www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2020; SP-9(9): 65-74

www.thepharmajournal.com
Received: 29-07-2020
Accepted: 10-09-2020

M Selvaraju
Professor and Head, Veterinary University Training and Research Centre, Tamil Nadu Veterinary and Animal Sciences University (TANUVAS), Manmangalam (Post), Karur, Tamil Nadu, India

S Prakash
Graduate Assistant, Department of Veterinary Gynaecology and Obstetrics, Veterinary College and Research Institute (TANUVAS), Namakkal, Tamil Nadu, India

V Varudharajan
Veterinary Graduate, Department of Veterinary Gynaecology and Obstetrics, Veterinary College and Research Institute (TANUVAS), Namakkal, Tamil Nadu, India

K Ravikumar
Assistant Professor, Department of Veterinary Gynaecology and Obstetrics, Veterinary College and Research Institute (TANUVAS), Namakkal, Tamil Nadu, India

M Palanisamy
Professor and Head, Department of Veterinary Gynaecology and Obstetrics, Veterinary College and Research Institute (TANUVAS), Namakkal, Tamil Nadu, India

D Gopikrishnan
Assistant Professor, Department of Veterinary Gynaecology and Obstetrics, Veterinary College and Research Institute (TANUVAS), Namakkal, Tamil Nadu, India

K Senthilkumar
Assistant Professor, Department of Veterinary Gynaecology and Obstetrics, Veterinary College and Research Institute (TANUVAS), Namakkal, Tamil Nadu, India

S Manokaran
Assistant Professor, Kangeyam Cattle Research Station (TANUVAS), Sathiamangalam (Post), Erode, Tamil Nadu, India

Corresponding Author:
M Selvaraju
Professor and Head, Veterinary University Training and Research Centre, Tamil Nadu Veterinary and Animal Sciences University (TANUVAS), Manmangalam (Post), Karur, Tamil Nadu, India

Obstetrical disorders in farm animals: A review

M Selvaraju, S Prakash, V Varudharajan, K Ravikumar, M Palanisamy, D Gopikrishnan, K Senthilkumar and S Manokaran

Abstract
Obstetrical problem in each animal is an emergency case and it requires patience, physical stamina, mental strength, presence of mind, tolerability and acceptability according to the need to save the life of the animal patient and fetus. At the same time while attending the obstetrical cases, it should be borne in mind that the future fertility of the animal should be protected. Unhygienic approach and hasty handling of each case not only threatens the fetus/dam's life but also veterinarian's life. Chromosomal aberrations during embryonic or fetal development causes varying degrees of structural deformities which may lead to dystocia, abortion, still birth or birth of poor growth off-springs in farm animals. Normally, dystocias due to fetal monstrosities require either fetotomy or cesarean section for the successful delivery of fetus, however per vaginum delivery is possible with small sized fetus and also in early fresh cases. Therefore, various types of dystocias including uterine torsion, uterine inertia, fetal asites, anasarca, hydrocephalus, schistosomus reflexus, perosomus elumbis, hydrallantois, arthrogryposis, fetal giantism, conjoined twins, bull dog monster, fetal mummification, maceration and hysterocele were discussed in terms of etiology, treatment and prognosis. Further, clinical management of cervicovaginal prolapse and total uterine prolapse in farm animals are documented. Cesarean section in sows under local infiltration anaesthesia has been presented. Deleterious effect of obstetrical conditions on future fertility also reviewed based on clinical evidence. To improve conception rate in retained fetal membranes affected cows, ovsynch protocol has been recommended.

Keywords: Dystocia, fetal monsters, uterine torsion, cows, buffaloes, goat, ewes, sows

Introduction
Reproductive potential is the key which determine the life time performance of farm animals. Dairy industry plays an important role in Indian economy. The profitable dairy farming is predominantly based on the two major inter-related factors, *viz*., nutrition and reproduction. For economic dairy farming, dairy cows irrespective of being exotic, crossbred or indigenous must calve regularly at every 12 to 13 month interval. Pre, peri and postpartum periods are regarded as important in the reproductive life of the cow because of its effect on the future fertility. Several precautions were reported as essential factors to reduce problems during these periods, whereas, obstetrical complications will result in reduced yield, increased risk of death or culling, lower fertility and increased treatment costs. Prolonged interval between calving or assisted delivery and onset of ovarian function due to obstetrical complications is regarded as one of the most important reproductive problems responsible for failure to maintain optimum reproductive efficiency, which in turn causes economic loss to the dairy farmers [1]. Dystocia is a welfare problem of cows and calves and is also of economic importance. It causes pain or pain and injury to the cow. Hence, it directly leads to poor welfare in cows. Moreover, dystocia may have negative effects on levels of milk yield and reproductive performance, causing calf or cow death or both, retained placenta, uterine prolapse, uterine rupture, perennial laceration, laceration in cervix/vagina/vulva, uterine infections, or increased involuntary culling. Other consequences of dystocia include veterinary fees, extra labor, and other management costs [2]. Hence this paper aims to analyse various obstetrical disorders and their successful managemental approaches in cows, buffaloes, sheep, goat and pigs.

Dystocia
There are two major types of dystocia. They are maternal and fetal causes. One of the most common maternal dystocia is uterine torsion. It is defined as rotation of the pregnant uterus on its longitudinal axis. It inflicts heavy economical losses to the farmers due to death of either fetus or dam or both beside impaired lactation. The etiology and pathogenesis of this condition is inadequately understood and remains open to speculation. A diverse list of contributing

causes has been proposed including the anatomy, slipping or sudden fall, the manner by which the animal lies down and gets up and strong movements of the fetus during first stage of labour [3].

Uterine torsion

Uterine torsion is a common complication of late first stage or early second stage labour in cows and buffaloes. However, at 75 days of gestation uterine torsion occurred in a Murrah buffalo and it was treated laparotomy in right upper plank approach [4]. Out of 852 dystocias analysed in cows and buffaloes, the incidence of uterine torsion in cows and buffaloes was 13.97 and 27.46%. The occurrences of uterine torsion in cows and buffaloes in response to parity (19.83 and 31.53 % in primiparous and 80.17 and 68.47% in pleuriparous), stage of gestation (91.60 and 92.31% in peripartum and 8.40 and 7.69% in prepartum), side of torsion (72.34, and 91.61% in right side and 27.66 and 8.39% in left side), side of torsion (32.98 and 14.19% in precervical and 67.02 and 85.81% in postcervical), sex of fetus (67.57 and 60.55% in male fetus and 32.43 and 39.45 % in female fetus) and livability (45.95 and 46.79% in live fetuses and 54.05 and 53.21% in dead fetuses, respectively) were found. The survivability of dam after detorsion in cows, buffaloes and overall survivability was 86.55, 88.46 and 87.82%, respectively. A sum of 49.10% cows and 51.52% buffaloes were affected with 90^0 to 180^0 uterine torsion [3]. Prompt diagnosis and treatment of uterine torsion yield favourable prognosis to the life and reproductive of the dam and life of the fetus. Rarely delayed cases of uterine torsion respond to rolling technique. In a delayed case of right side postcervical uterine torsion, Schaffer's technique was applied and delivered the macerated fetus part by part as bones and internal organs and found uneventful recovery of the dam due to proper follow up with fluid and antibiotic therapy [5].

Occurrence of uterine torsion in indigenous cow is rare. Post-cervical right side uterine torsion in a Hallikar cow was successfully corrected by Schaffer's method and delivered a live male fetus [6]. Haematology indicated the normocytic normochromic anaemia with leucocytosis in uterine in affected 24 water buffaloes. Leukogram revealed neutrophilia, eosinophilia and lymphocytopenia and concluded that these parameters might be the indicators of prognosis of uterine torsion in buffaloes [7]. The occurrence of uterine torsion in sheep and goat is rare. Uterine torsion in a Mecheri ewe was treated successfully with Schaffer's method [8]. However, uterine torsion with bicornual pregnancy in a doe was treated by laparohysterotomy. In this case, left uterine horn had two live male foetuses and right horn had 2 mummified foetuses [9].

Uterine inertia

In a non-descript sow, delayed case of dystocia due to uterine inertia was subjected to caesarean section under local infiltration and delivered 5 emphysematous foetuses with prompt recovery of the dam. No difficulty was in performing cesarean section under local infiltration [10]. Similar procedure was followed in Large White Yorkshire sow affected with dystocia due to secondary uterine inertia and the life of the sow was saved [11]. Caesarean section is easier, safer and rapid technique in sows. Irreducible vaginal prolapse, feto-pelvic disproportion including fetal emphysema, uterine inertia and non-dilatation of cervix are the indications for caesarean section in sows [10, 11].

Fetal ascites

Fetal ascites characterised by accumulation of fluid in the abdominal cavity causes dystocia commonly in cows. A case of fetal ascites which caused dystocia in non-descript buffalo [12] and in graded Murrah was reported [13]. In both the cases, the fetus was in posterior presentation with 2 hind limbs extended into the vaginal passage. Traction on hind limbs did not favour to deliver the fetus. Fetal abdomen was punctured with fetotome knife and 15-20 litres of fluid were drained out. Hence, in dystocia with normal P1, P2 and P3 with extended fore limbs and head in anterior presentation or hind limbs in posterior presentation, fetal ascites condition also should be suspected [12]. Similar case was reported in a Murrah buffalo in which the enlarged abdomen was punctured by using long obstetrical hook and the asceticfetus was delivered by traction [14]. The ascetic fetus had cystic kidneys with adventitious placenta and in this case.It was concluded that vascular disturbances in the uterus and/or cystic kidneys with diminished urinary excretion along with obstruction in lymphatics may be the cause of fetal ascites [13, 14]. However, fetal ascites in twoJersey and two HF crossbred cows with anterior presentation of fetus reported by other clinicians. They stated that application of William's long obstetrical hook in the abdominal wall just behind the costal arch was sufficient to release the ascetic fluid these four cases [15, 16]. In one Jersey cow affected with fetal ascites, both the kidneys of the fetus were cystic [16].

A rare case of congenital nephroblastoma weighing 3.8 kgs along with fetal ascites caused dystocia in a HF cow. However, the exact cause of the development of nephroblastoma was not known in cows [17]. Other investigators recorded fetal ascites with nephroblastoma in an 8 months pregnant Jersey crossbred cow and it was relieved through birth passage by traction. Along with 20 litres of fluid a round extra renal mass of 5.2 kgs was detected in the fetal abdomen. Histopathology of the mass revealed it was a nephroblastoma of extra-renal origin [18]. Dystocia due to fetal ascites with brachynathism was attended successfully in a non-descript doe. The fetus was in posterior presentation and fetal abdomen was punctured behind the ribs with long obstetrical hook meant for sheep and goat to evacuate one litre of ascetic fluid [19].

Fetal ascites with anasarca

Delayed and neglected case of dystocia due fetal anasarca resulted in death of the ewe and post-mortem examination of the fetus revealed accumulation of fluid in peritoneal cavity accompanied by hydrocele in the fetus [20]. In another case, fetal anasarca with ascites was delivered by fetotomy followed by evisceration in aewe [21]. In both the cases, the fetal membranes were leathery and edematous [20, 21].

Fetal hydrocephalus

Fetal dystocia due to abnormal development and malformations of the antenatal individual is very common. Hydrocephalus is defined as accumulation of excessive fluid in durameter or ventricles of the brain as a result of an imbalance between the formation and drainage of cerebrospinal fluid either in ventricular system or subarachnoid space characterized by marked enlargement of cranium. There are two types of hydrocephalus. 1. Internal hydrocephalus: characterized by accumulation of fluid in the cerebral ventricles 2. External hydrocephalus: accumulation of fluid outside the brain. Dystocia due to mild hydrocephalic

fetus was treated without puncturing the cranium in a HF cow [22]. Dystocia due to external hydrocephalus fetus in a Kangeyam cow was treated by cephalotomy and traction [23]. Very recently, successful management of dystocia due to live fetal hydrocephalus in a Jersey crossbred cow was documented [24]. In this case, the cow was cast and placed on the hind quarter elevator and by traction a live female fetus was extracted out. Examination of the fetus indicated the dome shaped head. Radiographic investigation of the fetal head revealed fluid accumulation in the ventricular part of the cranium. Ultrasonographic study of fetal head confirmed the fluid filled cranium. After a day of birth, the fetus died and post-mortem examination revealed fluid accumulation in the ventricles of brain. Karyotyping of the fetus revealed no chromosomal abnormality. The live fetusdelivered was not able to suckle the milk and has shown the signs of depression, weakness, drooping ears and head, blindness, recumbency and convulsion before death [24]. When the hydrocephalus becomes severe enough it cannot be relieved by force extraction and may require fetotomy [22]. Hydrocephalic fetus caused dystocia in a 1½ year old non-descript goat and 16 gauge needle was used to puncture the distended cranium, the fluid was evacuated and live fetus was delivered but it died within 6 hours [25].

Schistosomus reflexus

Schistosomus reflexus is a rare type of fetal monstrosity primarily reported in cattle and rare in small ruminants especially in ewes. It is a developmental defect characterized by a marked ventral curvature of the spine, deformed pelvis and the body and chest walls bent laterally with exposed thoracic and abdominal visceral organs. Fetotomy or caesarean section is mandatory for delivery of a fully grown schistosomus reflexus monster while, per-vaginal expulsion without any obstetrical assistance is noticed in small sized monster foetuses [26]. However, schistosomus reflexus fetus in four Jersey crossbred cows was delivered by forced extraction [27, 28, 29, 30]. The schistosomus fetus was delivered by fetotomy using Thygeson's wire saw embryotome [26]. Although the schistosomus reflexus fetus had full growth, the skin, musculature and peritoneum over the viscera behind the sternum were absent. Gross examination of the fetus revealed ventral curvature of the spine. The attachment of diaphragm was incomplete, the lung was small and liver got enlarged. The genetic predisposition in causing schistosomus reflexus could not be omitted. Multiple genes interplay play a vital role in the occurrence of this fetal anomaly [30]. Vaginal delivery of the Schistosomus reflexus fetus was carried out following cervicotomy in a Jersey crossbred cow [31] and in a HF heifer [32]. A rare case of dystocia due to schistosomus reflexus fetal monster in an indigenous breed, Gir heifer and its successful per-vaginal delivery is reported [33].

Dystocia caused by the schistosomus reflexus fetus in a Jersey crossbred heifer with narrow pelvis was delivered through caesarean by other scientists and they stated that schistosomus reflexus fetus is a congenital anomaly belongs to the battery of developmental defects involving incomplete closure of the ventral abdominal wall that makes it inside-out calf, malformed skeleton and inversion of spinal cord [34]. Similarly, schistosomus reflexus fetus in a doe was relieved through caesarean section in another clinical report. The affected fetus of the doe had an acute ventral curvature of the spine, chest and body wall stretched laterally with deformed pelvis. The visceral organs were completely exposed. The lungs, heart, spleen, intestine and pancreas appear to be normal. The skin, musculature and peritoneum over the viscera behind the xiphoid were absent. All the limbs were ankylosed and the liver was abnormal in shape [35]. Schistosomus reflexus fetus with vaginal tear in a Tellicherry doe was corrected by caesarean section although the exact cause of schistosomus reflexus is still ambiguous, the anomaly is mostly related to genetic factors, mutations, chromosomal aberrations, infectious agents and environmental factors or combination of all these factors [36].

Perosomus elumbis

Perosomus elumbis is an infrequent congenital fetal anomaly and is characterized by partial or complete agenesis of lumbo-sacral and coccygeal regions of spinal cord along with ankylosis of posterior limbs. Dystocia caused by perosomus elumbis fetus a Jersey crossbred cow was treated by cephalectomy followed by mutation operation and traction. Gross examination of fetus revealed fusion of lumbar and sacral vertebrae. Ankylosisof both fore and hind limbs noticed. Atrophy of muscles of the limbs was seen. The scrotum appeared normal and tail was flaccid. Since the size of the fetus was small, it was possible to relieve by per vaginum [37]. Perosomus elumbis with brachynathism [38] and perosomus elumbis fetus along with a mummified fetus [39] in non-descript does were relieved by mutation and forced extraction [38]. Developmental anomalies occur when a threshold of genetic and environmental disturbances is attained and compensatory mechanisms of fetus are overcome. Therefore pure genetic defects can originate from the mother, father or both and environmental tetratogens are numerous which include deficient or excess nutrition, chemicals, drugs, biotoxins, pesticides etc [37, 38, 39].

Arthrogryposis

Arthrogryposis is congenital malformation of fetus characterised by muscular dystrophy and generalized articular rigidity of head, neck and limb joints. Dystocia caused by arthrogryposis live fetus in a Jersey crossbred cow was relieved by caesarean section and the fetus died after 3 hours. The rigidity of limbs may be due to lack of extensibility of the muscles, ligaments or other atrophy resulting from neuropathy. The muscular rigidity may be caused by impaired neurogenic functions and motor activity of neurons in the spinal cord. Severe form of arthrogryposis have been found to have a genetic origin in man [40]. Wry neck is commonly noticed in equine dystocias with transverse pregnancies but rarely observed in bovines. A rare case of dystocia due to wry neck with arthrogryposis multiplex congenita (AMC) was relieved per vaginum in a Jersey crossbred cow [41].

Fetal giantism

True fetal giantism is usually associated with prolonged gestation resulting in dystocia. However at 9th month of gestation in a non-descript buffalo, dystocia occurred due to fetal giantism in posterior presentation with bilateral hip flexion. The dystocia was relieved by the correction of postural abnormality followed by evisceration and traction. Gross examination of the fetus revealed heavy muscular development all over the body. The fetal body was bare without skin. The lower jaw was underdeveloped indicating brachynathism. The fetus had reduced fat deposits, light bone, thin skin and excessive muscles indicative of fetal giantism due to muscular hypertrophy [42]. Dystocia due to muscular

hypertrophy of the fetus in a graded Murrah buffalo was relieved through caesarean section and the neck of the fetus was excessively enlarged due to the presence of large, firm, spherical masses fully covered by skin. The masses consisted of markedly enlarged muscles in the area of left splenius and right serratus ventralis cervicis muscle with marked deformity of the neck of the fetus. It could be due to massive adipose and fibrous connective tissue replacement of the markedly atrophic left splenius and right serratus ventralis cervicis muscle [43]. Fetal giantism in a Sirohi doe was also reported and treated with caesarean section and fetal weight was 8.37 kgs [44].

Bull dog monster

A bull dog monster fetus has a deformed fetus, compressed skull, flat head with a short nose and sloping fore head with short and stumpy limbs, a nose divided by furrows and a shortened upper jaw, giving a bull dog facial appearance. Bull dog calf is generally considered to be due to simple, autosomal recessive defects with some modifiers. Bull dog monster or achondroplastic calf caused dystocia in a Jersey crossbred cow on its second parity was delivered after amputation of head followed forced extraction and the weight of the fetus was 27.5 kgs [45]. Bull dog monster in a non-descript buffalo was relieved by assisted vaginal delivery in a non-descript buffalo [46]. The bull dog calf may be confused with fetal anasarca in which there is accumulation of fluid in the subcutaneous tissues and body cavities [45, 46]. Bull dog monster with anasarca in an ewe had caused dystocia and the fetus was delivered by caesarean section and the weight of the monster was 7.25 kg [47]. Bull dog monster dystocia with schistocephalus fissilabrus, fetal ascites and anasarca in a doe was treated by combined procedures of abdomenocentosis, mutation operation and traction. Schistocephalus fissilabrus is otherwise called as labium laporium or hare lip is a rare monstrosity [48].

Conjoined twins

Conjoined twins causing dystocias are common in cows and rare in other animals. Conjoined twins are produced from a single ovum and are monozygotic. They develop when incomplete separation occurs after the development of embryonic plate at 8 days. Depending upon the site of fusion/non-separation, the types of the twins may vary [49]. A dicephalus monostomus monster (two heads with single body) in a Jersey crossbred cow was delivered through birth passage following traction by applying obstetrical hook in the inner cantus of eye of one head. Caesarean section may be performed when the hydrocephalus fetus has ankylosed joints [50]. In a graded Murrah buffalo a conjoined twin monster (diplopagus) was fully developed upto term and had duplication at the thoracic region (thoracopagus) with four fore and four hind limbs. Hence, it was a diplopagus, thoracopagus, tetrabrachius and tetrapus monster in a water buffalo [51]. In a Jersey crossbred cow, dystocia due to dicephalus tetrabrachius thoracopagus tetrapus dicaudatus monster was relieved by caesarean section. Duplication of cranial part is common than that of caudal part. The present case was due to non-inherited teratogenic defect of development with early complete duplication of cranial and caudal parts [52]. Dicephalus is an embryonic duplication of the head resulting from incomplete twinning in humans and animals [52]. Monocephalus thoracopagus tetrabrachius tetrapus dicaudatus monster was successfully delivered through birth passage in a Jersey crossbred cow [53]. A double headed dead female fetus was delivered by forced extraction after applying long obstetrical hook in the right inner canthus of the fetus in a Murrah buffalo [54].

Hydrallantois

Hydrallantois or dropsy of allantois is a sporadic pathological condition of dairy cattle and buffaloes affecting late gestation. It accounts for about 80-90% of uterine hydrops and is characterized by a rapid and excessive accumulation of watery, amber colored fluid inside the allantoic cavity over a period of 5 to 20 days giving suspicion for twin or multiple pregnancy [55]. It has been reported in pleuriparous buffaloes [55, 56, 57, 58] and cows [59, 60, 61, 62, 63, 64], primiparous buffalo [65] and heifer [66] and goats [67, 68, 69, 70]. It is usually occurred with a diseased uterus in which most of the caruncles in one uterine horn are not functional and rest of the placentomes are enlarged enormously (hypertrophy) and probably diseased which led to formation of adventitious placenta in bovines. A reduction in the number of cotyledons has also been associated with Hydrallantois. The leathery, edematous placenta with hypertrophied cotyledons and caruncles were typically found in the buffaloes or cows or does affected with hydrallantois [55, 56, 63, 64, 68].The physiopathology of hydrallantois is related to the reduced placental vascularisation which may result in metabolic changes in the placental tissue and fetal membranes, thereby accumulation of fetal fluids occurs. Additionally fetal malformation, fetal hepatic or fetal renal disorders (e.g., hydronephrosis, cystic kidneys), umbilical cord torsion, decreased active transport of sodium across the chorio-allantoic membrane, increased permeability of the chorio-allantoic membrane, hormonal imbalances, Vitamin A deficiency resulting in decreased resistance to infections (compromise the no. of caruncles) and malnutrition cause hydrallantois [64, 70]. The polyurea resulted from the hydronephrosis of fetal kidneys was also a cause for excessive accumulation of the fluid inside the allantoic cavity [64]. If the hydrallantois is not diagnosed and treated early, in advanced conditions the animal is unable to rise and prognosis is hopeless. Increased hydraulic pressure on diaphragm due to excessive abdominal enlargement due to large volume of fluid causes difficulty in breathing there by treatment should be directed towards evacuation of uterus and termination of pregnancy by use of prostaglandins or caesarean. Therefore, hydrallantois is usually treated by terminating the pregnancy using prostaglandin $F_2\alpha$ and corticosteroids [55, 56, 57, 58, 61, 66, 69, 70]. In another clinical case [59], to avoid hypovolemic shock and withdraw the hydallantoic fluid slowly, a rusch catheter was fixed at the level of internal os the cervix by piercing allantoic bag and balloon was inflated with 10 ml of air in a Jersey pluriparous cow affected with hydrallantois at 9th month of gestation. The MTP was done using 25 mg $PGF_2\alpha$ and 40 mg dexamethasone. Since there was no progress in cervical dilatation, CS was performed to relieve dead, female, emphysematous fetus with ascites. Hence, before caesarean or MTP in hydrallantois, allantocentesis using rusch catheter is recommended [59, 61, 62, 64]. Hydrallantois complicated with fetal ascites in a Murrah buffalo heifer was reported [65]. A rare case of hydrallantois due to fetal ascites with cystic kidneys and adventitious placenta was recorded in a Jersey crossbred cow [64]. Excessive volume of fluid accompanied by the presence of a poorly viable, small fetus which was dead or died soon after delivery was noticed in almost all cases of

hydrallantois [55-70]. Further no animal has maintained pregnancy upto full length gestation [55-70]. Hydrallantois predispose to ventral hernia or rupture of prepubic tendon in the affected animals. Rupture of prepubic tendon occurred due to hydrallantois in a three year old pleuriparous goat and two dead foetuses were delivered through laparohysterotomy and life of dam was saved [68]. The common sequelae of hydrallantois are septic metritis and retention of fetal membranes (RFM) immediately after fetal delivery. However no case was suffered from RFM and septic metritis due to the proper antibiotic and fluid therapy [55-70]. Hydrallantois in a 8th month pregnant Murrah buffalo caused bloated bull frog appearance and the fetus had hydronephrosis and ascites [58]. Sagging of abdomen was noticed even after removal of foetuses from uterus through caesarean in a doe [67].

Hysterocele

Hysterocele in bovines may cause dystocia. A pluriparous, 8 months pregnant Jersey cow had traumatic injury due to automobile accident which resulted in left side ventral hysterocele. An elective caesarean was done to save the life of the dam by avoiding future dystocia [71]. Traumatic uterine rupture occurred in a doe due automobile accident during 4th month pregnancy and it caused of the escape of the fetus in to the abdominal cavity (ectopic pregnancy). An emergency laparotomy was performed to remove the fetus and repair the uterine rupture. Timely intervention saved the life of the doe [72].

Rupture of prepubic tendon

It occurs due to violence or trauma, twins, hydrops of fetal membranes, fetal giants in prolonged gestation and veratum poisoning in ewes. It leads to loss of all support of ventral and lateral abdominal wall and support for all the abdominal organs. Thereby the organ exerts the pressure on ventral abdominal vein lead to development of edema on ventral abdominal region. All these features were observed in one HF and two Jersey crossbred cows at their full term pregnancy affected with unilateral ventral hernia due to rupture of prepubic tendons [73]. Further, the attitude was a typical sawhorse one, with the elevation of tail head and the ischial tubercities and a ventral curvature in the loin. Although all the cows were in full term pregnant, considering the prognosis of the case and economy of the farmers, no treatment was indicated, all these three cows were culled. These animals are not fit for further breeding. Rupture of prepubic tendon occurs more commonly in draft mares when compared to light mares. Rarely massive haematomas in the region of the bovine udder may be mistaken for rupture of the prepubic tendon. In the cow caesarean is more successful than in the mare and may possibly be indicated in this condition. In relieving dystocia following rupture of prepubic tendon, rolling the cow or mare on its side or back will aid in bringing the foetus to the pelvic inlet for removal. Usually bilateral rupture of prepubic tendon has been reported [68, 73].

Fetal mummification and maceration

Fetal mummification occurs when the fetus dies due to genetic defects, torsion and compression of umbilical cord, placental defects or very rarely infections during second or third semester of gestation. The incidence is not common in sheep and goats. Dystocia caused by fetal mummification with live foetuses in a primiparous non-descript doe was managed through vaginal delivery. In this case a mummified fetus with bilateral shoulder flexion as a firm immobile mass caused dystocia [74]. In another case, mummified fetus through caesarean section was delivered after 12 hours of expulsion of normal fetus pervaginum due to the closure of cervix. The abdominal palpation and radiography help in this case aided to confirm the presence of fetal skeleton in the uterus [75].During fetal mummification, the corpus luteum remains intact, cervix not dilated, fetal fluids resorbed and fetus become dry and parchment like. In small ruminants this condition is associated with toxoplasmosis, chlamydophila, and border disease and coxiella infection. Ina Mecheriewe dystocia caused by mummified fetus in presence of normal was treated effectively through per-vaginal delivery [76].

Failure of an aborting fetus to be expelled through birth passage, perhaps due to uterine inertia or intrauterine infections leads to fetal emphysema and subsequently maceration of fetus occurs. During such conditions, bacteria reaches the uterus through dilated cervix, and by a combination of putrefaction and autolysis of soft tissues gets digested, leaving behind a mass of fetal bones within the uterus. Incomplete abortion after the third month of gestation is the main reason for a retained fetal bony mass in the uterus of cows and buffaloes. The available literature describes surgical treatment as difficult with a poor prognosis and a low likelihood of successful future pregnancy [77] or even slaughter, for fetal maceration, or per vaginal delivery of a macerated fetus through hormonal therapy. Hence a new technique of hysterotomy through colpotomy combined with cervicotomy for the treatment of fetal maceration in a cow was attempted in one clinical case. The affected cow was restrained by using 3 ml of 2% Lignocaine HCL. Then by inserting the fingers inside the cervical canal through the vagina, the cervix and vagina were pulled upto the level of vulva. First an incision of about 3-4cm was made on the dorsal aspect of vagina using BP blade but that space is not enough to exteriorize the uterus for hysterotomy. So the incision was extended upto the part of the cervix in dorsal aspect by pulling and keeping cervix in tension with William's long obstetrical hook. Then, both the uterine horns were located, grasped firmly and retracted through the cervical and vaginal incisions. The uterus was incised on the greater curvature of both horns to remove the fetal bones. Fetal bones, decomposed muscles and tissue debris were removed from the uterus. Uterine lumen exposed as much as possible and it was washed with normal saline. Then, the incision on the uterus was closed with double layer of Cushings followed by Lembert suture using chromic catgut No. 2. After replacing the uterus in its original position, the incision on the cervix and vagina was closed with simple interrupted suture using chromic catgut No.2 and cow recovered uneventfully after postoperative care [78]. An another case of fetal maceration due to artificial insemination in a six months pregnant buffalo was treated with antibiotics and fluids and bony fragments were removed every day manually through vaginal examination and within a week the buffalo became normal [79].

Vulval stenosis

Dystocia due to congenital vulval stenosis was corrected by dorsal episiotomy operation and delivered a live female fetus [80]. In another study, a non-descript buffalo admitted with the history of abortion with dystocia was examined and diagnosed as a case of dystocia due to abortion complicated with imperfect cervical dilatation and congenital vulval stenosis.

The combined operation of cervicotomy and episiotomy were performed and a dead male emphysematous fetus was delivered by forced traction [81].

Cervico-vaginal prolapse (CVP)

Cervico-vaginal prolapse (CVP) is most commonly observed during last 2-3 months of gestation in bovines. Early attention and treatment of CVP leads to prompt recovery without much complication. But in delayed or neglected cases, vaginal mucus membrane become contaminated and necrosed, accumulation of urine and inflammation and edema increases the size of the prolapsed mass to irreducible mass. Further, pain, continuous straining and restless of the affected cow or buffalo lead to laceration of the prolapsed mass followed by tear which further aggravates the condition and it becomes third degree CVP. Such type of third degree CVP in a buffalo was perfectly reduced by following standard procedures and recurrence was prevented by applying vulval retention suture [82, 83].

CVP usually involve protrusion of the portion of the floor, lateral walls and roof of vagina through vulva along with the cervix and uterus, moving caudally. Although it may be of multiple etiologies but placental estrogen production during latter half of gestation in cows causing relaxation of pelvic ligaments, vulva and vulval sphincter muscles are most feasible proposition although hereditary predisposition may not be neglected. Pessaries consist of a long narrow wine bottle or similar blunt round object inserted into the vagina after replacement [77]. A recent case study [84] describes the management of mishandled cases of postpartum CVP in two dairy cattle by quacks using foreign bodies, one with glass bottle and another with a stainless steel vessel as a recurrence prevention strategy without proper repositioning. Two Jersey cross bred cows one on its first parity (Case 1) and other on its second parity (Case 2) were brought with the history of both the animals calved recently, later showed continuous straining and prolapse of the vagina and cervix. Both the cases were treated by the local quacks, where they failed to reposition the mass to their normal position and prevented the recurrence by suturing the foreign body with the vulva. But due to the irregular reposition, both the animals exhibited continuous straining. The clinical examination revealed both the animals were anorectic with all other vital parameters in the normal range. By opening the suture made on the vulva, a glass bottle tied on its neck attached to the vulval retention suture in one cow and in other a stainless steel vessel. In both the cases, the vulval retention sutures were made in the vulva not in the hair-line which caused irritation in turn continuous straining by the animals. For both the animals, caudal epidural anaesthesia was achieved by injecting 5 ml of 2% Lignocaine hydrochloride into sacrococcygeal space. Before correction of CVP, the entire prolapsed mass was washed with soft soap and prolapsed masses was washed and cleaned with 2% potassium permanganate solution. Urine was relieved using urinary catheter. The prolapsed mass was lubricated with cetrimide cream and repositioned. Further, due to the foreign body, lot of soil and dirt were found in the vagina, which was cleared using intra-vaginal douche with 2% KMnO4 solution. The recurrence prevention was done by vulval retention suture using cross mattress suture pattern in the hair-line. Lacerative wound on the vulva was cleaned, dressed and Oint. Loraxene applied topically. In the reported two cases, the prolapse may be due to increased intra-abdominal pressure and improper feeding management. The cases were mishandled by the local quacks which further complicated the condition. Prompt and early corrective treatment by a veterinarian is suggested for this type of cases [84].

Rarely, vaginal leiomyoma may be confused with CVP in cows. A five year old Jersey cow was brought with the history of protrusion of vagina after 2 months of AI and rectal examination confirmed that the cow was pregnant. The examination of the vagina revealed a round, encapsulated, nodular mass of 12 cm diameter with a well defined neck attached to the left lateral wall of caudal vagina. Surgically the mass was removed and histopathology of the mass confirmed that it is a vaginal leiomyoma and it is a benign tumor. Hence one of the differential diagnoses for CVP is vaginal leiomyoma [85]. An interesting case of peripartum CVP with dystocia was treated effectively by cervicotomy followed by fetal delivery, repair of cervical incision and reduction of CVP in a Jersey crossbred cow [86].

Uterine prolapse

Uterine prolapse occurs as common complication of third stage labour especially in cows and buffaloes. It is an emergency case, which needs immediate treatment otherwise the interference in the blood supply to the prolapsed tissue may result in edema and cyanosis which may eventually lead to gangrene of uterus. Any delay in treatment of uterine prolapse may cause death of the dam due to irritation, inflammation, infection and shock. Total uterine prolapse in a Murrah buffalo [87] and in a Kangeyam heifer [88] was treated by 7Rs principles and both cases were saved. The occurrence is common in pleuriparous, however it was observed in heifer of indigenous Kangeyam breed of Tamilnadu [88]. Improper handling of uterine prolapse may cause rupture of vagina and or uterus and lead to protrusion of various abdominal visceral organs through tear. Protrusion of intestines through ruptured vagina in the mishandled case of uterine prolapse was treated after suturing the laceration and puncture with chromic catgut in a Kangeyam cow and the cow recovered uneventfully [89]. But in another case attended by a quack, improper handling of prolapse of uterus caused protrusion of abdominal viscera through ruptured vagina in a buffalo and the buffalo could not survive due to blood loss and shock [90].

In goats prolapse of uterus following normal or assisted delivery is rare. A non-descript doe suffered from uterine prolapse following normal delivery was treated by elevating the hind quarter by folding the hind limbs at the level of hock joints [91]. Uterine prolapse following abortion was reported in goats [92, 93, 94]. The retention of placenta and uterine inertia which resulted following abortion may be the cause for total uterine prolapse in these cases [93]. Total uterine prolapse after abortion in Sirohi goat was documented [95]. Total uterine prolapse after normal delivery in non-descript goats were also recorded by other investigators [96, 97].

Retained fetal membranes

Retained fetal membranes (RFM) is a common postpartum condition definitely prolonging the calving to conception and calving interval in bovines. Hence, to reduce this interval, RFM affected cows were treated with ovsynch protocol and found first service, second service and overall conception rate as 25, 50 and 75% respectively [98]. In a trial with ovsynch plus mineral mixture has further improved the conception rate [99]. The higher estrus intensity and conception rate were achieved with ovsynch treatment in normally calved and RFM affected cows [100]. The ovsynch protocol influenced the serum

progesterone and estrogen levels and improved the conception rate in RFM affected cows [101]. The increased conception rate in normally calved buffaloes than the RFM affected buffaloes was positively correlated with the healthy endometrial lining and endometrial glandular proliferation in cows [102].

Effect of obstetrical disorders

In cattle, the pathological conditions of female genital tract are most commonly encountered at and after parturition especially following poorly treated obstetrical disorders, producing lesions which may interfere with future fertility. Unilateral tubo-ovarian cyst with bilateral ovariobursal adhesion and perimetritis was reported in a buffalo. Bilateral ovariobursal adhesion results in sterility. In large animal practice, this type of pathological condition could be diagnosed clinically by obtaining detailed breeding history and careful rectal palpation aided with laparoscopic and ultrasonic examination [103].

A non-descript primiparous buffalo treated for retained fetal membranes exhibited repeat breeding syndrome and rectal examination revealed palpable fallopian tubes. PSP dye test indicated the bilateral tubal obstruction. The genital tract was examined after slaughter and confirmed the bilateral hydrosalpinx [104]. Trauma during or after calving in the vestibule of cows may predispose to obstruction of vestibular or bartholin's gland and may result in the development of cystic bartholin's gland [105] and in postpartum cows it should be differentiated from CVP [106]. Vaginal delivery of schistosomus reflexus fetus caused uterine rupture in a Jersey crossbred cow and the rupture was repaired by uterine eversion technique [107]. The various reproductive disorders reported [108] during postpartum periods in bovines could be prevented by attending the obstetrical cases properly.

Conclusions

Various etiological factors, diagnostic procedures, prognostic ideas and therapeutic measures in each obstetrical case presented in this review may help any clinician or veterinarian in the field to follow easily in order to save the life of farm animal to preserve their reproductive life in turn safeguard the rural farmers' economy.

References

1. Selvaraju M, Manokaran S, Prakash S, Ravikumar K, Palanisamy M. Bovine obstetrical management in field practice. Proceedings of Kerela Veterinary Science Congress, 2014, 175-179.
2. Dematawewa CMB, Berger PJ. Effect of dystocia on yield, fertility, and cow losses and an economic evaluation of dystocia scores for Holsteins. Journal of Dairy Science. 1997; 80:754-761.
3. Karthick C, Selvaraju M, Ezakial Napolean R, Doraisamy KA. Incidence of Uterine Torsion and its Occurrence in relation to various factors in cows and Buffaloes. Indian Journal of Animal Reproduction. 2015; 36(2):60-63.
4. Prakash S, Selvaraju M, Ravikumar K, Palanisamy M, Manokaran S, Ezakial Napoleon R. Surgical management of right post cervical uterine torsion during 75 days of gestation in a graded Murrah buffalo. Buffalo Bulletin. 2018; 37(1):93-96.
5. Selvaraju M, Palanisamy M, Ravikumar K, Manokaran S, Ezakial Napolean R. Uterine torsion and fetal maceration in a crossbred cow. Indian Veterinary Journal. 2012; 89:107-108.
6. Prakash S, Selvaraju M, Ravikumar K. Clinical management of post-cervical uterine torsion in a Cow. Intas Polivet. 2014; 15(2):241-242.
7. Karthick C, Selvaraju M, Ezakial Napolean R, Doraisamy KA. Hematological changes during uterine torsion and detorsion in buffaloes. Indian Veterinary Journal. 2016; 93(10):22-25.
8. Velladurai C, Selvaraju M, Ezakail Napolean R. Schaffer's method for the treatment of an ewe with uterine torsion. Indian Journal of Animal Reproduction. 2017; 38(1):106-107.
9. Manokaran S, Selvaraju M, Palanisamy M, Ezakial Napolean R. Uterine torsion in bicornual pregnancy in a goat. Indian Veterinary Journal. 2012; 89:88-89.
10. Selvaraju M, Kathiresan D, Karunakaran M, Veerapandian C. Successful caesarean section in a delayed case of dystocia in a non-descript sow. Indian Veterinary Journal. 2002; 79:956-957.
11. Selvaraju M, Ravikumar K, Senthilkumar S, Palanisamy M, Prabaharan V, Ravi R *et al*. Caesarean section in a Large White Yorkshire gilt, Indian Journal of Field Veterinarians. 2010; 5:39-40.
12. Selvaraju M, Kathiresan D, Karunakaran M, Veerapandian C. Dystocia due to fetal ascites in a non-descript buffalo - A case report. Cheiron. 2001; 30:180.
13. Selvaraju M, Ravikumar K, Palanisamy M, Prabaharan V, Ravi R, Ezakial Napolean R *et al*. Dystocia due to fetal ascites in a graded Murrah buffalo: A case report. Journal of Veterinary and Animal Sciences. 2009; 40:56-57.
14. Palanisamy M, Selvaraju M, Ravikumar K, Chandrahasan C. Fetal ascites in a buffalo. Indian Veterinary Journal. 2007; 84:1317-1318.
15. Ravikumar K, Selvaraju M, Kumarasen A, Sivaraman S. Dystocia due to fetal ascites in Jersey crossbred cow - A case Report. Shanlax International Journal of Veterinary Science. 2013; 1:32-33.
16. Prakash S, Selvaraju M, Ravikumar K, Palanisamy M, Manokaran S. Dystocia due to fetal ascites in bovines - a report of three cases. Indian Veterinary Journal. 2016; 93(12):58-59.
17. Madheswaran R, Palanisamy M, Manokaran S, Sivaseelan S, Balasubramanian GA, Vijayakumar G *et al*. Congenital Nephroblastoma in a Holstein-Friesian fetus - Case report. Veterinarski Arhiv. 2014; 84(2):199-204.
18. Palanisamy M, Manokaran S, Selvaraju M, Madheswaran R, Ravikumar K. Dystocia due to fetal ascites with Nephroblastoma in a Jersey Crossbred cow. Indian Veterinary Journal. 2016; 93(6):58-59.
19. Prakash S, Selvaraju M, Ravikumar K, Palanisamy M, Manokaran S. Dystocia due to fetal ascites with brachynathism in a doe. Indian Veterinary Journal. 2017; 94(2):66-67.
20. Selvaraju M, Vijay D, Chandrahasan C. A case of fetal anasarca in a sheep. Indian Veterinary Journal. 2004; 81:590-591.
21. Selvaraju M, Palanisamy M, Ravikumar K, Prabaharan V, Ravi R, Ezakial Napolean R *et al*. Dystocia due to fetal anasarca with ascites in a sheep- A case report. Journal of Veterinary and Animal Sciences. 2008; 39:62-63.
22. Palanisamy M, Selvaraju M, Ravikumar K, Ezakial Napolean R, Chandrahasan C. Dystocia due to fetal

hydrocephalus in a cow, Indian Veterinary Journal. 2007; 84(10):1091.
23. Prakash S, Selvaraju M, Ravikumar K, Palanisamy M. Obstetrical management of fetal hydrocephalus in a Kangeyam cow. Indian Veterinary Journal. 2016; 93(9):85-86.
24. Selvaraju M, Parthasarathy N, Varudharajan V, Prakash S, Ravikumar K. Dystocia due to live hydrocephalic fetus in a Jersey crossbred cow. International Journal of Current Microbiology and Applied Sciences. 2020; 9(06):1029-1032.
25. Selvaraju M, Richard Jagatheesan PN, Chandrahasan C. Dystocia due to fetal hydrocephalus in a non-descript goat. Tamil Nadu Journal of Veterinary and Animal Sciences. 2006; 2:255-256.
26. Selvaraju M, Ezakial Napolean R, Ravikumar K, Palanisamy M, Prabaharan V, Ravi R *et al*. Dystocia due to schistosomus reflexus in a cow: A case report. Journal of Veterinary and Animal Sciences. 2010; 41:71-72.
27. Selvaraju M, Kumaresan A, Ravikumar K, Sivaraman S, Manokaran S, Prakash S. Schistosomus Reflexus Fetus in a Cow - A Case Report. Shanlax International Journal of Veterinary Science. 2013; 1:28-29.
28. Velladurai C, Selvaraju M, Ezakial Napolean R. Dystocia due to schistosomus reflexus in a Crossbred Jersey cow-A case report. The Indian Journal of Veterinary Sciences and Biotechnology. 2015; 10(4):80-81.
29. Alagar S, Prakash S, Selvaraju M, Manokaran S, Ravikumar K, Palanisamy M *et al*. Dystocia due to schistosomus reflexus fetus in a Jersey crossbred heifer Tamil. 2nd National tamil conference – Veterinary Clinical section, TNAU, August, 2016, 65-67.
30. Prakash S, Selvaraju M, Ravikumar K, Palanisamy M. Dystocia due to schistomus reflexus fetus in heifers. A report of two cases. Indian Veterinary Journal. 2017; 94(2):79-80.
31. Manokaran S, Selvaraju M, Prabhakaran V, Senthilkumar K, Ezakial Napolean R, Palanisamy M. Per vaginal delivery of schistosmus reflexus monster fetus by cervicotomy in a Cow. International Journal of Livestock Research. 2014; 4(5):52-54.
32. Palanisamy M, Manokaran S, Vikramachakravarthi P, Ezakial Napolean R, Selvaraju M, Prakash S. Dystocia due to schistosomus reflexus in a Holstein Friesian crossbred heifer. Indian Veterinary Journal. 2018; 95(02):51-52.
33. Varudharajan V, Selvaraju M, Prakash S, Ravikumar K, Gopi Krishnan D, Senthilkumar K. Dystocia due to Schistosomus Reflexus Holstein Friesian Fetal Monster in a Gir Heifer. International Journal of Current Microbiology and Applied Sciences. 2019; 8(07):1190-1192. doi: https://doi.org/10.20546/ijcmas.2019; 807.141.
34. Manokaran S, Senthilkumar K, Selvaraju M, Prakash S, Palanisamy M, Jayachandran S. Dystocia due to schistosmus reflexus in a Jersey crossbred heifer affected with narrow pelvis. Indian Veterinary Journal 95. 2018; (08):54-55.
35. Ravikumar K, Selvaraju M, Kumaresan A, Sivaraman S. Schistosomus Reflexus in a Doe - A Case Report. Shanlax International Journal of Veterinary Science. 2013; 1:30-31.
36. Ravikumar K, Selvaraju M, Kumaresan A, Sivaraman S, Prakash S, Lavanya C. Dystocia due to Schistosomus Reflexus along with vaginal tear in a Tellicherry doe. Indian Veterinary Journal. 2014; 91(9):99-100.
37. Selvaraju M, Ravikumar K, Manokaran S, Palanisamy M, Ezakial Napolean R. Dystocia due to perosumus elumbis in a crossbred cow. Indian Veterinary Journal. 2012; 89:106-107.
38. Palanisamy M, Manokaran S, Selvaraju M, Ravikumar K, Kumaresan A. Dystocia due to Perosomus Elumbis with Brachygnathism in a Non-Descript Doe. Indian Veterinary Journal. 2016; 93(2):61-63.
39. Prakash S, Selvaraju M, Ravikumar K, Manokaran S, Senthilkumar K. Dystocia due to perosomus elumbis along with a mummified fetus in a non-descript doe, Indian Veterinary Journal. 2018; 95(10):60-61.
40. Selvaraju M, Palanisamy M, Kumaresan A, Ezakial Napolean R, Chandrahasan C. Dystocia due to Arthrogryposis fetus in a cross bred cow, Indian Veterinary Journal. 2009; 86:299-300.
41. Prakash S, Selvaraju M, Ravikumar K, Palanisamy M, Manokaran Sand Ezakial Napolean R. Dystocia due to Wry Neck with Arthrogryposis Multiplex Congenita (AMC) in a Jersey crossbred cow. Indian Veterinary Journal. 2016; 93(3):62-63.
42. Palanisamy M, Selvaraju M, Manokaran S, Ezakial Napolean R. Dystocia due to fetal giantism caused by muscular hypertrophy in a buffalo. Indian Veterinary Journal. 2012; 89:83-84.
43. Prabaharan V, Jayakumar K, Selvaraju M, Manokaran S, Ezakial Napolean R. Dystocia Due to Muscular Hypertrophy in a Graded Murrah Buffalo. Shanlax International Journal of Veterinary Science. 2013; 1:45-46.
44. Manokaran S, Palanisamy M, Selvaraju M, Prabaharan V, Ezakial Napolean R. Dystocia due to fetal giantism with brachygnathism in a Sirohi ewe, Indian Veterinary Journal. 2015; 92(7):66-67.
45. Manokaran S, Palanisamy M, Ravikumar K, Prabaharan V, Ezakial Napolean R, Selvaraju M. Dystocia due to bull dog calf in a Jersey crossbred cow. Indian Veterinary Journal. 2012; 89:81-82.
46. Prabaharan V, Jayakumar K, Kathirvel S, Selvaraju M, Dharmaceelan S. Dystocia Due to Bull Dog Calf in a Non-Descript Buffalo. Shanlax International Journal of Veterinary Science. 2013; 1:43-44.
47. Manokaran S, Selvaraju M, Palanisamy M, Ezakial Napolean R, Ravikumar K *et al*. Dystocia due to bull dog monster with fetal anasarca in an ewe. Indian Veterinary Journal. 2013; 90(5):96-97.
48. Selvaraju M, Varudharajan V, Prakash S, Ravikumar K, Senthilkumar K. Bull dog monster Dystocia with schistocephalus fissilabris, fetal ascites and anasarca in a doe. Indian Veterinary Journal. 2018; 95(11):57-58.
49. Prakash S, Selvaraju M, Ravikumar K, Manokaran S, Senthilkumar K. Per-vaginal delivery of dicephalus, monostomus, tetraophthalmus monster in a non-descript cow. Indian Veterinary Journal. 2018; 95(09):56-57.
50. Chandrahasan C, Krishnakumar K, Selvaraju M, Richard Jagatheesan PN, Ramesh Saravanakumar V. Dystocia due to dicephalus, monostomus monster in a crossbred cow. Indian Journal of Animal Reproduction. 2003; 24:175.
51. Selvaraju M, Kathiresan D, Veerapandian C. Dystocia due to conjoined twin Monster in a buffalo. Indian Veterinary Journal. 2002; 79:721-722.
52. Ravikumar K, Selvaraju M, Manokaran S. Dystocia due

to dicephalus, tetrabrachius thoracopagus tetrapus dicaudatus monster in a Jersey crossbred cow. Indian Veterinary Journal. 2012; 89:96-97.
53. Alagar S, Velladura C, Selvaraju M. Successful per-vaginal delivery of rare fetal monster in Jersey crossbred cow. Indian Veterinary Journal. 2018; 95(09):54-55.
54. Thangadurai R, Selvaraju M. Dystocia due to double headed monster fetus in Murrah buffalo under field condition, Indian Veterinary Journal. 2015; 92:61-62.
55. Manokaran S, Ravikumar K, Ezakial Napolean R, Palanisamy M, Selvaraju M. Hydrallantois in a non-descript buffalo; a case report. Indian Journal of Field Veterinarians. 2011; 7:69.
56. Selvaraju M, Manokaran S, Palanisamy M, Ezakial Napolean R, Ravikumar K. Hydroallantois in a she buffalo. Indian Journal of Animal Reproduction. 2012; 33:92-93.
57. Palanisamy M, Selvaraju M, Manokaran. Therapeutic management of hydrallantois in a buffalo. Intas Polivet. 2014; 15(2):219-220.
58. Palanisamy M, Madheswaran R, Selvaraju M, Ezakial Napolean R, Manokaran S, Ravikumar K. Hydrallantois in a buffalo due to fetal hydronephrosis, Indian Veterinary Journal. 2015; 92(8):60-62.
59. Napolean RE, Palanisamy M, Selvaraju M, Manokaran S. Successful management of hydrallantois in a Jersey crossbred cow. International Journal of Livestock Research. 2012; 2:213-216.
60. Manokaran S, Ezakial Napolean R, Palanisamy M, Selvaraju M. Hydrallantois in a Jersey crossbred cow: A case report. Indian Veterinary Journal. 2012; 89:86-87.
61. Velladurai C, Ezakial Napolean R, Selvaraju M. Management of Hydrallantois in a Jersey crossbred cow by transcervical allantocentesis. Indian Veterinary Journal. 2016; 93(4):66-68.
62. Manokaran S, Ezakial Napolean R, Palanisamy M, Selvaraju M, Prakash S. Clinical management of hydrallantois in a cow using transcervical allantocentesis. International Journal of Science, Environment and Technology. 2016; 5(4):1888-1892.
63. Prakash S, Selvaraju M, Ravikumar K, Palanisamy M, Manokaran S, Ezakial Napoleon R. Hydrallantois and management in a Jersey crossbred cow – Tamil. 2nd National Tamil conference - Veterinary Clinical section, TNAU, 2016, 62-64.
64. Varudharajan V, Selvaraju M, Ravikumar K, Prakash S. Clinical management of hydrallantois due to fetal ascites with cystic fetal kidneys and adventitious placenta by trans-cervical allantocentesis in a crossbred Jersey cow. Global Journal of Bio-sciences and Biotechnology. 2019; 8(02):231-234.
65. Prakash S, Selvaraju M, Ravikumar K, Manokaran S, Palanisamy M, Ezakial Napoleon R. Hydrallantois complicated with fetal ascites in a primiparous graded Murrah buffalo. Buffalo Bulletin. 2018; 37(1):97-100.
66. Prakash S, Selvaraju M, Ravikumar K, Ezakial Napoleon R. Clinical management of hydrallantois in a heifer. Intas Polivet. 2014; 15(2):215-216.
67. Vijayakumar G, Selvaraju M, Chandrahasan Cand, Subramanian M. Hydrallontois in a doe. A case report. Indian Veterinary Journal. 2001; 78:735-736.
68. Selvaraju M, Ravikumar K, Palanisamy M, Prabaharan V, Ezakial Napolean R, Ravi R *et al*. Rupture of prepubic tendon due to Hydrallantois in a goat: A case report. Journal of Veterinary and Animal Sciences. 2010; 41:64-65.
69. Alagar S, Velladurai C, Manivannan S, Selvaraju M. Successful Management of Hydroallantois in a Non-Descriptive Goat. International Journal of Current Microbiology and Applied Sciences. 2017; 6(11):4095-4099.
70. Palanisamy M, Manokaran S, Selvaraju M, Ezakial Napolean R. Hydrallantois in a non-descript goat. Indian Veterinary Journal. 2012; 89:101-102.
71. Manokaran S, Ravikumar K, Ezakial Napolean R, Palanisamy M, Selvaraju M. Traumatic ventral hysterocele in a Jersey crossbred cow - A case report. Indian Veterinary Journal. 2012; 89:91-92.
72. Manokaran S, Palanisamy M, Selvaraju M, Ezakial Napolean R. Traumatic uterine rupture in a non-descript doe. Indian Veterinary Journal. 2013; 90(1):90-91.
73. Prakash S, Selvaraju M, Ravikumar K. Unilateral rupture of prepubic tendon in cattle - a report of three cases. Indian Veterinary Journal. 2016; 93(9):66-67.
74. Prakash S, Selvaraju M, Ravikumar K, Sivaraman S, Palanisamy M. Dystocia due to fetal mummification along with a live fetus in a non-descript doe. Journal of Indian Veterinary Association. 2016; 14(1):89-90.
75. Selvaraju M, Krishnakumar K, Chandrahasan C, Vijay D. A case of fetal mummification in a non-descript doe. Cherion. 2004; 33:58.
76. Alagar S, Prakash S, Selvaraju M, Ravikumar K, Manokaran S. Papyraceous type of mummification leading to dystocia of a normal fetus in Mecheri ewe. Indian Journal of Animal Reproduction. 2017; 38(1):62-63.
77. Roberts SJ. Diseases and accidents during the gestation period. Diagnosis and treatment various types of dystocia. Injuries and diseases of the puerperal period. In: Veterinary Obstetrics and Genital Diseases (Theriogenology), Woodstock, 1986, VT, 230-359.
78. Prakash S, Selvaraju M, Ravikumar K, Manokaran S, Palanisamy M. Hysterotomy through colpotomy combined with cervicotomy for the treatment of fetal maceration in a cattle. Indian Journal of Animal Reproduction. 2017; 38(1):60-61.
79. Palanisamy M, Madheswaran R, Manokaran S, Selvaraju M, Ezakial Napolean R, Sivaseelan S. An unusual case of fetal maceration in a buffalo, Indian Veterinary Journal. 2014; 91(9):84-85.
80. Prakash S, Selvaraju M, Ravikumar K, Palanisamy M, Manokaran S, Ezakial Napoleon R. Congenital vulval stenosis and its surgical management by dorsal episiotomy in a crossbred heifer – Tamil. 2nd National Tamil cinference – Veterinary Clinical section, TNAU, 2016, 58-61.
81. Prakash S, Selvaraju M, Ravikumar K, Palanisamy M, Manokaran S, Ezakial Napoleon R. Combined technique of cervicotomy and episiotomy to deliver aborted fetus complicated with imperfect cervical dilatation and congenital vulval stenosis in a non-descript buffalo heifer. Buffalo Bulletin. 2018; 37(1):89-91.
82. Manokaran S, Palanisamy M, Selvaraju M, AbinayaSelvi R, Ravikumar K, Ezakial Napolean R. Management of third degree vagino-cervical prolapse and ruptured vulval lips in a non-descript buffalo. Buffalo Bulletin. 2012; 31:180-182.
83. Manokaran S, Selvaraju M, Palanisamy M. Management

of vagino-cervical prolapse with multiple vaginal tear in a buffalo. Intas Polivet. 2014; 15(2):468-469.
84. Varudharajan V, Selvaraju M, Prakash S, Ravikumar K. Management of Mishandled Cases of post-partum vagino-cervical prolapse by recurrence prevention with foreign body in two cows. International Journal of Current Microbiology and Applied Sciences. 2019; 8(05):68-71.
85. Selvaraju M, Manokaran S, Palanisamy M, Ezakial Napolean R, Ravikumar K, Prabaharan V *et al*. Vaginal Leiomyoma in a Jersey Crossbred Cow. Shanlax International Journal of Veterinary Science. 2013; 1:40-42.
86. Palanisamy M, Manokaran S, Ponnusamy KK, Selvaraju M, Vikramachakravarthi P, Ezakial Napolean R *et al*. Peripartum vagino-cervical prolapse with dystocia in a Jersey crossbred cow. Indian Veterinary Journal. 2018; 95(04):86-88.
87. Prakash S, Ravikumar K, Selvaraju M, Palanisamy M, Manokaran. Total uterine prolapse in a Murrah buffalo. Kerela Veterinary Science Congress, 2014, 235-236.
88. Prakash S, Selvaraju M, Manokaran S, Ravikumar K, Palanisamy M. Obstetrical management of total uterine prolapse in a Kangeyam heifer. International Journal of Science, Environment and Technology. 2016; 5(4):1952-1954.
89. Selvaraju M, Prakash S, Ravikumar K, Manokaran S, Palanisamy M, Senthilkumar K. Prolapse of the intestines through ruptured vagina and total uterine prolapse in a Kangayam cow. Indian Veterinary Journal. 2019; 96(03):62-63.
90. Selvaraju M, Veerapandian C, Kathiresan D, Kulasekar K, Chandrahasan C. Prolapse of uterus and abdominal viscera with vaginal tear in a buffalo. Indian Journal of Animal Reproduction. 2010; 31:70.
91. Selvaraju M, Vijayanand KR, Parthiban R, Vijay D, Richard Jagatheesan PN. Post-partum uterine prolapse in a doe. Indian Journal of Animal Reproduction. 2004; 25:74-75.
92. Palanisamy M, Selvaraju M, Ravikumar K, Chandrahasan C. Uterine eversion after abortion in a goat, Tamil Nadu Journal of Veterinary and Animal Sciences. 2007; 3:278-279.
93. Selvaraju M, Ravikumar K, Palanisamy M, Prabaharan V, Ezakial Napolean R, Ravi R *et al*. Total uterine prolapse after abortion in a goat. Indian Journal of Field Veterinarians. 2010; 5:73.
94. Palanisamy M, Manokaran S, Selvaraju M, Ezakial Napolean R. Uterine prolapse following abortion in a non-descript goat. Indian Veterinary Journal. 2012; 89:99-100.
95. Manokaran S, Selvaraju M, Palanisamy M, Ezakial Napoleon R. Management of uterine prolapse in a aborted doe. Intas Polivet. 2014; 15(2):450-451.
96. Thangadurai R, Selvaraju M. Management uterine prolapse in a non-descriptive in field condition. Indian Veterinary Journal. 2016; 93(1):54-56.
97. Velladurai C, Selvaraju M, Ezakial Napolean R. Postparturiant total uterine prolapse and its management in a goat. Indian Veterinary Journal. 2016; 93(11):60-61.
98. Velladurai C, Ezakial Napolean R, Selvaraju M, Doraisamy KA. Ovsynch protocol for improving oertrus and conception rate in retained fetal membrane (RFM) affected cows. Intas Polivet. 2015; 16(1):59-61.
99. Velladurai C, Ezakial Napolean R, Selvaraju M, Doraisamy KA. Inclusion of mineral mixture in ovsynch protocol improves conception rates in postpartum dairy cows. Intas Polivet. 2016; 17(1):56-57.
100. Velladurai C, Ezakial Napolean R, Selvaraju M, Doraisamy KA. Pattern of induced oestrus and conception rate following ovsynch programme in retained fetal membranes affected and normally calved cows. Indian Veterinary Journal. 2015; 92:84-86.
101. Velladurai C, Ezakial Napolean R, Selvaraju M. Ovsynch treatment protocol improved the conception rate in retained fetal membranes (RFM) treated cows. Indian Veterinary Journal. 2018; 95(09):24-25.
102. Velladurai C, Selvaraju M, Ezakial Napolean R. Study of histopathological changes of uterine endometrium and conception rate in normally calved and retained fetal membranes (RFM) treated cows, Indian Veterinary Journal. 2018; 95(10):36-39.
103. Joearosh A, Narayanan K, Selvaraju M, Balasubramanian S, Kathiresan D, Devanathan TG. Unilateral tubo-ovarian cyst with bilateral ovariobursal adhesion and perimetritis in a buffalo. Indian Journal of Animal Sciences. 2000; 70:43-44.
104. Selvaraju M, Vijayanand KR, Parthiban R, Veer Vikram Malhotra, Vijay D. Bilateral hydrosalpinx in a she buffalo. Indian Veterinary Journal. 2004; 81:100-101.
105. Selvaraju M, Palanisamy M, Prabaharan V, Ravikumar K, Ravi R, Chandrahasan C. Cystic Bartholin's gland in Jersey crossbred cow – A Case report. Indian Journal of Field Veterinarians. 2010; 5:74.
106. Manokaran S, Sivasankar K, Palanisamy M, Selvaraju M, Ezakial Napolean R. Unilateral bartholin's gland cyst in a Holstein Friesian crossbred cow. International Journal of Livestock Research. 2014; 4(9):48-50.
107. Alagar S, Manivannan S, Selvaraju M, Manokaran S, Ravikumar K. Repair of uterine rupture by eversion technique following schistosomus reflexus fetus delivery in a Jersey crossbred cow. Veterinary Science Research Journal. 2017; 8(1&2):38-40.
108. Selvaraju M, Veerapandian C, Kathiresan D, Chandrahasan C. Incidence of bovine reproductive disorders. Indian Veterinary Journal. 2005; 82:556.