PEER REVIEWED

Endoscopic Equipment for the Veterinary Practitioner

Julie Callahan Clark, DVM, Diplomate ACVIM

Photo by John Donges

Endoscopy is a **minimally invasive procedure** that allows the examiner to **look within an organ or body cavity** and gain diagnostic information, which includes grossly **evaluating an area of interest and obtaining tissue** for histopathologic evaluation.

While gastrointestinal (GI) endoscopy represents the most common use in veterinary medicine, endoscopes can be utilized to investigate multiple body systems (**Table**). Further, endoscopy can be therapeutic when used for foreign body retrieval, stone removal, or feeding tube placement.

SHOULD YOU OFFER ENDOSCOPY?

As the standard of care in veterinary medicine improves with advancing technology, clients expect a higher level of care and even seek out minimally invasive procedures for their pets. Endoscopy is a versatile tool that provides a nonsurgical option for diagnosis and treatment of a variety of disease conditions.

While becoming a proficient endoscopist takes extensive training, it is a skill that can be learned over time, eventually becoming a valuable component of your practice. This article provides a general overview of endoscopic equipment, instrumentation, and handling for practitioners interested in implementing an endoscopy program.

PURCHASE CONSIDERATIONS

The decision to purchase endoscopy equipment begins with an internal evaluation of your client base and their pets' needs:

- What procedures are you likely to perform and on what species?
- How frequently do you perceive the need for endoscopy?
- Can your clients afford the added cost of such a procedure?

Purchasing an endoscope is a significant commitment, from both a financial and training standpoint. Therefore, making the right purchase is imperative to implementing a successful program. Fortunately, both new and used equipment is available that can accommodate a variety of needs.

TABLE. PROCEDURES COMMONLY PERFORMED USING FLEXIBLE & RIGID ENDOSCOPES

FLEXIBLE ENDOSCOPY	RIGID ENDOSCOPY
• Bronchoscopy	• Arthroscopy
• Colonoscopy	• Female urethrocystoscopy
• Esophagoscopy	• Laparoscopy
• Gastroduodenoscopy	• Otoscopy
• Male dog urethrocystoscopy	• Rhinoscopy
• Nasopharyngoscopy	• Thoracoscopy
• Tracheoscopy	

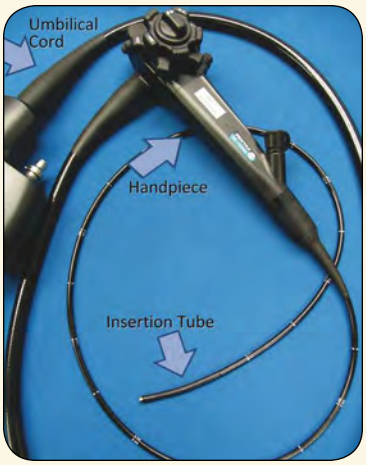

Figure 1. The basic endoscope with arrows pointing to the 3 main components: insertion tube, handpiece, and umbilical cord

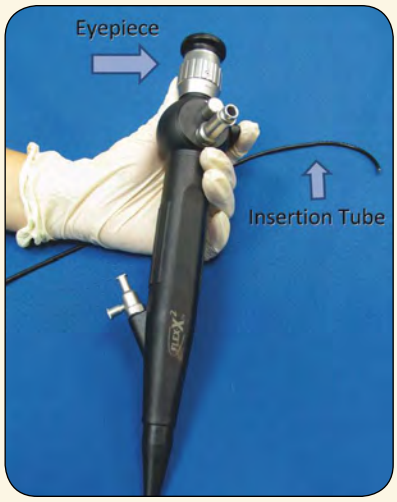

Figure 2. Storz (karlstorz.com) 7.5-Fr flexible fiberscope

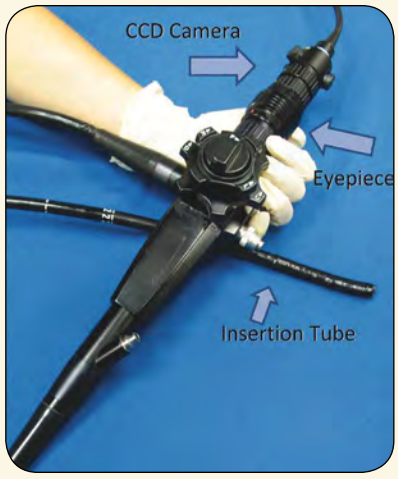

Figure 3. Pentax (pentaxmedical.com) flexible fiberscope with CCD camera attached to the eyepiece

A versatile scope—one that allows the user to perform a number of procedures—is ideal and most cost efficient. Other considerations include:

- **Type of scope**
- **Manufacturer**
- **Size**
- **Features**
- **Pricing.**

ENDOSCOPY EQUIPMENT BASICS

The basic endoscope (**Figure 1**) consists of the:

Insertion tube—Encases the mechanism for image transmission:
- » Fiberoptic glass bundles (fiberscope) or charge-coupled device (CCD) chip (videoendoscope)
- » Biopsy/suction channel
- » Irrigation/insufflation channel
- » Deflection control cables

- **Handpiece**—Includes the:
  - » Deflection control knobs
  - » Accessory channel entrance
  - » Irrigation/insufflation
  - » Suction valves
- **Umbilical cord**—Responsible for light transmission

FLEXIBLE ENDOSCOPES

There are 2 main types of flexible endoscopes: the fiberscope (**Figures 2 and 3**) and videoendoscope. The key differentiating feature is the mechanism by which an image is sensed and transmitted for viewing. Flexible endoscopes are used predominately for navigating the complex anatomy of the GI tract.

Fiberscope

Technology

For viewing, the image is carried from a lens at the tip of the endoscope via bundles of fiberoptic glass fibers to the lens at the eyepiece.

Other Equipment

A CCD video camera can be attached to the eyepiece, transmitting the image to a video monitor. When purchasing a fiberscope, adding a CCD camera is highly recommended—it (1) enables people, other than the operator, to participate actively in the procedure and (2) allows images and video to be recorded and saved for medical record documentation.

Advantages

The main advantages of fiberscopes are reduced cost and increased portability.

Limitations

Drawbacks include inferior image quality and potential breakage of individual fibers, leading to black spots that obscure the field of view (FOV).

Videoendoscope

Technology

For viewing, the image is transmitted from a CCD chip located in the distal tip of the endoscope to a video monitor via a processor. Depending on the manufacturer, the processor may be a separate piece of equipment or incorporated into the light source unit.

Advantages

The image quality of a videoendoscope is far superior to that of a

PREPURCHASE CONSIDERATIONS

Prior to purchasing endoscopy equipment, speak with customer service representatives from different manufacturers to determine which company offers the best system for your practice's specific needs. Key discussion points include:

- Cost
- Support services/training
- Warranty
- Availability of loaner equipment (should your scope require service).

Manufacturers of Commonly Used Endoscopy Equipment:

- **Fujinon:** fujifilmusa.com
- **MDS Inc:** mdsvet.com
- **Olympus:** olympusamerica.com
- **Pentax:** pentaxmedical.com
- **Storz:** karlstorz.com

fiberscope and, therefore, carries a greater cost. The absence of fiberoptic bundles (and broken fibers) ensures that the image will not contain black dots.

RIGID ENDOSCOPES

The rigid endoscope (**Figures 4 and 5**), also known as a telescope, is used predominantly for evaluation of nontubular structures, such as a body cavity or joint space. The telescope allows light to be directed to the area of interest. It contains glass lenses and fiberoptics but no flexible materials.

CARING FOR YOUR ENDOSCOPE

Following manufacturer guidelines about safe and appropriate cleaning is the best way to care for an endoscope.

LEAK TESTING

Prior to and after each procedure, perform a leak test to check for internal leaks. This test is performed using a manometer type pressure tester attached to the umbilical cord. Early detection of a leak, prior to submerging a portion of the scope into water or enzymatic cleaner, may prevent costly damage.

BETWEEN PROCEDURES

After each procedure:

1. **Wipe** the scope down using a soft cloth to remove residual organic material.
2. **Flush** the accessory channel with an enzymatic cleaner; nonabrasive, neutral pH cleaners are recommended (Enzol, aspjj.com; EZ-Zyme, miltex.com; MetriZyme, metrex.com).
3. **Rinse** the accessory channel with demineralized water; then **dry** with air (injected via a large luer-lock syringe).

This "quick clean" approach is appropriate between GI procedures because sterility is not crucial unless heightened concern for infectious disease exists. However, endoscopes used for respiratory and urinary procedures should be sterile, which is accomplished by:

- **Cold disinfection** using a glutaraldehyde solution (Cidex, aspjj.com; MetriCide, metrex.com)
- **Gas sterilization**.

Following cold disinfection, rinse the scope thoroughly in sterile water and dry with sterile towels.

THOROUGH CLEANING

Perform comprehensive cleaning after a procedure, if needed, or at the end of the day:

1. **Immerse** the scope in a dilute bath of enzymatic cleaner for 10 to 15 minutes, during which time the channel can be flushed and cleaned with channel cleaning brushes.
2. **Rinse** the scope using demineralized water.
3. **Hang** the scope to allow it to dry.
4. **Store** flexible scopes by hanging them; rigid scopes are best stored in protective cases once they are thoroughly dried.

SPECIFICATIONS

Flexible Endoscopes

- **Diameter:** Diameters of insertion tubes range from < 1 mm to 14 mm. Most scopes > 2 mm have an accessory channel and deflectable tip, which are desirable features when performing GI endoscopy.
- **Length:** Endoscope lengths range from 55 cm to 170 cm. Longer scopes (> 125 cm) are often required for duodenoscopy and colonoscopy in large-breed dogs.
- **Gastroscopes** are excellent endoscopes for most practices because they are versatile and have 4-way tip deflection and functional accessory channels.
  - » A gastroscope < 9 mm and at least 100 to 125 cm in length can be used for common procedures in most canine and feline patients.
  - » Larger diameter gastroscopes (> 7.8 mm) cannot be used for bronchoscopy, rhinoscopy, and urethrocystoscopy in cats or small dogs.
  - » Practices that routinely perform such procedures should consider a second smaller scope, such as a 5.4 mm to 6 mm endoscope.

Rigid Endoscopes

- **Diameter & Length:** When choosing telescope size, choose the largest diameter possible to maximize

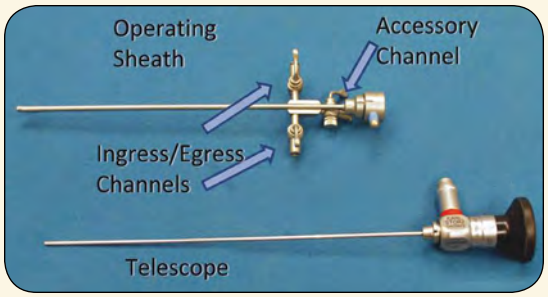

Figure 4. Storz 1.9-mm rigid telescope with associated operating sheath

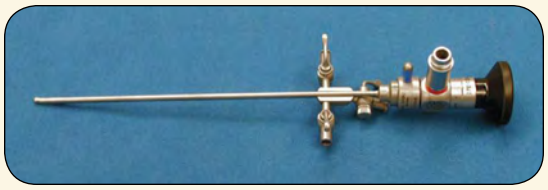

Figure 5. Storz operational telescope

Figure 6. Pentax light source unit

light transmission and FOV. Outer telescope diameters range from 1.9 mm to 10 mm while lengths range from 10 cm to 35 cm.

- **Viewing Angle:** Viewing angles range from 0° to 120°, though angles greater than 30° are rarely used in veterinary medicine. A forward viewing telescope (0°) is easiest to maneuver but provides a more limited view when compared to a 25° to 30° viewing angle.
- **Sheath/Cannula:** Telescopes are typically used in conjunction with a sheath or cannula. An operational sheath provides a conduit for diagnostic or surgical instruments, facilitates the ingress/egress of gas or fluid, and protects the scope.
- The **2.7-mm rigid endoscope** is a common, versatile telescope for veterinary practitioners that can be used for urethrocystoscopy (females), antegrade rhinoscopy, and otoscopy. The operating sheath can accommodate a 5-Fr flexible instrument, such as a biopsy forceps.
- **Semi-rigid telescopes** are available in very small diameters (1 mm) for evaluation of small lumens (ie, male cat urethra). Unfortunately, they have reduced optical quality and are rarely used.
- **Larger telescopes** are required for body cavity evaluation and are always used in combination with a trocar and cannula.

The use of telescopes for minimally invasive surgery is beyond the scope of this article. For more information on this topic, read **The Cutting Edge: Introducing Reduced Port Laparoscopic Surgery** in the January/February 2012 issue of *Today's Veterinary Practice*, available at **todaysveterinarypractice.com**.

COMPONENTS

Light Source

An important component of the basic endoscope system is the light source (**Figure 6**), which is essential to adequately illuminate the field of interest.

- A transmitting cable connects the light source to the endoscope.
- Xenon light sources are superior to halogen sources and are recommended for videoendoscopy.
- A 100- to 300-watt lamp is required and can potentially burn for 400 to 1000 hours.
- A spare lamp should be available at all times.

Most light source units have an air pump built in for insufflation—blowing of gas, such as carbon dioxide, into a body cavity—and irrigation.

- **Insufflation** is essential for GI endoscopy to maintain an open lumen for inspection and navigation.
- **Irrigation** is achieved when positive pressure forces fluid (distilled or demineralized water) through the insertion tube, allowing the user to clean the lens and/or FOV for optimal visualization.

Flexible endoscopy system, including the equipment tower, flat-screen monitors, flexible instrument storage unit, and wall suction units

These functions are controlled by valves found on the handpiece. *It is important to note that a carbon dioxide insufflator is recommended for rigid endoscopy because it provides better control of flow rate and air pressure. It also reduces the risk for air embolism when insufflating the abdomen, bladder, or a joint space.*

When using an operating telescope, irrigation is achieved via gravity with a fluid bag hung above the patient.

Suction

In addition to irrigation and insufflation, suction is the third critical feature of an endoscope. Adequate suction removes:

- Fluid or debris that may be obscuring the FOV
- Air instilled (1) at the end of the procedure or (2) if the patient's respiratory system becomes compromised due to overdistension during the procedure.

Any standard suction pump should be sufficient for most procedures; suction tubing connects the pump to the umbilical cord.

Monitor

Videoendoscopes transmit an image, via a processor, to a monitor. If you choose a rigid endoscope or fiberscope you will also need a video camera system in order to project the image.

- A **basic system** includes an endoscopic adapter/camera head (connects to the eyepiece of rigid endoscopes and fiberscopes), camera control unit, and monitor.
- There are 2 **camera types**: single-chip (CCD) and 3-chip (3 CCD) cameras. Three-chip cameras are preferred for their higher resolution and improved color reproduction.
- There are a variety of **analog video signal** formats that range in image quality:

Figure 7. Commonly used flexible instruments (left to right): Smooth cup biopsy forceps, loop snare, forked jaw graspers, raptor forceps, and alligator forceps

Figure 8. Depiction of endoscope handling

- » The least detail/lowest cost format is the composite or BNC format.
- » Quality increases with the Y/C (or S video) and RGB formats.
- » The RGB format is recommended for use with 3 CCD cameras.

- Cameras with **digital output** commonly use serial digital interface (SDI) that can transmit uncompressed digital video signals optimized for display on flat screens or digital recording.
  - » One of the highest standards is the digital video interface (DVI), which is typically reserved for high definition (HD) video cameras.
  - » For full HD, the 1080p format is considered the gold standard.
  - » To provide an optimal image the monitor must match or surpass the horizontal resolution of the video camera (500 lines of resolution for CCD versus 750 lines for 3 CCD cameras).

Instrumentation

Operating telescopes and flexible endoscopes can accommodate flexible instruments (**Figure 7**) through an accessory channel. Both reusable and single-use instruments are available.

- The most commonly used instruments include biopsy forceps and foreign body retrieval forceps.
- A variety of instruments are available depending on your practice's needs, including cytology brushes, stone retrieval baskets, injection/aspiration needles, and coagulating electrodes.

To protect the accessory channel:

- Avoid passing the instrument through a deflected tip.
- Never force an instrument when resistance is met.
- Ensure the instrument diameter does not exceed channel diameter prior to inserting instruments.

ENDOSCOPE HANDLING

Endoscopes are designed to be held in the operator's left hand (**Figure 8**).

- Use the **index finger of the left hand to control the suction valve** and the **middle finger to control the insufflation/irrigation valve**.
- The insufflation valve is triggered by placing your finger over the valve without depressing it; irrigation is initiated when the valve is depressed.
- If possible, use your **thumb to control the deflection knobs**.

Individuals with smaller hands may need their right hand to control the outer knob.
  - » The larger, inner knob deflects the scope upwards and downwards.
  - » The outer, smaller knob deflects left and right.
- Ideally, operators control the insertion tube, near the patient's mouth, with their **right hand**.

Navigation skills and insertion tube manipulation are best learned with repetition and practice. Two-day courses that incorporate lecture hours and wet lab experience are preferred for training.

IN SUMMARY

A variety of endoscopy equipment is available based on your practice's needs. Purchasing a versatile scope, undergoing appropriate training, and educating your clients are key to implementing a successful endoscopy program. ■

CCD = charge-coupled device; FOV = field of view; GI = gastrointestinal

Suggested Reading

Chamness CJ. Endoscopic instrumentation and documentation for flexible and rigid endoscopy. In Tams TR, Rawlings CA (eds): *Small Animal Endoscopy*, 3rd ed. St. Louis: Mosby, 2011, pp 3-26.

Denovo RC. Selecting a gastrointestinal endoscope. In Bonagura (ed): *Kirk's Current Veterinary Therapy*, 12th ed. Philadelphia: Saunders, 1995, pp 664-668.

Matz ME, Twedt DC. Endoscopic procedures for evaluation of the gastrointestinal tract. In Ettinger SJ, Feldman EC (eds): *Textbook of Veterinary Internal Medicine*, 7th ed. Philadelphia: Saunders, 2010, pp 443-446.

Tams TR. Gastrointestinal endoscopy: Instrumentation, handling technique, training, and implementation in practice. In Tams TR, Rawlings CA (eds): *Small Animal Endoscopy*, 3rd ed. St. Louis: Mosby, 2011, pp 27-40.

Van Lue SJ, Van Lue AP. Equipment and instrumentation in veterinary endoscopy. *Vet Clin North Am Small Anim Pract* 2009; 39:817-837.

Julie Callahan Clark, *DVM, Diplomate ACVIM, is a lecturer in small animal internal medicine at University of Pennsylvania's School of Veterinary Medicine. Her clinical interests include small animal gastroenterology and feline medicine and she spends the majority of her time seeing small animal patients as well as lecturing at the veterinary school and conducting clinical research. Dr. Callahan Clark received her DVM from Tufts University; then completed an internship at New England Animal Medical Center in West Bridgewater, Massachusetts, followed by a residency in internal medicine at University of Pennsylvania.*