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Case Report

Utilization of colpotomy in the mare

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Abstract

Colpotomy, or a surgical incision of the vagina, has been used as an approach to urogenital surgery in the mare since the early 20th century. The most common use of this approach is for ovariectomy, though it has also been reported as an approach to the urinary bladder for repair of tears and removal of cystoliths as well as to the uterus to facilitate reduction of a twin fetus via transuterine cranio-cervical dislocation. Advantages of the colpotomy approach include the ability to perform standing surgery (no need for general anesthesia), shortened surgical time, and a reduced postsurgical recovery time. Disadvantages are the blind nature of some procedures performed via colpotomy (i.e., ovariectomy and associated potential complications such as hemorrhage and postoperative evisceration, with the most serious being death of the mare). This manuscript reviews the various reported uses of colpotomy in the mare as well as potential complications.

Keywords: Mare, colpotomy, ovariectomy, bladder, twin reduction, urogenital surgery

Introduction

As early as 1903, colpotomy has been reported as a surgical approach in the mare.[1] Colpotomy can be used to gain access to the mare abdomen without the need for general anesthesia. This results in a shortened surgical time and reduced postoperative recovery time,[2] which translates into fewer anesthesia-associated risks to the mare and also a lower financial burden to the client. There are significant potential complications associated with colpotomy reported in the literature, including hemorrhage, evisceration, and peritonitis, though these may be minimized with proper surgical techniques and postoperative care.[3]

Ovariectomy via colpotomy

Indications for an ovariectomy include a desire to diminish estrus behavior in performance mares, create a teaser mare for stallion semen collection, or sterilize a recipient mare to be used in an embryo transfer program.[4] Additionally, neoplastic ovaries smaller than 10 cm or those that can easily be grasped and held in the surgeon's hand may be removed via colpotomy.[4] Other than colpotomy, surgical approaches for ovariectomy include celiotomy via the flank, ventral midline, or vaginal approach (natural orifice transluminal endoscopic surgery; NOTES), and the flank laparoscopic approach. The reduced surgical time compared to celiotomy and the lack of general anesthesia lowers the financial cost to the client, making colpotomy an attractive surgical option in some cases. While transvaginal NOTES and flank laparoscopy are also performed in the standing mare, the key difference between these approaches and conventional colpotomy is that the only specialized instrumentation required for conventional colpotomy is a chain ecraseur, while NOTES and laparoscopy require more advanced instrumentation.[5] Additionally, external scarring may be avoided with the use of the NOTES or colpotomy approaches.

Ovariectomy via colpotomy has been previously described in the literature.[4,6,7] Briefly, feed can be withheld from the mare for at least 24 hours prior to surgery with the goal of reducing the number of fecal balls present within the small colon that could be mistaken for an ovary during the procedure. Preoperative antibiotics and an anti-inflammatory (i.e., flunixin meglumine at 1.1 mg/kg IV) should be administered. The mare should be restrained in stocks with the tail wrapped and secured to one side. Sedation and analgesia may be achieved via administration of detomidine HCl (0.002–0.022 mg/kg IV) and butorphanol (0.002–0.022 mg/kg IV). Sedation may be re-dosed as needed throughout the procedure, or a continuous rate infusion (CRI) of detomidine or detomidine with butorphanol can be used. A caudal epidural should be administered with 2% lidocaine (0.22 mg/kg) alone or in combination with xylazine (0.17 mg/kg); this serves to desensitize a portion of the caudal reproductive tract, but its main benefit is prevention of straining by the mare during surgery. A

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caudal epidural may be administered in either the first or second intercoccygeal space in the mare (Figures 1 and 2). The angle of needle introduction should be 30° with horizontal rather than perpendicular to the spinal canal if the second intercoccygeal space is chosen.8 Manure should be evacuated from the rectum and the perineum should be cleansed with water and a mild soap, as is standard for any vaginal procedure in the mare. The vagina is prepared for surgery by introducing Betadine™ scrub on cotton pledgets followed by lavage with dilute Betadine™ solution. All of the solution is then evacuated, and the lips of the vulva are separated manually with the goal of creating a pneumovagina. Introduction of a sterile vaginal speculum will also facilitate this. The creation of a pneumovagina is one of the most important parts of ensuring a successful colpotomy. This results in a tight drum-like dilation of the cranial vaginal vault, making it easier to identify and avoid vaginal arteries and create a safe incision. Conversely, when the vaginal wall is flaccid, the stabbing motions required to make the vaginal incision can result in inadvertently nicking the internal iliac artery. The surgeon should at minimum wear sterile surgical gloves over sterile palpation sleeves. Once the surgeon has identified via palpation the site on the cranial vaginal wall where the incision will be made (usually at the 10 o'clock or 2 o'clock position, with the cervix being the center of the clockface6), a sterile laparotomy sponge soaked in 2% lidocaine is held up against this site for several minutes to provide topical anesthesia. A piece of suture or umbilical tape is then secured to a number 10 scalpel blade (to allow easy localization should the blade be accidentally dropped within the vagina), which the surgeon introduces into the vagina, taking care to keep the blade guarded until ready to make the incision (Figure 3). A small incision (approximately 1 cm, enough to just fit the tip of the surgeon's finger) is made through the vaginal wall and the scalpel is removed from the vagina. The surgeon first introduces one finger into the incision, bluntly dilating with increased numbers of fingers until the incision can accommodate the entire hand. At this point, the peritoneum is bluntly entered with either a quick forward stabbing motion with the forefinger or a tearing action with the thumb and forefinger (Figure 4). The hole in the peritoneum is then dilated until the hand and forearm of the surgeon are within the abdominal cavity. The ovaries are identified in situ and the ovarian pedicles are palpated for any abnormalities. Another lidocaine-soaked laparotomy sponge, this time with attached suture or umbilical tape, is taken into the abdomen and held against the ovarian pedicle for several minutes to provide some topical analgesia. The surgeon then obtains the chain ecraseur, with the loop of chain encircling the four fingers (Figure 5). The surgeon introduces the ecraseur into the vagina, through the colpotomy incision, and into the abdomen. The first ovary (usually the ovary that is contralateral to the colpotomy incision; i.e., remove the left ovary first if the colpotomy is on the right side of the vagina and vice versa) is identified and the chain loop is placed around the ovarian pedicle. Once certain that the chain encircles the ovarian pedicle and nothing else, the surgeon or an assistant begins slowly tightening the ecraseur (Figure 6). Continuous careful palpation of the chain and pedicle by the surgeon is necessary while the chain tightens to ensure that no bowel or mesentery slips into the loop and is inadvertently transected. Most mares will react to some extent while the chain tightens but should relax once the ovary is removed. It is important that there not be tension on the

Figure 1. Palpation of the space between the first and second coccygeal vertebrae (first intercoccygeal space) for administration of a caudal epidural in the mare.

Figure 2. Palpation of the space between the second and third coccygeal vertebrae (second intercoccygeal space) for administration of a caudal epidural in the mare.

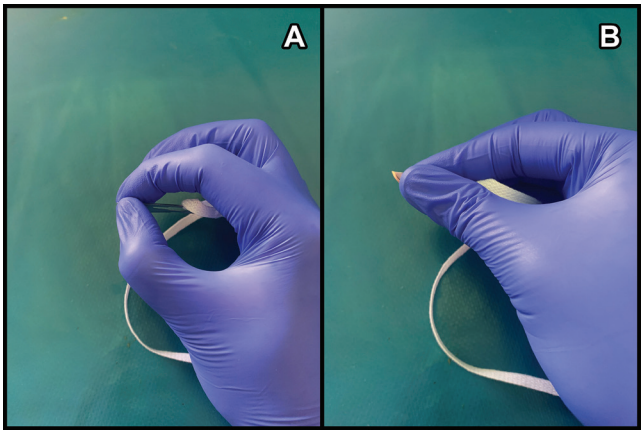

Figure 3. The scalpel blade must be carefully guarded while taken through the vestibule and vagina to avoid inadvertently damaging the mucosa. This can be done by grasping the tip of the blade between the flexed thumb and forefinger (A); the tip of the #10 blade is exposed by extending the thumb and forefinger (B).

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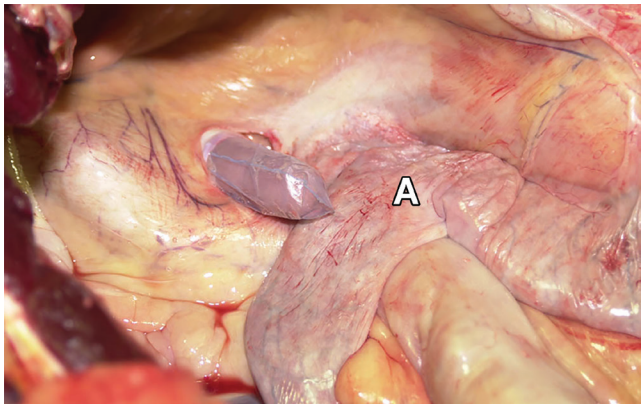

Figure 4. The surgeon's forefinger can be seen entering the abdominal cavity through the colpotomy. This image was taken with the aid of laparoscopy. For orientation, the uterus is labeled (A).

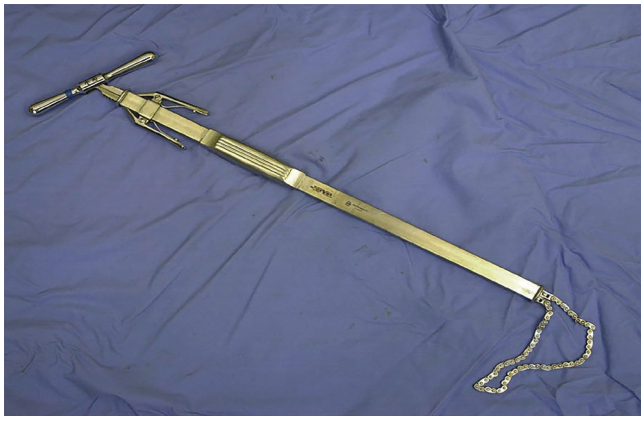

Figure 5. A standard chain ecraseur commonly used for ovariectomy via colpotomy.

pedicle while the chain is tightened, as this may increase the risk of hemorrhage from the ovarian artery via a recoiling action of the vessel once the ovary is removed.[4] The second ovary is removed in the same fashion as the first ovary, unless a unilateral ovariectomy is being performed (i.e., in the case of neoplasia). The colpotomy incision is not sutured, as this may lead to vaginitis and straining by the mare.[4] A Caslicks vulvoplasty should be performed to reduce the risk of ascending contamination of the vagina and abdomen, as well as to prevent catastrophic evisceration. Cross-tying the mare for 2–3 days postoperatively is optional. The purported value of cross-tying is to prevent recumbency and the associated intraabdominal pressure changes when the mare rises to reduce the chances of evisceration[4], this has been suggested to be unnecessary[6] and is not performed by the authors. Antimicrobial and analgesic therapy should be continued for 3–5 days postoperatively.[4] The colpotomy incision contracts rapidly (to one finger's diameter within 3 days[4]) and should be completely healed within 3 weeks.[6]

Utilization of colpotomy for twin reduction via cranio-cervical dislocation

Cranio-cervical dislocation (CCD) refers to the method of twin reduction commonly performed between days 55–150 of gestation whereby the first cervical vertebrae is manually

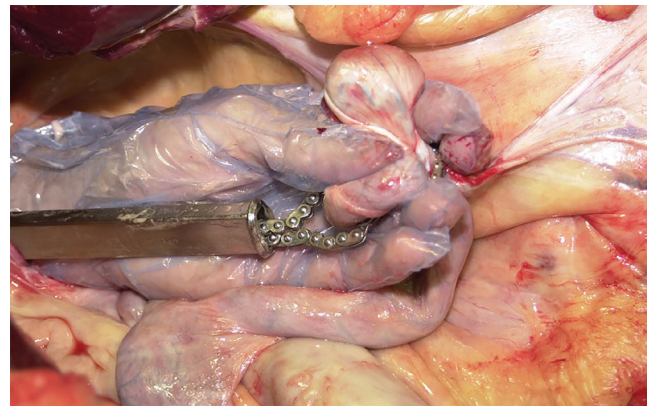

Figure 6. The surgeon's hand is grasping the ovary and the chain of the ecraseur encircles the ovarian pedicle. This image was taken prior to tightening the ecraseur. As the ecraseur tightens, the surgeon should continually palpate to ensure that the ovarian pedicle is the only structure within the chain loop and that no portion of the ovary is left behind.

dislocated from the cranium, severing the spinal cord and allowing the surviving twin to obtain nourishment from the entirety of the endometrium.[9] Various approaches have been described for CCD in the mare, including transrectal and flank laparotomy. A disadvantage of the transrectal approach is the potential for damage to the rectal mucosa, including a risk of rectal tearing due to the excessive manipulation inherent with the procedure. Like the flank laparotomy, the use of the colpotomy approach obviates that concern and it has recently been successfully used for the reduction of twins via CCD.[10,11] Bassett et al. describe a success rate of 71% (n = 29) when using CCD via colpotomy to reduce dizygotic twins and a success rate of 50% (n = 2) when reducing monozygotic twins.[11] One reason offered as a potential explanation for the difficulty in successfully reducing monozygotic twins is the intimate association of such twin fetuses within a single allantochorion.[11] Hall et al. successfully reduced dizygotic twins in a mare approximately 60 days pregnant, one being located within the uterine body, via CCD through colpotomy.[10] Neither the transrectal nor the laparotomy approach could be used in this case due to the position of the fetus within the uterine body. The colpotomy was performed as previously described for ovariectomy[4] and once the uterus was identified the fetus within the uterine body underwent CCD via transuterine manipulation. Immediately after the procedure, transrectal ultrasonography revealed a slow, faint heartbeat in the reduced twin, which completely subsided within the following 2 days. In this case, the mare went on to have a healthy singleton foal at approximately 342 days gestation.[10] It was concluded that transuterine CCD via colpotomy is a viable option for twin reduction.

Utilization of colpotomy to access the urinary bladder

The most common surgical disorder of the bladder in horses is cystolithiasis.[12] Type I (yellow-green and spiculated) and type II (gray-white and smooth) stones should be manually removed from the bladder, while horses with sabulous urolithiasis, which is secondary to bladder paralysis, are not surgical candidates and should be medically managed.[12] Rupture of the urinary bladder, or cystorrhexis, is more common in foals than in adult horses; in the adult cystorrhexis is most

commonly associated with urolithiasis, trauma, and parturition.[13] During parturition, the bladder may either become trapped between the pelvic brim of the mare and a bony prominence of the foal, or the urethra may become occluded during a dystocia, resulting in bladder rupture.[14] Single tears less than 5 cm in length may be medically managed via maintenance of a urinary catheter and abdominal drainage,[15] though primary surgical closure of defects is generally preferred.[14] Surgical approaches to the bladder reported in the literature include the traditional caudal ventral midline laparotomy, eversion of the bladder through a vaginal or urethral incision, direct eversion of the bladder through the urethral orifice, laparoscopy, and a transurethral endoscope-guided approach.[16] Approaches to the bladder that incorporate a colpotomy include incising the cranial vaginal wall, the urethra, or the urethral sphincter (urethral sphincterotomy). In one reported case of a postpartum mare with a ventral bladder tear, a 1–2 cm incision was made through the vaginal floor, 5–10 cm caudal to the cervix[17]; this approach will be described below.

A 1–2 cm incision was made through the vaginal floor and digitally enlarged until the peritoneal cavity could be entered, at which point the bladder was identified via palpation and everted through the colpotomy. An assistant surgeon kept the bladder everted in an appropriate position with stay sutures, while the primary surgeon repaired the defect in two layers. The bladder was then returned to the abdomen and the colpotomy sutured in a single simple continuous layer.[17]

Rodgerson et al. describe the use of a 24 F Foley catheter to facilitate identification of the optimal colpotomy site.[17] In this case, a postpartum mare was diagnosed with a ventral bladder tear via digital examination through the urethral orifice. The mare was sedated and restrained routinely for standing urogenital surgery. The Foley catheter was passed through the urethra and into the bladder and was digitally palpated to identify the site of colpotomy, which was approximately 5 cm cranial to the urethral orifice and 3 cm in length and extended into the urethra. The bladder tear was identified via digital palpation through the incision into the urethra, and traction was applied with an index finger through the tear to prolapse the bladder through the colpotomy. Stay sutures were used to maintain the bladder in position while the tear was closed in two layers. The bladder was returned to the abdomen and the urethral wall and vaginal floor were closed separately in a simple continuous pattern.[17]

Urethral sphincterotomy to exteriorize the bladder has been described.[13,18] In this approach, an approximately 5-cm-long colpotomy is created through the urethra and external urethral sphincter. The bladder is grasped, everted into the vagina, and repaired as previously described. While it has been reported that care should be taken to ensure that suture material does not enter the bladder lumen to prevent the formation of cystic calculi,[12] there are reports of full-thickness bladder repair in adult horses that did not result in any post-operative calculi formation.[13] In one case report, none of the mares that underwent urethral sphincterotomy experienced any complications, such as incontinence, urine pooling, or infertility.[17] However, there is evidence in the literature of postoperative urine dribbling and urine pooling after urethral sphincterotomy.[18]

Advantages of the standing vaginal approaches to the bladder are the decreased surgical time and lack of general anesthesia, the lack of external scarring (improved cosmesis), and the ability to access defects in the bladder that are unable to be exteriorized through a ventral midline laparotomy due to either their location or the extensive damage to the bladder that precludes the significant traction required for sufficient exteriorization. The above-described methods, while discussed in the context of repair of cystorrhexis, may also be used for removal of bladder stones. Alternative surgical approaches include laparoscopic and transurethral techniques, though as these procedures do not involve a colpotomy, they are beyond the scope of this manuscript. The reader is directed to other sources for information on these surgical techniques.[14,15,16,19]

Potential complications

Potential complications of the colpotomy approach in the mare include laceration of the vaginal artery during incision, hemorrhage from the ovarian pedicle post-ovariectomy, accidental dissection into the rectum or urinary bladder, postoperative evisceration, peritonitis, surgical site abscess or hematoma formation, and formation of vaginal adhesions.[3] Careful and intentional identification of the planned incision site via digital palpation and creation of a pneumovagina are ways to avoid laceration of major vessels during creation of the colpotomy. The transvaginal use of a 7.5 MHz linear array ultrasound probe with Doppler to identify the vaginal branch of the internal pudendal artery and the uterine branch of the urogenital artery prior to creation of the colpotomy has also been reported.[20] During ovariectomy, once the chain ecraseur has been released and the ovary removed, it can be difficult to identify excessive hemorrhage from the transected pedicle.[3] Further, as a decrease in serum total protein (TP) and packed cell volume (PCV) may not be evident for 6–24 hours postoperatively, using these parameters to monitor acute blood loss in the recently ovariectomized mare is difficult.[4] Clinical signs such as heart rate, respiratory rate, pulse quality, and mucous membrane color should be monitored in all postoperative mares, and fluid therapy and/or a whole blood transfusion may be considered. Placement of a Caslicks suture following the colpotomy procedure may prevent catastrophic evisceration of abdominal viscera out of the mare but will not prevent the viscera from gaining access to the vagina and vestibule.[3] Restraint of the mare in cross-ties to prevent recumbency for several days postoperatively may also be used to prevent evisceration from intraabdominal pressure changes, but there are conflicting opinions on this tactic.[4,6] Finally, as with any procedure that enters the abdomen, there is a risk of postoperative peritonitis. This risk, along with that of abscess and hematoma formation, can be minimized with meticulous surgical technique and maintenance of sterility.

Conclusion

Colpotomy is a useful approach for standing urogenital surgical procedures in the mare. Ovariectomy, twin reduction via CCD, and repair of cystorrhexis via colpotomy have all been reported in the literature. Potential complications such as hemorrhage and evisceration may be avoided with careful attention to detail and the use of appropriate precautions before, during, and after the procedure. With the advantages of both a shorter surgical time and a shorter postoperative recovery time, the lack of general anesthesia, and improved cosmesis, colpotomy should be considered a viable option in the experienced veterinarian's hands when planning urogenital procedures in the mare.

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References

1. Williams WL: Surgical and obstetrical operations. Ithaca: Cornell University Libraries; 1903.
2. Rodgerson DH, Loesch DA: Ovariectomy. In: McKinnon AO, Squires EL, Vaala WE, et al: editors. Equine Reproduction. 2nd edtion, Ames; Wiley-Blackwell: 2011:2564–2573.
3. Embertson RM: Selected urogenital surgery concerns and complications. Vet Clin North Am Equine Pract 2008;24:643–661. doi: 10.1016/j.cveq.2008.10.007
4. Prado T, Schumacher J: How to perform ovariectomy through a colpotomy. Equine Vet Educ 2017;31:209–213. doi: 10.1111/eve.12801
5. Pader K, Lescun TB, Freeman LJ: Standing ovariectomy in mares using a transvaginal natural orifice transluminal endoscopic surgery (NOTES®) approach. Vet Surg 2011;40:987–997. doi: 10.1111/j.1532-950X.2011.00871.x
6. Moll HD, Slone DE: Surgery of the ovaries. In: Wolfe DF, Moll HD: editors. Large Animal Urogenital Surgery. 2nd edition, Baltimore, MD; Williams & Wilkins: 1998: 137–141.
7. Colbern GT, Reagan WJ: Ovariectomy by colpotomy in mares. Compend Contin Educ Pract Vet 1987;9:1035–1038.
8. Lumb WV, Jones EW: Spinal anesthesia. In: Lumb WV, Jones EW: editors. Veterinary Anesthesia. 1st edition, Philadelphia, PA; Lea & Febiger: 1973: 414–415.
9. Sitters S, Wolfsdorf K: Twin reduction: cranio-cervical dislocation. In: Dascanio JJ, McCue PM: editors. Equine Reproductive Procedures. 1st edition, Hoboken; John Wiley & Sons: 2014: 222–225. doi: 10.1002/9781118904398.ch67
10. Hall S, Klabnik J, Yepez P, et al: Uterine body fetal reduction in a mare: cranio-cervical dislocation via colpotomy. Clin Theriogenol 2020;12:522–525. doi: 10.58292/ct.v12.9452
11. Bassett A, Rock K, Propp C, et al: Reduction of equine monozygotic twins using cranio-cervical dislocation via colpotomy. Clin Theriogenol 2021;13:319.
12. Schott HC, Woodie JB: Bladder. In: Auer JA, Stick JA: editors. Equine Surgery. 4th edition, St. Louis, MO; Elsevier/Saunders; 2012: 840–866. doi: 10.1016/B978-1-4377-0867-7.00065-X
13. Higuchi T, Nanao Y, Senba H: Repair of urinary bladder rupture through a urethrotomy and urethral sphincterotomy in four postpartum mares. Vet Surg 2002;31:344–348. doi: 10.1053/jvet.2002.33593
14. Rijkenhuizen ABM, Van Loon TJAM, Boswinkel M: Laparoscopic repair of a ruptured bladder in an adult mare. Equine Vet Educ 2008;20:183–189. doi: 10.2746/095777308X292137
15. Pye JL, Collins NM, Adkins AR: Transurethral endoscopic-guided intraluminal closure of multiple urinary bladder tears in a standing mare. Equine Vet Educ 2018;30:127–131. doi: 10.1111/eve.12622
16. Hall MD, Rodgerson DH: Transurethral intraluminal closure of a caudally located bladder neck tear in a standing mare. Equine Vet Educ 2020;32:111–115. doi: 10.1111/eve.13064
17. Rodgerson DH, Spirito MA, Thorpe PE, et al: Standing surgical repair of cystorrhexis in two mares. Vet Surg 1999;28:113–116. doi: 10.1053/jvet.1999.0113
18. White KK: Urethral sphincterotomy as an approach to repair of rupture of the urinary bladder: a case report. J Equine Med Surg 1977;1:250–253.
19. Stephen JO, Harty MS, Hollis AR, et al: A non-invasive technique for standing surgical repair of urinary bladder rupture in a post-partum mare: a case report. Irish Vet J 2009;62:734–736. doi: 10.1186/2046-0481-62-11-734
20. Alvarez AV, Boone L, Horzmann K, et al: Hybrid natural orifice transluminal endoscopy surgery (NOTES) to perform bilateral ovariectomy in mares. Vet Surg 2021;51:174–182. doi: 10.1111/vsu.13687