Perspectives of fetal dystocia in cattle and buffalo

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Abstract

We review the causes of fetal dystocia in cows and buffalo. Two fetal causes are distinct fetal oversize and fetal abnormalities. Fetal oversize is common in heifers, cows of beef cattle breeds, prolonged gestations, increased calf birth weight, male calves and perinatal fetal death with resultant emphysema. Fetal abnormalities include monsters, fetal diseases and fetal maldispositions, and it is difficult to deliver such fetuses because of their altered shape. Although monsters are rare in cattle, a large number of monstrosities have been reported in river buffalo; yet also here, overall incidence is low. Diseases of the fetus resulting in dystocia include hydrocephalus, ascites, anasarca and hydrothorax. The most common cause of dystocia in cattle seems to be fetal maldispositions, of which limb flexion and head deviation appear to be the most frequent. We provide a brief description of the management of dystocia from different causes in cattle and buffalo. A case analysis of 192 and 112 dystocia in cattle and buffalo, respectively, at our referral center revealed that dystocia is significantly higher (P<0.05) in first and second parity cows and buffalo, and that dystocia of fetal origin is common in cows (65.62%) but less frequent (40.17%) in buffalo. In buffalo, the single biggest cause of dystocia was uterine torsion (53.57%). Fetal survival was significantly (P<0.05) higher both in cows and buffalo when delivery was completed within 12 h of second stage of labor.

Introduction

Dystocia is defined as delayed or difficult calving, sometimes requiring significant human assistance.[1-3] It has a considerable impact on production and future reproduction of dairy[4-8] and beef[9,10] cows. It generally has a lower incidence in buffalo but still has a considerable impact on buffalo production (1-2%).[11,12] However, Khan *et al.*[13] analyzed the incidence of abnormal calvings in buffalo in various reports and found it to be between 5.6-12.6% in Murrah, 8.94% in Jaffarabadi and between 4.6 to 5.4% in Surti buffalo.

The reasons for such a low incidence in buffalo could be due to anatomical differences between cattle and buffalo. Buffalo have a more capacious pelvis, larger area of ileum, a free and easily separable fifth sacral vertebra,[14] easily dilatable small sized vaginal canal, and elongated and wide apart vulvar lips.[15] These anatomical differences mean that the first and second stages of labor in the buffalo can easily be completed within 20-70 min.[14,16,17]

The causes of dystocia have been described from a number of perspectives; either based on analysis of a large number of calving records in dairy[8,18-20] and beef cows[9,10,21,22] or on the basis of clinical findings.[23-25] Most reports of buffalo come from clinical data.[26-28] A large number of risk factors for dystocia have been identified.[2,4] It has also been recognized that the introduction of large sized beef bulls like Charolais and Simmental[10,21,29-31] and the Holstein Friesian bulls in dairy cows[18,32,33] has resulted in an increased incidence of dystocia, probably due to an increase in the body weight of the calf and the change in its shape. Such effects have not been documented for buffalo. A common finding in most studies is that dystocia is more frequent in the primiparous heifers[3,9,19,20,34,35] and that fetopelvic disproportion is the main cause of dystocia in heifers, whereas fetal maldispositions are common in pleuriparous cows.[33] The two major determinants of fetopelvic disproportions are calf birth weight and maternal pelvic size.[33,35,36] Many authors have described the causes of increased fetal weight[6,8,10,19,37] and attempts to reduce the incidence of dystocia have also been mentioned.[35,38-41] This study analyzes the causes of fetal oversize and the fetal abnormalities causing dystocia in cattle and buffalo, and their management. A critical evaluation is also made of the type of cases presented at our referral center.

Fetal dystocia

Studies on cattle indicate that the fetus is the major cause of dystocia[23-25,42,43] and abnormal fetal presentations at birth contribute to 1-5% of total dystocia cases.[22,44,45] In contrast, fetal origins of dystocia are less frequent in buffalo.[27]

Broadly speaking, the fetal origins of dystocia in cattle can be divided into those caused by excessive fetal size relative to the maternal pelvis (fetopelvic disproportion) and those caused by abnormalities of the fetus (fetal monsters, fetal diseases and fetal maldisposition).[46,47] Thus, in this study, fetal dystocia is reviewed according to fetal oversize and fetal abnormalities.

Fetal oversize

The most common cause of dystocia in cattle is fetopelvic disproportion.[46,48] This is most common in heifers when the fetus is of normal size for its breed but the maternal pelvis is not big enough, or the fetus is unusually large and cannot be delivered through a pelvic canal of normal size.[46] Mating between various breeds of cows may result in an increased incidence of dystocia due to fetopelvic disproportion.[49,50] Dystocia rates vary enormously between individual bulls of the same breed and this difference is many times greater than that which exists between breeds.[50] Similar differences are possibly also seen in buffalo. Birth weight, double muscling, maternal nutrition and pelvic capacity all affect fetal delivery and must be taken into consideration. Dystocia in double muscled cows is caused by the modified calf morphology that is induced by the muscular hypertrophy.[51] Thus, cesarean deliveries are required for 89.5% of the parturitions in Belgian Blue cows.[52] Excessively large sized fetuses can occur with prolonged gestation periods and such conditions are likely to occur with prolonged progesterone therapy, especially during mid- or late gestation.[53] Oversized fetuses cannot be delivered normally and, therefore, the decision to relieve dystocia either by fetotomy or cesarean delivery would depend on the condition of the fetus and/or the dam. Grossly oversized fetuses in a narrow birth canal must be removed by cesarean section. An attempt can be made to remove dead

oversized fetuses in a relaxed birth canal by fetotomy but if this fails, caesarean section is the last resort.

There are various reasons for fetal oversize, such as calf birth weight, calf sex, twins, and fetal death and emphysema. Some of these are described here.

Calf birth weight

A large number of studies conducted on dairy[3,8,19,35] and beef[10,54] cows point out that the calf birth weight, especially in 2-year old first calving heifers, significantly affects the difficultly in calving. In Holsteins, a 1 kg increase in calf birth weight increased the probability of dystocia by 13.0%.[19] The breed of the sire and the dam, along with genetic traits of both parents, play the most important role in determining birth weight.[36] Since birth weight is to some extent inheritable, the selection of bulls with low birth weights would be advantageous, but this would reduce subsequent growth rates. Attempts to modify birth weights of calves at calving without altering their subsequent growth rates have aimed at identifying the expected progeny difference (EPD) by using different bulls in the same breed. However, such attempts are expected to reduce, but not eliminate, difficulty in calving. Because EPDs are not comparable across breeds, selection of a sire on the basis of a low or negative EPD for birth weight may not be reliable if the heifer and sire are of different breeds.[46]

A few studies have observed that a large number of sires of two beef breeds (Charolais and Simmental)[29-31,34] and one dairy breed (Holstein)[3,18,33] contributed to an increased incidence of dystocia due to heavy birth weight of their calves, whereas Angus and Jersey breed sires reduce the incidence of dystocia due to lower calf birth weights.[31,55]

A comparatively novel aspect of fetal oversize is the *large offspring syndrome* in which a calf is the result of *in vitro* embryo production technologies.[56] Embryos are exposed to a variety of unusual environments during their growth which results in gross abnormalities of several organs, including increased muscle mass and alterations in muscle fibre.[57] The most striking feature of the syndrome is the large size of these calves at birth, resulting in increased frequencies of calving difficulties.[58]

In buffalo, fetal causes of dystocia are less frequent[27,59] and, surprisingly, in one study, dystocia was less frequent in primiparous (21.13%) compared to multiparous (78.87%) buffalo.[60] Buffalo are older at first calving, ranging from 36-52 months in different breeds.[61-66] This provides greater time for the pelvis of first calving heifers to develop. Moreover, calves born to second parity buffalo are heavier than all other parities[67] and the average birth weight of buffalo calves is lower

compared to Friesian cows.[64] Therefore, birth weight is a less frequent cause of dystocia in buffalo. However, there are no data available comparing breeding of heavier breeds, like Murrah or Nili Ravi, with the smaller breeds, like Surti, regarding the incidence of dystocia and calf birth weight.

Sex

Male calves are known to require more assistance at calving compared to female calves.[18,19,21,28,34] In addition, gestations with male calves are longer, which also influences the risk of dystocia.[68] Holstein male calves had a 40.0% higher incidence of dystocia.[69] The rate of dystocia for male and female calves differs between heifers and cows.[70] A few studies[22,30] have, however, observed that sex of the calf had little influence on dystocia in cows. The causes of dystocia are complex, and no more than 50% of the total variation in dystocia can be explained by factors that can be defined or measured.[41]

Twins

In general, multiple calvings are more difficult than single ones.[2,8] Cows with twins have a shorter gestation length and more dystocia.[71,72] Twin calves are known to be lighter in weight compared to single births.[73] However, the higher incidence of dystocia with twin births is due to malpresentation of one fetus[73] or simultaneous presentation of both fetuses.[74-76] Twins also reduce the breeding efficiency of dairy and beef cows.[77] Twin calvings in Holsteins resulted in 10.5 times higher probability of dystocia compared to single calvings.[69] Jersey and Holstein Friesian cows showed a similar trend.[6] The presence of simultaneous presentation of twin pregnancies should be diagnosed carefully, also to avoid misinterpreting monsters as twins, and one fetus should be repelled while the other is delivered by traction.

Fetal death and emphysema

It is difficult to show univocally whether intrauterine fetal death leads to dystocia or dystocia increases the chance of stillbirths.[78] It is thought that the death of a calf before the start of expulsion significantly increases the risk of malpresentation.[2] According to Johanson and Berger,[19] 49% of perinatal mortality was associated with unassisted births. Fetal death may result in an increase in fetal size due to putrefaction of the fetus and accumulation of gases in the subcutaneous tissue in the following 24-72 h.[27] This is known as fetal emphysema.

Emphysema is the sequel of all conditions resulting in fetal death or uterine inertia. It has also been observed in prolonged cases of uterine torsion and septic metritis. Fetal emphysema should always be suspected in prolonged cases of dystocia exceeding over 24 h.

After such prolonged cases, abdominal contractions are weak and intermittent for a few hours and then cease completely.[27,79] Fetid watery discharge may be seen and the vaginal mucus membrane is usually dry, swollen and inflamed. The uterine wall may be tightly contracted around the fetus and the cervix may also be contracted, especially in cows and less often in buffalo. The fetus is dead and swollen, and the crepitating feel is readily palpable. It may often be difficult to palpate the position and presentation of the fetus due to swollen limbs. Fetal emphysema is found fairly frequently in buffalo but reports are available only for river buffalo.[79] Invasion by microorganisms from the vagina is the common cause of emphysema in dead fetuses.

In these cases, prognosis is reserved because of the possible complications.[27] If the fetus is presented properly and in the correct position, large quantities of lubricant should be infused and the fetus removed by traction. In fetal maldispositions, it may be necessary to relieve the gas by deep incisions and/or partial fetotomy (which is easier) followed by correction of position and removal of the fetus by traction. Care and attention should be given to the general condition of the dam before handling. Cesarean section should only be considered as a last resort because of the potential dangers of developing peritonitis.

Fetal abnormalities

Fetal monstrosities

Mild developmental abnormalities of the ovum, embryo or fetus result in structural abnormalities in the fetus leading to *monstrosities*. Organic deviation in either structure or form or both, in one or several parts of the body, is known as monster. Most of the anomalies occur in early stage of cell differentiation when the conceptus is subjected to genetic and maternal influences. Hereditary defects due to autosomal recessive genes are common. Monstrosities are common in the buffalo. The incidence of monstrosities reported for cow is 0.5%,[80] whereas an incidence of 7.9%[26] to 12.8%[81] has been reported for river buffalo. Most of the monstrosities reported in buffalo are related to river buffalo; there are very little data available on swamp buffalo.

Fetuses with congenital defects are dead at birth, and anomalies of muscular skeletal and nervous systems are common in monsters. Dystocia due to monsters is usually relieved by cesarean section since fetotomy is of limited usefulness except in a few monsters. A large number of monstrosities have been reported both in cattle and buffalo but not all result in dystocia. It may be difficult for monsters to pass through the birth canal, either because of their altered shape or because of their relative size. The common monsters causing dystocia

are *Schistosoma reflexus, Perosomus elumbis, Double or conjoined monsters and Cyclopia.*

Schistosoma reflexus

This type of monster presents acute angulations of the vertebral column causing dorsal approximation of the head and tail. The main defect is skeletal, and the thoracic and abdominal tunics are absent or incomplete, ventrally exposing the visceral contents.[82] Diagnosis is based on the presence of fetal viscera, all the four legs, head and tail in the vaginal passage. The vertebral column presents a twisted appearance. Since the condition is hereditary, further breeding of the dam from the same sire is not advisable.[82,83] The incidence of *Schistosomus reflexus* as a cause of bovine dystocia in South Western Victoria was described to be 1.3%.[84] *Schistosoma reflexus* has been recorded in births of twin bovine offspring.[84-86] Such monsters have been reported in cattle[87-97] and river buffalo.[81,98-102] The calves may sometimes be delivered manually. [87,99] The exposed abdominal organs of the *Schistosoma* fetus, especially the intestines, should not be confused with the maternal intestines that are much bigger in size. Adequate lubrication of the birth canal is essential in the delivery of such fetuses. Partial fetotomy of the fetal parts is suggested if the spinal curvature is acute preventing passage of the fetus through the birth canal.[103] If this is not possible, a cesarean is required.[101]

Perosomus elumbis

Such monsters have been reported in cows[96,104-106] as well as riverine buffalo[107,108] and considered to be a congenital anomaly of unknown etiology.[109] The hind limbs of the fetus are very rigid which results in dystocia.[53] The monster usually shows congenital abnormality of the skeletal system. The lumbar and sacral regions are badly developed. There may be deformed pelvis and arthrogryposis of limbs. The primary abnormality is, however, hypoplasia of the spinal cord. It is difficult to deliver the fetus in cows manually but this is sometimes achieved in buffalo.[107]

Double or conjoined monsters

These consist of two fetuses joined together. They usually arise from a single ovum and are considered monozygotic. They are the most common type of monsters. Conjoined twins are also known as diplopagus monsters or *Siamese twins*. These twins also arise from a single ovum and are monozygotic. They are the result of incomplete division of a fertilized ovum and show great variation from partial duplication to almost complete separation of two individuals, joined in just a few places. A wide variety of conjoined twins have been described in cattle and buffalo.[110-121]

Either cranial or caudal parts of the body may be duplicated, the former being more common. The duplicated parts and increased number of limbs result in dystocia. Different terminologies are used to describe the monsters according to how many parts are duplicated and the number of places at which the fetuses are joined.[122] *Thoracopagus* means fusion at thorax. Conjoined twins with symmetrical components or component parts are called *Diplopagus monsters* or *Siamese twins*. Conjoined twins are common in cattle and equally common in buffalo (Table 1).[123-178] Conjoined twins can have all components nearly complete and these include *thoracopagus* (twins joined at or near sternum), *Pygopagus* (twins connected at sacrum), *Craniopagus* (twins united at heads) and *Ischiopagus* (twins joined at pelvic region and heads in opposite directions). Partial duplication of the cranial and caudal parts of the conjoined fetuses can occur. *Monocephalus* monsters have partial duplication of the frontal region, nose and mouth, and are called *diprosopus* or double face. Dicephalus monsters have two heads whereas *dipygus* monsters have duplications in the caudal region. Terms used to indicate the extra number of cranial limbs (forelimbs) are *dibrachuis* (two pairs of limbs), *tribrachius* (three pairs of limbs) *tetrabrachius* (four pairs of limbs), whereas the terms *dipus* (two pairs) *tripus* (three pairs) and *tetrapus* (four pairs) are used to describe duplicacy of hind limbs. The majority of the conjoined monsters are dead during dystocia and hence efforts to relieve dystocia in these cases should aim at fetotomy with caesarean section adopted as a last resort.[179] Grossly over enlarged and emphysematous monstrosities are extremely difficult to relieve by fetotomy and hence caesarean section should be performed. Table 1 shows the methods used to remove different monsters in various reports.

Cyclopia

Cyclopia has been described in cattle[180-185] and rarely in river buffalo.[104] The fetus is usually dead and has a single orbit and eyeball in the central head region. There is elongated soft tissue growth in the lower jaw region of the monster. Cyclopia is described as occurring due to malformations of a non-genetic nature. The body parts of the fetus are small[182] and fetuses can, therefore, be removed manually. [181,183] They are rarely born co-twin to a normal calf.

Fetal diseases

Various diseases of the fetus can result in the altered shape of the fetus and dystocia in cattle and buffalo. These include *hydrocephalus, ascitis, anasarca, hydrothorax,* and *tumors.*

Hydrocephalus

The condition has been described both in cows[186-200] and buffalo.[195,201-203] There is accumulation of excessive fluid in the ventricles of the brain or dura matter. Hydrocephalus is either external or internal. In the external hydrocephalus,[204] fluid accumulates in the subarachnoid space exterior to the brain whereas in the internal hydrocephalus,[94] fluid accumulates in the ventricles of the brain. Death of the fetus is due to pressure on vital centers of the brain. The frontal, temporal and parietal bones are usually involved becoming deformed, separated and thin. The condition does not affect fetal development but may result in death of the fetus at birth or soon after birth. In cattle, a simple autosomal recessive gene and autosomal dominant gene with incomplete penetrance has been known to be associated with hydrocephalus. In a few cases reported in buffalo, alopecia of the head region was evident. Diagnosis of the condition is easy if the fetus is in anterior presentation. In fetuses with very large heads, puncture of the head with a trochar is advocated to relieve dystocia, along with routine obstetric maneuvers.[202] Sometimes, the calf may be born normally[204] or by caesarean section when required.[139,194,201]

Ascites, anasarca and hydrothorax

Ascites is dropsy of the peritoneum.[205] Anasarca is general dropsy of tissues under the skin[206-208] whereas *hydrothorax* is the accumulation of fluid in the thoracic cavity. The exact causes of these conditions are not known but derangement of fetal circulation/obliteration of fetal lymphatics usually results in anasarca and diminished urinary excretion in ascites. Uterine disease or related factors may also play a role. Fluctuating swellings and edema may be palpable *per vaginum* at the time of delivery. Such calves are generally dead when born and may be weak if born alive. To relieve dystocia, fetotomy or puncture may be performed if the fetus is dead. Both ascitic and anasarcous fetuses have been reported to cause dystocia in cattle[209-212] and riverine buffaloes.[213-219] Many of the abnormal fetuses were delivered by abdominal puncture[211,214,216] or by caesarean section.[210,216]

Cystic enlargement of the urinary bladder of the fetus has been recorded.[220] Some studies have reported achondroplastic (bull dog) calves both in cattle[221-225] and buffalo.[81,226,227] In such monsters, the head is enlarged but limbs are short.

Other less significant monsters have been recorded, including *holocardius acardius* monsters recorded in cattle[228,229] and buffalo.[26,230-232] These monsters are born co-twin to a normal calf and are considered asymmetrical twins. The monsters are composed of outer skin enclosing a mass of fat. Mohan *et al.*[228] record-

ed a *compylorrachis* fetal monster with lateral curvature of the spine delivered manually in a cow. Buffalo fetuses with muscular hypertrophy and excessive abdominal fat caused dystocia in buffalo but vaginal delivery was achieved with assistance.[233-235] Likewise, buffalo fetus with arthrogryposis was relieved by partial fetotomy.[236] Fetal anencephaly has been reported to develop in 125-day bovine fetuses by inoculation of Blue tongue virus.[237] Similarly BVD virus is known to result in congenital malformations in calves.[238] Tumors of the fetus are a very rare cause of dystocia, and are only significant when they are large in size[238] and present on the external body surface of the fetus. Likewise, polysarca, the accumulation of excessive fat in the subcutaneous tissue, has also been rarely described. [53]

Fetal maldispositions

In recent literature on equine obstetrics,[239,240] the term fetal *maldispositions* has been suggested to imply any combination of abnormalities in presentation, position and/or posture,

Table 1. Reported methods of delivery of fetal monsters in cattle and buffaloes.

Monster type	Species	Manner of delivery	Reference
Monocephalus	Buffalo	Fetotomy	Sinha *et al*. 1984; 123 Sharma *et al*. 1992; 124
Diprosopus	Buffalo	Manual	Sahu, 1968; Sreemannaryana *et al*., 1980; Sharma *et al*., 2010 125-127
Dicephalus	Cow	Manual	Parikh, 1931; 128 Subbarayundie, 1934; Eichler and Krogh, 1985; 129-130 Mc Girr *et al*., 1987; Wakuri *et al*., 1990 131,132 Adsul *et al*., 1992; 133 Bakshi *et al*., 1992; Madarame *et al*., 1993; Madarame *et al*., 1994; 113,134,135 Saha *et al*., 1996; 136 Khan *et al*., 2007; 137 Khasatiya *et al*., 2008; Buck *et al*., 2009 138-139
	Buffalo	Manual	Rekhi, 1939; 140 Reddy and Balasubramanyam, 1950; 141 Jothi, 1956; Majeed *et al*., 1971; Rao *et al*., 1971; 142-144 Rao and Kottaya, 1976; 145 Bishnoi *et al*., 1984; 146 Dhingra *et al*., 1984; 147 Markandeya *et al*., 1989; 148 Bugalia *et al*., 1990; 104 Panchal *et al*., 1990; 149 Bhayani *et al*., 1991; 150 Bishnoi *et al*., 1992; Bakshi *et al*., 1992 114,115
		Fetotomy	Fetotomy Tandle and Suresh, 1993; 151 Chauhan and Verma, 1995; 117 Sharma *et al*., 1996; Suresh *et al*., 1999 152,153 Raju *et al*., 2000; 154 Bugalia *et al*., 2001; 119 Thirumalish and Azeemulla, 2001; 155
	Cow	Fetotomy	Dass, 1931; Otonari *et al*., 1993 156,157 Rao and Murthy, 1994; 158 Kumar *et al*., 1997; Bahr *et al*., 2004 159
	Carabao	Manual	Gadgil, 1967; Tacal, 1967; 110,160
	Cow	Cesarean	Rao *et al*., 1986; 161 Chandrahasan *et al*., 2003; 121 Abraham *et al*., 2007; 162
	Buffalo	Cesarean	Saleem *et al*., 1996; 163 Padile *et al*., 2001; El-Sheikh *et al*., 2010; 164,165
Conjoined twins	Buffalo	Cesarean	Velhankar *et al*., 1968; 166 Nauriyal and Pandey, 1979; 167 Urankar *et al*., 1994; 168 Kasiraj *et al*., 2001; 120
	Buffalo	Manual	Kohli *et al*., 1980; 169 Thakre *et al*., 1992; 116 Naidu *et al*., 1996; 170 Selvaraju *et al*., 2002; Jerome *et al*., 2010; 171-172
	Cow	Manual	Mahalingam, 1968; 173 Pandey and Shandomo, 1989; 112
	Cow	Cesarean	Saxena and Prakash, 1986; 111 Kondala Rao *et al*., 1997; Shulze *et al*., 2006; 174,175
Dipygus	Cow	Normal	Thakur, 1988; 176
	Buffalo	Fetotomy	Bugalia *et al*., 1985; 177 Sharma *et al*., 1992; 124 Antonie *et al*.,1997; 178
	Buffalo	Cesarean	Chauhan and Verma, 1995; 117

and the authors feel that the same term should be used in all veterinary obstetrics literature. Therefore, the term has been used in the present review to represent any abnormality in presentation, position and posture. Similarly, the terms used here, such as *cranial* and *caudal* presentation, appear to be more appropriate than *anterior* and *posterior* presentation as previously suggested.[240]

Various types of fetal dystocia due to fetal maldispositions have been reported in cattle and buffalo. It is thought that these are probably due to reduced viability of the offspring. Failure of the fetus to rotate from the intrauterine position to the normal parturient position may result in dystocia. The cranial presentation of fetuses is assumed to be no later than 216 days of gestation in normal pregnancies.[241] Parts of the fetus may get jammed at the pelvic brim leading to flexion/ rotation of the part involved and subsequent dystocia. Furthermore, transverse presentations and adhesions of the fetus invariably result in dystocia. The normal parturient presentation and position assumed by the normal fetus at the time of delivery is the cranial presentation dorso-sacral position with extended forelimbs and head resting on metacarpal bones. Any presentation or position other than this is likely to cause dystocia. The heritability of malpresentation was low (0.17) for Hereford and zero for Angus cows.[21] The caudal dorsal presentation was found to be the most frequent malpresentation, and limb flexion in cranial presentation, head deviation, breech, post ventral, transverse and ventro vertical presentation were 11.4%, 2.5%, 8.2%, 1.3%, 1.3% and 0.6%, respectively, in this study.[21]

Abnormal positions and postures are described for cranial (anterior) and caudal (posterior) presentations separately. The total incidence of dystocia due to fetal maldispositions described for the buffalo vary from 45.4[26] to 69.8%.[60] In dairy cattle, Wehrend *et al.*[43] have observed that incorrect fetal orientation of a dead fetus was the most frequent cause (38.9%) of dystocia and similar findings were recorded by Holland *et al.*[21] in beef cows.

Cranial (anterior) presentation

All the abnormal positions, such as the dorsopubic or dorsoillial, result in dystocia. The position is corrected by retropulsion using manual or mechanical rotation of the fetus. An anterior calving is usually easier than a posterior one. Nix *et al.*[22] recorded that abnormal presentation accounted for only 1% of the total number of calvings. However, amongst these cases, 70% were posterior presentations, while 30% were head and leg deviations. Bennett and Gregory[44] observed 3% of malpresentation in beef cows. Menard (242) observed the different kinds of malpresentation as: 27.5% head deviation and the same number of breech pre-

sentations, 23.5% dorsopubic presentation, 7% forelimb retention, 3.4% hock flexions and 1.3% transverse presentations.

In clinical studies on cows in Iraq, the incidence of fetal dystocia was 68.1% compared with 31.9% maternal dystocia. The proportions of malpresentations in the cranial and caudal presentation were 51.7% and 16.3%, respectively. In studies by Garrousi[45] using data of 2,140 calvings of Iranian HF cows, malpostionings of the fetus were observed in 5.04% of the calvings. Clinical studies on cows in Brazil found fetal dystocia was predominant (77.42%) compared to maternal dystocia. Malposition, fetal malformations and caudal presentations accounted for 46.77%, 3.22% and 17.24% of the cases of dystocia.[25]

In buffalo, many studies have reported that maternal dystocia is common compared to fetal dystocia[27,59] whereas others point out a higher number of dystocia of fetal origin.[60,81] Studies have also shown that cranial presentation malpresentations are common in buffalo dystocia (80-85%).[27,60]

Flexion of forelimbs

Deviation of forelimbs is the most common cause of dystocia due to fetal malpresentation in cattle and buffalo. When a portion of forelimb is caught in the pelvic inlet, it is forced backwards towards the body due to the contractions, resulting in dystocia due to an increase in the pectoral diameter. Flexion of one or both forelimbs at the knee (carpal flexion) is common in dystocia in cows and buffalo. Other conditions include incomplete extension of elbows and complete retention of one or both forelimbs (shoulder flexion).

Carpal flexion and lateral head deviations are the most common forms of maldispositions in cranial presentations of the fetus resulting in dystocia in cattle and buffalo.[53] Most of the abnormal presentations, positions and postures described for cattle are seen in the buffalo, but described mostly in river buffalo. In an analysis of 116 clinical cases of dystocia in local Iraqi breeds of cattle, 51.7% of dystocia were in anterior presentation[24] of which most were head deviation and limb flexion. Purohit and Mehta[27] observed 19.4 and 16.9% cases of limb flexion in clinical cases of dystocia in cattle and buffalo, respectively, whereas Srinivas *et al.*[60] observed 57.78% cases of limb flexion in buffalo dystocia.

Hind limb flexion in cranial presentation

The hind limb flexion of a fetus in cranial presentation can result in dystocia due to extension and retention of hind limbs at the stifle (*hip lock*) or the flexed hind limbs passing into the maternal pelvis (*dog sitting posture*). Hip lock occurs when the head and thorax of the fetus are out of the pelvic brim but stifles obstruct the pelvis. The condition can be

corrected by pushing the fetus back to disengage the pelvis followed by oblique traction to clear one stifle from the pelvic brim first. Undue pressure without pushing the pelvis back should be avoided and adequate lubrication must be provided in the birth canal. In our previous study, no such case was recorded.[27]

The dog sitting posture (ventrovertical presentation) is rarely seen and the flexion of the hind limbs is to an extent in which the fetus is practically vertical and hind limbs appear at the birth canal along with the forelimbs.[21] The condition can be diagnosed by the presence of the head and all four limbs at the birth canal with only the head and shoulders passing through the vulva.[122] Dystocia can be relieved by fetotomy/bisection of the fetus[43] or by caesarean section in difficult cases. It is usually extremely difficult to push the flexed hind limbs back, especially in longstanding dystocia in cows. The incidence of the dog sitting posture recorded at our center was 0.52% in cattle and zero in buffalo over a period of fifteen years.[27] A similar incidence of 0.6% was recorded elsewhere.[21]

The abnormal positions of the limbs can usually be corrected manually using sufficient lubrication and it is necessary to cup the hoof of the calf in the palm of the hand while extending the limb to prevent injury to the birth canal. Shoulder flexion should first be converted to a carpal flexion by traction on the flexed limb. The carpal flexion is then corrected by grasping the hoof of the fetus in the cupped hand. However, if the fetus is dead and emphysematous, or if ample space is not available in the pelvic canal, it may be necessary to amputate parts of the fetus, followed by correction and delivery by traction.[26]

Deviation of the head

Deviations of the head, although less common in buffalo than cows,[27] are more serious causes of dystocia than dystocia due to forelimb deviation. The most common deviation of the head is the lateral deviation;[27] other deviations such as upward or downward deviation are rarely found. The deviation is known to occur due to deflection of the nose against a partially open cervix, and with the progressive contractions of the uterus, the deviation may further increase.[243] When the deviations are slight and the fetus alive, the head can be brought to its normal position with manipulation, but there is a less positive prognosis when the fetus is dead and deviations are due to muscle contractures. Lateral deviation can be corrected by bringing the head into a normal position after repulsion and by using hooks and snares. In difficult cases, partial fetotomy may be performed.[26] Various options can be considered according to the individual case and the obstetrician's decision may depend on the space available in the pelvic

canal, the presence of emphysema and rigidness of the neck. In previous studies, the incidence of head deviation recorded varied from 2.5-20.4% in cows[21,22,27] and from 7.5-12.2% in buffaloes.[27,60] Two types of downward deviations are usually described. In the first, the nose of the fetus is towards the trachea and poll at the pelvic inlet (vertex presentation), and in the second, the entire head is dropped between the forelimbs (Nape presentation). Correction of the first type is easy, especially if the fetus is alive, and can be achieved by grasping the muzzle or nose. Correction of the second type is more difficult and may be attempted by repulsion of fetus. When manipulation of the fetus is not possible, fetotomy may have to be performed.[43] In difficult cases in the presence of a live fetus, caesarean section is advisable. Upward deviation of the head is rarely possible in cattle and buffalo.

Caudal (posterior) presentation

Caudal presentations usually culminate in dystocia, except when the fetus is in a *dorsosacral* position with both the hind limbs completely extended, although some assistance may still be required. During the delivery of a fetus in cranial presentation, the head of the fetus exerts maximum pressure on the birth canal facilitating its final dilation. Since this does not happen in a caudal presentation, the likelihood of dystocia is increased. The higher incidence of fetal mortality in caudal presentations is presumably due to asphyxiation of the fetus subsequent to rupture or compression of the umbilical cord. Any position other than dorso sacral may result in dystocia. Both *dorso pubic* and dorso *illial* positions can occur in caudal presentation and correction may be achieved by rotating the fetus. A *Dorso pubic* position should be taken very seriously and handled with care since parts of fetal limbs

can lacerate the maternal, vaginal or rectal wall. The presence of uterine torsion should be excluded before rotating a fetus and ample lubrication must be used during rotation. It is always safer to opt for a timely cesarean section, especially when there is little room for rotation of the fetus in the birth canal. Previous studies recorded the incidence of caudal presentation dystocia in dairy cows to vary from 3.8-17%.[4,24,27] In beef cows, 8.2% cases of breech presentation was seen in 8.2% and posterior ventral presentations in 1.3% of cases recorded by Holland *et al.*,[21] whereas Nix *et al.*[22] recorded only one breech presentation out of 20 abnormal births. In buffalo, the incidence of caudal presentation dystocia varied from 5.7-13.3%.[27,60]

Incomplete hind limb extension

Incomplete extension of the hind limbs in a caudal presentation can occur at the stifle, hock (*hock flexion posture*) and hips. Bilateral hip flexion in caudal presentation is known as breech presentation whereas unilateral hip flexion is referred as *hip flexion posture*.

Hock flexion is common in comparison with other deviations and correction is easy. However, care should be taken when making manipulative corrections in a caudal presentation.[27] The fetus is pushed forward, the hoof is grasped and the limb flexed. The hoof should be pulled medially and the foot drawn back in an arc. The hoof is then lifted over the pelvic brim and extended into the vaginal passage. The same procedure is repeated on the other limb and after correction the fetus is removed by traction. Breech presentation can be diagnosed by the presence of the tail and buttocks in the pelvic cavity.[43,122] It is one of the most difficult postures to manage, especially if the fetus is dead. The fetus is pushed forward and upward to bring the hocks nearer to the operator to convert the presentation to a hock flex-

ion posture and then correction is made accordingly. Bisection of the pelvis to remove one limb may be attempted in order to relieve dystocia. Epidural anesthesia and raising of the hind limbs are necessary to make the correction. Caesarean section may be performed in difficult cases.

Transverse and vertical presentation

Transverse presentation is characterized by the presence of the convex dorsum of the fetus facing the cervix. It can be *transverse* dorsal and *transverse ventral*. Ventral presentation is identified by the presence of the head and all four limbs in the pelvic canal. This condition should be differentiated from monsters and twins. These two presentations are rarely, if ever, encountered in cattle and buffalo. Although two studies evaluating calving records of beef and dairy cows recorded an incidence of transverse presentations to be 1.3%,[21,232] similar findings in other studies are scarce. Theoretically, the fetus must be corrected by conversion to cranial or caudal presentation. One end of the fetus is repelled while traction is applied on the other end. This is extremely difficult under practical situations, especially in a narrow birth canal, and therefore caesarean section must be performed to deliver the fetus.

In the vertical presentation, the fetal body is lying vertically across the pelvic inlet. The dog sitting position form of vertical presentation is extremely rare in cattle and can be due to faulty traction on hind limbs by inexperienced operators. The situation must be suspected if the head and shoulders of the calf have been delivered but no further progress is possible. The fetus must be repelled back using a crutch repeller, but this is possible only if the birth canal is sufficiently dilated, otherwise caesarean section is advisable.

Table 2. Proportion analysis according to parity, proportion live fetuses from time since dystocia onset and cause of dystocia in cows (n=192) and buffaloes (n=112). Referral cases Gynaecology outdoor, Veterinary College, Bikaner, Rajasthan, India from 1996-2010.

	Cattle				Buffaloes			
Parity	I	II	III	Above III	I	II	III	Above III
	32.3%	30.2%	14.5%	22.9%	30.4%	33.9%	18.7%	17.0%
Fetal survival	Upto 12 h	12-24 h	24-36 h	Above 36 h	Upto 12 h	12-24 h	24-36 h	Above 36 h
	81.96%	14.75%	3.27%	0%	90.0%	6.66%	3.33%	0%
Fetal dystocia								
Fetal maldisposition			48.95%		35.71%			
Fetal disease/monsters			02.08%		01.78%			
Fetal death/emphysema			14.58%		04.46%			
Total			65.62%		40.17%			
Maternal dystocia								
Narrow pelvis			04.68%		02.67%			
Incomplete cervical dilation			08.33%		01.78%			
Uterine torsion			14.58%		53.57%			
Uterine inertia			06.77%		01.78%			
Total			34.38%		59.82%			

Case analysis and discussion

We made a retrospective analysis of 192 cases of dystocia in cattle and 112 cases of dystocia in buffalo presented at our referral center during the period 1996 to 2010. The animals were brought by both local owners and those living further afield, and included the local Rathi, non-descript and HF crossbred cows and Murrah and non-descript buffaloes. All these assisted cases were included in the analysis. The effect of parity on the proportion of the total dystocia cases presented was compared between different parities by the χ^2 *test*. A t-test was used to compare the proportion of male and female calves in these assisted cases whereas the effect of time of presentation since onset of second stage of labor on fetal survival was compared by a z-test.

Fetal dystocia was common in cattle at our center comprising 65.62% of total cases presented, whereas maternal causes constituted 34.38% of total cases. Most of the cows presented were in their first parity (32.3%) but nearly equal proportions (30.2%) of cows were in second parity. A significantly lower (P<0.05) proportion of cows were presented in their third and subsequent parities. These findings are similar to a large number of previous studies analyzing calving data with reports of a high incidence of dystocia in heifers.[20,34,35]

In buffalo, maternal dystocia was common (59.82%) compared to fetal dystocia (40.17%), and uterine torsion was the most common cause of dystocia comprising 53.57% of the total cases of dystocia. Similar findings have been recently reported.[244,245] A slightly higher proportion of buffalo were in their second parity (33.91%) compared to first parity (30.3%), but a significantly (P<0.05) lower proportion of buffaloes were presented in subsequent parities. This is in agreement with previous reports.[60,67]

The effect of sex of calves on the proportion of cows or buffalo presenting dystocia was not significant (P>0.05). The time of presentation since onset of second stage labor had a significant (P<0.05) effect on fetal survival with a significantly higher (P<0.01) number of calves and buffalo calves being born alive when animals were presented within 12 h of onset of second stage of labor, irrespective of the type of dystocia and the correction procedure adopted. Beyond 36 h, no calf or buffalo calf was born alive. Previous reports have observed that fetal survival is dependent on the time since onset of labor in assisted cases.[24,43]

Maternal causes, like narrow pelvis due to breeding at a younger age or pelvic fracture, incomplete cervical dilation and uterine inertia, were seen in 4.68%, 8.33% and 6.77% of cows whereas these were less frequent in buffalo (2.67%, 1.78% and 1.78% of cases, respec-

tively). The total incidence of fetal maldispositions in cattle and buffalo at our center was 48.95 and 35.71%, respectively (Table 2). Fetal maldispositions in cattle comprised 48.95% of the total cases presented. Head and neck deviation and limb flexion were the most common cause for cranial presentation and only a small proportion of caudal presentations (3.12%). The incidence of a dorsopubic position recorded in cattle at our center was 1.56%. Other less frequent causes included fetal dropsical conditions (1.04%), fetal monsters (1.04%) and fetal emphysema (14.58%). Similar findings have been previously recorded in clinical settings in different locations.[27,43] In buffalo, fetal maldispositions were less frequent: only 33.92% of the total number of cases presented. The frequency of head/neck deviation and limb flexions was lower compared to that in cattle and caudal presentations were 6.25% of total dystocia. No case of fetal dropsy was seen in buffalo during the study period, and the frequency of fetal emphysema and monsters was 4.46 and 1.78%, respectively. The incidence of uterine torsion was 14.58% in cattle and 53.57% in buffalo. Similar findings have been observed in previous studies in buffalo.[27,60,244,245]

Studies analyzing calving difficulties in cattle have critically addressed the importance of calf birth weight, sex of calf and fetal death as important fetal causes of dystocia in cattle. However, in a clinical setting, the fetal size relative to the birth canal and the fetal maldispositions appear to be of prime importance as they decide the course of action to be taken by the clinician. The method adopted to correct the dystocia and fetal survival depend upon the time of presentation of the animal after the onset of second stage of labor and the expertise available. It can be concluded that fetal origins of dystocia are common in first and second parity cows and buffalo and these are generally caused by an oversized fetus or fetal maldispositions; fetal monsters and fetal diseases being rare. The most common fetal maldispositions are limb flexion and head deviation. Fetal dystocia is less frequent in buffalo.

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