder externally running below the skin and adhered to the areolar tissue layer.
- b) The deep layer of lateral suspensory ligament is also composed of mostly fibrous tissue. But unlike the superficial layer, it forms a thicker envelop covering most parts of the udder except at the bottom, as a result of which center of the udder tends to pull away from the body as the gland fills. Externally the deep layer

is attached to the superficial suspensory ligament and internally sends lamellae into the glandular part which becomes continuous with the interstitial framework of the udder. The lateral suspensory ligaments thus form the major support system of the udder.

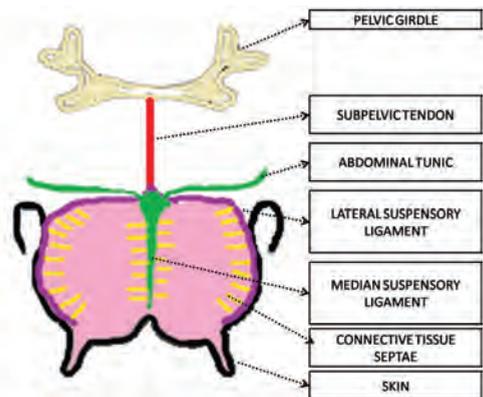
The median suspensory ligament originates from the abdominal wall and extends to the medial surface of the left and right halves of the udder. Unlike the lateral suspensory ligament, median ligament is elastic in nature and forms thick layer of yellow elastic sheet partially separating the left and the right halves of the udder. The elasticity and tensile strength of this ligament holds the weight of the udder when large amount of milk is produced. In addition, the ligament covers the center of gravity of udder, thereby providing balanced suspension of the udder.

**Mammary Gland**

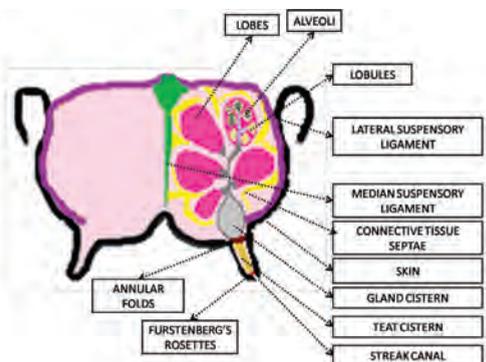
It is comprised of secretory ductular and connective tissue (Fig. 2) and the proportion of these tissues determine the milk producing ability. Therefore, a bigger udder having more connective tissue will produce less milk as compared to a smaller udder having more secretory tissue (Trautmann and Fiebiger 2002).

The secretory units are lined by simple cuboidal epithelium placed on a basal membrane surrounded by myoepithelial cells and arranged in a spherical structure called alveolus (Fig. 3). The height of the epithelium varies between different stages of reproductive life. Several alveoli join to form a lobule and several lobules surrounded by a connective tissue sheath forms a lobe. Milk is produced continuously in the alveoli of a lactating mammary gland.

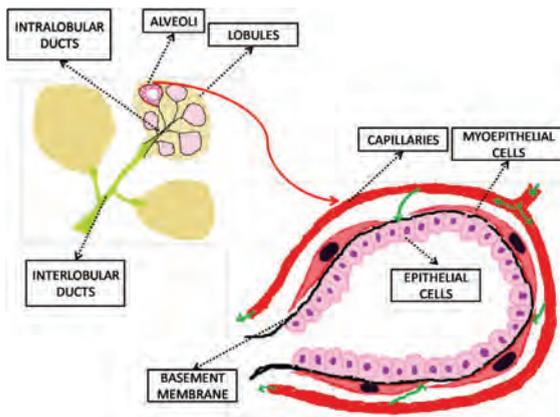
An extensive duct system is present in the mammary gland which drains the milk from the alveoli to the teat. The duct system is lined by stratified cuboidal to stratified columnar epithelium (Dellman and Eurell 2003). About 60-70% of the milk synthesized is stored in the alveoli and milk ducts. However, there are some large open pockets



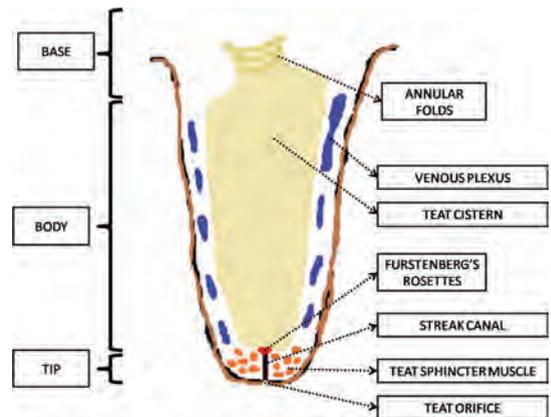
**Fig. 1.** Schematic diagram showing suspensory apparatus of buffalo udder



**Fig. 2.** Schematic diagram showing division of lobes, lobules and alveoli



**Fig. 3.** Schematic diagram showing alveolar structure



**Fig. 4.** Schematic diagram showing regions of teat sinus and streak canal

formed at the end of the interlobular ducts known as lactiferous sinuses lined by double layered columnar epithelium. These sinuses are divided into gland cistern and teat cistern by annular folds or cricoids rings. Only the gland cistern functions for milk storage and stores the remaining 30 - 40% of the formed milk.

### **Teat**

The teats are divided into different regions (Fig. 4) and are named as

1. Base or root
2. Body
3. Tip of teat

The base or root of the teat consists of the widest part of the teat cistern. Externally it is marked by the junction between the hair-bearing skin of the udder and the hairless skin of the teat. This region continues into the middle or the body of teat externally and the teat cistern internally. This teat cistern or sinus papillaris is a cavity within the teat continuous with the gland cistern (Paramasivan *et al* 2013). This region is lined with numerous longitudinal and circular folds in the mucosa forming pockets on the mucosal layer of the teat. The teat cistern fills with milk during the milk letdown which is removed by suckling action of the calf.

A large and elongated teat cistern is present in the cow and doe whereas a smaller cistern is seen in the ewe. In equines, swine and canines, there are multiple number of cavities per teat. Mare has 2, the sow has 2 or 3, cat has 5 to 7 and in the bitch 8 to 12 cavity systems are present per mammary complex. The teat cistern is continuous with the exterior of the teat through a narrow opening at the end of the teat, the ductus papillaris or papillary duct (commonly called streak canal or teat canal), which opens at the ostium papillae.

The streak canal connects the milk secreting system with the external environment and acts as the main barrier against intramammary infection. The longitudinal and circular sphincter muscle layers surrounding the canal keep it closed. With each lactation, the streak canal length increases and the canal patency decreases. The mucosal folds at the internal end of streak canal are known as Furstenberg's rosettes which act as the local defense against mastitis. It folds over the canal opening when the udder is full and prevents entry of pathogens. The keratin or keratin like substances present in the teat canal also acts as a barrier against pathogenic bacteria (Frandsen *et al* 2009).

During milking, the sphincter muscles relax to make the orifice opens; however, the streak canal remains open for an hour or more after milking. Mostly the pathogenic organisms causing mastitis gets inside the gland during this period. The chances of mastitis can be lowered by keeping cows standing for some time after milking. During the dry period, the canal is sealed by the keratin plug.

## References

- Dyce, K.M., Sack, W.O. & Wensing, C.J.G. 2010. *Textbook of Veterinary Anatomy*. 4th Edn. W B Saunders, Philadelphia.
- Frandsen, D.R., Wilke, W.L. & Fails, A.D. 2009. *Anatomy and physiology of farm animals*. Edn. 7th. pp 449-456
- Pandey, Y., Taluja, J.S., Vaish, R., Pandey, A., Gupta, N. & Kumar, D. 2018. Gross anatomical structure of the mammary gland in cow. *Journal of Entomology and Zoology Studies* **6**(4): 728-733
- Paramasivan, S., Geetha, R., Ushakumary, S., Basha, S.H., Kannan, T.A. & Kumaravel, A. 2013. Gross and microscopic anatomy of teat in madras red sheep. *Indian Veterinary Journal* **90**(4): 44-47
- Prasad, R.M.V., Sudhakar, K., Raghava, R.E., Gupta, R.B. & Mahender, M. 2010. Studies on the udder and teat morphology and their relationship with milk yield in Murrah buffaloes. *Livestock Research for Rural Development* **22**(1): 1-9
- Rowson, A.R., Daniels, K.M., Ellis, S.E. & Hovey, R.C. 2012. Growth and development of the mammary glands of livestock: a veritable barnyard of opportunities. *Seminars in Cell and Developmental Biology* **23**: 557-66.
- Susanta, P., Partha, D. & Kumar, R.G. 2013. Comparative cellular structure of udder and teat of desi and crossbred cows in reference to Mammary Gland immunity. *Indian Journal of Veterinary Anatomy* **25**(1): 16-17
- Trautmann, A. & Fiebiger, J. 2002. *Fundamentals of the histology of domestic animals*. Cumstock Publishing Associate, Ithaca, New York.

## SIGNIFICANCE OF STARCH IN DAIRY CATTLE NUTRITION

**Digvijay Singh, JS Hundal\*, Amit Sharma and Udeybir Singh**

Department of Veterinary nutrition, College of Veterinary Science (Ludhiana),  
Guru Angad Dev Veterinary and Animal Sciences University, Punjab-141004, India

\*Corresponding author E-mail: drjshundal@gmail.com

### Abstract

*Ruminant nutrition relies heavily on starch as an energy source. This carbohydrate is frequently utilised to improve rumen fermentation, support structural carbohydrate digestion and increase protein flow to the small intestine. Starch digestion is accomplished by microbial and digestive enzymes, which produce compounds that have positive or negative impact on animal health and performance, depending on the amount of starch in the diet. This article describe the basic characteristics of starches in common feed ingredients and fodder and their effects on ruminants. Conclusion: several factors affect starch digestibility, amylose/amylopectin ratio, the proportion of amorphous and crystalline endosperm, fermentable and bypass starch and physical-chemical processing of the feed. Optimization of starch with NDF level in the dairy ration is a critical nutritional management. Ingestion of large amounts of starch can trigger ruminal acidosis. However, its rational use in the diet has positive effects on body condition score and in milk yield and composition.*

**Keywords:** Cattle, Starch, Milk production and diet.

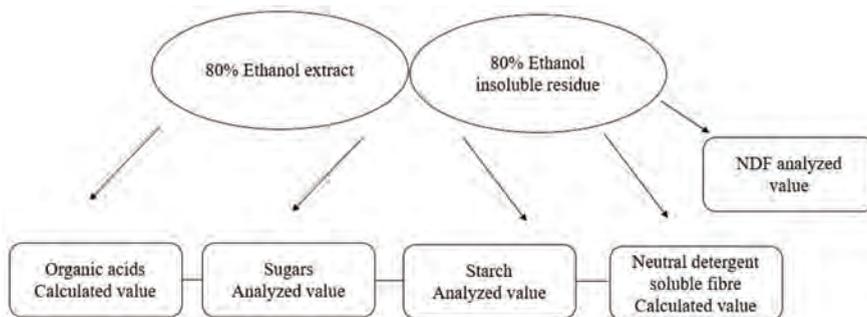
### Introduction

Ruminants have evolved their digestive system to digest fibrous feedstock and can convert low-quality protein to microbial protein via foregut microbial fermentation. Cellulose is a polysaccharide that forms the cell wall and structural integrity of plants, whereas starch is a major source of energy for seed germination. Morphologically, the majority of the starch is concentrated in the endosperm and distributed in four layers. Furthermore, when we look at the chemical composition, we can see that starch granules are made up of amylose (30-35 percent) and amylopectin (60-65 percent). The portion of endosperm which is rich in amylopectin forms crystalline starch granules, comparatively resistant to the enzymatic degradation than the amorphous starch consisting of amylose. In cereal grains, starch content ranges from 45% for oats to 72% for corn (DM basis). Most of the dietary starch is supplied by cereal grains. Forages vary in starch content from less than 12% of DM for maize fodder and leguminous forages to as much as 25-35% for corn silage. Maintaining optimal dietary starch level is important for fibre digestion, maximizing microbial protein yield to maintain the peak of milk production and body condition score in the Cattles. Before formulating the diet, it is necessary to consider the sources of starch, as well as the dynamics of starch degradation, factors

affecting the passage rate, the proportion of bypass and fermentable starch of total starch. Ruminal starch fermentation has a direct impact on ruminal pH, low ruminal time (pH < 5.8), VFA and soluble nitrogen escape for microbial synthesis. Starchy grains are commonly introduced to replace fibres in the diet to increase energy content and match the energy requirements of lactating animals. This increases DM intake (DMI) and animal performance (Allen, 2000).

### Starch and sugar estimation

The nonfiber CHO includes sugars, starches and the other reserve CHO such as galactans and pectins. The lab analysis for starch is determining the amount of dextrose (glucose) and multiplying it by a factor to come up with the starch content. In this system low molecular weight sugar and organic acids are separated from starch and non starch polysaccharides using 80 percent ethanol extraction,



**Fig. 1.** Partitioning neutral detergent soluble carbohydrate with 80 percent ethanol, direct analysis, and calculated estimates.

Despite its importance, there are only a few ways for determining total starch content in a diet. There is currently only one AOAC (2015) Official Method available (i.e., 920.40 for starch in the feed). Direct acid hydrolysis is time-consuming and may lack specificity depending on the compound feed constituents. Polarimetry [Ewers, ISO 6493:2000], Megazyme kit, YSI analyzer, and NIR [ISO 12099:2010] are some of the other quantitative methods. Hall used an Enzymatic-Colorimetric Method to characterise dietary Starch in Animal Feeds and Pet Food (Hall, 2015).

There are several factor which influences the starch estimation of ingredients such as grain varieties, processing of grains, climates and topographic location cultivars, method of estimation and others. A range of starch content in commonly available feed ingredients is listed below.

**Table 1. Starch content in commonly available feed ingredients**

Ingredients	Starch (% DM)
Corn grain	70 -75
Barley grain	50-56
Oat grain	40-44
Wheat grain	62-65
Hominy	50 - 55
Wheat midds	18-26
Wheat brans	22-26
Corn gluten feed	14-18
Corn gluten meal	15-18
Corn germ meal	15-18
Corn silage	20-45

### Starch and Sugar Recommendations

The precise starch and sugar concentration in dairy cattle diets is still not well known. However starch content in rations ranges from less than 20 percent for dry cows to more than 35 percent for lactating cows. Microbial crude protein synthesis can be maximized when rapidly soluble nitrogen in the rumen is synchronized with the soluble sugar and starch content of the diet. Usually, sugar levels range from three to nine percent on a dry matter basis. Aside from the level in the diet, there are several other factors to consider. Forage particle size, grain feeding frequency, starch digestion site, fibre digestibility, use of by-product feeds, grain processing method and dry matter intake are all factors to consider. Ruminal starch fermentation is extremely variable from less than 50% to greater than 90% and is a function of the rate of fermentation and retention time of feed particles in the rumen (Dann *et al*, 2014).

It's difficult to formulate rations that have the 'optimal' level of forage NDF or total NDF. It's not just important the amount of NDF, but the amount of starch and its digestibility should also be considered. The minimal amount of NDF should be increased to avoid exceeding the maximum amount of starch. The maximum amount of NDF allowed in the ration is determined by the cow's energy needs, the minimum amount of NSC required to maintain normal rumen function and the potential detrimental impact of excessive NDF on feed intake.

There are several indicators to monitor that may reflect rations improperly balanced or implemented for starch to fibre diet. These include milk fat percentage,

rumination and cud-chewing, dry matter intakes, metabolic problems (e.g., ketosis), lameness (laminitis), ruminal acidosis, and fecal consistency.

### **Deficient Starch or Excess NDF**

A diet that has a total NDF of more than 1.3 to 1.4 of percent body weight or a forage NDF of 1.1 percent of body weight, will be the diet of low starch content. Feeding situations of a lean period where NDF may be excessive and starch deficient in the diet fed, longer feed retention time in the rumen may occur, which can restrict dry matter intake. This would be a concern for cows in early lactation and high yielder. Animals fed a low-energy diet or herds that are not properly managed (overstocking) may have lower feed intake, metabolic diseases (subclinical ketosis) and a negative energy balance. A decrease in BCS and an increase in milk fat to milk protein ratio can be useful indicators; during early lactation, body fat starts to mobilise and milk fat increases.

### **Deficient NDF and Excess Starch**

Low NDF and high starch feeds have a deleterious impact on cow health. Ruminal acidosis is a word used to characterise this situation. Ruminal pH, milk fat percent and chewing activity are indicators that respond quickly to these feeding changes. Laminitis, ketosis, abomasal displacement and liver abscesses are some of the long-term side effects.

When cows were shifted to a low forage diet, they spent less time eating and ruminating. Because rumen acidosis reduces the frequency of rumination, cows' chewing activity is frequently utilised as an indicator for healthy animals. When watching rumination on a dairy farm, 60 percent or more of the herd should be ruminating (chewing cud) at any given moment, which is considered healthy rumen function (Stauder *et al*, 2020). First lactation animals had a greater subacute ruminal acidosis index (spent on average 4.6 hours/day longer below a pH of 5.8 compared to older cows), more susceptible to ruminal acidosis than older cows fed the same diets and feeding management. A sudden drop in milk fat percent may indicate low ruminal pH. Other nutritionally related reasons for low-fat tests include the amount and type of fat being fed and cows freshening at a low body condition (body condition score less than 3 on a 5-point scale)

Herd fecal consistency, or the presence of grains in feces, is another important practical indicator of starch-rich feed. During acidosis, manure consistency may become more fluid. This happens when a large amount of easily fermentable starch is consumed, causing lactic acid to pass to the lower digestive tract. In addition, some starch may escape the rumen and ferment it into volatile fatty acids in the large intestine. Rumen acidosis is also a major cause of laminitis. When the pH of the rumen drops below 5, endotoxins are released as a result of the microbes that have been killed, and this can cause histamine release. Histamine causes vasoconstriction in the hoof, resulting in laminar destruction and hoof deterioration.

In summary Carbohydrate nutrition is complex and necessitates a balanced approach between structural and non-structural components, particularly starch, when feeding dairy cattle. Every farm will require a unique approach based on forage quality, cereal grains fed and the various by-product feeds used to supplement the diet. Feed management practices and feed sources used can have a significant impact on how starch is utilised, whether it is fermented in the rumen or bypassed. When formulating the diet, the fibre and starch levels must take into account herd dynamics such as days in milk, cow physiological stage, and cow lactation. Imbalances in these diet critical components can have a negative impact on animal performance and health, with both short- and long-term consequences. Checking milk production, components and dry matter intake at the time of sampling is beneficial to ensure CHO/starch levels are in line with animal performance.

### References

- Association of American Feed Control Officials, Inc. AAFCO Official Publication, 2016, Champaign, IL.
- Hall, M.B., 2015 Determination of dietary starch in animal feeds and pet food by an enzymatic-colorimetric method: collaborative study. *J. AOAC Int.*, 98: 397-409
- Dann, H. M., H.A. Tucker, K.W. Cotanch, P.D. Krawczel, C.S. Mooney, R.J. Grant, T. Eguchi, 2014. Evaluation of lower-starch diets for lactating Holstein dairy cows. *J. Dairy Sci.* 97(11): 7151-7161.
- Stauder, A, E. Humer, V. Neubauer, N. Reisinger, A. Kaltenegger, Q. Zebeli, 2020. Distinct responses in feed sorting, chewing behavior, and ruminal acidosis risk between primiparous and multiparous Simmental cows fed diets differing in forage and starch levels. *J. Dairy Sci.* 103(9): 8467-8481.
- Oba, M. and M.S. Allen, 1999. Evaluation of the importance of digestibility of neutral detergent fiber from forage: Effects on dry matter intake and milk yield of dairy cows. *J. Dairy Sci.*, 82: 589-596.

## ANTHELMINTIC RESISTANCE AND ITS MANAGEMENT IN GASTROINTESTINAL NEMATODES OF SMALL RUMINANTS

Paramjit Kaur\*

Department of Veterinary Parasitology, College of Veterinary Science (Ludhiana),  
Guru Angad Dev Veterinary and Animal Sciences University, Punjab-141004, India

\*Corresponding Author E-mail: paramvet53@rediffmail.com

### Abstract

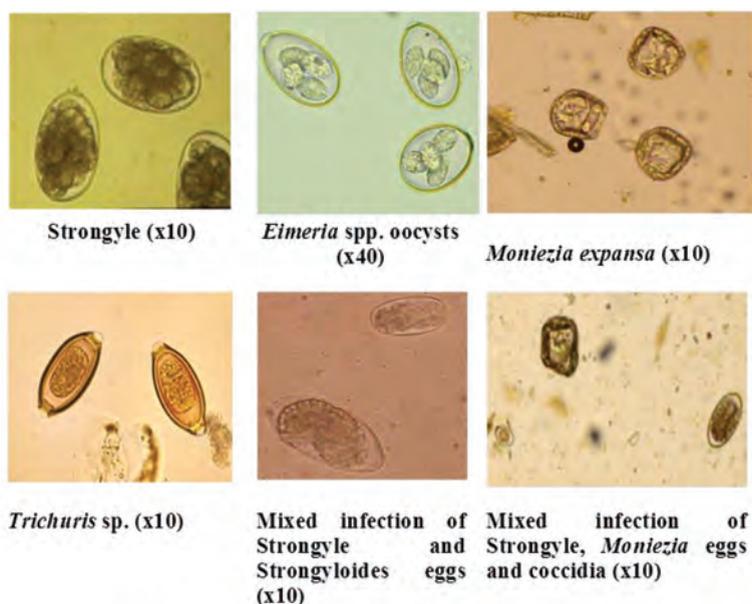
*Anthelmintic Resistance (AR) menace especially in GIT nematodes of small ruminants is of serious concern worldwide. The documented reports showed the failure of multiple drugs at the farms. The development of new novel anthelmintics required multiples challenges from cost of development to end users and hasty rate of development. To overcome the problem of AR, regular monitoring by reliable diagnostic tools and further to slow down the development of resistance, integrated approaches are the need of the time.*

**Key words:** Anthelmintic Resistance, Gastrointestinal Parasites, Goats, Management, Sheep

### Introduction

Livestock sector in India is gaining potential over the years; the gross national livestock population is 535.78 million. The population of sheep and goat increased by 14.1% and 10.1%, respectively over the last census according to 20<sup>th</sup> Livestock Census depict that that farmers are adopting rearing of small ruminants. The small ruminants are primarily reared by the marginal landless farmers on the extensive grazing management that make these animals more susceptible to the gastrointestinal (GIT) parasitic infections. The problem of GIT parasitic infections is main challenge in small ruminants of tropical and subtropical parts of the world due to the favourable geoclimatic conditions for the development of the parasites. The transmission of the GIT parasites is by direct (faeco-oral) route in majority of the worms as the pasture contamination by the infected animals; grant the danger to the next healthy animals, if grazed in the contaminated areas. Some countries has estimated the economic loss by the parasitic diseases as about 1 billion \$ in Australia, 7.11 billion dollars in Brazil and supposed to be tens of billions dollars globally (Rober *et al.*, 2013). Common GIT parasites of the small ruminants include *Haemonchus contortus*, *Trichostrongylus circumcincta*, *Ostertagia trifurcata*, *Trichostrongylus axei*, *Strongyloides* species, *Moniezia* species, amphistomes and coccidia species. Among these nematodes, *H. contortus* is the most pathogenic predominant, haematophagous parasite (0.05 ml/ parasite/day) and estimated cost incurred on its treatment alone in India is 103 million USD per annum (Peter & Chandrawathani, 2005). In Punjab state an overall prevalence of GIT parasite in sheep and goat of different agroclimatic zones of Punjab is in range of 83-84% (Singh *et al.*, 2017; Pawar *et al.*, 2019).

The routine diagnosis of GIT parasites is based on coproscopic analysis of the faecal samples for the ova/cyst (Figure 1). At least the genus of parasites is identified from the shape, size and typical features of the eggs except the strongyloid type that have overlapping morphological characteristics. Gastrointestinal parasites control at most of the farms is based on judicious use of the anthelmintics rather than the management that embrace the integrated approaches. Presently, the three classes of anthelmintics most commonly used in livestock are benzimidazoles (BZs), macrocyclic lactones (MLs) and cholinergic agonists (mainly levamisole). Since the early 1960, the chemical control of parasites in animals was very fruitful as the available anthelmintics reduced the parasite burden effectively, wide margin of safety, broad spectrum nature and cost effective. But over the time the injudicious use of the anthelmintic drugs has led to a severe and dramatic level of anthelmintic resistance (AR), primarily in small ruminant gastrointestinal nematodes. The increasing development of AR in parasites of livestock is threatening to animal health and production worldwide.



**Fig. 1:** Eggs/oocysts of common GIT parasites of sheep & goats

**AR and its types:** Anthelmintic resistance is a heritable loss of sensitivity of an anthelmintic in a parasite population that was earlier susceptible to the similar anthelmintic. On scientific basis the resistance has been identified by an increase in the proportion of organisms in a population carrying a gene demonstrated to be linked with resistance (Prichard, 2007). The three types of AR, namely cross resistance, side resistance and multiple resistance exists. The side and cross resistances are condition in which a drug-selected population has a gene coding for a mechanism that defeats the toxicity of the drugs within a mode

of action families and from different mode of action families, respectively. Resistance among benzimidazoles anthelmintics is considered as an example of side resistance. It is reported that strains that are resistant to levamisole also develop side resistance to morantel. Development of resistance to two or more anthelmintic having a similar or different mechanism of action is known as multiple resistance. The status of AR at the representative farm of sheep and goats in Punjab state showed multiple drug resistance ((Buttar *et al.*, 2012; Singh *et al.*, 2017a; Pawar *et al.*, 2019).

**Factors accountable for the development of AR:** The multifarious factors responsible for development of AR are genetic, biological, operational or environmental factors. The major factor is the parasite biology that includes genetic framework, fecundity and the interval between numbers of generation produced, host parasite interaction (parasitism) which involves on hypobiosis. It is presumed that resistance alleles already exist within the parasite population, prior to the first introduction of a drug. The environmental conditions include climate, presence of the worms in body of the host or free living stages. However, mainly the operational factors such as frequency of deworming, under dosing, mass treatment of the herd, single drug regimens (continuous use of one class of anthelmintics), time of dosing, post treatment immediately move the animal to the grazing, scrounge of resistance by introducing any new animal in the herd, irrelevant use of the drug etc.

**Detection of AR:** With the fast pace of the development of AR, there is an urgent requirement of reliable and established detection tool. *In vivo* and *in vitro* assays are used to detect and test AR. *In vivo* assays include faecal egg count reduction test (FECRT), and Controlled test. The most widely used method for detecting and monitoring the presence of anthelmintic resistance in GIT parasites at field level is FECRT, which is appropriate for all types of anthelmintics. For FECRT, faecal samples are collected before and after the day of treatment with the anthelmintic to be tested. Using a modified McMaster technique, eggs per gram faeces (EPG) is estimated. Seven to 10 days later of treatment fecal sample is again collected and tested for EPG. The percentage in reduction in egg count is calculated based on the arithmetic mean of the individual or group of animals. The However, the controlled test is the most reliable method of assessing anthelmintic efficacy but rarely used because of slaughtering of the tested animals, costly and laborious. *In vivo* assays owe the limitation that it not suitable if the resistant worm population is less than 25 percent. *In vitro* assays includes Egg Hatch Assay (EHA), Larval Development Assay (LDA), Larval Paralysis test (LPT). The LDA test is suitable for the detection of resistance to all the classes of anthelmintics and is more appropriate for dose discriminations.

The molecular based allele specific PCR (AS-PCR) only employed for the detection of benzimidazole resistance only, as the molecular mechanisms for resistance to

tetrahydropyrimidines and macrocyclic lactones are not fully explored. AS-PCR is more sensitive and specific test that can perceive the level of resistance less than 1 percent and is widely explored throughout the world to detect the BZ resistance in *H. contortus*. By AS-PCR the larval population of *H. contortus* in sheep of western zone of Punjab showed 30.0 and 70.0% susceptible and resistance allelic frequencies, respectively (Singh *et al.*, 2019).

**Mitigation of strategies for reduction in development of AR:** As reported in several published documents, the cause for increase of resistance to anthelmintics is due to the selection of resistant individuals in the worm population as a result of repeated anthelmintic exposure. To slow down the further development of resistance, following integrated parasite managemental practices needs to be followed:

### A. Treatment strategies

**Correct dosage and appropriate use of anthelmintic:** Under dosing and overdosing leads to the resistance. The anthelmintic should be given as per the weight of the animals. Fasting of animals for up to 24 hours may improve efficacy of dewormers, especially when using benzimidazoles and ivermectin. However, water should not be restricted.

**Drug rotation:** Alteration of the anthelmintic with class of antiparasitic drugs having different mode of action is must follow to slow down the resistance development.

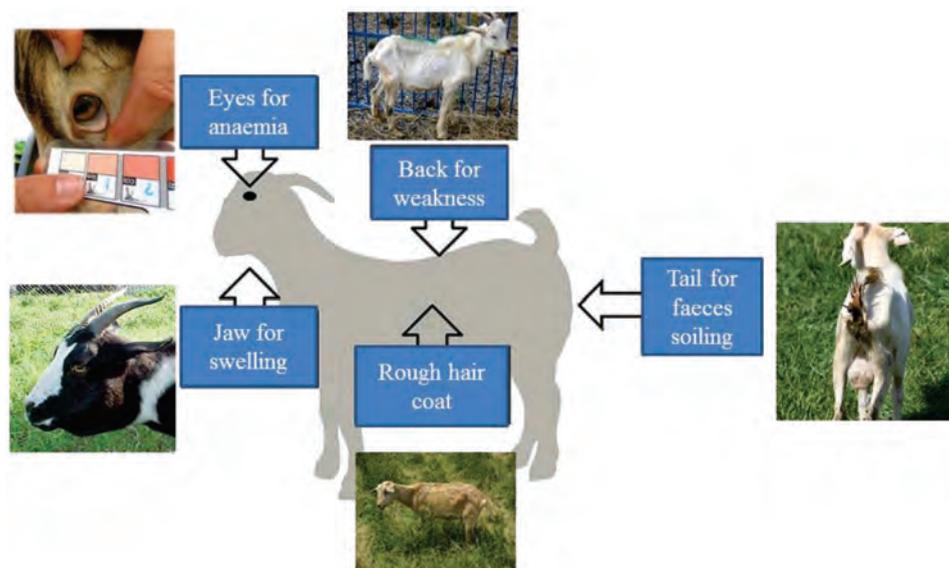
**Treatment with combination of drugs:** Using formulations that contain two anthelmintics, each with a different mode of action have been proved successful in extending the life of combined chemicals.

**Testing of anthelmintic resistance:** The exact status to monitor the AR development at farms is feasible only, if routine testing of the efficacy of the anthelmintics by *in vivo* or *in vitro* assays at regular interval carried out.

**Targeted selective treatment (TST):** As per the rule that only 20% animals in herds are the shedder for 80% of the parasite, accordingly treatment should be given to that affected animals only. For TST, five check points; eye evaluation for anaemia, back for body condition scoring, tail for soiling with faeces, jaw for swelling and rough hair coat and use of FAMACHA tool is very effective (Figure 2).

### B. Alternative approaches to anthelmintics

**Plant based anthelmintics:** Indigenous plants like *Areca catechu*, *Artemisia vulgaris*, *Calotropis procera*, *Melia azadarach*, *Chrysanthemum* spp., *Carica papaya*, *Heracleum* spp., *Azadirachta indica*, *Allium sativum*, *Heyysarvum coronarium*, *Artemisia maritime*, etc showed potential anthelmintic activities against nematode parasites (Verma *et al.*, 2018). Condensed tannin containing forages or tanniferous plants have also been investigated for potential effect against either incoming parasite larvae and/or already



**Fig. 2:** Five check point for TST

established worms. To make it more practical the thorough scientific investigation regarding the active constituent of the phyto-anthelmintics and its toxicity is required. The scope of the phytoanthelmintics in near future is seen as low-cost alternative solution to control GIT parasites in animal by farmers.

**Quarantine and surveillance measures:** Strictly follow the quarantine measure for the entry of new animals into the herd. Then regular testing of the biological samples for every new addition, dose with triple-class anthelmintic therapy, and faecal egg count reduction tests is obligatory (Shalaby, 2013).

**Immunological approach:** The advancement in field of recombinant technology has given a ray of hope for the vaccine development based on the recombinant antigen or DNA. Baberbex, first vaccine for the nematode *H. contortus* based on the concealed antigen (purified protein) and currently in use for sheep and goats Australia, South Africa, and the UK.

**Genetic trait manipulation:** Numerous breeds of ovines; as East African Masai, Red Masai sheep, Florida Native, Barbados Blackbelly, St Croix etc. around the world are known to be carry the natural resistant gene to parasitic infection. The cross breeding programme with the susceptible breeds is the best long term weapon against internal parasites control programme.

**Refugia:** It is the vital factor for combating the AR in parasites. Refugia mean the proportion of the worm population escaping exposure to anthelmintics. Free living stages

of the parasite that never exposed to anthelmintic and are said to be in refugia. Worms in refugia provides a pool of genes susceptible to anthelmintics, thus diluting the frequency of resistance genes. As the relative size of refugia increases, the rate of evolution towards resistance decreases (Singh & Swarnkar, 2008).

**Bio-control:** Various agents like plants (leguminous grasses), or bacteria (*Bacillus thuringiensis*), predacious fungi (*Duddingtonia flagrans*, *Arthobotrys* spp. & *Monacrosporium* spp), endoparasitic fungi (*Drechmeria coniospora* and *Harposporium anguillulae*) are source of bio-control for the parasitic and free living stages of the nematode parasites. Predacious fungi produces specialized adhesive knobs, networks, rings on the mycelium that traps the nematode, while endoparasitic fungi's spores penetrate the cuticle of the parasites and lead to death of worm lodged in the gut.

**Pasture management:** It includes the pasture rest and rotation. The already grazed pasture by sheep and goats should be given rest for at least two months in tropical areas and upto 6 months in temperate areas in order to destroy the free living developmental stages and for the dilution of the contaminated pastures. Burning and ploughing of the pasture will eliminate the infective stages of the parasites.

**Grazing strategies:** It include animal density (5–7 goats/acre) in order to avoid the overstocking, zero grazing or clean or safe pastures especially for the young animals, alternative species wise grazing means sheep and goats followed by cattle and buffaloes, age wise grazing. The grazing time is more important criteria suitable for the Indian small ruminant owners due to no private land or pastures for grazing. It is advised to take the animals for grazing when there is sufficient sunlight, not too early in morning or in late evening or in the rainy day, as most of the infective larval stages available on the tip of the forages.

**General management:** Good hygienic practices, balanced nutrition, clean environment in and around the animals, clean water, proper disposal of the faeces in a pit, proper drainage system in the sheds to prevent moisture content that are more favourable for the growth of parasites, regular monitor of the parasite load at the farms based on faecal sample analysis. These general measures will support in the decline of the parasitic infections, the consequences of it results into the reduction of anthelmintic usage which in turns into leads to the dilution of the resistant parasite population on and off the host.

## References

- Buttar, B. S., Rai, H. S., Singh, N. K., Haque, M., & Rath, S. S. (2012). Emergence of anthelmintic resistance in an organized sheep farm in Punjab. *Journal of Veterinary Parasitology* **26**(1): 69-71.
- Kaplan, R.M. (2004). Drug resistance in nematodes of veterinary importance: a status report. *Trends in Parasitology* **20**(10):477–481.

- Pawar, P. D., Singla, L. D., Kaur, P., Bal, M. S., & Javed, M. (2019). Evaluation of multiple anthelmintic resistance for gastrointestinal nematodes using different faecal egg count reduction methods in small ruminants of Punjab, India. *Acta Parasitologica* **64**(3):456-463.
- Peter, J. W., & Chandrawathani, P. (2005). *Haemonchus contortus*: parasite problem No. 1 from Tropics - Polar Circle. Problems and prospects for control based on epidemiology. *Tropical Biomedicine* **22**(2): 131–137.
- Prichard, R.K.(2007). Markers for benzimidazole resistance in human parasitic nematodes. *Parasitology* **134**: 1087-1092.
- Roeber, F., Jex, A. R., & Gasser, R. B. (2013). Impact of gastrointestinal parasitic nematodes of sheep, and the role of advanced molecular tools for exploring epidemiology and drug resistance- an Australian perspective. *Parasites & Vectors* **6**: 153-157.
- Shalaby, H.A. (2013). Anthelmintics Resistance; How to overcome it. *Iranian Journal of Parasitology* **8**: 18-32.
- Singh, D., & Swarnkar, C.P. (2008). Role of refugia in management of anthelmintic resistance in nematodes of small ruminants—a review. *Indian Journal of Small Ruminants* **14**(2):141-80.
- Singh, E., Kaur, P., Singla, L. D., & Bal, M. S. (2017). Prevalence of gastrointestinal parasitism in small ruminants in western zone of Punjab, India. *Veterinary World* **10**(1): 61-66.
- Singh, E., Kaur, P., Singla, L. D., Sankar, M. & Bal, M. S. (2019). Molecular detection of benzimidazole resistance in *Haemonchus contortus* of sheep in Punjab, India. *Indian Journal of Animal Sciences* **89**(12): 1322–1326.
- Singh, R., Bal, M. S., Singla, L. D., & Kaur, P. (2017a). Detection of anthelmintic resistance in sheep and goat against fenbendazole by faecal egg count reduction test. *Journal of Parasitic Diseases* **41**(2): 463–466.
- Verma, R., Lata, K., & Das, G. (2018). An overview of anthelmintic resistance in gastrointestinal nematodes of livestock and its management: India perspectives. *International Journal of Chemical Studies* **6**(2): 1755-1762.

## BACTERIAL CAUSE OF ABORTION AND INFERTILITY IN CATTLE

Pallvi Slathia and Deepti Narang

Department of Veterinary Microbiology, College of Veterinary Science (Ludhiana),  
Guru Angad Dev Veterinary and Animal Sciences University, Punjab-141004, India

\*Corresponding author email: [deeptivet@rediffmail.com](mailto:deeptivet@rediffmail.com)

### Abstract:

*Infertility and abortion have a variety of causes, ranging from minor managerial errors to complex multi-factorial disease complexes caused by many elements such as physical, chemical, biological, and environmental agents. Infectious biological agents (pathogens such as Leptospira, Campylobacter, Brucella, Listeria, Salmonella, among others) are a major cause of reproductive disorders in cattle and are given higher priority in the industry (Yoo 2010). Causes of reproductive disorder such as infertility and abortion are numerous and range from simple management errors to complicated multi-factorial disease complexes due to different factors such as physical, chemical, biological and environmental agents. Because of their zoonotic potential, these factors are also significant from a public health standpoint.*

**Keywords:** *Infertility, Abortion, Leptospira, Campylobacter, Brucella, Listeria, Salmonella.*

### Introduction

Pathogenic bacteria such as *Brucella abortus*, *Leptospira interrogans*, *Campylobacter fetus*, *Listeria monocytogenes* and *Salmonella* species are important cause of abortion and reproductive failure.

***Brucella abortus*:** Brucellosis is considered to be the most important reproductive disease of cattle. *B. abortus* (a Gram- negative coccobacilli, non-spore forming, non-motile and non- encapsulated) causes bovine brucellosis (also known as Bang's disease), which causes abortions in bovines and infertility in bulls. Infection in bulls may affect the testicles, epididymis, seminal vesicle and ampulla. The infected males secrete the organism in semen, so they play an active role in the spread of the disease.

Infection with *B. abortus* had a long and varied incubation period, as well as the prevalence of latent infection in calves born to infected cows without a subsequent serological response. Bacteria can live inside the infected host cells by forming a membrane-bound compartment that stops them from fusing with lysosomes and allows them to replicate intracellularly. The disease is marked by abortion in the last trimester of pregnancy and significant adverse effects on the male reproductive system. Ingestion of contaminated feed and water containing infected placentas or aborted fetuses, as well as penetration through abraded skin, are the most prevalent routes of infection. After ingestion, *Brucella*

penetrates the mucosa of the nasal or oral cavities, internalizing in Peyer's patches by M cells, spreading to surrounding lymph nodes, proliferating in macrophages, and spreading via blood to other tissues, including the pregnant uterus. During bacteremia, it infects the gravid uterus and multiplies in large numbers in chorioallantoic trophoblasts, causing trophoblast necrosis and chorioallantoic ulceration. *Brucella* organisms replicate in trophoblasts, resulting in foetal bacteremia. In sexually mature animals, once infection is established, it tends to last eternally. However, not all infections result in abortion, and only around 20% of affected cows have multiple pregnancies.

In cattle, *B. abortus* has a marked tropism for placental tissues, which results in placentitis. The intercotyledonary placenta can become dry, thicker, and cracked in severe cases, giving it the appearance of Moroccan leather. A thick, yellowish exudate may cover the intercotyledonary placenta. Cotyledons may have necrotic foci that are covered by an exudate. Fetal lungs are occasionally swollen, firm to the touch, and covered in fine fibrin strands. Despite the fact that the organism is produced in milk, there are no visible lesions in the mammary gland. Autolysis and oedema are present in varying degrees in the aborted fetus.

Brucellosis is diagnosed using either direct or indirect laboratory procedures. Bacterial isolation and identification are employed as direct approaches. From foetal abomasal contents, lung, placenta, and uterine secretions, the organism can be easily separated. It can also be found in colostrum, milk, and meconium. Direct method has high specificity but is time consuming and requires appropriate level of biosafety. PCR is used to detect the presence of bacteria's genetic material. Serological tests like RBPT, tube agglutination, and slide agglutination are used more often. Immunohistochemistry (IHC) can be used to detect the presence of *Brucella* antigens in tissue and to illustrate the organism's dispersion throughout the tissues, which is a useful feature in pathogenesis research ( [Khan M Z](#) and [Zahoor](#) 2018).

***Leptospira interrogans*:** Leptospirosis is an economically important bacterial infection of livestock which not only results in reproductive losses due to abortions, stillbirths and infertility but also results in non-reproductive losses due to septicemia and nephritis. Leptospirosis is also known as most widespread zoonotic disease and has more than 15 known species and over 200 pathogenic serovars. Infection with *Leptospira* of the serovar hardjo group is the most common cause of leptospirosis in cattle and is a major cause of infertility.

Infection occurs through exposure of bacteria to the mucosal membrane, resulting in no or mild acute clinical symptoms. *Leptospira interrogans* serovar hardjo has long been recognized to induce miscarriage, stillbirth, or the birth of weak calves in cattle, however the symptoms are most commonly seen in pregnant heifers. Because these

germs cause hypofertility and miscarriage and can survive in frozen sperm, bulls used for artificial insemination must be given special attention. The seminal vesicles of the bull are considered to be a major site for the localization of *Leptospira interrogans* serovar hardjo. Abortions usually occur 2 to 12 weeks after infection in cattle without any obvious clinical disease. The pathogen settles in the host's kidneys and genital tract after generating primary bacteremia. *Leptospira*, which is found in the kidneys, is discharged in the urine and can infect other animals. The most economically important indication of *Leptospira interrogans* serovar hardjo infection is persistent infection of the male and female genital tracts, which can remain for more than 12 months (Chacko *et al.*, 2021).

Fluorescent antibody test (FAT), bacterial culture, Polymerase Chain Reaction (PCR), and Immuno Histo Chemistry (IHC) using tissue samples are all diagnostic techniques for *Leptospira* infection. Leptospiral infection is diagnosed by serological assays such as Enzyme-linked Immunosorbent Assay (ELISA) and Microscopic Agglutination Test (MAT).

### ***Campylobacter fetus***

The bacterial venereal disease bovine genital campylobacteriosis (BGC) can cause infertility, early embryonic death, and miscarriages in cattle caused by *Campylobacter fetus*. *Campylobacter fetus* is divided into two subspecies: *C. fetus* subsp. *foetal* and *C. fetus* subsp. *veneralis*. In cattle, *C. fetus* subsp. *veneralis* adapts well to the reproductive system, but *C. fetus* subsp. *fetus* induces abortion. Both subspecies are Gram-negative, microaerophilic organisms with a comma-shaped or S-shaped morphology. Bulls are asymptomatic carriers of the disease. The infection's clinical effects are seen in the cow. The infection is undetectable and affects the epithelium of bulls' prepuce. The introduction of organisms in a vulnerable herd is followed by a period of sterility for all breeding females (120 days). In chronically infected herds, however, only newly introduced susceptible animals show evidence of infertility.

The rate of infection transfer from sick bulls to susceptible cows could be as high as 100%. Infected bulls can carry the bacterium for an infinite period of time in their preputial cavity. Bulls do not become permanent carriers until they are at least 4 years old, and most do not become carriers until they are 5 to 6 years old. With age, the formation of epithelial crypts in the penile mucosa creates a favorable environment for the bacteria. Because infection in young bulls is temporary, sexual interaction with an infected cow is required for transmission. Bull-to-bull transmission can occur as a result of contaminated sperm collection equipment or mounting action when bulls are kept in the same location.

The organism settles in the anterior vaginal and cervix after exposure, and infection spreads to the uterus and oviducts in 12 to 14 days. Fertilization and early embryonic

development are usually unaffected by infection. Because of the inflammatory response in the uterus and oviducts, uterine infection causes early fetal mortality. The number of organisms in the original infective dosage and the rate of multiplication within the uterus appear to affect the clinical symptoms of infection in women. On days 15 to 80, rapid replication occurs, resulting in early embryonic death. The return to estrus will be delayed because embryonic mortality usually occurs after maternal identification of pregnancy (days 15–17). Mid-term abortion is caused by slower replication. Fertility resumes as *Campylobacter foetus* spp. *veneralis* is gradually eradicated from the oviducts and uterus. The organism can be found in the cervix and vaginal canal for several months, during which time the cow can infect you. Vaginitis, cervicitis, and endometritis are all symptoms of vaginitis. The irregular and delayed returns to estrus are a feature of *Campylobacter* infection. Infertility is caused by the death of an embryo at an early stage (Facciola *et al.*, 2017).

Isolation of the organism, demonstration of the agent in foetal tissues, preputial scrapings, or vaginal mucus using direct fluorescent antibody (FAT) tests, or detection of antibodies in vaginal mucus using an enzyme-linked immunosorbent assay (ELISA) or agglutination tests can all be used to make a diagnosis.

***Listeria monocytogenes*:** *Listeria monocytogenes* are Gram-positive, non-acid-fast bacteria that look like tiny rods. Even though their survival duration outside their host varies based on their habitat, they can survive for years in soil, milk, silage, and feces (Zundel and Bernard 2006). Intercurrent disease, climate, the animal's pregnant status, stress, and other factors can all predispose the animal. Cattle outbreaks are most common in the winter and early spring. The organism enters the host mostly through eating, where it settles in placentomes and replicates in the amniotic fluid of pregnant animals. Abortion is most commonly performed in the second trimester of pregnancy. Diagnostic tests such as organism isolation and identification, clinical signs, and appropriate therapeutic and preventive actions are all beneficial.

***Salmonella* spp.:** Infection with *Salmonella enterica* subsp. *enterica* serovar Dublin produces significant clinical illness in cattle. This bacterium causes a variety of clinical symptoms, with abortion being one of the most prevalent outcomes. Other clinical signs, such as fever, may appear before an abortion occurs. The organism appears to enter the fetus through the placenta and cause septicemia and the death of the fetus. In the aborted fetus, edema of the subcutis can be seen, as well as the presence of serosanguinous fluid in the peritoneal cavity. Abortion is most commonly performed 200 days after conception. To protect cattle from *S. Dublin* infection, several live attenuated and lethal vaccinations have been employed.

In addition to above mentioned bacterial agents, other acute infectious agents which may cause abortion in cattle includes: anthrax, black leg, *Haemophilus somonus* etc.

### References:

- Chacko, CS., Lakshmi, SS., Jayakumar, A., Binu, SL., Pant, RD., Giri, A., Chand, S. and UP N. (2021). A short review on leptospirosis: Clinical manifestations, diagnosis and treatment. *Clinical Epidemiology and Global Health* **11**.
- Facciola, A., Riso, R., Avventuroso, E., Visalli, G., Delia, SA. and Lagana, P. (2017). *Campylobacter*: from microbiology to prevention. *Journal of Preventive Medicine and Hygiene* **58**: 79-92.
- Khan, MZ. and Zahoor, M. (2018). An Overview of Brucellosis in Cattle and Humans, and its Serological and Molecular Diagnosis in Control Strategies. *Tropical Medicine and Infectious Disease* **3(2)**: 65.
- Yoo H S. (2010). Infectious causes of reproductive disorders in cattle. *Journal of Reproduction and Development* **56**: 53-60.
- Zundel, E. and Bernard, S. (2006). *Listeria monocytogenes* translocates throughout the digestive tract in asymptomatic sheep. *Journal of Medical Microbiology* **55**: 1717 – 23.

## CLINICO-PATHOLOGICAL ALTERATIONS IN POSTPARTURIENT HEMOGLOBINURIA

Priyanka, Mandeep Kaur, Nittin Dev Singh\* and Geeta Devi

Department of Veterinary Pathology, College of Veterinary Science (Ludhiana),  
Guru Angad Dev Veterinary and Animal Sciences University, Punjab-141004, India

\*Corresponding author E-mail: ndsingh@gmail.com

### Abstract

*PPH (postpartum hemoglobinuria) is a random noninfectious condition that affects bovines all over the world. PPH is particularly common in high-productive cows and buffaloes during advanced pregnancy and early lactation. It is a serious threat to the dairy cattle and buffaloes, affecting a large number of animals each year. Hypophosphatemia in high-yielding milking cows and buffaloes during the early stages of milk production is thought to be the reason of this condition. If the phosphorus level in blood serum is reduced, the phospholipid layers of red blood cells are disrupted, resulting to increase osmotic fragility of RBCs leading to intravascular hemolysis. Therefore, this condition is mainly characterized by hemoglobinuria, intravenous hemolysis, severe anemia and mortality due to anemia and hypoxia. The most prevalent diagnostic techniques for this condition are urinalysis and hematological results. Many research have suggested that injecting sodium acid phosphate with vital minerals and supportive anti-oxidant therapy can be employed as a therapeutic strategy for the treatment and this condition can be prevented by providing mineral mixture containing phosphorus according to requirement for maintenance and production.*

**Keywords:** Anemia, Buffalo, Hypophosphotemia and Post-partum hemoglobinuria,

Post parturient hemoglobinuria is also known with other names viz. Red water, Hypophosphatemia and Lahumutna which usually affects high-yielding dairy cows and buffaloes sporadically at the onset of lactation. It is mainly characterized by intravascular hemolysis, hemoglobinuria, anemia and death. It is most commonly seen in adult females of 7-10 years of age during 3rd – 8th lactation. Buffaloes are found to be more susceptible than cows. In cows it usually occurs after parturition whereas buffaloes are mostly commonly affected during advanced pregnancy and early lactation.

**Etiology:** It occurs due to deficiency of phosphorous (hypophosphatemia) in body of animals.

Following factors are responsible for the deficiency of phosphorus in animals:

1. Deficiency of phosphorous in diet
  - When forages grown in phosphorus deficient soil.
  - When animals are exclusively fed on hay and straws which are deficient in

phosphorus.

- Drought conditions also reduce phosphorus content in forage.
  - Feeding of cruciferous plants like rape, kale, turnip which are deficient in phosphorus.
2. Reduced absorption of phosphorus from gut
    - Deficiency of vitamin D
    - More Calcium, Aluminum, iron or phytates in diet.
    - Improper calcium and phosphorus ratio.
    - Ruminal stasis and intestinal diseases (diarrhoea).
  3. Increased requirement of phosphorus
    - Phosphorus requirement increases after parturition because most of the phosphorus (0.93-1g/Kg) drains through milk in recently calved animals.
    - There is also increased requirement of phosphorus for the development of foetus during advanced pregnancy.

The higher incidence of this disease is mostly observed in buffaloes fed exclusively on dry roughages or with very low quantity of concentrate as compared to those who are receiving good amount of concentrate or ad libitum greens.

**Pathogenesis:** Due to hypophosphatemia, RBC glycolysis gets affected which leads to decrease in ATP formation. It further decreases the RBC wall phospholipid synthesis which will not be able to maintain the integrity of wall of RBC and phosphorylation of actomyosin which is known to increase osmotic fragility of the RBCs. On the other hand, due to less ATP, decrease in glutathione (antioxidant) synthesis causes oxidative damage of RBCs, predisposing it to intravascular hemolysis and hemoglobinuria that leads to formation of Heinz bodies (precipitation of Hb) and initiate anaemia. This hemoglobin badly affects the kidneys and lead to hemoglobinuric nephrosis. Therefore, death of animal will occur due to anemia and kidney failure.

Along with phosphorus, copper deficiency also potentiate the RBCs susceptibility to oxidative stress. Other potential causes are hemolytic or oxidative plant toxins (often from *Brassica spp*, sugar beets, or green forage).

**Clinicopathological findings:** Affected animal displays anorexia, dullness, depression and weakness. Marked drop in milk yield with subnormal or normal temperature. Anemia causes tachypnoea in early stage and laboured breathing in later stages. Paler mucus membrane, usually noticed 2-3 days after onset of disease. Hemoglobinuria leads to light to dark coffee colored urine, a characteristic sign. Jaundice is seen in later

stages of disease. Passage of pasty faeces with straining is a consistent finding. Cows that survive the hemolytic crisis may take several weeks to recover completely. In severe cases, brisket edema, recumbency and death occurs. Post mortem examination reveals icterus throughout body, swollen and fatty liver, discolored urine in urinary bladder, pale and enlarged kidney. Histopathologically, there is marked necrosis of tubular epithelium and hemosiderin deposition is seen due to hemoglobinuria in which hemoglobin affects the kidney and liver tissue reveals centrilobular necrosis with hemosiderin deposition. Hematology reveals macrocytic hypochromic anemia with Heinz bodies in RBCs, low Hb, PCV and TEC values. Changes in leukocyte count include leukocytosis associated with neutrophilia. Biochemical changes reveals marked decrease in serum inorganic phosphorus level (Normal phosphorus level is 4-6mg %), BUN values increases (Normal BUN value is 6-24 mg%) and bilirubin value increases (Normal bilirubin values are 0-1.9 mg%). On centrifugation of urine, RBC settle at bottom in hematuria whereas in hemoglobinuria the color remains unchanged. and positive for proteins, ketone bodies, bile pigments and bile salts.

**Diagnosis:** Diagnosis of post parturient hemoglobinuria is usually made by recognition of clinic-pathological findings, particularly dark colored urine and anemia during the characteristic stage of lactation, macrocytic hypochromic anemia, low Hb, PCV and TEC, decrease in serum inorganic phosphorus level (Normal phosphorus level is 4-6mg %), increase in BUN values increases (Normal BUN value is 6-24 mg%) and bilirubin values (Normal bilirubin values are 0-1.9 mg%). Diagnostic testing and feed or pasture analysis can be performed to identify toxic plants and deficiency of phosphorus, copper, and other antioxidants.

**Treatment:** Give sodium acid phosphate @ 80 gm IV as a 20% solution in dextrose or distilled water for 2-4 days is highly effective. Inj. Tonoricin/Inj. Tonophosphon@30ml IV daily for 2-4days is also effective. Antioxidants viz., Ascorbicacid@15-20mg/kg IVdaily for 2-4days, Vit.E and Selenium (Inj. EcareSe) @1ml/25-50kg IM daily for 2-4 days to relieve oxidative stress and thus prevents hemolysis. Copper glycinate (120 mg available copper) has been recommended in cases in which copper deficiency is suspected as the underlying cause. Supportive treatment includes Inj. Dextrose 20% 500-1000 ml IV daily for 2-3days which provide energy and also helps in utilization of phosphorus by RBC, Inj. liver extract with 'B' complex@5mlIMdailyfor5-7days, Haematinic mixture comprising  $\text{FeSO}_4 - 5\text{gm} + \text{CuSO}_4 - 0.2\text{gm} + \text{Cobalt sulphate} - 0.2\text{gm}$ . In jaggery orally for 7-10 days to correct anaemia and Mineral mixture@50gm daily orally to maintain serum Pi levels. In severe cases with PCV <15%, transfusion of whole blood is indicated.

## Prevention

- 1) Regular provision of mineral mixture containing phosphorus according to the requirement for maintenance and production.

Weight of animal (kg)	Phosphorus requirement		
	Maintenance (g)	Pregnancy (g)	Milk production
400	13	18	1.7 to 2.4 g per kg of milk production
500	15	22	

- 2) Provision of adequate quantity of concentrates and greens adlib. Removing the intake of cruciferous plants, Lucerne, berseem
- 3) Protect the recently calved or advance pregnant animals from cold stress.

## References

- Resum, N. S., Kour, P., Singh, H., & Sharma, N. (2017). Post-partum hemoglobinuria (PPH) in Bovine. *Theriogenology Insight-An International Journal of Reproduction in all Animals* 7(1): 51-59.
- Hussein, H. A., El-Amir, Y. O., Amer, A. A., & Elghaffar, S. K. (2013). Bacillary hemoglobinuria in dairy cows: clinical, hematological, biochemical, and pathological alterations. *Comparative Clinical Pathology* 22(6):1137-1143.
- Rahmati, S., Aziz, A., Tawfeeq, M. M., Zabuli, J., & Nazhat, S. A. (2021). Clinical Features of Post-Parturient Hemoglobinuria in Dairy Cattle and Buffaloes: A Review. *Open Journal of Veterinary Medicine* 11(04): 143.

## CANINE LYMPHOMA - AN OVERVIEW

**Mohanapriya Thangaraj\*, Vishal Mahajan and Leishangthem Geeta Devi**

Department of Veterinary Pathology, College of Veterinary Science (Ludhiana),  
Guru Angad Dev Veterinary and Animal Sciences University, Punjab-141004, India

\*Corresponding author E-mail: priya.vet21@gmail.com

### Abstract

*Canine lymphoma (cL) is a common malignant tumors occurring in dogs. The recent incidence rate estimated was 20-114 cases per 100,000 dogs. The cL was comparable to non-Hodgkin lymphoma of human in many aspects. The etiology was not known, but to an extent some environmental factors and genetic susceptibility play a pivotal role. The affected dog shows vague clinical presentation and commonly regional or generalized lymphadenopathy. For the diagnosis of cL, the fine needle aspiration cytology is the best method, further to classify and subtype the neoplasm as T-cell lymphoma and B-cell lymphoma, the immunophenotyping by Immunohistochemistry, flow cytometry and PCR techniques are needed. Among all types of lymphoma, high grade is more prevalent than the low grade lymphoma. This paper provides the over view about the canine lymphoma.*

**Key Words:** *Canine Lymphoma, Diagnosis, Immunophenotyping, Lymphadenopathy*

### Introduction

The lymphoma is the most frequently diagnosed haematologic neoplasms in canine oncology treated by chemotherapy. The etiology of canine lymphoma (cL) is multifactorial and environmental factors play a pivotal role (Valli *et al.*, 2013). In the past recent years, the estimated minimal annual incidence rate is 13-114 cases per 100,000 dogs (Zandvliet, 2016) The cL and human non-Hodgkin lymphoma have many similarities including molecular and biological behavior, clinical presentation and the treatment response (Vail and MacEwen, 2000). The cytopathology is the primary diagnostic and is screening test to grade it. This paper aims to furnish details on cL to veterinary practitioners.

### Age, Breed and Sex predilection

Lymphoma predominantly affects the middle-aged to older dogs, mean age is 5-10 years, any breeds and gender. However, some studies reported that the boxers being highly susceptible to T-cell lymphomas, whereas German shepherd and Rottweiler are predisposed to B-cell Lymphoma (Comazzi *et al.*, 2018).

### Clinical presentation

An important clinical finding in dogs suffering from cL is generalized peripheral lymphadenomegaly (multicentric forms) along with reduced appetite and weakness. The

extra nodal forms like gastrointestinal, hepatic, splenic, pulmonary, ocular and renal forms reveals the signs like vomiting, diarrhoea, ascites, respiratory distress, partial or complete blindness, polyuria-polydispsia, chronic or recurring fever, chronic wasting appearance and chronic skin or cutaneous lesions (Zandvliet *et al.*, 2016).

### Haemato-biochemical changes

The haematological changes in cL include normocytic and normochromic ewith decreased values of PCV, and TEC. However, both the leucocytosis and leucopenia and thrombocytopenia may also occurs. Hypercalcemia and elevated BUN values are also observed (Thangapandiyan *et al.*, 2017).

Mild to Moderate non-regenerative anaemia along with altered liver and kidney function enzymes, depend upon organ involvement. Hypoproteinaemia and hypoglycaemia are occasionally observed. Hypercalcaemia is documented exclusively in T-cell lymphoma (Zandvliet, 2016).

### Classification

Canine malignant lymphoma is a heterogenous form of neoplasm with variable morphology, diverse clinical signs, different prognosis and treatment. The staging of the canine multicentric lymphoma (Owen, 1980) is followed by World Health organization (Table.1).

**Table 1. The World Health Organization (WHO) stages for canine multicentric lymphoma (Owen, 1980)**

Stage	Lymphnode(s)/ Organ involvement
I	Single node or lymphoid tissue in single organ (excluding bone marrow)
II	Regional involvement of multiple lymphnodes (+/- Tonsils)
III	Generalized lymphnode involvement
IV	Stage I-III with involvement of liver and/or spleen
V	Stage I-IV with involvement of blood or bone marrow
Substage	
A	Absence of systemic signs
B	Preeence of Sytemic signs (Fever, >10% weight loss, hypercalcaemia)

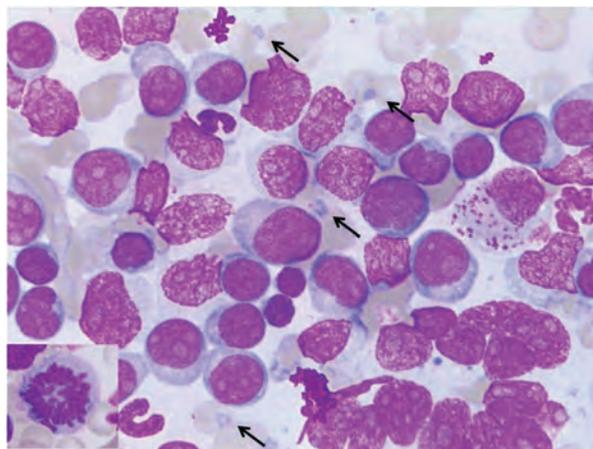
**Table 2. Updated Kiel Classification (Valli *et al.*, 2013)**

Low grade	High grade
<b>Small cell lymphoma</b> 1. Lymphocytic 2. Lymphoplasmacytic 3. Centrocytic 4. Clear cell 5. Centroblastic-Centrocytic 6. Macronucleated medium-sized cell	1. Centroblastic monomorphic 2. Centroblastic polymorphic a. Predominantly small cell b. predominantly large cell 3. Immunoblastic 4. Lymphoblastic 5. Blastic small cell- unclassifiable 6. Polymorphic- mixed, small and large cells 7. Anaplastic

The updated Kiel classification based on cytological and histological criteria into two divisions as low and high shown in Table 2. The International Lymphoma Study Group (ILSG) published a Revised European American Lymphoma (REAL) classification, it is based on cell morphology, immunophenotype, genetic features and clinical presentation shown in Table.3 (Valli *et al.*, 2013).

### Cytological and histopathological diagnosis

The fine needle aspiration cytology of affected lymphnodes is usually diagnostic for lymphoma by considering the percentage of neoplastic cells, mostly immature blastic type of cells with monomorphic appearance of the smear. Generally, more than 70-80% of blast cells (Fig.1) suggest lymphoma. The nucleus of the blast cells maybe binucleated or multinucleated with prominent nucleoli and mitotic figures are usually seen. The small



**Fig. 1:** Lymphnode FNAC - Lymphoma - Monomorphic large lymphoblast cells (>80%) with multiple prominent nucleoli and scattered lymphoglandular bodies (black arrow), few small and intermediate lymphocytes. Inset at left bottom: Mitotic figure.

**Table 3. Revised European-American Classification of Lymphoid Neoplasms/ WHO classification ( Valli *et al.*, 2013)**

<b>B cell Neoplasms</b>	<b>T Cell Neoplasms and putative Natural Killer Cell neoplasm</b>
1. Precursor B cell neoplasms	Precursor T cell neoplasm
2. Precursor B lymphoblastic leukemia/ lymphoma	1. Precursor T lymphoblastic/ Lymphoma/leukemia
3. Mature (peripheral) B cell neoplasms	2. Mature (peripheral) T cell and natural killer cell neoplasms
4. B cell chronic lymphocytic leukemia/ prolymphocytic	3. T cell prolymphocytic leukemia
5. Leukemia/small lymphocytic lymphoma/	4. Large granular lymphocyte leukemia (LGL)
6. B cell prolymphocytic leukemia	a. Aggressive natural killer (NK) cell leukemia
7. Lymphoplasmacytic lymphoma	b. Peripheral T cell lymphomas, unspecified
8. Splenic marginal zone B cell lymphoma	c. Adult T cell lymphoma/ leukemia
9. Plasma cell myeloma/ plasmacytoma	d. Intestinal T cell lymphoma (+enteropathy associated)
10. Extranodal marginal zone B cell lymphoma of mucosa-associated lymphoid tissue type	5. Hepatosplenic $\gamma\delta$ T cell lymphoma
11. Nodal marginal zone lymphoma	6. Subcutaneous panniculitis-like T cell lymphoma
12. Follicular lymphoma	7. Mycosis fungoides/ Sezary syndrome
13. Mantle cell lymphoma	8. Anaplastic large cell lymphoma, T and null cell primary cutaneous type
14. Diffuse large B cell lymphoma	9. Peripheral T cell lymphoma not otherwise specified
15. Mediastinal large B cell lymphoma	10. Angioimmunoblastic T cell lymphoma
16. Burkitt's lymphoma/Burkitt's cell leukemia	11. Angiocentric T cell lymphoma
17. Provisional entity: high-grade B cell lymphoma Burkitt's-like	
18. Primary effusion lymphoma	

(2-7 $\mu$ m), basophilic, round or irregular cytoplasmic fragments of cytoplasm of neoplastic lymphoid cells are called lymphoglandular bodies are observed. The cellular atypia is uncommon in lymphoma (Sapierzyński *et al.*, 2010).

The histopathological examination of most canine lymphoma reveals the high-grade lymphoma. Histologically, characterized by the morphological criteria like nuclear size, morphology, chromatin pattern, numbers of nucleus and nucleolus, location of nucleoli and mitotic index (MI). Depends on the MI, it will be graded as low (G1),

medium and high by the presence of 0-5, medium (G2) with 6-10 and high grade (G3) with >10 mitotic figures/400x. The lymphnode architecture will be completely lost with “starry sky pattern” of the lymphoid follicles or fading follicle with thinning of capsule. Tangible body macrophages (TBM) is due to increased proliferation and death apoptotic bodies which is mostly present in high grade lymphoma (Ponce *et al.*, 2010 and Martini *et al.*, 2021).

### **Immunophenotyping**

Immunophenotyping of dog lymphomas can be determined by immunocytochemistry (ICC), Immunohistochemistry (IHC), Flow cytometry (FC) and PCR assay for antigen receptor rearrangement (PARR). IHC is the most standard and gold standard techniques in immunophenotyping in correlation with histopathology. The most commonly used antibodies like pan T-cell marker CD3 for T-cell lymphoma. The potential B-cell marker is Pax-5 and CD79a for B-cell Lymphoma (Jark *et al.*, 2020)

### **Therapy**

Grading of cL is very important pertaining to decision making and predicting the outcome. The biological behaviour of cL suggests the chemotherapy as the greater choice to extend the survival period of dogs. Most of the chemotherapy was formulated to intermediate - high grade lymphoma. For the low grade lymphoma ‘watchful waiting’ strategy is recommended. The single-agent therapy with doxorubicin (5x21days) is most effective. The multi-agent therapy protocols include combination of cyclophosphamide, doxorubicin (Hydroxydaunorubicin), vincristin (Oncovin) and prednisolone, so called CHOP therapy (University of Wisconsin-Madison Protocol) is used to treat lymphoma. Radiotherapy and immunotherapy plays a limited role in veterinary oncology compared with human oncology treatment (Zandvliet, 2016).

### **Conclusion**

The summarized information about cL can be drawn as basic minimal invasive cytopathological technique gives the accurate diagnosis and further it will be enhanced by histopathological grading, immunocyto and histochemical staining with specific antibody markers. The B-cell lymphoma has better prognosis and long median survival years than the T-cell lymphoma. The recent advanced techniques like PCR antigen receptor rearrangement and miRNA expression helps to focus on tailored therapy including cell targeted therapy and immunotherapy and further to assess the better prognosis in canine lymphoma.

### **References**

Comazzi, S., Marelli, S., Cozzi, M., Rizzi, R., Finotello, R., Henriques, J., Pastor, J., Ponce, F., Rohrer-Bley, C., Rütgen, B. C. & Teske, E. (2018). Breed-associated

- risks for developing canine lymphoma differ among countries: an European canine lymphoma network study. *BMC Veterinary Research* **14**(1):232-238. <https://doi.org/10.1186/s12917-018-1557-2>
- Jark, P.C, Fracacio<sup>1</sup>, C.P., Anai, L.A., Silva, M.C.L., Calazans, S.G., Senhorello, I.L.S., Costa, M.T., Sequeira, J.L. & Sueiro, F.A.R. (2020). Histopathological and immunophenotypical characterization of canine multicentric lymphoma in Brazil: a study of 203 cases. *Arquivo Brasileiro de Medicina Veterinária Zootecnia* **72**(3): 787-793. <https://dx.doi.org/10.1590/1678-4162-11484>
- Martini, V., Marano, G., Aresu, L., Bonfanti, U., Boracchi, P., ..... Comazzi, S. (2021). Performance of lymph node cytopathology in diagnosis and characterization of lymphoma in dogs. *Journal of Veterinary Internal Medicine* **36**(1):204–214. <https://doi.org/10.1111/jvim.16326>
- Owen, LN. (1980). TNM classification of tumours in domestic animals. 1<sup>st</sup> Edn. Geneva: World Health Organization.
- Ponce, F., Marchal, T., Magnol, J. P., Turinelli, V., Ledieu, D., Bonnefont, C., Pastor, M., Delignette, M. L & Fournel-Fleury, C. (2010). A morphological study of 608 cases of canine malignant lymphoma in France with a focus on comparative similarities between canine and human lymphoma morphology. *Veterinary Pathology* **47**(3): 414–433. <https://doi.org/10.1177/0300985810363902>
- Sapierzyński, R., Micuń, J., Jagielski, D. & Jurka, P. (2010). Cytopathology of canine lymphomas (100 cases). *Polish Journal of Veterinary Sciences* **13**(4): 653-659. <https://doi.org/10.2478/v10181-010-0015-2>
- Thangapandiyan, M., Balachandran, C., Jeyaraja, K., Raja, A., and Sridhar, R. (2017). Study on haematological alterations in canine lymphoma. *The Pharma Innovation Journal* **6**(10): 116-118.
- Vail, D. M., & MacEwen, E. G. (2000). Spontaneously Occurring Tumors of Companion Animals as Models for Human Cancer. *Cancer Investigation* **18**(8):781–792. <https://doi.org/10.3109/07357900009012210>
- Valli, V. E., Kass, P. H., Myint, M. S. & Scott, F. (2013). Canine Lymphomas. Association of classification type, disease stage, tumor subtype, mitotic rate, and treatment with survival. *Veterinary Pathology* **50**(5): 738–748. <https://doi.org/10.1177/0300985813478210>
- Zandvliet, M. (2016). Canine lymphoma: a review. *Veterinary Quarterly* **36**(2):76-104. <https://dx.doi.org/10.1080/01652176.2016.1152633>

## LIGHTNING SAFETY OF LIVESTOCK

**Biswadeep Jena\* and Mehak Mahant**

Department of Veterinary Surgery and Radiology, College of Veterinary Science (Ludhiana),  
Guru Angad Dev Veterinary and Animal Sciences University, Punjab-141004, India

\*Corresponding author E-mail: biswadeep44@gmail.com

### Abstract

*With burgeoning threats from lightning strikes, present communication envisages delineating principles behind lightning deaths and proposing safety tips from lightning strikes to prevent livestock deaths courtesy of lightning, with the ultimate aim of preventing economic loss to the farming community.*

**Keywords:** *Livestock safety, lightning strike, natural calamity, sudden death*

### Introduction

Lightning is one of the oldest observed natural phenomena on earth. It is a giant spark of electricity in the atmosphere between clouds, the air, or the ground (Gomes, 2012; Vanneste *et al.*, 2015). Around 2,500 people die annually due to lightning strikes across India. Effects of lightning on human life have been extensively reported but the same has been ignored when it comes to our livestock. There has been sparse reporting of maimed livestock due to lightning. One heart wrenching report of lightning in north-eastern Assam state wiping out a herd of 18 elephants in May, 2021 is still etched in our mind (Fig. 1). According to annual lightning report 2020-2021 submitted by India Meteorological Department (IMD) in association with Climate Resilient Observing-Systems Promotion Council (CROPC), there has been 34% rise in lightning strikes in the country, due to rising temperatures courtesy of climate change. Among all the states of India, **Punjab** witnessed 331% increase, highest, in lightning strikes. Punjab is a livestock rich state where farmers are more dependent on animal husbandry. With burgeoning threat from lightning, it is high time to create awareness among farmers towards lightning safety to prevent loss of livestock in future. This awareness can only be inculcated through our veterinary fraternity.

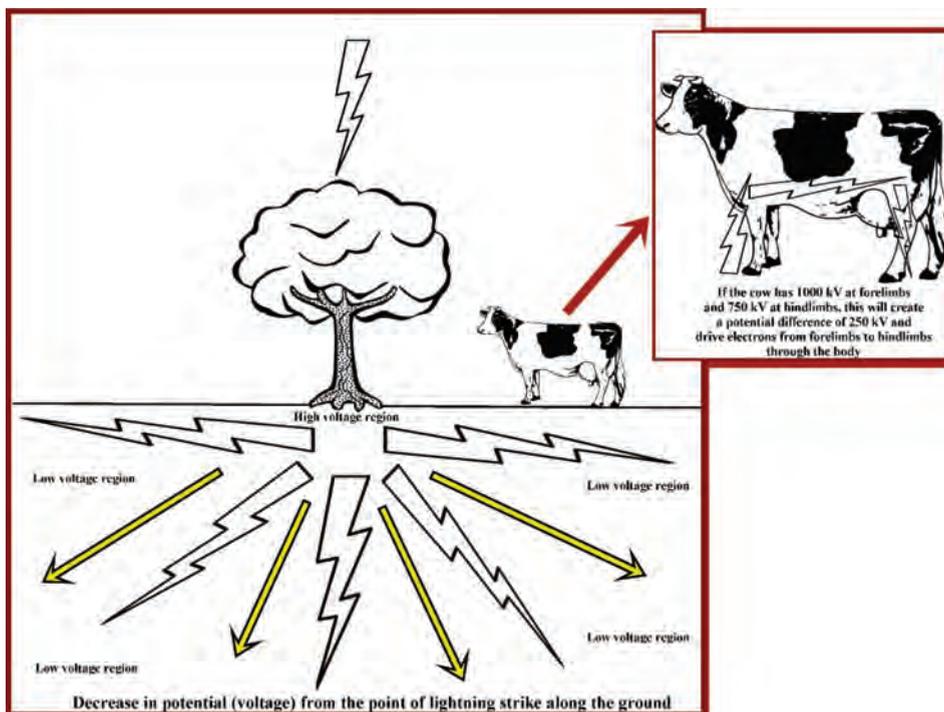


**Fig. 1:** 18 wild elephants found dead in Assam due to lightning strikes (Reprinted from Kalita, 2021)

## Reasons Behind Lightning Death

Lightning is a short duration transient current which may flow to ground several times during a single flash. To be injured or temporarily disabled, an animal may not essentially be struck by lightning. Even if it is close to the point of strike it may receive lethal injuries to which the victim may succumb. The shock wave generated by lightning channel due to sudden expansion of air may damage the skin or ear drums when an animal is very close to the point of strike. Furthermore, intense light may cause vision imparity of the animals close by. Animals underneath a large tree, large pole or inside a tent on wooden poles may receive a side flash if the tree or the tent is hit by lightning. Sometimes lightning current passes through the animals as it is tied to a tree/ metal pole/ metal stump/ wooden stump by a metal chain (Gomes, 2012; Schulze *et al.*, 2016).

As shown in figure 2, the potential at the point where the lightning current enters ground (tree) is usually at a large value, typically in the order of several hundreds of thousands of volts. This potential rapidly decreases as one moves radially away from the point of injection (tree) of current to ground. As the potential pass through the body of the animal, a potential difference is created and drives electrons along the gradient of potential difference (Gomes, 2012; Schulze *et al.*, 2016).

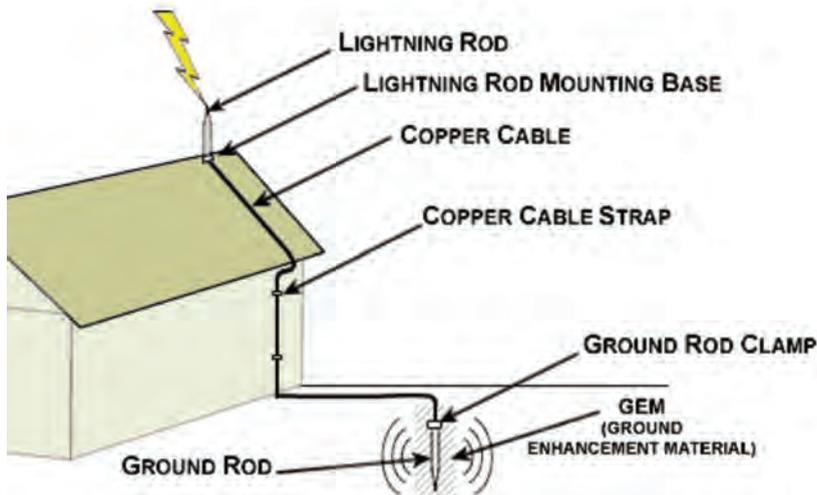


**Fig. 2:** Showing distribution of potential when a tree is struck by lightning. Insert showing potential difference created across body of an animal (Adapted from Sonkar, 2018)

The passage of current inside the body may lead the animal into ventricular fibrillation (unsynchronized muscle operation of the heart), respiratory arrest (inability to breath), burning of vital organs such as brain, liver, kidneys, etc. and internal bleeding due to bursting of blood vessels, mechanical lesions of internal organs and haemorrhages. The animal may also suffer from nervous system damage, broken bones and loss of hearing or eyesight. Lightning injuries can lead to permanent disabilities or death (Gomes, 2012; Schulze *et al.*, 2016; Vanneste *et al.*, 2015).

### Safety Tips from Lightning Strike

- In case of a cattle shed/ shelter, a lightning rod attached to ground earthing rod through copper cable. For efficient earthing, ground rod should be packed around with commercially available ground enhancement materials (GEM) [Brand name - Erico<sup>®</sup> GEM] for superior ground conductivity (Fig 3) (Gomes, 2012).



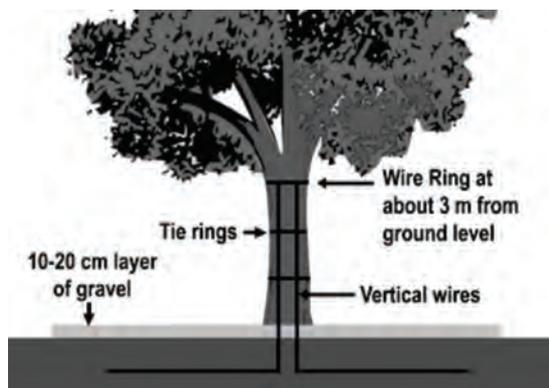
**Fig. 3:** Showing lightning safety for a cattle shed/ shelter (Reprinted from Equiptest, 2019)

It is a natural behaviour of herding animals to move towards fences or take shelter under trees as a storm approaches. Hence, there should be a preventive mechanism of animals approaching the metal fences during thunderstorm activities (Gomes, 2012).

- In the case of fences with metal wires, should be grounded at regular intervals; at least at the supporting poles (which are usually placed 3–5 m apart).
- If the fence is made on a concrete foundation and vertical metal poles, the poles should be welded to the iron reinforcement during the construction.
- In the case of fences with wooden poles and metal wires, it is advisable to check the condition of the buried parts at most once in 5 years

In many animal farms, it is a common site to have a solitary tree with large span of branch shade (ex – Banyan tree). The tree provides the needed shade for the animals during hot daytime. However, the same tree may bring death to the animal during thunderstorms. Hence, there should be a preventive mechanism of animals approaching the large trees during thunderstorm activities (Fig 4) (Gomes, 2012).

- A metal wire ring should be installed around the tree trunk at about 3 m above ground level. Most of the barbed wires available in the market satisfy this condition.
- Connect 3–4 wires with similar cross section, each of length about 10 m, to the ring at nearly equal spacing.
- The wires should be extended vertically down towards the base of the tree.
- Tie up the vertical wires by metal wire rings at about each 1 m interval.
- At the base of the tree, wires should be buried at about 50 cm below the ground level and extended radially away.
- Cover the ground surface (at least the part of ground underneath the branch span) with a 10– 20 cm layer of gravel or any other earth material that has extremely high resistivity.

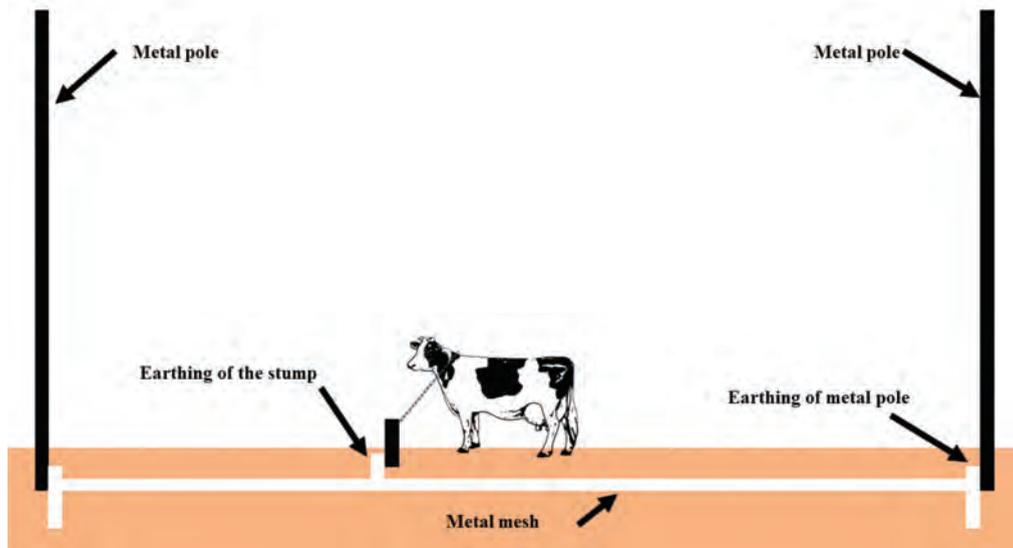


**Fig. 4:** Proposed safety mechanism to protect animals that seek shelter under isolated trees in the field (Reprinted from Gomes, 2012).

In contrast to the agricultural animals herded in large fields, animals in captivity or domesticated animals, which have greater chances of being hit with lightning strike inside shelters, can be better protected by the proposed mechanism as shown in Fig 5 (Gomes, 2012).

- A special place should be prepared to tie up these animals under thunderstorm conditions.
- They should never be tied up to large isolated trees.
- The area, within which the animal is allowed to move, should be laid with a mesh of metal strips (GI pipes, GI tapes, barbed wire etc) 0.5 m underneath the ground surface.
- Four metal poles should be installed and well-grounded as well as joined to metal mesh.

- If the animal owner is using metal chain, the stump should also be grounded and joined to the metal mesh.



**Fig. 5:** proposed safety mechanism to protect captive animals (Adapted from Gomes, 2012).

## References

- Equiptest. (2019). *Lightning Protection – What it is and why you need it!* <https://www.equiptest.co.uk/lightning-protection-what-it-is-and-why-you-need-it/>
- Gomes, C. (2012). Lightning safety of animals. *International journal of biometeorology*, 56(6), 1011-1023. <https://doi.org/10.1007/s00484-011-0515-5>
- Kalita, P. (2021, May 14). 18 elephants die in suspected lightning strike in Assam Forest. *The Times of India: Guwahati Edition*. <https://timesofindia.indiatimes.com/city/guwahati/18-jumbos-found-dead-inside-assam-forest/articleshow/82624270.cms>
- Schulze, C., Peters, M., Baumgärtner, W., & Wohlsein, P. (2016). Electrical injuries in animals: causes, pathogenesis, and morphological findings. *Veterinary pathology*, 53(5), 1018-1029. <https://doi.org/10.1177/0300985816643371>
- Sonkar, R. (2018, July 13). Lightning Safety Outdoors. *Industrial Health & Safety Review*. <https://www.isrmag.com/lightning-safety-outdoors/>
- Vanneste, E., Weyens, P., Poelman, D. R., Chiers, K., Deprez, P., & Pardon, B. (2015). Lightning related fatalities in livestock: Veterinary expertise and the added value of lightning location data. *The Veterinary Journal*, 203(1), 103-108. <https://doi.org/10.1016/j.tvjl.2014.10.024>

## POSTSURGICAL LAPAROTOMY WOUND DEHISCENCE IN SMALL ANIMALS

Aseem Goyal\*, Vikas Garg, Ashwani Kumar

Department of Veterinary Surgery & Radiology, College of Veterinary Science (Ludhiana),  
Guru Angad Dev Veterinary and Animal Sciences University, Punjab-141004, India

Corresponding author E-mail: aseemgoyal6451@gmail.com

### Abstract

*In small animals, ventral midline (linea alba) is the most comprehensive approach for exploratory and diverse therapeutic purposes. Dehiscence of surgical wound is one of the most common complications. This article describes relevant surgical anatomy, surgical dissection, identification of the linea alba, incision and closure of the laparotomy wound, possible complications and management.*

**Keywords:** *Evisceration, falciform fat, incisional hernia, linea alba, suture materials*

### Introduction

Ventral midline (linea alba) incision is the most comprehensive approach for a diverse reasons such as exploratory laparotomy and therapeutic purposes. Dehiscence is one of the most common and serious complications of the ventral midline laparotomy (Claeys 2016) that may be avoided by following standard surgical principles. It is crucial to understand the surgical anatomy of ventral abdominal wall, appropriate suture materials, suture pattern and postoperative care to ensure uneventful recovery. This article attempted to explain relevant surgical anatomy, identification of the linea alba, incision and closure of the linea alba laparotomy wound, possible complications and management.

### Surgical anatomy of the ventral midline

Linea alba (a thin white line) is formed by joining the abdominal muscles of either side as tendinous and fibrous structure that runs in the ventral aspect of the body from the xiphoid to pubis. Rectus abdominus muscles are easily located longitudinally on the either sides of linea alba and are covered by external rectus sheath which is toughest and is a very important anatomical structure concerning abdominal incision closure. Linea alba lacks blood supply and innervation and is easiest to locate near the umbilicus owing to its maximum thickness around it (Smeak, 2014).

### Sites of skin incision to approach abdominal organs

Site of skin incision on the ventral midline is chosen depending upon the topographic position of the organ or part of the abdomen to be explored. For exploratory surgery, the entire abdomen along with the inguinal areas and the caudal portion of the

thorax should be prepared aseptically for surgery so as to provide ample space in case the incision needs to be extended. Broadly speaking, a cranial abdominal incision (i.e., from the xiphoid process to the umbilicus) permit access to liver and stomach, duodenum, spleen, kidneys. Mid abdominal incision are indicated to approach intestine or any mid abdominal lesion. Whereas the caudal abdominal incision (between the umbilicus to pubis) helps to approach female genital organs, urinary bladder, retained testicles. In females, the skin incision on the abdomen is made straight while in male, the incision to reach the caudal abdomen is deviated laterally to the parapenile area; however, the further incision is made over the linea alba.

### **Incision on subcutaneous fascia and linea alba**

Following skin incision, any subcutaneous and subdermal vessels are clamped and cauterized. The subcutaneous (SC) fascia is incised using surgical blade and is separated (not resected) from the underlying muscles (not from the skin) using metzenbaum scissors to expose linea alba and the external rectus sheath (Fig. 1A & 1B). Excessive separation of subcutaneous fascia may be avoided so as to prevent accumulation of exudates in the potential dead space. The linea alba is tented using thumb forceps and a stab incision is made using a BP blade and the incision is further extended using Mayo scissors.



**Fig. 1.** (A) Photograph showing separation of subcutaneous fascia using Metzenbaum scissors (A) to exposure of linea alba and external rectus sheath (B)

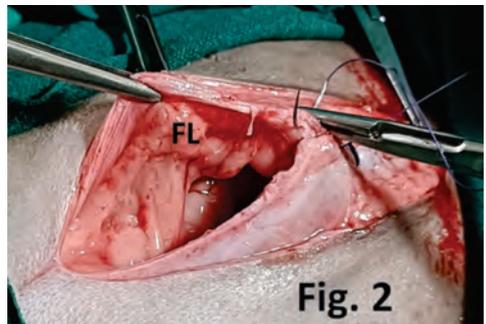
### **Closure of the surgical incision**

**Suture Materials:** Synthetic absorbable suture materials such as polyglactin 910 (PGA 910) and polydioxanone (PDS) are recommended for abdominal incision closure (Tan et. al., 2003). Non-absorbable suture materials (silk/Linen) are not used as these may lead to complications like surgical sinus due to non-absorbability thus leading to delayed healing. The chromic catgut is not preferred for abdominal closure due to rapid loss of its tensile strength and slower healing process of the linea alba. The PGA 910 material has better knot security than PDS but the former being braided so more traumatic (causes tissue drag) and thus may cause surgical wound dehiscence (Papazoglou *et al.*, 2010).

**Suture Pattern:** For the closure of the abdominal incision, either simple interrupted or simple continuous suture patterns are used. The simple continuous suture pattern offers easy and fast closure along with lesser foreign (suture) material in the wound but is more predisposed to dehiscence as compared to the simple interrupted sutures if not properly tied with appropriate amount of knots. So when using continuous suture pattern, the first tie must have atleast 6 to 8 knots (particularly for sutures with poor knot ability such as PDS) and the continuity must be interrupted at every 4-5 cm of incision by placing additional knots.

**Size of Suture Materials:** A 2-0 suture can be used in case of small (upto 10-15 Kg) dogs and a number 0 suture material can be used in case of large dogs when applying continuous sutures whereas, a 3-0 can be used in small dogs and cats and a 2-0 may be used in larger dogs in case where interrupted suture pattern is applied.

**Surgical technique:** Depending upon the dog size, a 5-10 mm of tissue on the either sides of the suture line should be included in the suture bites. When incorporating all the layers of the abdominal wall is necessary (as in the case of cranial and mid abdominal incision closure), one should ensure to avoid incorporating falciform ligament in the sutures; otherwise dehiscence may occur. Alternatively the falciform ligament must be excised and cauterized to achieve haemostasis. For the caudal one third of the abdominal incision, there is no need to incorporate full thickness of the abdominal wall in the sutures; just including external rectus sheath provides sufficient strength for healing. To ensure exclusion of falciform ligament, the needle should exit from the cut end of the linea alba (Fig. 2). In pups or young dogs having soft tissue with less holding power, irrespective of the site of incision, it is preferred to include rectus abdominal muscle along with external rectus sheath in sutures.



**Fig. 2.** Photograph showing technique of suture bite placement to avoid entrapment of Falciform ligament.

**Subcutaneous or skin suturing:** The subcutaneous tissue is closed in a simple continuous manner using 2-0 or 3-0 (one size smaller than that used for linea alba closure) rapidly absorbable suture materials. Thicker suture materials cause irritation for a prolonged period thus delaying healing and complications. Before or during application of the continuous subcutaneous closure, a few simple interrupted sutures or bites should be applied from the intermediate tissues so that minimum of dead-space is left behind. Non-absorbable sutures such as polypropylene or nylon using simple interrupted pattern are preferred for skin.

## Complications

The suture line should be checked daily for redness or swelling or discharge. The complications arise mainly due to furious behaviour of the animal, self-inflicted trauma, owner compliance or infection.

**Seroma formation:** It is the build-up of serosanguineous fluid in the potential dead space subcutaneously or within muscle layers that leads to wound dehiscence. It is rare following intra-abdominal surgery but is common in cases where a large tumour/mass had been removed particularly from the inguinal region. The occurrence of postoperative seroma can be minimized by eliminating the potential dead space by applying a few interrupted sutures using absorbable suture materials. Additionally, Penrose drains may be placed to facilitate drainage. Abdominal bandaging and immobilization can also minimise seroma formation.

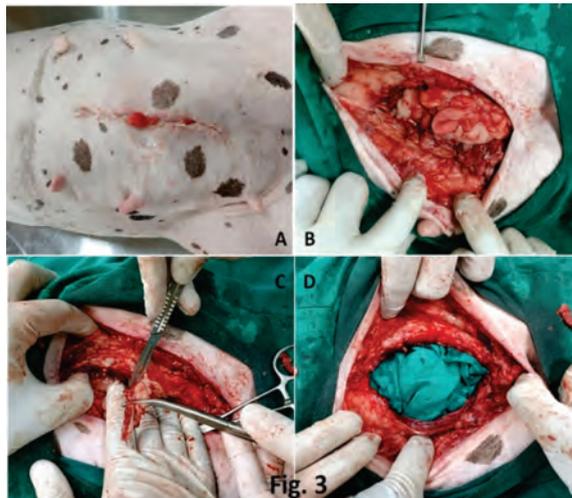
**Dehiscence and Incisional Hernia:** The various predisposing factors associated with suture dehiscence (Claeys 2016) are as follow:

- **Inadequacy of technique:** Sutured wound is weakest at the site of knot placement followed by suture tissue interface and suture itself due to quick absorption or premature mechanical failure. So improper tying of knots, improper selection of suture material such as inadequacy of suture size, suture pattern, rate of absorption etc. Also, multifilament suture material can lead to increased tissue trauma (tissue drag), and increased capillarity leading to more bacterial growth. Other factors include improper needle selection, sutures placed too loose or tight, too quick absorption of sutures, premature removal of sutures, poor suture holding capacity of the tissue as in case where sutures are applied on necrotic tissue. Fat or tissue entrapment in the sutured edges predisposes to dehiscence and incisional hernia.
- **Excessive tension:** The tension on the suture line exceeding the tension bearing strength of the sutures can lead to suture breakage. Also excessive tension may lead to ischemic necrosis of the tissue leading to the sutures to cut out the tissue and lead to dehiscence. Increased forces imposed on the wound, primarily generated by excessive intraabdominal pressure or muscle tension. Wound dehiscence is also accelerated by uncontrolled exercise, violent coughing, or straining after surgery.
- **Infection:** Bacteria release proteolytic enzymes that lead to delayed healing.
- **Systemic factors:** Various underlying systemic factors such as anaemia, endocrine disturbances, nutritional imbalance, hypoproteinemia, hypovolemia etc may also lead to the wound dehiscence.
- Other factors like old age, uncooperative behaviour, self-inflicting trauma, or any

kind of underlying tumor, foreign body or hematoma/seroma may lead to delayed healing and suture dehiscence.

### Management of suture dehiscence and incisional hernia

**Cutaneous wound dehiscence:** Serosanguineous discharge from the suture line, subcutaneous edema and bruising, and necrosis of the skin margins are all clinical indicators of cutaneous dehiscence. If infection is linked to cutaneous dehiscence, pussy discharge may be seen. Management of suture dehiscence involves copious lavage, debridement of the dead tissue and primary closure of the skin if no infection is suspected. If the suture dehiscence is observed due to seroma formation, then drains should be used to allow proper drainage and minimize the dead space. If infection is present in the underlying tissue that is indicated by pussy discharge then the wound is treated as an open wound and second intention healing is expected along with daily antiseptic dressing and using paraffin gauze when the granulating tissue start to appear. Systemic broad spectrum antibiotics are prescribed along with supportive medication.



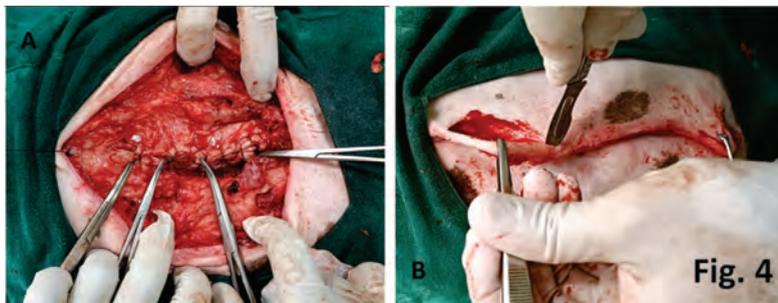
**Fig. 3.** Photographs demonstrating abdominal wound dehiscence following caesarean section in a Pit bull. (A) Evisceration (omentum) on day 6 after surgery, (B) adhesions and rounded muscle margins, (C) Freshening of muscle margins, (D) clean muscle margins.

**Abdominal wall dehiscence:** If acute (occurs within 3-5 days of surgery), it is very serious (evisceration), otherwise leads to incisional hernia. Acute abdominal wall dehiscence (evisceration) is usually associated with exposure of abdominal tissue (omentum) or organs (spleen, intestine) out through the skin (Fig. 3A), and should be treated immediately (Smeak 2014).

Animal should be stabilized using IV fluids, herniated organs are covered with sterilized gauze. Under general anaesthesia, the abdomen is explored, aseptically, the

damaged tissue / organs are repaired, abdomen is lavaged, all the adhesions are broken bluntly with fingers and the eviscerated abdominal organs are reposed back inside the abdomen (Fig. 3B).

The muscle edges are freshened up by excising necrotic tissues using BP blade/ Mayo scissors (Fig. 3C and D). The muscular layer is sutured using continuous/simple interrupted suture pattern using appropriate absorbable suture materials (Fig. 4A). Skin edges are also freshened up by sharp incision (Fig. 4B) before suturing. The treatment of chronic abdominal hernias without evisceration is not treated as an emergency if the condition of the animal is stable. The skin is incised normally and the hernia is treated in a standard manner.



**Fig. 4.** Photograph showing (A) laparotomy wound closure by simple continuous suture with interruptions, (B) freshening of cutaneous margins before suturing.

## References

- Claeys, S. (2016). Dehiscence. In Griffon, D. & Hamaide A (Eds.), *Complications in Small Animal Surgery* (pp. 55-63). John Wiley & Sons, Inc. <https://doi.org/10.1002/9781119421344.ch9>
- Smeak, D. D. (2019). Identifying the linea alba and avoiding paramedian incisions during midline celiotomy. *Clinician's Brief*, 74-79.
- Tan, R. H. H., Bell, R. J. W., Dowling, B. A., & Dart, A. J. (2003). Suture materials: composition and applications in veterinary wound repair. *Australian Veterinary Journal*, 81(3), 140-145. <https://doi.org/10.1111/j.1751-0813.2003.tb11075.x>
- Papazoglou, L. G., Tsioli, V., Papaioannou, N., Georgiadis, M., Savvas, I., Prassinou, N., Kouti, V., Bikiaris, D., Hadzigiannakis, C., & Zavros, N. (2010). Comparison of absorbable and nonabsorbable sutures for intradermal skin closure in cats. *The Canadian Veterinary Journal*, 51(7), 770-772.

## SERTOLI CELL TUMOUR IN DOGS

**Nikita Gupta, Vandana Sangwan\* and Arun Anand**

Department of Veterinary Surgery & Radiology, College of Veterinary Science (Ludhiana)  
Guru Angad Dev Veterinary and Animal Sciences University, Punjab-141004, India

\*Corresponding author E-mail: drvandanasangwan@rediffmail.com

### Abstract

*The study describes the clinical signs, diagnosis and treatment of sertoli cell tumour in dogs. The clinical sign of cryptorchidism (unilateral or bilateral), hyperplasia of teats, symmetrical alopecia and hyperpigmentation of skin leads towards sertoli cell tumour. Radiography and ultrasonography are the available facilities at field level which can help in the clinical diagnosis of the condition. Though, histopathology confirms the diagnosis. Surgical removal of the retained testicle is recommended in such dogs.*

**Keywords:** Cryptorchid, dog, metaplasia, prostate, retained testicle, sertoli cell tumour

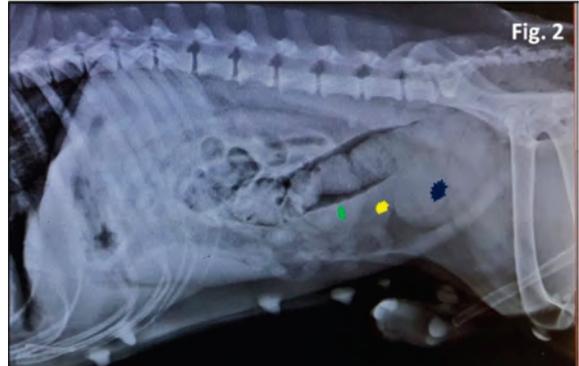
### Introduction

Testicular tumours are frequently reported in dogs (5-15% of all the tumours), with sertoli cell tumour, seminoma, interstitial cell tumour being the 3 main types (England & Heimendahl, 2010). Sertoli Cell tumour is the most common tumour of cryptorchid testicle, which may have been retained in inguinal region or in abdomen. Sertoli cell tumour has also been reported in the descended scrotal testicle (Post & Kilborn, 1987). Sertoli cell tumours have the highest incidence of metastasis amongst the testicular tumours (England & Heimendahl, 2010), and may occur in dogs of less than 10 years of age, unlike other testicular tumours (Fossum, 2018).

**Case History and Presentation:** Most of the cases of Sertoli Cell Tumours are noted as incidental findings, during the routine clinical examination or when the dog is presented for other complaints. Initially, only a mass may be palpable in inguinal or mid abdominal region, which may gradually increase in size, compressing and destroying surrounding testicular tissue and extending along the spermatic cord (Slatter, 1985). There is development of Paraneoplastic Syndrome of Feminization due to hyperestrogenism, where the male dogs take on female characteristics. The clinical signs associated with feminization syndrome include bilateral symmetrical alopecia, gynaecomastia (nipple elongation and mammary enlargement) (Fig. 1), brittle hair, poor hair regrowth, thin skin, hyperpigmentation, penile atrophy, pendulous prepuce, reduced libido, male attraction, squatting micturation, prostatic metaplasia, and myelotoxicity (has guarded prognosis). All clinical signs are usually not shown by all the dogs. Abdominal palpation may reveal presence of hard mass in mid abdominal region. Sometimes there is a history of abdominal enlargement, where the size of sertoli cell tumour is large. Some dogs with medium size tumour may have spermatic chord torsion, leading to signs pain in dog.



**Fig. 1.** Photograph showing gynecomastia, pendulous prepuce and thin skin in a dog with one testicle retained. The single scrotal testicle was removed 5yrs back.



**Fig. 2.** Radiograph showing 3 soft tissue organs in the caudal abdomen region which require ultrasonography for differentiation.

## Diagnosis

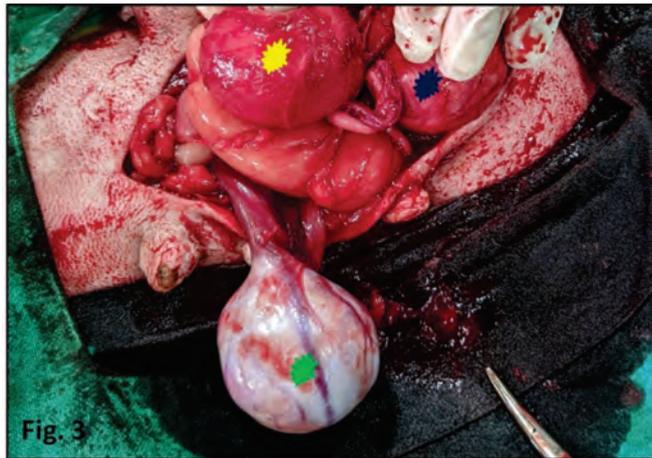
The lateral radiographs of thorax and abdomen (Fig. 2) are advised to look for metastasis and size of tumour. The radiograph usually shows soft tissue opacity cranial to the urinary bladder region. Presence of metaplasia of prostate may confuse the radiographic findings.

Ultrasonography helps in differentiating the urinary bladder, prostate and testicle. The hemato-biochemical parameters are usually normal, but sometimes may show signs of myelotoxicity.

## Treatment

Ventral midline celiotomy is required through parapenile or just cranial to prepuce approach under general anaesthesia for abdominally retained testicles. The enlarged testicle usually is not found at the usual site (underneath the urinary bladder) but has moved cranial to urinary bladder (in mid abdomen), due to its weight. The spermatic chord gets elongated. The testicle is required to be exteriorized out of the abdomen and the spermatic chord is ligated and the testicle is removed (Fig. 3). The clinical signs and size of prostate usually start regressing soon after the tumour removal but if they persist or reoccurs, it may be suggestive of metastasis.

Hyperestrogenism is responsible for feminization syndrome in dogs suffering from Sertoli Cell Tumour. Clinical signs, physical examination and diagnostic imaging aid in the diagnosis of Sertoli Cell Tumour, however, confirmatory diagnosis can only be made by histopathology of the biopsy sample. Removal of undescended testicular mass is recommended with excellent prognosis.



**Fig. 3.** Photograph showing the enlarged retained testicle (green star), the urinary bladder (yellow star), and the enlarged prostate (blue star) during laparotomy.

### References

- England, G. C., & Heimendahl, A. V. (2010). *BSAVA manual of canine and feline reproduction and neonatology* (No. Ed. 2). British Small Animal Veterinary Association.
- Fossum, T. W. (2018). *Small animal surgery e-book*. Elsevier Health Sciences.
- Post, K., & Kilborn, S. H. (1987). Canine sertoli cell tumor: a medical records search and literature review. *The Canadian veterinary journal = La revue veterinaire canadienne*, 28(7), 427–431
- Slatter, D. H. (1985). *Small animal surgery*. Saunders company, 1, 689-699.

## TECHNIQUE OF EXTERNAL COAPTATION FOR THE MANAGEMENT OF METACARPAL AND METATARSAL FRACTURE IN BOVINES

**Akashdeep Singh Hundal and Vandana Sangwan\***

Department of Veterinary Surgery & Radiology, College of Veterinary Science (Ludhiana),  
Guru Angad Dev Veterinary and Animal Sciences University, Punjab-141004, India

\*corresponding author E-mail: drvandanasangwan@rediffmail.com

### **Abstract**

Metacarpal and metatarsal fractures are common in Bovine. External coaptation with the help of aluminium splints and fiberglass cast is the best adopted method in young to heavy adult bovine in the region of Punjab, India. The article describes the step wise pictorial presentation of the technique for the application of external coaptation using aluminium splints and fiberglass cast for the management of metacarpal and metatarsal fractures in Bovine.

**Keywords:** *Aluminium, bovine, buffalo, external coaptation, fiberglass cast*

### **Introduction**

The fractures of metacarpal and metatarsal are the most common in Bovines (Prasad *et al.*, 2019). The prognosis of fracture in bovine depends on the severity of injury (eg, open versus closed fracture, tissues damage, neurovascular trauma), location and type of fractures (eg, articular or non-articular), expected success rate of treatment, cost of treatment and the potential economic and genetic value of the animal (Jean and Anderson 2014). Various prognostic factors have been described for the successful outcome of use of external coaptation for the repair of metatarsal and metacarpal fractures (Prasad *et al.*, 2020). The recumbent bovines and those with open fractures bear poor prognostic outcome and may require, limb amputation or euthanasia (Jean and Anderson 2014, Prasad *et al.*, 2020). However, the closed fracture of metacarpal and metatarsal in standing bovine bear excellent outcome for the metacarpal and metatarsal fractures (Prasad *et al.*, 2020). Full effort should be made at field level to avoid the fracture becoming open, with proper first-aid and application of cast there and then only. The article describes the step wise technique for the application of external coaptation using aluminium splints and fiberglass cast.

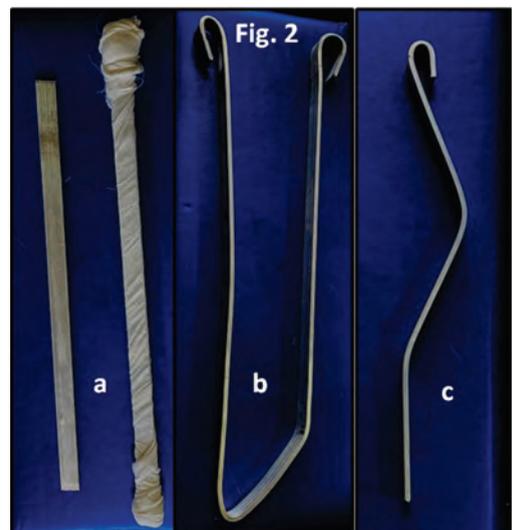
## Descriptive Technique

**Materials required:** (The material quantity mentioned here is for an adult bovine, Fig. 1)



1. Thick jute ropes for restraining/casting of the bovine.
2. Sedation with xylazine (@0.1mg/Kg i.e 2ml for a 400 kg buffalo, Intramuscular) only if the bovine is non-pregnant, male and excited, otherwise inj. melonex is sufficient to calm the bovine.

3. Aluminium splint (5-6mm thick and 24mm wide) of 6-8ft length. The thickness of splint may be reduced for very young bovines or the splint arms may be doubled for heavy bovines. The aluminium splint can be used as a straight splint, which is easy to make by just cutting the required length with a pin cutter and then padding the ends with thick cotton pads (Fig. 2a and b). Straight splints are good for young and sub-adult bovines and also for cows with smaller inter-digital space. The other way to use these aluminium splints is to make a 'U-shaped splint, where the U portion gets fit in the inter-digital space (Fig. 2c). 'U' splints are good for adult buffaloes. The length of the arms of splints is from the pastern joint to the mid/proximal of radius bone for metacarpal bone



and upto mid tibia for metatarsal bone. The shape of the splint is straight for metacarpal bone but need slight bowing for the metatarsal bone in the region of hock joint (Fig. 2d). The Splints can be applied on the cranial and caudal side of the bone only (for young bovines), or cranial, caudal, medial and lateral side for the adult heavy bovines.

4. Zinc oxide powder: 80gms.
5. Small bucket with water (warm if winter)
6. Cotton: 500gms for metacarpal in adult bovine and 750gms for metatarsal. Keep ready thick cotton rolls before proceeding.
7. Cotton bandages (fine quality) 6inches: 10-12, Dip these bandages in water bucket, as it will increase their strength.
8. Nada (thick braided cotton string): one big roll. Make roll of the nada and dip it in water bucket.
9. Fiberglass cast '5 inch width: Two for metacarpal and 3 for metatarsal.
10. Antibiotics and painkillers, if the fracture is open.
11. Surgical blade: for making window, if fracture is open.

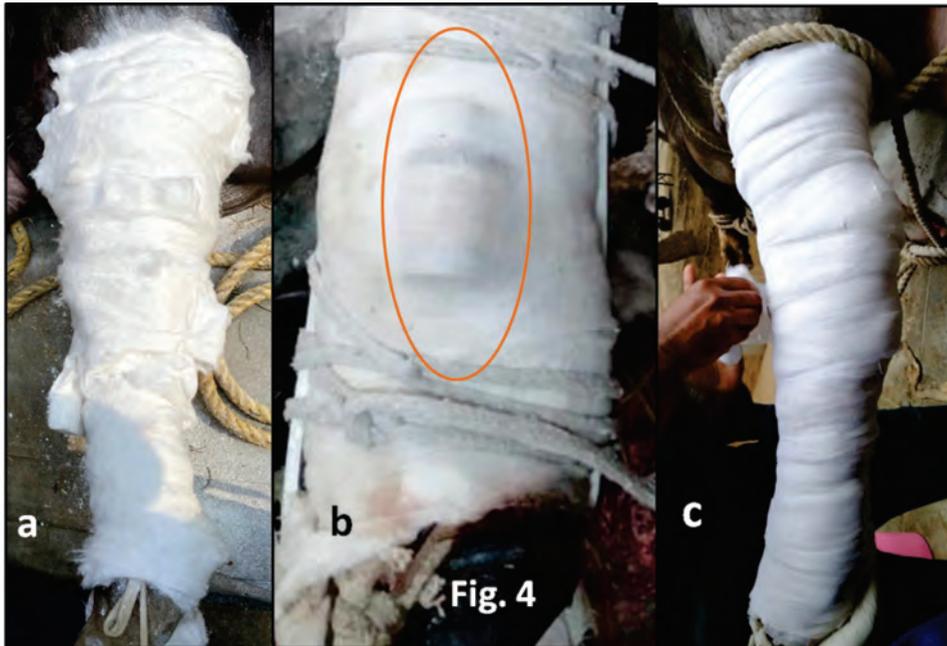
#### Steps for the application of aluminium splint incorporated fiberglass cast



1. Restrain the bovine in lateral recumbency on some padded trolley or base by keeping the fractured limb up (Fig. 3a). If the wound is on medial side, the bovine may be first casted with the fracture limb down and later for application of cast, may need to rotate the bovine. Care must be taken while rotating the bovine in advance pregnancy as it may lead to uterine torsion (in this situation, keep the

limb up and dress the wound by bending below).

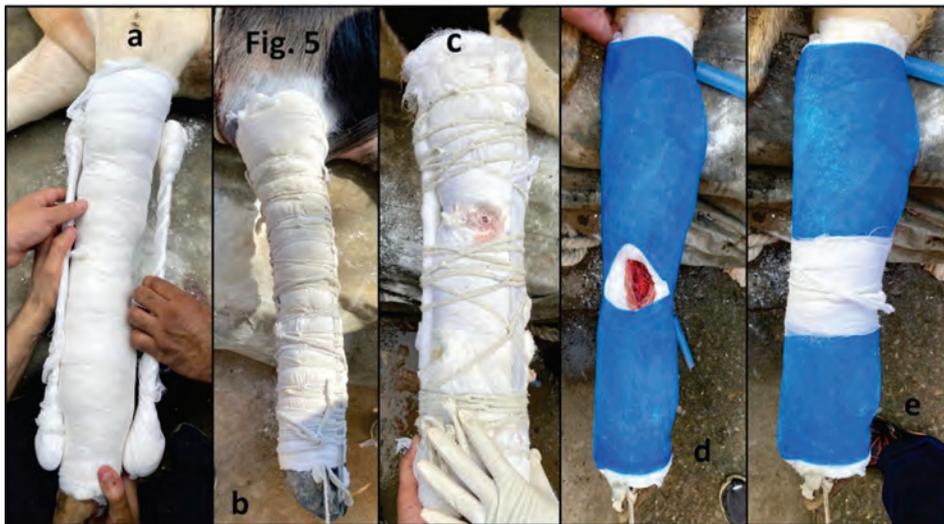
2. The affected limb is pulled by using traction applied at the level of hoof and if required under the elbow on the opposite direction (Fig. 3b, red arrows). The traction can be simply made with a thick cotton rope tied to a wooden stick or left over aluminium splint piece. The knot on the hoof with the thick cotton rope is half slip knot, which can be easily opened by pulling the smaller thread later (after cast application).
3. If there is a wound at the fracture site, it is washed thoroughly with normal saline solution and flushing betadine in it. If free bone pieces are felt, they can be removed.
4. Zinc oxide powder is liberally applied all over the limb (Fig. 3c) as it is healthy for skin.



5. Unroll the cotton rolls all over the limb for both type of fractures (Fig. 4a). If the fracture is open, keep a melonex (Fig. 4b) or antibiotic vial on the wound (as a mark for later opening the cast at that site) and then apply cotton over it. Keep the vial stable at that site, every time while crossing the site. The cotton layer should be sufficient to not to cause sores with splints.
6. Unroll cotton bandages all over the cotton in a neat and tight manner (Fig. 4c).
7. Apply the splints (kept ready of proper size with ends padded) on the required sides (Fig. 5a). One person need to hold the splints while the other will tighten

them with nada (thick cotton rope).

8. Tie the nada in interlocking fashion (Fig. 5b). Start tightening the nada from above the dewclaws (as tightening below it, may lead to tourniquet). For very young calves, instead of nada, cotton bandage can be used to fix the splints.
9. Wrap one wet bandage over the tightened nada.
10. Make window over the vial kept at the start (if open fracture) with surgical blade (Fig. 5c). Remove the vial and adjust the window as per the site and size of the wound.

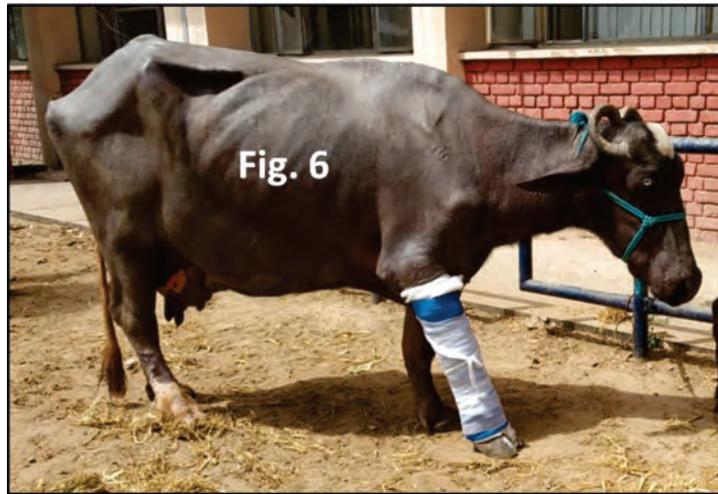


11. Wear disposable gloves and unroll fiberglass bandage (Fig. 5d). The fiberglass can be slightly wet before application. The window can be avoided, while applying fiberglass or may need to make it again. At least 2 layer of fiberglass is applied.
12. The wound is to be bandaged with a thick cotton pad (Fig. 5e).
13. Antibiotics and painkillers are required if the fracture is open. Daily dry dressing of the wound is required with the use of betadine, nebasulf, zinc oxide etc.

#### Points to remember:

1. Window should always be made even for puncture wounds or deep lacerates as they are infected and later become big wounds.
2. Fix the proximal and distal joints in the cast and splints.
3. For the opening of the fiberglass cast:
  - a. Closed fracture in very young calves (less than month) at 3-4 weeks.
  - b. Closed fracture in young heifers, at 1.5 to 2 months.

- c. Closed fractures in adult bovine, 2.5-3 months.
  - d. For, open fractures the time may vary.
3. The Fiberglass cast with aluminium splints provide great support to the bovine while standing and walking and it has been observed to provide immediate weight bearing after application (Fig. 6).



The technique of conservative management of metacarpal and metatarsal fractures has been described in the article. The technique is viable and is recommended for application of metacarpal and metatarsal fractures at field level. The technique does not require radiographs and if, applied correctly and at the earliest, can save many fractures to become open in bovines.

### References

- Jean, G. S. & Anderson, D. E. (2014). Decision analysis for fracture management in cattle. *Veterinary Clinics of North America: Food Animal Practice*, **30**(1), 1-10.
- Yadav, G.P., Sangwan, V. & Kumar, A. (2019). Comparative occurrence pattern of fractures in cattle and buffaloes. *Veterinary World*, **12** (7), 1154-59. Doi 10.14202/vetworld.2019.1154-1159.
- Yadav, G.P., Sangwan, V., Kumar, A., Mahajan, S.K. & Gupta, A. (2019). Prognostic factors associated with successful outcome of metacarpal and metatarsal fractures repaired using external coaptation in bovines. *Indian Journal of Animal Research*. **54** (5), 578-592.

## **TELE-EXTENSION IN GADVASU**

**R K Sharma and Amandeep Singh**

Department of Veterinary and Animal Husbandry Extension Education  
College of Veterinary Science (Ludhiana),  
Guru Angad Dev Veterinary and Animal Sciences University, Punjab-141004, India

Extension services are mainly concerned with the transfer of technologies through demonstrations, trainings and transfer of information through print and electronic media. The extension services are, therefore, a link between the innovative system or research system and recipient system i.e. livestock industry or livestock farming families. Increasing trend in the diversification of agriculture with animal farming and adoption of dairy and intensive poultry farming on commercial scale in Punjab requires introduction of innovative livestock production systems including efficient marketing expertise within the extension services.

The extension services in veterinary and animal sciences are only 5-10 per cent of the total agricultural extension services that too availed by the elite livestock farmers. Among rural masses, a vast majority is landless or has small land holdings and depends on livestock for their livelihood. Such landless or small/marginal farmers are the major contributors towards the milk and meat production (small ruminants) in the country. These small and marginal farmers which constitute a large segment of the rural society can't visit University campus to get required animal production technology interventions.

Livestock sector needs to grow at a faster rate than in the past to allow for higher per capita income and consumption. It is an accepted fact that the sound animal husbandry development is essential for the overall economic progress. Rising consumer prosperity and the search by farmers for higher incomes will simultaneously drive livestock diversification. Export opportunities for livestock products are also expected to continue to grow, provided India could meet the stability, quality and presentation standards demanded by foreign trade and consumers, and maintain its comparative advantage as a relatively low-cost producer.

Technology generation and transfer will have to focus more strongly than ever before on the themes of optimization in the management of their available resources by producers, sustainability, coping with diversity by adapting technology more specifically to agro-ecological or social circumstances and raising the economic efficiency of animal husbandry. To make information transfer more practical and cost effective, greater use of modern information technology and communication among researchers, extensionists and farmers should be made.

Public extension system requires a paradigm shift from top-down, blanket

dissemination of technological packages towards providing producers with the knowledge and understanding with which they solve their own area-specific problems. Continuous two-way interaction among the farmers and animal husbandry scientists is the most critical component of Livestock Extension.

Due to financial, distance or time constraints, livestock farmers can't access extension agencies in time. The tele-extension or consultancy through digital mode is the only way to reach the hitherto unreached farmers. Covid-19 pandemic or lockdown further necessitates the existence of quick extension to deal with emergency situation of animals at field level.

It was felt as the need of the hour to establish a Pashu Palak Tele-Advisory Kendra (PP-TAK) at GADVASU to provide leverage to the extensive telecom infrastructure available in the state to deliver extension services to the livestock farming community. Accordingly, the National Bank for Agriculture and Rural Development (NABARD), Regional Office-Punjab, Chandigarh was requested for financial aid through a project proposal and the same was granted on 24.03.2022. Thus, Pashu Palak Tele-Advisory Kendra at GADVASU, Ludhiana was established and inaugurated by worthy Vice-Chancellor of GADVASU, Ludhiana along with Chief General Manager of NABARD, Chandigarh on 03.06.2021. Within few weeks, it became functional through establishment of two connecting lines i.e. 62832-58834 and 62832-97919.

The major aims of PP-TAK are

1. To provide quick solutions for farmer queries in local language through telephony/text message/ instructional videos.
2. To provide technical inputs related to A.H. activities to farmers.
3. To serve as a feedback mechanism for the policy makers.
4. To forge strong Research Extension Farmer Linkages.

The farmers, field functionaries or other stakeholders can enquire about anything related to livestock farming. The lines are functional from 9.00 AM to 5.00 PM on all week days except Sundays and declared holidays.

The dedicated numbers of PP-TAK have been disseminated to livestock farmers and other stakeholders in all the corners of the state through many platforms i.e. through various social media like WhatsApp groups, Facebook etc. These have also been put up at different places in the University campus frequently visited by the farmers.

The banners, prepared in vernacular language have been pasted at different KVKs (Krishi Vigyan Kendra), RRTCs (Regional Research Stations), Milk Cooperative



ਪਸ਼ੂ ਪਾਲਕ ਟੈਲੀ ਐਡਵਾਇਜ਼ਰੀ ਕੇਂਦਰ

**PASHU PALAK-TELE ADVISORY KENDRA**  
(GADVASU LUDHIANA)

**Dedicated Numbers**

**+91-62832-97919**

**+91-62832-58834**



ਖ਼ਬਰੀ ਖ਼ਬਰੀ ਖ਼ਬਰੀ

ਪੰਜਾਬ ਦੇ ਸਮੁੱਚੇ ਪਸ਼ੂ-ਪਾਲਕਾਂ ਦੀ ਭਲਾਈ ਲਈ ਵੈਟਨਰੀ ਯੂਨੀਵਰਸਿਟੀ, ਲੁਧਿਆਣਾ ਦੁਆਰਾ "ਪਸ਼ੂ ਪਾਲਕ-ਟੈਲੀ ਐਡਵਾਇਜ਼ਰੀ ਕੇਂਦਰ" ਸਥਾਪਿਤ ਕੀਤਾ ਗਿਆ ਹੈ। ਪਸ਼ੂ ਪਾਲਣ (ਡੋਅਰੀ, ਮੁਰਗੀ, ਸੂਰ, ਬੱਕਰੀ ਪਾਲਣ ਆਦਿ) ਨਾਲ ਸਬੰਧਤ ਸਮੱਸਿਆਵਾਂ ਦੇ ਹੱਲ ਲਈ ਯੂਨੀਵਰਸਿਟੀ ਦੇ ਮਾਹਿਰਾਂ ਨਾਲ ਹੇਠ ਲਿਖੇ ਨੰਬਰਾਂ ਤੇ ਸੰਪਰਕ ਕਰ ਸਕਦੇ ਹੋ।

**62832-97919**

**62832-58834**

ਸੰਪਰਕ ਕਰਨ ਲਈ ਸਮਾਂ : ਸੋਮਵਾਰ ਤੋਂ ਸ਼ਨੀਵਾਰ ਤੱਕ  
ਸਵੇਰੇ 9:00 ਵਜੇ ਤੋਂ ਸ਼ਾਮ 5:00 ਵਜੇ ਤੱਕ

ਪਸ਼ੂ ਪਾਲਕ ਟੈਲੀ ਐਡਵਾਇਜ਼ਰੀ ਕੇਂਦਰ  
ਗੁਰੂ ਅੰਗਦ ਦੇਵ ਵੈਟਨਰੀ ਅਤੇ ਐਨੀਮਲ ਸਾਇੰਸ  
ਯੂਨੀਵਰਸਿਟੀ, ਲੁਧਿਆਣਾ (ਪੰਜਾਬ)



Societies, Important Chemist shops, Seed stores, Feed Stores, Fertilizer Stores etc.

The important queries along with their answers are being published in monthly magazine, "Vigayanak Pashu Palan". After a stipulated period, the calls will be analyzed and the information so created will be shared with the policy makers.

It is hoped that this type of telecommunication will establish strong linkage between the farmers and the University all around Punjab. This call center facility of the University will usher a new era and will provide impetus to livestock farming in information deficit areas. Linking the centre to a Mobile App will further increase its utility. The establishment of call centre will encourage farmers to adopt scientific livestock practices, thereby, leading to enhancement in overall livestock production.

## GUIDELINES TO AUTHORS

Dear authors, 'Vet Alumnus' - the official organ of the Alumni Association, College of Veterinary Science (Ludhiana), Guru Angad Dev Veterinary and Animal Sciences University, Punjab-141004, India is a registered journal with ISSN 2319-5762 and is being published biannually in the months of June and December every year. Recently published issues of the 'Vet Alumnus' are available as OPEN ACCESS on <https://www.gadvasu.in/page/vet-alumnus>

### Types of paper:

Manuscript of clinical or practical application interest in the form of a mini review and research article (upto 2500 words) or short note, description of emerging diagnostic or therapeutic technique(s), clinical, technical and popular articles (upto 1500 words) will be considered for publication. Each submission will be subjected to editorial revisions before publication.

### Manuscript:

- The TITLE should be short, specific and informative, written in capital letters.
- The BYLINE should contain full names of all the authors, affiliation and the email of the corresponding author as per example below:

Example: **Varinder Uppal\***, **Anuradha Gupta**, **Neelam Bansal** and **Opinder Singh**

Department of Veterinary Anatomy, College of Veterinary Science (Ludhiana), Guru Angad Dev Veterinary and Animal Sciences University, Punjab -141004, India

\*Corresponding author email: [v.uppal@yahoo.com](mailto:v.uppal@yahoo.com)

- The maximum number of authors should be restricted to 3. More authors may be included with proper justification given in the covering letter.
- All research based manuscripts should have an ABSTRACT with 3-5 KEYWORDS, written in alphabetical order. Body of the article must be comprised of brief INTRODUCTION, METHODOLOGY, RESULTS, and DISCUSSION. The body of other types of manuscripts should be divided into suitable subheads.
- All FIGURES/TABLES must be well-labeled, titled and quoted at appropriate places in the text.
- REFERENCES: List 5 to 7 recent and relevant references in the alphabetical order as per example below:

Example: Uppal, V., Gupta, A., Bansal, N. & Singh, O. (2015). Anatomical differences in appendicular skeleton of cattle and buffalo. *Vet Alumnus* 36(1): 22-23.

- Papers should be TYPE WRITTEN, and DOUBLE SPACED throughout (including references and tables) on A4 size with a 2.5 cm margin at the top, bottom and left and right-hand side. Articles (including illustrations) should be submitted in electronic form after a thorough check up of typographical/grammatical errors and plagiarism.
- Well written and structured articles as per the above guidelines can be submitted to the Editor on email: [editor.vetalumnus@gmail.com](mailto:editor.vetalumnus@gmail.com).
- Authors shall be sole responsible for the contents of the article.
- There are NO PUBLICATION CHARGES for the authors.

## Connect with us



<https://www.gadvasu.in/>



**You Tube**



**COVS, GADVASU**



**Farmer friendly  
e-extension**

**Alumni Association  
College of Veterinary Science  
Guru Angad Dev Veterinary and Animal Sciences University  
Ludhiana-141004, Punjab, India**