Use of high-power ultrasonic shears for laparoscopic ovariectomy in mares

Jeffery G. Alldredge, DVM, MS, and Dean A. Hendrickson, DVM, MS, DACVS

Various methods for bilateral ovariectomy in mares have been described. In recent years, laparoscopic approaches have become popular because they are less invasive than techniques that involve laparotomy, provide better visibility, allow for tension-free ligation of the ovarian pedicle, and eliminate the need for general anesthesia. Laparoscopic techniques that have been described include sharp dissection and ligature placement, sequential electrocoagulation and sharp transection, use of a vessel sealing device and sharp transection, and simultaneous transection and hemostasis with an ultrasonic instrument. These techniques all have advantages and disadvantages related to equipment costs, speed, reliability, and technical difficulty. The purpose of the present report was to describe the use of high-power ultrasonic shears for laparoscopic ovariectomy in mares.

Surgical Technique

A routine preoperative evaluation consisting of a complete physical examination, rectal palpation, and quantification of PCV and serum total protein concentration was performed, and food, but not water, was withheld for 24 hours prior to surgery. Procaine penicillin G (20,000 U/kg [9,090 U/lb], IM) and phenylbutazone (4.4 mg/kg [2 mg/lb], PO) were administered 2 hours before surgery. Immediately prior to surgery, the mare was placed in stocks and hair was clipped from both flanks and over the tail head. All 3 sites were then prepared for aseptic surgery. Detomidine hydrochloride (40 µg/kg [18 µg/lb]), diluted with sterile saline (0.9% NaCl) solution to a volume of 10 mL, was injected into the epidural space through a needle inserted in the Cd1-2 intervertebral space. An inverted-L block was performed in each paralumbar fossa with mepivacaine (50 mL of a 20 mg/mL solution in each fossa).

Three 1- to 2-cm-long vertical skin incisions were created in each paralumbar fossa for use as portals. The first portal was located midway between the 18th rib and the cranial aspect of the tuber coxae at the level of the ventral aspect of the tuber coxae. A mare urinary catheter was inserted through this portal, and the abdomen was insufflated with carbon dioxide to an intra-abdominal pressure of 15 mm Hg. The second portal was placed approximately 6 cm dorsal and 3 cm cranial to the first portal. The third portal was placed approximately 6 cm ventral and 3 cm caudal to the first portal. An 11-mm-diameter, 20-cm-long cannula with a blunt trocar was inserted through the most dorsal portal, and 10-mm-diameter, 15-cm-long cannulas with blunt trocars were placed through the 2 more ventral portals. Portals and cannulas were placed in the left paralumbar fossa first; placement in the right paralumbar fossa was done without visualization from the left side.

A 30°, 10-mm-diameter, 57-cm-long laparoscope was inserted into the abdomen through the most dorsal cannula in the left paralumbar fossa. A claw grasping forceps was inserted through the most ventral portal and used to grasp and manipulate the left ovary during dissection. A 5-mm-diameter, 30-cm-long, high-power ultrasonic shears with 1-cm jaws was inserted through the middle portal and positioned at the cranial pole of the left ovary. The jaws were closed across a portion of the ovarian pedicle, and the unit was discharged until the tissue within the jaws was transected (Figure 1). The jaws were then repeatedly repositioned and the unit was discharged until the ovary was completely amputated (Figure 2). The entire amputation was completed with the shears at the maximum power setting.

Following amputation of the left ovary, the pedicle was inspected and the extent of hemostasis was determined. If excessive bleeding was present, the shears was reapplied and discharged. If bleeding was still present after this, a ligating clip was applied to the bleeding vessel. After amputation, the left ovary was secured with grasping forceps and left in the caudal portion of the abdomen while the right ovary was amputated. The procedure for amputation of the right ovary was as follows:

Figure 1—Photograph illustrating application of a high-power ultrasonic shears to the ovarian pedicle during laparoscopic ovariectomy in a mare.
Laparoscopic ovariectomy with high-power ultrasonic shears during laparoscopic ovariectomy in a mare.

Figure 2—Photograph of the appearance of the ovarian pedicle following coagulation and transaction with high-power ultrasonic shears during laparoscopic ovariectomy in a mare.

Results

Laparoscopic ovariectomy with high-power ultrasonic shears was performed in 10 mares of various breeds. Mares were between 4 and 20 years old (mean, 10.1 years) at the time of surgery and weighed between 377 and 491 kg (830 and 1,080 lb). Nine mares underwent ovariectomy because of behavior problems (eg, unruly behavior and decreased athletic performance) associated with estrus; 1 mare underwent ovariectomy because of chronic laminitis that was exacerbated by estrus.

No major operative or postoperative complications were identified in any of the mares. However, the ultrasonic shears did occasionally have to be removed from the abdomen to remove char that accumulated in the jaws of the instrument. In 1 mare, the instrument failed to close appropriately on the ovarian pedicle because of a mechanical break in the locking mechanism of the jaws that, in turn, prevented activation of the device. The instrument had to be replaced to allow the procedure to be completed.

For 10 of the 20 (50%) ovaries, excessive bleeding was encountered following amputation of the ovary, and the shears was reapplied and discharged in an attempt to stop the bleeding. However, this was successful for only 2 of the 10 ovarian pedicles, and application of ligating clips was required to control mild persistent hemorrhage from the remaining 8 pedicles.

The left ovaries ranged from 50 to 80 mm (mean, 61 mm) in diameter, and the right ovaries ranged from 50 to 70 mm (mean, 64 mm) in diameter. The right and left ovaries could be removed through the left paralumbar fossa in 9 of the 10 mares. In the remaining mare, the right ovary could not be passed under the descending colon because the mare became agitated. Therefore, the right ovary was removed through the right paralumbar fossa.

Time required to complete the procedure ranged from 50 to 90 minutes (mean, 67.5 minutes). However, surgery time decreased with experience with the procedure, and mean surgery time for the last 5 mares was 58 minutes. Epidural administration of detomidine provided adequate sedation for the entire procedure in all mares, and no additional sedatives were required.

During the first 24 hours after surgery, all mares remained bright and alert. Heart rate, respiratory rate, and rectal temperature remained within reference limits, and horses had minimal signs of pain or discomfort while in their stalls. Packed cell volumes, total protein concentrations, heart rates, and rectal temperatures 12 and 24 hours after surgery were essentially unchanged, compared with preoperative values. All incisions developed mild edema and subcutaneous emphysema, which was expected and considered a normal sequel of the procedure. This swelling and emphysema resolved spontaneously in all mares.

Owners were contacted by telephone 12 months after the procedure and did not report any complications; all were satisfied with the behavioral and cosmetic results. The mare with chronic laminitis thought to be associated with estrus reportedly had estrus-like behavior following ovariectomy, although to a lesser degree, but the laminitis had resolved.
Discussion

High-power ultrasonic dissecting instruments have been used extensively in human surgery in recent years. Their popularity is attributable to the fact that they can be used to simultaneously cut and coagulate supported and unsupported tissues in a single step. These instruments also increase visibility by eliminating smoke production and cause less collateral or proximal thermal tissue damage than do electrosurgical instruments. They are also technically easy to use.

Our interest in ultrasonic instrumentation was based on the desire to develop a more efficient and technically easier method for ovariectomy in mares. Ultrasonic shears are widely used in human laparoscopic procedures and are reported to be capable of coagulating vessels up to 3 mm in diameter. The function of the shears is dependent on piezoelectric crystals in the hand piece, which cause the jaws of the instrument to vibrate at a rate of 55,000 times per second. This vibration produces frictional energy that is directly proportional to the activation time of the instrument and the displacement of the instrument tips during each cycle. The frictional energy that is produced heats the tissue within and surrounding the jaws of the instrument, causing vessels in this tissue to coagulate while tissue in the jaws is transected.

The high-power ultrasonic shears used in mares described in the present report was able to efficiently transect the ovarian pedicle. No major complications were associated with use of this technique, and owners were satisfied with the outcome. One disadvantage of the procedure was the cost of the ultrasonic generator (approx $20,000) and hand piece (approx $300).

The quality of hemostasis obtained with the ultrasonic shears appeared to be related to the power setting, which controls the amount of displacement of the instrument jaws, that was used. At lower power settings, heat production and transfer to the tissue are slower, resulting in greater coagulation but slower dissection, whereas at higher power settings, the opposite is true. For mares described in the present report, we used the highest power setting for the instrument in an effort to maximize the speed of dissection; however, this may have limited hemostasis of the ovarian vasculature in some cases and increased the need for ligating clip application. This potential pitfall may have been avoided by using a lower power setting when larger vessels were being transected and a higher power setting for dissection of other tissues. Authors of a previous report of the use of a harmonic scalpel for ovariectomy in mares found that hemostasis could be achieved by bluntly dissecting the mesovarium to reduce tissue thickness prior to application of the instrument. In contrast, we wanted to determine whether the high-power ultrasonic shears could be used to coagulate and transect the ovarian pedicle without this extra step. Bluntly dissecting the mesovarium to reduce tissue thickness prior to application of the shears may have reduced the need for ligating clip application; however, further study is needed to substantiate this assumption.

References