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A comparison of peritoneal fluid values in mares following bilateral laparoscopic ovariectomy using a vessel sealing and dividing device versus placement of two ligating loops

Kathryn A. Seabaugh [a,1], Laurie R. Goodrich [a,*], Andrea A. Bohn [b], Paul S. Morley [a], Dean A. Hendrickson [a]

[a] Department of Clinical Sciences, College of Veterinary Medicine and Biomedical Sciences, Colorado State University, Fort Collins, CO 80523, USA
[b] Department of Microbiology, Immunology and Pathology, Colorado State University, Fort Collins, CO 80523-1619, USA

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ABSTRACT

The objective of this study was to determine the effect of bilateral laparoscopic ovariectomy on peritoneal fluid values in mares and compare how this effect was modified by the method of ovarian vessel hemostasis used. Ten mares undergoing standing bilateral laparoscopic ovariectomy were used in a randomized clinical study. During surgery, blood vessels within the mesovarium were either: (1) sealed and transected with a vessel sealing and dividing device (VSDD), or (2) ligated using two loops placed proximal to each ovary and then the mesovarium transected using laparoscopic scissors. The ovaries were removed through the ipsilateral body wall. Abdominocentesis was performed before surgery and 24 h and 72 h after surgery.

Markers of peritoneal inflammation, as measured by total nucleated cell count, total protein (TP) and red blood cell count via abdominocentesis, were consistently increased for all groups compared to preoperative values. The mean (range) of TP for the VSDD group was 4.14 (3.9–4.5) g/dL, and that for the ligating loop group was 3.18 (2.7–3.5) g/dL. Use of the VSDD resulted in significantly greater TP concentrations in the abdominal fluid at 24 h and 72 h post-operatively when compared to a ligating loop ($P < 0.001$ and 0.04, respectively).

Introduction

Ovariectomy is commonly performed in mares to remove ovarian tumors, manage unacceptable behavior during estrus or for elective spays. A variety of surgical approaches have been used (Embertson, 2006; Pader et al., 2011a and b; Rocken et al., 2011; Fischer, 2012). Laparoscopic removal of ovaries has become popular due to the ability to accurately access the ovary, to perform ovarian pedicle ligation without tension, and to monitor hemostasis immediately following transection.

A wide range of methods have been used to establish hemostasis of the ovarian pedicle during laparoscopic removal (Hendrickson, 2006; Rocken et al., 2011; Fischer, 2012). The techniques selected by the authors in this study were a ligating loop and the use of a vessel sealing and dividing device (VSDD).

Potential critical complications during equine laparoscopy include intestinal, splenic, or large vessel puncture and inadequate hemostasis of the ovarian pedicle (Hendrickson, 2008). Septic peritonitis, adhesions, ileus, and incisional complications can also result in the days immediately following laparoscopy. A horse may display signs of discomfort in the immediate post-operative period and evaluation of fluid obtained via abdominocentesis can help differentiate between a critical post-operative complication and post-operative discomfort.

However there are currently no reference values available for total nucleated cell counts (TNCC), total protein (TP) or red blood cell count (RBCC) following routine laparoscopic ovariectomy. The objectives of this study were (1) to determine the post-operative peritoneal fluid values following standing bilateral laparoscopic ovariectomy using either a VSDD (LigaSure, Atlas Laparoscopic Sealer/Divider Instrument) or two ligating loops, and (2) to compare the values from the two techniques.

Materials and methods

Cases

Ten mares, admitted to Colorado State University Veterinary Teaching Hospital for bilateral ovariectomy between January 2009 and September 2011, were used for the study. Five mares were randomly assigned to either the VSDD group or the

* Corresponding author. Tel.: +1 970 297 5000.
E-mail address: laurie.goodrich@colostate.edu (L.R. Goodrich).
[1] Current address: Department of Large Animal Medicine and Surgery, College of Veterinary Medicine, University of Georgia, Athens, GA 30605, USA.

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ligating loop group. Randomization was performed prior to the start of the study to create an order of group assignment. Cases were then assigned to each group as they presented to the hospital. Client consent was obtained prior to participation in the study which was approved by the Colorado State University Institutional Animal Care and Use Committee.

Surgical procedure

Feed was withheld from all patients for 18–24 h prior to surgery. Pre-operatively, all mares received a dose of cefazolin (10 mg/kg, intravenously [IV]; Apotex), gentamicin sulfate (6.6 mg/kg, IV; MWI) and flunixin meglumine (1.1 mg/kg, IV; Prevail, MWI). The mares were sedated with butorphanol tartrate (0.01 mg/kg, IV; Torbugesic, Fort Dodge Animal Health) and detomidine hydrochloride (0.01 mg/kg; Dormosedan, Pfizer) and a level plane of sedation was maintained with a continuous infusion of detomidine hydrochloride (20 mg/L) and butorphanol tartrate (10 mg/L) in sodium chloride (Abbot Laboratories), at a rate of approximately 1–2 drops/s (10 drops/mL).

Both paralumbar fossae were prepared for aseptic surgery. Mepivacaine hydrochloride (Carbocaine-V, Pfizer) was injected subcutaneously bilaterally at the three portal sites in each paralumbar fossa for local anesthesia (0.01–0.05 mL/kg per site) (Hendrickson, 2006). The middle portal site was level with the ventral aspect of the tuber coxae, half-way between the tuber coxae and the last rib. The dorsal portal was 2–4 cm dorsal and 2–4 cm cranial to the middle portal. The ventral portal was 2–4 cm ventral to the middle portal.

A 2 cm incision was made in the left paralumbar fossa through skin, subcutaneous tissue and external abdominal oblique fascia for the middle portal site. A controlled access laparoscopic cannula (10 mm diameter, 20 cm long, Karl Storz Veterinary Endoscopy) was inserted into the abdomen using visual monitoring with a 0° laparoscope (40 cm in length and 10 mm in diameter, Richard Wolf Medical Instruments). The peritoneal space was insufflated with carbon dioxide to 10–15 mmHg. Stab incisions were made for the remaining two instrument portals on the left side. Two 10 mm diameter, 20 cm long cannulas with blunt obturators (Karl Storz Veterinary Endoscopy) were then inserted into the abdomen. A 30° forward viewing laparoscope (56 cm in length and 10 mm in diameter, Karl Storz Veterinary Endoscopy) was inserted into the dorsal cannula.

The left ovary was observed and grasped with laparoscopic Babcock forceps. Mepivacaine hydrochloride (0.01–0.05 mL/kg) was injected into the mesovarium using the laparoscopic injection needle.

For the VSDD group, the ovary was grasped with acute claw laparoscopic grasping forceps and the VSDD (LigaSure, Atlas Laparoscopic Sealer/Divider Instrument) jaws were applied to the mesovarium, activated (setting 3 bars or 190–275 V), and the tissue transected by the integrated blade. If an alarm sounded that indicated failure of an appropriate seal, the instrument was re-activated until the appropriate alarm was triggered. This process was repeated across the entire mesovarium (Fig. 1).

For the ligating loop group, a 4-S modified Roeder knot (Sharp and Dorsey, 1997) was used to create the loop extra-corporeally. Two ligating loops of 1 polyglyconate (Maxon, Covidien) were placed proximally around the mesovarium and tightened

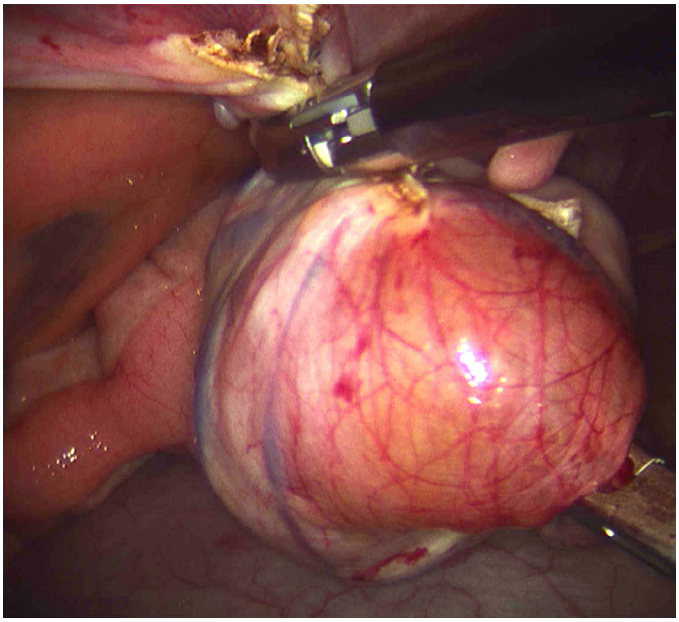

Fig. 1. Removal of the ovary with a vessel sealing and dividing device (LigaSure).

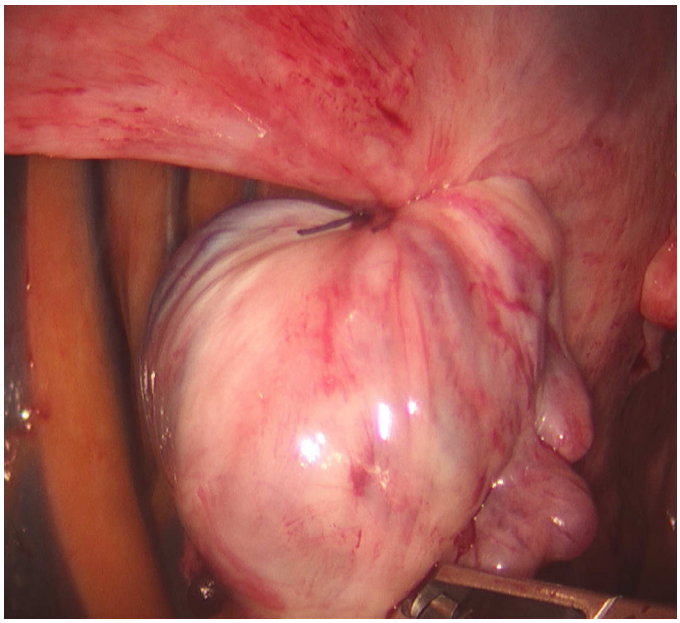

Fig. 2. Placement of a ligating loop tied with a 4-S modified Roeder knot around the mesovarium.

(Fig. 2) using a laparoscopic knot pusher. After placement of the ligating loops, the ovary was grasped with acute claw laparoscopic grasping forceps and laparoscopic scissors were used to transect the mesovarium distal to the ligating loops. The tissue was transected at a safe distance from the ligature to minimize the risk of ligature slippage or inadvertently cutting the ligature.

Once the left mesovarium was transected, the ovary was held by the grasping forceps and remained in the abdomen while a similar approach was performed to amputate the right ovary. The left ovary was always transected first.

Upon transection of both ovaries, the remaining mesovarium was assessed for bleeding and the ovaries were removed from their respective side of the abdomen. The ventral two portal sites on each side of the abdomen were connected by incising through the skin and subcutaneous tissue. The muscle layers and peritoneum were bluntly separated and the ovaries were extracted with gentle traction. The muscle layers, subcutaneous tissue and skin were closed in a conventional manner. The time for surgery was recorded for each case.

Post-operatively, the patients received one dose of cefazolin (10 mg/kg, IV, Apotex) 8 h after the initial dose and maintained on phenylbutazone (2.2 mg/kg, PO, twice daily, Bute Boluses, Vedco) for 4 days. Complete physical examinations, including temperature, pulse, respiration and incisional assessment, were performed twice daily until discharge from the hospital.

Peritoneal fluid analysis

Immediately pre-operatively, and 24 h and 72 h post-operatively an abdominocentesis was performed with an 18 G, 3.81 cm (1.5 inch) needle in a sterile fashion. The needle was inserted to the right of ventral midline and caudal to the xyphoid. Ultrasound was used to identify fluid between bowel and body wall. Insertion of the needle was not performed under ultrasound guidance. If the 3.81 cm needle did not enter the peritoneal space or if ultrasound revealed the body wall to be > 3.81 cm, an 18 G, 8.89 cm (3.5 inch) spinal needle was employed. If a sample was not obtained after manipulation of the needle, another needle was placed, and this was counted as a further attempt. This was continued until a sample consistent with peritoneal fluid was obtained. The number of attempts and any evidence of enterocentesis or splenic contamination as a result of abdominocentesis were recorded.

The abdominal fluid was collected into an EDTA tube and submitted for fluid analysis, including a differential count and cytology. The mean volume of fluid collected was 1.0 mL (range = 0.2–3.0 mL). TNCC, TP and RBCC were the values of interest.

Statistics

A power calculation was performed a priori to determine the number of cases needed to identify a difference in nucleated cell counts between the two groups. From the power calculation, it was determined that a difference of > 12,500 cells/μL could be noted with five horses in each group if the standard deviation was < 3150 cells/μL with a power of 80% and a significance of 5%.

Patient history and laboratory results were obtained from their records. Differences between groups were compared using fixed effects linear regression. Different