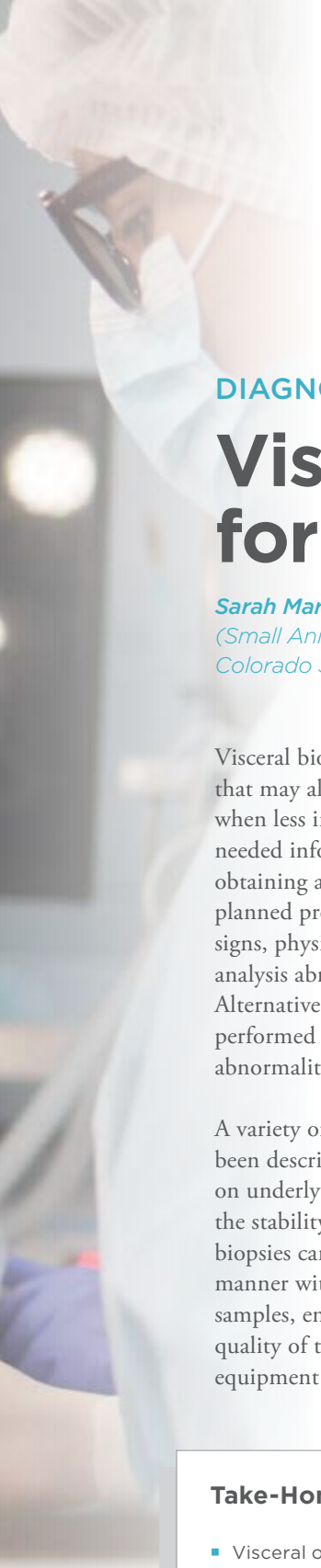
enko.stock/shutterstock.com

Abstract

Visceral organ biopsy is an important diagnostic tool that can be performed as a planned procedure or when an abnormality is incidentally found during abdominal exploratory surgery. Organs that are commonly biopsied include the liver, gastrointestinal tract, and lymph nodes. Most commonly, samples are submitted for histopathology, but, in some cases, culture with antimicrobial susceptibility or other specialized testing may be indicated.



DIAGNOSTICS

Visceral Organ Biopsy for Companion Animals

***Sarah Marvel**, DVM, MS, DACVS-SA, ACVS Fellow, Surgical Oncology and Minimally Invasive Surgery (Small Animal Soft Tissue)*
Colorado State University College of Veterinary Medicine & Biomedical Sciences, Fort Collins, Colorado

Visceral biopsy is an important diagnostic tool that may also provide prognostic information when less invasive diagnostics fail to provide needed information or are not adequate for obtaining a definitive diagnosis. It can be a planned procedure based on persistent clinical signs, physical examination findings, blood analysis abnormalities, and/or imaging findings. Alternatively, abdominal exploratory surgery performed for unrelated reasons may reveal abnormalities that necessitate visceral biopsy.

A variety of approaches and techniques have been described for obtaining biopsies depending on underlying clinical signs, affected organs, and the stability of the patient. In some cases, biopsies can be performed in a less invasive manner with image-guided percutaneous biopsy samples, endoscopy, or laparoscopy; however, the quality of the sample may be limited, or the equipment required to obtain the biopsy may not be readily available.[1-6] One readily available approach is a laparotomy with a diagnostic abdominal exploration followed by visceral biopsy tailored to the needs of the patient.

INSTRUMENTATION

A few key pieces of instrumentation are beneficial when visceral biopsies are performed during laparotomy:

- **A self-retaining abdominal retractor** such as a Balfour retractor or a Lone Star retractor laterally retracts the sides of the body wall, improving exposure and visualization of abdominal organs.
- **DeBakey thumb forceps** have fine teeth and are less traumatic compared with Adson-Brown thumb forceps. Delicate handling of visceral organs and biopsy samples is essential to obtain diagnostic samples in a complication-free manner.

Take-Home Points

- Visceral organ biopsy is a readily available diagnostic tool that can be combined with abdominal exploratory surgery.
- Adequate exposure, delicate tissue handling, and good surgical technique facilitate diagnostic sampling and minimize complications.
- Biopsies are most commonly performed of the liver, gastrointestinal tract, and lymph node.
- Obtaining multiple biopsy samples can improve diagnostic accuracy for diffuse disease processes commonly found in the liver and small intestine.

- **A pair of atraumatic Doyen intestinal clamps** can be beneficial when performing intestinal biopsy. They are designed to be clamped across the intestine to prevent contamination of ingesta while the small bowel is opened.

ABDOMINAL EXPLORATION

Visual examination along with palpation of visceral organs helps identify abnormalities and determine which organs should be biopsied. There is no standardized way to perform an abdominal exploration, but the surgeon should be systematic, similar to the approach used for a physical examination, to ensure that all structures have been assessed. A midline laparotomy beginning just caudal to the xiphoid and extending toward the pubis is performed to allow for a thorough exploration (**VIDEO 1**). The falciform ligament can be excised to improve visualization within the cranial abdomen. A Balfour self-retaining retractor is placed and laparotomy sponges and/or huck towels are placed along either side to protect the viscera from the skin. The diaphragm is visualized and all portions of the liver, biliary tree, and stomach are palpated. Retraction of the descending duodenum to the patient's left enables visualization of the right limb of the pancreas, right kidney, caudal vena cava, portal vein, and the right ovary if indicated. The right adrenal gland is closely associated with the caudal vena cava and can be difficult to visualize.

The duodenocolic ligament tethers the distal duodenum, making it difficult to trace the descending duodenum to the ascending duodenum and aboral small intestine. One option from here is to move to the descending colon, which can be grasped within the left lower quadrant and traced orally to the transverse colon, ascending colon, cecum, ileum, and jejunum and back to the descending duodenum. While the small bowel is being inspected, lymph nodes should be assessed near the ileocolic junction, as well as the root of the mesentery. The spleen is found on the left side and is tethered to the greater curvature of the stomach.

The descending colon can be retracted to the right side to reveal the left kidney, left adrenal gland, and left ovary if indicated. The left adrenal gland is identified at the cranial pole of the left kidney by the phrenicoabdominal vein traversing across it to the caudal vena cava. The stomach is retracted ventrally and cranially to reveal the left limb of the pancreas. For improved visualization or access to biopsy the left limb of the pancreas, the omental bursa can be opened by gently tearing the superficial leaf of the omentum. The bladder, ureters, and/or uterus or prostate are inspected caudally if indicated. The prostate can be difficult to visualize, but it can be easily palpated following the dorsal aspect of the trigone and palpating caudally.

VISCERAL ORGAN BIOPSY

Although all organs can be biopsied, the most commonly performed visceral organ biopsy procedures—including the liver, stomach, small intestine, lymph nodes, and pancreas—will be discussed below. Biopsy of other visceral organs is less common, and the value of the diagnostic information must be weighed against the risk of the biopsy. Incisional biopsy of the spleen carries the risk of hemorrhage with a sample that is difficult to interpret due to its vascular nature and is thus often avoided. Full-thickness biopsy of the large bowel is generally avoided because partial-thickness samples can easily be obtained via colonoscopy and full-thickness samples carry a risk of colonic incisional healing complications. Renal biopsies are not routinely performed because the diagnostic information achieved from the biopsy may not alter medical management of the patient. The most common indication for renal biopsy is proteinuria, and biopsy can be performed percutaneously with ultrasound guidance or surgically with a laparoscopy or laparotomy. While wedge biopsy of the kidney yields a better-quality sample, there is a risk of hemorrhage.[7]

Liver

Liver biopsy is indicated when there are persistent elevations of liver enzymes, hyperbilirubinemia or elevations in serum bile acids, nodules, masses, or

VIDEO 1
When performing a midline laparotomy for abdominal exploration, begin just caudal to the xiphoid and extend toward the pubis.

VIDEO 2
A nonperipheral liver biopsy is performed using a 4-mm or 6-mm Baker's punch.

diffuse changes throughout the liver parenchyma.[2,8] When diffuse parenchymal changes are present, biopsies are often collected from at least 2 to 3 different liver lobes because certain processes may not be equally distributed throughout the liver.[2] Tissue samples are collected for histopathology, aerobic and anaerobic culture, and heavy metal analysis (copper, iron, and zinc) depending on the suspected underlying condition. Large biopsy samples can be divided, allowing for a portion to be submitted for histopathology and another portion to be submitted for culture or other testing.

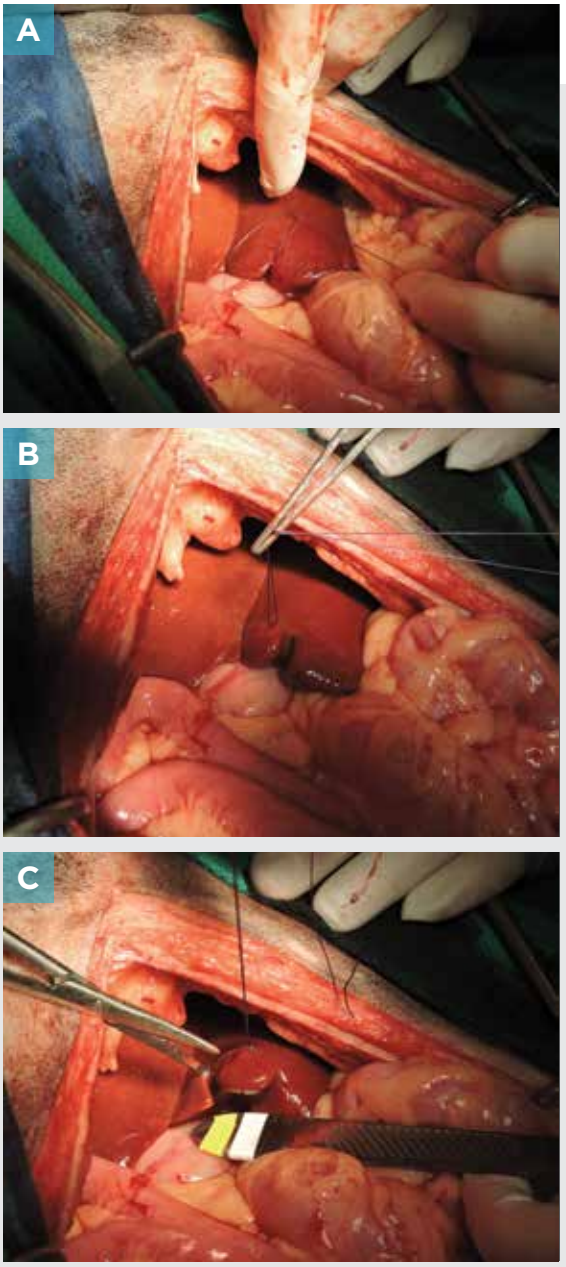


FIGURE 1. (A) During guillotine biopsy of the liver, the suture is anchored in a natural fissure. **(B)** After the suture has been secured with 4 throws, the suture tags are temporarily left long to provide a handle to stabilize the biopsy. **(C)** Metzenbaum scissors are used to cut the biopsy sample ~3 mm distal to the suture.

While it is helpful to have an assistant retract the liver caudally by placing a hand between the liver and the diaphragm, liver biopsy can be easily performed without an assistant. Ensure that the laparotomy extends to the xiphoid. Pack laparotomy sponges between the liver and diaphragm to mobilize the liver caudally. Note: Wrap the radiopaque tag of the laparotomy sponges around the Balfour retractor or clamp with a hemostat to ensure that laparotomy sponges are removed prior to closure. A sponge count should also be performed.

For a nonperipheral biopsy or a biopsy of a specific nodule or mass, a 4-mm or 6-mm Baker's punch is commonly used (**VIDEO 2**). The punch is positioned perpendicular to the tissue and is rotated to cut a cylinder of liver parenchyma. The punch can then be rotated 45 degrees to cut the deep attachments. If the deep attachments do not completely release, Metzenbaum scissors can be used to trim the deep attachments. The biopsy is gently extracted with DeBakey thumb forceps. Minor hemorrhage will occur. Liver parenchyma is friable, and suturing the defect can be challenging. Gelatin sponge aids in clot formation and is placed in the defect in lieu of suturing. Digital pressure with a laparotomy sponge can be temporarily applied if there is residual hemorrhage.

For a peripheral biopsy, either a guillotine technique or crushing clamp method can be performed. The author prefers a small-gauge 3-0 multifilament absorbable suture for this technique, but monofilament suture can also be used. A loop of suture is placed around the distal tip of a liver lobe. It is helpful to slide the suture into a natural fissure to prevent the suture from sliding off the lobe when tightened (**FIGURE 1A**). If a fissure is not present, hemostats can be applied perpendicular to the edge of the liver lobe to crush the liver parenchyma and create a fissure. The suture is slipped over the edge of the liver, encompassing 7 to 10 mm in length. As the suture is tensioned, it will crush through the liver parenchyma and compress the deeper vessels. At least 4 secure throws are performed, leaving the tags of the suture long to use as a temporary handle (**FIGURE 1B**). Metzenbaum scissors are used to cut the biopsy sample ~3 mm distal to the suture, to prevent the suture from slipping off the liver (**FIGURE 1C**). Finally, the tags of

the suture are cut short. Alternatively, a crushing clamp can also be placed across the tip of a liver lobe for 30 seconds or more. The sample is cut distal to the clamp and the clamp is removed after several minutes. The author typically reserves this technique for small patients where the peripheral liver tissue is not enlarged.

Stomach

Indications for gastric biopsy include persistent vomiting with no identified cause, gastric nodules, thickenings, or masses.

The stomach is packed with laparotomy sponges, and stay sutures of 3-0 or 4-0 monofilament suture are placed in the ventral aspect of the stomach centered between the greater and lesser curvature or near the proposed biopsy site. If an assistant is not present to retract the stay sutures ventrally, the sutures can be draped over the Balfour retractor to allow for hands-free retraction of the ventral aspect of the stomach. A #11 scalpel blade is used to make a full-thickness stab incision into the stomach. Often the submucosa–mucosa layer falls away and an additional stab incision is necessary to enter the lumen of the stomach.

The incision is extended with Metzenbaum scissors. One edge of the incision is removed with scissors or a scalpel blade, resulting in a full-thickness biopsy. Suction is used to prevent contamination. The author prefers a Yankauer suction tip. Gastrotomy closure is performed using 3-0 or 4-0 monofilament absorbable suture in a full-thickness simple continuous or interrupted appositional pattern, with bites spaced 3 to 4 mm away from the edge and 3 mm apart from each other. A 2-layer closure can also be performed but is often unnecessary.

Small Intestine

Indications for small intestinal biopsy include chronic weight loss or small bowel diarrhea, intestinal thickening or masses, or a negative exploratory surgery for small bowel obstruction.[6,9-11]

For diffuse small intestinal disease, multiple biopsies are performed from all segments: duodenum, jejunum, and ileum.[6,10,11] Once a segment of bowel is isolated, laparotomy sponges are used to pack off the segment, ingesta is milked away from the biopsy site, and either an assistant's fingers or atraumatic Doyen forceps are used to stop the flow of ingesta oral and aboral to the proposed incision. A stab incision with a #15 or #11 scalpel blade is made along the antimesenteric surface of the bowel and extended with Metzenbaum scissors or a scalpel blade. One edge of the incision is grasped, and scissors or a blade are used to excise a 1-mm full-thickness ellipse of tissue. It can be difficult to traction the edge of the biopsy sample without crushing it, and a variety of other biopsy techniques can be used. A stay suture can be placed on the antimesenteric surface (**FIGURE 2A**), and an elliptical-shaped incision can be made excising the biopsy sample with the stay suture (**FIGURE 2B**). Caution is used to prevent a wedge-shaped incision that narrows toward the mucosal surface. Alternatively, a Baker's punch (4 to 6 mm) can be used along the antimesenteric surface (**VIDEO 3**).

Intestinal closure is performed in 1 layer to prevent narrowing of the intestinal lumen. Closure is performed with 4-0 monofilament absorbable suture in a simple interrupted or simple, continuous, full-thickness

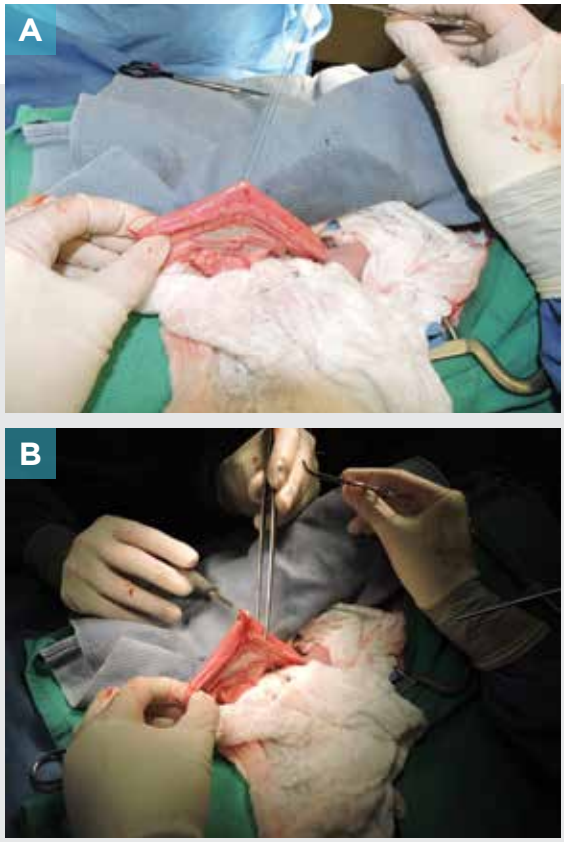


FIGURE 2. (A) A stay suture is placed along the antimesenteric surface of the small intestine to provide traction for the biopsy sample, which prevents grasping and crushing of the samples with forceps. **(B)** An elliptical incision is then made around the stay suture.

appositional pattern with enough tension to create a seal but not crush the tissues (**VIDEO 4**). Sutures are placed approximately 2 to 3 mm from the edge of the incision and 2 to 3 mm apart. For continuous pattern closures, the suture line should start and end beyond the incision. The holding layer is the submucosa, and sutures must engage this layer. The biopsy site can also be closed in a transverse manner to prevent narrowing of the lumen (**FIGURE 3**). After closure, leak testing[12] or visual assessment can be performed. Local lavage is performed, and gloves and instruments are changed before performing other procedures.

Lymph Node

Lymph node biopsy is indicated when enlarged lymph nodes are noted during abdominal exploration or for staging purposes when removing a neoplastic process. Samples are typically collected for histopathology but can also be collected for aerobic/anaerobic culture if indicated. Although there are numerous lymph nodes throughout the abdominal cavity that can be biopsied, mesenteric lymph nodes found along the root of the mesentery of the small intestine and near the ileocolic junction are accessible and routinely biopsied.

While mesenteric lymph nodes can be freely dissected and extirpated, complete removal of certain mesenteric lymph nodes can be challenging, in which case an incisional biopsy is performed. Gentle tissue handling is essential as tissue can be friable. The peritoneal layer overlying the tip of the lymph node is incised. A small, curved hemostat is used to bluntly dissect between the peritoneum and the lymph node. A guillotine technique is performed by passing a suture around the periphery of the lymph node and crushing through the parenchyma. The tissue distal to the suture is excised with scissors. Closure of the peritoneum is not necessary unless a large full-thickness hole is made in the mesentery. Alternatively, if the shape of the lymph node is not ovoid, a wedge incision can be performed with a #11 or #15 blade. Take note of the depth of the biopsy to ensure that the blood supply to the intestine is not compromised during the biopsy. Hemorrhage is controlled by placing a cruciate suture in the capsule of the lymph node/overlying peritoneum with 4-0 monofilament rapidly absorbable suture.

Pancreas

Indications for pancreatic biopsy include nodules or masses, inflammation, or atrophy of the pancreas.[13] Although routine biopsies of the liver, gastrointestinal tract, and abdominal lymph nodes are performed commonly without evidence of gross disease, the pancreas is typically only biopsied when grossly abnormal. Pancreatic biopsies can be performed without concern for pancreatitis as long as gentle tissue handling techniques are employed and the blood supply is preserved.

When diffuse disease is present, biopsy is typically performed in the left limb or at the distal aspect of the right limb of the pancreas due to its distance from the vascular supply and ductal system. The duodenum is retracted ventrally and to the left to expose the right limb of the pancreas. The thin peritoneal layer is incised near the intended biopsy site. A loop of suture (3-0 or 4-0 monofilament or multifilament suture) is passed around the area of interest and tied, crushing through the pancreatic tissue. The tissue sample distal to the suture is transected with Metzenbaum scissors.

FIGURE 3. Intestinal biopsies can be closed in transverse orientation.

VIDEO 3
For diffuse small intestinal disease, multiple biopsies are performed of the duodenum, jejunum, and ileum.

VIDEO 4
Closure is performed with 4-0 monofilament absorbable suture following completion of an intestinal biopsy.

COMPLICATIONS

Complications after visceral organ biopsy vary depending on the organ that was biopsied. In general, visceral organ biopsy is well tolerated and complications are minimal with delicate tissue handling but may include hemorrhage, ileus, postoperative pancreatitis, and incisional complications. One of the most severe complications following gastrointestinal biopsy is leakage and dehiscence resulting in septic peritonitis.[10] Patients should be monitored closely for signs of peritonitis, which typically occurs within the first 3 to 5 days following surgery.

SUMMARY

Regardless of whether visceral organ biopsy is preplanned or abnormalities are found during abdominal exploration that necessitates biopsy, visceral organ biopsy is an important diagnostic tool. Preoperative diagnostics and intraoperative exploratory findings will determine which organs should be biopsied. When diffuse pathology is present (e.g., liver, small intestine), multiple samples may be required to maximize the value of the diagnostic information. Good exposure and gentle tissue handling are key to obtaining diagnostic samples and minimizing the risk of complications. TVP

References

1. Willard MD, Mansell J, Fosgate GT, et al. Effect of sample quality on the sensitivity of endoscopic biopsy for detecting gastric and duodenal lesions in dogs and cats. *J Vet Intern Med*. 2008;22(5):1084-1089.
2. Rothuizen J, Twedt D. Liver biopsy techniques. *Vet Clin North Am Small Anim Pract*. 2009;39(3):469-480.
3. Scott KD, Zoran DL, Mansell J, et al. Utility of endoscopic biopsies of the duodenum and ileum for diagnosis of inflammatory bowel disease and small cell lymphoma in cats. *J Vet Intern Med*. 2011;25(6):1253-1257.
4. Slovak JE, Wang C, Morrison JA, et al. Endoscopic assessment of the duodenum in dogs with inflammatory bowel disease. *J Vet Intern Med*. 2014;28(5):1442-1446.
5. Shamir SK, Singh A, Mayhew PD, et al. Evaluation of minimally invasive small intestinal exploration and targeted abdominal organ biopsy with use of a wound retraction device in dogs: 27 cases (2010-2017). *JAVMA*. 2019;255(1):78-84.
6. Marsilio S, Freiche V, Johnson E, et al. ACVIM consensus statement guidelines on diagnosing and distinguishing low-grad neoplastic from inflammatory lymphocytic chronic enteropathies in cats. *J Vet Intern Med*. 2023;37(3):794-816.
7. Vaden SL, Levine JF, Lees GF et al. Renal biopsy: a retrospective study of methods and complications in 283 dogs and 65 cats. *J Vet Intern Med*. 2005;19(6):794-801. https://doi.org/10.1111/j.1939-1676.2005.tb02767.x
8. Webster CRL, Center SA, Cullen JM, et al. ACVIM consensus statement on the diagnosis and treatment of chronic hepatitis in dogs. *J Vet Intern Med*. 2019;33(3):1173-1200.
9. Boothe HW, Slater MR, Hobson HP, et al. Exploratory celiotomy in 200 non-traumatized dogs and cats. *Vet Surg*. 1992;21(6):452-457.
10. Shales CJ, Warren J, Anderson DM, et al. Complications following full-thickness small intestinal biopsy in 66 dogs: a retrospective study. *J Small Anim Pract*. 2005;46(7):317-321.
11. Kleinschmidt S, Harder J, Nolte I, et al. Chronic inflammatory and non-inflammatory diseases of the gastrointestinal tract in cats: diagnostic advantages of full-thickness intestinal and extraintestinal biopsies. *J Feline Med Surg*. 2010;12(2):97-103.
12. Saile K, Boothe HW, Boothe DM. Saline volume necessary to achieve predetermined intraluminal pressures during leak testing of small intestinal biopsy sites in the dog. *Vet Surg*. 2010;39(7):900-903.
13. Webb CB, Trott C. Laparoscopic diagnosis of pancreatic disease in dogs and cats. *J Vet Intern Med*. 2008;22(6):1263-1266.

chewy health

Your partner in care

Caring for pets is what you care about most. We can help you do it with an entire suite of solutions like **PracticeHub™,** a platform that streamlines your prescription process at no cost to your clinic. Just select, review and approve. It's that easy.

For more info contact us at **vetsupport@chewyhealth.com.**

Sarah Marvel

Dr. Marvel achieved board certification in small animal surgery from the American College of Veterinary Surgeons in 2014. Following her surgical residency, she completed fellowships in surgical oncology and minimally invasive surgery (small animal soft tissue) at Colorado State University. She is an assistant professor in general surgery at Colorado State University. She has an interest in emergency surgery, surgical oncology, and minimally invasive soft tissue surgery.