

## Clinical management of the equine oviduct

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### Introduction

Macroscopic and microscopic anomalies of the oviducts are common (87.69%), but infertility is rarely attributed to oviductal problems.<sup>1</sup> One should consider evaluation of the oviducts after other genital tract abnormalities have been dismissed as the cause of a mare's infertility and the mare has been properly bred with adequate amounts of good quality semen at the optimal time over several estrus cycles. Certain oviductal problems may be treated to allow a mare to become pregnant and carry a foal to term. Assisted reproductive techniques that involve harvesting oocytes may be required to produce foals from mares that have permanent bilateral oviduct abnormalities.

**Keywords:** Mare, oviduct, oviductal patency, PGE<sub>2</sub>

### Oviductal anomalies

#### Hydatid of Morgagni (accessory uterine tube)

Hydatid of Morgagni cysts are the most common structural oviductal anomaly and are usually present on the cranial edge of the infundibulum. These cysts result from more than one ostium forming from the coelomic epithelium in fetal life. Most fimbrial cysts are small and an incidental finding in fertile mares that require no treatment.<sup>2</sup> Although not proven to cause infertility a large cyst could have the potential to prevent the fimbria from covering the ovulation fossa at the time of ovulation and interfere with the transport of the oocyte. A Nd:YAG laser has been used to remove large fimbrial cysts and was found to maintain hemostasis and prevent the formation of postoperative adhesions.<sup>3</sup>

#### Cystic remnant of the mesonephric duct

Mesonephric duct remnants are commonly seen and usually occur unilaterally. These paraovarian cysts are frequently seen in pregnant mares, and not thought to contribute to infertility.<sup>1</sup>

#### Adhesions

The most common (66.5%) macroscopic abnormality of the oviduct is thin strands of fibrous tissue that extend from the infundibulum to the ovary or serosal surface of the genital tract and can be seen at postmortem in mares that have produced many foals. Less commonly (26.8%), bands of thick strands of fibrous tissue are seen traversing the oviduct in a superficial, perpendicular and nonocclusive fashion.<sup>1</sup> Although the etiology is not completely understood the thin strands are often seen with blood clots and may be associated with ovulation. The thicker ( $\geq 4$  mm thick) bands have not been seen to be associated with blood clots. Transluminal adhesions of the oviduct are rarely seen.<sup>2</sup>

#### Hydrosalpinx

Hydrosalpinx in the mare is rare and reports include both unilateral and bilateral cases. Hydrosalpinx can be congenital and due to segmental aplasia of the tubular tract of the infundibulum.<sup>2,4</sup> One reported case was bilateral and related to an ascending infection. The author has seen one multiparous mare with a history of pelvic fracture that spent an extended period of time in a sling and subsequently developed bilateral hydrosalpinx. If the hydrosalpinx is unilateral one may consider removal of its ipsilateral ovary to force the mare to cycle from the remaining ovary that is adjacent to the normal oviduct. Otherwise the mare's follicular activity can be managed carefully and insemination only performed when the preovulatory follicle is ipsilateral to the normal oviduct. A mare with bilateral hydrosalpinx would require an assisted reproductive technique that entailed oocytes to be harvested to produce a foal.

## Salpingitis

In spite of the frequent occurrence of endometritis it has been assumed that the incidence of salpingitis is low in the mare because the oviducts are positioned dorsally to the uterus and the prominent oviduct papillae at the utero tubal junction prevent a uterine infection from ascending into the oviducts.<sup>5,6</sup> In two abattoir studies, 7 to 37% of the samples evaluated had salpingitis. Rather than a focal lesion in the oviduct the inflammation seen tended to be a slight but widespread infiltration of lymphocytes (and occasionally eosinophils). Rarely was there occlusion of the oviduct associated with the inflammation.<sup>1</sup> Although cases of infundibulitis were seen without associated endometritis most (80%) cases of isthmic salpingitis occurred concurrently with endometritis. Although specific therapy for salpingitis and for that matter even cervicitis is rarely instituted, clinical dogma has been that resolution of chronic endometritis is necessary for inflammation in the oviduct to subside. Unfortunately a definitive and fail-safe antemortem diagnostic method for salpingitis is not available at this time.

## Globular masses

Accumulations of type I collagen fibers have been reported in the lumen of the oviduct of 18.5 - 87% of mares.<sup>1,7</sup> These globular masses are not cellular and the oviductal epithelium adjacent to them is healthy and intact. Masses may be bilateral or unilateral and are seen in multiparous, pregnant, primiparous and maiden mares. The incidence is greater in older (> 7 years) mares than mares two to seven years of age. Globular masses tend to lodge at the bends of the tortuous oviduct and at the ampullary-isthmus junction. Interestingly unfertilized ova may be present proximally and distally to the collagen mass.<sup>7</sup> Occasionally collagen fibers occupy the entire luminal diameter of the oviduct and may even distend the lumen.

The discovery that prostaglandin E2 (PGE<sub>2</sub>) was responsible for the transport of embryos through the isthmus demonstrated that oviduct transport is not a passive event.<sup>8</sup> It is not surprising that material may accumulate in the oviduct since unfertilized oocytes are retained. Obviously some luminal content in the oviduct is not pathological as unfertilized oocytes are commonly seen in uterine lavage effluent when an embryo is recovered. Obstructions due to an excessive accumulation of globular masses have been cleared by direct flushing or application of PGE<sub>2</sub> to the oviduct.<sup>3,9,10</sup>

## History and physical examination

Considering that significant abnormalities of the oviduct are not common and since the diagnostic tests are time consuming, possibly inconclusive, invasive and not without risk to the mare, it is recommended that a thorough evaluation of the mare's genital tract and management be made before pursuing specific oviductal diagnostic tests and treatment. All breeding records should be evaluated to determine a history of prolonged infertility in spite of repeat breeding with adequate doses of good quality semen from fertile stallions just prior to documented ovulations. A thorough evaluation of the genital tract should be made that includes visual examination of the external genitalia, palpation and ultrasonography per rectum, direct palpation of the cervix per vaginum, cytological examination of an endometrial swab or low volume lavage, aerobic culture of an endometrial swab, histological evaluation of an endometrial biopsy sample and hysteroscopy. A karyotype should be performed to rule out a chromosome abnormality. If the barren mare has been properly bred repeatedly, has no genital tract abnormalities and has a normal karyotype, one might then consider evaluation of the oviducts.

## Diagnostic tests

Although none of the diagnostic tests to evaluate a mare's oviduct are fail-safe the following are techniques that have been used with varying degrees of success.

### Starch grain test

The starch grain test involves the intraperitoneal deposition of a starch suspension onto the ovary. If the oviduct is patent the starch granules are transported through the oviduct into the uterus.<sup>11</sup> The procedure is performed on the day of ovulation or on day seven of diestrus. It is recommended that one

oviduct be evaluated and then the procedure be repeated on the other oviduct the next cycle. Sterile soluble starch powder (1 gm) is mixed in 10 ml of cool sterile water. The mare's paralumbar fossa is clipped and aseptically prepared. The genital tract is palpated per rectum and one ovary is manually positioned adjacent to the paralumbar fossa. Five ml of 2% lidocaine are infused subcutaneously and deep into the flank muscles at the site over the ovary. A stab incision is made through the skin. A 12 cm 18 gauge spinal needle is directed toward the ovulation fossa of the hand-held ovary and passed through the flank. Care should be taken to not lance the ovary with spinal needle. The cool starch solution (5 ml) is then infused over the surface of the ovary. The procedure is repeated on the other ovary the next estrous cycle. The uterus is then lavaged with a small volume (20-30 ml) of sterile saline daily for seven days or until starch is identified in the uterine lavage fluid. Each day a drop of the effluent is mixed with 1-2 drops of 2% Lugol's iodine on a microscope slide, compressed with a cover slip and examined on a bright light microscope (10 X objective). The starch granules stain blue. When the procedure is performed on the day of ovulation in a mare with patent oviducts the starch granules are expected to be seen in the uterus on day four to seven of diestrus. When the procedure is performed on day seven of diestrus the starch is expected to be in the uterus within 24 hours.<sup>11</sup>

#### Transvaginal application of fluorescent microspheres

After cleansing the perineum the vagina is douched with 500 ml sterile saline containing 0.05% inorganic iodine and then 50 mls of 2% lidocaine diluted with 450 ml sterile saline. A cold-sterilized transvaginal ultrasound probe is used to visualize one ovary that is held in position by direct palpation per rectum. Using a 60 cm, 18 gauge, single channel, sterile needle in the biopsy channel of the ultrasound probe, two million red, 15 µm microspheres (Fluoresbrite® Flow Cytometry Microspheres, Polysciences Inc., Warrenton, PA) suspended in 5 ml of sterile saline are deposited over the surface of one ovary. Two million green, 15 µm microspheres are suspended in 5 ml of sterile saline and then deposited over the surface of the other ovary. The mare's uterus is lavaged with 1 L sterile saline at 24 and 48 hours after microsphere deposition. The saline lavage effluent can be either centrifuged at 1500 rpm for 10 minutes, the supernatant decanted and the pellet suspended in 5 ml sterile saline or filtered through a 2-µm filter to separate microspheres and other particulate debris from the larger volume of fluid. The centrifuged or filtered samples are then examined by flow cytometry for the presence of microspheres and fluorescence pattern (green and red) which indicate that the oviducts of each respective oviduct are patent.

Microspheres did not pass though the oviducts of 23% of the barren mares (3/13) examined using this technique.<sup>12</sup>

#### Laparoscopic application of fluorescent microspheres

Each paralumbar fossa is clipped and surgically prepared. An operating laparoscope and oviductal grasping forceps are used to place an 8 Fr polypropylene catheter through the flank and into the oviduct of a sedated diestrus mare. Two million colored fluorescent microspheres suspended in 0.5 ml of a 1.5% solution of carboxymethylcellulose are inserted into one oviduct. Microspheres of a different color are then laparoscopically guided into the other oviduct via the other flank.

Microspheres passed into the uterus of 43% of healthy diestrus mares examined in a study indicating that those mare's oviducts were patent. Mares that did not have the microspheres pass into the uterus were found to have fimbrial adhesions, oviductal plug formations, unilateral hydrosalpinx and cysts of the infundibulum or oviduct.<sup>13</sup>

#### Laparoscopic oviduct infusion

After a 24 hr feed restriction, mares are sedated and their paralumbar fossae are aseptically prepared and infiltrated with 2% lidocaine for laparoscopy. A rigid laparoscope with a 30° viewing angle is positioned through an instrument portal located at the ventral level of the tuber coxae, midway between the tuber coxae and the last rib. Three other portals are created, one located 10 cm ventral and 2 located 5 cm ventral and 5 cm cranial or caudal to the laparoscope portal. Visualization of the entire length of the oviduct is possible with this flank approach. Two laparoscopic Babcock forceps are used to grasp each

side of the infundibulum to expose the abdominal ostium in the center of the infundibulum. A 7 Ch. balloon catheter is passed through the lower instrument portal and inserted 2 cm into the ampulla. The catheter cuff is inflated with 2 ml air. One Babcock forceps is then positioned over the abdominal ostium and catheter to secure the catheter in place. Sterile methylene blue solution (20 ml) is flushed through the oviduct. The procedure is repeated on the other side. Presence of the methylene blue solution is determined hysteroscopically 15 minutes post-operatively.

Catheterization of the ampulla was successful in 63.7% (7/11) of the mares. In 71% of these mares methylene blue was found in the uterus indicating the oviducts were patent.<sup>14</sup>

### **Therapeutic procedures**

The following techniques have been used to treat mares suspected of having oviduct dysfunction.

#### **Retrograde flush**

General anesthesia is administered, and a diestrous mare is placed in dorsal recumbency and surgically prepared for a paramedial incision on the left and right side. One ovary and the tip of the ipsilateral uterine horn are exteriorized through a paramedical incision. The oviduct is examined and the uterotubal junction palpated. An incision is made in the tip of the uterine horn adjacent to the oviduct papilla. The endometrium is everted so that the papilla is exposed. A 0.5 inch 24 gauge blunt ended catheter is placed into the papilla and 12 ml of saline containing a fluorescein dye is gently flushed through the oviduct. The effluent is collected at the ostium in the infundibulum and examined for the presence of masses. The uterine incision is closed with a double row of mattress sutures, the ovary and uterus returned to the abdomen and the procedure is repeated on the opposite oviduct.

Using this procedure, oviductal flushing was successful and oviductal masses were expelled in five of eight infertile mares. Three of the five mares produced foals subsequently.<sup>9</sup>

#### **Normograde flush**

After a 24 hr fast a mare is administered general anesthesia and placed in dorsal recumbency. A pelvic tilt apparatus is used to flex the mare at the lumbo-sacral junction to better exteriorize the genital tract through a 10 cm ventral midline incision just cranial to the mammary gland. The ovary and ipsilateral uterine horn are carefully examined for fimbrial adhesions, parafimbrial cysts and obvious oviduct abnormalities. A Doyen intestinal forceps is placed 5 cm from the cranial tip of the uterine horn. An 8 Fr Foley 30 cm 5 ml balloon catheter is inserted into the ampulla and the balloon was inflated with 1.0-1.5 ml of air. Strong digital pressure is applied over the catheter cranial to the balloon and 20 ml of 5% solution of new methylene blue dye in normal saline is slowly injected through the catheter. Confirmation of patency is ascertained by aspirating 10-20 ml of normal saline from the lumen of the tip of the occluded uterine horn. The normograde flush procedure is then repeated on the opposite oviduct. If an oviduct is occluded the serosal surface of the oviduct is saturated with 2% lidocaine and carefully flushed. Care must be taken to avoid rupturing the oviduct.

In the study that reports this technique, if only one oviduct was occluded the ipsilateral ovary was removed. Three of 31 barren mares with no other known cause for the infertility had patent oviducts. Thirteen (13/31) mares had bilateral oviductal occlusion. The blockage was relieved in twelve of these occluded mares and 67% (8/12) became pregnant after their next breeding. Of the mares with unilateral oviductal blockage (6/31) that were unilaterally ovariectomized and then bred, 83% (5/6) became pregnant after their first breeding.<sup>3</sup>

#### **Laparoscopic application of PGE<sub>2</sub>**

Feed is withheld for 24 hours prior to laparoscopic surgery. Each flank is clipped and surgically prepared. The standing mare is sedated by administration of detomidine hydrochloride (10 µg/kg) IV and butorphanol tartrate (10 µg/kg) IV. The skin and underlying musculature of the portal sites are infiltrated with 2% lidocaine. An 11.5 mm (o.d.) trocar and cannula are passed through a 1 cm skin incision 15 cm below the dorsal aspect of the tuber coxae. The abdomen is insufflated with CO<sub>2</sub> gas. A

10 mm o.d. rigid laparoscope with a 30° viewing angle is used to view the ovary, oviducts and tip of the ipsilateral uterine horn. A 7.5 mm o.d. trocar and cannula is inserted through the abdominal muscles approximately 5 cm dorsal to the laparoscope. An atraumatic forceps is passed through this cannula to manipulate the ovary and mesovarium and position the oviduct so that the infundibulum, ampulla and isthmus can be visualized. The forceps are withdrawn and a plastic insemination pipette is used to apply 0.5 ml of a commercial preparation of triacetic gel containing 0.2 mg PGE<sub>2</sub> to the serosal surface of the ampulla and isthmus. The CO<sub>2</sub> gas is released from the abdomen, cannulae are withdrawn and the skin incisions closed. This procedure is then repeated on the opposite flank.<sup>15</sup>

In a study using this technique 14 of 15 chronically barren mares that were treated with PGE<sub>2</sub> conceived when subsequently bred.<sup>10</sup>

## Conclusions

Many anomalies of the oviduct do not interfere with fertility. A few diagnostic tests have been used to detect problems of the oviduct but a definitive ante-mortem diagnosis of oviduct dysfunction may be difficult to ascertain. If the oviduct is thought to be the cause of the infertility a procedure may be available to correct the underlying abnormality. The laparoscopic application of PGE<sub>2</sub> to the oviduct seems effective for oviducts that have luminal occlusions. If the oviductal problem is unilateral and irreversible the ipsilateral ovary can be removed to force the mare to cycle on the remaining ovary that is adjacent to the normal oviduct. Alternatively the mare's ovarian activity can be manipulated and breeding scheduled only when the ovary adjacent to a normal oviduct contains the preovulatory follicle. Foals can be produced if the oviduct problem is bilateral and irreversible in breeds that permit artificial reproductive techniques. An oocyte can be harvested and transferred to the oviduct of an inseminated recipient mare, where fertilization can occur and the recipient mare can then carry the pregnancy to term.<sup>16</sup> Another option for the oocyte would be intracytoplasmic sperm injection (ICSI) with the resulting embryo cultured in the laboratory and then transferred into a recipient mare that would carry the pregnancy to term.<sup>17</sup> One should remember to consider the oviduct when other causes of infertility have been eliminated in the chronically barren mare.

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