ASSISTANCE TO STATES FOR CONTROL OF ANIMAL DISEASES (ASCAD) TRAINING COURSE

ADVANCES IN SURGICAL AND IMAGING TECHNIQUES FOR ANIMALS

October 14-19, 2013

Department of Veterinary Surgery & Radiology
College of Veterinary Science & Animal Husbandry
Junagadh Agricultural University, Junagadh-362001, Gujarat, India
ASSISTANCE TO STATES FOR CONTROL OF ANIMAL DISEASES (ASCAD) TRAINING COURSE

on

ADVANCES IN SURGICAL AND IMAGING TECHNIQUES FOR ANIMALS

October 14-19, 2013

Course Director
Dr. P H Vataliya

Course Co-ordinator
Dr. P B Patel

Editors
Dr. Vineet Kumar
Dr. S H Talekar
Dr. J V Vadalia
Dr. A M Patel

Department of Veterinary Surgery & Radiology
College of Veterinary Science & Animal Husbandry
Junagadh Agricultural University, Junagadh-362001, Gujarat, India
Gujarat state has achieved more than 10% growth in agriculture GDP in the past decade where growth in animal husbandry sector has contributed satisfactory especially by ensuring livelihood security to rural population.

The growth in the livestock sector can be sustained only through better livestock health services where medical, gynecological and surgical interventions become imperative in various ailments of livestock.

Advancement in the imaging tools for the diagnosis of ailments of livestock requiring surgical intervention, the adaption of new methods of surgical approach and adoption of modern surgical tools makes the veterinary surgery and radiology an exciting field of livestock health services.

The present training on the “Advances in Surgical and Imaging Techniques for Animals” aims at updating the field veterinarians on recent advances.

The compendium covers an array of topics viz. current diagnostic techniques and advanced surgical modalities. I am delighted to note that, Dr. P.B. Patel, Professor & Head of Veterinary Surgery and Radiology and the team of surgeons have made sincere efforts to make this volume an important resources book. I hope the training will be highly interactive, fruitful and will be of immense help to the field veterinarians to meet the challenges of threatening animal diseases and will contribute to improve the livestock health and wealth.

(P. H. Vataliya)
Course Director & Dean
College of Veterinary Science & A. H. JAU, Junagadh
MESSAGE

The Department of Veterinary Surgery and Radiology, College of Veterinary Science & Animal Husbandry is fully furnished with advance diagnostic facilities like CR system, Positive Pressure Ventilation, Dental Scalars, Ultrasonography, Veterinary patient monitor, ECG, Small Animal Inhalant Anesthetic Machine etc. The construction of small animal clinical complex building is also completed. This will be giving an important leverage to small animal surgery and radiology at Veterinary College, Junagadh.

The training course on “Advances in Surgical and Imaging Techniques for Animals” include advance diagnostic techniques such as Computerized Radiography, Ultrasonography, General and Regional anesthetic techniques beside basic operation like tumor, abdominal surgery, and diaphragmatic hernia in large and small animals. The compendium has been meticulously compiled by the teachers of the department which I hope, will be a useful document and guide for the further reference to veterinarians.

I am thankful to Dr. A. J. Kachhiapatel, Director, Animal Husbandry. Government of Gujarat, Gadhinagar and Dr. P. H. Vataliya, Principal & Dean, College of Veterinary Science & Animal Husbandry, Junagadh Agricultural University, Junagadh for giving full support for conducting the training course.

(P. B. Patel)
Course Co-ordinator,
Professor & Head
Department of Veterinary Surgery & Radiology
College of Veterinary Science & A. H.
JAU, Junagadh
Participants: Training on "Advances in Surgical and Imaging Techniques for Animals"
October 14-19, 2013

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name and Correspondence Address</th>
<th>Email</th>
<th>Phone No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dr. Valjibhai Veljibhai Bhut V. O., District Panchayat, Junagadh</td>
<td></td>
<td>9723617921</td>
</tr>
<tr>
<td>2</td>
<td>Dr. Sunilkumar Maheshbhai Patel V. O., District Panchayat, Surendranagar</td>
<td><a href="mailto:drsunil1984@gmail.com">drsunil1984@gmail.com</a></td>
<td>9714331333</td>
</tr>
<tr>
<td>3</td>
<td>Dr. Kalpeshkumar Prabhatbhai Deshai V. O., District Panchayat, Rajkot</td>
<td><a href="mailto:kalpeshvet@yahoo.co.in">kalpeshvet@yahoo.co.in</a></td>
<td>9428023028</td>
</tr>
<tr>
<td>4</td>
<td>Dr. Milindkumar Harshadray Fotariya V. O., District Panchayat, Rajkot</td>
<td><a href="mailto:milind.vety@gmail.com">milind.vety@gmail.com</a></td>
<td>9974416601</td>
</tr>
<tr>
<td>5</td>
<td>Dr. Yusufbhai Valibhai Mansuri V. O., District Panchayat, Rajkot</td>
<td><a href="mailto:yusufmansuri35@yahoo.in">yusufmansuri35@yahoo.in</a></td>
<td>9427059188</td>
</tr>
<tr>
<td>6</td>
<td>Dr. Parikshitkumar Natvarlal Prajapati V. O., District Panchayat, Jamnagar</td>
<td><a href="mailto:dr.parikshit05@yahoo.com">dr.parikshit05@yahoo.com</a></td>
<td>9574513634</td>
</tr>
<tr>
<td>7</td>
<td>Dr. Vasantbhai Rameshbhai Parmar V. O., District Panchayat, Jamnagar</td>
<td><a href="mailto:vasantvet@gmail.com">vasantvet@gmail.com</a></td>
<td>9974453754</td>
</tr>
<tr>
<td>8</td>
<td>Dr. Jayesh Dineshbhai Makvana V. O., District Panchayat, Amreli</td>
<td></td>
<td>9426852738</td>
</tr>
<tr>
<td>9</td>
<td>Dr. Pravinkumar Nagjibhai Chaudhari V. O., District Panchayat, Amreli</td>
<td><a href="mailto:pnvety@gmail.com">pnvety@gmail.com</a></td>
<td>9429288990</td>
</tr>
<tr>
<td>10</td>
<td>Dr. Kiritkumar Jayantilal Chavda V. O., District Panchayat, Junagadh</td>
<td><a href="mailto:kirit_vets@yahoo.co.in">kirit_vets@yahoo.co.in</a></td>
<td>9725767741</td>
</tr>
</tbody>
</table>
# LIST OF FACULTY MEMBERS

Department of Veterinary Surgery & Radiology  
College of Veterinary Science & Animal Husbandry  
Junagadh Agricultural University, Junagadh-362001

<table>
<thead>
<tr>
<th>Name of Faculty Member</th>
<th>Photograph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. P. B. Patel</td>
<td><img src="image1" alt="Dr. P. B. Patel" /></td>
</tr>
<tr>
<td>Professor &amp; Head</td>
<td><img src="image2" alt="Dr. P. B. Patel" /></td>
</tr>
<tr>
<td>Phone: 094274 84944</td>
<td><img src="image3" alt="Dr. P. B. Patel" /></td>
</tr>
<tr>
<td><a href="mailto:pbpatel1564@gmail.com">pbpatel1564@gmail.com</a></td>
<td><img src="image4" alt="Dr. P. B. Patel" /></td>
</tr>
<tr>
<td>Dr. S. H. Talekar</td>
<td><img src="image5" alt="Dr. S. H. Talekar" /></td>
</tr>
<tr>
<td>Associate Professor</td>
<td><img src="image6" alt="Dr. S. H. Talekar" /></td>
</tr>
<tr>
<td>Phone: 095580 04859</td>
<td><img src="image7" alt="Dr. S. H. Talekar" /></td>
</tr>
<tr>
<td><a href="mailto:shivaji.talekar@gmail.com">shivaji.talekar@gmail.com</a></td>
<td><img src="image8" alt="Dr. S. H. Talekar" /></td>
</tr>
<tr>
<td>Dr. Jignesh V. Vadalia</td>
<td><img src="image9" alt="Dr. Jignesh V. Vadalia" /></td>
</tr>
<tr>
<td>Assistant Professor</td>
<td><img src="image10" alt="Dr. Jignesh V. Vadalia" /></td>
</tr>
<tr>
<td>Phone: 089809 57065</td>
<td><img src="image11" alt="Dr. Jignesh V. Vadalia" /></td>
</tr>
<tr>
<td><a href="mailto:dr.jvvpatel@gmail.com">dr.jvvpatel@gmail.com</a></td>
<td><img src="image12" alt="Dr. Jignesh V. Vadalia" /></td>
</tr>
<tr>
<td>Dr. A. M. Patel</td>
<td><img src="image13" alt="Dr. A. M. Patel" /></td>
</tr>
<tr>
<td>Assistant Professor</td>
<td><img src="image14" alt="Dr. A. M. Patel" /></td>
</tr>
<tr>
<td>Phone: 094083 87407</td>
<td><img src="image15" alt="Dr. A. M. Patel" /></td>
</tr>
<tr>
<td><a href="mailto:dratulvet07@yahoo.co.in">dratulvet07@yahoo.co.in</a></td>
<td><img src="image16" alt="Dr. A. M. Patel" /></td>
</tr>
<tr>
<td>Dr. Vineet Kumar</td>
<td><img src="image17" alt="Dr. Vineet Kumar" /></td>
</tr>
<tr>
<td>Assistant Professor</td>
<td><img src="image18" alt="Dr. Vineet Kumar" /></td>
</tr>
<tr>
<td>Phone: 096013 54407</td>
<td><img src="image19" alt="Dr. Vineet Kumar" /></td>
</tr>
<tr>
<td><a href="mailto:bharadwaj374@gmail.com">bharadwaj374@gmail.com</a></td>
<td><img src="image20" alt="Dr. Vineet Kumar" /></td>
</tr>
</tbody>
</table>
## INDEX

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Topic</th>
<th>Author</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Modern diagnostic techniques in veterinary surgery</td>
<td>P. B. Patel</td>
<td>1-3</td>
</tr>
<tr>
<td>2</td>
<td>Laminitis in equine</td>
<td>J. V. Vadalia</td>
<td>4-5</td>
</tr>
<tr>
<td>3</td>
<td>Topographic anatomy of surgical sites in animals</td>
<td>Anil Sharma</td>
<td>6-10</td>
</tr>
<tr>
<td>4</td>
<td>General anaesthetic techniques for abdominal surgery in canines</td>
<td>S. H. Talekar</td>
<td>11-13</td>
</tr>
<tr>
<td>5</td>
<td>Anatomical location for regional nerve blocks in domestic animals</td>
<td>Vishnudeo Kumar</td>
<td>14-17</td>
</tr>
<tr>
<td>6</td>
<td>Cryosurgery in Veterinary Patients</td>
<td>J. V. Vadalia</td>
<td>18-19</td>
</tr>
<tr>
<td>7</td>
<td>Ultrasonography and endoscopy techniques in veterinary practice</td>
<td>S. H. Talekar</td>
<td>20-24</td>
</tr>
<tr>
<td>8</td>
<td>Management of urolithiasis in small animals</td>
<td>Vineet Kumar</td>
<td>25-28</td>
</tr>
<tr>
<td>9</td>
<td>Regional anaesthetic techniques in large animals</td>
<td>P. B. Patel</td>
<td>29-31</td>
</tr>
<tr>
<td>10</td>
<td>Surgical affections of eye in small animals</td>
<td>J. V. Vadalia</td>
<td>32-35</td>
</tr>
<tr>
<td>11</td>
<td>Mammary gland (breast) tumors in dogs</td>
<td>A. M. Patel</td>
<td>36-38</td>
</tr>
<tr>
<td>12</td>
<td>MRI, CT Scan and Digital Radiography</td>
<td>S. H. Talekar</td>
<td>39-41</td>
</tr>
<tr>
<td>13</td>
<td>Recent advances for the management of abdominal wall defects</td>
<td>Vineet Kumar</td>
<td>42-43</td>
</tr>
<tr>
<td>14</td>
<td>Surgical affections of ear in small animals</td>
<td>J. V. Vadalia</td>
<td>44-46</td>
</tr>
<tr>
<td>15</td>
<td>Management of diaphragmatic hernia in buffalo</td>
<td>P. B. Patel</td>
<td>47-49</td>
</tr>
<tr>
<td>16</td>
<td>External and internal immobilization of fracture</td>
<td>A. M. Patel</td>
<td>50-54</td>
</tr>
<tr>
<td>17</td>
<td>Critical care and management</td>
<td>J. S. Patel</td>
<td>55-60</td>
</tr>
<tr>
<td>18</td>
<td>Use of X-ray for the diagnosis in small animal</td>
<td>A. M. Patel</td>
<td>61-64</td>
</tr>
<tr>
<td>19</td>
<td>Contrast radiography</td>
<td>P. B. Patel</td>
<td>65-67</td>
</tr>
<tr>
<td>20</td>
<td>Management of intestinal obstruction in small animals</td>
<td>Vineet Kumar</td>
<td>68-70</td>
</tr>
<tr>
<td>21</td>
<td>Ultrasonography for gynaecological disorders in veterinary patient</td>
<td>Rupesh Raval</td>
<td>71-74</td>
</tr>
<tr>
<td>22</td>
<td>Reticular foreign body syndrome in large animals</td>
<td>P. B. Patel</td>
<td>74-79</td>
</tr>
</tbody>
</table>
Diagnostic techniques are considered as an integral part of all the methods available for the diagnosis of pathological conditions. A wide variety of pathological lesions can be diagnosed by radiography and other specialized techniques such as diagnostic ultrasound, computed tomography and magnetic resonance imaging are becoming more popular now. Diagnostic Ultrasonography has empowered the veterinary clinician with a non invasive means of evaluating the thorax, abdominal cavity, musculoskeletal system and other tissues/organs with accuracy.

All these imaging modalities have brought changes in the diagnosis of a clinical case. Precise and an instant diagnosis of an intricate case can be made with their usage. The modalities which can be used under Indian conditions are:

1) **Image Intensifier T.V. system**
   Generally used in orthopedics surgery. This facilitates fracture repair using a small incision thus achieving minimal invasive surgical maneuver. IITV helps in X-ray imaging of the intraoperative site for the intraoperative orthopedics manipulations, and the same can be stored for future reference purpose. This facilitates introduction of Steinman pin giving a small incision.

2) **Ultrasound**
   In small animal and equine practice, ultrasound is routinely used as a diagnostic aid. Applications of ultrasound in ruminants have not been fully exploited, except in pregnancy. There could be numerous organs which can be scanned using an ultrasound scanner.

Ultrasonography seems to have a promising future in veterinary medicine, particularly for the assessment of intra-periabdominal disease.

Ultrasonography is viewed as the single most versatile addition to the noninvasive and nonsurgical armamentarium of the veterinary clinician since the advent of fiberoptic endoscope. Although other sophisticated imaging modalities like CT and nuclear imaging can provide additional information, the accessibility and cost effectiveness of these procedures do not make these as promising as Ultrasonography.

3) **Computed tomography**
   CT has been an extremely significant development which has a unique cross sectional imaging ability useful for the diagnosis of tumors, malformations, inflammation, degenerative and vascular diseases and trauma. CT is a diagnostic modality that is fundamentally different from X-ray method in which an organ is scanned in successive layers by a narrow beam of X-rays in such a way that the transmission of X-ray photons across a particular layer can be measured and by means of a computer, used to construct a picture of the internal structure.

4) **MRI**
   MRI is a highly sensitive and noninvasive technique providing accurate and detailed anatomic images with good contrast and spatial resolution. However, in veterinary medicine MRI is still in its infancy and its use is infrequent. To date, MRI has been used in developed countries in clinical cases as well as a research tool.
especially for CNS diseases in small animals. MRI has a wide spectrum of application. It can be used for imaging all body regions in small animals, but only the extremities and the head can be imagined in large animals. It is useful in answering many questions related to the musculoskeletal diseases in animals such as understanding the pathogenesis of navicular disease, traumatic arthritis and osteochondrosis in equines and wobbler syndrome in dogs. The newer applications of MRI are Magnetic resonance angiography and MR spectroscopy. It is especially used to differentiate an inflammatory process from a neoplastic mass, tumors from peritumoral oedema. It is more specific and sensitive in detecting localizing and differentiating osteomyelitis, cellulites and abscess. However, its use is contraindicated in pregnancy.

5) Nuclear scintigraphy

Nuclear scintigraphy is a highly sensitive advanced procedure in which radioisotopes are used to detect the functional abnormalities of the body system. The interpretation is based on the appearance of the increased (hot spots) or decreased (cold spots) radioactivity regions. For eg. an active process is indicated by a hot spot while a dull process like lack of perfusion is indicated by cold spot. Nuclear scintigraphy has been used to detect functional disorders of the kidney, liver, lungs, GI tract, thyroid gland and many other organs. It is very useful in the diagnosis of occult lameness, lung perfusion and ventilation and patency of the ureter in both large and small animals. Also used for vertebral column imaging and monitoring the progress of fracture healing and in tumor detection.

6) DSA

DSA is a radiographic modality which allows dynamic imaging of the vascular system following intravascular injection of iodinated X-ray contrast media through the use of image intensification, enhancement of the iodine signal and digital processing of the image data. Temporal subtraction of the images obtained during the first arterial phase of injection of the contrast medium from the images obtained before and after contrast medium administration yield images which are devoid of bone and soft tissue. This imaging modality plays an important role in highlighting the vascular pathologies like stenosis etc.

7) Laparoscopy

Laparoscopy has been a valuable diagnostic and therapeutic tool in human clinical medicine. Only in the last 15 years, its use has been extensive in various animal species for research and clinical diagnostic and therapeutic purposes. Laparoscopic surgery offers significant advantages over open surgeries in fields of cholecystotomy, appendicectomy, vagotomy, hernia repair and adhesion release etc. For gynecological problems like ovarian cyst or in the case of oophorectomies and hysterectomies, laparoscopic surgery (scarless surgery) is now considered a better alternative in addition to laparoscopic sterilization. The most advantageous characteristic of laparoscopy is that it allows direct examination of abdominal cavity with only minimal and superficial surgical intervention. Thoracoscopy has been employed in man for the diagnosis and treatment of diseases of the pleura, lung, mediastinum, great vessels, pericardium and oesophagus. Visceral inspection of the
thoracic cavity by thoracoscopy has been used to provide a more accurate diagnosis and prognosis in horses affected with pleurapneumonia and other thoracic and oesophageal disorders. Thoracoscopy allows visualization and biopsy of a large surface of the lung and provides adequate specimen for histopathological diagnosis.

8) **Endoscopy**

It is a minimal invasive diagnostic modality which aids in a best way to document mucosal inflammation-hyperemia, active bleeding, irregular mucosal surface, and facilitates biopsy in tubular organs like the GI tract, and respiratory and the urogenital organ systems.

9) **Pulse Oximetry**

Pulse oximetry represents the greatest advance in the patient monitoring. It has the unique advantage of continuously monitoring the saturation of haemoglobin with oxygen, easily and noninvasively, providing a measure of cardiorespiratory function.

The fundamental physical property that allows the pulse oximeter to measure the oxygen saturation of hemoglobin is that blood changes colour as haemoglobin absorbs varying amounts of light dependent on its saturation with oxygen.

Hence, pulse oximetry remains the standard of care during anaesthesia as well as in the recovery room and intensive care unit. A vital part of treating equine problems is an initial accurate diagnosis. High quality images are an important aspect of this.

As well fixed and mobile X-ray machines, the Hospital has an image intensifier for intra-operative monitoring with x-rays.

The Arsenics Impact ultrasound machine provides high quality images of muscles, tendons and ligaments; whereas the Ving-med System can image the equine thorax and abdomen, as well as giving detailed analysis of blood flow in various organs and tissues.

To conclude, the advances in diagnostic technology in veterinary surgery is in infancy stage in India. An all out effort is required to introduce the basic imaging modality - ultrasound in veterinary practice at district polyclinics and city hospitals. The use of radiology needs to be strengthened by its optimum use in clinical cases.
Laminitis in Equine

J V Vadalia

Department of Surgery & Radiology, College of Veterinary Science & Animal Husbandry, Junagadh Agricultural University, Junagadh-362001

Laminitis is an avascular necrosis involving the sensitive laminae, which intermesh with the hoof wall. The exact cause is unknown, but blood bypasses the dermal laminae via arteriovenous shunts at the base of the laminae, either due to increased postcapillary resistance and edema within the laminae or as a direct effect of opening of the shunts due to vasoactive compounds. The unique housing of the blood supply to the foot in a nonexpandable structure (the hoof) may accentuate the impact of blood flow changes. Laminitis occurs in association with conditions that cause endotoxemia such as acute gastrointestinal diseases and metritis. However, endotoxemia is not consistently found in cases of experimentally induced laminitis, and laminitis has not been induced by administration of endotoxin. Therefore, there must be other mechanisms involved.

The outcome is a loss of blood supply to the laminae, despite an increase in blood flow to the foot. This leads to separation of the dermal and epidermal laminae and an unstable pedal bone within the foot. The pedal bone may rotate due to the pull of the deep digital flexor tendon or, with more extensive laminae involvement, displace distally. The most common causes are grain engorgement, grazing in lush pastures, postfoaling metritis, and systemic gram-negative bacterial infections. In fat ponies, it is common to find laminitis during the spring months, when the soluble carbohydrate content increases in grasses and clovers. Laminitis can also occur in a single limb due to excessive weight bearing for a prolonged period.

History and presenting signs

Over feeding of grain. Gastrointestinal problems, particularly after colic surgery, retained placenta. Fat pony grazing lush pasture. Recent pleuritis or pneumonia due to gram-negative infection. Non-weight-bearing lameness in opposite limb.

Clinical findings and diagnosis

Although all four feet can be involved in laminitis, the forelimbs are more frequently affected than the hindlimbs. Affected horses show reluctance to move, and a typical "sawhorse" stance is seen with the forelimbs placed well out in front of the body. It will be difficult to pick up one of the forelegs. Examination usually will reveal increased heat in the feet and around the coronary band, with intense pain on application of the hoof testers. Palpation of the palmar arteries over the abaxial surface of the sesamoid bones will reveal an increase in both rate and amplitude of the pulse. An abaxial nerve block (see Fig. 4-26) will improve the signs of lameness, but in acute cases, it is contraindicated due to instability of the pedal bone. Signs of pedal bone rotation or sinking include a palpable indentation at the dorsal aspect of the coronary band and protrusion of the sole, dorsal to the apex of the frog. In chronic cases, abnormal hoof wall growth with a greater distance between growth rings at the heels than at the toe, and a concave dorsal hoof wall, are noted.
Treatment

In acute cases of laminitis, it is important to establish the cause so that treatment can be directed at eliminating the sources of vasoactive substances.

In cases of grain engorgement, 3 to 4 L of paraffin should be administered by stomach tube to help eliminate the grain from the gastrointestinal tract. Where metritis is the initiating cause, aggressive irrigation of the uterus to remove accumulated exudates should be combined with systemic broad-spectrum antibiotics. Early in the course of disease, application of cold to the feet will be helpful in decreasing the severity of the problem. This can be done most simply by standing the horse in cold water. If there are signs of shock (prolonged capillary refill time, injected mucous membranes, etc.), intravenous fluid therapy may be required (20-40 mL/kg of a polyionic, isotonic fluid).

In acute cases the horse should be confined to a stall, preferably with a deep sand bed as even walking has the potential to exacerbate displacement and rotation of an unstable pedal bone.

If cases are identified within the first 48 hours, peripheral vasodilators such as acepromazine will improve digital blood flow and have been shown to prevent the development of chronic laminitis in a high proportion of cases. Acepromazine also has the advantage of sedating the horse, thus reducing movement. Therapy should be continued for 48 hours. Chronic cases of laminitis rarely respond to this type of treatment. Non steroidal anti-inflammatory drugs such as phenylbutazone, flunixin meglumine, or ketoprofen are essential. Maximal dose rates are used for the first 2 to 4 days, and continuation of therapy for depending on the response. Of the non-steroidal anti-inflammatory drugs, phenylbutazone appears to be the drug of choice for effective pain relief. It is important to realize that non steroidal anti-inflammatory drugs have the potential to cause toxic effects, particularly on the gastrointestinal system, and potential toxicity should be monitored by intermittent measurement of plasma total protein concentration.

Many different methods have been suggested to provide support for an unstable pedal bone. Deep sand bedding conforms well to the sole and also has the advantage of allowing the horse to stand with its feet at the most comfortable angle. Padded bandages can be applied to the feet if there is any risk of sole penetration. In acute cases shoeing should be avoided, because the concussion will cause pain, and prolonged weight bearing on the opposite limb is detrimental. Hoof wall resection is indicated where there is marked separation and the dorsal lamina is providing no support to the pedal bone and/or is applying excessive pressure to the coronary band, preventing normal growth. Sectioning of the deep digital flexor tendon, as a salvage procedure, can be used in cases that are not responding to therapy. Although often providing relief from signs, there is evidence that it does not improve the long-term prognosis. In chronic laminitis where some pedal bone stability has returned, corrective trimming of the feet is essential. Because the blood supply to the coronary band at the heels is greater than at the dorsal midline, it is important to trim back the excessively long heels to maintain normal heel height and to square the toe to facilitate break over. Progress can be assessed from lateral radiographs.
The study of topographic anatomy based on regions or divisions of the body and emphasizing the relations between various structures (muscles and nerves and arteries etc.) in that region. Different structures are studied as they present during the course of dissection. This is used as applied part of the subject where the structures of some specific sites are studied for application in surgical practice.

Operations of head region

1. Ligation of stenson’s duct in bovine
   **Indications** - In persistent salivary fistula and to prevent excess salivation.
   **Site** - Immediately in front of anterior border of the masseter muscle and About 1/2 to 1 inch above the inferior border of the horizontal ramus of the mandible where the duct can be palpated.
   **Surgical anatomy** - The duct of the parotid salivary gland (Stenson’s duct) arises from the ventro-medial aspect of the gland and proceeds along the ventral and anterior borders of the masseter muscle to open into the vestibule of the mouth at the level of 5th upper cheek tooth through papilla salivalis. Anterior to masseter it is related to facial artery and vein in front.

2. Zepp’s operation (dogs)
   The external ear canal is not a straight tube. It has a horizontal portion and vertical portion formed by the tubular portion of concha.

   **Indications** - to facilitate good drainage through the external ear canal in dogs.
   **Site** - The tubular portion of the antero-external aspect of concha and skin below it.

3. Amputation of horn
   **Indications** - Irreparable injury, malignant disease of horn.
   **Sites** - I. Below the base of horn.
   II. Any level above the base of the horn but below the seat of damage. This is preceded by cornual nerve block.
   **Surgical anatomy** - The cornual process is a part of the frontal bone. It is covered by corium (sensitive portion) and shell (insensitive portion) which all together form horn. At the base of horn appreciate cornual artery, vein & nerve. Tourniquet is applied to prevent bleeding from cornual vessels.

4. Enucleation of eyeball: Refers to removable of eye ball.
   **Indication** - Irreparable injury, orbital abscess and malignant disease.
   **Surgical Anatomy** - The eye ball is situated in the bony orbit formed by the frontal, lacrimal and malar bones. There are seven muscles of the eyeball in the orbit, viz., Superior rectus, inferior rectus, medial rectus, lateral rectus; superior oblique, inferior oblique and retractor oculi muscles are present. Retract the skin edges and the eyeball along with its muscles will be detached from the bony orbit by blunt dissection.

5. Hyovertebrotomy of the gullet pouch
**Indication**- empyema of the guttural pouch.

**Sites**- Ventral site: An incision is made in the Viborg’s triangle which is formed by the tendon of sternomandibularis muscle, the linguofacial vein and the angle of the mandible. The pouch wall is palpable when enlarged and a stab incision is made through the ventral wall of pouch to provide drainage.

Lateral site- An incision is made along the line parallel with the anterior border of the wing of the atlas.

**Surgical anatomy**- In equines, the guttural pouch is a thin walled peculiar caudoventral diverticulum of the auditory tube. It is located caudo-dorsal to the pharynx and on the beginning of the esophagus. Its capacity in adult horse is about 300 ml. The inflammation of the guttural pouch is usually catarrhal due to mucous type of secretory mucosal lining. Avoid the damage to the external carotid artery and IX and XII cranial nerves.

**Operations of neck and thorax region**

1. **Oesophagotomy**
   **Indications** - Oesophageal obstruction (choke)
   **Site** - on the left side of the neck along the superior border of jugular furrow, close to the level of the obstruction.
   **Surgical anatomy**- from 3rd cervical vertebra onwards oesophagus deviates to left side of trachea. Dorso-lateral to the oesophagus carotid sheath is present containing the internal jugular vein, common carotid artery and vagosympathetic trunk. While ventrally it is related left recurrent laryngeal nerve.

2. **Tracheotomy**
   **Indications** - Persistent epistaxis and obstruction of the upper respiratory tract.
   **Site** - it is 1 to 2 inches longitudinally along the ventral aspect of the neck, preferably at the junction of its upper and middle third since here the two opposite muscles diverge so that trachea is bare and directly under skin.
   **Surgical anatomy**- trachea is in midline below the bodies of cervical and first four thoracic vertebrae and it is covered by the two bands of sternothyro-hyoideus muscle in neck region.

3. **Paracentesis thoracis**
   **Indications** - to relieve severe respiratory distress in moist pleurisy and collection of fluid samples for diagnostic purpose.
   **Site** - 6th or 7th intercostal space below level of costo-chondral junction.

**Operations of abdominal region**

1. **Paracentesis abdomen**
   **Indications** - To relieve excess gases from the rumen, collection of rumen liquor for diagnostic purpose.
   **Site** - Paralumbar fossa on left side in cattle.

2. **Laparotomy**
   **Indications** – gastrotomy, enterotomy and enterectomy, hysterectomy etc.
   **Sites**- a. **Flank site**: Left side-For rumenotomy, spleenectomy. Right side - enterotomy
   Vertical or oblique incision on the hollow of the flank is made.
   b. **Ventral Midline site**: Incision through the linea alba between the xiphoid cartilage of sternum and pubic symphysis for caesarean operation.
This site is preferred since it is least vascular.

c. **Paramedian site**- parallel to the linea Alba along the belly of rectus abdominis muscle for caesarean operation.

d. **Para rectal site**- parallel to rectus abdominis muscle along its lateral border for caesarean operation.

e. **Paracostal site**- for abomasotomy in ruminants on right side.

**Surgical anatomy**- lateral wall of the abdominal cavity is formed by obliquis abdominis externus, internus and transversus abdominis muscles and floor is formed by rectus abdominis muscle and linea alba which is formed by aponeurosis of externi, interni and transverse muscles of two sides.

3. **Rumenotomy**

**Indications** - persistent rumen impaction, hair balls and other foreign bodies in the rumen or reticulum, frothy bloat etc.

**Site** - left flank (paralumbar fossa) a vertical incision or near last rib in case of large size animal in traumatic reticulitis cases.

Incision can be made in the direction of muscle fibers there by avoiding sutures (suture less laparotomy) then rumenotomy is done. The layers incised in wall of rumen from exterior to interior are serosa, muscularis and mucosa.

**Surgical anatomy**- rumen occupies almost left half of the abdominal cavity from 7th or 8th intercostals space to the pelvic inlet and extends over the median plane to the right side ventrally.

The structures to be cut in rumenotomy included skin, subcutis and subcutaneous fat; external obliques muscle, the fibers are directed downward and backward. Internal obliques muscle, the fibers are run downward and forward. The transverse abdominis muscle which is thin and fibers extend in a perpendicular direction. In addition, deep iliac fascia, sub peritoneal fat, parietal layer of peritoneum and the rumen wall is seen. The 1st and 2nd lumbar nerves which run nearly perpendicular in direction are encountered while incising the structures in this region.

4. **Gastrotomy in dog**

**Indications**- Foreign bodies in the stomach, chronic gastric ulcer, Neoplasm etc.

**Site** - 1. Midline incision between the xiphoid cartilage and umbilicus.

2. Para costal incision on the left side in large and deep chested animal.

**Surgical anatomy**- stomach of dog is lies largely in the transverse position more to the left of the median plane. It forms an extensive concavity in the caudal surface of the liver. The greater curvature is convex and extended from the cardiac to the pylorus and is attached by the greater omentum. Stomach wall consist of serosa, muscularis (inner circular and outer longitudinal layers), submucosa and mucosa.

5. **Caesarean section**

**Indications** - Uterine inertia, dystocia, torsion of uterus etc.

**Sites** - Many sites are there for this operation.

I. Between the anterior mammary veins and the midline either on left or right side from the front of the udder forwards.
II. Parallel to milk vein.
III. Oblique flank incision downwards and forward from a little below the external angle of ilium on right side.
IV. Vertical incision on the right paralumbar fossa.

6. Ovariohysterectomy
Removal of both ovaries and uterus. Uterus consists of two horns and each horn is continued anteriorly by oviduct which ends near ovary.

7. Cystotomy
**Indications** - calculi in urinary bladder and neoplastic growth.
**Site** - the prepubic site is chosen along linea alba starting in front of the pubic symphysis to a length of about 3 to 4 inches forward.
**Surgical anatomy** - it is a musculo-membranous sac lies on the floor of the pelvic cavity. It varies according to contents and sex. Ventral surface is related to pelvic floor and reaches to abdomen when it distends. The dorsal surface in male is related to rectum, genital fold, terminal part of vas deferens, seminal vesicles and the prostate gland. In female it is related ventrally to the body of uterus and vagina. When the bladder is full the vertex reaches the rumen and intestine.

8. Urethrotomy
**Indications** - urethral calculi, amputation of the penis to make a urethral fistula.
**Site** - Post scrotal site: for removal of obstruction at the sigmoid flexure. It is about three inches the scrotum along the median line.
Ischial site: for removal of obstructions close to ischial arch, it is two inches below the ischial arch downwards along the median line.
**Surgical anatomy** - the penis of ruminants is comparatively thin and long. Near the scrotum penis forms a sigmoid flexure. It is the common seat of urethral obstructions. The corpora cavernosa penis has a strong thick tunica albuginea. After the transaction of the skin, at the operation site, in the ischial arch of the male animal, the structures are encountered between the skin and subcutaneous connective tissue are retractor penis muscle, bulbocavernous muscle, corpus cavernosum urethrae, and Urethra.

**Operations of the limbs**
1. Patellar desmotomy
**Indications** - in chronic subluxation of patella.
**Site** - close to the insertion of the medial ligament to the anterior tuberosity of tibia.
**Surgical anatomy** - comprised of femoro-patellar and femoro – tibial articulation. Femoro-Patellar articulation having three straight ligaments- medial, middle and lateral patellar ligaments. The patella gets fixed above the trochlea of femur and the medial straight ligament is tightly over stretched behind the medial trochlear ridge which prevents the downward return of the patella. This is because medial ridge of trochlea of femur is larger and higher than lateral one. So the stifle joint is in an extended state and animal drags the limb. This is more common in the emaciated animals.

The site mentioned above is most suitable site as it is easier to locate. Causes less bleeding and there
is no danger of injuring to the joint capsule. Bleeding if any is from geniculate artery supplying this joint which is a branch of femoral artery. The object of the operation is to mechanically bring down the patella by cutting the tensed medial straight ligament of the patella.

2. Amputation of forelimb

Indications - multiple fracture, irreparable injury, tumour and gangrene.

Site - common site is at junction of lower and middle third of the forearm.

Surgical anatomy - observe extensor carpi radialis, medial digital extensor, common digital extensor, lateral digital extensor. Ulnaris lateralis, radial nerve and cephalic vein on dorsal aspect. Observe flexor carpi radialis, flexor carpi ulnaris, superficial digital flexor, deep digital flexor, radial artery, ulnar artery, median nerve and ulnar nerve on volar aspect.

3. Amputation of hind limb

Indications - multiple fracture, irreparable injury, tumour and gangrene.

Site - at the middle third of the leg region.

Surgical anatomy - observe gastrocnemius, popliteus, superficial digital flexor, deep digital flexor and tibial nerve on plantar aspect. Observe complex muscle, tibialis anterior, peroneus longus, lateral digital extensor, peroneal nerve and anterior tibial artery and veins on dorsal aspect.

Operation of tail

Amputation

Indications - to improve appearance of the animal, injury or neoplasm of the tail, tail gangrene.

Site - above the seat of injury, between two adjacent vertebrae.

Bleeding is mainly from the middle Coccygeal artery. So tourniquet is applied proximal to incision.

Surgical anatomy - the skeletal framework of tail is made up of coccygeal vertebrae. The paired muscles of the tail are enclosed in the strong coccygeal fascia which is loosely attached at the root of the tail. Sacro-coccygeus dorsalis muscles lie on either side of the dorso-median aspect of the tail. Sacro-coccygeus lateralis muscles lie immediately lateral to dorsalis. Sacro-coccygeus ventralis lies on the ventral aspect of the sacrum and Coccygeal vertebrae. Intertransversalis caudae consists of muscular bundle and lie on the lateral aspect of the tail between sacrococcygeus lateralis and ventralis.
A general anesthetic to a healthy dog should bear little risk as compared to unhealthy dogs in case of abdominal surgery. Many choices are available to administered anesthetic protocols to meet the demand of increased sophistication of abdominal surgical procedures, and with smooth induction, careful monitoring in oxygenation, circulation and ventilation, and attention to fluid balance and smooth recovery, a safe anesthesia in dogs.

Surgery of the stomach or intestines is very common. Reasons for operating on the gastrointestinal tract include ovariohysterectomy or spaying, gastric dilatation volvulus (GDV), caesarian section (C.S.) in bitches, splenectomy, nephrectomy ingested foreign bodies, cancer, twisted intestines, intussusception, bloat, and to collect full-thickness biopsies of the intestines, etc. A variety of diagnostic tests are done prior to the abdominal exploratory in order to pinpoint where the problem is and what the nature of it is.

**Pre-anesthetic considerations**

Fasting for about twelve hours usually ensures a dog will have an empty stomach. With held water till premedication is not given or at least two hours prior to give anesthesia. Laboratory test is always useful informing about outcome of surgery and to be a safer side for judging animal is ready to take stress of surgery. Before proceeding surgery or prior to anesthesia, minimum information about blood test including CBC, PCV, SGPT, TP, BUN and glucose is compulsory to finalize either give general anesthesia or wait if animal status is not healthy according to result or change the anesthetic protocol if required.

A detail physical and clinical examination to determine any abnormalities must be carried out. Auscultation for cardiac dysrhythmias and murmurs, or abnormal lung sounds will provide useful information regarding preexisting cardiopulmonary disease. Stabilize dog if debilitated by giving fluid therapy.

**Pre-anesthesia**

Pre-anesthesia facilitates smooth induction and reduces anesthetic dose maintenance. There are many choices available for Pre-anesthesia. It contains Sedative (xylazine, diazepam) neuroleptanalgesia (e.g. acepromazine and morphine), Anti cholinergic (atropine sulphate), tranquilizers (siquil, largactil, acepromazine), etc. all preanesthetic provides better restraint and analgesia.

**Common Anesthetic used for abdominal surgery in dogs**

**Ketamine and its combinations**

Ketamine is generally used at the dose rate of 10 mg/kg which produces good anesthesia in dogs for any type of abdominal surgery. Ketamine is dissociative anesthesia which increased muscle rigidity and excessive salivation. Ketamine may cause increased heart rate, cardiac output, and blood pressure so pre-anesthetic sedatives are combined with ketamine to induce deep sedation or light anesthesia with good muscle relaxation.

Diazepam at 0.5-1 mg/kg added to ketamine either IM or IV produces deep sedation often recumbency. Butorphanol 0.1-0.4 mg/kg, Medetomidine at 5 – 40
Mcg/kg, Midazolam is administered at 0.1 – 0.3 mg/kg IV, IM can be used as a combination for better sedation, analgesia and muscle relaxation. Diazepam can be substituted by xyalzine 0.1-0.5 mg/kg, resulting in longer duration of effect.

**Barbiturates**

**Pentobarbitone sodium:** it depresses the CNS and takes appreciable time to cross blood brain barrier. The drug depress respiratory centre. It causes slight fall in blood press due to peripheral vasodilatation and is destroyed primarily in liver and some of it is excreted through urine. Dog dose rate of pentobarbitone sodium is 20-25 mg/kg I/V.

**Thiopentone sodium:** it produces brief period of unconsciousness. It crosses placental barrier with great speed. Its injection followed by a period of apnoeoa it is a myocardial depressant. It depress respiratory centre parallel to depth of narcosis. Recovery is slower. Ataxia is nearly always present. Dose rate is given in canine is 7-13 lb/kg or 15-20 mg/kg. Strictly I/V. The solution of thiopental has a very high pH and the drug can only be given intravenously.

**Thiamylal Sodium:** Closely resemble to thiopentone but it is more potent and less cumulative effect, less excitement during induction and recovery. Premedication with atropine sulphate to check salivation is necessary. Dog dose rate of Thiamylal Sodium is 20-25 mg/kg I/V.

**Methohexitone sodium:** two to three time more potent than thiopentone sodium. It has short duration effect rapid injection may produce transient hypotension but blood pressure soon return to normal. Rapid recovery to full alterness, even after prolong anesthesia. Dog dose rate of Methohexitone sodium is 10 mg/kg I/V to effect.

**Other non barbiturates:**

**Profofol:** it is used in dog, causes smooth induction of anesthesia. This is dose dependent respiratory depression. It can be used combination with acepromazine. Dog dose rate of profofol is 6 mg/kg I/V if not premedicated or 4 mg/kg if premedicated.

**Inhalation anesthetic agents:**

**Isoflurane:** it can be administered with oxygen and nitrous oxide or any mixture with halothane etc. it causes respiratory and cardiac depression but it is dose dependent. Highly volatile and has low blood solubility. It has low partition coefficient so rapid recovery from any depth of anesthesia, great muscle relaxation it is used 1.3 minimum alveolar concentration (MAC). Vapor setting is at 3-4 % in dogs at induction with oxygen flow at 60 ml/kg/min and is reduced between 1.5-3 % during the maintenance with oxygen flow at 20 ml/kg/min.

**Methods of inhalation induction**

General anesthesia can be induced by administering isoflurane, halothane, sevoflurane, or desflurane via a facemask .There are two methods; ‘incremental’ or ‘crash’ induction. ‘Incremental’ induction technique uses 3 min of preoxygenation and then introduction of 0.5 % vapor setting for 30-60 seconds and then 0.5 % increment for the same period. ‘Crash’ induction is achieved with 3-5 % vapor set of isoflurane following pre-oxygenation. The dog will more likely struggle with the crash induction method. It is preferable to use non-rebreathing circuits for quicker induction and then switched to the circle
rebreathing systems even for animals weighing more than 6 kg.

Tracheal intubation in dogs is important before giving inhalation anesthesia. Inhalation anesthesia is the method of choice for maintaining anesthesia for most prolonged procedures. Halothane, isoflurane, sevoflurane, desflurane and nitrous oxide are available. The advantages are patent airway, rapid control of anesthetic depth, quick and smooth recovery, and disadvantages are more pronounced cardiovascular depression including myocardial depression, hypotension, bradycardia and irritation to upper respiratory tract.

**Monitoring of patient during anesthesia**

Anesthetic monitoring is important to maintain a proper plane of anesthesia and to prevent excessive insult to the cardiovascular, respiratory, and central nervous systems. Anesthetic depth can be measured by observation of the following signs: physical movement or jaw chewing in response to stimulation, eye position and degree of muscle tone, and presence or absence of palpebral reflexes etc. Variables used to monitor the cardiovascular system include heart rate, pulse pressure, mucous membrane color, and capillary refill time. Direct blood pressure measurement can provide continuous hemodynamic status of the animal and can be easily accomplished through catheterizing the auricular artery.

The ECG is useful to monitor cardiac dysrhythmias. The respiratory system is evaluated by monitoring respiratory rate and volume. It can be estimated by observing the emptying of the rebreathing bag of the anesthetic machine during respiratory cycles. Pulse oximetry and/or arterial blood gas analysis provide information of the ventilatory efficiency.

Ocular reflexes are used to monitor the central nervous system. Ophthalmic ointment should be applied to the eyes during anesthesia to prevent corneal injury. Body temperature is also an important parameter to monitor during anesthesia. Because of the tendency for anesthetized animals to lose body heat, supplemental heat sources are often required to maintain adequate body temperature (100-103.5°F).

**Post operative pain management and recovery:** Post operative management is necessary to give proper painkillers. Recovery is smooth then problem is not arise but if there is seizures and hypovolemia or hypothermia etc we have to give treatment accordingly.

**Conclusion**

Any General anesthesia in abdominal surgery is not safe until we should not take a proper care. Inhalation anesthesia is good for maintenance in any type of abdominal surgery.
Regional nerve blocks are temporary blocking of pathway for passage of impulses by injecting local anaesthetic solution resulting in desensitization and paresis in the region. The successful regional nerve blocks require the thorough knowledge of anatomy of the particular region, course of nerve and the proper site of injection. The regional anaesthesia is not only used for surgical operations but also for diagnosis, prognosis, remove the pain, lameness due to chronic conditions and splints, ringbone, navicular disease, laminitis (Horse) etc.

Nerve blocks of head region

1. Cornual nerve block: Cornual nerve is a sensory nerve supplying to the horn core and skin around its base. It is a branch of lacrimal nerve which is a division of the ophthalmic branch of trigeminal nerve (CLOT). The cornual nerve emerges behind the orbit and ascends along frontal crest and placed relatively superficial in the upper third covered by skin and the thin layer of frontalis. The caudal part of the nerve is having close association with the superficial temporal artery.

Indications- For amputations of horn in certain conditions affecting the horn eg. Horn cancer and fracture of horn.

Site- Close to frontal crest of the frontal bone about one inch below the base of horn.

In case of goat two site to block the cornual nerve - Behind the root of the supraorbital process to block the lacrimal branch and close to dorsal margin of the orbit to block the infratrochlear branch.

2. Mandibular nerve block: The mandibular nerve is a branch of trigeminal and enters the mandibular foramen on the medial aspect of vertical ramus of the mandible and emerges through mental foramen on the lateral aspect of the mandible. During its course sensory branches are given off to teeth and gums of lower jaw.

Indications- To desensitize the cheek teeth, alveoli and gums of lower jaw.

Site: Cattle and Horse - At the mandibular foramen on the medial aspect of the vertical ramus. The Mandibular foramen is located at the intersection of two imaginary line passing along the masticatory surface of mandibular cheek teeth and perpendicular line running through the lateral canthus of the eye.

Dog - The Mandibular foramen is located at the depression just in front of the angular process of mandible.

3. Mental nerve block: The mandibular nerve gains exit at the mental foramen on the lateral aspect of the horizontal ramus of the mandible.

Indications- To desensitized the lower lip.

Site- At the mental foramen on the lateral aspect of the horizontal ramus of the mandible near the body.

Dog - Mental foramen is located immediately below the root of second lower premolar tooth about ½ the
distance between the dorsal and ventral border of the mandible.

4. Maxillary nerve block: The maxillary nerve which is a branch of the trigeminal nerve, is sensory in nature and emerges through the foramen orbitotorotundum, passes forwards in the pterygopalatine fossa and enters into infraorbital canal through maxillary foramen. The maxillary nerve gives branches to the teeth of upper jaw.

**Indications** - To desensitize the teeth, alveoli and gums of upper jaw.

**Site** - The maxillary foramen to be reached by inoculation needle through the site 2 to 3 cm below the external canthus of the eye and between the posterior border of the malar bone and coronoid process of mandible.

5. Infraorbital nerve block:
Infraorbital nerve is the continuation of maxillary nerve and emerges out through infraorbital foramen just rostral to the facial tuberosity and dorsal to the first molar teeth.

**Indications** - Surgical interference with the upper lip and nostrils.

**Site** - Cattle-The infraorbital foramen is reached through above the level of the upper third cheek tooth.

Horse- The infraorbital foramen is reached through a line drawn between the nasomaxillary notch and the anterior end of facial crest. The middle of this line is located and a finger breadth towards the eye.

6. Supraorbital (Frontal) Nerve block:
Supraorbital is one of the terminal branches of the ophthalmic division of the fifth cranial nerve. It is accompanied by the supraorbital artery and sensory to the upper eyelid.

**Indication** - To desensitize the upper eyelid.

**Site** - At the root of the supraorbital process.

7. Orbital nerve block: Ophthalmic and maxillary branches of trigeminal nerve are sensory in nature and emerge out from the cranium through foremen orbitotorotundum. The ophthalmic nerve supplies branches to the eye ball proper, eyelids, conjunctiva, lacrimal sac and third eyelid. While zygomatic branch of maxillary nerve supplies to skin of lower eyelid.

**Indication** - Evisceration of the eyeball, orbital abscesses, malignant diseases of eye

**Site** - Foramen orbitotorotundrum reached through behind the middle of the supraorbital process in the temporal fossa.

8. Retrobulbar block:
This block provides akinesia of the extraocular muscles by blocking cranial nerves II, III, and VI, thereby preventing movement of the globe.

**Indication** - Enucleation of the eye or for surgery of the cornea.

**Site** - The needle placement for retrobulbar injection are the midway between medial and lateral canthus of eye or the upper and lower eyelids. The surgeon’s finger is used to deflect the globe to protect it from the point of the needle.

9. Auriculopalpebral nerve block:
Auriculopalpebral nerve supplies to the orbicularis oculi muscles it is the one of the branches of facial nerve and motor to eyelid and auricular muscle.

**Indication** - Surgical affection related to eyelid.

**Site** - At the level of the zygomatic arch.
Nerve block of trunk region
Paravertebral nerve block: The nerve supply to the flank region is by thirteenth thoracic and first and second lumbar spinal nerves. Each nerve has dorsal and ventral branches. The dorsal branch supplies to the muscles of the loin. The ventral branch supplies to the skin, abdominal muscles and peritoneum. In addition to this the 3rd lumbar nerve supplies a cutaneous branch to the flank region. The ventral branch travels the intertransverse ligament so anaesthetic solution should be injected below this ligament.

**Indication** - Laprotomy, rumenotomy, ruminal fistula, caesarean section etc.

**Site** - The last thoracic nerve is blocked about 5 to 6 cm lateral to the mid dorsal line at a point behind the level of the last rib. The sites of blocking the first three lumbar nerves are 5 to 6 cm lateral to mid dorsal line and behind the transverse process of first three lumbar vertebrae respectively.

**Epidural nerve block**
Epidural space is the space between the spinal canal and the spinal duramater. This space is filled with fat and areolar tissue.

**Indication** - Surgery of hind limbs and posterior regions of the body, for surgical manipulations of penis in bull and correction of prolapses of uterus and vagina in cow.

**Site** -
1. Sacrococcygeal site (between sacrum and first coccygeal vertebrae).
2. Inter coccygeal site (between first and second coccygeal vertebrae). (In dog and cat lumbo-sacral space).

Pudic nerve block
Pudic nerve is the continuation of the ventral branch of the 3rd sacral nerve with a variable contribution from 2nd and 4th sacral spinal nerves. It can be best judged by palpating per rectum the internal pudic artery on the ventro-lateral aspect of the pelvic cavity just cranial to the lesser sciatic foramen. The artery is usually one inch below the nerve.

**Indications** - Surgical interference with the penis and prepuce.

**Site** - The ischiorectal fossa of either side (the depression between the anal orifice and the ischial tuberosity).

**Nerve blocks of the limbs:**
The nerve blocks in limbs are indicated for operations on a site distal to the point of nerve block. It is also used in diagnosis in order to localized lameness.

**A. Fore limb**

1. **Median Nerve block:** The median nerve passes below and beneath the pronator teres muscle. It is then runs down along the forearm between the radius and flexor carpi radialis muscles. Median nerve supplies pronator teres, flexor carpi radialis, superficial digital flexor, humeral and radial heads of deep digital flexor muscles.

**Site** - Below the medial tuberosity of the radius at the groove between caudal border of the radius and flexor carpi radialis muscle.

2. **Ulnar nerve block:** At the lower one third of the forearm this nerve lies relatively superficial between the flexor carpi ulnaris and ulnaris lateralis muscle. Ulnar nerve supplies the flexor
carpi ulnaris, superficial digital flexor and ulnar head of deep digital flexor.

**Site** - A few inches above accessory carpal

**3. Volar nerve block:** The volar or metacarpal nerves are terminal branches of the median nerve. The lateral volar nerve merges with the deep branch of the ulnar nerve. The medial volar nerve is accompanied by the medial volar metacarpal artery the lateral volar nerve is accompanied by lateral volar metacarpal artery. Each volar metacarpal nerve continues as respective volar abaxial digital nerve where as volar common digital nerve is formed by union of middle branches of median nerve.

**Site** - High volar block - 5 to 7 cm above the fetlock in the depression between suspensory ligament and deep flexor tendon both on medial and lateral aspects.

Low volar block - Midway between the fetlock and coronet in between deep digital flexor and superficial digital flexor both on medial and lateral aspects.

**B. Hind limb**

**1. Saphanous nerve block:** This is a branch of the femoral nerve and is motor to the Sartorius muscle and sensory to the medial surface of the thigh, stifle and leg.

**Site** - It can be located in the femoral triangle as it runs distally just cranial to the femoral artery. Using the arterial pulse as a landmark, 2-5 ml of 2% procaine hydrochloride or equivalent is injected anterior to the artery.

**2. Tibial nerve block:** The tibial nerve is continuation of the sciatic nerve. In the proximal third of the leg the nerve is under the cover of the medial head of the gastrocnemius muscle and lies along the medial aspect of the superficial digital flexor muscle. Tibial nerve supplies branches to the muscles of the plantar aspect of the leg.

**Site** - On the medial aspect of the leg about a hands breadth above the point of hock and ½ inch in front of the tendoachillis.

**3. Peroneal nerve block:** The peroneal nerve is a branch of sciatic nerve and passes over the lateral head of Gastrocnemius muscle downwards and forwards and divides into superficial and deep peroneal branches. The nerve gives branches to the all the dorsolateral group of muscles of the leg.

**Site** - Two inches below and behind the lateral condyle of the tibia in the groove between peroneus longus and lateral digital extensor muscles.
Cryosurgery is veterinary patients
J V Vadalia
Department of Surgery & Radiology, College of Veterinary Science & Animal Husbandry, Junagadh Agricultural University, Junagadh-362001

Cryosurgery is the destruction of tissue by the controlled application of cold temperature. The term comes from the Greek words, Cryo (κρύο) meaning “icy cold” and Surgery (χειρουργική) meaning “hand work” or “handiwork”. Minor Surgery and minimal invasive surgery. Easy to perform, heals quickly, minimal complications.

Cryobiology
Tissue destruction by freezing can be done by two ways:
1. Direct or Early
   By intracellular and extracellular crystal or ice formation. Change in cell’s ability to regulate ion permeability and cause swelling and death of cell
2. Indirect or Delayed
   Due to vascular stasis, the permeability of vessels is increased which causes loss of plasma. Damage to endothelium of arterioles and venules
3. Tissue react to cold depending on water content. cellularity. vascularity
4. Dry tissues are resistant to damage by freezing
5. The cellular components of peripheral nerves are destroyed by freezing, not fibrous epithelium and so regeneration is possible
6. Damage to tendons or ligaments is irreversible and should be avoided
7. After tissue necrosis by freezing, cutaneous tissues heal by normal inflammation, granulation, epithelialization

Factors affecting cryosurgery
1. The length of time of application
2. The method of application
3. The type and thickness of lesion treated
4. The lesion location (body area)

Cryogens
A Cryogen is a Medium for Extracting heat from a target tissue. Uses of Cryogens are limited because of Dangers of combustion & Tissue require rapid freezing. LN2 and N2O are cryogens used most commonly in Veterinary Oncological Surgery. CO2 can also be used but it cause fatal embolus formation when delivered in body cavity. LN2 is the most versatile cryogen having boiling point of -195.8 °C & can be used as a spray or with a probe.

Cryosurgical instruments
1. Cryo sprays:
   Self pressurizing spray guns deliver a combination of vapour and droplets of LN2 on target tissue or surface. Most effective and versatile method. The size of spray droplet is controlled by:
   ✓ The diameter of orifice
   ✓ The volume of cryogen released, regulated by “Trigger”
2. Cryoprobes:
   Can be cooled by circulating LN2 or By releasing a high pressure gas through a small orifice within the tip of probe. Easier to control and less lethal to tissues.

Surgical procedure
- Preparation of Patients:
  Preparation of site is less important. Clipping of hairs will permit. Easier visual inspection of the expanding ice ball. Recognition of potential problems with cryogen run-off
- Anaesthesia
General anaesthesia mostly not needed
Sedation is only required for cryosurgery.
The Animal is sedated, restrained and
Surgical site is desensitized by Local or
Topical Anaesthetics. Adjacent areas are
protected by Petroleum jelly and Shield

- Monitoring of the Frozen Area:
  - It can be done by subjectively or
    objectively
  - Subjective Assessment by Visual
    Inspection and Palpation of Ice ball

Objective Monitoring by use of Pyometers
to measure temp. achieved beyond limit of
the target tissue.

Post operative sequelae

1. Swelling:
   - Due to local vasodilation and
     increased vascular permeability
   - It is self limiting and resolved
     within 48 hours

2. Bleeding:
   - May result in hemorrhage but
     not life threatening

3. Necrosis:
   1. It forms a dry scab that protects
      underlying healing wound

   2. The scab slough off in 10-14
days

3. Depigmentation: melanocytes and hair
   follicles are destroyed

4. Odour

Indications

- Neoplastic and benign cutaneous
  lesions
- Choice of treatment for benign,
  perianal, oral and ocular tumours
  as it do not require sterile surgical
  field
- Successful experimental
  cryosurgery on prostate, adrenal
  gland, kidney and liver
- Cryodestruction of lesions within
  body cavity and endoscopic delivery of cryogens.

Contraindications

- Cutaneous Mast Cell Tumours
- Tumor that have major Bony
  involvement
- Low Water containing Cortical
  Bone
- Highly vascular Calcious Bone
Ultrasound and Endoscopy Techniques in Veterinary Practice

Shivaji H. Talekar and Vineet Kumar
Department of Surgery & Radiology, College of Veterinary Science & Animal Husbandry, Junagadh Agricultural University, Junagadh-362001

Ultrasound Sonography is defined as sound waves of frequencies greater than which is audible to the human ear i.e. greater than 20000 Hz. Frequencies between 1-10 MHz are mainly used for purpose of diagnosis. Ultrasound waves travels in a pulse and when it is reflected back it becomes an echo. It is pulse echo principle which is used for ultrasound imaging.

Sonography has become an important and popular diagnostic tools in veterinary practice in both small animals as well as large animals. Popularity of Ultrasonography in veterinary practice because of it is simple, non-invasive diagnostic procedure that seldom requires the use of tranquilizers or anesthetics, and equipment that is affordable and easy to operate has become available. Diagnostic ultrasound is a non ionizing form of energy that has minimal known health risks. Ultrasound is able to image radiolucent objects, such as urate and cystine uroliths, and foreign bodies such as wood and string. The pancreas, adrenal glands, ovaries, lymph nodes and internal structures of the eye. Free fluid is easily penetrated by ultrasound. Gases are reflect ultrasound, which creates artifacts on the sonogram.

Sonography can be used to use to detect pregnancy earlier than radiography. Fetuses are easily detected by ultrasound. Fetal heart can be monitored by real time ultrasound; even fetal death is readily detected sonographically. Real time ultrasound allows clinicians to evaluate movement of organs such as heart and bowel. Ultrasound can be used to guide needles or biopsy instruments into organ mass. Ultrasound collect more diagnostic information with less effort on the part of clinicians, less stress to the patient, less expense to clinicians.

Abdominal Sonography

Abdominal Sonography and ultrasound guided biopsies often eliminates exploratory laparotomy. In large animals ultrasound can diagnose diaphragmatic hernia, omasal impaction, abomasal impaction, reticular or liver abscess, lung cysts or abscess etc. Ultrasound can be used for therapy of tendinitis, arthritis etc. Ultrasound has many industrial uses like ultrasound cleaners etc. Ultrasound scalers are used in veterinary and human dentistry.

Abdominal Ultrasonography is increasingly used in veterinary medicine and has an important role in decision making process or emergency situation in colic in horses as well as GDV cases in dogs. Rectal palpation may detect distended loops of intestinal obstruction, but sonographically we can confirm to degree of distension of intestinal wall, and presence or absence of intestinal motility.

Ultrasound machine

Most of the ultrasound machines are equipped with a 3, 5, and 7.5 MHz probe. Large animal practices and newer ultrasound machine may also have a 10 MHz transducer Larger the number, higher the frequency of sound waves emitted from the probe (7.5
millions of cycles per second verses 3 million cycle per second).

Higher the frequency, greater the resolution of the picture, but less depth of penetration.

10 MHz transducers used for horse tendon, 7.5 MHz for average size dog as well as 3.5 MHz for very large size dog echocardiography and deep structure study.

Types of transducers

Three are three types of transducers, Linear: These are composed of thin rectangular clips lined up side by side, each producing sound waves. The beam thus produces is rectangular shape and permit a good visualization of superficial structures with an easy analysis of the anatomical relationship. This can be used for abdominal scan in small animals or by doing slight modification in shape of transducer z (rectal or vaginal transducer) it can be used for diagnosis of, urinary bladder or uterus examination etc . in large animals.

Convex: The composition of this transducer is similar to that of linear except that the crystals are placed in a curvilinear fashion. Thus with the same, contact area imaging of a greater area can be effected.

Micro- convex and Sector: Such transducers contain a single or more crystal which oscillate or rotate to produce a fan shaped beam. The small size gives them more maneuverability and access to more organs through a small contact area.

Display

Display mode: there are three modes of display in diagnostic ultrasound i.e., A, B and M modes.

A-mode (A stand for amplitude)

It displays two parameters of the echoes in the form of spikes i.e., distance from the transducer and the amplitude. The horizontal line shows the distance and the amplitude is depicted on the vertical line.

B-mode (B stand for brightness):

The brightness of the dot is made proportional to the amplitude of the echo. The picture represents a slice of area covered by transducer. The information of the amplitude is maintained in the brightness of the dot on the screen.

M-mode (M stand for motion):

This is an adaptation of real, time scanning. It records the position and motion of the echo and resembles B- mode. Each spikes on the display is replace with dot. These images are moved along a horizontal axis showing the movement of structures along that line. A wiggly line represents the motion of echo with time. Organ movement will be viewed in real time when the images displayed in a B mode scan are formed rapidly and presented in sequences.

Conclusion

Veterinary practice Ultrasound sonography is now an important diagnostic aid in future it is compulsory to learn about sonography.

Endoscopy

Endoscopy is the use of specialized video cameras to evaluate areas within the body in a minimally invasive manner. In most instances, endoscopy is performed for diagnostic purposes allowing visualization and sampling of abnormalities. However, endoscopy can also be used for therapeutic purposes as well, termed interventional endoscopy.

Endoscopy allows a visual examination of internal organs and body parts without invasive exploratory surgery. Optical lenses were developed
which could be used in viewing devices and endoscopy could start to be used. Endoscopy is performed with either a rigid or flexible fiber optic instrument. Flexible endoscopes such as those used in the examination of the stomach consist of a long, flexible insertion tube with a bending tip at the end that enters the body, an eyepiece, and a control section.

The tip of the endoscope is manipulated using a control knob in the hand piece. In addition to the fiber bundles which provide the light source, two channels are present within the endoscope. One channel permits various endoscopic tools to be passed and fluids to be suctioned or samples taken. The other allows air or water to be passed into the stomach/intestine to insufflate (inject air into the area), or wash away mucus from the viewing port.

Special video cameras can be attached to the endoscopes which allow viewing of the exam on a television screen, as well as recording the exam on video. The rigid endoscope cannot be used in some areas, such as the stomach because it does not have the bending tip, so it cannot be flexed to allow examination of all parts of the stomach.

**Types of endoscopy**

**Flexible endoscopy**

**Bronchoscopy:** an exam of the lower airways.

**Colonoscopy:** an exam of the transverse colon, ascending colon, cecum, large bowel, and rectum.

**Endoscopy:** an exam of the esophagus, stomach, and upper intestines.

**Rigid endoscopy**

**Arthroscopy:** an exam of soft tissue structures and joint cartilage, which is not visible on radiographs. Decreased damage to the joint and shortened recovery times are two advantages of arthroscopy over arthrotomy (surgical exam of the joint). Disadvantages include its limitation during diagnostic and corrective surgical procedures in small patients.

**Cystoscopy:** an examination of the vagina, urethral opening, urethra, bladder, and urethral openings.

**Laparoscopy:** an exam of the abdominal cavity performed through a small incision in the wall of the abdomen or through the navel. It is done in veterinary medicine to obtain hepatic (liver) and renal (kidney) biopsy samples.

**Proctoscopy:** an exam of the large bowel and rectum.

**Rhinoscopy:** an exam of the nasal cavity and nasopharynx (junction between the nasal area and the back of the throat).

**Thoracoscopy:** an examination of the chest cavity. This is currently not performed frequently in veterinary medicine.

**Respiratory tract endoscopy**

**Rhinoscopy:** an exam of the nasal cavity and nasopharynx (junction between the nasal area and the back of the throat). This procedure is used to evaluate patients with clinical signs such as sneezing, nasal discharge, nasal congestion, or nasal bleeding. It is allows visualization of the nasal cavity and the back of the throat.

**Tracheoscopy/Bronchoscopy**

These procedures are commonly performed together to evaluate the trachea and the lower airways. Patients with chronic cough, respiratory difficulties, pneumonia, or airway disease can benefit from these evaluations. In addition to visualizing the airways, samples can be obtained using bronchoalveolar lavage (BAL) or
an endoscopic brush for cytology and cultures.

**Upper gastrointestinal endoscopy**

**Esophagoscopy:** This procedure allows evaluation of the esophagus and can be useful in patients with clinical signs such as regurgitation, excessive drooling, or difficulty swallowing. Esophagoscopy can be utilized to diagnosis diseases such as esophagitis, esophageal masses, esophageal strictures, and esophageal foreign bodies.

**Gastroscopy:** this procedure allows thorough evaluation of the inside of the stomach. The procedure is of benefit in evaluating patients with conditions such as chronic vomiting, anorexia, suspected GI bleeding, or gastric masses.

**Lower gastrointestinal endoscopy**

**Colonoscopy:** This procedure is used to evaluate the colon or large intestine. In order to maximize the benefits of this procedure, the colon must be properly prepared, or cleared out. This is accomplished by giving an oral solution and multiple enemas during the 12-24 hours prior to the procedure. Colonoscopy is used to evaluate patients with large bowel diarrhea, fresh blood in the stool, difficulty defecating, or with abnormal findings on a digital rectal exam. Similar to upper GI endoscopy, biopsy samples can be obtained to help make a definitive diagnosis

**Urinary and Genital Tract Endoscopy**

**Cystoscopy/Urethroscopy/Vaginoscopy:** Cystoscopy, urethroscopy, and vaginoscopy are used to evaluate the urinary bladder, urethra, and vagina, respectively. These procedures are usually performed concurrently. Patients with chronic or recurrent lower urinary tract disease may benefit from this form of endoscopy. It can be used to look for abnormalities such as anatomic irregularities (e.g., any abnormality), urinary stones, masses, or polyps. In some instances, stones or polyps can be removed during endoscopy.

**Abdominal endoscopy**

**Laparoscopy:** Laparoscopy allows evaluation of abdominal organs using a minimally invasive procedure. An endoscopic camera and instruments are introduced into the abdomen using two to three incisions that are 5-10 mm in length. The organs of the abdomen including the liver, gall bladder, kidneys, pancreas, and GI tract can then be visualized. Biopsies of abnormal organs can be obtained and this form of the procedure is called diagnostic laparoscopy. Liver biopsy is the most common reason for performing diagnostic laparoscopy and has several advantages over ultrasound-guided and open surgical biopsy techniques. Laparoscopy can also be used therapeutically.

**Advantage of endoscopy**

✓ Evaluating the digestive system is that it is nonsurgical.

✓ The technique allows for visualization of the lining of the digestive system

✓ Direct Biopsy samples can take from organs.

✓ Many foreign bodies in the esophagus and stomach may be removed via endoscopy.

✓ Specialized video camera with high resolution to evaluate is now available in market for better and accurate diagnosis.

**Disadvantage of endoscopy**

✓ Necessity to give general anesthesia to the patient
✓ Adequate laboratory testing and radiology is required before an endoscopy
✓ Evaluation of blood test before giving anesthesia is important for confirmation of patient is ready to take anesthetic risk or not
✓ Fasting of animals are at least 12 hours before an elective endoscopy
✓ General anesthesia with tracheal intubation is recommended
✓ A mouth gag is used to prevent damage to the endoscope.
✓ If lower part is to be examine it requires fasting more than 24 hrs to 48 hrs.
✓ Enemas are compulsory to clean the intestines
✓ Care should be required at the time of endoscopy like tearing of intestine; perforation wound otherwise immediate surgery is required to correct the problem.

Conclusion
Endoscopy is very good fast diagnostic as well as therapeutic tool in emergency cases like chock, oesophageal obstructions etc. In veterinary practice endoscopy is now becomes very popular and compulsory tools.
Urolithiasis is a common clinical problem in dogs and cats. Several risk factors for urolith formation, such as breed, sex, age, diet composition, water intake, infection of the urinary tract, environment and drug administration, have been recognised. Many minerals may precipitate in the urinary tract but magnesium ammonium phosphate hexahydrate (struvite) and calcium oxalate are the predominant mineral types in urolithiasis in dogs and cats. Prevalence of struvite, calcium oxalate, and urate urolithiasis in dogs are 49.6%, 31.4% and 8%, whereas in cats it is 42.4%, 46.3% and 5.6%. In both species, the incidence of struvite urolithiasis is decreasing while the incidence of calcium oxalate urolithiasis is increasing. More than 99% of uroliths in dogs and cats occur in the lower urinary tract (urinary bladder and urethra).

**Etiology**
Formation, dissolution, and prevention of uroliths involve complex physical processes. Major factors include supersaturation of urine with calculogenic minerals resulting in crystal formation, effects of urinary inhibitors of crystallization and aggregation, urinary crystallloid complexors, effects of urinary promoters of crystal aggregation and growth, and effects of noncrystalline matrix.

**Diagnosis**

**History and clinical signs**
Struvite, xanthine, and cystine uroliths occur in young adult animals, and calcium oxalate uroliths form in middle aged to older animals. In dogs and cats younger than 1 year, infection-induced struvite and urate uroliths are most common. Historical information may include previous urinary tract disease, underlying metabolic disease predisposing to urolith formation, or no preexisting disease. When uroliths occur in the lower urinary tract, clinical signs may include stranguria, hematuria, pollakiuria, inappropriate urination, and urethral obstruction. Clinical signs associated with uroliths that form in kidneys or ureters may include polysystemic illness (vomiting, depression, and anorexia) or abdominal pain, although many upper urinary tract uroliths are not associated with clinical signs. Uroliths may form with other metabolic diseases, such as bacterial urinary tract infections, hypercalcemia, hyperadrenocorticism, hyperparathyroidism, and liver disease; clinical signs of the underlying disease may be most obvious.

**Physical examination**
Physical examination findings are often normal unless urethral obstruction is present. Urocystoliths may be palpated in approximately 20% dogs and cats. Animals that form ammonium urate urocystoliths with portosystemic shunting of blood may be small in stature, look unkempt, or exhibit signs of hepatoencephalopathy. Dogs with hyperadrenocorticism may show signs typical of that endocrinopathy.

**Laboratory examination**

**Serum biochemical analysis**
Serum biochemical analysis is usually normal. Hypercalcemia may be
observed in approximately 4% of dogs and 35% of cats with calcium oxalate uroliths. A low blood urea nitrogen (BUN) concentration, hyperammonemia, and hyperuric acidemia may be observed in animals with ammonium urate uroliths that form because of portosystemic shunting of blood. Hyperuric acidemia is observed in dogs with urate uroliths. Azotemia, hyperkalemia, and metabolic acidosis may be observed if urethral obstruction is present.

Urinalysis
Abnormalities may include haematuria, pyuria, bacteriuria, and crystalluria. Although a bacterial urinary tract infection induces most struvite uroliths formed in dogs and in some cats, presence of a urinary tract infection does not necessarily prove that uroliths are composed of struvite. Infection with a urease-producing organism is required for infection-induced struvite uroliths to form.

Urine culture
Urine cultures should be positive for a urease-producing organism (usually Staphylococcus species, occasionally Proteus, Streptococcus, Klebsiella or Ureaplasma species) in the presence of infection-induced struvite uroliths. Urine cultures may be positive with any urolith in which a secondary bacterial urinary tract infection has occurred.

Additional laboratory testing
Additional laboratory testing may be indicated in animals with predisposing metabolic diseases such as portosystemic shunts (urate uroliths; provocative serum bile acid testing, contrast portography or transcolonic nuclear imaging) and hyperadrenocorticism (calcium oxalate or struvite uroliths; ACTH stimulation testing, low-dose dexamethasone suppression test, high-dose dexamethasone suppression test or abdominal ultrasonography).

Imaging studies
Survey radiography is often sufficient for detection of uroliths if they are radiopaque. Urate and cystine uroliths are inconsistently observed because of low mineral density. Use of double-contrast cystography improves the detection of urocystoliths. Excretory urography may be necessary to identify nephroliths and ureteroliths and to determine whether ureteral obstruction is present. Ultrasonography may demonstrate uroliths, but it is difficult to determine the number of uroliths ultrasonographically.

Analysis of uroliths
Quantitative analysis of uroliths voided during micturition or retrieved through voiding urohydropropulsion, urinary catheterization, or cystotomy provides the most information about the mineral composition of uroliths.

Treatments
Urocystoliths that are smaller than the smallest diameter of the urethra may be retrieved by voiding urohydropropulsion or a catheter-assisted retrieval technique. Surgical removal or medical dissolution of uroliths should not be the end point of therapy because many types of uroliths are recurrent. Appropriate preventive measures and follow-up evaluations are required.

Retrograde urohydropropulsion
Uroliths that cause urethral obstruction are retropropulsed into the urinary bladder if possible. The dog or cat is sedated or anesthetized, and a red rubber catheter (dogs, 5.0 to 8.0 French) or
polypropylene catheter (cats, 3.5 French) is inserted to the site of obstruction. Sterile lubricant-fluid solution is infused under pressure. Most urethroliths can be moved into the bladder successfully with this procedure. Urate, cystine and most struvite uruliths move easily because of their smooth texture; calcium oxalate uroliths are less mobile because of their irregular surface texture. This procedure is not successful if uroliths are embedded in the urethral mucosa or if there is a stricture proximal to the uroliths in the urethra.

**Voiding urohydropropulsion**

It is done under deep sedation or general anaesthesia. It may be used to retrieve uroliths that have a diameter smaller than the smallest luminal diameter of the urethra. Uroliths smaller than approximately 5 mm in female cats, 1 mm in male cats, 10 to 15 mm in female dogs, and 1 to 5 mm in male dogs can typically be retrieved. For larger uroliths, a cystotomy must be performed or medical dissolution attempted.

**Medical dissolution of uroliths**

Dissolution of infection-induced struvite uroliths is possible with appropriate antimicrobial therapy and a diet which is restricted in protein and magnesium and induces aciduria. Average dissolution time is 8 to 10 weeks.

No protocol available for dissolution of calcium oxalate uroliths. Surgical removal remains the treatment of choice for calcium oxalate uroliths.

Dissolution of ammonium urate uroliths in animals with portosystemic shunting of blood has not been successful; therefore, surgical removal remains the treatment of choice.

Urate uroliths may be dissolved with use of allopurinol (15 mg/kg orally at every 12 hours in dogs & 7.5 mg/kg orally at every 12 hours in cats) and a low-protein, alkalinizing diet. Average time for dissolution is 4 weeks.

Xanthine is a purine that is metabolized to uric acid primarily by the hepatic enzyme xanthine oxidase. In dogs and cats receiving allopurinol for treatment of urate uroliths, xanthine concentrations in serum and urine increase. Xanthine uroliths also occur spontaneously in cats. Xanthine uroliths cannot be dissolved medically.

Cystine uroliths may be dissolved with use of 2-mercaptopropionylglycine (15 mg/kg orally at every 12 hours) and feeding a low-protein, alkalinizing diet. Average time for dissolution is 4 to 6 weeks. 2-Mercaptopropionylglycine is used with caution in cats because there is a higher rate of complications, such as blood dyscrasias and gastrointestinal signs, than in dogs.

Other mineral types, such as calcium phosphate and silica, cannot be dissolved.

**Prevention of uroliths**

Prevention of sterile struvite uroliths can be achieved by feeding a diet that produces a urine pH between 6.1 and 6.5 because struvite is more soluble in acidic urine (pH < 6.8). Dietary magnesium restriction may also be useful. Most "struvite prevention" diets are restricted in magnesium and phosphorus and induce aciduria compared with routine maintenance diets.

Feeding a protein and sodium restricted, alkalinizing diet to dogs delays recurrence of calcium oxalate uroliths. If a neutral to slightly alkaline urine pH is not produced by diet, potassium citrate may be
given (initial dose, 75 mg/kg orally every 12 hours; adjust to induce a urine pH of 7.0 to 7.5). In cats with hypercalcemia and calcium oxalate uroliths, prevention is more successful with feeding of a higher-fiber diet and administration of potassium citrate (initial dose, 75 mg/kg orally every 12 hours; adjust to induce a urine pH of 7.0 to 7.5). Other proposed treatments include vitamin B6 (2 mg/kg orally at every 24 hours) and hydrochlorothiazide (2 to 4 mg/kg orally at every 12 hours). Because calcium oxalate uroliths recur, serial monitoring of urinalyses and repeated survey abdominal radiographs are important.

Feeding a low-protein, alkalinizing diet to dogs with urate calculi in the absence of portosystemic shunts prevents recurrence in approximately 80% of cases. If urate crystalluria persists despite feeding of an appropriate preventive diet, allopurinol may be administered (7 to 10 mg/kg orally at every 12 to 24 hours). Feeding a low-protein, alkalinizing diet to cats has been more than 95% successful in preventing recurrence of urate calculi. Use of allopurinol in cats is not recommended until safety and efficacy studies are done.

Feeding a low-protein, alkalinizing diet has been successful in preventing recurrence in animals that form xanthine uroliths unassociated with allopurinol formation.

Feeding a low-protein, alkalinizing diet is highly successful in preventing formation of cystine uroliths. Cystine solubility increases in alkaline urine; therefore, maintaining a urine pH above 7.5 is important. If the urine pH is not above 7.5, potassium citrate may be administered (initial dose, 75 mg/kg orally every 12 hours; adjust dose to induce a urine pH above 7.5). Alternatively, 2-mercaptopyrrolidone glycine (15 mg/kg orally every 24 hours) with alkalinization therapy with or without modification of diet can be tried.

Surgical removal and lithotripsy

Nephroliths and ureteroliths are commonly composed of calcium oxalate. Surgical removal and lithotripsy are the only options if uroliths must be removed from the kidneys or ureters because calcium oxalate uroliths cannot be dissolved medically. The decision to remove a nephrolith or ureterolith should be considered carefully because of the difficulty associated with ureteral surgery and long-term damage to a kidney induced by nephrotomy. Hence, nephroliths or ureteroliths should be monitored by abdominal radiography at every 3 to 6 months. If it is increasing in size or number or causing pain, hematuria, infection, or obstruction, they should be removed surgically to attempt to prevent loss of the associated kidney. By performing cystotomy and urethrotomy, upper urinary tract uroliths are removed.
Regional anaesthetic techniques in large animals

Regional anaesthesia is brought about by blocking conduction in the sensory nerve or nerves innervating the region where an operation is to be performed. The operative field itself is not touched while its sensitivity is being abolished. Success in regional analgesia comes from through knowledge of topographical anatomy of the nerves and the site of injection.

**Local anaesthesia**

The local anaesthetic decreases the permeability of the excitable membrane to Na⁺ and in higher concentration also block the K⁺ channels.

The anaesthetics are mainly inactivated in livers by estrases, amidases.

**Toxicity**

Multiple injections near a highly vascular area may result into toxicity. The symptoms arise from CNS and include restlessness, muscular tremors or even tonic convulsions. The stimulation is followed by depression, hypotension and some degree of respiratory depression. Fatalities in neonates are common. If toxicity occurs, diazepam or barbiturates can be used to overcome convulsions.

**Nerve Blocks**

**Peterson’s eye block**

The ideal site to anaesthesia the eye and its associated structures is just at the foramen orbitotorundum from where oculomotor, trochear and abducons nerves and ophthalmic, maxillary and mandibular nerves emerge. In this technique a 2.5 cm 16 G needle is first introduce under aseptic condition though the skin in the depression just caudal to point where the supraorbital process meets the zygomatic arch. A 12cm long 18 G needle is then inserted through previously placed needle and pushed till it strikes coronoid process of the mandible. It is redirected towards the petrygopalatinate fossa rostral to the foramen orbitotorundum at a depth of 8-10 cm, and 15-20 ml of 2 per cent lignocaine is injected. To block auriculopalpebral nerve, to paralysis eyelids, 18 G needle is withdrawn to the S/C tissue and redirected caudally and laterally. Five to seven ml of solution is injected at this place. The technique blocks the orbit and eyelids.

Adverse effects are orbital haemorrhage, pressure on eye ball and damage to optic nerve.

**Auriculopalpebral nerve block**

causes motor paralysis of the eyelids and facilitation examination of the eye or removal of foreign bodies.

**Mental nerve block**

It can be used for surgery of the lower lip and lower jaw. In bovine the mental foramen is located on the lateral aspect of the ramus just behind the fourth incisor. A 3-4 cm long 20 G needle is inserted slowly into the foramen and 10-15 ml of 2 percent lignocaine is injected.

**Mandibular-alveolar nerve block**

Mandibular alveolar nerve is blocked at the mandibular foramen on medial aspect of the ramus of the mandible. In bovines, the needle is inserted from the angle of the jaw along the mandible surface of the ramus of the mandible, at a point where an imaginary line along the masticatory surface of the lower molar teeth is crossed by another imaginary vertical line from the lateral canthus of the eye. A 15 cm long, 18 G needle is used. About 20 ml of 2 percent lignocaine is injected to induce analgesia of the molar teeth, incisors and lower lip.

**Infraorbital nerve block**
The block is used for surgery of the upper lip, nostrils, incisors and gums. Infraorbital nerve emerges from the infraorbital foramen which is located rostral to facial tuberosity, dorsal to first molar tooth. A 4 cm long 20 G needle is inserted about 2.5 cm deep into the caunal and 5-10 ml of 2 percent lignocaine is injected to block the nerve.

**Cornual nerve block**

The block is indicated for surgery of the horn. The corneal nerve passes through the peri orbital tissue dorsally to run along the lateral border of the frontal crest where to the base of horn. In cattle, an 18 G needle is inserted midway between nerves is superficial. About 5 ml of 2 percent lignocaine is injected around the nerve. In older animal or if the horns are well developed, the skin sensation may come from first or second cervical nerve. Therefore, in such cases, some amount of local anaesthetic should be infiltrated just caudal to the base horn.

**Proximal paravertebral anaesthesia**

In bovines, the dorsal and ventral nerve routes of the last thoracic (T13) and first and second lumber (L1, L2) spinal nerves are blocked on emerging from the respective intervertebral foramen.

The site is about 5 cm from the midline, for T13 just cranial to the transverse process of the L1, for L1 just cranial to the transverse process of the L2 and for L2 just cranial to the transverse process of the L3. The skin over the sites is desensitised by injecting 2 to 3 ml of 2 percent lignocaine using a 2 cm long 15 G needle. Using this needle as a cannula, a 15 cm, 18 G needle is inserted down to contact the cranial edge of the transverse process of the lumbar vertebra. The needle is then advanced about one centimetre to pass through the intertransverse ligament. About 10 ml of 2 percent lignocaine is injected to block the ventral branch of the respective nerve. The needle is withdrawn above the intertransverse ligament and another 5 ml of the solution is injected at the level of dorsal surface of the transverse process to block the dorsal branch of the respective nerve. For rumenotomy blocking the flank, the L2 nerve should also be blocked.

**Distal paravertebral anaesthesia**

A lateral approach is followed in this technique to desensitize the dorsal and ventral branches of the T13, L1 and L2 nerve of cattle at the distal ends of the lumbar transverse process of the L1, L2 and L4 vertebrae. The local anaesthetic solution is deposited dorsal and ventral to the end of transverse process and about 20 ml of the solution is injected at each site in a fun-shaped fashion. The needle is completely withdrawn and reinserted dorsal to the transverse process in a slightly caudal direction where the cutaneous branch of the dorsal rami is blocked with about 5 ml of the solution at each site.

**Epidural anaesthesia**

In this technique, a local anaesthetic agent is injected into the epidural space. Caudal epidural block is routinely used in bovines to block the coccygeal and sacral nerves so as to desensitize the tail, anus, perineum, valve and vagina. The technique is used in obstetrical procedure and for surgery. It is also used to check tenesmus. Cranial (anterior or high) epidural block can be used in calves, sheep and goats to desensitize the abdominal region. Usually caudal block is differentiated from the cranial block by the absence of incoordination of the limbs with the foramen. Both cranial and caudal blocks can be produced from the same site by increasing the volume of local anaesthetic agent used as larger volumes facilitate the spread of solution cranially. The most commonly used sites are the sacrococcygeal space and the first intercoccygeal space. In the buffalo, the sacral ridge is inlined more downward.
and so the anaesthetic solution may not sometimes reach the uppermost parts when first intercoccygeal space is used. Therefore, the sacrococcygeal space should be prefered. In routine practice, 2 percent lignocaine is used. Repeated injection can be given to prolong the duration of effect. Alternatively, longer acting agents like bupivacaine can be used.

The site is located by elevating and lowering the tail and palpating the depression between the sacral and first coccygeal or between the first and second coccygeal vertebrae. In cattle and buffaloes, a 10 cm 18 G needle is inserted at a median plane at a right angle or at 10 to 15° to the vertical. Small quantity of the local anaesthetic solution is injected to make a dermal weal.

The needle is then pushed down till it contacts the floor of the vertebral canal. A syringe filled with local anaesthetic the presence of blood. If blood is present the needle is withdrawn, checked of the blood clot and reinserted. Eight to ten ml of 2 percent lignocaine is then injected. If the needle id in correct position, there is practically no resistance felt during the injection. If the resistance is felt, the needle should be slightly withdrawn and redirected.
Common Surgical Affection of Eye in Small Animals

J V Vadalia
Department of Surgery & Radiology, College of Veterinary Science & Animal Husbandry,
Junagadh Agricultural University, Junagadh-362001

1. Entropion
   Inversion of lid margins of the eyelid

Etiology
A. Congenital
   Involving the lower eyelid. Commonly seen in Chow-chow, Bloodhound, Labrador, Doberman, St. Bernard, Irish setter
B. Acquired
   Cicatricial contraction following injuries. Chronic inflammation due to blepharospasms associated with the painful eye disease known as spastic entropion.

Symptoms
   Typical in rolling of the lid margin, Epiphora, Blepharospasms, conjunctivitis or keratitis, vascularization (Pannus) or ulceration of the cornea.

Treatment
   Surgical
   Elliptical piece of the offending eyelid removed with a pair of scissors or scalpel. Wound sutured with fine silk or catgut. Postoperatively, topical eye antibiotics with corticosteroids for 6-8 days. Local antiseptic dressing of the suture line for 8-10 days or till the sutures are removed.

2. Ectropion
   Typical eversion of the lid margin exposing the palpebral and bulbar conjunctiva

Etiology
A. Congenital
   due to the inadequacy of lateral retractor muscle of the eye.
B. Acquired
   due to decreased tone of the orbicularis oculi muscle. Secondary to trauma, surgery, thermal or chemical injury or chronic inflammation.

Symptoms:
   Typical turning out of the lid margin, Epiphora, Blepharospasms, May be conjunctivitis or keratitis.

Treatment
   Surgical
   V-Y blepharoplasty is done under suitable anesthetic technique. Postoperatively, topical eye antibiotics with corticosteroid for 6-8 days. Local antiseptic dressing of the suture line for 8-10 days or till the sutures are removed.

3. Hordeolum
   Localized suppurative inflammation of lid margin usually due to Staph

   External Hordeolum: Also known as ‘Sty’, involves glands of Zies and Moll. Seen in young dogs characterized by solitary or multiple small abscesses on the lid margin. Internal Hordeolum: Also known as ‘Chalazion’ and involves meibomian glands. Mostly seen on the palpebral conjunctiva. Common in middle aged dogs.

   Treatment
   Hot compression of the swelling followed by manual compression with cotton plug and then flushing the affected eye using 2% Boric acid or NSS. Topical antibiotics with corticosteroids qid daily for 6-8 days.

4. Prolapse of the gland (cherry eye)
   Protrusion of the gland over the free edges of 3rd eyelid is called hypertrophy, hyperplasia or adenoma. Commonly known as “Cherry Eye”.

ASCAD training on “Advances in surgical and imaging techniques for animals” held at COVSc&AH, JAU, Junagadh from 14th to 19th October 2013

32
Develops due to the congenital weakness of connective tissue in between cartilage and the glandular tissue. If unilateral, other eye should be examined for potential prolapse.

**Treatment**

If possible return the gland to its normal position under general anesthesia and keep it in position by suturing. Alternately, if the above procedure fails, surgical removal of the gland is done. Check hemorrhage with topical adrenaline (1:5000). Postoperatively install topical antibiotics with corticosteroids for 5-7 days.

5. **Prolapse of 3rd eyelid**

An acquired condition mostly seen due to median canthus injury leading to weakness of the connective tissue anchorage to the orbital tissue. Surgical excision is done under regional block followed by topical antibiotics with corticosteroids for 8-10 days. A technique used to protect the cornea for better healing during many disease conditions.

**Indications:**
Corneal ulcers, iris prolapsed, management of corneal wounds

6. **Hyphema**

Blood in the anterior chamber. Whole of the eye looks red. Mostly seen in some trauma. Not so common causes are Warfarin poisoning, severe anterior uveitis, glaucoma.

**Treatment:**

There is no satisfactory treatment to stop slow bleeding from retinal detachment. Treatment of the primary cause is a must (glaucoma, iridocyclitis etc.). Paracentasis of the anterior chamber at 6 ‘O’ clock position using No. 11 BP blade for easy removal of the clotted blood from the chamber. Thereafter flush the anterior chamber with 1000 to 1250 units/ml fibrinolysin and NSS. Use of topical mydriatics (1% atropine) with antibiotic and corticosteroids combinations is quite helpful in the management of the condition.

7. **Extirpation of Eye Ball**

**Indications**

Neoplastic growth of the eye ball and adjacent tissue. Penetrating wounds associated with evacuation of ocular contents and causing irreparable injury to the eye. Supportive destruction of the eye.

**Site of operation and anaesthesia**

Between eye ball and orbital rim through the skin of both eye lids about half cm from the border. The animal is controlled in lateral recumbency with the affected side up. Sedative/tranquilizer or general anaesthesia can be administered depending upon the temperament of animal. Analgesia at the site of operation is achieved by auriculo palpebral and retrobulbar nerve blocks or by infiltration of local anaesthetic into upper and lower eye lids and deeper tissues at the site of incision, in case sedative or tranquilizers are used.

**Surgical technique**

The upper and lower eye lids are sutured together with a continuous suture leaving the suture ends at least 15-20 cm long for grasping and applying traction during the operative procedure. An incision completely encircling the eye lids is made approximately 1/2 cm from the margin of the lids. The incision is extended around the entire circumference of the lid margin between the orbital rim and eyeball by blunt dissection taking care
not to puncture conjunctiva. Haemorrhage is carefully controlled either by ligation or forcipressure. Conjunctiva from the lids back to its attachment to the orbit is separated leaving its attachment to the border of the lids. The dissection is carried out back to the point of insertion of the conjunctiva to the orbit. All the muscles of the eye are incised with scissors and finally the optic nerve is cut. Before cutting, the optic vessels are ligated firmly in order to control the haemorrhage. All the periorbital fat is left in place. The haemorrhage is controlled with gauze pressure temporarily packed up inside the orbital cavity. All the blood clots are removed from the cavity. Temporary pack is removed and a 70-80 cm long piece of bandage impregnated in antiseptic lotion is inserted into the orbital cavity. Outer skin edges of the lids are sutured with interrupted sutures in order to close the wound leaving a little portion of impregnated gauze outside towards the inner canthus.

Post operative care
A pressure bandage should be tied for about 24 hours after the Operation. A 15-20 cm piece of impregnated bandage should be removed on 3rd and 7th day, and the rest on 10th day after the operation. A course of antibiotics should be administered for 4-5 days or till the healing is complete. The sutures of the lids should be removed 8 to 10 days after the operation or till the healing is complete.

8. Cataract
Opacity of lens or its capsule. Develops due to the opacification of lens fibers and change in the water content of the lens. Disruption of lamellar architectural arrangement of lens fibers or its capsule which results in the loss of the transparency of the lens.

Classification
- Capsular or False Cataract: When the lesions are present in the capsule.
- Lenticular or true cataract: When the lesions are present in the lens itself.
- Capsulo-lenticular or mixed

Depending upon the etiology:
- Developmental cataract: Congenital or juvenile cataract.
- Traumatic cataract: Due to certain external violence and resultant perforating wound.
- Classification
- Senile cataract: Seen in the old age.
- Diabetic cataract: Seen in Diabetes mellitus.
- Radiation cataract: Rare in animals.
- Toxic cataract: In naphthalene poisoning, uremia, drug toxicity (pilocarpine) and certain metallic toxicity (Thallium, Cobalt and Selenium).
- Complicated cataract: Secondary to other ocular disease like uveitis, lens luxation, retinal detachment, intraocular tumors and glaucoma.

Stages of cataract
- Incipient stage: Beginning of cataract when streaks or vacuoles are seen in the nucleus or just inside the posterior capsule. The vision is normal.
- Immature stage: There is cloudiness of the lens but fundic reflex (Reflection of light from the tapetum) is still present. Slight difficulty in walking.
✓ **Mature stage:** There is shrinkage of the lens with complete opacity. The fundic reflex is absent. The cataract is often referred as ‘ripe’ cataract.

✓ **Hypermature stage:** There is further decrease in the size of the lens with liquefaction of the cortex. The lens appears milky or speckled in the appearance. Finally the nucleus may sink to the bottom (Morgagian cataract) and may be there is return of the vision.

**Symptoms and diagnosis**

✓ History of progressive loss of vision.
✓ Focal or diffuse opacity of the lens.
✓ The lens appears ‘**pearly white**’.

**Treatment**

**Medical treatment**

The aim of medical treatment is to promote the absorption of inflammatory exudates. Many drugs have been tried like Catamed or Cataline 1-2 drops twice daily. Homeopathic medicine ‘Senararia’ can also be tried.

Other drugs which have been tried are iodine, calcium, cysteine, sulfonamides, acetazolamide preparations for topical use. The success rate with medicinal treatment is very less and it is believed that any apparent improvement in the vision was not due to the medication but probably due to spontaneous cataract resorption. 1-2% topical atropine can be used twice weekly to dilate the pupil and enhance the vision.

**B) Surgical treatment**

Surgical removal of the cataract lens is done under general anaesthesia. The aim is to restore aphakic vision. Mostly two methods of lens extraction are recommended i.e.

**Extracapsular** (the anterior capsule of lens is removed and lens content is expelled)

**Intracapsular** removal (no opening is made in the capsule and the zonular attachments are severed and the lens is delivered within the capsule). Various methods which can be employed for the removal of the cataract lens are: Ultrasonic fragmentation, Aspiration technique with needle or after fragmentation.
Mammary Gland (Breast) Tumors in Dogs

A M Patel, H M Padheriya and P B Patel
Department of Surgery & Radiology, College of Veterinary Science & Animal Husbandry, Junagadh Agricultural University, Junagadh-362001

Mammary gland tumors are the most common tumors in dogs. In fact, among unspayed females the risk of a mammary tumor is 26 percent. Most mammary gland tumors occur in bitches over 6 years of age (the average age is 10). Forty-five percent are cancerous and 55 percent are benign. An increased incidence occurs in sporting breeds, Poodles, Boston Terriers, and Dachshunds. Multiple tumors are common. If a bitch has one tumor, she is three times more likely to have or develop a second tumor.

Anatomy

The mammary glands in female dogs vary in number and can be determined by counting the nipples. The typical bitch has 10 mammary glands, five on each side of the midline, beginning on the chest and extending to the groin. The largest glands are located near the groin.

The mammary gland is a modified apocrine sweat gland found only in mammals. It consists of a network of ducts surrounded by a fibrovascular and adipocyte-rich stroma. The development of this gland is unique, as the last stages of development occur in the adult female only during pregnancy. With each pregnancy there is proliferation of the ductal tissue, differentiation to milk-producing acini, secretion of milk by the acinar cells, and, at the end of lactation, involution of the secretory component of the gland with preservation of the ductal structures.

Table: Lymphatic drainage of the mammary gland in the bitch

<table>
<thead>
<tr>
<th>Mammary Gland</th>
<th>Normal Lymphatic</th>
<th>Neoplastic Lymphatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cranial Thoracic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caudal Thoracic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cranial Abdominal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caudal Abdominal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inguinal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig 2: Lymphatic supply of mammary gland

The mammary gland is a modified apocrine sweat gland found only in mammals. It consists of a network of ducts surrounded by a fibrovascular and adipocyte-rich stroma. The development of this gland is unique, as the last stages of development occur in the adult female only during pregnancy. With each pregnancy there is proliferation of the ductal tissue, differentiation to milk-producing acini, secretion of milk by the acinar cells, and, at the end of lactation, involution of the secretory component of the gland with preservation of the ductal structures.
Drainage

<table>
<thead>
<tr>
<th>Region</th>
<th>Drainage</th>
<th>Drainage</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1, cranial thoracic</td>
<td>Axillary LN</td>
<td>Axillary LN, sternal LN</td>
</tr>
<tr>
<td>M2, caudal thoracic</td>
<td>Axillary LN</td>
<td>Axillary LN, sternal LN</td>
</tr>
<tr>
<td>M3, cranial Abdominal</td>
<td>Axillary LN, superficial inguinal LN</td>
<td>Axillary LN, superficial inguinal LN, medial iliac LN</td>
</tr>
<tr>
<td>M4, caudal Abdominal</td>
<td>Superficial inguinal LN</td>
<td>Superficial inguinal LN, axillary LN</td>
</tr>
<tr>
<td>M5, inguinal</td>
<td>Superficial inguinal LN</td>
<td>Superficial inguinal LN, popliteal LN, lymphatics—medial thigh</td>
</tr>
</tbody>
</table>

Mammary Tumor

The principal sign is a painless lump or mass. Most lumps occur in the larger glands closest to the groin. A mass may be large or small, with boundaries that are distinct or indefinite. Some lumps are freely moveable, while others adhere to the overlying skin or underlying muscle. Occasionally, the mass ulcerates the skin and bleeds.

Inflammatory cancer is a rapidly progressive neoplasm that spreads throughout the chain of mammary glands and into surrounding skin and fat. Death usually comes in a matter of weeks. Inflammatory cancer may be difficult to distinguish from acute septic mastitis. Malignant tumors spread widely, primarily to the pelvic lymph nodes and lungs. Before embarking on treatment, a chest X-ray should be taken to rule out lung metastases, present in 30 percent of these cancers. Ultrasonography is useful in determining whether the pelvic lymph nodes are involved. Biopsy of the tumor may not be necessary if surgical removal is contemplated. Inflammatory cancer, however, must be biopsied, because there is little to be gained in attempting aggressive treatment in these tumors.

Benign growths are often smooth, small, and slow growing. Signs of malignant tumors include rapid growth, irregular shape, and firm attachment to the skin or underlying tissue, bleeding, and ulceration. Occasionally, tumors that have been small for a long period of time may suddenly grow quickly and aggressively, but this is the exception not the rule.

Treatment

Removing the lump with adequate margins of normal tissue is the treatment of choice for all mammary tumors, whether benign or malignant. How much tissue will be removed depends on the size and location of the tumor. Removing a small tumor with a rim of normal tissue is called a lumpectomy. A simple mastectomy is the removal of the entire mammary gland. A complete unilateral mastectomy is the removal of all five mammary glands on one side of the body. The inguinal lymph nodes are often included in a unilateral mastectomy. A specimen is then submitted to a pathologist for a tissue diagnosis to determine the prognosis.

The success rate of surgery depends on the biological potential and the size of the tumor. Benign tumors are cured. Bitches with small malignant tumors less than 1 inch (25cm) across have favorable cure rates. Those with large,
aggressive tumors are more likely to have metastatic disease and a poor prognosis. The addition of chemotherapy, immunotherapy, and complete ovariohysterectomy does not improve cure rates, although chemotherapy may offer some relief in bitches with advanced cancers that cannot be surgically excised.

**Prevention**

Spaying a female before the first heat cycle reduces her risk of breast cancer to less than 1 percent. If she is spayed after one heat period, her risk is still only 8 percent. After two heat cycles, however, there is no reduction in risk. It is important to examine the mammary glands of unspayed bitches every month, starting at 6 years of age or younger. If feel a suspicious lump or swelling, than do medical checkup. Thus, the opportunity to cure many mammary cancers is lost.
MRI, CT Scan and Digital Radiography
Shivaji H. Talekar and Vineet Kumar
Department of Surgery & Radiology, College of Veterinary Science & Animal Husbandry,
Junagadh Agricultural University, Junagadh-362001

Magnetic resonance imaging (MRI) is a sophisticated computerized imaging technique, which has been a clinical diagnostic tool since 1980. MRI is used to create images with extraordinary detail of the body or brain by applying nuclear magnetic resonance phenomena. The distribution of hydrogen nuclei (protons), found in cellular water, depends on the tissue type and whether or not the tissue is healthy or diseased. MRI measures and records changes in the magnetic properties of these protons. The MRI technique uses a strong magnetic field, pulsed electromagnetic fields known as gradients, and radio waves to excite the protons and produce the image in the region of interest. The image is produced then displayed on a gray scale from black to bright white. The image brightness is a complex function of the hydrogen concentration or intensity. Contrast, described as the difference between signal intensities, provides the optimum difference between light and dark regions of the tissue or organ to help the veterinarian detect lesions, such as a tumor. Although MRI is normally a noninvasive technique, contrast agents can be administered to a patient to enhance a region of interest.

Soft tissue, such as internal organs, is relatively transparent to X-rays, limiting the practical application of other imaging modalities such as computed tomography (CT). MRI, however, has excellent sensitivity for these tissues with 100% increase in soft tissue resolution compared to its closest competitor CT. MRI has the additional benefit of not using ionizing radiation. The magnetic resonance phenomenon has been steadily gaining in vitro application in the fields of chemistry, biochemistry, and the medical life sciences since its inception in 1946.

The technique was first extended to a live animal by Jasper Jackson in 1967, and the first two-dimensional MR image was generated in 1972 by Paul Lauterbur. Since initial reports of the identification of central nervous system (CNS) abnormalities by magnetic resonance imaging during the 1980's, the progression of MR as a diagnostic modality for CNS disease has been rapid. Magnetic Resonance Imaging became routine in human medicine during the 1980s. The superior clarity of the images, particularly of the brain, combined with its non invasive nature led to its quick acceptance.

MRI in Veterinary Practice

Until recently MRI has had limited application in veterinary medicine, primarily due to the expense of the imaging unit and associated computer needs, as well as the requirement for specially constructed rooms to house the units. However, a few specialty veterinary facilities including Advanced Veterinary Medical Imaging have obtained their own imaging units for veterinary use. Most veterinary facilities rely on older, used equipment. Our new, state of the art, high field GE MRI scanner will ensure a more efficient and rapid exam. Furthermore the most sophisticated monitoring equipment available will minimize anesthetic related concerns. Advanced Veterinary Medical Imaging has acquired the most dedicated and skilled staff available in the MRI
industry today in an effort to provide the best care possible for your pet.

An MRI (magnetic resonance imaging) scan is similar to an X-ray in that it will provide the veterinarian images of the inside of your dog, but it provides more detail and it is safer because it does not use radiation. While an X-ray or an ultrasound scan will show the size and shape of an internal organ or tissue, an MRI scan will show what the inside of the organ or tissue looks like.

The dog will need to be placed under general anesthesia because it needs to remain perfectly still for up to two hours. The dog will be allowed only water on the day of the scan, and it will need about two hours after the scan to recover from the anesthesia. The imaging specialist will usually be able to make a diagnosis while the dog is recovering.

MRI scans for dogs are normally reserved for diagnosing problems with the brain and spinal chord and they are only used when more traditional diagnostic techniques can't determine the problem with the dog. MRIs are also starting to be used for diagnosing problems with bones and joints in dogs.

An MRI uses magnetic fields to create images of the dog's body. The dog is placed inside a giant magnet which sends radio waves into the body. When the magnet is turned off, the body releases the radio waves which the computer uses to make an image of the body.

**CT (CAT) Scanning**

Computed Tomography (CT) imaging uses X-rays in conjunction with digital X-ray detectors and computer processors to image the patient. A CT scan is sometimes called a CAT scan (for computed axial tomography)

For a CT scan, a dog is placed under anesthesia, positioned on a table that slides the pet through a ring containing the x-ray source and the X-ray detectors. The CT images are cross-sectional slices of the area imaged, as if the patient was cut like a loaf of bread. These slices can be examined one by one to reveal the details inside.

Contrast agents containing iodine are typically administered intravenously as part of the scanning process to enhance visualization of abnormal soft tissues and blood vessels. The General anesthesia is typically used because most studies require the patient to remain motionless for a few minutes.

A CT scan can take a few minutes to an hour depending on the complexity of the exam, the size of the patient, and the number of body regions examined. After the CT scan is acquired and the patient is awake, CT images can be further processed and reconstructed into two-dimensional and three-dimensional images using computer manipulation for further analysis as radiologists evaluate the images.

CT scan is a non-invasive, non-painful for better diagnosis of cancers, fractures etc.

**Digital Radiography (X-Rays)**

Radiographs or “x-rays” are used to evaluate muscular-skeletal structures, cardiovascular, gastrointestinal, pulmonary, urinary, and reproductive systems. Digital radiography offers numerous benefits: Immediate observation of radiographic images, less x-ray exposure, improved image quality, Ability to enhance images, more accurately diagnose problems. Data Storage for easy history and retrieval, Quick communication with specialists.
Digital radiography is an updated version of X-ray imaging. Instead of using electromagnetic radiation and chemical processing to record an X-ray on to film, digital radiography uses digital X-ray sensors to record the X-ray onto an image capture device, which then creates a digital image file. This file can then be used by veterinarians to interpret the X-ray, and the file can be attached to a patient’s record for future reference.

Two types of digital radiography are used. The first, known as indirect digital radiography, involves amorphous silicon (a-Si) flat panel detectors, and it works by converting X-ray images to light and channeling the image through an amorphous silicon photodiode layer that converts it to a digital signal. Thin film transistors (TFTs) then read this digital output, and it is turned into a data file that can be viewed by the X-ray technician.

The second type is direct digital radiography and involves amorphous selenium (a-Se) flat panel detectors. This uses a high-voltage electrode to accelerate X-ray photons through a selenium layer, and the pattern is then recorded. This creates an image file that is sent directly to the technician and on to the radiologist.

No change in X ray machine use 60,100,160,500mA X ray Machine. Gelatin coated X ray plate is required. digital image receptor IP, image processing unit, image management system, image data storage device, a communication network, a display device and laser printer, Scanner is required material for digital radiography.

**Advantages of digital radiography**
- Save times, better quality
- better post processing unit
- Integrated with radiographic equipment
- easy to learn and adopt,
- Decrease chances of repeated exposures.
- Portable versions are available in the market.

**Dis-advantages**
- Very costly replacements are costly
- Annual maintenance contract part too costly
- Number of artifacts viz, phantom image, dead pixels etc.

**Conclusion**
MRI, CT and Digital radiography is recent advance diagnostic tools now a day used in veterinary practice. MRI, CT and Digital radiography have its own advantage and good enough to have better diagnosis for veterinary clinician for routine cases.
Abdominal wall defects, may be congenital (umbilical hernia) or acquired (ventral, inguinal and scrotal hernias). Often, such defects result from prior abdominal surgery, trauma or weakness of abdominal musculature, massive infection, or tumor resection. Prevention of evisceration, creation of a tension free abdominal wall repair and stable soft tissue coverage are the goals of abdominal wall reconstruction. Decisions regarding technique are based on the location and size of the defect. Currently open primary tissue closure of these defects is routinely practiced. This surgical approach can lead to wound dehiscence, recurrence and non-healing of the wound. Another surgical approach for tension-free repair of these defects is open or laparoscopic prosthetic mesh placement. Non-absorbable synthetic mesh is one of the most widely used prosthetic materials for reconstruction of these defects. The use of nonabsorbable, synthetic mesh material has been reported to cause complications such as mesh extrusion, bowel adherence, fistula formation, wound infection, skin erosion and seroma development. Biological meshes may be an attractive option to deal with these synthetic mesh-related complications.

**Diagnosis**

**History and clinical signs**

A history of trauma is common with abdominal hernias. Palpation at the site of defects may reveal presence of a large, soft, round mass with a discernible ring. Multiple loops of bowel could be palpated traversing the hernial ring.

**Diagnostic imaging**

Ultrasonographic examination is one of the valuable tool to confirm the abdominal wall defects. It may also help to define contents of hernias.

**Treatment**

Surgical procedures are performed under either local analgesia or general anaesthesia depending upon the species of the animals. Animals were then positioned in dorsal or lateral recumbency, according to the type and position of the hernia, and the proposed surgical site is prepared for aseptic surgery. In cases of ventral and umbilical hernias, ring is identified following cutaneous and hernial sac dissection. After hernial contents reduction, ring is repaired with adequate size biological mesh using techniques such as onlay (mesh is placed anterior to external sheath of rectus abdominis muscle), inlay (mesh is placed in the abdominal wall defect and sutured to wound edges), pre-peritoneal or sublay (mesh is placed dorsal to rectus abdominis muscle and anterior to internal sheath of rectus abdominis muscle) or intra-peritoneal technique (mesh is placed on peritoneum from within abdominal cavity). These techniques are depicted in figure given below.

In case of caudal abdominal hernias (inguinal and scrotal hernias), a straight incision is made directly over the external inguinal ring. The subcutaneous tissues and skin are dissected from the hernial sac, and the fibrous outer layer of the hernial sac is incised. The tunica vaginalis is opened, and hernial contents...
are reduced. The spermatic cord is transfixed with absorbable suture materials just distal to the inguinal ring and emasculated between the ligatures, and testes are removed. The tunica vaginalis is closed. Biological mesh is placed between the closed vaginal tunic and the deep inguinal ring and sutured craniolaterally to the internal abdominal oblique muscle and ventromedially to the rectus abdominis muscle (deep inguinal canal) using preplaced surgical silk in a horizontal mattress pattern. The subcutaneous tissues are closed in 2 layers, using absorbable suture material. The skin incision is then closed using nonabsorbable suture material in a horizontal mattress suture pattern.
Surgical Affections of Ear in Small Animals

J V Vadalia

Department of Surgery & Radiology, College of Veterinary Science & Animal Husbandry,
Junagadh Agricultural University, Junagadh-362001

Surgical disorders of the pinna

A-Wounds

Most of recent ear injuries are traumatic as a result of biting, barbed wire or tree and are characterized by perfuse hemorrhage, while old wounds are either extension of neglected recent wounds or occur as a result of seton, mild irritation after using rope or chain tie at the base of the horn.

Symptoms

The same general symptoms of wound (hemorrhage in recent wounds, and cellulites and infection in old one).

Prognosis

When a part of the tip of the pinna has been avulsed, it is difficult to restore the ear appearance. The splitted or punctured ear should be repaired surgically as quickly as possible to achieve the maximal cosmetic appearance of the ear.

Treatment

In recent wounds, arresting of bleeding should have the priority. The wound edges are excised and refreshed (including the cartilage if necessary). Divided cartilage is not sutured but the skin over the cartilage on both sides is sutured. The head of the animal should be restrained to prevent the animal from rubbing the ear against fixed objects. The aftercare is the same as general principles used for ordinary wound. Treatment of the old wounds follows the rules of general surgery (daily dressing with antiseptic and injection of antibiotic).

B-Ear fistula

It is a dentigerous cyst with fistulous opening on the ear’s anterior edge.

Symptoms

An opening of the fistula is present at the anterior edge of the ear 1-3 cm from its base, through which a gray mucoid or purulent fluid comes out and runs down the temporal and buccal regions and dries. The skin around the opening shows excoriation. The fistulous tract is connected to a tooth-like structure that can be determined by passing a probe or by radiography.

Treatment

Treatment is primarily surgical and includes surgical excision of the fistula with separation of the bony tooth-like structure form its attachment to the temporal bone, then the wound is closed in layers.

C-Auricular cellulitis

It is an inflammatory condition of the earflap as a result of pyogenic infection of the ear wound.

Symptoms

The earflap is swollen (of 1-2 cm thickness), warm, and painful. The swollen earflap droops to one side and can’t be raised. Serous fluid exudates form the ear, dries on both surfaces of the ears and forms crusts.

Treatment

The external auditory meatus is backed with cotton, an ear bandage is applied and moisted with warm water every 2 hours. Massive dose of antibiotic should be administered. The fate of such condition is either resorption or abscess formation over the earflap. When an abscess is formed,
it is treated by the general principles of surgical treatment without splitting of the cartilage but if necrosis occurred in the cartilage, it is indicated to perform partial amputation of the ear flap.

**D-Neoplasms of the external ear**

The most predominant type of neoplasms observed on the ear is the wart or papilloma, which is a benign tumor, but other types of tumors can involve the deeper auricular tissues.

**Treatment**

Neoplasms of the ear can be treated either by surgical resection, cryotherapy or thermally. Neoplasms on the edge of the ear flap or on its inner or outer surface are removed surgically and in some cases it is necessary to remove a part of the cartilage during resection. While neoplasms of deep auricular tissue, that cause obstruction of the external ear canal, should be removed with the canal itself.

**E-Broken conchal cartilage**

**Treatment**

The condition is treated surgically by incising and reflecting the skin over the injured cartilage, then two or three Kirschner wire pins are inserted into the cartilage and fixed externally to the skin by stitch.

The cartilage is suture with wire suture by simple interrupted pattern and the skin is closed routinely. The wire pins are removed 16-20 days after surgery.

**F-Hematoma of the ear**

The condition is a common affection in pet animals. The exact cause of such affection is not well known, but it is accepted that it is a self-inflicting trauma leading to rupture of blood vessels.

**Symptoms**

Accumulation of blood between the skin and the cartilage, either on one side or on both sides, and the size and consistency of the hematoma depend up on the duration and severity of trauma.

**Treatment**

It is treated either by application of counter irritants or antiflugeotic to facilitate resorption if the condition is recent and small-sized or by drainage technique. Sometimes it is better to leave it for 7-10 days to permit closure of the ruptured vessels and clotting of the blood, and then surgical incision is indicated.

**1-Drainage technique**

It is a method used for recent hematoma on the concave surface of the pinna to facilitate drainage of the hematoma by applying two plastic teat canulas at the proximal and distal aspects of the hematoma via stab incision of the skin. The canulas are fixed by silk, and the hematoma is flushed with sterile saline daily with monitoring the maintenance of the drainage, and they are removed after 7-21 days when the drainage is minimal.

**2-Incision-Suture Technique**

A medial S-shape incision is made along the hematoma, the clot is removed, the cavity is flushed with saline, the pinna is sutured with non-absorbable suture material using through and through mattress suture pattern parallel to the incision and the ear vessels in order to close the dead space, the ear is bandaged and prevented from self-traumatization, the bandage is changed frequently and removed after 7 days when the drainage is diminished, and the sutures are removed after 14 days. Disadvantage of
this technique is the possibility of thickening and wrinkling of the ear.

3- Incision-sutureless technique

An elliptical incision is made from end to end of the hematoma to expose it, the cavity is flushed, the ear is firmly taped to expose the incision, the pinna is reflected over a large roll of cast padding and taped in place, and a nonstick dressing bad is applied to the incision and changed according to the need for three weeks. Suturing is not used in this technique.

G- Otitis externa

It is an inflammation of the epithelium of the external ear canal characterized by an increased production of ceruminous and sebaceous material, desquamation of epithelium, and pain.

Etiology

The usual causes of otitis externa are parasitic infestation, bacterial or fungal infection, allergy, trauma, or presence of foreign body.

Signs

Chronic cases can change the size and characters of the external ear canal permanently. The epithelium can be thickened, fibrosed, and ulcerated, and if the epithelium become scarred, the canal undergo stenosis.

Treatment

Medical

The initial treatment is directed toward irrigation and cleaning of the canal with antiseptic and topical antibiotic, antifungal or antiparasitic according to the cause with parenteral injection of antibiotic and using of ceruminolytic agents. Chronic case is better treated by topical Swimmer solution (three parts 70% isopropyl alcohol and one part vinegar) that has cleaning and drying action and changes the pH.

Surgical

1- Lateral vertical ear canal resection

It is performed in order to provide ventilation, and remove moister, humidity, and temperature.

2- Vertical canal ablation

It is indicated when the horizontal ear canal is obliterated with proliferative tissue and the animal didn’t response to resection of the vertical ear canal.

3- Total ear canal ablation

It is used for removal of the entire vertical and horizontal ear canal, and is indicated for treatment of severe ear trauma, neoplasia of the horizontal canal, or persistent otitis externa following the two previously mentioned techniques.

H- Otitis media

It is an inflammation of the mucous membrane of the tympanic cavity as a result of extension of infection from the pharynx through the eustacian tube or from otitis externa after perforation of the tympanic membrane. In the horse it is also caused by infection of the upper respiratory tract and the guttural pouch.

Signs

The head is held to one side, disturbance of the movement, equilibrium, and general condition of the animal. Foul-smell pus comes out from the external ear and soils the hair below it.

Treatment

The condition is usually incurable in the horse, and treatment attempts include irrigation with antiseptic and application of antibiotic.
Diaphragmatic hernia (DH) is defined as the passage of abdominal viscera into the thoracic cavity through a congenital or acquired opening in the diaphragm. Commonly, it is the reticulum which herniates into the thorax, however, the omasum, abomasums, loops of intestine, spleen or liver may also get involved without exhibiting additional specific clinical signs.

**Etiology**

1) Chronic and repeated trauma by foreign bodies.
2) Weakness of diaphragm.
3) Physical forces: Last stage of gestation and parturition.

**Symptoms**

(1) General condition and appearance

The animal with D.H. will show progressive emaciation, weakness, dehydration leading to death. In chronic cases skin is dig with patches where hair has been rubbed off.

(2) Chronic tympany

It is one of the commonest sign seen in animals suffering from DH. The tympany is mild in cases where there is small protrusion of reticulum. However, with more herniation of reticulum the signs becomes severe due to adhesion between reticulum other structure i.e., lungs, pericardium, diaphragm, thoracic wall and hernia ring. Involvement of oesophageal groove lead to the derangement in the normal alignment of the cardia and oesophageal groove and reticulo-omasal opening. The distortion of this groove prevents the eruption of gas and thus result in the distention of rumen. The motility is reduced in majority of cases. Some of affected animals show intermittent constipation or diarrhoea. Undigested feed is occasionally seen in faeces. All the animals show gradually decreased in milk yield.

**Diagnosis**

I. History and symptoms

i. Chronic recurrent tympany occurring
ii. History of advance gestation or recent parturition
iii. The animal usually shows movement with bent and abduction of fore limbs.
iv. Incomplete or complete cessation yield.
v. Intermittent constipation or diarrhoea.
vi. Ruminal ingesta is frothy.

II. Physical examination

i. The rectal temperature is normal with slightly low pulse rate
ii. Auscultation: The cardiac sound is muffled in most of the cases. The reticular sound is heard cranial to 6th rib in the thoracic region.

III. Thoracic puncture

Aspiration of the reticular contents through the 5th and 6th intercostals space reveals ingesta. This procedure is however, involves risk of ingesta into the pleural or mediastinal space leading to further complication.

IV. Radiography

Both plain and contrast radiography is best tool for diagnosis.

V. Exploratory laparotomy/ rumenotomy

**Treatment**

In the first step, rumenotomy is performed routinely under local anaesthesia, approximately 2/3rd of total rumen contents are evacuated. Size and
location of ring in the diaphragm are noted. Foreign bodies, penetrating and non-penetrating, are removed and pH is corrected. Suturing of rumen, muscles and skin is done in routine. A period of 2-3 days is given before herniorrhaphy.

**Anaesthetic management**

Animal is administered about 10 liters of normal saline before surgery; 1-2 liters of dextrose with saline administered intravenously a day before herniorrhaphy is helpful. If herniorrhaphy is performed under general anaesthesia mechanical ventilation of lung is mandatory. Different combination such as chloral hydrate-thiopental, chloral hydrate-diazepam-thiopental are used with oxygen along or with halothane. Continuous drip of saline with lignocain is given throughout the operation.

**Surgical approaches for diaphragmatic herniorrhaphy**

**Abdominal approach**

The operation is performed under general anaesthesia and mechanical ventilation. Animal is secured in dorsal recumbency and abdomen is entered through post-xiphoid crescent shaped incision. Ring is located and reticulum is separated by blunt dissection and is pulles back into the abdomen. Special care is to be exercised in case of a reticular abscess or fibrous nodules as reticulum is likely to get opened. The edges of the ring are cleared and ring is sutured by continuous lock sutures with silk #3. Negative pressure in the thorax is created either by suction or hyperinflation of lung before closing last sutures. Abdominal incision is closed with silk #3 by horizontal sutures mattress and skin is closed similarly. Animal is gently tited in the lateral recumbency. Routine antibiotic, analgesics and B-complex injection are given post operastively. Ventral wound is carefully protected.

**Advantage:** There is direct access to the ring and greater degree of freedom is there while separating and suturing hernia ring.

**Disadvantage:** Excessive stress related to recumbency is said to be a major disadvantage. Other problems related to intra-operative manipulations and wound and its management.

**Thoracic approach**

This is perform under general anaesthesia and mechanical ventilation and in left lateral recumbency the diaphragm is approached from right thoracic side by 6th or 7th rib resection. After skin incision muscles are incised end and later by incising and periosteum on the rib is separated, the rib is first cut at the proximal end and later disarticulate at the costo-chondral junction. Thorax is then entered by incising periosteum and pleura. Reticulum is separated by blunt dissection and pushed back into the abdomen. Ring is sutured and thoracic incision is closed. Negative pressure in the thorax is achived by suction. Routine antibiotic, analgesics and B-complex injection are given post-operatively.

**Advantages:** Recumbancy related cardio-pulmonary stress is less.

**Disadvantages:** Limited exposure and surgeons’work in close vicinity of vital structures e.g., venacava lungs, heart etc. Other complications are related to intra-operative manipulation and wound and its management.

**Other approaches**

Successful diaphragmatic herniorrhaphy through abdominal approaches in cast animals under sedation and local infiltration analgesia have been reported. In this technique the animal is restrained in dorsal or semi-dorsal
recumbency and sedation. Local anaesthesia is infiltrated in the post xiphoid area. Other procedures are same as done for abdominal approach.

**Advantage:** This method may be suitable for field condition where facilities of mechanical ventilation are not available.

**Disadvantage:** Accidental rupture of mediastinum leading to collapse of both the lungs, difficulty in restraint in dorsal recumbency, collapse due to respiratory failure as result of left lung functional disorder particularly in recumbent animals and pain during surgery are the major disadvantages.

**General post-operative management**

Routine antibiotics, analgesics and B-complex injection are given daily. Rumen tonic e.g. Liv-52, yeast tablets etc. To promote rumen microflora are required.

In some cases rumen cud transplantation may be required. *Ad. lib.* Water should be given and common salt may be added to it. Green fodder is provided and to start with 2-3 kg. Twice is given and increased gradually so that full quota is attained in about a month’s time. Wound dressing and wound protection is meticulously followed to avoid post-operative infection.
The external fixator is one of the mainstays of operative fracture treatment. It allows “local damage control” for fractures with severe soft-tissue injuries and can be used for definitive treatment of many fractures as it provides relative stability, which results in healing by callus formation. External fixation is an essential part of damage control surgery in polytrauma as it permits rapid stabilization of fractures with minimal additional (surgical) injury. Deformity correction and bone transport are also possible with external fixation.

Principles of fractures treatment

The ideal objective of fracture treatment is to provide a completely rehabilitated patient as quickly as possible. Successful fracture treatment comprises a perfectly aligned bone of full length that has solidly united joints that are freely movable to their fullest range, and musculature, innervation, and integument surrounding the site of the previous fracture that are completely normal. It is important that the surgeon strive to meet these criteria using all avenues of treatment by means of operative and nonoperative management of the fracture. The objectives to be strived for include the following:

1. Sufficient reconstruction or restoration of normal form to meet the requirements expected of the limb
2. Immobilization of bone fragments until fracture healing has occurred
3. Mobilization of all joints involved during the process of fracture healing to prevent joint stiffness, fracture disease, and muscle atrophy.
4. Rehabilitation of the patient within a reasonable home, allowing the animal to continue at the level of service at which it functioned previous to the injury.

Depending on the fracture, one animal might be treated in a cast or splint, whereas another animal would require open reduction and internal fixation. No hard and fast rules can be given in all cases for a method of optimal treatment. Treatment regimes suggested in this textbook should be evaluated in light of the needs and abilities of the readers to optimally treat their patients.

Methods of management

Fracture management can be classified according to the type of method used to achieve bony union. This classification is given below:

- Closed reduction with external fixation such as a cast or splint
- Open reduction without internal fixation, with reduction maintained in a cast or splint
- External skeletal fixation in which reduction may be either open or closed and immobilization of the bone is maintained through the use of pins, clamps, and sidebars
- Open reduction with internal fixation, such as intramedullary pins or plate and screws
- Closed reduction with internal fixation: rather than making the exposure in the fracture site, an incision is made through the skin allowing introduction of the internal fixation device, for
example, closed intra-medullary pinning or Kuntscher nailing. These modalities of treatment constitute the majority of cases treated in small animal orthopedics.

**Closed reduction**

Closed reduction, usually with external fixation in the form of a cast or splint, can be accomplished in many fractures seen in small animal orthopedics. The technique is used whenever a fracture can be reduced to the point at which the displacement is not more than one half the width of the diaphysis of the broken bone. Axial and rotational alignment should be correct, and the fracture should be inherently stable after reduction so overriding does not occur when the animal is placed in a cast or splint. If these criteria are met, the animal's fracture can be safely treated with external fixation. One additional problem associated with casting and splinting is immobilization of joints above and below the fracture site. Although it has been shown by Sarmiento that it is unnecessary to immobilize the joint above and below the fracture site, it is often advantageous to do so to maintain stability at the fracture site, thus initiating fracture healing. If immobilization of the joint above or below the fracture site will cause limitation of joint movement following fracture healing, other forms of fracture treatment should be considered. The most common fracture treated with closed reduction and cast or splint immobilization in our clinic is that of the radius and ulna, followed with less frequency by the tibia. The humerus and femur are treated with closed reduction and external fixation less commonly. Metacarpal, metatarsal, and other shorter bones can also be immobilized in a cast or splint after reduction.

Contraindications for closed reduction and external fixation are unstable fractures that cannot be reduced or are overriding and have uncorrectable rotational or angular deformities. Closed reduction is also contraindicated for fractures that when immobilized through external fixation in cast or splints may cause joint stiffness or fracture disease.

If closed reduction is planned, it is important that it be done as soon as possible following the injury. Although it is important to ascertain that the dog is in stable condition before anesthesia, it is also important to obtain the closed reduction before there is sufficient swelling and hematoma formation to immobilize the fragments. Muscle spasm resulting in overriding and shortening as well as hematoma formation, which causes swelling, occur quickly following injury.

Faster and more adequate reduction with less soft tissue trauma can often be accomplished if gentle traction is applied first. Fractures of the radius and ulna, for instance, are often treated by suspension of the limb with gentle traction for 10 to 15 minutes prior to closed reduction. This helps stretch the muscles involved without causing the secondary trauma associated with manipulation. Whenever closed reduction is accomplished, the leg should be prepped in a standard fashion as would be done for an open reduction and the closed reduction is carried out in a sterile manner using cap, mask, and gloves. If by chance a closed fracture becomes an open one through manipulation, the risk of contamination and infection is decreased considerably and the wound can then be managed appropriately. The reduction itself is usually accomplished after flexing
the elbow by toggling bone ends together and then reestablishing the axis of the bone with proper rotation. Flexion of the elbow releases some tension of the extensors of the forearm, making reduction easier. All closed reductions should be checked radiographically to ascertain that the criteria described above are met.

**Open reduction without internal fixation**

Occasionally transverse or short oblique fractures occur with sufficient overriding that closed reduction is impossible. These fractures are completely stable once reduced; therefore, an open reduction is accomplished using a bone elevator to reduce the fracture fragment, and no internal fixation is necessary. These fractures are then incorporated in plaster or some cast material and treated as closed fractures after closed reduction. Fractures treated in this manner include midshaft to distal one third radial and ulnar fractures and proximal transverse tibial fractures. By obtaining a perfect reduction, these fractures usually heal rapidly without further interference of the blood supply by an internal fixation device. When performing open reduction without internal fixation, it is important that internal fixation equipment be available should it become necessary at the time of surgery.

Reduction of the fracture itself is accomplished by using an elevator inserted into the medullary cavity of the proximal fragment and then levering the distal fragment into place while removing the elevator. It is important to interdigitate the fracture surfaces perfectly so that they are stable. The surrounding musculature then exerts further axial force against the fracture surfaces to provide stability. The reduction must be adequately maintained while applying the cast or splint. The position used for this procedure maintains firm gentle traction on the extremity during the entire procedure to allow adequate immobility to apply a cast following reduction. The surgical exposure necessary for such fracture reduction is usually minimal and the time interval to accomplish this is often shorter than that of the manipulation required to perform closed reduction of closed fractures; therefore, the risks of infection are extremely low.

**External skeletal fixation**

Transfixation pinning, whether using half pins or full pins, can be accomplished by means of either open or closed reduction techniques. Occasionally in severely comminuted fractures, the proximal and distal fragments are grasped with the transfixation pins to maintain axial alignment, allowing the central comminuted aspect of the fracture to coalesce and heal. In these cases open reduction is usually not carried out, but the end result is satisfactory. Transfixation pinning is also often used with open reduction of open fractures following thorough surgical debridement.

Contraindications for external pin fixation include fractures in which an adequate purchase of the fracture fragment cannot be obtained with the use of the transfixation pin. It is best not to use transfixation pins through areas where a large muscle mass must be penetrated to attach the pin to the bone, since this causes soft tissue necrosis and may lead to more serious pin tract infection.

Complications include pin tract infection, loosening of the fixation, breakage of the clamps where transfixation
pins are connected to sidebars, and bending of pins or sidebars causing deviation of the axis of the bone in question.

**Open reduction and internal fixation**

Open reduction and internal fixation allows the anatomical reduction of fracture fragments with complete control over their immobilization. This excellent reduction and stability encourages rapid union with earlier useful function of the limb. The need for an external splint or cast, which would compromise the function of the joint and lead to muscle atrophy, is eliminated.

Indications for open reduction and internal fixation include fractures that require open reduction because of inability to reduce and/or stabilize the fracture by closed means. Many comminuted or overriding fractures cannot be brought into adequate approximation and alignment by closed methods; therefore these fractures must be treated by open reduction and internal fixation. Most of these fractures are inherently unstable when reduced; hence the internal fixation must be applied after the open reduction. Certain fractures can be treated with closed reduction and internal fixation, but the best functional result is usually achieved with open reduction and internal fixation. The criteria for using one method over another depend on the expected result, the final desired function of the animal, and the skill of the surgeon. Occasionally open reduction and internal fixation is performed with the goal of limiting the convalescent period of rehabilitation. The total time of the surgeon involved with the patient decreases, since it is unnecessary to perform cast or splint changes weekly over a continuing period. This results in faster rehabilitation of the dog and fewer problems for the owner. Fractures associated with arterial laceration and/or nerve trunk enervation are often opened as a result of these complications. Since it is important to immobilize the fracture to prevent re-injury of the trapped nerve or injured blood vessel, internal fixation is accomplished at this time.

In open fractures it is often necessary to debride the bone surgically. Since these fractures are already open, it may be advantageous to provide internal fixation to immobilize the bone, which in turn assists in immobilizing the soft tissues, thus speeding consolidation of the wound as well as the fracture. Certain open fractures should not be treated with internal fixation.

Problems associated with open reduction over and above those associated with closed reduction relate to the risks of infection. Therefore open reduction should not be considered if the soft tissues are incapable of healing. This is not uncommon in badly comminuted fractures in which the vascularity of the soft tissues may be compromised as a result of the explosive nature of the fracture injury itself. Additional contraindications to open reduction with internal fixation are associated with lack of adequate equipment to accomplish the proposed procedure and inadequate training or skill of the surgeon. The equipment available for performing certain internal fixation procedures is not a luxury but a necessity. When contemplating open reduction and internal fixation, the surgeon should have available every instrument necessary to accomplish the proposed task. It is important to have several back-up measures in readiness, supported by adequate equipment, should the proposed procedure fail. Although there are times
when procedures will not proceed as planned, the excuse of inadequate equipment associated with failure of internal fixation only reflects the lack of preparedness of the surgeon.

Open reduction and internal fixation should be carried out as soon as the patient is able to withstand the rigors of anesthesia. It is important that the animal be stable and can be assumed to survive the procedure before attempting open reduction and internal fixation. If the open reduction and internal fixation can be accomplished before a great deal of swelling has occurred, the reduction of the fragments is much easier and the time of surgery reduced. Since the time of surgery is often related to the susceptibility of the patient to infection, this is a significant point to consider. The literature reports that delayed open reduction and internal fixation is associated with a decreased rate of nonunion. This delay of approximately 10 days probably allows the soft tissues to revascularize, resulting in healthier tissue at the time of surgical interference. The problem associated with this delay is that the reduction itself can be difficult to accomplish. The slight advantage of decreased rates of nonunion associated with experimental animals therefore becomes of secondary importance when treating clinical patients. It is important, however, not to perform open reduction and internal fixation at the height of the edema phase, since closure of the wound may be jeopardized by suture line tension, resulting in tissue necrosis and wound breakdown with impending infection of both soft tissue and bone.
Critical Care and Management

J. S. Patel, Joice P. Joseph, Amit Prasad, Bhavika R Patel
Department of Medicine, College of Veterinary Science & Animal Husbandry, Junagadh Agricultural University, Junagadh-362001

Critical care medicine is a rapidly growing field of Veterinary small animal medicine in the developing countries in the recent past. Critical care unit is a vital component of Veterinary teaching hospital in treating emergency and critically ill patients. The veterinarian working in critical care unit should have a thorough knowledge on the art of triage and initial stabilization the patient, recognize the disease conditions, differential diagnosis and treating the case in a rapid manner in order to save the life of the animal presented with poor physiological reserves. Small animal critical care practice also need skills on the emergency procedures and use of critical care facilities. This paper will discuss the triage, critical care facilities and important emergency conditions in small animal practice.

Triage:
Triage, a French word trier, means to sort. It is a method of quickly identifying animals who have immediately life threatening injuries/conditions and who have the best chance of surviving. Triage includes prehospital and hospital triaging the patients.

Pre hospital triage:
1. Call for help.
2. Alert oncoming traffic.
3. Moving the animal to safe location
4. Is there patent airway? – Extend head and neck; wipe mucus, blood or vomitus from the mouth. In unconscious animal, maintain head and neck stability.
5. If no evidence of breathing or gum colour is blue, begin mouth to nose breathing 15-20/min.
6. If no sign of cardiac function, begin external cardiac compression 80-120/min.
7. If any haemorrhage, apply firm pressure using a clean cloth, towel, paper towel, feminine hygiene product etc. Cover any external wounds using a bandage material soaked in warm water.
8. If any obvious fracture, immobilize the area with home made splints.
9. If burns, place wet cool towels over the burned area. Remove and replace as the compress warms to body temperature
10. In shivering or in shock, wrap to conserve heat
11. In heat stroke, cool the animal with room temperature wet towel (not cold) and transport to clinic.

Hospital Triage: Involves five steps
Step 1: Recognition of life threatening Disease
Step 2: Be prepared
Step 3: Establish a triage classification system
Step 4: Arrival at the Veterinary Clinic
Step 5: Patient stabilization

Step 1: Recognition of life threatening Disease
• Goal should be to select and triage the patients that have serious traumatic injury / acute illness.
• Without recognition of life threatening processes and their potential sequela, one can’t effectively triage patients, which will inevitably result in increasing morbidity and mortality.
• Typically, life threatening conditions are associated with cardiac, pulmonary and neurological disorders, environmental injuries and intra abdominal disorders.

Step 2: Be prepared
1. Education:
- Tutorials and conference education
- Practical training sessions on basic and advance life support techniques: endotracheal intubation, positive pressure ventilation, intravenous catheter placement, IV fluid set up, ECG set up and preparing equipment for centesis.

2. Emergency ready area
- Locate in a central area
- Equipments should be readily accessible including an oxygen supply, endotracheal tubes, anesthetic equipment, Ambu-bag, IV catheters, IV fluid pumps, needles, syringes, equipments for centesis, emergency drugs and good light source.
- Clear labeling
- Stock levels to be checked after each use or on weekly base

3. In house laboratory, Team approach
4. SOP (Standard Operating Procedures) – aid in ensuring important diagnostic and treatment steps are not over looked.

Step 3: Establish a triage classification system
- Based on the urgency of needed treatment
- Can change rapidly during first four hours of admission
- If there is concern regarding a patient, place in more serious class
- Ensure all staff is aware of your triage system

Class I:
Most seriously ill, should receive treatment with seconds. These include
- Traumatic respiratory failure
- Cardiopulmonary arrest or airway obstructions
- All unconscious animals

Class II:
Very seriously ill, critical patients. Require treatment within minutes (up to 1 hr following the onset of severe symptoms).
- Multiple injuries, GI torsions ,Burn victims, Penetrating wounds
- Shock or bleeding but has adequate airway and ventilatory functions

Class III:
Require definitive management within a few hours
- No shock ,Minor trauma
- Ventilatory and cardiovascular function present ,Superficial wounds

Class IV:
Less serious
- Non trauma related
- Vomiting, diarrhea or lameness

Step 4: Arrival at the veterinary clinic:
Receptionist to be trained to recognize life threatening conditions
- Emotional support of the client
- Continual update of the client
- Evaluate with in 1 minute of arrival at the clinic

Primary survey:
Initial evaluations-ABCDE and it should be completed in 30 – 60 sec

A – AIRWAY
- Patency of airway and adequacy of ventilation should be assessed.
- Respiratory noises – High pitched stridor/sonorous, wheezes suggestive of partial airway obstruction or bronchial constriction respectively.
- Commissures of mouth – move with inhalation / exhalation?
- Exaggerated ventilatory effort (open mouth breathing, flaring of nostrils)
- Expiratory distress with an abdominal push on exhalation
- Posture – Orthopnea (head extended & elbow abducted)
- Paradoxical chest wall movement (flail chest)
- Auscultate thorax bilaterally – crackles, muffled, inspiratory wheezes
- Colour of mucous membrane – Pink, Pale, cyanotic.

B=BREATHING
- Breathing?
Eupnea- Normal ventilatory nature and rate. Tidal volume should be 10-20ml/min, rate (8-20/min)
Tachypnea-hypoxia, hypercapnea, hyperthermia, pain and metabolic acidosis
Bradypnea & Apnea-Intracranial space occupying lesions, drug induced, hypo or severe hyper capnea and medullary respiratory centre dysfunction.
• Auscultation for breathing sounds – absent or diminished breath sounds suggestive of pleural filling problem
• Assess chest wall integrity – crepitus indicate s/c emphysema
• Look for blood or secretions from mouth or nares
• Observe for gag or swallow reflexes
• Breathing patterns
  ➢ Rapid and shallow, deep and slow with respiratory stress
  ➢ Apnea shows medullary dysfunction
  ➢ Cheyne stokes breathing is characterized by cyclic hypoventilation and is attributed to greater than normal delays in the medullary response to changing carbon dioxide levels
  ➢ Biot’s breathing is characterized by cyclic hyperventilation and apnea and is a sign of serious medullary disturbance.
  ➢ Apneustic breathing may be associated with brain stem disease.

Rhythm: Common arrhythmias: PAC, PVC, atrial fibrillation & Ventricular tachycardia. All pulse abnormalities should be confirmed by ECG.
• CRT? It is an indication of peripheral perfusion. Normal 1-2 minue. Prolonged CRT is due to vasoconstriction (caused by hypovolemia, excitement, ear and pain).

D=Disability
Levels of consciousness (LOC)
1. Obtunded: State of decreased responsiveness
   Less responsive to visual/tactile stimuli, quiet/dull. This may arise from a variety of complications and illnesses.
2. Stupor: Can be aroused only with painful stimuli. Is a sign of severe neurologic or metabolic derangement.
3. Coma, Can not be aroused with any stimuli.
   Coma and seizures are signs of abnormal cerebral electrical activity from primary neurologic disease or secondary to metabolic derangements such as hepatic encephalopathy

Motor activity
1. Ambulatory Vs nonambulatory
2. Ataxia, hemiparesis, tetraparesis or hemiplegia
3. Decerebrate posture
   • Opisthotonous with extensor rigidity of all 4 limbs
   • Mentation is stuporous to comatous. Indicates lesion on the rostral pons and midbrain

Pupillary abnormalities
1. Unilateral mydriatic, unresponsive pupil loss of parasympathetic innervations to the eye. Can indicate increased intra cranial pressure. R/O topical ophthalmic atropine or tropicamide.
2. Bilateral miosis- May precede bilateral mydriatic unresponsive
pupils. Can be seen with diffuse metabolic encephalopathies or diffuse mid brain compression with increased intracranial pressure
3. Bilateral mydriatic, unresponsive pupils: Fixed and dilated pupils. Severe bilateral compression or destruction of the midbrain or cranial nerve III. Typically from bilateral cerebral herniation.

E=Rapid whole body examination
Perform a rapid whole body exam looking for wounds, lacerations, punctures, bruises, fractures, abdominal pain/distension and any other signs of debilitation.
Secondary survey
A CRASH PLAN
A=Airway
C & R = Cardiovascular & Respiratory
A= Abdomen
Palpate for pain
Any penetrating wound
Reddening around umbilicus suggest intraabdominal hage
Fluid wave? Mass? Examine inguinal, caudal thoracic and paralumbar regions
Clip the fur and look for bruises or penetrating wounds
Auscultate for borborygmis
H=Head
Eyes: Examine for ulcers with fluorescent dye, aniscoria? Horner's syndrome?
Examine ear, mouth, teeth and nose,All cranial nerves
P=Pelvis
Examine perineum, rectum, genitalia-
Perform rectal examinations,Examine for fracture, hemorrhage.
L=Limbs: Any open or closed fracture?
Quickly splint to prevent further damage and help to control pain.
A=Arteries
Examine pulse, B.P. Blood pressure is a prodascular capacity and blood volume. Tuct of cardiac output, These 3 parameters are in a careful balance.
Normals are
Systolic 100-120 mmHg,Diastolic 50-100 mmHg,Mean 70-120 mm Hg
(Systolic BP + 2(Diastolic BP)/3)
Hypotension (<80 systolic BP ; <60 mean BP): Vasodilation, hypovolemia, arrhythmia, anesthetic drugs.
N=Nerves
Consciousness (normal, obtunded, stuporous and coma)

Ancillary diagnostic evaluations
Haemodynamic techniques
ECG, BP, Pulse oximetry
Imaging techniques:
X ray of thorax and abdomen to rule pneumothorax, pulmonary contusion, diaphragmatic hernia, pleural or abdominal effusion or pneumoperitoneum.
Laboratory evaluations:
To evaluate PCV, Total solids, ity, CBC, BUN, Urine specific gravity, CBC, Peripheral blood smear for platelet count, morphology of RBC and WBC, Arterial blood and electrolytes, Coagulation parameters (ACT, PT, APTT), Serum biochemistry profile and Urinalysis.

Invasive testing
- Thoraco centesis,Abdominocentesis,Diagnostic peritoneal lavage

Step 5: Patient stabilization
- Repeated evaluation of the patient is an essential component of emergency medicine
- Concentrate on the respiratory, circulatory and neurological symptoms
- Complete physical examination

The rapidly decompensating patient
Animals that do not respond to initial resuscitation usually have severe ongoing or preexisting physiological disturbances that contribute to continued instability.
The most frequently seen clinical problems associated with decompensating patients are:

- Internal hemorrhage, Pneumothorax
- Coagulopathies-disseminated intra vascular coagulation (DIC)
- Bowel and gastric rupture-central nervous system edema and hemorrhage
- Sepsis or septic shock – fever, pain, hypovolemia, abnormal patterns of ventilation, abnormal levels of consciousness, tachycardia, tachypnea and lowered blood glucose levels
- Rupture of the urinary bladder, Oliguria and Acute renal failure.

**Cardiopulmonary resuscitation**
Set of the procedures designed to increase oxygen delivery to the heart and the brain during cardiac arrest.

Ultimate goals of CPR are

- To restore spontaneous, effective cardiac and respiratory efforts
- Once agonal breathing or LOC is identified
- First step is to intubate, Intilation of breathing
- Confirmation of cardiac arrest, efforts at cardiac compression

**Closed chest CPR**

- Right lateral recumency to facilitate venous return to the heart
- In small dogs compression of the heart – 70-90 compressions /min
- In small breed dogs more effective cardiac compressions can be achieved using one hand on either side of thorax
- In large breed dogs both hands are placed higher on the chest wall and the chest and the chest and heart are compressed between the table and the hands.
- Interposed abdominal compressions are an adjunctive CPR procedure

- In cats the heart can be stabilized and compressed using single hand with the thumb on one side and three fingers on the other side of the chest
- Successful CPR – femoral or lingual arterial pulses.

If pulse are not identified

- CPR efforts should be evaluated and adjusted
- Administration of epinephrine and or vasopressin,
- Administration of crystalloid or colloids
- Open chest CPR for manual cardiac compression

**Most commonly used drugs**

**Atropine:**
Dose: 0.04 mg/kg IV or intratracheal. Can repeat q3-5 mins x 3 doses
Indication: Slow heart rate or no heart rate (vagolytic)

**Epinephrine 1: 1000**
Low dose: 0.01 mg/kg IV. Can repeat q 3-5 mins: If no effect increase dose or use vasopressin
High dose: 0.1 mg/kg IV. Intratracheal dose: 0.03-0.1 mg/kg IV
Indication: Asystole/no heart rate: Increases copronory and cerebral perfusion (alph2agonism.)

**Lidocaine** 20 mg/ml: Dose: 2 mg/kg. Indication: Ventricular premature contractions.

**Less commonly used**

- Sodium bicarbonate 1 mEq/ml: Dose: 1mEq/k Indication: Severe metabolic acidosis
- Calcium gluconate 10%: 100 mg/ml: Dose 50 mg /kg (0.5-1.5 ml/kg) Slow bolus Indication:Hyper kalema (ie blocked cat, Addison’s disease), low calcium (ie. Eclampsia, calcium channel blocker toxicity)
- Magnesium 4 mEq/ml Dose: 0.2 mEq/kg slowly over 10 minutes
Indications: Refractory ventricular arrhythmias, prolonged CPR
  • Vasopressin 20 units/ml. Dose 02 U-0.8U/kg (IT: 0.4-1.2U/kg)
Indications: Ventricular fibrillation after defibrillation, atrial fibrillation, Ventricular tachycardia
  • Naloxone 0.4mg/ml: Dose 0.04mg/kg
Indications: Overdose of opioid, reversal of opioid medications.

Conclusions

1. Sound understanding of life threatening conditions
2. Astute observation of the patient
3. Good support staff: Knowledgeable, work well under condition of stress
4. Well organized treatment
5. Well defined set of guidelines for identification and management of emergency patients
6. Constant reevaluation of patients
7. Team work

<table>
<thead>
<tr>
<th>MM Colour</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pink</td>
<td>Normal</td>
</tr>
<tr>
<td>Yellow</td>
<td>Liver disease</td>
</tr>
<tr>
<td>Pale/ White</td>
<td>Blood loss, anemia or shock</td>
</tr>
<tr>
<td>Brick red / Injected</td>
<td>Sepsis, polycythemia, hyperthermia</td>
</tr>
<tr>
<td>Grey</td>
<td>Due to stagnation of blood</td>
</tr>
<tr>
<td>Blue (cyanosis)</td>
<td>Hypoxia, methemoglobinemia and peripheral stagnation of blood due to shock. In anemia, cyanosis may not be seen. For cyanosis to occur 5 g% unoxygenated hemoglobin must be present.</td>
</tr>
</tbody>
</table>
Use of X-Ray for the Diagnosis in Small Animal

A M Patel, H M Padheriya, P B Patel
Department of Surgery & Radiology, College of Veterinary Science & Animal Husbandry, Junagadh Agricultural University, Junagadh-362001

X-rays were discovered by Wilhelm Roentgen in 1895. They are electromagnetic energy waves that are far more energetic than light rays. X-rays are most commonly used for medical diagnosis, but also for cancer treatment. The heart of an X-ray machine is a vacuum-sealed glass cylinder containing a pair of electrodes. When electricity is sent through the tube, X-rays are released at the positive electrode. The high-energy rays pass through soft body tissue, but get absorbed by dense material such as bone. This creates ‘shadows’ that can be captured with photographic or fluoroscopic techniques.

An x-ray (radiograph) is a noninvasive medical test that helps physicians diagnose and treat medical conditions. Imaging with x-rays involves exposing a part of the body to a small dose of ionizing radiation to produce pictures of the inside of the body. X-rays are the oldest and most frequently used form of medical imaging. X-Ray imaging is used for diagnosing various medical problems in bones, chest, upper and lower gastrointestinal tract, contrast studies and a myriad of fluoroscopic studies. For example, a radiograph can determine broken bones, joint dislocation, fracture, infection, arthritis, bone cancer and locate foreign objects in soft tissue.

Physicians use the examination to help diagnose or monitor treatment for conditions such as: pneumonia, heart failure, emphysema, lung cancer or other medical conditions. Routine Radiography, Tomography, Barium Studies (upper and lower GI tract), Contrast studies (IVP, Hysterosalpingogram, Arthrograms, Cholangiogram) are carried out for various disease diagnosis.

When X-ray is used
Bone is a very hard and dense tissue that shows up clearly on X-rays. X-rays are therefore very useful for diagnosing bone-related problems. X-rays can be used to help identify:

- Fractures and breaks
- Problems with teeth, such as tooth decay
- Thinning and weakening of the bones (osteoporosis).
- Bone infection (osteomyelitis).
- An abnormal curvature of the spine (scoliosis).
- Bone cancers, such as osteosarcoma.

X-rays are also sometimes used during investigative or therapeutic procedures to help the surgeon guide equipment to the area being examined or treated. For example, X-rays are often used during a coronary angioplasty, where a catheter (a long, thin, flexible tube) is inserted into a blood vessel either in your groin or arm. X-rays are used to guide the tip of the catheter to the heart or the arteries that supply to heart. A special fluid that shows up clearly on X-rays (contrast medium) is injected through the catheter. The images that are produced (angiograms) are able to highlight whether a blood vessel is blocked.

Diagnostic use of X-ray
Diagnostic uses of radiation can be considered according to the type of detector used as well as according to whether the source of the radiation is outside or within the patient's body. The former case, "passive" investigation, is typified by conventional X-ray imaging: the physical basis of the information is the transmission (or in some cases the scattering) of radiation as it passes through the body. Distinctions among tissues are often enhanced by injection or ingestion of materials that are substantially more or less likely to scatter or transmit the radiation than the tissues themselves (e.g., Barium...
enemas, air bubbles). "Active" investigations are typified by the "gamma camera" and "PET" scanner: a radioactive biochemical is introduced into the body and the radiation is detected by position- or direction-sensitive means, so that the site within the body can be established. Like the enhanced contrast studies alluded to above, such studies may be either dynamic (following the initial bolus through the patient's circulatory or digestive systems) or equilibrium (after thorough mixing, which may take minutes, hours, or days, depending on the system involved).

1. Film X-rays

In medical diagnostic applications the radiation source is typically an X-ray machine operating with an accelerating potential between 50 and 150 kV. There are two basic types of X-ray film for diagnostic or research uses: "screen" and "no screen."

2. Fluoroscopy

If the radiation is displayed visibly at the same time it is detected, the clinician can observe dynamic processes, such as the beating heart or a probe moving through a cardiac artery or vein. The material was chosen on the basis of visible light emission upon bombardment with X-rays, a special case of fluorescence, which generally refers to the emission of longer-wavelength electromagnetic radiation upon bombardment by shorter-wavelength radiation. Direct X-ray fluoroscopy has two major problems: first, the detection is not very efficient, so that a larger dose of radiation to the patient is required. Second, there is often a great deal of scattered radiation or radiation.

3. Gamma Cameras

Gamma cameras provide images based on the straight-line propagation of gamma radiation. Labeled biochemicals are administered to the patient, either by mouth or injection, and the radiation examined by a detector that includes a great many individually reporting sensitive regions, each exposed only through collimators that prevent radiation from reaching it unless the source is along a particular line. The set of all such lines covers an area on the patient's body, and the radiation as a function of position provides information comparable to that of a conventional X-ray, except that the signal depends on the local concentration of the labeled biochemical, so it can be relevant to particular metabolic or circulatory processes.

4. Scanners

Although the physical principles underlying their operation are not the same, CAT, PET, and NMR (or MRI) scanners have much in common: they provide an image, typically of a cross-section through the patient's body, limb, or head, presented either on a video display or on film made from a video display, based on computation from a multitude of measurements, of the same property, made for successive, adjacent or overlapping, segments of the patient's body. Usually the varying quantitative results will be displayed as a range of colors (a "false color image"). Computed Axial Tomography was the first of these techniques to be widely used. The "axial" refers to the fact that the segments measured all pass through the same axis, in different directions. In the CAT scanner, the measurement made is of X-ray transmission along these "diameters" through the patient. The information presented is a picture of a cross-section through that part of the patient, typically showing X-ray transparency levels by different colors or by shades of gray.

Positron Emission Tomography, a more recent innovation, may be viewed as an exotic sort of Gamma Camera. A radioactive material that emits low-energy positive beta rays is introduced into the patient's body. The decay positrons travel a modest distance through the tissues in a random direction before coming to rest, where they annihilate with electrons from the atoms present there. The annihilation photons are of an energy that is highly penetrating, so much of the dose to the patient will come from the initial kinetic energy of the positron and from any X-rays.
emitted as the atomic electrons rearrange themselves following the nuclear transformation.

Nuclear Magnetic Resonance scanners are the most recent of these devices. Unlike the CAT and PET scanners, they are truly non-invasive, since they subject the patient to no ionizing radiation. Because some people recoil at the mention of the word "nuclear," they are now being called "Magnetic Resonance Imaging" (or "MRI") scanners, but the physics is the same benign thing. Another of their major advantages clinically, besides being non-invasive, is that they produce images based on different chemical conditions, so the combination of PET scan or gamma camera images with MRI scans may permit a much more confident diagnosis and treatment planning than would be possible based on any one technique alone.

Contrast medium

Contrast medium is liquid that contains dye. It is sometimes swallowed or injected before an X-ray is taken and shows up clearly in white, helping to distinguish between different structures in the body. Contrast medium is usually harmless and passes out of the body in your urine. However, in rare cases it can cause an allergic reaction.

Contrast radiography for different parts of body

1. Dacrocystorhinography

Dacrocystorhinography is the contrast radiographic study of the nasolacrimal duct. This is indicated in cases suspected of partial or complete obstruction, atresia, inflammation, deviation or distortion of the nasolacrimal duct. Quick radiographic exposures are required if water soluble agents are used because of their rapid drainage.

2. Sialography

Contrast radiographic study of the salivary glands and duct is called Sialography. In ruminants main indications are:
i) To diagnose space occupying lesions of parotid gland,
ii) To locate the site of obstruction in the stenson’s duct,
iii) To locate the site of leakage of saliva in cases of sialocele.

3. Bronchography

Bronchography is the radiographic visualization of the bronchial tree after infusing oily contrast media into the airways. Bronchography should be done cautiously in patients with cardiopulmonary diseases. Only one lung should be investigated at a time.

4. Barium Swallow (Oesophagography)

The technique is used to evaluate both structural and functional status of oesophagus after introduction of a positive contrast media. Oesophagography is indicated to diagnose case of oesophageal obstruction, stenosis, diverticulum and mucosal diseases.

5. Reticulography

This technique is usually indicated to diagnose cases of reticular hernia in buffaloes and cattle by feeding barium sulphate suspension to the animal.

6. Barium series

The technique is used to examine radiographically the gastro intestinal tract. It is routinely used in small animals but is of limited value in large ruminants. The procedure is indicated to evaluate structural and functional status of gastrointestinal tract. The technique should be avoided if rupture of the stomach or intestines is suspected.

7. Peritoneography

It is radiographic study of the peritoneal cavity and its contents after introduction of negative contrast agent (pneumoperitoneography) or a combination of a negative and a positive contrast agent (double contrast peritoneography). The technique is indicated to visualize outlines of various abdominal organs and to locate a
suspected abdominal mass. It should not be used if diaphragmatic hernia is suspected because of risk of pneumothorax.

8. **Renal angiography**

The technique is used to visualize renal vascular architecture and also helps to assess renal cortex to medulla ratio.

9. **Myelography**

The technique refers to the contrast radiographic examination of the spinal cord and emerging spinal roots after injecting the contrast material into the subarchnoid space. It is indicated to diagnose intervertebral disc protrusion, intraspinal lesions, vertebral canal haemorrhage and spinal cord oedema. It should not be used in cases of meningitis, myelitis and myelomalacia.

10. **Arteriography**

It refers to the contrast radiographic examination of arterial system of an area. It is indicated to study the arterial pattern in normal subjects and also to diagnose arterial occlusion.

11. **Fasciagraphy**

It is a contrast radiographic study of tendons and associated structures. The technique can be used to diagnose adhesion, calcification and rupture of tendons and muscle.

12. **Intravenous Pyelography (Excretory Urography)**

Intravenous xylography (IVP) refers to contrast radiographic examination of the kidneys and ureters after introduction of positive contrast medium. Apart from being an aid to diagnose abnormalities of urinary tract, the technique also serves as a rough index to kidney function. It should never be used in severely dehydrated patients because of risk of fatal anuria.

13. **Urethrogram**

The technique is indicated to diagnose abnormalities of urethra in male such as urethral obstruction, stenosis and fistula.

14. **Cystography**

It refers to the contrast radiographic examination of urinary bladder and is indicated to diagnose structural abnormalities and diseases of bladder such as cystoliths, carcinomas and rupture of bladder.

15. **Angiography**

Angiography is a type of X-ray used to examine blood vessels. The images created during angiography are called angiograms. As blood vessels do not show up clearly on ordinary X-rays, contrast medium is injected into the area being examined.
A contrast medium is a either highly radiolucent or highly radiopaque substance, which is administrated to a patient to increase radiographic contrast within an organ or system. Contrast radiography is a special radiographic procedure using contrast media. Contrast studies are used to supplement or confirm information gained from routine survey radiographs.

Classification
There are two categories of contrast media:

a) **Positive contrast media**
   (Elements of high atomic number)
   - Barium sulphate preparation
   - Water soluble iodine preparation
   - Viscous and oily preparation
   - Preparations excreted through biliary system (cholycystopaques)

b) **Negative contrast media**
   (Agents with low specific gravity)

Indication
It is used in certain cases to delineate internal structure, which allows the visualization of soft tissue structures and evolution of size, shape and position. It is also possible to assess the physiological condition.

Contrast techniques
**Barium series:** gastrointestinal tract is studied in this technique. Contrast study may be positive, negative or double contrast.

**Positive contrast study:** barium or water soluble iodine preparation may be used. Micro pulverized barium suspension @ 2-5 ml/kg body wt. is administrated slowly into the buccal pouch. Stomach tube may also be used administer the contrast agents directly into the stomach.

**Double contrast study**
Here either air through a stomach tube or a carbonated beverage (50 – 60 ml) may be given before or, after the use of barium. Water soluble iodine compound @ 7 ml/kg body weight by using stomach tube (as these agents are very bitter test) should be used when perforation of the oesophagus, stomach or intestine is suspected. As the stomach usually contains some gas or swelled air, virtually all contrast studied are double contrast studies. Double contrast studies are particularly valuable in studying the gastric mucosa.

**Negative contrast study**
Room air is given by a stomach tube @ 6 to 12 ml/ kg body weight, or a carbonated beverage (30 to 60 ml) may be given. Negative contrast study is useful to located radiolucent foreign body.

**Barium enema**
Barium enema is used to outline the colon and rectum in suspected cases of intra-luminal or extra-luminal obstructions. This technique is not indicated if perforation is suspected. Ten to 24 hours fasting prior to this procedure is advisable. Laxative is needed to be administered 12 hrs. Before the study. Warm soap water enema is administered about 2hrs before. Deep sedation or general anaesthesia is desirable to eliminate straining Barium suspension of about 15 to 20%(W/V) concentration @20 to 30ml/kg body weight is administered slowly through a cuffed rectal catheter by gravity flow from a large contain or by using syringe.
**Oesophagography**

It is contrast radiographic study of oesophagus. This technique is used to evaluate both structural and functional status of the oesophagus. Oesophagography is useful to diagnose oesophageal obstruction, stenosis, diverticulum and mucosal diseases. Barium sulphate suspension (micro pulverized barium sulphate suspension) is usually use contrast agent.

A barium paste is useful to study the mucosa of oesophagus since it adheres better to the oesophageal folds. If rupture of the oesophagus is suspected, it is preferable to use water soluble contrast agent instead of barium. Dose of barium suspension is 5 ml/kg body wt. through the buccal pouch. Radiographs are taken as soon as the last of the barium is being swallowed. If the oesophagus is grossly dilated, additional amounts of barium will be required to outline its lumen fully. Normally, longitudinal folds of the mucous membrane is observed in dog while in cat, longitudinal folds in the proximal ¾ of the oesophagus and the distal ¼th has oblique mucosal folds, giving a herringbone pattern.

**Gastrography**

Reveals stomach rugae with barium contrast studies of stomach. Barium meal study of descending duodenum shows lymphatic craters on the anti-mesenteric border of the duodenum, visualized as depression, which may be mistaken for ulcers, and it is called as pseudo-ulcers.

**Dacrocystorhinography**

It’s study of nasolacrimal ducts where contrast agents are administered into the ducts by means of cannula inserted into the superior puncta lacrimata. Radiographs are taken in quick succession just after administration of contrast agents. The procedure is indicated in cases of suspected partial or complete obstruction, atresia, inflammation, deviation or distortion of the nasolacrimal duct.

**Sialography**

Contrast radiographic study of the salivary glands and ducts is called sialography. It’s performed to locate the site of obstruction in the stenson’s duct and leakage of saliva in cases of sialocele. Sialograph is also done to diagnose space-occupying lesions of the parotid gland.

Under sedation and local anaesthesia, salivary ducts through its opening in the oral cavity is exteriorized, cannulated and 0.1 to 0.3 ml of oily material or upto 2 ml of aqueous contrast medium is administered into the salivary duct.

**Bronchography**

It’s the contrast radiography of the bronchial tree. The patient is anaesthetized and intubated. The contrast material is then administered by means of a catheter through the endotracheal tube. The catheter is placed at the point just cranial to its bifurcation and the contrast agent is deposited. One lung is studied at a time. The lung to be radiographed is positioned in lateral recumbancy so that gravity carries the contrast materials i.e. for Bronchography of left lung, left lateral recumbancy is the correct positioning. Selective bronchography can be done under fluoroscopic control. Two ml of contrast agents are adequate for each lung. A 50 to 60 % w/v 1 ml per bronchus has been recommended. Bronchography should be done cautiously in patients with cardiopulmonary disease.

**Angiocardiography**

A cannula is inserted into the external jugular vein and contrast medium is administered in a bolus form and the radiograph is taken.

**Myelography**

Flex the lead ventrally and palpate the wings of the atlas, spine of the axis, and occipital protuberance. Draw a line between the wings and a line from the occipital
protuberance to the spine of axis. Placed the needle on midline ½ inch in front of the line between the wings. Go roughly parallel to the caudal wall of the skull and feel for the “pop” of resistance as the needle passes through the dorsal atlanto-occipital ligament. Stop when through the ligament. Positive contrast medium (non-ionic and of low osmolarity) is injected into the spinal subarachnoid space and radiograph is taken at different time interval. The subarachnoid space becomes visible as two white lines are separated by a space (spinal cord). Normal radiograph shows smooth contrast lines. Two bulging site one at cervical and another at lumber area are normal due to brachial plexus and lumber intumescence.

Any deviations in the contrast lines, therefore in the cord is to be looked. Discontinuity or thinning in the pushed inward could be due to a mass outside the meninges (herniation of disc). Contrast medium is heavier than CSF, so gravity can be used to move it up or down the subarachnoid space.

**Contraindication**

Barium sulphate, if take into the thoracic or abdominal cavities, may cause granulomatous response as it not absorbed or eliminated. Therefore, it should not be used if there is any possibility of perforation of the gastrointestinal tract.
Management of Intestinal Obstruction in Small Animals

Vineet Kumar and S H Talekar
Department of Surgery & Radiology, College of Veterinary Science & Animal Husbandry, Junagadh Agricultural University, Junagadh-362001

Intussusception, foreign bodies, torsion, incarceration, volvulus, and neoplasia are the possible causes of the intestinal obstruction in dogs and cats. Intussusception is defined as invagination of one segment of intestine (intussusceptum) into the lumen of an immediately adjoining segment (intussucipiens) and has been reported in both humans and animals. It is most commonly occurring at the ileoceccolic junction in dogs where invagination is usually in the normal direction of peristalsis. Although, majority of intestinal intussusceptions reported in dogs are idiopathic in nature, many conditions reportedly predispose dogs to their formation, including intestinal parasitism, viral enteritis, intestinal foreign bodies, and intraluminal and extraluminal mass lesions.

Diagnosis

History and clinical signs

Seventy-five percent of dogs diagnosed with intestinal intussusceptions are younger than 1 year of age. German shepherds dogs and Siamese cats may be predisposed to intestinal intussusception.

The most common presenting clinical signs in dogs with intestinal intussusceptions are vomiting, diarrhea with hematochezia or melena, anorexia, and weight loss. Other reported clinical signs include dehydration, abdominal pain, tenesmus, and rectal prolapse. A palpable abdominal mass was present in 50% to 70% of dogs with intussusception, most frequently in the cranial abdomen. The clinical signs of intestinal intussusception may be acute or chronic in nature. The reported duration of signs from onset to presentation ranges from 1 to 90 days. The nature, severity, and duration of clinical signs are related to the location of the intussusception within the intestinal tract. The most severe clinical signs, including vomiting and electrolyte imbalance, are more likely to occur with intussusceptions that are in the proximal intestinal tract (i.e., enterointeretic). Other factors, such as the degree of intestinal obstruction, the amount of compromised intestine involved in the intussusceptum, and the presence and severity of peritonitis, may contribute to both the severity and duration of clinical signs prior to presentation.

Physical examination

Physical examination in dogs with intestinal intussusceptions may reveal a palpable cranial abdominal mass. In some cases, the intussusceptum may protrude from the anus, in which case the intussusceptum must be differentiated from a rectal prolapse. This is accomplished by attempting to pass a blunt, lubricated probe between the rectal wall and the prolapsed tissue. In the case of a small-intestinal or colonic intussusception, the probe can be passed to a level cranial to the pubis; however, the probe cannot be advanced when a rectal prolapse is present.
Imaging

Abdominal radiographs in dogs with intussusceptions commonly reveal fluid- or gas-distended bowels, consistent with mechanical intestinal obstruction. A soft-tissue opacity mass may be identified on survey radiographs, but a definitive diagnosis of intussusception is difficult without contrast radiography or ultrasonography. In some cases, there is sufficient gas accumulation within the affected bowel to outline the intussusceptum on plain radiographs. Contrast radiography using either an upper gastrointestinal study or a barium enema may increase the likelihood of diagnosing intussusceptions. The most appropriate contrast radiographic study to perform depends on the type of intussusception suspected. Enterocolic, cecocolic, or colocolic intussusceptions are best identified with a barium enema, while intussusceptions in a more orad location (i.e., enterenteric) are best identified by an upper GI study or ultrasound. Contrast media may outline the intussusceptum within the lumen of the intussuscipiens of an enterocolic intussusception following a barium enema, or a ribbon of contrast media may be present within the intussusceptum of an enterocolic, a cecocolic, or an ileocolic intussusception following an upper GI contrast study. Factors influencing the success of positive contrast studies include location of the intussusception, completeness of the obstruction, and the presence of significant intestinal ileus.

Abdominal ultrasonography has also been shown to be a reliable diagnostic tool for diagnosis of intestinal intussusceptions in dogs. The characteristic ultrasonographic appearance of an intestinal intussusception is a series of concentric rings in the transverse plane, frequently described as a “target sign” or “bullseye lesion,” and multiple parallel lines in the longitudinal plane. These findings correlate with the different layers of intestinal wall of the intussusceptum and intussuscipiens present within the intussusception.

Treatment and Prevention

Before surgical intervention, the patient’s hemodynamic and electrolyte status must be stabilized. Definitive treatment of intestinal intussusception must include reduction of the intussusceptum from the intussuscipiens and reestablishment of a patent GI tract. In dogs, this requires exploratory celiotomy and either manual reduction of the intussusception or resection of the intussusception with anastomosis of the remaining intestine. Manual reduction of the intussusception should be attempted by gentle “milking” of the intussusceptum from within the intussuscipiens. This technique should employ more pressure on the intussuscipiens in an effort to reduce the intussusceptum by pushing it out rather than using traction on the intussusceptum. Care must be taken to avoid tearing the serosa. Serosal adhesions, vascular compromise, or the presence of intestinal perforation prohibited manual reduction and necessitated resection and anastomosis in dogs.

The recurrence rate of intestinal intussusception after surgical intervention in dogs reportedly ranges from 3% to 25%. Recurrence of the disease process in both dogs and humans usually occurs in an anatomic location other than the original site. The recurrence is frequently in a location orad to the original
intussusception and is reported more commonly in idiopathic intussusceptions. Butorphanol tartrate has been reported to decrease the occurrence of intussusception formation. It is hypothesized that opioid administration increases the tone of the small intestine and reduces or prevents local bowel wall inhomogeneity and segmental ileus and, therefore, decreases the likelihood of intussusception.

Enteroplication, defined as the formation of permanent serosal adhesions between adjacent loops of small intestine, has been advocated as a means to prevent recurrence of intussusception in dogs. Complications of enteroplication included intestinal obstruction with vegetative material and strangulation of enteroplicated loops of jejunum between enteroplication sutures.
The ultrasonography is currently in regular application in veterinary practice in the field of research as well as diagnostic purpose. The physiological status of ovaries and uterus along with pregnancy diagnosis possible through this technique. Recently, studies on ovarian follicular dynamics and success in retrieving immature oocyte repeatedly from live cattle through ultrasound guided oocytes aspiration technique made this technology possible to play vital role in the success of in vitro fertilization and embryo transfer technology. Ultrasonography has become an important tool in research programmes and has been integrated into clinical as well as animal reproduction.

**Principles of ultrasonography**

Before ultrasound technology can be put to use in animal reproduction it is essential to understand basic principles by which ultrasound images are generated. Ultrasound waves are the sound waves inaudible to human ear and operate at frequencies of 1 to 10 megahertz (MHz). The normal range of sound that human being can perceive is 20 to 20,000 Hz. A sound wave with a frequency higher than 20,000 Hz is called as Ultrasound. The ultrasonography utilizes high frequency sound waves to produce image of tissue and internal organs.

The sound waves are produced by vibrations of specialized crystals called “Piezo Crystals” which are fixed on ultrasound transducer. The vibrations of crystals are generated by pulses of electric current. These waves are directed through tissue of interest by moving and varying the angle of transducer. Thus, ultrasound waves travel from a transducer in a pulse, strike to tissue of interest and then reflect back from tissue to transducer in form of an echo. These echoes received by transducer are electrically converted by computer either in to sound, which can be heard by ear phone or in to pictures which can be monitored in screen. Thus, transducer acts both as transmitter of sound waves as well as receiver of echos. The echos received by transducer are converted in to electric impulses and displayed on ultrasound screen as varying shades of grey (Black to White).The most common used frequencies of ultrasound in large animal reproduction are 3.5, 5.0 and 7.5 MHz.

**Modes of ultrasound**

There are three modes of ultrasound machines viz. A mode, B mode and M mode.

A mode is amplitude mode and depicted as line graph. One dimensional display of echo, fat and lean (meat animals) thickness measurement.

B mode is brightness modality and most of the ultrasound scanners used in bovine reproductive research is linear array B-mode. It is a two dimensional display in the form of dots.

M mode is an adaptation of B mode and used for evaluation of moving structures such as heart.
Handling of the machine

Connect the transducer in its transducer channel of the machine, connect the cord of the printer to the scanner, Connect the scanner and the printer to the main electric line through CVT, set up operational systems like contrast, brightness, focus, TCG, programme etc. of the machine. Keep the transducer in freeze position when not in use, scanning in a completely dark area is preferred.

Preparation of the animal

Preferably withheld feed for 12-24 hours, provide plenty of drinking water, shave and clean ventral abdominal wall for transabdominal scanning, Tab. Charcol or Gasex and mild laxative may be given 12 hours prior to scanning. Clean off the faecal material before rectal scanning.

Scanning approaches

Transrectal scanning: Animal is restrained standing inside a travis, Rectal transducer is taken per rectum under a sleeve for scanning. Commonly used in large animals, place acoustic surface of transducer on structures and avoid obstruction of finger, avoid entry of excessive air in to rectum.

Transabdominal scanning: Approached from ventral abdominal wall. Commonly used in small animal, put the animal on dorsal recumbency, scanning on lateral/ventral abdomen of standing animal is also done, apply adequate ultrasound gel on the skin surface, put the transducer head on the gel of skin surface and scan the underlying organs.

Recording of images

Labeling of images and measurements can be done, selected image on the screen is freezed and print is taken.

Interpretation of ultrasound images

Ultrasonic images are usually displayed as white against black background. Various terms used to describe the image are:

Hyperechogenic: This represents the bright echoes that appear as white on screen. Such images are given by highly reflective interfaces of dense tissues such as fetal bones, bovine cervix etc.

Hypoechogenic: These appear as grey image on dark screen and are given by interfaces of moderate reflection.

Anechoic or echoiuscent: In absence of an echo the images appear as black on screen and are presented by complete transmission of sound waves like follicular fluid, chorionic or amniotic fluid.

Image quality and examining conditions

Examination conditions must be optimized for better production and interpretation of ultrasound images. It is found to be interaction of four factors: (1) operator, (2) scanner (3) environment and (4) animal.

The ultrasound instrument should be placed close to the operator at eye level to control the adjustments and to facilitate viewing. A high quality probe is another prerequisite. The intensity of ambient light should be dim to reduce reflections and avoid excessive brightness or contrast. As mentioned earlier animals must be well restraints for better interpretation of ultrasound image.
Limitation of ultrasonography

Ultrasonography is not particularly useful in the lungs because air causes a great deal of artifact. Diagnostics images sometimes cannot be obtained because of patients’ built. Ultrasound image will not be of diagnostic in scans of abdomen if there are excessive bowel gases. All types of imaging in radiology, ultrasonography is the most operator dependent.

Clinical applications of ultrasound scanning in bovine reproduction

In bovine reproduction ultrasonography has been used for pregnancy diagnosis, determination of fetal sex, diagnosis of early embryonic death, diagnosis of follicular and luteal cyst, evaluation of superovulatory response and recently transvaginal ultrasound guided follicular aspiration of oocytes for in vitro fertilization and embryo transfer programme.

1. Pregnancy diagnosis

It is possible to recognize the presence of an embryo within the uterus between days 12 and 14 following insemination. It is evident that a 5 MHz or 7.5 MHz transducer provides more reliable information than a 3 MHz transducer for early pregnancy diagnosis in cattle. Embryonic vesicle gradually increases in length until day 26 when it starts encroaching in to opposite horn. By day 32, the embryonic vesicle fully occupies both the horns. The heartbeat is visualized between day 26 and 19. Fluid filled structures (eyes, brain, heart and stomach) are easily recognized because of non-echogenic nature of their contents. Visualization of entire fetus is difficult in advance pregnancy because of limited field of view and depth penetration of sound waves. However, reliable period for pregnancy diagnosis with a positive predictive value of over 95 per cent varies between days 20 and 42 post-breeding. Based on these results the most realistic early date for reliable pregnancy diagnosis by ultrasound under field condition may be day 30 post-breeding. The gravid horn starts to sink ventrally in abdominal cavity between days 30 and 130 of pregnancy. In such cases the gravid horn can be drawn back by manipulating the cervix caudally using gentle digital pressure through rectal wall.

2. Determination of fetal sex

A very recent exciting use of ultrasound technology is determination of fetal gender by determining the relative location of genital tubercle. The genital tubercle is forerunner of penis and clitoris. It begins to develop between the hind limbs, and then gradually moves close to the umbilicus in male, and beneath the tail in females. Bovine fetal sex can be determined between day 73 and 120 of gestation with 5 MHz probe being used for early and 3 MHz probe for later stage of gestation. Fetal sex can be determined even earlier with 7.5 MHz probe but not earlier than day 45 of pregnancy because of small size of fetus and sex organs. The sex determination should be performed between days 50 to 70 of gestational order to obtain highest degree of accuracy. The fetal landmarks, such as heartbeats, umbilical cord, rear legs and tail are used for orientation.

3. Diagnosis of ovarian follicular and luteal cysts

In field condition follicular cysts, luteal cysts and cystic corpus Luteum is well
recognized problem and differentiation by per rectal examination is difficult. The follicular cysts, cystic corpus luteum and leuteal cysts are successfully diagnosed through ultrasonography which is based on presence of different echogenic structures present on surface on ovary.

4. Uterine pathology

The use of ultrasound for post-partum or post-estrual examinations will allow early detection of potential uterine pathology. Ultrasound will allow differentiation of uterine cyst (focal fluid filled areas), pyometra (fluid with increased echogenisity), dead fetus (no heart beats), resorbing fetus (poorly delineated gestational sacks with or without fetal remains), and premature placental separation (fluid between uterine wall and placental tissue).

5. Studies on morphological changes in ovaries and uterus

Diagnostic ultrasound technology provides rapid non-invasive form of visual access to the ovaries, uterus and cervix for evaluating normal morphological changes in cattle. Image of ovaries are primarily composed of follicles and corpus Luteum. As follicular fluid is non-echogenic follicles appears as black, roughly spherical areas on ultrasound images. Ovulation can be detected by the acute disappearance of a large follicle and subsequent formation of CL. The luteal tissue appears as grey to white on ultrasound image. During estrus there is marked edematous expansion of endometrial folds. Estrus echo texture is characterized by alternating and inter-twisting areas of hyper and hypoechogenisity. The hyper-echogenic areas (white) are attributed to the dense connective tissue folds and the hypogenic (dark) areas are attributed to the outer portion of edematous therefore, makes possible to estimate accurately the stage of estrus cycle in individual animal. Ultrasound scanning also helps to know the timing of ovulation, thus it aids in timely breeding of animals.

Clinical applications of ultrasound scanning in male animal

Orchitis: It is defined as inflammation of the testis and usually occurs in conjunction with epididymitis. Testicular enlargement, decrease echogenisity and hypervascularity are typical findings. In the acute phase of orchitis, testis or focal areas of the testis appear less echogenic than a normal testicle. Increased blood flow from hyperemia may be identified and reactive hydrocele may be present. Hypervascularity may be the only abnormal finding, so Color Doppler analysis is more sensitive in the diagnosis of orchitis than is grey scale sonography.

Testicular torsion: Testicular torsion is a twisting of the spermatic cord, which results in the loss of blood supply to the testis and blocks the venous drainage of blood from the testicle. In the acute phase, the epididymis and testis enlarge and the testis appears hypoechoic and inhomogeneous.

Conclusion

Ultrasound scanning is important tool for the study of reproductive process in bovines. It is effectively applied for understanding of follicular dynamics, early pregnancy diagnosis and identification of fetal sex. This technique plays key role in the study of abnormalities of reproductive organs and developmental abnormalities of the fetus.
The incidence of Foreign Body Syndrome were higher in India may be attributed to practice of livestock rearing based on hand feeding compared to pasture rearing. Among the buffalo breeds highest (23.88%) were recorded in Murrah-cross buffaloes Higher incidence has been reported in recently calved buffaloes and that too older buffaloes compared to lactating and dry buffaloes.

The condition tends to be more common during drought because animals are grazing closer to the ground or are being fed harvested material that is contaminated with foreign objects, such as short ends of baling wire. The disease presents considerable difficulty in diagnosis because ruminalatony and abdominal discomfort may occur in other diseases. The various conditions originating from Foreign Body Syndrome are traumatic reticulitis, traumatic reticuloperitonitis (Local and diffuse), traumatic pericarditis, diaphragmatic hernia. Other minor complications are reticular abscess, vagal indigestion or Hoflands Syndrome, hepatic abscess, splenic abscess, rupture of left gastro-epiploic artery, traumatic pneumonia and pleurisy, mediastinal abscess.

Factors attributed to emergence of foreign body syndrome

Rapid industrialization and rapid civilization has resulted in increased incidence of the Foreign Body Syndrome, due to spread of metallic and non-metallic garbage and waste and thus more incidence of these cases are reported in highly industrialized and urbanized areas such as Punjab, Haryana and other big cities. Due to intensive system of Livestock rearing for maximal production, high-rise in deficiency state especially of calcium, phosphorus and micro-minerals, has resulted in perverted appetite, which is one important factor for intentional ingestion of foreign objects. In our country, buffaloes and cattle rearing are generally based on backyard rearing or organized dairy farms based on stall-feeding. Thus the chance of occurrence of Foreign Body Syndrome is more as maximal intake of foreign bodies is via chaffed feed.

Etiology

The typical foreign body is a metallic object, such as a piece of wire or a nail, often greater than 2.5 cm in length But sometimes non-metallic objects like stiff broom-bristles or sharp pieces of plastics and their lodgment into the reticulum, due to anatomical predisposition has also been reported A large number of adult dairy buffaloes have metallic foreign bodies in their reticulum without signs of clinical disease and occasionally non-perforating foreign bodies such as ball bearings, stones, coins may be passed out in faeces. It is likely that a predisposing factor in otherwise normal buffalo, such as tenesmus or a gravid uterus, causes migration of the foreign body into the reticular wall. Buffaloes are clumsy and indiscriminate feeder and they take a nail or some other metallic objects into their mouth and it passes beyond the dorsum of the tongue, they do not seem to be able to split it out and in most cases reaches abomasum. Apart from this some animals suffer from mineral deficiencies seem to relish objects with a mineral or metallic taste. Swallowed foreign bodies may lodge in the upper esophagus and cause obstruction in the esophageal groove and
vomiting but in most instances they pass to the reticulum. Many lie there without causing any harm but the honeycomb-like structure of the reticulum provides many sites for fixation of the foreign body and contractions of the reticulum are sufficient to push a sharp-pointed object through the wall.

**Diagnosis**

**Complete Blood Count (CBC)**

The CBC in a buffaloes with TRP can vary depending on whether the peritonitis is acute or chronic and localized or diffuse. In general, animal with persistent purulent inflammation have leukocyte counts ranging from 5,000-15,000 cells/µL, with neutrophilia (unsegmented neutrophils) Although lymphocytes are the predominant leukocyte circulating in healthy cattle, endogenous corticosteroid release secondary to stress may cause lymphopenia by cell redistribution; circulating lymphocytes do not re-enter the lymphatics but become sequestered in lymphoid tissue and bone marrow. Affected animal also will show hyperfibrinogenemia, with fibrinogen concentrations greater than 1,000 mg dL⁻¹. Fibrinogen is an acute phase and in cattle may be the best indicator of acute inflammation because fibrinogen concentrations often increase prior to development of neutrophilia.

Some buffaloes with acute, localized peritonitis will have CBCs within normal reference intervals, while others will have a degenerative left shift. Buffaloes with acute diffuse peritonitis, the onset is sudden with complete anorexia and a marked drop in milk yield. Sub acute abdominal pain is common in most cases and the animal is reluctant to move. Walking, particularly downhill, is often accompanied by grunting. Most animals prefer to remain standing for long periods. Arching of the back occurs in some of cases along with the appearance of tenseness of the back and the abdominal muscles so that the animal appears gaunt or ‘tucked-up’. Defecation and urination cause pain and accompany usually with grunting. This results in constipation, scant feces and in some cases retention of urine. In others there is recumbency and reluctance to stand.

Regurgitation, kyphosis, abduction of elbows, pellet dung, poorly digested fiber, recurrent bloat, Brisket edema, muffling heart sounds were observed. The general behavior and attitude of all the animals were unsettled. The rectal temperature varied from 38.95 to 39.45°C in cows and 38.43 to 39.50°C in buffaloes. The heart rate was between 44.90 and 89.00 in cows and 78.75 and 82.00 min⁻¹ in buffaloes and the respiratory rate varied between 32.64 and 39.45 in cows and 30.14 and 39.50 min⁻¹ in buffaloes. Ruminal motility reduces in all cases. Out of the five grunt tests conducted, scootch test (70.15%), reticular grunt (67.16%) and xiphisternum percussion (64.18%) were found to give highest positive results in TRP and allied syndrome. Sometimes, trembling of muscles over the left side on the back of elbow, occasionally over rumen and rarely on both sides is reported.

A moderate systemic reaction is common in acute localized peritonitis. In acute localized peritonitis the clinical sign commences 24 h after the penetration. The temperature, the heart rate is about 80 min⁻¹ and the respiratory rate about 30 min⁻¹. Temperatures above 40°C (104°F) accompanied by heart rates greater than 90 min⁻¹ suggest severe complications. Rumination is absent and reticulo-rumen movements are markedly depressed and usually absent. In 75% cases with induration of medial reticular wall due to traumatic
injury, the normal tension receptor activity is abolished and hypomotility of rumen-reticulococcurs. The rumen may appear to be full because of the presence of a free-gas bloat with moderate distension of the left paralumbar fossa. Pain can be elicited by deep palpation of the abdominal wall just caudal to the xiphisternum. Palpation is done using short, sharp pushes with the closed fist or knee and also have a degenerative left shift. In chronic cases, a mature neutrophilia is common. Neutrophilia in the absence of leukocytosis was indicative of diffuse traumatic reticuloperitonitis. There is daily periodic shift of TLC from higher to lower or vice-versa and a definite neutrophilic shift to left is observed as the continuous progress from normal to acute diffuse peritonitis. Neutrophilia has also been observed in a buffalo with extra-reticular fibrous nodules.

Serum biochemical profile
The most common chemistry abnormality associated with TRP is hyperproteinemia with a hyperglobulinemia. Total protein concentration greater than 10 mg dL^-1 is highly suggestive of TRP. Highly significant increase in globulin and fibrinogen levels and decreases in albumin and Plasma Protein: Fibrinogen ratio (PP: F) was recorded.

Other chemistry abnormalities associated with TRP may include hypochloremia, hypokalemia and metabolic alkalosis; these abnormalities are secondary to ruminal hypomotility. Decreased rumen function cannot maintain normal plasma/rumen chlorine gradients and ruminal chloride ions increase. Chloride ions also can become sequestered in cases of severe ruminal hypomotility. Metabolic alkalosis occurs secondarily. Hypokalemia results primarily by anorexia, but may be potentiated slightly by ion exchange caused by the alkalisosis. With alkalisosis, intracellular H^+ ions can be exchanged for extracellular K^+ ions, decreasing serum potassium concentrations. This effect is minor as compared with K^+ ion shifts associated with acidosis.

The changes in haematological values and biochemical parameters such as elevation of fibrinogen, aspartate aminotransferase and alkaline phosphatase are suggestive of inflammatory changes in the body not only traumatic reticulo-peritonitis. Although the haematological examination is of considerable value as a diagnostic aid in TRP, these alterations are non-specific and can also be seen in association with other bacterial infections following severe stress.

Abdominocentesis
Normal peritoneal fluid of an adult cow is straw-colored, clear and odorless. Protein and fibrinogen concentrations can vary from 1.0-3.0 g dL^-1 and 100-500 g dL^-1, respectively. The nucleated cell count should be less than 10,000 cells μL^-1. The majority of nucleated cells are non-degenerate neutrophils and mononuclear cells. At least 10% of the nucleated cell population should consist of eosinophils. Turbid samples or samples containing gross pus or fibrin is indicative of peritonitis, at least locally. It is, however, normal for bovine peritoneal fluid to clot upon standing. Nucleated cell count, cell percentages and character of cells present can be suggestive of disease. If a sample contains immature, degenerative, or toxic neutrophils, purulent peritonitis can be suspected. Samples with greater than 40% neutrophils or less than 10% eosinophils are also indicative of purulent peritonitis. Intr-
nuclear bacteria and degenerate neutrophils indicate septic peritonitis.

Normal cytological findings do not exclude TRP since bovines tend to wall-off inflammation in the peritoneal cavity, making it more difficult to diagnose local peritonitis.

Laparoscopy and Metal Detection (Ferrosope): Right flank laparoscopy using a flexible fiberoptic laparoscope, 14 mm diameter and 1120 mm working length, is a reliable diagnostic aid for the presence of traumatic reticuloperitonitis.

Metal detectors were used at one time to aid in the diagnosis of traumatic reticuloperitonitis and in rapid collection of data on incidence of foreign body in the fore-stomach of the ruminants. Ferrous metallic foreign bodies can be detected with metal detectors but the instruments are of limited use because most normal diary bovines are positive for metal over the reticular area.

**Radiographic findings**

Radiological examination of the reticulum with the animal in dorsal recumbency (dorsal reticulography) is an accurate diagnostic method for the evaluation of cattle with suspected traumatic reticuloperitonitis. An X-ray machine with a capacity of 1000-1250 mA and 150 kV is needed. The major advantages of radiography are that metallic foreign bodies can be visualized and their position determined. Radiography as an aid in the diagnosis of the conditions includes a typically positioned foreign bodies, abnormal gas shadows in the region of the reticulum and depression in the cranio-ventral margin of the reticulum. Small gas inclusion or gas bubbles over a fluid interface in the region of the reticulum are pathogenic for the condition, resulting from gas-producing bacteria involved in the abscess formation or from compartmentalization of gas from the reticulum. Some of the associated lesions like phrenic abscess, reticular abscess, cardiophrenic adhesions and pneumothorax can also be diagnosed.

**Ultrasonographic findings**

Ultrasonography is useful for observing reticular motility and for recognizing fibrinous deposits, abscess and accumulation of fluids. However, metal foreign bodies and magnets cannot be visualized and radiography remains the best method for this purpose. The reticulum and adjacent organs of cattle and buffaloes can be examined with ultrasonography using a 3.5 MHz linear transducer applied to the ventral midline of the thorax over the 6th and 7th inter-costal spaces and from the left and right sides of the midline. The reticulum can be visualized in more than 90% of cows in spite of interference by the ribs and sternum. A healthy bovine reticulum appears as half moon shaped structure with a smooth contour that contract at regular interval in ultrasonography. Ultrasonography examination includes observation of reticular motility during three-minute period, of reticular contours and of adjacent structure such as the diaphragm, anterior dorsal blind sac of rumen, the ventral sac of the rumen, the spleen, omasum, abomasum and liver. In cows with disturbed reticular motility, biphasic contractions are slower than normal or indistinct and the numbers of contractions are reduced. Fibrinous changes appear as echogenic deposits, sometimes accompanied by hypoechoic fluid.

**Treatment**

The choice of treatment is largely governed by economics and the facilities and time available for surgery. Since
reticular foreign bodies often migrate back into the lumen of the reticulum, conservative treatment can have good results. Conservative treatment consists of instillation of a magnet to recover or immobilize the metal foreign body (if iron-containing), by administration of antibacterial drugs to control the progression and possibly the oral administration of a magnet. The animal can be tied or sanctioned or confined in a box stall for several days. The immobilization facilitates the formation of adhesions and removal of the foreign body, may be further aided by standing the animal on an inclined plane. Either made of a door or planks or by packing earth under the front feet of the animal. The front feet should be elevated about 25 cm above the floor. Feed, particularly the roughage should be reduced to about half. The response is often so good that the farmer is tempted to turn the cow loose before the allotted time and relapses frequently occur. Antimicrobials are administered parentally daily for 3-5 days. Sulfamethazine at the rate of 150 mg kg\(^{-1}\) body weight daily for 3-5 days provided good results in uncomplicated cases. Penicillin or broad spectrum antimicrobials given parentally daily for 3-5 days are also widely used with empirical success. For lactating dairy cattle, those antimicrobials with a short milk withdrawal period are desirable. The general effect appears to be good and a high rate of recovery is recorded with antimicrobials parentally combined with immobilization provided treatment is begun early. Bovines past their 6th month of pregnancy are likely to show incomplete recovery or relapse. Affected animal can also be treated with 3-7 days of systemic antibiotic therapy (ceftriaxone, ampicillin, or tetracycline), stall rest and other supportive therapy as indicated. Affected animal should be re-evaluated in 48-72 h. If a magnet is already in place or conservative therapy is not successful, an exploratory laparotomy or rumenotomy is indicated for removal of the foreign body. The recovery rate after surgery is likely to be much lower if only complicated cases are operated on. A rumenotomy, satisfactorily performed, is the best treatment but is unnecessary in many cases because of the tendency of the foreign body to fall back into the reticulum. The best general policy is to treat the animal conservatively for 3 days and if marked improvement has not occurred by that time to perform a rumenotomy.

**Prevention**

Prevention of TRP is preferred to either conservative medical treatment or surgery.

Although one source does not believe magnets are an effective preventative measure. The majority of clinicians agree that all cattle over one year of age should have a prophylactic magnet placed in the reticulum. Following oral administration, most magnets do not enter the reticulum directly, but are first deposited in the cranial sac of the rumen before entering the reticulum following ruminal contractions. Buffaloes should be kept away from construction sites and crop fields should be monitored for metal debris. Also, processed feed can be passed over magnets to recover any iron-containing foreign bodies prior to being fed to these animals.
Faculty and Participants of ASCAD Training Course

Department of veterinary Surgery and Radiology
College of Veterinary Science and Animal Husbandry
Junagadh Agricultural University, Junagadh-362001