

Laparoscopy in Llamas and Alpacas

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Accurate differentiation of medical and surgical lesions in the abdomen of camelids often is difficult because of their stoic nature. Peritoneal fluid samples are difficult to obtain and changes in peritoneal fluid constituents may not be specific to surgical or medical conditions. Laparoscopy may provide a rapid method for examination of the abdomen with reduced morbidity compared to that for exploratory celiotomy. Routine laparoscopy for evaluation of reproductive structures in llamas and alpacas appears to be a safe procedure;^{2,3,10,13} however, systemic effects of laparoscopy have not been objectively evaluated.

Surgical approach for laparoscopy and laparoscopic anatomy have been described in cattle, horses, and llamas.^{1,4-6,15} Abdominal anatomy in camelids is markedly different from horses and cattle.^{1,4-9,14} In the context of this article, the term “camelid” is used to refer to procedures equally applicable to llamas and alpacas. When specific differences are notable, the term llama or alpaca is used.

Preparation for Laparoscopy

Distention of viscera with ingesta—but especially gas—is the principal impediment to performing laparoscopy. Distended viscera may cause abortion of laparoscopy and conversion of the procedure to laparotomy if viewing is obstructed or if there is interference to instrument access. Whenever possible, feed and water should be withheld for a minimum of 24 hours prior to laparoscopy. Antibiotics and non-steroidal anti-inflammatory drugs are routinely administered prior to surgery. Diagnostic laparoscopy is easily performed in llamas with the animal standing and sedated. However, alpacas readily assume recumbency when uncomfortable and should be placed in a sternal (cushed) position for conscious laparoscopy. For operative laparoscopy, I prefer to perform procedures under general anesthesia. Short procedures can be completed using injectable anesthesia alone, but inhalational anesthesia is ideal for procedures requiring more than 30 to 45 minutes to complete.

Paralumbar approach

Right or left paralumbar laparoscopic access is performed with the camelid standing or in right lateral recumbency. The paralumbar region, defined caudally by the area of the stifle, cranially by the last palpable

rib, dorsally by the transverse processes of the lumbar vertebrae, and ventrally by the tapered aspect of the abdominal wall, is clipped and prepared for aseptic surgery. A 2-cm skin incision is made in the dorsal, central aspect of the prepared area and a trochar and cannula are placed into the peritoneal cavity, using a standard technique.^{2,3,13} Carbon dioxide gas is insufflated and the peak intra-abdominal pressure maintained at < 22 mm Hg. A 32-cm rigid laparoscope is sufficient to perform a systematic examination of the abdomen.¹ After completion of laparoscopy, the fascia of the external abdominal oblique muscle is apposed using No. 2-0 polyglactin 910 in a simple continuous pattern. Skin edges are apposed in routine fashion.

From the left side, the first forestomach compartment (C1), spleen, and diaphragm are viewed in the cranial region of the abdomen. The left kidney can be observed caudal and medial to the dorsal attachment of C1. Perirenal fat may obscure the kidney from direct view. Small intestine can be observed dorsal and caudal to C1, but differentiation of specific segments of the small intestine is more difficult. The left inguinal ring can be observed in most standing animals without additional instruments, but recumbent animals require use of an endoscopic retractor to reflect viscera out of the field of view.

Right paralumbar laparoscopy provides viewing of the third forestomach compartment (C3), C1, and diaphragm in the cranial and middle region of the abdomen. The first forestomach compartment can be observed when performing RPL laparoscopy in a recumbent position and is identified by the longitudinal rows of small saccules protruding from its ventromedial surface. The third forestomach compartment has a long tubular appearance, with a prominent serosal vascular pattern and omental attachments on the greater curvature. The second forestomach compartment (C2) is rarely identified. The right kidney is observed in the dorsal region of the abdomen protruding into the peritoneal cavity and surrounded by perirenal fat. The caudate and right lobes of the liver are observed cranial and lateral to C3. The small intestine, including the proximal portion of the jejunum and duodenum, are easily found. The proximal loop of the spiral colon (ascending colon) can be viewed in the caudoventral region of the abdomen and is identified as a large, tubular viscera without associated omentum or large serosal vessels. The spiral colon is identified by the interserosal mesentery. The urinary

bladder is viewed in the caudal region of the abdomen and is evident by its dark color and characteristic musculature. The inguinal ring is viewed as described for LPL laparoscopy.

Ventral midline approach

Access for ventral midline laparoscopy is done by entry 2-cm caudal to the umbilicus. A 2-cm skin incision is made on the ventral midline and a trocar and cannula are placed into the abdomen. Carbon dioxide gas is insufflated as previously described. After completion of laparoscopy, the linea alba is apposed using No. 0 polyglactin 910 in an appositional pattern. Skin edges are apposed in routine fashion.

Ventral midline laparoscopy provides viewing of the ventral aspect of C1, liver, spleen, and diaphragm in the cranial region of the abdomen. Rows of individual saccules are observed protruding from the ventral aspect of C1. The caudoventral edge of the liver is fimbriated and can be found near the attachment of the right crus of the diaphragm to the abdominal wall. The third forestomach compartment can be identified in the right hemi-abdomen and the small intestine is observed in the caudal abdomen. The proximal loop of the ascending colon and the spiral colon are also often observed.

Potential complications of laparoscopy

Suboptimal placement of portals is a common mistake. If the paralumbar incision is made too far dorsal in the paralumbar region, retroperitoneal placement of the laparoscope is possible. Gas insufflation of the retroperitoneal space can prevent successful completion of laparoscopy. Hemorrhage into the abdomen, usually caused by inadvertent trauma to viscera, can cause abortion of the laparoscopy because of obstruction to viewing. Complications observed after surgery have been minor and most resolve without treatment.

Operative Laparoscopy

Surgical conditions of the abdomen of llamas include ascending colon impaction, uterine torsion, perforation of C3, small intestinal obstruction, and urolithiasis.^{9,11,14} Medical conditions of the abdomen that may be difficult to differentiate from surgical lesions include enteritis, C3 ulceration, colon ulceration, and peritonitis.^{9,12} Laparoscopy may provide a rapid, less invasive method for evaluation of the abdomen, compared to exploratory celiotomy. The optimal site for laparoscopy should be chosen on the basis of the most likely site of the

suspected lesion. Right paralumbar or ventral midline laparoscopy should provide the most information for general examination of the abdomen. Laparoscopy-guided biopsy of the liver, spleen, and kidneys may be useful for evaluation of these tissues. Laparoscopic examination of reproductive structures is readily accomplished and has been described in New World camelids.^{2,3,13} I have used laparoscopy to resolve uterine adhesions, ovarian adhesions, intestinal adhesions, ovarian cysts, endometrial cysts, ovarian neoplasia, ovariohysterectomy, and for serial evaluation of ovarian activity.

With practice, good working equipment, proper patient selection and preparation, laparoscopy can be rapidly and efficiently performed. Of the more than 1000 published laparoscopy procedures in camelids for manipulation of reproductive structures in llamas and alpacas, only 1 (0.08%) resulted in inadvertent penetration of viscera (C1).^{3,13}

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