Endoscopy has been used in avian medicine since the 1970s, primarily for determining gender in birds that are not sexually dimorphic. With the advent of acceptable inhalation anesthetics, the safety of this procedure has increased while the stress to the patient has decreased. Unless otherwise noted, the descriptions in this chapter are of psittacine patients and related procedures using rigid endoscopes (Fig 24.1).

Endoscopes are fiberoptic probes that utilize magnification to facilitate visual inspection of internal body structures. Endoscopy can complement imaging modalities such as radiography and ultrasonography. Direct visualization of internal structures by the endoscope affords numerous advantages as a diagnostic tool (Tables 24.1-24.4). There are instances where the use of a semi-rigid or a flexible endoscope is advantageous. Rigid endoscopes are available in a variety of viewing angles (Figs 24.3a-b).

While most endoscopic procedures are minimally invasive, they do require anesthesia for restraint and pain management. Endoscopic visualization performed by an experienced practitioner carries minimal risk. However, the risk increases when more invasive procedures (biopsy, surgery) are performed (Table 24.5). In order to minimize the risk to the patient and maximize the diagnostic information, the practitioner should become proficient with endoscopic location and visualization of internal structures. Cadavers are excellent training tools, as they allow immediate comparison between what is visualized endoscopically and the actual organs or gross necropsy (see Chapter 26, Diagnostic Value of Necropsy).
Table 24.1 | Characteristics of Endoscopes
(see Figs 24.1, 24.2a-c)

<table>
<thead>
<tr>
<th>Endoscopes</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rigid</td>
<td>• Best choice for primary scope&lt;br&gt;• 2.7 mm diameter, 30° viewing angle, 19 cm length recommended&lt;br&gt;• 1.9 mm diameter provides acceptable imaging for most patients and procedures&lt;br&gt;• 4.0 mm provides best imaging but is too large for some avian patients&lt;br&gt;• Quality varies between manufacturers (Fig 24.1)</td>
</tr>
<tr>
<td>Flexible</td>
<td>• Recommended for a second scope&lt;br&gt;• Preferred for evaluating proventriculus, ventriculus and oviduct&lt;br&gt;• 3 mm diameter is most useful, has three ports to accommodate the lens, fiberoptic light bundle, instruments&lt;br&gt;• Quality differs between manufacturers (Figs 24.2a-c)</td>
</tr>
<tr>
<td>Semi-rigid*</td>
<td>• 1.2 mm diameter ideal for small patients, small orifices&lt;br&gt;• See Chapter 1, Clinical Practice, Fig 1.13</td>
</tr>
</tbody>
</table>

Note: Diameters of scopes do not include sheaths and their working channels.

Table 24.2 | Light Sources

<table>
<thead>
<tr>
<th>Light source</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halogen: xenon</td>
<td>• Gives the most light</td>
</tr>
<tr>
<td>Computed flash generator</td>
<td>• Necessary for 35-mm slide documentation</td>
</tr>
<tr>
<td>Light cable</td>
<td>• Must be compatible with the light source</td>
</tr>
<tr>
<td>Otoscope handle</td>
<td>• Portable scopes are available that attach to otoscopes&lt;br&gt;• Less expensive, most provide adequate illumination</td>
</tr>
</tbody>
</table>

Table 24.3 | Lenses for Rigid Endoscopes

<table>
<thead>
<tr>
<th>Lens</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single lens</td>
<td>Lower-quality image&lt;br&gt;Less expensive</td>
</tr>
<tr>
<td>Rod lens</td>
<td>Best-quality image&lt;br&gt;More expensive</td>
</tr>
</tbody>
</table>

Table 24.4 | Viewing Angles for Rigid Endoscopes
(see Fig 24.3a-e)

<table>
<thead>
<tr>
<th>Angle</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°</td>
<td>• Natural straightforward orientation&lt;br&gt;• Good for examination of the ear canal, oral cavity, crop, trachea&lt;br&gt;• Superior for photodocumentation</td>
</tr>
<tr>
<td>30°</td>
<td>• Forward oblique angle&lt;br&gt;• Allows visualization of a larger area by rotating the scope</td>
</tr>
</tbody>
</table>

Table 24.5 | Surgical Equipment Used during Endoscopy

- Small, curved mosquito hemostats<br>- Tissue-handling forceps<br>- Scalpel, #15 blade<br>- Needle holder<br>- Small scissors<br>- Suture

Fig 24.1 | Rigid endoscopes most commonly used in avian endoscopy. Top to bottom: 1.9 mm 0°, 2.7 mm 30°, 4 mm 0°.

Fig 24.2a | A flexible endoscope allows more maneuverability in viewing lungs and the gastrointestinal system.

Fig 24.2b | The 3-mm measurement of a small, flexible endoscope.

Fig 24.2c | The fiberoptic bundle (a) for light and visualization, the air or flushing port (b), and an instrument port (c) of a 3-mm flexible endoscope.
Most of the body can be examined using endoscopy. Apart from the visual assessment, tissue sampling is possible using the working channel and biopsy tools (Table 24.6). A sterile sheath is particularly valuable for microbiological sampling (especially of the deeper respiratory system). The sheath prevents contamination of the sample.

New surgical procedures using multiple endoscopes, multiple sites and radical new instruments are being developed (Fig 24.4). The use of a flexible needle can have multiple applications (Figs 24.5a,b).

**Preparation and Contraindications**

Duration of pre-endoscopic fasting will parallel that of presurgical fasting for similar procedures. Longer fasts may be required to facilitate visualization of abdominal organs. General anesthetic techniques and requirements are discussed in Chapter 33, Updates in Anesthesia and Monitoring.

Birds with bleeding dyscrasias are at heightened surgical risk, especially when an organ biopsy is performed. The
presence of cystic structures within the coelom, organomegaly or the presence of any fluid will complicate the procedure and increase the risk to the patient. Fluid should be carefully drained or reduced with diuretics prior to endoscopy. Obesity often reduces the view in the body cavity, increasing the risk of organ damage.

**Coelomic Laparoscopy Studies**

**LEFT LATERAL APPROACH**

The endoscopic approach to the coelomic cavity depends on the diagnostic goal of the procedure (Fig 24.6) and the results of previous imaging studies. The approach caudal to the last rib is ideal for exploration of the entire coelom (Fig 24.7). Due to the presence of an ovary in most avian species on only the left side, approach from the left is generally utilized to allow visualization of female reproductive structures (see the section on gonads later in this chapter). The anesthetized bird is placed on its right side, with the left wing extended dorso cranially. The left leg may be pulled either cranially or caudally. The following description is for the approach with the leg extended caudally (Fig 24.8).

Orientation to the surgical site is provided in Figs 24.9-24.11. A small incision is made in the skin, followed by a caudal reflection of the muscle layers with curved forceps. Penetration into the air sac is accompanied by a palpable and sometimes audible pop. The use of blunt instruments for this penetration cannot be overemphasized. Sharp instruments may damage underlying tissue. The caudal thoracic air sac is most often penetrated, however, the abdominal or cranial thoracic air sacs also may be entered (Figs 24.12a,b). Some clinicians prefer to enter between the ribs. This is best accomplished by using a curved mosquito hemostat to elevate the ribs prior to penetration. However, using this technique the intercostal muscle is damaged, which is a disadvantage. The direction of penetration should be toward the cranial rib (remaining laterally positioned) to avoid the liver. The scope is stabilized with the tips of the forefinger and thumb while the hand rests on the table (Fig 24.13).

The scope is advanced between the legs of the forceps. The air sacs will then be visible. Clear air sacs allow visualization of the gonad, the adrenal gland, and the cranial division of the kidney, through the abdominal air sac (Fig 24.14). Cranial to this triad is the left lung. In larger birds, the scope may be advanced through the ostium between the lung and air sac to examine the bronchi (Figs 24.15-24.17). The medial lung, heart and liver can be seen as the scope advances cranially into the cranial thoracic air sac.

The ureter, uterus, and ductus deferens are seen ventral to the kidney, and intestinal loops come into view if the scope is directed ventrally from the original entry site. The proventriculus/ventriculus, liver and often the spleen may be visualized when the scope is directed cranioventrally. The punctured air sacs close rapidly and heal uneventfully. The skin incision can be closed with sutures or tissue glue.

A similar approach to the coelom is made by entering caudal to the pelvic limb, which is pulled cranially. The incision is made caudal to the last rib. With this approach, there is less chance of entering the cranial thoracic air sac.
Fig 24.6 | The various endoscopic entry sites overlying the artist’s rendition of bones with colored areas representing the various air sacs encountered in endoscopy. Blue represents the intraclavicular, yellow the cranial thoracic, green the caudal thoracic and orange the abdominal air sacs.

Fig 24.7 | An artist’s rendition of the organs encountered in endoscopy from the left lateral aspect. 1) heart 2) liver 3) trachea and lungs 4) proventriculus 5) ventriculus 6) intestines 7) kidney 8) spleen 9) adrenal-gonad area. The red star is a typical entry location.

Fig 24.8 | Right lateral recumbency, left leg caudal. This bird is malpositioned; not being in a true lateral, which is critical for organ relationships. Secondly, it can be seen that in this blue crowned conure the area in front of the leg has a thick fat pad (arrow) that has to be penetrated to reach the musculature.

Fig 24.9 | The middle of a triangle formed by the spine (1), m. iliotibialis (2) and last rib (3); the red arrow represents the most common lateral point of entry for laparoscopy.
Fig 24.10 | The muscle iliotibialis (a) overlies the point of entry, demonstrated on a dead bird with skin removed.

Fig 24.11 | Using a curved forceps, the m. iliotibialis (a) is reflected caudally and the underlying fascia is penetrated caudal to the last rib (b), as is demonstrated here on a dead bird with skin removed.

Figs 24.12a,b | Entering the body cavity caudal to the last rib usually places the scope into the caudal thoracic air sac (b). Changing the route of penetration slightly, the scope is guided into the abdominal air sac (c) where the kidney (a) is located. One must penetrate the confluent wall of the medial aspect of the caudal thoracic air sac and the left lateral wall of the abdominal air sac.

Fig 24.13 | Correct anchoring of the tip of the scope. The hand should always be in contact with the bird while the wrist is rested on the table.

Fig 24.14 | View into the abdominal air sac. Kidney (a), ovary (b), intestine (c), adrenal gland (d), ureter and oviduct (e).
VENTRAL MIDLINE APPROACH

The bird is positioned in dorsal recumbency and a ventral midline approach to the coelom is made. A layer of fat may be present just under the linea alba in the area directly caudal to the sternum. Care must be taken on smaller birds not to inadvertently penetrate the duodenum or pancreas. The duodenum, pancreas and central liver can be examined from this approach.

Air Sacs

Normally the air sacs are transparent, although a few vessels may be present (Fig 24.18). Fatty infiltrates may be noted during routine examination without associated pathology. Opacity and small vessels in the wall of an air sac are early signs of inflammation (Fig 24.19). Other abnormalities of the air sacs include increased vascular-ity, thickened walls and granulomas (Fig 24.20). These changes may be due to infectious processes, or to inhalation of respiratory irritants (ie, smoke, volatile chemicals). In some cases, a definitive diagnosis can be made from visualization, cytology and/or biopsy of air sac lesions (Figs 24.21a-c). Removal or debulking such lesions has been described using laser and radiosurgery via the endoscope.

Lungs and Bronchi

The lungs are dark pink with a prominent reticular pattern. Within the lungs, the anastamosing bronchi are visible (see Figs 24.16, 24.17). Pneumonia will obscure the normally well-defined parenchymal pattern of the lung. A yellow discoloration of the lung tissue is often noted with pneumonia (Fig 24.22). Anthracosis (focal black
**Fig 24.19** | Prominent vessels in the air sac, opacity or small granulomas are signs of infections and/or irritation from environmental contaminants (smoke, volatile chemicals).

**Fig 24.20** | Granulomas are forming in this case of air sacculitis.

**Fig 24.21a** | Fruiting aspergilloma in the air sac. This presentation carries a guarded prognosis.

**Fig 24.21b** | Active aspergilloma in an air sac with fluid exudate.

**Fig 24.21c** | Removal of an old aspergilloma using a biopsy forceps.

**Fig 24.22** | Internal lung tissue of a bird with dyspnea, viewed from the caudal thoracic air sac. Yellow areas and the loss of the typical lung parenchyma are signs of pneumonia. A biopsy to aid in specific diagnosis and treatment is highly recommended. The black spots are soot (anthracosis) and can be found in birds from smokers or cities.
spots) is regularly found in birds from cities, industrial areas or the homes of smokers (Fig 24.22). Bleeding from trauma can be diagnosed by endoscopic examination (Fig 24.23).

**Proventriculus, Ventriculus — Serosal Examination**

The proventriculus is an elongated, usually white organ located in the ventral coelom, surrounded by the abdominal air sac and the liver. The surface appearance and size of the proventriculus are diagnostically important. An enlarged proventriculus with a glossy surface might indicate proventricular dilatation disease (PDD). Focal bleeding may indicate foreign bodies or infections. The ventriculus cannot always be visualized. In birds with a muscular ventriculus, abnormalities are seldom discernible endoscopically (see Chapter 26, Diagnostic Value of Necropsy).

**Liver**

The liver is a large organ of uniform brownish red color. The liver border tapers to an edge (Fig 24.24). A rounded liver border is not normal and may indicate infection or hepatic lipidosis (Fig 24.25). The liver color changes to yellow with fatty liver. Focal bleeding in the liver appears bright red, while hemosiderosis appears dark red that over time can turn black in color (Fig 24.26). Multiple white foci represent necrosis, abscesses or neoplasia (Figs 24.27, 24.28). Pseudomembranous infiltrates of the liver capsule and air sacs may also be due to infection, inflammation or neoplasia (Fig 24.29). Liver biopsies offer very valuable diagnostic information (see Chapter 15, Evaluating and Treating the Liver).

**Heart and Pericardium**

The lateral approach through the caudal thoracic air sac into the cranial thoracic air sac allows the visualization of the heart and pericardium. Pericardial effusions can be drained utilizing this approach. The normal pericardium is transparent (Fig 24.30a). A milky pericardium is the result of pericarditis. The presence of fat at the heart...
base and heart apex is normal. An absence of fat is a sign of starvation or chronic disease. The main heart vessels are visible at the heart base as thick white tubes with regular pulses (Fig 24.30b). The cardiac nerve supply can be found emanating from the thoracic vertebrae.

**Kidney**

The avian kidney is divided into three divisions. The adrenal gland and gonad are present at the cranial pole of the kidney (Fig 24.31). The ureter can be seen and, in most cases, traced to the cloaca. The kidney is brown-red-orange. Star-shaped collecting tubules filled with urates are often visible on the surface. These structures become hidden in swollen kidneys (Fig 24.32). Yellow to white deposits on the surface of the kidney are often uric acid crystals and may indicate renal gout (Fig 24.33). These foci might occur due to dehydration as well. After rehydration the foci are eliminated, while in the case of gout the foci are still present. Obesity can make the kidney appear diffusely yellow. Abscesses or cysts may appear as large yellow spots (Figs 24.34, 24.35). Neoplasias or other gross abnormalities should be biopsied; assuming that the patient’s condition is sufficiently stable (see Chapter 16, Evaluating and Treating the Kidneys).
Fig 24.31 | Kidney (a), adrenal gland (b) and testicle (c). Apart from the clearly visible testicles, the absence of a ligament crossing the cranial pole of the kidney represents a male bird. The lumpy nature of the kidney surface is normal for swans.

Fig 24.32 | A swollen kidney as seen in acute nephritis. Note the lack of predominate stellate vasculature pattern associated with the renal glomeruli.

Fig 24.33 | Uric acid deposits within the kidney. If this situation remains after several applications of intravenous fluids, renal gout is likely.

Fig 24.34 | Renal cyst. Abscess or neoplasia are possible differential diagnoses.

Fig 24.35 | Apart from the color changes of this kidney (K), multiple yellow foci are visible. The typical renal structure is no longer detectable. Histological examination of a renal biopsy showed a pyelonephritis. The ovary (O) has many involuted follicles.

**Gonads**

The left lateral approach is best for viewing gonads because hens generally lack a right ovary. Right ovaries may be present in juvenile birds, especially in accipiters. Gonads are present ventral to the cranial poles of the kidneys.

DNA methods are available for sexing most monomorphic avian species and are less invasive than surgically sexing. Endoscopic sexing has the advantage of allowing direct visualization and evaluation of the gonads and other organs. Sexual function can be estimated and any damage from sterilization or castration can be observed. The normal appearance of the gonads varies between species. The right side should be examined if the gonads are not clearly observed or discernible as to either ovary or testes, or if presumed abnormalities are present. Gonads increase in size during sexual activity (Figs 24.36-24.38). Gonads can be small due to stress, malnutrition,
Fig 24.36 | In juvenile birds, the rudimentary ovary on the right side still might be visible, sometimes showing single follicles (arrow). The normal left ovary is at the 9-11 position.

Fig 24.37 | Secondary or tertiary follicles dramatically increase in size during the reproduction cycle. Pathological alterations such as inflammation or neoplasias might lead to similar findings. A detailed anamnesis indicating sexual display behavior may indicate an active ovary. If a large follicle is very close to the tip of the endoscope, the follicle can be easily confused with a testicle.

Fig 24.38 | A cluster of follicles makes identification of the ovary (a) easy. More important is the detection of the suspensory ligament (b) of the ovary. It crosses the cranial pole of the kidney. Apart from sexing, evaluation of the ligament is important to judge the possible breeding performance of the bird. Adrenal gland (c).

Fig 24.39 | In juvenile birds, the ovary (a) might be difficult to detect. Only the suspensory ligament (c) at the cranial pole of the kidney (e) characterizes the female bird. Lung (d), adrenal (b). Small ovarian follicles are not an accurate estimation of age or reproductive ability.

Female Birds

The *ligamentum dorsale oviductus* (suspensory ligament) from the ovary crosses the cranial pole of the kidney coursing toward the uterus (Fig 24.38). Lacking visualization of a well-defined gonad, this ligament is the main evidence for sexing the bird as a female. The ovaries can be difficult to detect in juvenile birds (Fig 24.39). When examining breeding birds this ligament must be carefully assessed. In cases where this ligament is damaged or absent, the breeding performance of the bird is questionable (Fig 24.40). If this ligament is cut in juvenile birds, they will not lay eggs. A large uterus may indicate previous egg laying or pathology. Inactive ovaries may be flat with a cobblestone appearance, while active ovaries may appear as a cluster of spheres. The size and number of visible follicles will vary with the age and reproductive status of the hen. Immature ovaries are sometimes difficult to distinguish from testicles. The ovary is generally an off-white, yellowish color, but pigmentation (usually black) occurs in some species (Fig 24.41). In addition, the entire uterus should be evaluated.

Male Birds

In male birds there is no *ligamentum dorsale oviductus*...
Chapter 24 | \textit{Diagnostic Value of Endoscopy and Biopsy}

Fig 24.40 | The ovary (O) is clearly visible and the suspensory ligament is missing. This bird cannot be recommended for breeding. The kidney (K) has just been biopsied (arrow).

Fig 24.41 | Some avian species have melanistic gonads, as is seen in this ovary.

Fig 24.42a | The testes (1) is at the cranial pole of the kidney (2) and close to the adrenal gland (3).

Fig 24.42b | Both paired testes are pictured here. With increased size of the left testicle or opacity of air sacs, the right testicle may be obscured from view.

(Figs 24.42a,b). The paired testicles are normally oval shaped with one to three faint vessels crossing the surface. In birds with clear air sacs, both the left and right testicles may be visualized from the left lateral approach. In some species the testicles are pigmented (eg, Cacatua, some macaws and wading birds). The tortuous course of the ductus deferens makes it distinguishable from the ureter (Fig 24.43). The size of the testicles, epididymides and ductus deferens vary with the species, size, age and breeding condition of the individual bird (Fig 24.44). The breeding potential of a male bird normally cannot be assessed by visual observation of the male anatomy. If a reproductive problem is suspected, a testicular biopsy is suggested (Fig 24.45).

Adrenal Gland

Adrenal glands vary in color, size and shape (see Fig 24.42a). They may be confused with immature or inactive gonads. If the gonads are well-developed, the adrenal glands may be obscured. The adrenal glands are usually located immediately cranial to the gonads. Changes in size or increased vascularity of the adrenal glands may indicate stress or disease (Fig 24.46).

Intestine

Visible pathologic changes of the intestinal serosal surface are uncommon. Coelomic filarial worms are a rare finding in captive bred psittacines, but are regularly seen in birds of prey (Figs 24.47, 24.48). The intestine has a smooth surface covered with many vessels. The generally redish-gray color varies according to the intestinal fluid. White foci may be a sign of previous penetration by endoparasites. Both thinning and thickening of the intestinal wall are signs of enteritis. Thinning can be appreciated endoscopically from the visibility of intestinal contents. Necrosis of the intestine wall might be visible in cases of clostridiosis or coccidiosis. Enlarged ceca filled with caseous yellow material could indicate histomoniasis.
Pancreas

The pancreas lies within the duodenal loop (Fig 24.49). The pancreas is a white-yellow color with a homogeneous matrix. Color changes, glassy appearance or an uneven surface often accompany pathologies and may warrant biopsy (see Chapter 26, Diagnostic Value of Necropsy).

Spleen

Psittacine spleens are round, purplish and often speckled (Fig 24.50). The spleen is located at the dorsal aspect of the proventricular/ventricular junction on the right side from a lateral approach. Splenomegaly (immune response), yellow appearance (fatty spleen) and multiple white foci (necrosis) are possible pathological alterations (Figs 24.51, 24.52). Chlamydiophilosis and other bacterial diseases would be included in the differential. The spleen can be biopsied utilizing the same precautions as in mammals.

Tracheoscopy Studies

TRACHEA AND THYROID GLAND

The trachea and thyroid gland can be approached via the cervical branch of the cervicocephalic air sac, the clavicular air sac or through the coelomic cavity. The thyroid gland is visible as an elliptical pink structure attached to the trachea near the syrinx (Fig 24.53). Alterations in size or a shiny appearance are considered abnormal and a biopsy may be indicated.

ENDO-TRACHEAL EXAMINATION

Endoscopic examination of the tracheal lumen is accomplished by extending the patient’s neck and gently advancing the scope through the larynx and down the trachea (Fig 24.54). Unless the procedure is very rapid, an air sac breathing tube is necessary (see Chapter 33, Updates in Anesthesia and Monitoring). Many endoscopes are equipped with a protective sheath. Removal
Fig 24.47 | *Serratospiculum* sp. in the air sac in a falcon.

Fig 24.48 | The same bird as Fig 24.47 12 days after treatment with ivermectin. The dead worm can easily be confused with a bacterial infection.

Fig 24.49 | The pancreas (P) identified in the duodenal loop (D). The pancreas should have a homogeneous structure and color.

Fig 24.50 | Using the left lateral approach, the spleen (a) is accessible from the abdominal air sac by pushing the proventriculus in the caudal-ventral direction to expose the right side of the proventriculus. The psittacine spleen is round and similar in color (red-brown) to the kidney and liver. Intestine (b).

Fig 24.51 | Enlarged spleen of a bird with psittacosis.

Fig 24.52 | Pale color changes and enlargement of a spleen.
Performing a tracheobronchoscopy. The neck of the bird must be fully extended. A beak speculum allows a better view and is safer for the scope in case the bird wakes up and attempts to bite the instrument. Anesthesia can be delivered via an air sac tube.

The thyroid gland on the carotid artery adjacent to the trachea as seen from the interclavicular air sac. A laparoscopic approach may be used by pushing the scope cranial, passing over the heart ventrally and following the trachea (a). The thyroid gland (b) can be visualized.

The thyroid gland on the carotid artery adjacent to the trachea as seen from the interclavicular air sac. A laparoscopic approach may be used by pushing the scope cranial, passing over the heart ventrally and following the trachea (a). The thyroid gland (b) can be visualized.

Normal trachea.

A case of severe tracheitis. The tracheal rings appear distorted due to the mucosal swelling, sloughing and hemorrhage.

of this sheath will decrease the scope’s diameter and enable its introduction into the trachea of smaller birds. Unfortunately, this also increases the chance for damage to the endoscope. An unsheathed 1.2-mm scope can allow visualization of the trachea of birds the size of canaries and finches (Fig 24.58). Without the sheath, the tracheal lumen can be examined, but no instruments can be introduced into the visual field in such a small patient. Evaluation should be made of the tracheal color, and mucosal texture. The mucosa of the trachea and the bronchi are light pink and glistening. The tracheal rings are clearly visible (Fig 24.55a). In cases of tracheitis, the mucosa becomes red and swollen, making the rings less obvious (Fig 24.55b). Tracheal exudates, when present, should be collected for cytology and culture. Possible abnormalities of the trachea include strictures, tumors, inflammation, parasites, fungal granulomas and foreign bodies (Figs 24.56, 24.57). The tracheal diameter typically decreases toward the syrinx. The narrowed diameter and the tracheal bifurcation into the main stem bronchi make this area particularly prone to fungal granulomas and foreign bodies. Some degree of post-examination hyperemia of the trachea is normal.

Acute dyspnea warrants endoscopic tracheal examination once the patient is stabilized. Hemorrhage of the tracheal mucosa may be seen with polytetrafluoroethylene toxicosis. More pronounced pathology would be expected in the lung parenchyma with this condition.

Respiratory parasites often can be visualized with the endoscope (Figs 24.57, 24.59). If mites are suspected and not visualized, swabbing the scope onto a sterile slide and examining the slide microscopically may reveal tracheal mites.
Pharyngoscopy and Upper GI Studies

**OROPHARYNX**

Sufficient anesthesia or restraint is necessary to prevent damage to the endoscope by the bird’s beak. In addition, the use of a beak speculum is advantageous. While under anesthesia, the bird is held in a ventral recumbency position and the neck is fully extended (Fig 24.61). This position allows endoscopic examination of the inner surface of the beak, oral cavity, choana, rhinal cavity, tongue and larynx. The shape of the tongue differs from species to species. The infundibular cleft should be free of swelling and debris. Check the entire oral cavity for signs of pathology (Table 24.7).

**RHINAL CAVITY**

The rhinal cavity can be entered from the choana and the turbinates examined. The operculum prevents the passage of a scope through the nares. The points used to perform an infraorbital flushing technique also can be entered endoscopically.

**ESOPHAGUS, CROP, PROVENTRICULUS, VENTRICULUS – MUCOSAL EXAMINATION**

Examination of the esophagus, crop and proventriculus via the oral cavity is a common procedure (Fig 24.62). As the esophagus, crop (Fig 24.63) and proventriculus are hollow organs, insufflation is necessary for visualization.

**Table 24.7 | Common Oral Pathology in Psittacines**

- Squamous metaplasia
- Keratinized debris
- Blunting of choanal papillae
- Plaques
- Fungal or yeast colonization
- Parasites: trichomonads
- Bacterial infection
- Oral papillomas: most common in Ara spp.
- Oral neoplasias: fibrosarcoma, squamous cell carcinoma
- Trauma
- Ulcerations
Prior to gastroscopy, a fasting period is important to allow maximum viewing without the presence of food. Insufflation with air or sterile fluids is commonly used for positioning and advancement of the endoscope.

Sterile fluids allow the flushing out of debris and subsequent dilation of the GI tract. This greatly aids in visualization. It is important that the fluid be warm to the touch to avoid decreasing the body temperature of the bird. A working channel is necessary to aim the washing solution. This working channel should have two taps, one for fluids in and one for fluids out (see Fig 24.60). The third port is ideal to allow simultaneous passage of a biopsy or grasping forceps. The fluid inlet is attached to an infusion bag or bottle positioned at a higher elevation. A larger infusion tube is connected to the fluid outlet leading to a collecting container. The two taps allow accurate control of the amount of fluid within the digestive system, expanding the organs as needed for examination. The fluid outlet is closed and the selected portion of the GI tract is dilated until good visualization of the mucosa is achieved. The fluid outlet is then opened in order to flush out mucus and small particles. Opening the fluid inlet again can increase the pressure. To avoid aspiration, fluid should not be allowed to exit the digestive tract through the oral cavity, which could and often does lead to the contents being inhaled. Occlusion of the scope and esophagus to retain the infused air or fluid in the crop can be easily accomplished by placement of digital pressure on the scope and esophagus. Although the tracheal rings are solid in birds, caution
should be used to prevent restriction of normal airflow. In addition, the bird should be positioned in ventral recumbency with the head lower than the body. An endotracheal tube should be in place (Fig 24.61).

The mucosal surfaces of the esophagus and the crop vary between species. The mucous membranes of the esophagus, crop and proventriculus are a homogeneous pink (Fig 24.62). The mucosa of the esophagus is usually smooth; the crop has furrows and the proventriculus papillae (Fig 24.63). Focal dark red or bleeding areas are signs of irritation, which can be due to foreign bodies, infections, ulcerations, or neoplasia. A yellow coating of the mucosa can be seen with trichomoniasis, candidiasis, the diphtheric form of avian pox or vitamin A deficiency or excess. If there is a loss of the proventricular mucous membrane’s normal color it might be a sign of a wall suggesting PDD. Biopsy of the proventriculus or the crop and submission for histopathology may confirm a suspected diagnosis of PDD. However the significant risk of dehiscence must be considered prior to obtaining a proventricular biopsy. To evaluate the proventriculus in larger psittacines, it may be necessary to introduce the scope through an ingluviotomy incision. A preferred location for this incision is to the left and somewhat dorsally, to avoid postoperative pressure on the crop incision from ingesta. An area of reduced vascularity is ideal. The scope is introduced and advanced carefully into the thoracic esophagus, continuing caudally to the proventricular lumen. This procedure is useful for proventricular biopsies and retrieval of foreign bodies. A flexible scope is mandatory to evaluate a fragile proventriculus (eg, normal lories, large macaws and all cases of PDD) or all ventriculi.

**Cloacoscopy Studies**

**CLOACA**

The endoscope simplifies cloacal examination. Insufflation is necessary for viewing to maintain an adequate distance between the scope and tissues under examination. A soft rubber feeding tube may be used, with digital pressure applied around the scope barrel to retain the air or fluid.

When performing a cloacoscopy, the bird is placed in dorsal recumbency and the endoscope is inserted with its working channel. Insufflation is usually done using fluid (see description at Esophagus, Crop, Proventriculus, Ventriculus - Mucosal Examination, above). Feces and urine are almost always present and should be washed out for optimal visualization. The mucosal surface is pink with ureteral papillae (Fig 24.64). Urine can be seen emanating from these ostia of the ureters (Fig 24.65). Hyperemic cloacal membranes are indicative of inflammation or infections. Rough and red raised areas (cauliflower shape) are suggestive of papillomatosis. Inside the cloaca, the openings of the ureters, the rectum and, in female birds, the uterus can be viewed. The oviduct can sometimes be entered and the caudal chambers investigated. The occurrence of fresh blood within the feces is a clinical indication for cloacoscopy, as it may originate from the cloaca, the intestine, the ureters or the uterus.

**Otoscopy Studies**

**EAR**

In most species, feathers conceal the opening of the ear canal. The external orifice can vary from <2 mm in small
species and up to 6 cm in some large raptors. The normal tympanic membrane is clear and slightly convex. Otitis externa is not a common finding in psittacines, but bacterial, fungal, neoplastic and allergic conditions may occur. In raptors, common findings are bleeding into the ear canal from head trauma.

**Nerve Studies**

The nerves of the brachial plexus are seen anterior and lateral to the heart (Fig 24.66a) The sacral plexus sometimes visible dorsal to the kidney (see Fig 24.66b).

*Ed Note: Harrison has used endoscopy to evaluate nerve damage. Muscles, nerves, vessels, tendons and ligaments can be examined using the endoscope. In cases of trauma, air or fluids can be injected subcutaneously to provide a path for the scope to follow anatomical structures into the area of trauma. This technique could be useful to investigate brachial plexus evulsion, nerve transection, thrombi, emboli, and traumatic damage to soft tissue.*

**Endoscopic-guided Biopsies**

Coordinating the endoscope and the biopsy instrument can be challenging. The advent of sheaths that are now provided with many endoscopes has simplified this procedure by allowing the biopsy forceps to approach the site without changing the field of vision. The small size of the biopsy forceps used for these procedures usually precludes serious hemorrhage. Endoscopic-guided biopsies allow sampling of organs under direct visualization (Fig 24.67). In general, biopsies of the lung, air sac, liver, kidney, spleen, gonads, proventriculus, ventriculus, thyroid gland and mucosal membranes of esophagus, crop and cloaca are possible using a biopsy forceps within a working channel. Aspiration biopsies are possible using a long, flexible needle with a Teflon cover (see Table 24.6). Puncture of cysts, bone marrow biopsies or lavage sampling are the ideal uses for this needle. In case of a general alteration of an organ, the biopsy should be taken from the organ’s border (Fig 24.68). Contraindications of...
biopsies are similar to those mentioned for endoscopy. Endoscopic procedures, in particular tissue biopsies, lead to changes in certain blood values; therefore, planned blood sampling must be performed before endoscopy.

**Endoscopic-guided Surgical Procedures**

Endoscopic-guided sterilization or castration is possible. This might be indicated in chronic egg laying or birds that are aggressive during breeding season. As castration is quite complex, sterilization represents a quick and easy procedure, as the gonads need not be removed. This can be accomplished using electrosurgery with a bipolar endoscopic forceps (Figs 24.69a,b). Performing this procedure when the bird is sexually inactive reduces the risk of hemorrhage. (Sterilization may hormonally influence behaviors). In juvenile or hormonally inactive females the challenge one is faced with is making the
distinction between the ureter and the quiescent oviduct. The ureter is marked by urates, or its regularly occurring contractions (Fig 24.70). Administering intravenous fluids will increase the likelihood of seeing urates pass down the ureter.

Endoscopic-guided obliteration of air sac granulomas or papillomas in the cloaca is possible. Endoscopic-guided laser diodes have been used to obliterate granulomas within the trachea or air sac. Multiple-entry endoscopic surgery has been developed for resection of tumors or castrations (Fig 24.71). Instruments are guided into the endoscopic field of vision using trocars. Laser or radio-surgery is helpful to maintain hemostasis.

Complication During and After Endoscopy

Hemorrhage is the main complication arising from endoscopy. The kidney can be damaged during penetration of the air sac at the beginning of the laparoscopy. Perforations of the proventriculus may result in fatal peritonitis. If major bleeding occurs, electrocoagulation, oxidized regenerated cellulose or sterile sticks of cotton wool can be used. The bird should be placed at a 45° angle with the head elevated to prevent blood from entering the lungs. This keeps the blood in the caudal air sacs. If a large entry site has been created, the site may need deep sutures to close the muscles and prevent subcutaneous emphysema. Postsurgical closure of air sac defects is usually not necessary. If emphysema occurs, it should be punctured and deflated regularly until these defects close themselves. When performing endoscopy on multiple subjects sufficient sterilization time for the equipment is imperative to avoid transmission of disease.

Product Mentioned in the Text

b. 22-gauge aspiration needle within a teflon tube, Storz, www.karlstorzvet.com

References and Recommended Reading