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Avian Coelioscopy

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Introduction

Avian veterinarians have been performing endoscopic assessments of the avian reproductive tract for many years, and despite the advent of DNA probes for sex identification of many species, clinicians involved with breeders, wholesalers, or retailers may still be asked to perform "surgical sexing". The ability to exploit the airsac system of birds enables the endoscopist to visualize most, if not all, of the major organs of clinical interest including liver, lung, airsac, heart, kidney, adrenal, spleen, pancreas, reproductive and intestinal tracts. This review has been written with the general practitioner in mind, and only the most commonly employed avian techniques have been described. For more detailed descriptions the reader should consult the references (Lierz, 2006; Divers 2010, 2011).

Instrumentation

Given the variation in size, species-specific anatomy, and variety of procedures that may be performed, a selection of different endoscopes and instruments may be required. However, when dealing with most companion birds, the 2.7 mm system offers flexibility and diagnostic power for an affordable investment (Table 1).

The 2.7 mm system is most widespread in practice, offers greatest versatility, and can be expanded as individual practice caseload dictates. This system offers several advantages including single-entry procedures, ports for gas or fluid infusion, and an operating channel for the introduction of 1.7 mm (5 Fr) instruments. In addition, the 1.9 mm telescope with integrated sheath, and the 1 mm semi-rigid miniscope are extremely useful for smaller species.

The telescope is connected via a fiber-optic light guide cable to a light source. While halogen light sources are far cheaper and very effective for small animals < 2 kg, xenon light sources provide better quality light and an intensity that can illuminate the body cavities of larger animals.

An endovideo camera connected to the eye-piece of the telescope, although once considered a luxury addition, is an integral part of the endoscopy system and greatly facilitates the surgeon's performance. Cameras, available in both PAL and NTSC formats, can vary dramatically in cost from budget single-chip cameras to 3-chip digital high definition models. However, the fact is that any camera, however cheap, will greatly improve performance compared to using the eye-piece, and will facilitate photo-documentation. The Tele Pack system combines a hybrid xenon light source, endovideo camera, and LCD monitor with digital storage which is well suited for avian endoscopy. Operating room set-up is important and the monitor should be positioned directly in front of the endoscopist, with instruments within easy reach. CO2 insufflation is contraindicated in avian coelioscopy as the endoscopic equipment is positioned within the respiratory system. However, the use of saline infusion can be especially helpful, especially when dealing with a hollow viscus (e.g. gastro-intestinal tract, bladder, cloaca).

The 1.7 mm (5 Fr) grasping forceps are useful for manipulating tissues, debridement and retrieving foreign objects or parasites. The fine aspiration/injection needle can be used for the aspiration of fluid from cystic structures where biopsy may be contraindicated due to post-sampling leakage. The needle can also be used for irrigation, and drug administration. The flexible biopsy forceps are used to harvest tissue samples for histopathology and microbiology. The small sample size usually permits the collection of several biopsies for multiple laboratory tests, and serial biopsies to monitor disease progression over time to assess response to treatment. To take a tissue sample, the biopsy forceps are inserted down the operating channel and into the field of view. It is much easier to advance and manipulate the sheath-telescope-instrument as a single device than to try and keep the sheath-telescope still and independently move the biopsy forceps back and forth. With the biopsy forceps held open, the sheath-telescope-instrument is advanced to the tissue of interest and when tissue enters the biopsy cup, the handle is released. These instruments are delicate and the biopsy handle is only required to open the biopsy jaws. The handle's spring mechanism is usually sufficient to take a soft tissue biopsy without additional manual pressure, as long as the instrument is sharp. Clamping down on the handle will damage the forceps and increase biopsy crush artifact. Some organs may be protected by a more fibrous membrane. The fixed blade of the scissors is inserted at a shallow angle through the membrane, and the sheath-telescope-scissors are advanced as a single unit, cutting the membrane as they proceed. The scissors can then be replaced by the biopsy forceps to take a sample through the capsular incision.

Biopsies are delicate and measure approx 1.3 mm3 in size when collected using a 1.7 mm instrument. Handling and other histological artifacts are reduced by gently dislodging the tissue from the biopsy cups into a small volume of sterile saline, before then decanting into a biopsy cassette, and submitting in 10% neutral buffered formalin. Picking the biopsy out of the instrument using a needle will cause severe damage, and even moistened cotton-tipped applicators have been shown to cause tissue alteration. Biopsies for microbiology are best submitted in sterile saline for immediate processing. Alternatively, if mailing to a laboratory, they should be submitted in appropriate transport media. For the submission of samples for toxicology or parasitology, it is wise to consult with the laboratory prior to sample collection.

Coelioscopy

The general handling techniques used in avian endoscopy are similar to those employed for domesticated animals. However, the fact that most companion birds weigh < 1kg requires careful control with the base of the telescope, eyepiece, and camera supported using the superior hand and the terminal end held by thumb and forefinger of the inferior hand.

There are four basic approaches to the coelom; left, right, ventral, and interclavicular. Physical examination, diagnostic imaging (including radiography and ultrasonography), and clinical pathology should be conducted to identify the most appropriate approach. For example, the spleen is best visualized via a left approach, the psittacine pancreas from the right, and both liver lobes can only be seen from a ventral approach. Most approaches to the avian coelom involve entry into and examination from within the airsacs. Therefore, it is important to keep sheath ports closed to avoid anaesthetic compromise. In addition, left and right approaches should be avoided in birds with ascites because fluid leakage into the airsac system is almost unavoidable; however, in such cases, a ventral midline approach is practical.

The most commonly employed procedure involves a left approach into the airsac system because male and female reproductive organs can always be seen (only a few species have bilateral ovaries). The bird is positioned in right lateral recumbency with wings secured dorsad over the bird's back using self-adhesive tape. The left pelvic limb is pulled craniad and secured to the neck, again using self-adhesive bandage, to expose the left flank. The entry site is located immediately behind the last rib, and just ventral to the flexor cruris medialis muscle as it courses from caudal stifle to ischium (Figure 1). Very few feathers, if any, need to be plucked prior to aseptic preparation of the area. Following a 2-4 mm skin incision, straight haemostats, directed in a slight craniodorsal direction, are used to bluntly dissect between the thin subcutaneous tissues and enter the left caudal thoracic airsac. The haemostats are replaced by the sheathed telescope, and correct position within the caudal thoracic airsac is confirmed by the identification of lung (straight ahead), cranial thoracic airsac (left), abdominal airsac (right), caudal edge of liver and proventriculus (ventral), and ribs and intercostal muscles (dorsal).

Exploration of adjacent airsacs is accomplished by pressing the tip of the telescope against the airsac membrane and advancing the telescope in a sweeping motion until the airsac membranes are breached. Normal membranes are transparent and tissues in the adjacent airsac can be visualized and avoided. Great care is required when breaking through thickened, opaque airsacs because vision is impaired and visceral trauma can occur if the telescope is blindly advanced. Lung, liver, heart and associated great vessels can be examined from the cranial thoracic airsac, while urogenital, intestinal, splenic, adrenal, and associated vasculature can be visualized from the abdominal airsac.

There is no need to repair the small holes punctured in the airsac membranes as they generally heal within 5-10 days. Post-operative subcutaneous emphysema may be seen in some birds when only skin closure is performed. Therefore, either a single absorbable (e.g. poliglecaprone 25) suture that incorporates both muscle and skin, or a two layer closure is recommended.

The right approach is essentially the same as previously described. Of particular note is the asymmetrical location of the psittacine pancreas, which can be most easily accessed from the right abdominal airsac in most species by following the duodenum (most caudal intestinal loop) caudoventrad.

The ventral approach provides excellent access to both left and right liver lobes. In cases of ascites, the ventral approach is preferred because the telescope can enter the hepatoperitoneal cavity without entering the airsac system. The bird is positioned in dorsal recumbency and following aseptic preparation, entry is made in the ventral midline, just caudal to the keel. The hepatoperitoneal cavity is divided into left and right sides and the midline membrane can be perforated as previously described.

In order to identify and preserve the crop, a larger surgical approach (1 cm) is required in the mid-ventral coelomic inlet to identify and avoid the crop. Upon entering the clavicular airsac, the telescope must be carefully advanced because of the close proximity of left and right brachiocephalic branches, and other major vessels in this region. The clavicular approach is less commonly utilized but does provide access to the syringeal region, heart and great vessels, and has been useful for the identification, sampling, and treatment of cranial coelomic masses.

Biopsy Techniques

One of the greatest benefits of endoscopy is that when an abnormal structure or pathological lesion is observed, biopsies can be taken under direct visual control. Biopsies can be harvested from the kidneys, gonads, liver, spleen, pancreas, lung, fat, airsac, coelomic musculature, and, in general, any abnormal soft tissue structure. It is important to examine as much of the target structure as possible to determine whether pathology is focal, multifocal or diffuse. In cases of diffuse renal or hepatic disease (e.g. tubulonephrosis, nephrocalcinosis, hepatic lipidosis, hepatitis), two or three biopsies taken from the most convenient sites are generally diagnostic. Ultrasound-guided and blind-percutaneous biopsy techniques may be equally effective in diagnosing diffuse disease. However, poorer visualization of closely associated structures makes iatrogenic trauma more likely. Most diagnostic failures occur because of poor tissue selection for biopsy, and this is especially true when dealing with focal (e.g. abscess, neoplasm, cyst) and multifocal diseases (e.g. pyogranulomata, mycobacteriosis). In these cases, direct endoscopic visualization offers the best chance of sampling the most appropriate area(s). In cases of focal or multifocal disease, single or multiple discrete lesions are visible and biopsies should ideally be harvested from the edge of the lesion taking normal and abnormal tissue in the same biopsy sample for both microbiology and histology. Alternatively, and technically easier, small biopsies can be collected from the abnormal and normal areas and submitted together for comparison. Focal disease deep within an organ showing no surface lesions, although rare, may be missed on endoscopic examination. It is important to correlate biopsy histopathology and microbiology with clinicopathologic data when dealing with organ disease. It is often surprising how biopsy results provide a definitive diagnosis even in the face of unremarkable clinicopathologic data.

When confronted by a potentially cystic lesion or abscess, it is safer to first attempt drainage using fine needle aspiration, rather than risk leakage into the airsacs or coelom. When attempting to take a liver or lung biopsy, it is preferable to first incise the airsac and serosal membranes using endoscopic scissors. This provides better access to the tissue parenchyma and yields biopsies of superior histological quality with minimal artifacts. Biopsies of the spleen, kidney, testis, adrenal and most pathologic lesions can usually be taken without the use of scissors. Post-sampling haemorrhage tends to be minor and inconsequential thanks to the avian extrinsic coagulation pathway, and in particular, tissue-associated thromboplastin.

In cases of diffuse liver pathology, the most accessible sampling site from a lateral approach is the caudal edge of the liver, located on the ventral floor of the caudal thoracic airsac. To access the liver it is necessary to incise the airsac and hepatoperitoneal membranes using scissors (Figure 2). The scissors are opened and the fixed blade is gently inserted through the membranes parallel with the caudal edge of the liver. While keeping the blades open, the scissors-sheath-telescope unit is elevated and advanced to extend the incision. Once the incision is large enough to permit the introduction of biopsy forceps, the blades are closed and the scissors retracted. Biopsy forceps are then inserted through the incision, and a clean liver sample can be collected. Multiple biopsies can be taken from the same site. Biopsy without first incising the membranes overlying the liver tends to result in greater biopsy artifact.

Renal biopsies can be collected from the cranial, middle or caudal divisions of the kidney from within the abdominal airsacs. In general, there is no need to use scissors as the renal parenchyma protrudes and is easily accessed with minimal artifact (Figure 3).

Lung tissue is most accessible from within the left or right caudal thoracic airsacs. The airsac and pleural membranes must first be incised using scissors. It is generally easier to rotate the scissors within the operating channel, such that the fixed blade is dorsal. The scissors-sheath-telescope unit is advanced and the point of the fixed blade is inserted through the membranes covering the lung. The scissors-sheath-telescope unit is then gently moved ventrad creating a dorsoventral incision through which biopsy forceps can be inserted to collect lung biopsies.

The spleen is best visualized from within the left abdominal airsac, and although greater haemorrhage is usually associated with biopsy, the clinical consequences appear minimal.

Pancreatic biopsies are most easily collected from within the right abdominal airsac of psittacine birds.

Complications

The major complications encountered are typically associated with anaesthesia, and the advanced disease state of many birds at the time of presentation. The importance of stabilization, and a thorough pre-operative evaluation cannot be overemphasized. Endotracheal intubation, ventilation, intravenous or intraosseous catheterization with perioperative fluid support, and warm air/water blankets are important. Minor hqemorrhage following tissue biopsy is common but generally insignificant. Most endoscopy issues are related to operator error until experience and ability have been gained. In general, the ability to examine birds internally and collect tissue samples greatly aids diagnosis and improves treatment success.

Post-Operative Care

Birds should be closely supervised on recovery as anaesthetic compromise can ensue following extubation and cessation of cardiorespiratory support. Fluid therapy and nutritional support should continue, with psittacine and passerine birds eating within an hour of recovery. Meloxicam is used routinely post-operatively, although opiates and local anaesthetics are useful as part of a balanced approach to analgesia. Typically birds return to normal function quickly following single entry diagnostic procedures compared to more traditional, invasive surgery. Sutures are removed at 7-10 days if still present.

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Table 1. Endoscopic instrumentation for companion birds.

Equipment Description	Primary Indications
Visualisation and Documentation	
Endovideo camera and monitor Xenon light source and light guide cable Digital capture device (e.g. AIDA-DVD)	Required for all endoscopy procedures
Rigid Telescopes and Endoscopes	
1.9 mm x 18.5 cm telescope, 30o oblique, with integrated 3.3 mm operating sheath	Preferred for birds <100 grams
2.7 mm x 18 cm telescope, 30o oblique 4.8 mm operating sheath	Preferred for birds <100 grams
Flexible instruments for use with rigid telescopes and operating sheaths	
1 mm biopsy forceps 1 mm grasping forceps	For use with 1.9 mm telescope and integrated sheath
1.7 mm biopsy forceps 1.7 mm single-action scissors 1.7 mm remote injection needle 1.7 mm grasping/retrieval forceps 1.7 mm wire basket retrieval 1.7 mm needle end radiosurgery electrode 1.7 mm polypectomy snare	For use with 2.7 mm telescope and 4.8 mm operating sheath
Insufflation	
Sterile saline suspended above endoscopy table with intravenous drip line to a port on the operating sheath	Used for sterile saline infusion for ingluvioscopy, gastroscopy and cloacoscopy

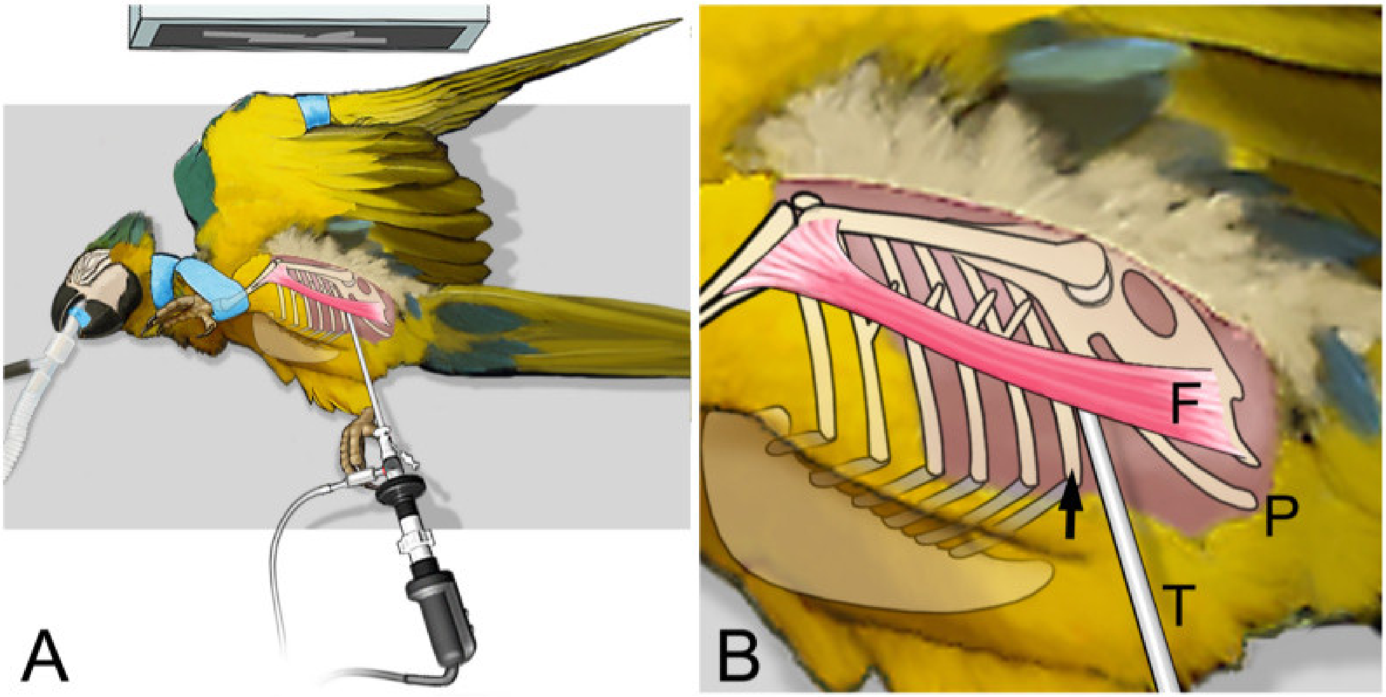

Figure 1. (A) Macaw in right lateral recumbency having left coelioscopic approach undertaken. (B) Close up of the telescope (T) entering the bird just ventral to the flexor cruris medialis muscle (F), just caudal to the last rib (black arrow), and well cranial of the pubis bone (P).

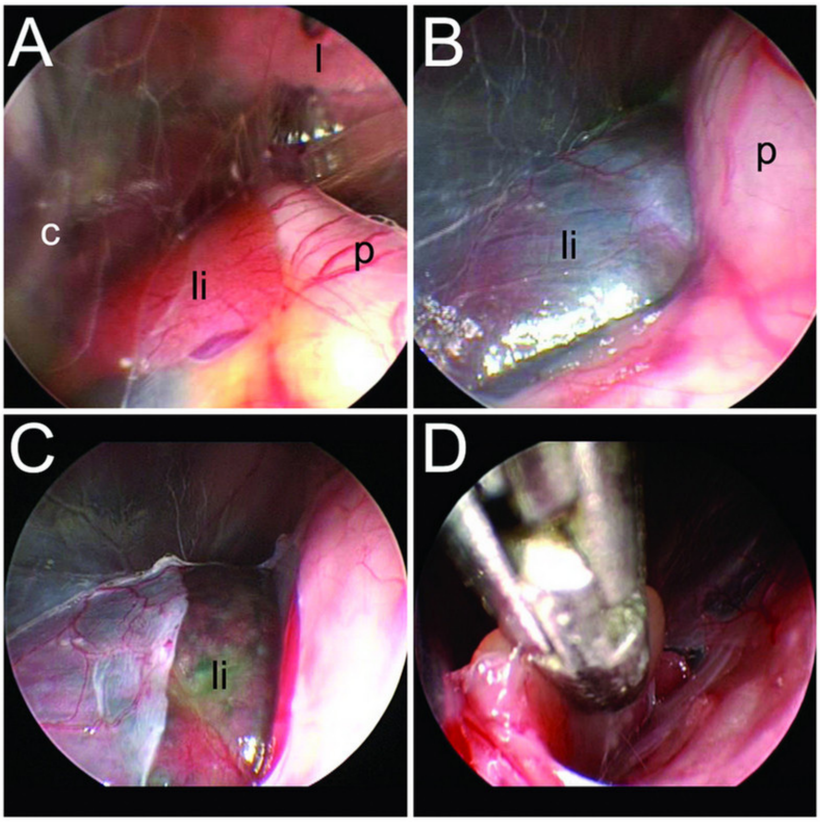

Figure 2. Liver examination and biopsy from within the left caudal thoracic airsac. (A) View of the normal liver (li), proventriculus (p), lung (l), and cranial thoracic airsac (c) in an amazon. (B) View of the swollen and discolored liver (li), and distended proventriculus in a black palm cockatoo with Chlamydophilosis. (C) In preparation for biopsy, the ventral floor of caudal thoracic airsac and the hepatoperitoneal membranes have been incised using 1.7 mm scissors to expose the liver parenchyma (li). (D) 1.7 mm biopsy forceps are used to collect a sample of liver.

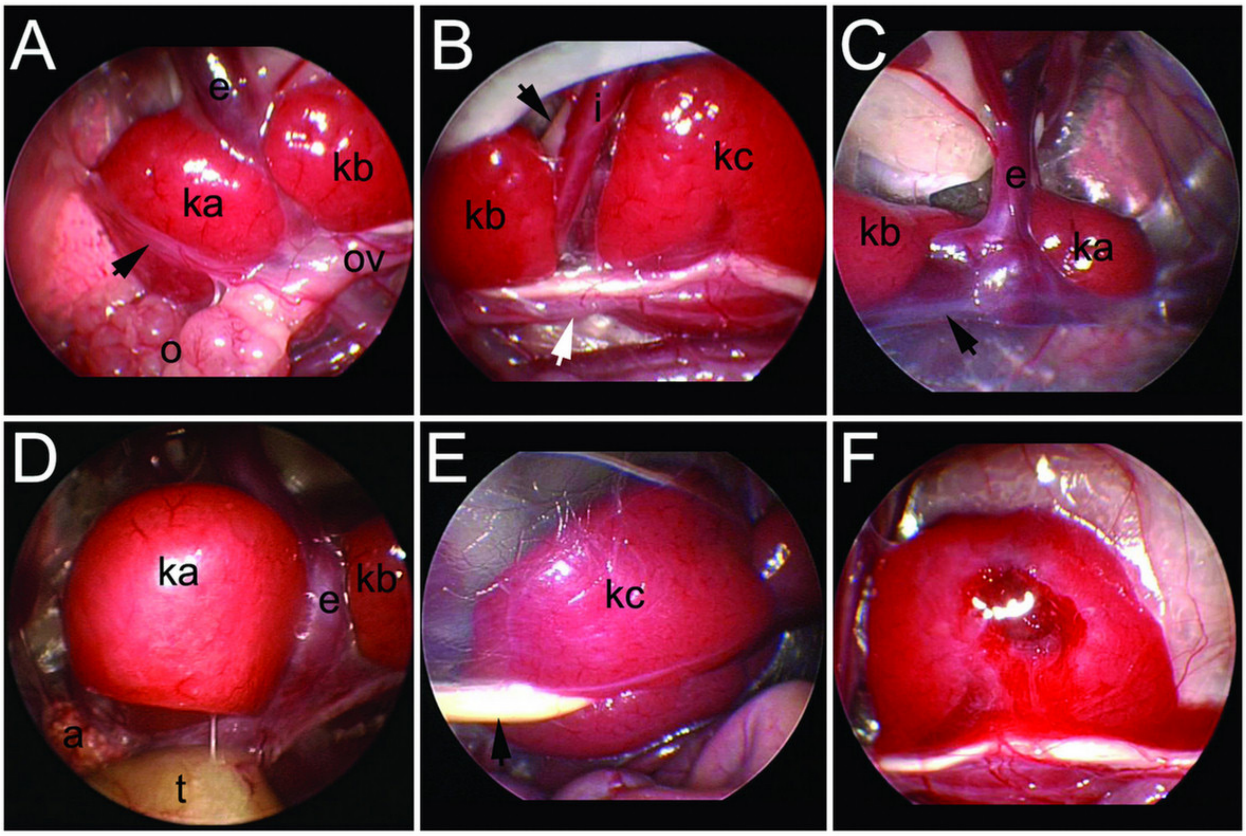

Figure 3. Renal examination and biopsy from within the abdominal airsac. (A) External iliac vein (e) running between the cranial (ka) and caudal (kb) divisions of the left kidney. Note the close association of the ovary (o), suspensory ligament (l), and oviduct (ov). (B) Ischiatic vein (i) and spinal nerves (black arrow) running between the middle (kb) and caudal (kc) divisions of the left kidney, with the ureter and immature oviduct (white arrow) coursing ventromediad. (C) Abnormally small cranial (ka) and middle (kb) divisions of the right kidney in a macaw. The external iliac vein (e) and ureter (arrow) are also shown. Such anomalies can be congenital or the result of chronic disease and renal fibrosis. (D) Swollen cranial division of the left kidney (ka) due to bacterial glomerulonephritis in an amazon parrot, causing caudal displacement of the external iliac vein (e). The middle division of the kidney (kb), adrenal (a), and testis (t) are also visible. (E) Renomegaly of the right kidney (kc) and dilation of the ureter (arrow) associated with lead intoxication and renal tubular necrosis in a macaw. (F) Caudal division of the kidney following biopsy using 1.7 mm biopsy forceps. Note the minor haemorrhage that usually stops quickly thanks to avian tissue-bound thromboplastin.