Understanding dystocia in the field: part 1

Difficult births (dystocias) are not uncommon for horses and present significant risks to mare and foal, with potentially fatal consequences. A sound understanding of the normal physiological processes before and during parturition are essential to enable vets to quickly identify when these processes deviate from the norm. To rapidly diagnose the cause of the dystocia, the attending obstetrician should be assured in their approach; resolute in their decision making; and prompt in action if the risks of mare and foal morbidity and mortality are to be managed. Constructive communication with the mare's owners is essential to allow adequate planning to prioritise the outcome. The future fertility of the mare is imperative in many cases yet is often overlooked. The obstetrician must be dynamic and be prepared to alter their approach when necessary. This review outlines the causes of dystocia and the recommended approaches to resolution.

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Dystocia in equines can be life-threatening to both dam and foetus, and represents a genuine emergency. Dystocia is reported to affect between 1–13.2% of foalings, with large Draft and pony breeds considered to be at higher risk than other breeds (Ginther and Williams, 1996; Lu et al 2006; Frazer, 2007). Dystocia was found to be less likely in maiden Thoroughbred mares (8.5%) than barren mares (12.7%) or mares that had previously foaled (14.2%) (Squires et al, 2013). Regardless of breed or parity, it is recommended that all equine births are attended so that if manual intervention is required, it can be provided in a timely fashion.

Normal foetal kinetics in utero

From approximately 2 months into gestation, the equine foetus is highly active (Allen and Bracher, 1992). The characteristically long umbilical cord facilitates free movement within the allantoic cavity between the uterine body and gravid horn, and alterations in foetal polarity between cranial and caudal presentation occur regularly. Between 5–7 months, both horns contract and the foetus is confined to the uterine body. By 7 months, the uterine horns form an acute angle over the dorsal aspect of the markedly enlarged uterine body. The foetus' hindfeet regain access to the gravid uterine horn, which is only possible while in cranial presentation and dorsal recumbency (Ginther, 1998). The hindfeet advance through the horn lumen with continued growth, to reach the horn tip by 10 months. Once the hindlimbs are enclosed within the gravid horn, the foetus is committed to a cranial longitudinal presentation. These utero-foetal interactions ensure that the vast majority (98.9%) of births occur in cranial longitudinal presentation; with only 1.0% in caudal longitudinal presentation and 0.1% in transverse presentation (Vandeplassche, 1987). Significant episodic foetal activity continues to term, which can be vigorous and sometimes clearly visible through the mare's flank. The soft eponychium extending from the pointed foetal hooves is thought to provide some cushioning to protect the uterus from potential injury.

Physiology of parturition

An understanding of the physiological events associated with eutocia (normal parturition) is vital to allow one to identify and effectively treat cases of dystocia. The average duration of pregnancy is 341–344 days, although parturition at any point between 315 and 388 days gestation may be considered normal (McCue and Ferris, 2012; Davies Morel et al, 2002).

The process of parturition can be divided into stages 1, 2 and 3. During stage 1, cervical relaxation occurs, accompanied by the onset of coordinated uterine contractions, which often elicit restless behaviour, mild colic signs and sweating. It is thought that the increase in uterotonicity during stage 1 stimulates the foetus to voluntarily extend its forelimbs and head towards the pelvic inlet. Passage of foetal extremities into the pelvic canal stimulates pituitary oxytocin release, which intensifies myometrial contractility. Stage 2 commences at the point of rupture of the allantochorion and associated release of allantoic fluid. Active straining ensues, usually in lateral recumbency, though periods of intense abdominal effort are often interrupted by one or two brief intervals of standing. At least one foetal forefoot should appear through the vulvae within 5 minutes of allantochorionic rupture. The opposite forefoot generally appears soon after, with both feet orientated sole down. The head rests between each carpus and rotates

with the forelimbs from an initial dorsopubic position, rotating to dorsosacral as the muzzle appears externally. The foetal shoulders represent the widest cross-sectional region, therefore each shoulder transits the pelvic inlet individually, which is why the forelimbs appear at the vulvae in a staggered fashion. Intense straining continues until the hips traverse the pelvic canal, after which point the mare usually rests for a few minutes, with the distal hindlimbs often undelivered. The hindlimbs are extracted and umbilical cord broken either when the mare finally stands, or during the foal's early attempts to rise. Stage 2 is usually complete within 20–30 minutes, or slightly longer in maiden mares (Ginther and Williams, 1996; Frazer, 2007). Stage 3 follows, and terminates after expulsion of the foetal membranes which, in normal circumstances, occurs within 1–3 hours (Stanton, 2011).

The variable gestation length in horses, and consequential unpredictability of impending parturition compared with that in other species coupled with a tendency to only foal at night, with a rapid, explosive labour process, makes the imperative of attending all foalings a challenge to any breeder. Familiarity with the signs of impending parturition can certainly help. Within the last few weeks of pregnancy, mammary gland enlargement occurs and is usually more apparent in multiparous than primiparous mares. The teats remain fairly small until the last week of gestation, when the teat sinuses fill with colostrum and visibly enlarge. Often in the final 24–48 hours, droplets of dried colostrum will appear at the teat ends (commonly termed wax). This is usually a reliable indicator that parturition is near, although some mares appear to 'wax-up' as much as 1–2 weeks before foaling. In the final week of pregnancy, the muscular and ligamentous structures surrounding the pelvis and perineum often palpably relax, while the vulva softens and elongates in the hours before foaling. While these trends provide an aid in forecasting the timing of parturition, the subjective and gradually evolving nature of some of the changes makes predicting imminent labour a less-than-perfect art more than a science.

Electrolyte and pH analysis of udder secretions in late gestation provide the most scientific means of predicting imminent parturition. However, these tests can only offer reassurance that foaling is or is not likely over the subsequent 12–24 hours and, as such, need to be repeated regularly, creating significant expense. Various foaling alarm technologies are available, which provide an alert either in response to mare recumbency, increased sweating or forced vulvar parting. While these technologies provide reassurance, all have their potential drawbacks and unfortunately are not a reliable substitute to physical monitoring. Supervision must not be obtrusive, as external stressors can suppress myometrial contractions and delay labour (Frazer, 2007). Monitoring of foaling mares via live video feed is considered the most reliable and unobtrusive approach.

If delivery is delayed, the risk of asphyxia or hypoxic disease to the foetus increases. Therefore, prompt recognition and resolution of dystocia is key to foal survival. Clients should be educated regarding the expected timeline of events during a normal foaling and most critically, when to call for veterinary assistance. Prolonged or unprogressive first- or second-stage labour can indicate obstetrical abnormalities and a delay in intervention can result in a maldisposed foetus becoming impacted in the pelvic canal, severely complicating the chances of a swift resolution. Therefore, the time at which the allantochorion ruptures and stage 2 commences should be accurately recorded, before observing the mare's efforts closely. Most mares require minimal assistance. However, the following scenarios warrant a manual vaginal examination and/or prompt veterinary assistance:

- Failure of the amnion or a foetal body part to appear through the vulvae within 5 minutes of allantochorionic rupture.
- Lack of appreciable progress in delivery within 10 minutes of allantochorionic rupture.
- Absence of strong uterine contractions.
- Foal's feet being upside down.
- Abnormal combination of body parts at the vulvae (one limb, forelimbs with no head, head with no forelimbs).
- Failure of the chorioallantois to rupture and the appearance of an intact villous chorion at the vulvae ('red bag').

The information the clinician receives from a client calling regarding a dystocia will determine the advice, as will the obstetrician's proximity to the particular stud. A red bag, for example,

Table 1: Terminology associated with dystocia description and management.

Term	Definition
Dystocia	Difficult labour.
Foetal maldisposition	Collective term describing an abnormal foetal presentation, position or posture.
Presentation	Orientation of the long-axis of the foetus relative to the dam's spine, i.e. longitudinal or transverse, coupled with the portion of foetus entering the pelvic canal, i.e. cranial, caudal, ventral or dorsal.
Position	Location of the foetal dorsum relative to the mare's pelvic quadrants (sacral, ilial or pubic), i.e. dorsosacral, right/left dorsoilial, dorsopubic, or right/left cephaloiliac.
Posture	Specific location of the foetal extremities relative to foetal trunk; in normal circumstances the cervical spine and forelimbs are extended.
Repulsion	Pressure applied in a caudocranial direction to return a foetus or foetal extremity from the pelvic canal to the uterus to free up space for manipulations.
Mutation	Manoeuvring of foetal extremities to correct an abnormal position or posture.
Version	Manual adjustment of the presentation of a foetus, e.g. from transverse to longitudinal presentation.
Assisted vaginal delivery (AVD)	Manual correction of dystocia and foetal delivery in a conscious restrained mare.
Controlled vaginal delivery (CVD)	Manual correction of dystocia and foetal delivery in an anaesthetised mare. Mare is usually positioned in dorsal recumbency with the hindquarters hoisted 2-3 feet via hobbles and a winch or front-end loader (Trendelenburg position) so the foetus falls cranially, freeing up space in the pelvic canal for manual manipulations.
NB: A foetus approaching the pelvic inlet in a normal presentation, position and posture would be described as cranial-longitudinal, dorsosacral, with extended neck and forelimbs.	

cannot wait and therefore needs to be addressed immediately by the owner. The author often returns the owner's phone call while in the car, in order to piece together a more complete history, and to provide relevant guidance and support. Generally, owners are not remotely coached through an attempt to resolve a foetal maldisposition. Experienced foaling personnel have usually already made an unsuccessful attempt, while inexperienced individuals neither have the drugs, equipment or know how to make a realistic effort at resolution, and also risk subjecting the mare's reproductive tract to undue trauma or inadvertently complicating the dystocia.

Causes of dystocia

Foetal maldisposition

Foetal maldisposition is responsible for most dystocias. Most cases involve an appropriately presented foetus but with abnormal posture of the long foetal limbs and neck. Foetal malposture may be seen in normal foals, or may be caused by flexural limb/spinal deformities or foetal compromise and subsequent failure to extend the head and/or neck towards the pelvic brim (*Figure 1*). Although the utero-foetal interactions discussed previously ensure that malpresentation occurs in only 1.1% of deliveries, 14–24% of referred dystocias involved caudal longitudinal or transverse presentation (Vandeplassche, 1987; Frazer et al, 1997; Byron et al, 2003) (*Figure 2*). Foetal maldisposition is discussed in more specific detail later in this article.

Foetopelvic disproportion

Dystocia caused by absolute foetopelvic disproportion is rare, compared with the bovine species, as a result of the equine pelvic shape favouring delivery and uterine size limiting foetal growth, even after prolonged gestation (Frazer, 2007) (*Figure 3*). Relative fetopelvic disproportion may be more common in maiden mares, indeed, manual traction is more often required in primpiparous deliveries, while healed pelvic fractures can result in significant narrowing of the pelvic canal (Turner, 2007). Frazer et al (1997) found foetopelvic disproportion to be responsible for only 1.3% of referral dystocias.

Foetal congenital abnormalities

Developmental abnormalities accounted for 12% of referral dystocias. Contracted foal syndrome, which includes flexural limb deformities, scoliosis and torticollis (wry-neck) (*Figure 4*) represented the most common cause, followed by hydrocephaly (Frazer et al, 1997) (*Figure 5*). Dystocia due to hydrocephaly is more commonly observed in pony breeds due to the proportionally larger domed skull (Frazer, 2011a).

Twin pregnancy

Twins are an uncommon cause of dystocia, and can be mistaken for a ventrotransverse presentation if a combination of forelimbs and hindlimbs are identified at the pelvic inlet. Frazer et al (1997) found twinning accounted for 4% of referral dystocias, while Giles et al (1993) reported twinning to be responsible for over 6% of cases of abortion, stillbirth and neonatal death. The prevalence is considered to be much lower nowadays, as a result of the widespread advancement in ultrasound-guided detection and reduction of early twins (Frazer, 2011a).

Other maternal causes

Uterine torsion more commonly occurs before term (7.5–10.5 months). However, torsion at term is possible and was found to

Figure 1. Dystocia caused by ventrally deviated head and neck. The foetal poll was palpable and the muzzle was retrieved and guided into the pelvic inlet, allowing an uncomplicated assisted vaginal delivery. Although born alive, the foal was euthanised because of congenital deviation of the rostral maxilla and nasal septum (wry-nose).

Figure 2: Dystocia caused by a ventro-transverse presentation resulting from severe scoliosis. The foal was delivered dead via caesarian section. The mare survived and bred successfully in subsequent seasons.

Figure 3: Foal born uneventfully following 400 days of pregnancy, demonstrating clearly the lack of correlation between gestation length and birth weight, unlike in some other species.

account for 5–10% of referred dystocias (Vandeplassche, 1972). Primary uterine inertia results in unprogressive labour due to insufficient uterine contractions, and was seen in 2% of referral dystocias. Secondary uterine inertia is also a possible consequence of prolonged dystocia resulting in myometrial exhaustion (Frazer et al, 1997; Busse and Uberti, 2020).

Equipment and drugs for managing dystocia

Equine practitioners with a broodmare caseload should have a well-stocked dystocia kit which can be easily accessed in an emergency. The kit should be carefully assembled at the start of the foaling season and it's contents regularly stock-checked.

Equipment

Such a kit should contain obstetrical chains with handles and nylon ropes to assist with manual delivery, as well as a clean nasogastric tube, pump and bucket for intrauterine infusion of lubricant. Additional instrumentation such as a blunt eye hook, obstetrical snare, detorsion rod, Kuhn's crutch repeller with long rope, or GYN-stick® (Heberex, Enschede, NL) may be carried by more experienced practitioners, and can aid delivery in some situations. Equipment necessary for foal resuscitation should include an oxygen cylinder, endotracheal and/or nasotracheal tube and self-inflating resuscitation bag (Ambu® SPUR® II, Ambu Ltd, St. Ives, Cambridgeshire), as well as adrenalin and supplies to administer intravenous fluid therapy. It is recommended that studs also have their own oxygen cylinder and aspirator-resuscitator with mask (McCulloch Medical™, Elmwood, Wisconsin). The dystocia kit should also contain the instrumentation necessary for fetotomy, which includes a fetotome, wire threader, saw wire, wire cutter, handles, curved wire introducer, fetotomy knife and Krey's hook (Frazer, 2011b).

Drugs

Chemical restraint

Foaling mares are often agitated and can be unpredictable in their behaviour. Therefore, the use of sedative or tranquillising drugs is often necessary allow interventional efforts to be performed safely. Specific drug choice and dose varies depending on mare temperament, clinical status, dystocia diagnosis, and whether the foetus is alive or dead due to the potential risk of reduced placental perfusion and foetal cardiovascular compromise (Luukkanen et al, 1997). Mild tranquillisation with acetylpromazine (ACP) can produce sufficient anxiolysis to facilitate safe intervention in some cases, with minimal deleterious effect on foetal viability. More robust chemical restraint can be provided using α-2 agonists; xylazine is the preference over detomidine if the foetus is alive, due to its shorter duration of action. α-2 agonists can produce marked and sometimes sudden hypersensitivity so should always be used in combination with either ACP, or the opioid butorphanol, which provides adjunctive sedative and analgesic properties, though its depressant effects can also be experienced by the foetus. Some authors recommend that mares that are given opioids during foaling later receive mineral oil to reduce the risk of impaction due to gut stasis (Frazer, 2007). Caudal epidural anaesthesia is rarely performed in dystocia cases because of time limitations, and its inability to suppress uterine or abdominal contractions. However, if fetotomy is to be

Figure 4. Dystocia caused by lateral deviation of the head and neck due to severe torticollis ('wry-neck'). The foal was delivered via caesarian section. Note the simultaneous wry-nose. The mare survived, conceived 2 months later and foaled uneventfully the following season.

performed in a standing mare, desensitisation of the vagina via epidural inhibits the Ferguson reflex, which facilitates accurate wire placement, thus minimising soft tissue trauma. A low dose caudal lidocaine-xylazine epidural is advised, to reduce the risk of ataxia (Grubb et al, 1992).

General anaesthesia

Short-duration general anaesthesia (GA) may be warranted in some circumstances, such as when there is no referral option and unsuccessful attempts at assisted vaginal delivery have extended beyond 10 minutes. GA leads to cessation of all conscious expulsive efforts, as well as myometrial contractions. Drug choice is influenced by the objectives: rapid induction of anaesthesia, with minimal respiratory and cardiovascular depressant effects on dam and foetus. Xylazine premedication (0.8–1.0 mg/kg, intravenously [IV]), followed by induction with ketamine (2.2–2.5 mg/kg, IV) and diazepam (0.08 mg/kg, IV) is considered the most suitable protocol for achieving these goals. Around 10-15 minutes of anaesthesia should be expected. Following induction, an IV infusion of guaifenesin (50g), ketamine (1-2g) and xylazine (500mg) combined in 1L saline, administered to effect by an assistant, induces more profound relaxation of the mare and allows the duration of anaesthesia to be prolonged. Obstetricians should be aware that the anaesthetic risks to an in-labour mare are elevated as a result of reduced blood pressure caused by the vasodilatory effects of endogenous oxytocin; compromised ventilation and oxygenation due to increased pressure on the diaphragm exerted by the pregnant uterus and Trendelenburg positioning; reduced functional residual capacity; as well as the potential for aspiration of stomach contents due to decreased cardiac sphincter tone. Prolonged hoisting of the hindquarters can also lead to hind limb paresis. Therefore, the duration of anaesthesia should be strictly minimised and all of the mare's vital signs monitored closely by an assistant throughout (Bidwell, 2013).

Tocolysis

Partial inhibition of uterine contractions to facilitate repulsion or corrective manipulations may be achieved using tocolytic drugs, off-licence, if available. Clenbuterol, a β2-adrenoreceptor agonist, administered IV (0.8 μg/kg) rapidly induces limited myometrial relaxation, with minimal deleterious cardiovascular effects on the foetus (Card and Wood, 1995). Isoxsuprine, a β2-adrenoreceptor agonist - α-adrenoreceptor antagonist, administered IV (0.6mg/kg) also induces uterine relaxation, which is anecdotally more profound than that achieved with clenbuterol. The superior degree of tocolysis produced by isoxsuprine is not attributed to its α-adrenergic antagonism. However, as myometrial smooth muscle expresses β-adrenoreceptors only (Erkert and MacAllister, 2002).

Foal resuscitation

Cardiopulmonary cerebral resuscitation (CPCR) of the neonate may be necessary. The principal drug used for CPCR is epinephrine, an α-adrenoreceptor agonist, which raises vascular tone, and

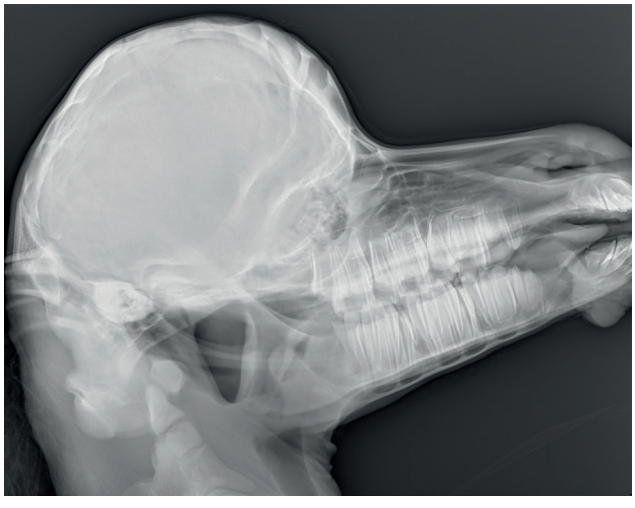

Figure 5: Dystocia caused by congenital hydrocephaly, preventing spontaneous extension of head and neck through pelvic canal with fore limbs. Assisted vaginal delivery was performed without decompression of the cranium and the foal was euthanised immediately after birth.

consequently aortic diastolic pressure, elevating coronary artery blood flow and myocardial circulation. The epinephrine dose rate is 0.01-0.02mg/kg via IV or intraosseus routes, and 0.1-0.2mg/kg if delivered via the intratracheal route. Doxapram has been historically utilised as a respiratory stimulant in neonates. However, it is now known to be ineffective in resolving secondary apnoea. Doxapram also reduces cerebral circulation and increases cardiac muscle oxygen demand, therefore is not recommended for neonatal resuscitation (Corley and Axon, 2005).

KEY POINTS

- Prompt recognition and resolution of dystocia is key to foal survival.
- Foetal maldisposition is responsible for most dystocias.
- Clinicians should have a fully stocked ready-to-go dystocia kit, as well as drugs and equipment necessary for chemical restraint, anaesthesia and foal resuscitation.
- Diagnosis of the cause of dystocia, time elapsed since allantochorionic rupture and foetal vitality status must all be established before manual resolution is attempted.

Evaluation and planning

Initial assessment

A prompt evaluation of the mare's clinical status should be made first, paying particular attention to gingival mucous membrane colour and capillary refill time for evidence of haemorrhage or shock. The vulvar area is then examined for exposed foetal extremities, foetal membranes and/or discharge. Foetal extremities are still moist if intervention has been called for quickly, whereas dry, oedematous body parts confirm parturition has been prolonged. Significant vulvar haemorrhage indicates soft tissue trauma, while a foul-smelling discharge likely represents the presence of a dead, emphysematous foetus. Preliminary observation of the perineal area should also be used to rule out secondary rectal prolapse, bladder eversion or prolapse of viscera through the vulvae. Throughout this initial assessment, or during the attending veterinarian's journey to the client's premises, a thorough history should be acquired from the owner to include the mare's age and parity, number of days pregnant; duration of stage one; time elapsed since allantochorionic rupture; time to exposure of foetal extremities or foetal membranes through the vulvae and whether any manual intervention was attempted. Other information such as previous cases of dystocia, periparturient diseases or pelvic injuries may or may not be relevant but should also be gathered at this time.

Diagnosis

An internal manual examination is performed, usually in the mare's stable, which should be clean, well lit and adequately sized to perform the procedure safely. Confinement in stocks is not advised due to the likelihood of recumbency. However, sufficient restraint is vital because of the unpredictable nature of parturient mares. A nose twitch or lip chain may suffice. However, chemical restraint can be used at this stage, if necessary. The tail should be bandaged and the perineal region cleaned thoroughly with dilute disinfectant, along with the practitioner's hands and arms. Serious consideration must be made towards minimising trauma to the vaginal and cervical mucosa, which are prone to developing fibrosis and adhesions, with potentially severe consequences for subsequent fertility. Full length examination sleeves are strongly recommended, their protective benefits outweighing the minor loss of tactile sensation and grip (Frazer, 2007). Copious lubricant should be applied liberally and regularly. A swift manual examination of the caudal reproductive tract is made to check for lacerations or haematomas, to assess the extent of cervical relaxation and wheth-

er any palpable pelvic irregularities are present. Then, the foetal disposition is determined, including its presentation, position and posture, as well as foetal vitality. Uterine torsion must be ruled out in cases of foetal malposition, which usually occurs cranial to the cervix (unlike in bovidae) and is therefore diagnosed via transrectal palpation (Vasey and Russell, 2011). If overt foetal movement is not present, pinching of the tongue or coronary band, or palpation of the eyelid may elicit a response. If within reach, palpation of the thoracic cardiac apex beat is diagnostic. Evasive foetal responses to stimulation or manipulation can complicate the dystocia and is a common cause of cervical malposture (Frazer, 2007). Therefore, at this early stage, to maintain control of the head, if present, it is recommended a rope snare is placed behind the ears and tightened into the mouth. EQ

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