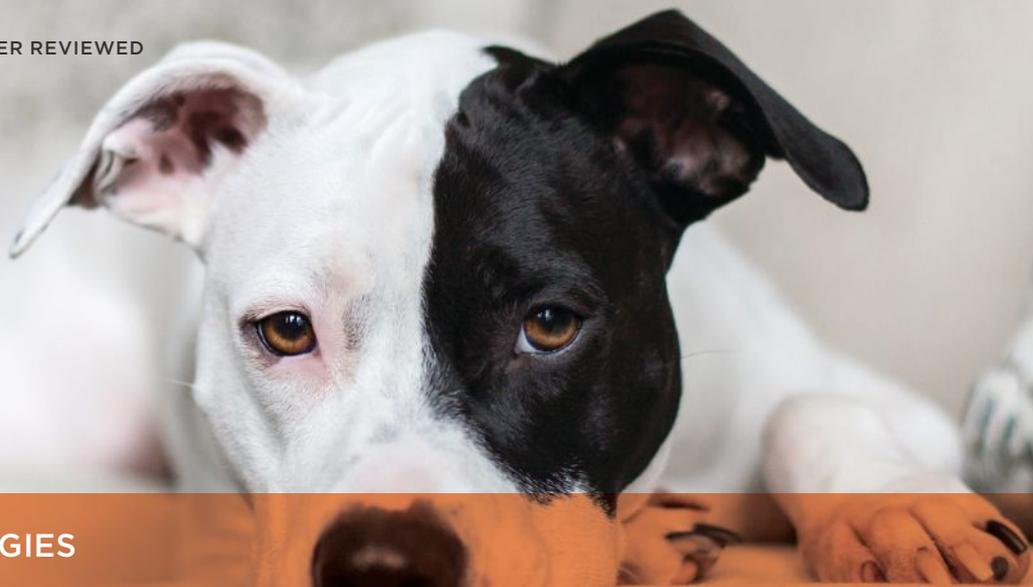


### SHARP AS A NEEDLE

Ultrasound-guided fine needle aspiration and needle core biopsy are relatively safe, low cost, minimally invasive techniques for obtaining diagnostic tissue samples.



## MANAGEMENT STRATEGIES

# Ultrasound-Guided Fine Needle Aspiration and Core Biopsy

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Ultrasound examination is an excellent diagnostic tool for detecting visceral abnormalities in small animals. Many ultrasound findings, however, can be nonspecific. Although masses, nodules, effusions, and other macromorphologic abnormalities can be readily identified, tissue samples are often necessary for a more definitive diagnosis. Ultrasound-guided fine needle aspiration (FNA) and core biopsy are safe, minimally invasive techniques that can help obtain an etiologic diagnosis.<sup>1</sup>

### INDICATIONS

Percutaneous ultrasound-guided FNA and biopsy procedures are routinely employed in small animal medicine to determine if a lesion represents inflammation, infection, or neoplasia. They are also performed when laboratory abnormalities suggest an underlying disease and when staging is desired for neoplastic disease.

Many locations and types of lesions can be sampled using ultrasound guidance (**BOX 1**). Abdominocentesis, pleurocentesis, and pericardiocentesis are also commonly performed with ultrasound guidance. In addition, ultrasound can identify and guide needles into lesions along bone surfaces.<sup>3,4</sup> Samples obtained from these sites can be submitted for fluid, cytologic, culture, and/or biochemical analysis.

### BOX 1 Locations Suitable for Ultrasound-Guided Needle Sampling

#### Transabdominal ultrasound<sup>2</sup>

- Liver
- Gallbladder
- Spleen
- Gastrointestinal tract
- Adrenal glands
- Pancreas
- Prostate gland
- Bladder
- Kidneys
- Ovaries
- Uterus
- Intra-abdominal lymph nodes
- Mesenteric masses
- Abdominal ascitic fluid, cysts, and abscesses

#### Cervical ultrasound

- Thyroid and parathyroid glands
- Regional lymph nodes

#### Noncardiac thoracic ultrasound

- Lungs
- Mediastinum
- Pleural and thoracic wall lesions

**TABLE 1** Risks of Ultrasound-Guided Needle Procedures and How to Avoid Them

RISK	CAUSE(S)	HOW TO AVOID
Hemorrhage	<ul style="list-style-type: none"> <li>■ Accidental puncture of a large blood vessel</li> <li>■ Pre-existing coagulopathy</li> </ul>	<ul style="list-style-type: none"> <li>■ Visualize the tip of the needle</li> <li>■ Use the smallest-gauge needle necessary</li> <li>■ Employ sedation as needed</li> <li>■ Apply color flow Doppler technique to identify local blood vessels</li> <li>■ Prescreen for coagulopathy</li> </ul>
Peritonitis, sepsis	<ul style="list-style-type: none"> <li>■ Accidental introduction of an infectious agent</li> <li>■ Accidental puncture of the gastrointestinal tract</li> <li>■ Abscess leakage</li> </ul>	<ul style="list-style-type: none"> <li>■ Use good sterile technique</li> <li>■ Visualize the tip of the needle</li> <li>■ Use sedation as needed</li> <li>■ Defer for open surgical drainage if abscess is suspected</li> </ul>
Pneumothorax	Air leakage into the pleural space secondary to pulmonary puncture or tear	<ul style="list-style-type: none"> <li>■ Visualize the tip of the needle</li> <li>■ Use the smallest needle necessary</li> <li>■ Employ sedation as needed</li> </ul>
Seeding of neoplastic cells along the needle tract	Documented risk with transitional cell carcinoma, prostate cancer, and feline pulmonary adenocarcinoma <sup>7</sup>	<ul style="list-style-type: none"> <li>■ Use alternative sampling technique</li> <li>■ Evaluate risk versus benefit</li> </ul>
Fatal shock reaction in cats	Presumably due to excessive vagal response	Avoid the use of fully automatic biopsy needles in cats
Hypertensive crisis	Potential for catecholamine release when adrenal gland pheochromocytoma is sampled	<ul style="list-style-type: none"> <li>■ Use caution when sampling adrenal glands or avoid altogether when pheochromocytoma is suspected</li> <li>■ Defer for surgical adrenalectomy or to specialty clinic where more intensive patient monitoring, support, and management can be provided</li> </ul>

## POTENTIAL CHALLENGES

Ultrasound-guided biopsy may not be possible where gas or bone prevents access to the lesion. Repositioning the patient or changing the transducer position may create a better window. Otherwise, computed tomography, fluoroscopy, or open surgical sampling may be necessary. Structures and lesions located deep in the pelvic canal may not be accessible by a transabdominal approach. In cases that involve the prostate, bladder, and distal urethra, ultrasound guidance can still be used to obtain samples via traumatic urethral catheterization.

While some larger gastrointestinal masses may be amenable to ultrasound-guided biopsy, smaller lesions may be harder to access and exfoliate, especially if penetration of the gastrointestinal lumen is to be avoided. Laparoscopic or surgical biopsy is indicated for these cases.

## ADVANTAGES OF ULTRASOUND-GUIDED SAMPLING

The advantages to performing ultrasound-guided needle sampling—either FNA or core biopsy—are numerous. It is a safe, minimally invasive, rapid

technique that is relatively inexpensive compared with more invasive diagnostic procedures, and there is no radiation exposure.<sup>5</sup> No other imaging-guided technique allows the same precise, real-time observation of the sampling device and immediate postprocedure monitoring. Ultrasound guidance enables avoidance of low diagnostic yield regions, such as central tumor necrosis, and high-risk regions, such as blood vessels and the renal medulla. The information gained from ultrasound-guided needle sampling can help with patient prognosis, surgical planning, chemotherapy options, and radiation treatment. It may also eliminate the need for surgery.

## POTENTIAL COMPLICATIONS

The risk for complications of ultrasound-guided biopsy is influenced by the sonographer's training and experience, the needle size, the tissue being sampled, and the location of the lesion. The most common complication associated with ultrasound-guided needle procedures is hemorrhage (**TABLE 1**). In most cases, bleeding is minimal and self-limiting.

The risk for pneumothorax exists when aspirations or biopsies on the thoracic cavity are performed or when a

**TABLE 2** When to Choose Fine Needle Aspiration or Core Biopsy

INDICATIONS	FNA	CORE BIOPSY
Small, solid masses	x	
Cystic lesions	x	
Highly vascular lesions	x	
Diffuse infiltrative disease	x	x
Large masses	x	x
Histopathology desired		x

high paracostal approach to the liver is used.<sup>6</sup> When pneumothorax does occur, it is usually small and self-limiting.

Although seeding of neoplastic cells along the needle track has been reported with certain cancers (TABLE 1), it is rare. In these cases, the benefit versus risk must be considered. Bladder and prostatic tumors can be sampled by ultrasound-guided traumatic urethral catheterization, which eliminates the risk of abdominal seeding.

Fatal shock reactions have been associated with the use of fully automatic biopsy needles in cats. This is presumably due to the pressure wave and subsequent vagotonia created by firing the device.<sup>8</sup> Semi-automatic or manual core biopsy devices can be employed instead. Care must be exercised when FNA is performed on the adrenal glands owing to their high vascularity and the risk of triggering a hypertensive crisis if a pheochromocytoma is present. Referral for surgical biopsy may be preferable.

### FINE NEEDLE ASPIRATION VERSUS CORE BIOPSY

In deciding whether to perform FNA or core biopsy, factors such as the size, suspected type, vascularity, and location of the abnormality must be considered, along with the risk to the patient.<sup>9</sup> TABLE 2 provides general guidelines to help decide when to use FNA versus core biopsy for tissue sampling. If a patient has a coagulopathy or is unstable for sedation, or if the operator is unable to obtain access to the sampling site without penetrating other organs, neither core biopsy nor FNA may be suitable.

#### Fine Needle Aspiration

One advantage of FNA over core biopsy is that it usually requires very little to no sedation.<sup>1</sup> However,

ultrasound-guided FNA samples are smaller than core biopsy samples. As such, the cytologic results may be nonspecific or may not correlate with the final histopathologic diagnosis.<sup>10,11</sup> This is a common problem with some liver and spleen aspirates where core, laparoscopic, or surgical biopsy may be a better choice depending on the lesion location and clinical presentation.

#### Core Biopsy

Core biopsy needles are easier to visualize on ultrasound imaging than the needles used for FNA and provide superior samples; however, they are associated with a higher rate of complications such as hemorrhage.<sup>5,12</sup> Smaller-gauge core biopsy needles can be used to lower the risk of hemorrhage, although this may also lower sample quality owing to smaller size, tissue crushing, and tissue fragmentation.<sup>13</sup> Sometimes even core biopsy samples are too small for a definitive diagnosis. In these cases, laparoscopic or surgical biopsy is indicated.

### SAMPLING PROCEDURES

#### Equipment

When FNA is being performed, a 22-gauge by 1½-inch needle is adequate to obtain cytologic samples for most lesions; however, deeper lesions may require longer spinal needles. The stylet used with spinal needles decreases the chance of collecting nondiagnostic tissue (e.g., abdominal fat) during placement (FIGURE 1). The stylet is left in place until the lesion is reached.



**FIGURE 1.** Supplies for ultrasound-guided fine needle aspiration, from left: sterile syringe, 1½-inch 22- and 25-gauge hypodermic needles, sample collection tubes, slides, culturette, and spinal needle.



Lesions that are prone to blood contamination can be sampled with smaller, 25-gauge needles.

Core biopsy needles range in size from 14- to 18-gauge and vary in length. Both automatic and semiautomatic core biopsy systems are available (**FIGURE 2**). Automatic systems may be more economical and precise, but because they eject the needle tip beyond the needle placement point, they require adequate evaluation of the depth of the lesion. Fully automatic biopsy needles may best be avoided in cats based on the potential for fatal shock reactions.<sup>8</sup> The advantage of semiautomatic systems is they do not eject the cutting core beyond the needle point visualized in the lesion. This may help prevent inadvertent penetration of surrounding tissues (**FIGURE 3**).

## Patient Preparation

Preparation of the patient for ultrasound-guided sampling should include a minimum database of packed cell volume, total solids, platelet count, and coagulation profile.<sup>14</sup> A coagulation profile is optional for FNA procedures but is recommended for patients with signs of coagulopathy or that are systemically ill.<sup>2,15</sup> Some patients undergoing ultrasound-guided FNA may not require sedation; however, nervous, uncooperative patients or those with lesions that are difficult to reach should be sedated to minimize adverse events. Patients undergoing ultrasound-guided core biopsies should always be heavily sedated or completely anesthetized to eliminate movement during the procedure. Patient fasting is indicated to limit complications associated with aspiration during sedation.



**FIGURE 2.** Two fully automatic core biopsy needles (left) and two semiautomatic core biopsy needles (right).

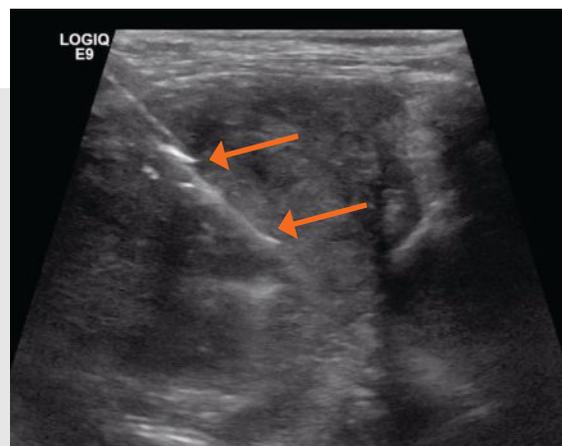
Fully automatic biopsy needles may best be avoided in cats based on the potential for fatal shock reactions.<sup>8</sup>

Depending on the organ to be sampled, the patient is placed in either dorsal or lateral recumbency. Patients undergoing sampling of thoracic lesions are positioned in lateral recumbency and examined from the nondependent side.<sup>16</sup> The surrounding area is clipped and ultrasound gel is removed to prevent artifact in cytologic samples. A sterile preparation of the skin is recommended for core biopsy, but alcohol preparation is often adequate for FNA.

## Sample Collection

The ultrasound probe may be covered with a sterile sleeve or glove to maintain the sterile field, and sterile jelly can be used for acoustic coupling.<sup>2,16</sup> Alternatively, a sterile field may be maintained by preventing the probe from contacting the needle's point of entrance.

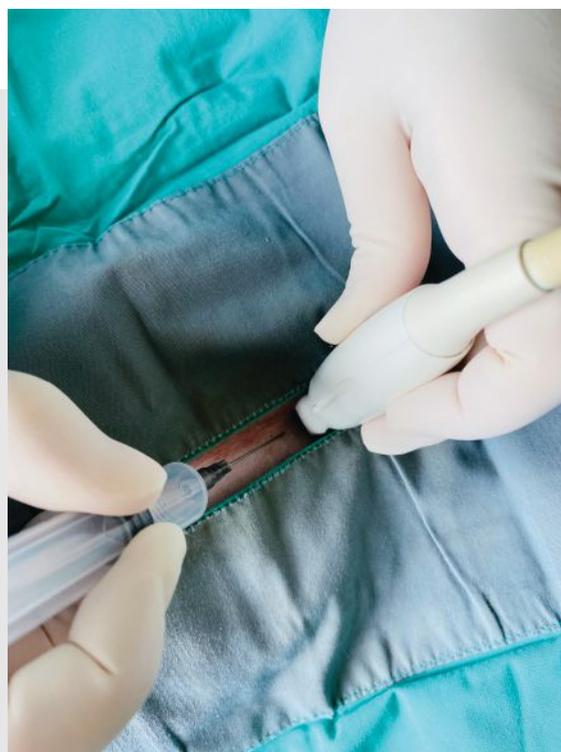
Many ultrasound machines come with software that accommodates the use of a biopsy guide that indicates the needle's path during the biopsy. The disadvantage of these guides is that they offer little flexibility in



**FIGURE 3.** Ultrasound image of a Tru-Cut core biopsy needle taking a sample from a mediastinal mass. The **arrows** point to the needle sample notch.

Hospitalization for 4 to 6 hours is recommended after needle core biopsy owing to the greater potential for bleeding.

adjusting the path of the needle. A freehand needle placement technique can be used instead and is the same for FNA and needle core biopsy. In this technique, the needle is positioned cranial or caudal to the probe and lined up exactly with the probe marker in a sagittal plane in order to be seen within the ultrasound beam (FIGURE 4). Care must be taken to avoid needle insertion into the probe. The angle of the needle varies according to the depth of the lesion, with deeper lesions requiring more acute angles to the probe. Mastering this technique may be achieved through practice on a phantom model.<sup>17</sup>



**FIGURE 4.** Ultrasound-guided fine needle aspiration demonstrating correct needle positioning with the needle lined up exactly with the probe marker in a sagittal plane.

## Core Biopsy

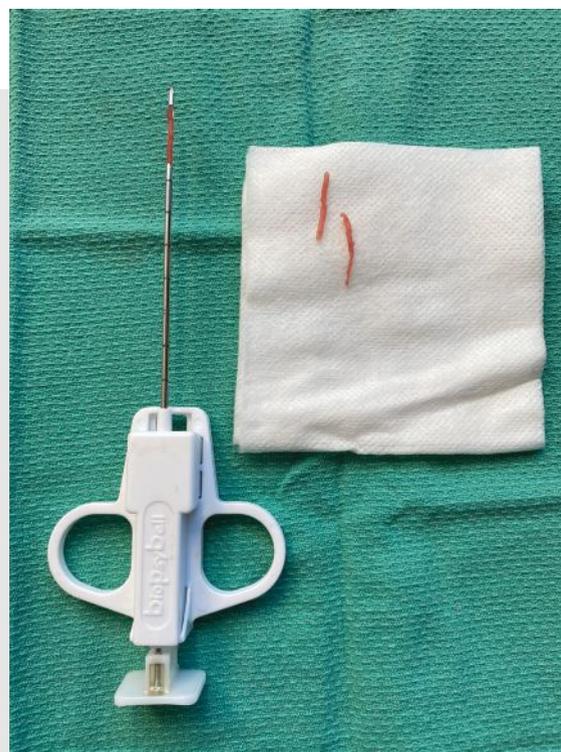
For core biopsy, a small skin incision is needed to facilitate needle passage. Once the needle is positioned in the lesion, the trigger is released and the needle removed. The core sample can then be gently teased from the needle and placed in formalin for histologic assessment (FIGURE 5).

## Fine Needle Aspiration

For FNA, the needle is attached to a 6-mL syringe containing 1 to 2 mL of air that will aid in expelling the sample onto a glass slide. For solid lesions, a rapid, pecking technique is used to collect cells from the lesion. For liquid or cystic lesions, the needle may be attached to an extension set that is then attached to a needle of appropriate size for aspiration. Fluid collected from such lesions can be prepared for cytologic assessment and/or submitted for culture and sensitivity testing. Slides are prepared for cytology in standard fashion.

## Postprocedure Monitoring

The patient should be monitored for complications



**FIGURE 5.** Semiautomatic core biopsy needle with a tissue sample present in the sampling notch. Core samples to be submitted in formalin for histopathology are displayed.



post-biopsy. Hospitalization for 4 to 6 hours is recommended after needle core biopsy owing to the greater potential for bleeding. The abdomen or thorax can be scanned for fluid accumulation and the patient monitored for breathing difficulty that may occur with pneumothorax. Packed cell volume and total solids measurement can be repeated 4 to 5 hours after biopsy to monitor for blood loss, which would warrant a repeat scan.<sup>15</sup>

## CONCLUSION

Ultrasound-guided FNA and needle core biopsy are excellent techniques for obtaining diagnostic tissue samples. The procedures are relatively safe, low cost, minimally invasive, and frequently necessary for obtaining a definitive diagnosis and making an appropriate diagnostic and treatment plan. While complications are possible, they are usually minimal, especially when the procedure is performed by a highly trained and experienced veterinary sonographer. **TVP**

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Dr. Pankatz is a graduate of the Ontario Veterinary College and has been in small animal general practice for 23 years. She completed the IVUSS Certification program in 2014 and has served as president on the IVUSS Board of Directors. She owns and manages Mountain Vista Veterinary Hospital in Ontario, Canada, as well as South Georgian Bay Veterinary Ultrasound and MIS, where her primary focus is providing onsite abdominal, thoracic, musculoskeletal and ocular ultrasound services, echocardiography, and laparoscopic/endoscopic services.



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