

Uterine torsion in the mare: a review and three case reports

Baarmoedertorsie bij de merrie: een overzicht en een bespreking van 3 gevallen

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ABSTRACT

When a mare exhibits signs of colic during the last trimester of gestation, uterine torsion should always be part of the differential diagnosis. Uterine torsion is an infrequently occurring but serious complication in pregnant mares. In this article a review is given of the appearance, causes, symptoms, diagnostic examinations, treatment options and prognosis for the mare, as well as for her foal. At the end, three unusual cases are described.

SAMENVATTING

Wanneer een hoogdrachtige merrie kolieksymptomen vertoont, moet men steeds bedacht zijn op een uterustorsie. Deze complicatie komt weinig voor maar kan ernstige gevolgen hebben voor de merrie en het veulen. In dit artikel wordt een overzicht gegeven van het voorkomen van uterustorsie, de oorzaken, de symptomen, het stellen van de diagnose, de behandelingsmogelijkheden en de prognose voor de merrie en het veulen. Tot besluit worden er enkele klinische gevallen besproken.

APPEARANCE

Uterine torsion is an infrequent but serious complication in pregnant mares. It constitutes 5 to 10% of all serious obstetric problems in horses (Vandeplassche *et al.*, 1961). Although uterine torsion mostly occurs during the last trimester of pregnancy (Pascoe *et al.*, 1981; Dolente, 2004) or immediately prior to parturition (Vandeplassche *et al.*, 1971; Pascoe *et al.*, 1981; Perkins *et al.*, 1992; Immegart, 1997; McGladdery, 2001), it is also reported to occur in early pregnancy (Ruffin *et al.* 1995). In cases that occur near term, the fetus can assume an abnormal position, which may contribute to the uterine torsion and thus may cause dystocia (Vasey, 1993).

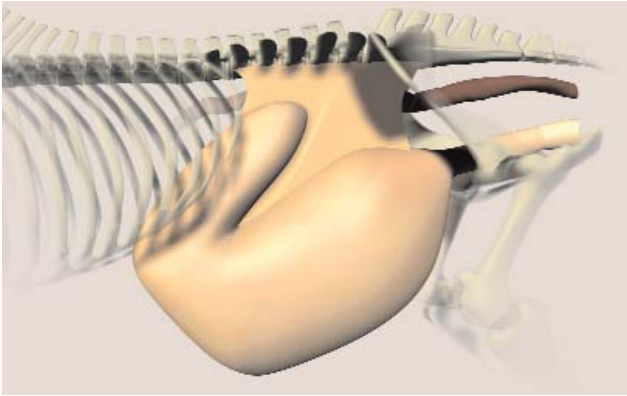
The end result is torsion of the uterine horns and body through 180 to 540° or even more, in either clockwise (Pascoe *et al.*, 1981; Chaney *et al.*, 2007) or counter-clockwise (Spincemaille *et al.*, 1970) direction as viewed from the rear (Vasey, 1993). The broad ligaments, or mesometrium, that suspend the uterus have an extensive dorsal base in the sublumbar region, which limits the incidence of uterine torsion in the mare compared to the cow (Figures 1 and 2) (Taylor *et al.*, 1989; Vasey, 1993). No breed or age predilection has been demonstrated in the horse (Spincemaille *et al.*, 1970; Vasey, 1993).

CAUSES

The causes of uterine torsion in the mare are not well defined, but they include factors such as vigorous fetal movement, rolling of the mare, sudden falls, a large fetus in a relatively small volume of fetal fluid, lack of tone in the pregnant uterus, a long mesometrium, and the presence of a large, deep abdomen (Spincemaille *et al.*, 1970; Roberts, 1971; Taylor *et al.*, 1989; Vasey, 1993; Immegart 1997).

SYMPTOMS

The diagnosis of uterine torsion should always be considered in mares that exhibit mild signs of colic during the last trimester of gestation (Spincemaille *et al.*, 1970; Vasey, 1993). Usually these mild, intermittent signs of colic respond poorly or only temporarily to analgesics (Spincemaille *et al.*, 1970; Vasey, 1993). Signs of colic associated with uterine torsion include depression, periodic pawing, looking at the flank, restlessness, sweating, inappetence, frequent urination, sawhorse stance, kicking at the abdomen and rolling (Roberts, 1971; Pascoe *et al.*, 1981; Pascoe and Pascoe, 1988; Vasey, 1993; Perkins and Frazer, 1994; Dolente, 2004). Violent rolling movements are rarely described in these cases (Pascoe



Figures 1 and 2. 1: (left lateral view). The broad ligaments, or mesometrium, that suspends the uterus, have an extensive dorsal base in the sublumbar region, which limits the incidence of uterine torsion in the mare compared to the cow. 2: (caudal view).

et al., 1981). The signs can be confused with impending parturition or abortion (Perkins and Frazer, 1994; Dolente, 2004). The severity of pain in the acute phase is related to the degree of torsion (Taylor *et al.*, 1989; Vasey, 1993). Greater rotation increases the restriction of blood flow to and from the uterus and increases uterine congestion (Taylor *et al.*, 1989). Symptoms may be present for a variable duration, from a couple of hours to 3 days or more (Pascoe *et al.*, 1981; Taylor *et al.*, 1989). In the event of chronic uterine torsion, the symptoms may be vague and include inappetence and depression, or may not be evident at all (Doyle *et al.*, 2002). Rectal temperature, and heart and respiratory rates are then within normal limits or only slightly elevated. Abdominal auscultation will reveal normal or reduced gastrointestinal sounds (Pascoe and Pascoe, 1988; Vasey, 1993).

If torsion is associated with uterine rupture, signs of more severe systemic disease may be evident, such as fever, tachycardia, hypovolemia, depression and signs of peritonitis (Steel and Gibson, 2001; Dolente, 2004). Signs of more severe abdominal pain and other symptoms such as nasogastric reflux, absence of gastrointestinal tract sounds and scant feces may be associated with concurrent involvement of the gastrointestinal tract due to conditions such as colon impaction, ischemia, and incarceration of segments of the intestinal tract (Roberts, 1971; Wichtel *et al.*, 1988; Perkins and Frazer, 1994).

If torsion of the uterus occurs near term, dystocia may be the presenting sign. Abdominal contractions are usually absent, as the torsion prevents the fetus from being pushed into the pelvic canal (Vasey, 1993).

DIAGNOSIS

A definitive diagnosis is based on careful rectal palpation. In late pregnancy, the broad ligaments are pulled tightly downward by the gravid uterus, in front of the pelvic rim. Torsion of the uterus causes asymmetry of these ligaments, especially when the torsion exceeds 180° (Vasey, 1993) (Figure 3). In the event of a counter-clockwise torsion, the left uterine ligament, which originates from the left sublumbar

region, is strongly stretched and runs immediately downwards under the uterine body. The right uterine ligament runs from its origin at the right sublumbar region to the left of the abdomen and then under the uterine body, so the right ligament is located more cranially (Figure 4). When the torsion is clockwise, the right ligament is more tense and runs immediately under the right side of the uterus; the left ligament runs to the right, over the uterine body, cranially of the right ligament, and then under the uterus (Pascoe and Pascoe, 1988; Taylor *et al.*, 1989; Vasey, 1993; Perkins *et al.*, 1996; Steel and Gibson, 2001). The severity of the torsion is indicated by the amount of tension on the ligaments (Vasey, 1993). Occasionally the position and orientation of the rectum may be useful in establishing the direction of uterine torsion (Vasey, 1993). Some constriction of the small colon may exist, depending on the stage of gestation and the degree and site of the torsion, which will restrict exploration of the abdomen (Figure 5) (Pascoe *et al.*, 1981; Pascoe and Pascoe, 1988; Vasey, 1993). Concurrent tympany of the small or large colon may also make rectal examination difficult (Vasey, 1993).

All palpable organs within the abdominal cavity should be examined to rule out a concurrent gastrointestinal condition. Any tense band in a pregnant mare needs to be carefully examined to distinguish



Figure 3. Left lateral view of a counter clock torsion over 540° in a late term mare after euthanasia.

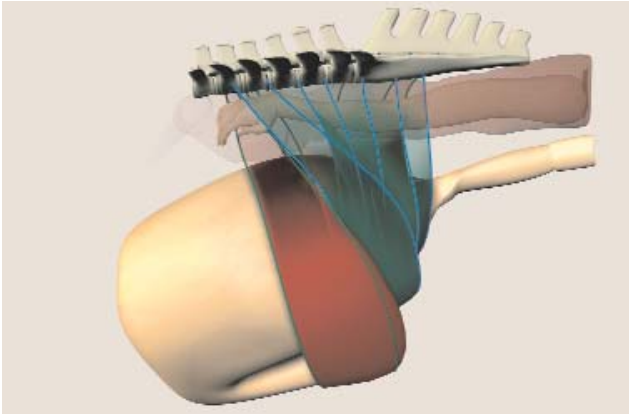


Figure 4. (left lateral view). In the event of a counter-clockwise torsion, the right uterine ligament runs from its origin at the right sub lumbar region to the left of the abdomen and then under the uterine body, so the right ligament is located more cranially.

between the taenia coli and the broad ligaments of the uterus (Vasey, 1993).

When possible, the fetus should be palpated to determine whether it is alive or dead, as this may influence the surgical approach (Pascoe *et al.*, 1981). However, on rectal palpation, it might be difficult to reach the fetus because of its cranial displacement by the torsion (Vasey, 1993). Transabdominal ultrasonography must be used to determine fetal compromise or death and uterine rupture (Dolente, 2004), or to examine the abdomen for signs of intestinal obstruction (Steel and Gibson, 2001).

Detection of gas within the uterus or recognition of a thickened irregular uterine surface increases the likelihood that the fetus is dead, that portions of the uterus are necrotic or that the uterus has ruptured. Therefore the uterine wall should be palpated carefully. Rupture of the uterus is not an uncommon sequel to prolonged uterine torsion, and the location and extent of this rupture will influence surgical access and the resultant prognosis (Vasey, 1993). Palpation of a fetus outside the uterus also indicates that uterine rupture has occurred (Pascoe and Pascoe, 1988). In contrast to uterine torsion in the cow, the cervix and cranial portion of the vagina are involved in only 4% of uterine torsions in the mare. Therefore, vaginal examination is of little diagnostic use in the mare (Perkins *et al.*, 1996) and is contraindicated.

Transrectal palpation is considered essential for the diagnosis of uterine torsion, though the findings may be inconclusive in some cases. In the 2 mares with a chronic uterine torsion, Doyle *et al.* (2002) could not feel any broad ligaments on rectal palpation, and during surgery they could not find the broad ligaments and ovaries in these mares. They assumed that the broad ligaments underwent necrosis because of the long duration of the torsion, and that the ligaments were no longer present at the time of surgery. A congenital abnormality such as hypoplasia or the absence of broad ligaments should also be considered. This abnormality may explain the development of torsion without signs of colic, the continued survival of

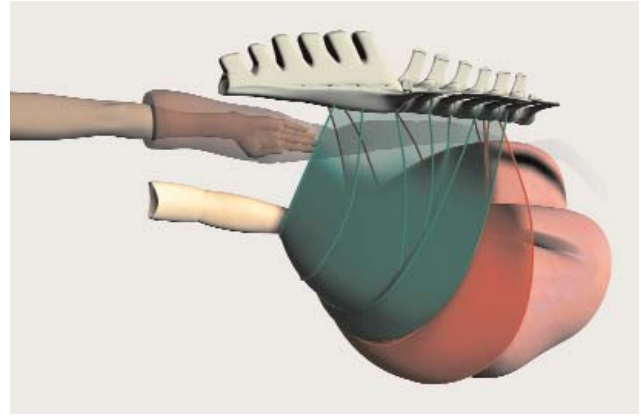


Figure 5. Right lateral view of a clockwise torsion with restriction of the small colon which will restrict expansion of the abdomen.

the uterus because of a major blood supply from another source, and the unusual tightness of the constriction at the point of torsion (Doyle *et al.*, 2002).

Abdominal paracentesis is indicated in mares with colic, particularly if rectal examination does not confirm a diagnosis of uterine torsion or a concurrent gastro-intestinal lesion is suspected. Peritoneal fluid may be difficult to obtain from a mare in late pregnancy, because the uterus occupies a large area of the ventral abdomen. The peritoneal fluid characteristics of mares prepartum and postpartum do not differ significantly from that of normal peritoneal fluid (Vandeplassche *et al.*, 1961; Pascoe and Pascoe, 1988).

Once the diagnosis of uterine torsion is established, immediate intervention and correction is recommended to optimize the chances of fetal and maternal survival (Taylor *et al.*, 1989).

TREATMENT

Different techniques have been suggested to correct equine uterine torsion. The method of preference should be based on the degree of torsion, severity of pain, fetal viability, surgeon's preference and client financial constraints (Steel and Gibson, 2001).

Manual rotation through the cervix

When uterine torsion has been diagnosed *at term*, an attempt should be made to correct the torsion manually *per vaginam*. Successful delivery depends on passage through the cervical canal of the clinician's well-lubricated hand and arm (Spincemaille *et al.*, 1970; Vasey, 1993). This will usually only be possible if the torsion is less than 270° (Vasey, 1993). Vandeplassche *et al.* (1961) were not able to get their hand through the cervix in 6 out of 10 mares with torsion at the end of gestation, 2 of which had a uterine torsion of 540°. If the fetal membranes are intact, they should be ruptured to release fluid and reduce the size and weight of the uterus and its contents (Vasey, 1993). It is essential that the mare remains standing

throughout the procedure. Hence sedatives should be avoided, but epidural anesthesia may help to eliminate abdominal straining (Vasey, 1993; Steel and Gibson, 2001). Elevation of the mare's hindquarters will provide more space in the posterior part of the abdominal cavity, as the intestines will move forward (Vasey, 1993). The clinician's hand and arm should be inserted as deeply as possible into the uterus and a substantial part of the fetus (upper foreleg or body) should be grasped. The fetus and uterus are rocked left and right through small arcs (25-30 cm) until, with an extra effort in a semi-circular motion opposite to the direction of the torsion, detorsion is accomplished. A second effort may be necessary for complete detorsion (Taylor *et al.*, 1989; Vasey, 1993). Complete detorsion is recognized by normal dorsosacral delivery of the fetus, lack of twisting of the uterine body, and normal position of the uterine ligaments during rectal palpation (Vasey, 1993).

After correction of the torsion, the mare should spontaneously start second stage labor, although this may be delayed because vascular congestion and edema may diminish uterine contractility (Vasey, 1993). If the uterine and cervical congestion prevent normal cervical dilatation or if the mare does not spontaneously deliver the foal following full dilatation of the cervix, either the mare can be induced to foal with oxytocine or the foal can be delivered with manual assistance (Taylor *et al.*, 1989; Vasey, 1993). If sufficient cervical dilatation does not occur, a caesarean section is indicated (Taylor *et al.*, 1989).

Over 80% of the uterine torsions seen at parturition can be corrected using the technique described above (Vandeplassche, 1980; Vasey, 1993). Manual detorsion of a dead fetus is more difficult and involves more risk of uterus lesions (Vasey, 1993).

Mares at parturition, with a partial torsion in which the cervix is sufficiently dilated to deliver the foal, need to be carefully evaluated. Traction applied to the foal in these cases may cause cervical and uterine rupture, resulting in fatal hemorrhage or peritonitis.

Rolling

Rolling of the anesthetized mare can be used to correct uterine torsion during the last trimester of pregnancy, but it should not be used near term because of the increased risk of uterine rupture (Wichtel *et al.*, 1988). To roll the mare, she is first anesthetized and placed in lateral recumbency on the side to which the torsion is directed. The mare is then turned quickly in the direction of the twist, with the objective to turn the body around the uterine axis. For example, if a clockwise torsion to the right is diagnosed, the mare is positioned in right lateral recumbency and rotated in a clockwise direction. The result of the rolling technique depends on the tendency of the gravid uterus to maintain a constant position while the maternal position changes. Occasionally, the rolling procedure needs to be repeated or the mare needs to be rocked back and forth while positioned in dorsal recumbency

to help correct the uterine torsion (Guthrie, 1982; Vasey, 1993).

A modification of this technique involves the use of a plank of wood to stabilize the fetus while the mare is rotated. A person kneels on a board (2 to 3 m long and 20 to 30 cm wide) that has one end across the recumbent mare's upper paralumbar region and the other end on the floor. The mare is then rolled as described above, although more slowly to reduce the risk of uterine rupture (Bowen *et al.*, 1976; Wichtel *et al.*, 1988; Taylor *et al.*, 1989; Vasey, 1993). In cases where the fetus is ballottable through the abdominal wall, the plank is repositioned during the rolling procedure as necessary to maintain maximal leverage on the fetus (Vasey, 1993). To achieve correction, this procedure may need to be repeated several times. Progress is assessed by rectal palpation, but this might be difficult on the recumbent mare (Taylor *et al.*, 1989; Vasey, 1993).

The complications of rolling include uterine rupture, especially in mares close to term, premature placental separation, death of the fetus, and abortion or premature delivery (Immegart, 1997).

Early reports using this non-surgical method were associated with a high mortality rate of both mare (40%) and fetus (71%), possibly because of separation of the allantochorion from the endometrium with subsequent abortion, premature birth, uterine rupture and death of the fetus (Vandeplassche *et al.*, 1971). However, more recent reports (Guthrie, 1982; Wichtel *et al.*, 1988) reported better results, with a mare mortality rate of 13% (1/8) and a fetal mortality rate of 25% (2/8). This can be explained by the use of an improved rolling technique and patient selection of non-parturient mares (Vasey, 1993). Correction by rolling leaves a non-compromised abdominal wall for subsequent labor, it is less expensive than celiotomy and less likely to lead to post-procedural complications (Doyle *et al.*, 2002), but it does not permit the assessment of uterine viability or associated gastrointestinal lesions (Ruffin *et al.*, 1995; Chaney *et al.*, 2007).

Standing flank laparotomy

In tractable mares without evidence of uterine rupture, uterine torsion is by preference corrected by the standing flank laparotomy (Pascoe *et al.*, 1981; Pascoe and Pascoe, 1988; Vasey, 1993). A flank incision is made on the side towards which the uterus is rotated (Pascoe and Pascoe, 1988; Vasey, 1993). It is easier to turn the uterus into its normal position by lifting and then repelling rather than by pulling, which may predispose rupture of the uterine wall (Pascoe *et al.*, 1981). Nevertheless, Pascoe *et al.* (1981) did not experience any untoward difficulties when incising the flank opposite to the direction of the torsion. If the direction of the torsion is not clear, then the incision should be made in the left flank (Pascoe and Pascoe, 1988; Vasey, 1993).

The mare is placed in stocks and sedated, though

in a manner such that she remains standing throughout the procedure. The appropriate paralumbar fossa is clipped and prepared for aseptic surgery. Skin and abdominal muscles are desensitized by local infiltration with 2% lidocaine (Vasey, 1993). A standard grid approach is used in which the skin and the subcutaneous tissue are incised in a vertical direction; the external, the internal and the transverse abdominal muscle are divided in the direction of their fibers (Figure 6) (Vaughan, 1972; Pascoe *et al.*, 1981; Pascoe and Pascoe, 1988). The peritoneum is perforated and the aperture extended in a vertical plane to provide sufficient room for introduction of the surgeon's arm (Pascoe *et al.*, 1981; Pascoe and Pascoe, 1988). In at-term mares, near-term mares and mares with a narrow flank, the standard grid technique is modified by transecting the external abdominal oblique muscle in the same plane as the skin and the subcutaneous tissue (Pascoe *et al.*, 1981). This transection usually allows insertion of both surgeons' arms into the abdomen and makes correction of the torsion more easy (Taylor *et al.*, 1989). Vasey (1993) advocated the use of the modified grid approach, though generally with introduction of only one arm.

The direction of the uterine torsion is confirmed by palpating intra-abdominally the direction of displacement of the broad ligaments of the uterus (Pascoe *et al.*, 1981; Pascoe and Pascoe, 1988) and palpating the dorsal surface of the uterine body forward from the cervix (Vasey, 1993). If the uterus is rotated towards the incision site, the surgeon's arm is passed deeply along the body wall under the uterus and a prominent part of the fetus (if possible, the hocks) is grasped through the uterine wall. Gently rocking movements towards the surgeon, followed by repulsion of the dorsal surface of the uterus, will correct the torsion (Vandeplassche *et al.*, 1971; Pascoe *et al.*, 1981; Pascoe and Pascoe, 1988; Taylor *et al.*, 1989; Vasey, 1993; Perkins and Frazer, 1994). When the uterus is rotated away from the incision, correction is accomplished by alternating pulling movements towards the operator, and lifting and repositioning the uterus away from the surgeon (Pascoe *et al.*, 1981; Pascoe and Pascoe, 1988).

In cases of prolonged, severe torsion in which the uterine wall is edematous and friable because of venous congestion, detorsion needs to be performed carefully to avoid uterine rupture. In these cases, lengthening the incision and inserting both arms to lift and repel the uterus concurrently may be helpful (Vasey, 1993). Occasionally, dual flank incisions with two surgeons, one on each side, may be necessary to correct a difficult uterine torsion in mares in advanced pregnancy (Vasey, 1993; Perkins and Frazer, 1994). Perkins *et al.* (1996) had to use bilateral flank incisions and even a third person to help correct torsion transvaginally in a late-term Belgian draft mare.

Correction of the uterine torsion is confirmed by abdominal or rectal palpation of the broad ligaments and the dorsal surface of the uterus starting at the cervix (Pascoe *et al.*, 1981; Pascoe and Pascoe, 1988;



Figure 6. (left lateral view). A standard grid approach is used in which the skin and the subcutaneous tissue are incised in a vertical direction. The external, the internal and the transverse abdominal muscle are divided in the direction of their fibres.

Vasey, 1993; Perkins and Frazer, 1994). The uterus is palpated for the presence of tears, hemorrhage, edema, necrosis and congestion, and the fetal responses are evaluated in an attempt to determine whether the fetus is alive or not (Perkins *et al.*, 1992). If the fetus is determined to be dead, immediate delivery per vaginam (Pascoe and Pascoe, 1988) or by caesarean section in dorsal recumbency (Pascoe and Pascoe, 1988; Vasey, 1993; Immegart, 1997) is recommended.

Prior to closure, the abdomen is palpated for abnormalities (Pascoe *et al.*, 1981; Pascoe and Pascoe, 1988). The peritoneum is routinely left open, and the incision is closed by careful apposition of the muscle layers, subcutis and the skin. A subcutaneous drain is placed if there is excessive separation of the subcutaneous tissue from the abdominal muscles (Pascoe and Pascoe, 1988).

Standing flank laparotomy is performed with sedation and local anaesthesia, which may optimize fetus survival. In the late gestation mare, however, the use of a standing flank laparotomy for correction may be challenging due to the uterine size, and may not be feasible in mares suffering from moderate to severe pain (Chaney *et al.*, 2007). Very nervous or violent mares are also not ideal patients for correction by standing flank laparotomy. Manual untwisting becomes more difficult in advanced gestation (> 10 months) (Pascoe and Pascoe, 1988).

When the uterus is ruptured before or during manipulation, or the uterus is determined to be necrotic, it is advisable to finish the procedure under general anesthesia, either through the same incision of preferably through median celiotomy (Pascoe and Pascoe, 1988).

Ventral midline laparotomy

Ventral midline laparotomy is indicated if uterine rupture has occurred, the torsion cannot be corrected in standing position, the mare is close to term (Pascoe *et al.*, 1981), the mare has intractable pain suggestive of gastrointestinal involvement (Perkins and Frazer, 1994; Steel and Gibson, 2001), or the mare is very nervous or violent.

Following induction of general anesthesia, the mare is positioned in dorsal recumbency and a 25 cm long ventral midline incision is made immediately cranial to the umbilicus. This approach allows better access to the abdomen and enables both arms to be inserted through the incision to correct the torsion. If a hysterotomy is indicated, for example in the case of a dead fetus (Pascoe *et al.*, 1981; Steel and Gibson, 2001), it must be performed first, because afterwards the torsion is easier to correct (Vasey, 1993).

The advantages of the ventral midline approach include easier correction of uterine torsion in advanced pregnancy and better access. The uterus can easily be inspected for the presence of tears, hemorrhage, edema, necrosis, and congestion (Perkins and Frazer, 1994; Steel and Gibson, 2001). The midline incision makes it easier to perform a hysterotomy, if indicated, to repair uterine wall rupture and to treat concomitant gastrointestinal problems (Vasey, 1993). The disadvantages include the stress of general anesthesia on the mare and fetus, the surgical facilities that are needed, the price of the operation, and the severe strain on the ventral incision if the mare goes into labor soon after surgery (Vasey, 1993; Immegart, 1997).

Preoperatively, the mare is given broad spectrum antibiotics and a non-steroidal anti-inflammatory drug, such as flunixin meglumine, to counteract the risk of endotoxaemia and prostaglandin release associated with abdominal surgery. Postoperatively, antibiotics and non-steroidal anti-inflammatory drugs are administered, if necessary. In the pregnant mare, progesterone supplementation will usually be continued for at least a week to counteract the prostaglandin release. The mare is confined to a stall for 3 to 4 weeks. She should be observed for any signs of abortion, such as the loss of the cervical mucus plug, udder development, vulva discharge or early signs of parturition (Vasey, 1993).

In the case of chronic torsion with a dead fetus, it is recommended to remove the fetus and all uterine fluid before correction, because the uterus is too friable to withstand reposition without rupture while the fetus is left in place. In these cases a ventral midline approach is necessary to allow careful manipulation of the friable uterus and to provide adequate access to

arteries for ligation, as a hysterectomy is indicated (Doyle *et al.*, 2002).

PROGNOSIS

In an older study, Spincemaille *et al.* (1970) obtained a survival rate of 58% in mares and 29% in fetuses following correction of uterine torsion. In the study of Pascoe *et al.* (1981), 73% of the mares and 53% of the fetuses survived. Nowadays the prognosis for survival after correction of uterine torsion is better, being 84% for mares and 54% for fetuses, respectively (Chaney *et al.*, 2007). Mare survival is significantly associated with the stage of gestation in which torsion occurs and the mare's heart rate at the time of admission to the hospital. Mares that develop uterine torsion at ≥ 320 days of gestation are less likely to survive (65%) compared to mares with uterine torsion < 320 days (97%). The mean heart rate at admission to the hospital of surviving mares (59 bpm) is significantly lower than that for mares that die (74 bpm). The duration of clinical signs, degree of rotation, method of correction, arterial oxygen pressure (PaO₂), mean arterial pressure and packed cell volume at the time of admission are not significantly associated with mare survival (Chaney *et al.*, 2007). Mare survival rate is also dependent on the degree of uterine compromise and worsens if uterine rupture with subsequent peritonitis is present (Dolente 2004). In the case of chronic uterine torsion, the prognosis for survival of the mare is good when she is treated by ventral midline celiotomy, followed by a caesarean section, a correction of the torsion and a hysterectomy (Doyle *et al.*, 2002).

If uterine congestion is minimal, the prognosis for fetal survival is fair (Taylor *et al.*, 1989). The stage of gestation at which uterine torsion occurs significantly influences fetus survival. When torsion occurs at < 320 days, 72% survive, compared to 32% when torsion occurs at ≥ 320 days. The survival rate of fetuses older than 320 days of gestation is significantly better when the uterine torsion is corrected by a standing flank laparotomy compared to a ventral midline celiotomy. Neither PaO₂ nor mean arterial pressure are associated with fetus viability (Chaney *et al.*, 2007). In the study of Doyle *et al.* (2002) on chronic uterine torsion in the mare, none of the fetuses survived. Approximately half of the fetuses died during the period of torsion; the other half died following correction of the torsion. The additional fetal loss following rotational correction can be a result of premature placental separation, severe stress to the dam or fetus, or both, and of uterine wall necrosis and rupture (Vasey, 1993; Immegart, 1997).

The fertility of the mare is usually not compromised (Pascoe *et al.*, 1981). In the study of Chaney *et al.* (2007), information on rebreeding was available for 36 mares: 67% were successfully rebred, 14% did not become pregnant after correction of the torsion, and in 19% rebreeding was not attempted. Nonsurgical or surgical correction of uterine torsion does not adversely affect the mare's subsequent reproductive

performance unless either uterine rupture has occurred or a caesarean section was performed (Vasey, 1993). Hysterectomy can be performed if the uterus is severely compromised and the reproductive future of the mare is not a concern to the owner (Dolente, 2004).

Complications arising from uterine torsion include abortion (Pascoe *et al.*, 1981; Pascoe and Pascoe, 1988; Vasey, 1993; Ruffin *et al.* 1995), loss of the cervical mucus plug (Pascoe *et al.*, 1981; Pascoe and Pascoe, 1988), premature placental separation (Vasey, 1993), incarceration of the small colon (Pascoe *et al.*, 1981), subcutaneous seroma formation (Pascoe and Pascoe, 1988), partial or complete dehiscence of the incision wound (Vasey, 1993), uterine rupture (Spincemaille *et al.*, 1970; Vasey, 1993; Steel and Gibson, 2001), peritonitis after necrosis, leakage or rupture of the uterine wall (Pascoe and Pascoe, 1988, Vasey 1993), death of the mare from circulatory and endotoxemic shock (Spincemaille *et al.*, 1970; Pascoe and Pascoe, 1988; Perkins *et al.*, 1992; Vasey, 1993), irreversible thrombosis (Vandeplassche *et al.*, 1971), hematomata (Vandeplassche *et al.*, 1971), extreme venous congestion (Vandeplassche *et al.*, 1971) and reoccurrence of uterine torsion during the same pregnancy (Vasey, 1993). The chance of abortion after correction is determined by the degree of vascular compromise of the placental circulation. This is influenced by the duration of torsion, the degree of rotation and the involvement of the broad ligaments (Pascoe *et al.*, 1981).

CASE HISTORIES

Three unusual cases of uterine torsion in the mare are discussed.

Case 1

A 12-year-old warm blood mare 320 days pregnant was brought to the clinic with mild signs of colic and was suspected to have been suffering from a left uterine torsion for seven days already. On arrival, the mare was colicky, had a diminished skin turgor and a heart rate of 44 beats per minute. On auscultation, no borborygmi could be heard and on rectal palpation, a severe uterine torsion to the left hand side (counter clockwise) was felt, together with a living fetus. A decision was made to perform a standing flank laparotomy. She was premedicated and a standard grid incision was made in the left flank. Upon opening of the abdomen, it was noted that a lot of fibrin was already present in the peritoneal fluid. The veterinary surgeon tried to accomplish detorsion of the uterus. Unfortunately, this was impossible and a second incision had to be made in the right flank. With a second surgeon assisting on the right side and a third person assisting per rectum, detorsion succeeded. On days 4 and 7 post-surgery, she did exhibit fever (up to 39.6°) and mild colic. Day 11 after the operation the fetus was checked again and found to be alive, the CTUP (Combined uterine – placental thickness) was

within normal limits (11.7 mm, no = 8.51-11.77 mm) (Renaudin *et al.*, 2003) and the fetal fluids were free of debris. Later that day, the mare gave birth to a filly. The placenta was expelled easily. Seventeen days postpartum, she started once again to show signs of colic. A trans-abdominal puncture was performed and the peritoneal fluid had a white blood cell concentration of 160000 x 10⁹/L (normal value = less than 5000 cells/ μ L) (Hardy, 2004). Because of the bad prognosis, the mare was euthanized. On pathological examination, a large atonic uterus with diffusely distributed subserosal and submucosal hemorrhages was found. Focal fibrinous peritonitis with adhesion between small colon and peritoneum cranioventrally of the left flank surgical incision was present. A mesenterial lymphadenopathy and ileus were observed.

Case 2

A ten-year-old jenny-ass, presumably more than 12 months pregnant, was sent to the clinic since the owners thought that she was in labor.

Rectal palpation was rather difficult because of the animal's small size (height of the withers about 120 cm); a uterine torsion to the left was felt. On transrectal ultrasound, a fetus in anterior presentation could be seen. The cervix was closed; clear fetal fluids and a normal CTUP were observed. On transabdominal ultrasound, no heartbeat could be noted in the pregnant uterus. A vaginal examination was performed. Folds in the cervix and vagina indicated that both were involved as well. Once the cervix was fully dilated, reposition of the uterus was manually performed and a dead foal was extracted. The next day, the temperature was elevated (38.5°), so the uterus was flushed with saline. Three days later, the temperature dropped and the jenny-ass started to eat normally. On the fourth day, she was discharged from the clinic.

Case 3

A 5-year-old warm blood mare at day 316 of gestation was referred to the clinic. The mare had been colicky for twelve hours and was suspected to be suffering from uterine torsion. On arrival, she had a heart rate of 64 beats per minute. On auscultation, only a few borborygmi were audible. On rectal palpation, no uterine torsion could be felt, and the fetus and uterine wall felt normal. As everything seemed to be normal, the mare was placed in the stable for observation. The next day the mare again showed signs of severe colic and this time rectal palpation revealed a uterine torsion to the right hand side (clockwise) with severely tensed ligaments

Because of this tension, and in consultation with the owner, the decision was made to perform a ventral midline laparotomy. After premedication, she was put under general anesthesia. The operation was performed without any complications, and during detorsion it became clear that the uterus was rotated over more than 360°. After the operation, the mare was

treated with a NSAID for 5 days. She also received antibiotics, 0.044 mg/kg bwt altrenogest (Regumate Equine[®], Intervet) once a day and 8 mg/kg bwt pentoxifylline (Torental[®], Sanofi-Aventis) twice a day. The operation wound, temperature, fetus and CTUP were checked regularly. Fifteen days after the operation (i.e. 332 days of pregnancy), the mare went into labor. She would not lie down and her abdominal strains were not sufficient to expel the foal. The foal was extracted while the mare was standing. The foal was injected with 3000 IU of tetanus serum (anti-tetanus serum[®], Intervet) and 1 mg/kg bwt ceftiofur (Excenel[®], Pfizer A. H.) and was given its first colostrum. After one hour, the mare expelled the placenta with its chorionic side outermost. The foal was very thrifty and viable, suckled in time and meconium was expelled in time as well. The next day the foal's IgG level was checked (glutar aldehyde test) and found to be less than 800 mg/dl, for which reason the foal was given 1.5L of plasma I.V. The ceftiofur treatment of the foal was continued for four days. As the mare did not produce enough milk, she was treated with 300 mg domperidone orally (Domperidon Teva[®], Teva) 3 times a day to stimulate milk production. Two days post-partum, the foal's IgG level was still less than 800 mg/dl and the foal was given another 0.75L of plasma. On the third day, the foal had an elevated temperature (38.9°C), it would not get up to nurse, and its respiration was rapid and difficult. On auscultation of the lungs, a scouring sound was heard unilaterally and a lot of comet jets were seen on ultrasound. As treatment, the foal was given 1 g amoxicillin, 200 mg clavulanate potassium (Augmentin[®], GSK) 3 times a day, Sodium benzylpenicillin 2.5 million I.U. I.V. (Penicilline 5.000.000 IE inj[®], Kela) 3 times a day, ketoprofen 150mg (Ketofen 10%[®], Merial) twice a day and an infusion with glucose (50ml Glucose 5% voor infusie in Viaflex[®], Baxter) as its suckling reflex deteriorated. It also received 0.03 mg of clenbuterol (Ventipulmin inject opl.[®], Boehringer Ingelheim) and 150 mg acetylcysteine (Lysomucil[®], Zambon) by aerosol, 4 times a day. During that night the foal died. Pathological examination revealed slight amounts of serosanguinous fluid in the pericard, multiple linear myocardial hemorrhages and voluminous, non-collapsed, consolidated, fluid-filled lungs. Histological examination of the lungs revealed a mild interstitial pneumonia with alveolar septa lined by hyaline membranes, suggesting an immature lung with insufficient surfactant production.

DISCUSSION

In the first case, the mare suffered from chronic uterine torsion. In the event of chronic uterine torsion, Doyle *et al.* (2002) advise to perform a ventral midline celiotomy followed by a cesarean section, correction of the torsion and ovariohysterectomy, if necessary. In the cases that Doyle *et al.* described (2002), the fetus was dead upon arrival, while in this case the fetus was still alive. Therefore reposition of the torsion was

attempted by lateral flank laparotomy, leaving the fetus inside. This probably saved the foal's life. Unfortunately, the mare developed an adhesive peritonitis and had to be euthanized later on. Peritonitis is usually accompanied by a uterine tear (Vasey, 2003; Dolente, 2004), but in this case no tear was present. Most probably the peritonitis was caused by transudation of liquids out of the compromised uterus. The degree of compromise depends on the duration and degree of uterine torsion. Moreover, standing flank laparotomy cannot be performed as sterilely as an operation under general anesthesia, and as such might have deteriorated the condition of the mare.

The second case was complicated by the small size of the jenny-ass. It can be assumed that uterine torsion is less common in small breeds because of the smaller abdominal cavity. In the study of Spincemaille *et al.* (1970), only 4 of the 41 cases were ponies; breed predilection could not be proved. The small diameter of the rectum makes it impossible for some veterinarians to perform a decent rectal examination, and an increased risk of rectal tearing always exists.

In the third case, a histological examination of the lung of the foal revealed several alveolar hyaline membranes. Avery and Mead (1959) found that in premature infants a deficiency in lung surfactant was correlated to the occurrence of hyaline membrane disease, now generally called respiratory distress syndrome (RDS). In the foal, two forms of RDS are recognized: neonatal respiratory distress syndrome (NRDS) and acute respiratory distress syndrome (ARDS). NRDS is seen in immature, surfactant-deficient lungs, resulting in alveoli that are difficult to distend and which tend to collapse after expiration. This deficiency in pulmonary surfactant contributes to the development of pulmonary edema and hyaline membranes (Frevert, 1994). In equine species, it seems that surfactant maturation occurs very late in gestation and is not always fully developed at the end of gestation (Pattle *et al.*, 1975). ARDS is mostly caused by gram-negative bacteria and thus by sepsis, resulting in endotoxin-induced lung injury. NRDS is seen in premature or dysmature foals and develops within hours of birth. On the other hand, foals with ARDS may have a history of normal foaling with the development of respiratory distress hours to days after parturition (Frevert, 1994). The foal in this study developed respiratory distress after 3 days. On histopathology, a mild interstitial pneumonia was seen, which pointed in the direction of an immature lung with insufficient surfactant production, either with or without septic pneumonia. Unfortunately, no signs of lung injury were visible; Bacterial examination of lung tissue was not performed.

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