SOFT TISSUE SURGERY

A Guide to Exploratory Laparotomy

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Exploratory laparotomy or celiotomy is commonly performed for diagnosis, treatment, or prognostication of traumatic, inflammatory, infectious, neoplastic, and congenital abdominal conditions. While preoperative diagnostics such as radiography, ultrasound, and computed tomography may provide information on the underlying condition, results of these tests do not always correlate with intraoperative findings. For example, major discrepancies in diagnosis were noted in 25% of patients that underwent abdominal ultrasound and subsequent exploration.¹ Thorough exploratory laparotomy is a key component of abdominal surgery.

PREOPERATIVE PREPARATION

Perioperative antimicrobials are administered to animals with existing infection or prophylactically for surgical wounds classified as clean-contaminated, contaminated, or dirty. Prophylactic antimicrobials are given intravenously 30 to 60 minutes before incision and may be repeated during the procedure, depending on surgical duration, predicted contaminants, and the drug’s metabolism in that species. In dogs, an intramuscular or subcutaneous dose of cefazolin can be given concurrently with the intravenous dose to provide extended prophylaxis.²³

The patient’s entire abdomen and caudal thorax are clipped and aseptically prepared. In male dogs, the preputial cavity is flushed with saline or water before application of antiseptic solution, since antiseptics are inactivated by organic material.⁴ For female dogs with suspected urinary tract obstruction, the perivulvar region is also clipped and prepped so that it can be draped in for intraoperative catheterization. Before beginning the procedure, the surgeon and anesthetist or veterinary nurse should review a surgical checklist that includes preoperative and intraoperative medications, a surgical sponge count, and a list of surgical and anesthetic concerns. BOX 1 lists the surgical equipment that should be available.

OPEN CASE

Exploratory laparotomy is used to diagnose or further investigate problems inside the abdomen that could not be achieved via preoperative diagnostics.
For a full exploratory laparotomy, the abdomen is incised from xiphoid to pubis. In male dogs, the skin and subcutaneous incisions deviate laterally around the prepuce; branches of the caudal superficial epigastric vessels may require ligation or cauterization. Once the subcutaneous tissues are incised, the abdominal cavity is entered through an incision in the linea alba (FIGURE 1). If the linea is difficult to identify, the subcutaneous tissues can be sharply transected with scissors at their midline attachments (FIGURE 2).5

The falciform ligament often obscures visualization of cranial abdominal components and requires lateral transection and cranial ligation. A self-retaining retractor (e.g., Balfour) helps maintain visualization, particularly of the cranial abdomen; the surgeon should verify there are no organs trapped between its lateral blades and the abdominal wall. Moistened laparotomy sponges can be placed underneath retractor blades to protect underlying skin and muscle.

Once the abdomen is open, the presence, quantity, and quality of fluid should be assessed. If septic effusion is encountered, samples for culture and Gram stain should be obtained. For patients with hemoperitoneum, blood loss can be calculated by adding the amount of blood in the suction canister to the estimated amount of gauze saturated with blood. When completely soaked, a 4 x 4 gauze pad will hold approximately 12 mL of blood, while a 30 cm x 30 cm laparotomy sponge will hold approximately 100 mL of blood.6

EVALUATION
An appropriate exploratory laparotomy relies on the veterinarian’s knowledge of anatomy (FIGURE 3) and attention to detail. To avoid missing lesions, a consistent, systematic technique is used. One common method is to sequentially examine structures in the cranial abdomen (diaphragm, liver, gallbladder, stomach, pylorus, proximal duodenum, spleen), right and left gutters (descending duodenum, pancreas, kidneys, adrenal glands, ovaries, descending colon), and caudal abdomen (urinary bladder, ureters, uterus, urethra, prostate, sublumbar lymph nodes), before “running”...
INDICATION: OSURNIA is indicated for the treatment of otitis externa in dogs associated with susceptive strains of bacteria (Staphylococcus pseudintermedius and yeast (Malassezia pachydermatis)).

DOSAGE AND ADMINISTRATION: OSURNIA should be administered in the clinic. Clean and dry the external ear canal before administering the initial dose of the product. Administer one dose (1 tube per affected ear) and repeat application in 7 days. Do not clean the ear canal for 14 days after the initial administration to allow contact of the gel with the ear canal. Clearing the ear may affect product effectiveness (see Effectiveness in the product insert). If alternative otic therapies are required it is recommended to clean the ears before application. Upon lube by twisting the soft tip. Insert the flexible tip into the affected external ear canal(s) and expel entire tube contents into the external ear canal(s). After application, gently massage the base of the ear to allow the gel to penetrate to the inner part of the ear canal.

CONTRAINDICATIONS: Do not use in dogs with known tympanic perforation (see Precautions in the product insert). Do not use in dogs with a hypersensitivity to florfenicol, terbinafine, or betamethasone acetate.

WARNING:
- Human Safety Warning: OSURNIA may cause eye injury and irritation Not for use in humans. Keep 1st and all medications out of reach of children. Consult a physician in case of accidental ingestion by humans. In case of accidental skin contact, wash area thoroughly with water. Avoid contact to the eyes. In case of accidental eye contact, flush thoroughly with water for at least 15 minutes. If symptoms develop, seek medical advice.
- Precautions: Wear eye protection when administering OSURNIA and restrain the dog to minimize post-application head shaking. Reducing the potential for splatter of product will help prevent accidental eye exposure in people and dogs and help to prevent ocular injury. Do not administer orally. The use of OSURNIA in dogs with perforated tympanic membrane has not been evaluated. The integrity of the tympanic membrane should be confirmed before administering this product. Reevaluate the dog if hearing loss or signs of vestibular dysfunction are observed during treatment. Use of topical otic corticosteroids has been associated with adrenocortical suppression and ototoxicity. Do not use in dogs with impaired hepatic function (see Animal Safety and Adverse Reactions in the product insert). The safe use of OSURNIA in dogs used for breeding purposes, during pregnancy, or in lactating bitches has not been evaluated.

ADVERSE REACTIONS: The following adverse reactions were reported during the course of a US field study for treatment of otitis externa in dogs treated with OSURNIA in decreasing order: elevated liver enzymes, vomiting, weight loss (>10% body weight) and hearing loss. To report suspected adverse events, for technical assistance or to obtain a copy of the SDS, contact Dechra Veterinary Products at (866) 903-2472. For additional information about adverse drug experience reporting for animal drugs, contact FSA at 1-866-FDA-VETS or online at http://www.fda.gov/animalveterinary/safetyhealth.

POST-APPROVAL EXPERIENCE (2020): The following adverse events are based on post-approval adverse drug experience reporting for OSURNIA. Not all adverse events are reported to FDA/CVM. It is not always possible to reliably estimate the adverse event frequency or establish a causal relationship to product exposure using this data.

In humans, accidental exposure leading to conjunctival and other ocular injuries such as eye irritation, burning, stinging, and itchiness have been reported to occur when the dog shook its head after application of OSURNIA. In dogs, the adverse events reported for OSURNIA are presented below in decreasing order of reporting frequency: Deafness, ear discharge, ear pain and irritation, vomiting, and facial paralysis.

INFORMATION FOR DOG OWNERS: Owners should be advised that adverse reactions may occur following administration of OSURNIA and should observe dog for signs such as deafness, pain and irritation, vomiting, head shaking, head tilt, incoordination, eye pain and ocular discharge (see Animal Safety and Post-Approval Experience in the product insert). Owners should be advised to contact their veterinarian if any of the above signs are observed.

Owners should also be informed that splatter may occur if the dog shakes its head following administration of OSURNIA which may lead to ocular exposure. A result, eye injuries in humans and dogs have been reported including corneal ulcers.

EFFICACY/EFFECTIVENESS: Effectiveness was evaluated in 235 dogs with otitis externa. The study was a double-masked field study with a placebo control (see the study). One hundred and ninety-nine dogs were treated with OSURNIA and seventy-six dogs were treated with the placebo control. All dogs were evaluated for safety. Treatment (1 mL) was administered to the affected ear and repeated 7 days later. Prior to the first administration, the ears were cleaned with soap but not prior to the Day 7 administration. Six clinical signs associated with otitis externa were evaluated: pain, erythema, exudate, swelling, odor and ulceration. Total clinical scores were assigned for a dog based on the severity of each clinical sign on Days 7, 14, 21 and 45. Success was determined by clinical improvement at Day 45. The success rates of the two groups were significantly different (p=0.0094). 64.78% of dogs administered OSURNIA were successfully treated, compared to 34.42% of the dogs in the placebo control group.

STORAGE CONDITIONS: OSURNIA should be stored under refrigerated conditions between 26° - 40°F (–2° - 4°C). To facilitate comfort during administration, OSURNIA may be brought to room temperature and stored for up to three months.

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the intestines (i.e., examining and palpating them for lesions). If lesions are not found, the surgeon should be prepared to take a variety of samples for diagnosis, particularly in patients with digestive tract signs.

Diaphragm
The diaphragmatic central tendon and muscular pars lateralis and costalis are normally taut and concave. Flaccidity or loss of concavity can indicate the presence of pneumothorax, pleural effusion, intrathoracic masses, or diaphragmatic hernia. Any of these findings should trigger a request for immediate ventilation monitoring and support. Diaphragmatic visualization requires hepatic, gastrointestinal, and splenic retraction.

Liver and Gallbladder
The liver consists of left lateral, left medial, quadrate, right medial, right lateral, and caudate lobes. The gallbladder lies between the quadrate and right medial liver lobes; the apical half is visible, while the remainder is adhered to surrounding hepatic tissue. Normal liver lobes are dark red, smooth, and sharply marginated. A normal gallbladder is oval or round, thin walled, and easily expressible in dogs. Because the common bile duct and pancreatic duct in cats may be conjoined or open in close proximity, gallbladder expression is not recommended in cats. Hepatic abnormalities include changes in size, texture, or color; marginal rounding; and bleeding or mass-like lesions. Abnormal gallbladders are often firm, distended, discolored, or adhered to other organs.

For generalized or peripheral liver disease, a guillotine biopsy can be performed by ligating a portion of the lobe margin with a loop of absorbable suture tied with a single surgeon’s throw (FIGURE 4). Hepatic tissue is excised distal to the ligature, which is left in place. Likelihood of obtaining diagnostic samples is increased when multiple liver lobes are biopsied. Focal or central lesions are sampled with a skin biopsy punch. If hemorrhage persists after sample removal, a clotting adjuvant can be applied to the defect.

If hepatobiliary infection is suspected, cholecentesis can be performed in conjunction with liver biopsies and cultures. If bile is thin, a 25-gauge needle may be sufficient for gallbladder aspiration. The needle can be inserted through adherent hepatic tissue to reduce leakage; if inserted through the gallbladder apex, the gallbladder should be fully drained to decrease the risk of bile leakage. Cholecentesis should be avoided in patients with biliary mucoceles, questionable gallbladder wall integrity, or complete biliary tract obstruction.

Stomach
The stomach consists of the cardia, fundus, body, and pylorus. The dorsal aspect of the stomach is viewed by making a hole in the ventral leaf of the greater omentum to enter the omental bursa. The left limb of the pancreas and splenic vasculature can be examined through the omental opening at the same time. The only firm portion of the stomach is the pylorus. The stomach should be assessed for abnormal coloration, thickness, or vascular pattern. Biopsy is performed via a full-thickness gastrotomy. For surgeons unfamiliar with normal pylorus size and thickness, pyloric assessment may require gastrotomy and digital insertion.

Spleen
The spleen lies in close association with the greater curvature of the stomach and is attached to it by the gastrosplenic ligament. A normal spleen is dark purple

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in color, with smooth, rounded edges, but size and color can vary depending on the degree of splenic contraction and effect of anesthetic drugs. The spleen is evaluated for changes in size, symmetry, and texture; capsular integrity; and vascular supply (e.g., tears, thrombosis, torsion). Although splenic biopsy can be performed using a guillotine technique or wedge incision and closure, the spleen is usually completely removed if neoplasia, thrombosis, or infection is suspected.

Descending Duodenum and Right Limb of the Pancreas

The descending duodenum is the most dorsal intestinal structure in the right gutter and is easily identified by the associated right limb of the pancreas. Blood supply to the descending duodenum forms an arcade from the anastomosis of the cranio- and caudo-pancreaticoduodenal branches of the cranial mesenteric artery; these vessels often traverse through the right limb of the pancreas. The body of the pancreas sits adjacent to the pylorus, while the left pancreatic limb lies within the greater omentum along the splenic artery and vein and adjacent to the stomach and transverse colon. The common bile duct enters the serosal surface of the descending duodenum and travels intramurally about a centimeter before opening intraluminally at the major duodenal papilla. In animals with common bile duct dilation, the surrounding pancreas should be evaluated for evidence of inflammation or scarring, and the free and intramural portions of the duct can be gently palpated for obstructive choledocholiths or masses.

Pancreatic lobar tissue is normally white to pale pink, soft, thin, and pliable. The tissue can be gently palpated for nodules if an insulinoma is suspected; however, extensive or rough palpation could lead to pancreatic ischemia or inflammation. Pancreatic biopsy can be performed via blunt dissection of lobules or ligation of a free edge using a guillotine technique. Avoid sampling areas that contain major vessels or pancreatic ducts; if the pancreaticoduodenal vessels are damaged, blood supply to the duodenum could be interrupted.

Kidneys and Adrenal Glands

The kidneys lie within the retroperitoneal space and are often surrounded by fat. Both kidneys should be roughly the same size and shape and have a smooth exterior. Because of their retroperitoneal position and surrounding fat, the ureters are usually not visible as they exit the renal pelvis. Cortical renal biopsies are most often performed with a 16-gauge automated biopsy needle; for best results, 2 core samples are recommended. Renal parenchyma bleeds extensively; however, hemorrhage from needle biopsy will usually subside with local digital pressure.

The adrenal glands are elongated, whitish-tan, and firm. The left gland lies medial to the cranial pole of the left kidney and is usually visible lateral to the caudal vena cava and under the left phrenicoabdominal vein. The right adrenal gland is more cranial and may lie dorsal to the caudal vena cava, making it more difficult to see. The glands can be examined and palpated for enlargement or nodules, but because of adjacent vascular structures, sampling is not recommended unless the surgeon has advanced training.

Ovaries and Uterine Horns

In intact females, the ovaries and proximal uterine horns lie caudodorsal to the kidneys. They are usually located by retracting the descending duodenum or descending colon and associated viscera to the animal’s left or right, respectively, to visualize the “gutters” of the abdominal cavity. Normal ovaries and uterus vary in size and shape depending on the reproductive stage. They should be examined for masses and cysts. In ovariectomized animals displaying signs of estrus, peritoneal tissue caudal to the kidneys and adjacent intestinal mesentery or omentum should be examined and palpated for nodules; these will be more obvious if the animal is in heat. Ovarian remnants may overlie the ureters and must therefore be dissected out carefully.

Caudal Urogenital Tract

A normal, distended urinary bladder is thin-walled, smooth, and relatively vascular. If the bladder is
enlarged and obstructing visibility, it can be emptied by manual expression, cystocentesis, or catherization. The decompressed bladder can be retracted caudoventrally out of the abdominal cavity to expose the ureters, which enter at the trigone, and underlying dorsal structures such as uterine body/cervix, descending colon, and sublumbar lymph nodes.

The bladder narrows down into the trigone and proximal urethra, which is obscured by the prostate in male dogs. The canine prostate is normally bilobed and can be quite small and firm in castrated dogs. It should be examined for abnormal enlargement, fluid pockets (cysts or abscesses), or masses. Lateral to the bladder, trigone, and urethra, the vas deferens and testicular vessels become closely associated as they descend toward the inguinal canals. A cryptorchid testicle can be located by following the testicular artery and vein from the level of the kidneys or the vas deferens from the prostate.

Body Wall
While the abdominal gutters are exposed or the bladder exteriorized, the dorsal and lateral peritoneal surfaces of the body wall can be examined. Distortion or disruption may be an indication of trauma or retroperitoneal hemorrhage, abscessation, or masses (FIGURE 5).

Gastrointestinal Tract
Although various portions of the gastrointestinal tract will already have been examined visually, a final examination is performed by palpating the entire tract for changes in surface texture, color, diameter, thickness, and peristalsis (FIGURE 6). The jejunum is the longest, most mobile portion of the small intestine and the most likely region to be obstructed by intestinal foreign bodies. Peyer’s patches are clusters of lymphoid follicles located within the small intestine; these should not be misinterpreted as neoplastic lesions.

The ileum is easily identified by its antimesenteric branches of the ileocecal artery and vein. The adjacent cecum is a C-shaped, gas-filled protrusion. The ileoceccolic junction is another common location for foreign body entrapment. The colon consists of

FIGURE 5. Laceration of the transversus abdominus (circled).

FIGURE 6. Bite wound of the small intestine with secondary mesenteric laceration (circled).

FIGURE 7. Incisional biopsy of the small intestine.

FIGURE 8. Severely enlarged mesenteric lymph nodes (arrow).
ascending, transverse, and descending portions, with the descending colon continuing as the rectum at about the level of the pelvic brim.

Intestinal biopsy can be performed by using a scalpel blade or skin biopsy punch to remove a full-thickness piece of tissue (FIGURE 7). Intestinal closure requires precise apposition to prevent postoperative leakage or dehiscence; most commonly, absorbable 3-0 or 4-0 monofilament suture material is used. After closure, the segment of intestine can be checked for leakage by occluding the lumen orad and aborad to the site and distending the enclosed segment with sterile saline injected through a 25-gauge needle. When testing a 10-cm intestinal segment, 16 to 19 mL of saline should be injected if digital occlusion is used, whereas 12 to 15 mL of saline is injected if Doyen forceps are used. Omentum should be tacked over the incision to improve the seal and reduce the risk of leakage.

Lymph Nodes
Lymph nodes that are enlarged or abnormal in texture can be sampled by aspiration, incisional biopsy, or excisional biopsy (FIGURE 8). The lymph node should be carefully dissected free from surrounding mesentery or peritoneum, if possible. If complete excision is unsafe, a biopsy of a free end can be performed using a guillotine technique, or a piece of the lymph node can be removed with a wedge or shaving incision.

PREPARING FOR CLOSURE
Before closure, the need for postoperative enteral nutrition and fluid support should be considered. Nasogastric tubes are easily placed and removed, and if the anesthetist advances the tube intraoperatively, the surgeon can confirm its placement within the stomach, obviating the need for postoperative radiographs.

If the gastrointestinal tract has been entered, gloves and instruments are changed. The abdomen can be lavaged with warm sterile saline to decrease inflammatory mediators, remove bacteria or contaminants, and warm the patient. If the procedure had minimal contamination, lavage can be limited to the area around the biopsy or incisional site. If septic peritonitis is suspected, the peritoneum should be lavaged until the returning fluid is clear; this may require more than 200 mL/kg sterile saline. Once all intraabdominal procedures are complete, sponges and laparotomy pads are counted to verify none have been left in the abdomen.

CLOSURE
An interrupted or simple continuous pattern can be used to appose the linea or external rectus sheath; the peritoneum does not need to be included. During subcutaneous tissue closure, fat can be intermittently tacked to the external rectus sheath to decrease the risk of seroma formation. The skin edges can be apposed with buried intradermal sutures, external sutures, or staples.

POSTOPERATIVE CONSIDERATIONS
General postoperative care should include intravenous fluids, pain control, and nursing care. Unless significant contamination has occurred or infection is present, postoperative antibiotics are usually not warranted. Incisional complications are reported in 4.6% of animals undergoing laparotomy and may include surgical site infection or inflammation, dehiscence, pain, and seroma formation.

References