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Alice has been working in Dorset as a farm veterinary surgeon since graduating from the University of Bristol in 2009. She joined the team at Friars Moor Livestock Health – a member practice of XLVets – where she became an Associate Director in 2020. She helps run discussion groups for beef farmers, calf rearers, high-yielding and block-calving dairy herds, and is on the Dairy Sheep and Goat Conference committee. Alice graduated from the University of Liverpool in 2018 with the Diploma in Bovine Reproduction and completed the CertAVP A module to gain Advanced Practitioner Status in Bovine Reproduction in 2020. Her interests include cattle fertility, teaching calving courses, heifer breeding, bull fertility, AI training, control of infectious disease, sustainable farming and support for students embarking on a veterinary career.*

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**Suggested Personal & Professional Development (PPD)*

CALVING

Common calving problems

The objectives for managing a cow at calving should be the same regardless of whether the cow is in a dairy or beef system. The aim should be to deliver a viable calf and to ensure minimal complications so that cows are able to either enter the milking herd or rear their calf successfully.

The economic drive to rear a beef calf per cow per year focuses the importance of effective calving management; however, the attitude of accepting a dairy calf loss because the cow will still milk is not acceptable. Calf welfare must not be compromised and should be at the forefront of any calving management plan. When considering common calving problems, dystocia, as well as perinatal mortality, should be addressed.

Dystocia

A calving problem becomes apparent when eutocia is delayed. If the cow does not progress through the first two stages of labour as expected, assistance is required to ensure the survival of the calf and the dam. Dystocia may be defined as calving difficulty resulting from prolonged spontaneous calving, or prolonged or severe assisted extraction (Mee, 2004). Causes of dystocia are often multifaceted (Norman, 2007) and can be associated with either the dam or the calf.

Dam-associated causes of dystocia

Examination of the dam could reveal an obstruction of the birth canal. Common findings include relative feto-pelvic incompatibility (Mee, 2004) where there is a small maternal pelvic area and a normal-sized calf; a uterine torsion; or incomplete cervical and vulval dilation. Alternatively, the cervix may fully dilate with no obstruction, but labour fails to progress owing to uterine inertia. When the myometrium does not contract normally, the calf expulsion through the birth canal fails to advance. There are primary and secondary causes of uterine inertia (see **Table 1**) but, commonly, a physicality (overstretching or exhaustion) or a physiological imbalance (hormone defect or hypocalcaemia) occurs. Less common dam defects may include hydrallantois or hydramnios.

Calf-associated causes of dystocia

Examination of the calf in utero may reveal absolute feto-pelvic incompatibility (Mee, 2004) where the calf is oversized and cannot be delivered through the pelvis. When pressure builds inside the uterus, the fetus should rotate into position ready for delivery. Fetal maldisposition occurs when the fetus does not move into the correct position, presentation or posture. If the fetus is not positioned to activate the pressure-sensitive neurons in the cervix, signals that reach the oxytocin-releasing neurons in the hypothalamus (Norman, 2007) are delayed which can lead to dystocia.

Twin calvings and less common fetal deformities such as schistosomus reflexus or atresia defects should also be considered.

Risk factors for calf-associated causes of dystocia are in **Table 2**.

Intervention with dystocia

When to intervene, how to correct dystocia and when to call for veterinary assistance is not always a straightforward decision for farmers. Ultimately, the judgment made at this crucial stage can influence the success of the outcome, the viability of the calf and subsequent performance and lifespan of the dam.

The cow may seek isolation up to 36 hours before calving. At this stage, a cow can be moved to the calving facilities as lower calf mortality rates occur when cows calve in such facilities. However, 10-20 per cent of cows and heifers may show no signs of stage 1 and begin with stage 2 (Mee, 2004); they should not be moved, as a disturbance at this later time is likely to interrupt eutocia.

Within 12-24 hours of delivery, cows become restless. Stage 1 starts with relaxation of the pelvic ligament, followed by abdominal contractions, and lasts on average for six hours; although some heifers may take up to 24 hours (Norman, 2007). Mild abdominal straining will occur more frequently towards the end of stage 1. The pressure stimulates cervical dilation leading to emergence and rupture of the allantochorion, followed by emergence and rupture of the amnion one hour later. If straining does not occur, is unproductive, ceases or intensifies, intervention is required.

Stage 2 commences with the emergence of the amnion and fetal hooves and concludes with the birth of a calf, minutes to hours later. Gundelach et al (2009) state

> "Causes of dystocia are often multifaceted"

Dam causes of dystocia	Risk factors for causes of dystocia
Common causes:	
Relative feto-pelvic incompatibility	Sire, weight and pelvic area at service, weight, age and BCS at calving (most common cause in primiparae dams)
Uterine torsion	Fetal oversize, excess fetal movement (during stage 1), debility, lack of exercise, mechanical factors (sudden slip/fall/knock)
Incomplete vulval and cervical dilation	Periparturient environmental stress and disturbance, hormonal asynchrony, premature calving
Primary uterine inertia	Physiological imbalance: hypocalcaemia/hormone defect, old age, debility, lack of exercise, premature calving, maldisposition of calf
Secondary uterine inertia	Physical effect: overstretched/exhaustion, bradytocia, twins
Less common causes:	
Hydrallantois	Abnormal functioning placentomes, infection
Hydramnios	Genetic association, defective fetal organ systems, defective placentation, impaired fetal ability to swallow

Table 1. Risk factors for dam-associated causes of dystocia

Calf causes of dystocia	Risk factors for causes of dystocia
Common causes:	
Absolute feto-pelvic incompatibility	Sire, breed, gestation length, gender
Fetal maldisposition	Sire, gender, overfeeding and limited space, disease, calf death (most common cause in pluriparae dams)
Twin calving	Parity (older cows), season, previous twin calving, associated with high milk yield and increased dry matter intakes
Less common causes:	
Schistosomus reflexus	Genetic association, genetic defect caused by teratogens
Atresia defects	Genetic association, iatrogenic, associated with early rectal pregnancy diagnosis palpation (<42 days), breed (Holstein)

Table 2. Risk factors for calf-associated causes of dystocia

that intervention should occur if a calf has not been delivered within two hours; whereas Schuenemann et al (2011) suggested a threshold of 65-70 minutes after the appearance of the amnion or feet respectively.

Stage 3 marks the expulsion of the fetal membranes and should occur within 12 hours of delivery. Observation of behavioural and physical changes are important; however, they can vary between individuals. The onset of stages may not be seen, in which case intervention should still occur with any indication of abnormality, maternal ill health, fetal or maternal distress, abnormal contractions, premature placental separation or failure of the calf to advance.

Before intervention examination takes place, a cow must be restrained safely. When conducting a vaginal examination, the vulva should be cleaned before introducing a clean, excessively lubed, gloved arm. The birth canal should be examined for existing damage, followed by an assessment of fetal fluids (Mee, 2004), fetal disposition and calf vitality (Mee, 2008; Taverne et al, 2012; Mee 2017; Mee, 2018) (see **Table 3**).

Before assisted vaginal delivery can commence, the cervix must be fully dilated and the veterinary surgeon must be confident that feto-pelvic size is compatible. Correction of maldisposition may require epidural anaesthesia. A calf can only be delivered in an anterior (head first) or posterior (hindlimbs first) longitudinal presentation, in a dorsosacral position (right side up) with normal posture (both limbs extended and head forwards, if in anterior position).

Careful rope placement is key. Ropes knotted once above and once below the fetlock joint spreads the force of the traction. Knots should be positioned on the flexor tendon side of the leg (underside of forelimbs and topside of hindlimbs). The head can be guided through the pelvis by cupping a hand over the head, or a rope can be placed around the back of the head (hooked behind the ears) to prevent the head twisting back. When traction is required, it should only occur with the cow's contractions.

The force and direction of applied traction is key. Excessive force will cause fetal cortisol levels to rise; increasing the risk of death (Tenhagen et al, 2007). During unassisted eutocia, it is estimated that 70kg of uterine and abdominal force is required for delivery (Hindson, 1978). However, an applied force of 170kg may fracture a leg (Schuijt, 1990). Care must be taken since a strong person can apply 200kg and a mechanical calving aid can apply 400kg (Norman, 2007). With forward calving, the direction of traction must stay parallel to the cow's spine until the ribcage is present, at which point abdominal contractions naturally pause to allow the calf to breath (this should be recognised), and then continue with a downwards angle. The angle

Guideline for assessment of calf vitality and procedures for calf resuscitation

Vitality assessment in utero:

- confirm heartbeat/umbilical cord pulse
- check for interdigitial, bulbar, swallowing, lingual and anal reflexes –
- but, consider six per cent of live fetuses may have absent reflexes
- meconium-stained fluid indicates intrauterine hypoxia and bradytocia
- red fluid indicates placental haemorrhage or late fetal death.

Vitality assessment for neonate:

- a vital calf has good response reflex tests (same as above)
- flaccid musculature and cyanosed membranes are indicative of poor vitality
- normal respiratory rate = 30-50 breaths/minute
- normal heart rate = 100-150 beats/minute
- poor vitality if heartbeat < 60 beats/minute or irregular
- rectal temperature should be 39.5°C

If the calf is found dead, the timing of death can be estimated as such:

- signs of aerated lung on post-mortem, colostrum in the stomach, worn eponychia and no signs of autolysis indicate death after delivery
- signs of trauma (fractures or haemorrhage) or bradytocia (localised oedema) and aerated lung on post-mortem indicate death during delivery
- corneal opacity indicates the calf died >12 hours before birth
- subcutaneous oedema indicates the calf died >2 days before birth
- hair/hooves sloughing indicates the calf died >1 week before birth
- mummification indicates the fetus died > 3 weeks before birth.

Resuscitation procedure for neonate:

- establish a patent airway by clearing nasopharynx with suction or suspend calf for no longer than one minute
- where there is a heartbeat but the calf is not breathing, use a respiratory pump (pinch oesophagus to ensure air does not enter the stomach)
- bicarbonate buffer treatment (where vitality is poor, but respiration is established)
- place in sternal recumbency
- prevent hypothermia
- apply umbilical treatment
- ensure colostrum feeding.

Table 3. Guideline for assessment of calf vitality and procedures for calf resuscitation

> "Excessive force will cause fetal cortisol levels to rise; increasing the risk of death"

of traction for backwards calving must remain parallel to the cow's spine, once the hips have presented past the vulva the calf should be delivered rapidly to avoid asphyxiation.

Traction is likely to be successful if one person can extend the forelimb fetlocks 10-15 cm beyond the vulva or can extend the (hindlimb) hocks to appear at the vulva (Norman, 2007).

Traction is unlikely to be successful if the fetus has crossed forelimbs since this indicates that the shoulders are too broad to pass through the birth canal. If it is not possible to keep a hand between the calf and the pelvis, this indicates forced passage through the birth canal and may cause soft tissue damage; if the soles of a calf in anterior presentation are rotated medially, a narrow ventral pelvic inlet could be forcing the elbows together (Norman, 2007).

In some cases, the decision to perform a caesarean section is clear; for example, when there is feto-pelvic incompatibility, failure of cervical dilation or when a uterine torsion cannot be corrected.

However, surgery should also be pursued where correction of fetal maldisposition fails after 15-30 minutes or where delivery of a calf in normal anterior presentation fails after 10-15 minutes (Mee, 2004). There is overwhelming evidence that attempts to deliver the calf by farmers prior to a caesarean section for 30 minutes or longer are associated with increased maternal deaths compared to not attempting calf delivery (Karvountzis, 2018).

Preventing dystocia

To reduce dystocia, the risk factors for the causes of dystocia need to be considered. **Tables 1** and **2** list both the common causes of dystocia (Norman, 2007) alongside associated risk factors (Meijering 1984; Nielen et al 1989; Colburn et al 1997; Mee, 2004, Mee, 2008; Mee et al, 2011). Management practices should focus on reducing these risks; where possible, this is achieved through pre-breeding planning, gestational monitoring and good management.

Pre-breeding planning should include pelvic and reproductive tract scoring of heifers (Miller et al, 2018); especially beef breeds, sire selection (for calving ease) and the use of sex-sorted semen (to avoid larger male calves). Norman et al (2010) found that difficult births declined by 28 per cent for heifers and 64 per cent for cows with the use of sex-sorted semen.

Gestational monitoring should include body condition scoring (BCS) of dams to avoid the problems associated with relative feto-pelvic incompatibility when BCS is greater than three. Pregnancy ultrasound scanning at the optimal time of 30-90 days after service should take place to identify a viable fetus and to diagnose twins. With an accurate expected calving date, increased surveillance can be organised and additional scans can be planned to monitor twin pregnancies that can suffer from higher losses compared to single pregnancies.

Gestational management should also concentrate on minimising the stress associated with any group changes and environmental disturbances that can lead to incomplete cervical and vulval dilation.

Figure 1. Calf pictured in sternal recumbancy, having been delivered via caesarean section (dystocia due to absolute feto-pelvic incompatability).

"Welfare losses should not be overlooked since pain was found to have a negative effect on production 60 days after severe dystocia"

Figure 2. Meconium stained stillborn calf – oedematous swelling of tongue and aerated lung indicating death due to bradytocia during calving.

Figure 3a. Assisted calving of a cow with uterine inertia due to hypocalcaemia – after administration of intravenous calcium, the calf was delivered alive with mild traction.

Figure 3b. The live bull calf delivered after the assisted calving of the dam with uterine inertia due to hypocalcaemia.

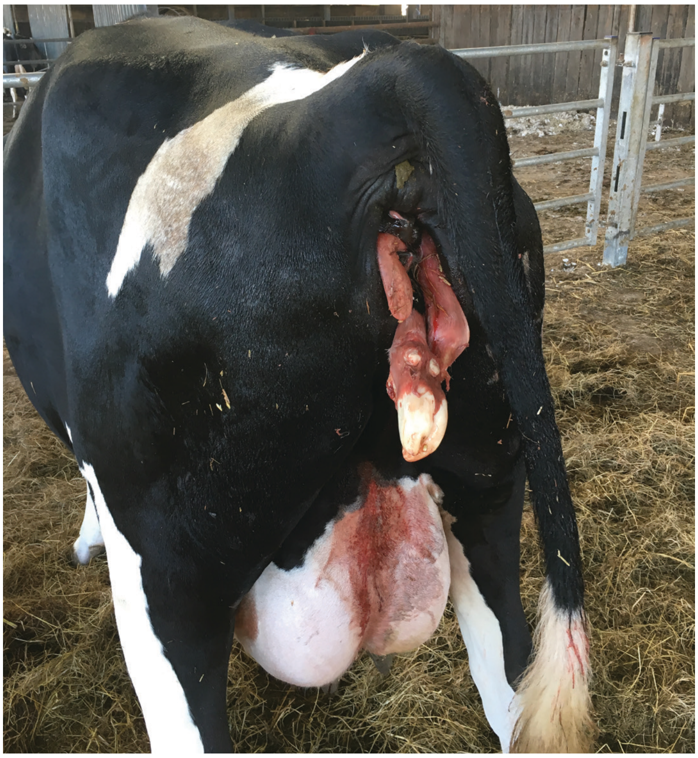

Figure 4a. *Initial presentation of cow with dystocia, examination revealed two forelimbs, two hindlimbs and the head of the calf in the birth canal.*

Figure 4b. *Schistosomus reflexus calf delivered via caesarean section.*

Older cows are at risk of milk fever, and therefore uterine inertia may require calcium treatments. High BCS dairy cows or those carrying twins may be at risk of dystocia, fatty liver and ketosis. Supportive treatments such as monensin boluses and choline prior to calving can improve rumen and liver function respectively; as well as reduce lactation diseases such as retained fetal membranes, endometritis, metritis and displaced abomasum.

Perinatal mortality

John Mee (2019) defines perinatal mortality as, 'death of the perinate prior to, during or within 48 hours of calving, following a gestation period of 260 days, irrespective of the cause of death or the circumstances related to calving'. Perinatal mortality continues to significantly contribute to calf losses, with more than 60 per cent of producers reporting their highest number of calf deaths to occur at birth (Mee et al, 2019).

Rates of perinatal mortality are high (four to seven per cent) (Szenci, 2003). The most common cause of death during dystocia is bradytocia, where a delay in the first two stages of labour occurs (Mee, 2018). With delayed assistance, severe acidosis occurs leading to the development of hypoxic lesions (meningeal, subepicardial and subpleural haemorrhages) (Mee, 1991).

Maldisposition or traumatocia are the second and third most common causes of perinatal mortality respectively (Mee, 2018). Calves that are delivered by strong – compared to mild – traction are at risk of increased respiratory and metabolic acidosis, and take longer to achieve sternal recumbency (Mee, 1991). This is significant, as when the time to achieve sternal recumbency is greater than 15 minutes, chances of survival are poor (Szenci, 2003).

Intervention with perinatal mortality

There is strong evidence to suggest that earlier intervention can prevent the majority of perinatal deaths. A staggering 90 per cent of calves that died within the perinatal period were found to be alive at the start of calving; with 75 per cent of perinatal mortality occurring within one hour of calving; 10 per cent prepartum; and 15 per cent postpartum (Mee, 2008).

Management of the neonate is a priority and a triage approach to the assessment of vitality and resuscitation (see **Table 3**) is recommended (Mee, 2016; Mee, 2018).

Preventing perinatal mortality

The most common cause of perinatal mortality is bradytocia, and the duration of stage 2 is a key risk factor (Gundelach et al, 2009); therefore, intervention should occur when stage 2 fails to progress after two hours. Insufficient monitoring has a negative effect on the duration of stage 2 (Gundelach et al, 2009) and subsequently on perinatal mortality. We should, therefore, ensure that methods are in place (such as video monitor devices or increased labour and observations) to avoid this.

Conclusion

Efforts should focus on reducing the risks of dystocia to reduce the associated economic losses. Tenhagen (2007) and Colburn (1997) recorded prolonged time to conception after severe dystocia, and found cows had a reduced milk yield and increased culling rate after caesarean section (Tenhagen et al, 2007). Welfare losses should not be overlooked since pain was found to have a negative effect on production 60 days after severe dystocia (Thompson et al, 1983). Postnatal care of the cow is just as important as postnatal care of the calf.

Beef and dairy calf perinatal mortality also remains a welfare concern and, by addressing the risks associated with the most common causes of death, this can hopefully improve. Direct calf losses are obvious, but associated economic losses should also be considered such as delayed genetic progress, fewer replacements for voluntary culls, increased cost of replacements (Mee et al, 2019) and reduced milk yield (-1.1kg/day) for cows with stillbirth parturition (Bicalho et al, 2008). The cost to the US dairy industry due to the loss of replacement heifers alone was estimated to be $125 million/year (Bicalho et al, 2008). It is in the interest of all systems to view perinatal losses as relevant and damaging. ■

PPD Questions

1. What is the most common cause of perinatal mortality?
2. What is the estimated force emitted by uterine and abdominal contractions during eutocia?
3. How long has a stillborn calf been dead if corneal opacity is present?
4. How long does stage 1 labour last for, on average?
5. What is the optimal body temperature of a neonatal calf?

Answers:
1. Bradytocia **2.** 70kg **3.** >12 hours **4.** six hours **5.** 39.5oC.

References

Bicalho, R.C. et al. (2008). Stillbirth parturition reduces milk production in Holstein cows. Preventive Veterinary Medicine 84 , 112–120.

Colburn, D.J. et al. (1997). Effects of Sire, Dam Traits, Calf Traits, and Environment on Dystocia and Subsequent Reproduction of Two-Year-Old Heifers. Journal of Animal Science 75 , 1452–1460.

Gundelach, Y. et al. (2009). Risk factors for perinatal mortality in dairy cattle: Cow and foetal factors, calving process. Theriogenology 71, 901–909.

Hindson, J.C. (1978). Quantification of obstetric traction. The Veterinary record 102 , 327–332.

Karvountzis, S. (2018). Caesarean Sections. Lecture at Univeristy of Liverpool for DBR , 1–16.

Mee, J. et al. (2019). Risk Factors For, And Causes Of, Perinatal Calf Mortality And Implications For Calf Welfare. Manas Journal of Agriculture Veterinary and Life Sciences 9 , 35–41.

Mee, J.F. (2016). A practitioner's guide to post-mortem examination of an aborted or stillborn calf. Livestock 21 , 38–43.

Mee, J.F. (1991). Bovine perinatal mortality and parturient problems in Irish dairy herds. PhD Dissertation, National University of Ireland , 1–365.

Mee, J.F. (2018). Investigation of Stillbirths. Lecture at Univeristy of Liverpool for DBR , 1–13.

Mee, J.F. (2004). Managing the dairy cow at calving time. Veterinary Clinics of North America - Food Animal Practice 20 , 521–546.

Mee, J.F. (2008). Newborn Dairy Calf Management. Veterinary Clinics of North America: Food Animal Practice 24 , 1–17.

Mee, J.F. (2008). Prevalence and risk factors for dystocia in dairy cattle: A review. The Veterinary Journal 176 , 93–101.

Mee, J.F. et al. (2011). Risk factors for calving assistance and dystocia in pasture-based Holstein–Friesian heifers and cows in Ireland. The Veterinary Journal 18, 189–194.
Mee, J.F. et al. (2017). Survive to 5 : Can we keep more newborn calves alive 1–7.

Meijering, A. (1984). Dystocia and stillbirth in cattle - A review of causes, relations and implications. Livestock Production Science 11 , 143–177.

Miller, A. et al. (2018). A UK based clinical trial, evaluating a 5 day Co-Synch plus CIDR protocol and the licensed 7 day CIDR protocol in both dairy and beef maiden heifers. University of Liverpool, Diploma in Bovine Reproduction Dissertation, 1–35.

Nielen, M. et al. (1989). Twinning in dairy cattle: A study of risk factors and effects. Theriogenology 32, 845–862.

Norman, S. (2007). Parturition and Dystocia. Current Therapy in Large Animal Theriogenology ,310–335.

Schuenemann, G.M. et al. (2011). Assessment of calving progress and reference times for obstetric intervention during dystocia in Holstein dairy cows. Journal of Dairy Science 94 , 5494–5501.

Schuijt, G. (1990). Iatrogenic fractures of ribs and vertebrae during delivery in perinatally dying calves: 235 cases (1978-1988). Journal of the American Veterinary Medical Association 197, 1196–1202.

Szenci, O. Role of acid-base disturbances in perinatal mortality of calves: a review. Veterinary Bulletin 73.

Taverne, M.A. et al. (2012). Bovine Perinatology. PhD Utrecht University , 1–30.

Tenhagen, B.-A. et al. (2007). Effect of Various Degrees of Dystocia in Dairy Cattle on Calf Viability, Milk Production, Fertility and Culling. Journal of veterinary medicine. A, Physiology, pathology, clinical medicine 54 , 98–102.

Thompson, J.R. et al. (1983). Interrelationships of parturition problems, production of subsequent lactation, reproduction, and age at first calving. Journal of dairy science 66 , 1119–1127.