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Avian Radiology

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Whole body radiographs along with a complete blood cell count and a plasma biochemistry profile are commonly used to evaluate the avian patient. As demonstrated by Nuth, et al. (2014), obtaining radiographs of high diagnostic quality by careful consideration of technical variables, such as proper exposure, positioning and minimizing artifacts, will reduce misinterpretation. The following is a general overview of avian radiology for the avian clinician without getting into advance imaging techniques.

Technique

In general, avian radiographs are taken as "table-top" techniques with the patient positioned directly on the radiographic plate. Because most avian patients are small, mAs (milliamperage-seconds) and kVp (kilovolt peak) settings are at the low end of the scale and the exposure time is minimized to avoid movement artifact created by the rapid respirations. Standard modern radiographic equipment is adequate for obtaining avian radiographs. Avian patients generally require short exposure times (0.015- 0.05 seconds) using at least a 300 mA (milliamps), 10-20 kVp, according to Krautwald-Junghanns and Trinkhaus (2000). Radiographic quality is enhanced with the use of high detail film-screen combinations or digital techniques. Technique charts that are based on the radiographic equipment and film-screen combinations or digital system for a few commonly seen avian species are established by most avian veterinary hospitals. Digital radiographs, in general, create significantly lower number of image artifacts and significantly higher frequency of proper labeling versus film radiographs.

Because of the relative small size of most avian patients, whole body images that include the coelomic cavity, head, and pectoral and pelvic limbs are typically obtained for screening purposes. Obtaining only two views, ventral-dorsal (VD) and lateral radiographs, minimizes the time of radiographic examination. Additional views may be required for larger avian species to include the head and limbs or smaller birds with fractures.

Restraint

Sedation or general anesthesia is often required for radiographic examinations of birds as an effort to alleviate patient stress, prevent iatrogenic injury, and ensure proper positioning radiographs of high diagnostic quality. Because Isoflurane produces rapid induction and recovery times, it is often used to obtain radiographs of the avian patient. It can be used safely to anesthetize highly excitable and very ill birds that would not tolerate manual restraint. Appropriate masking tape can be used to tape the wings, legs, and sometimes the neck in proper position to minimize damage to feathers.

Positioning and Views

Ideal positioning for a bird for a VD radiograph will be reflected by an image that shows superimposition of the spine and the keel; extension of the head and neck; the wings extended from the shoulders symmetrically to the sides, and the legs extended caudally. The acetabula and scapulae should be symmetrical. To achieve the proper VD positioning, the bird is placed in dorsal recumbency, directly on the cassette for tabletop technique or directly on the table for film-tray technique. The wings are extended laterally, and evenly secured to the table or cassette by placing tape at the level of the mid antebrachium. The length of tape must be long enough to span the entire wing, including the feathers. Extend each leg caudally and tape separately, at the level of the tarsometatarsus. Check the alignment of the keel over the spine before obtaining the image. The entire coelomic cavity should be included within collimation in most species of companion birds. Slight deviations from this ideal positioning may provide acceptable diagnostic images, but severely rotated views should be retaken.

Ideal positioning for a bird for a lateral radiograph will be reflected by an image that shows a straight spine and keel; superimposed coxofemoral and scapulohumeral joints; and a symmetric pectoral girdle with the coracoids and the two sides of the furcula superimposed over each other. To achieve the proper lateral positioning, the bird is placed in right lateral recumbency (the most common position), directly on the cassette for tabletop technique or directly on the table for film-tray technique. If the bird has a pathological lesion, then place the affected side closest to the cassette. The wing closest to the cassette is extended dorsally above the spine and secured with tape placed across the mid-diaphysis of the antebrachium. The second wing is extended dorsal to the coelom, above the spine, and secured with separate tape in a similar manner as with the first wing. The second wing is often positioned slightly behind the first to easily identify each wing on the radiographic image. Each leg is extended individually caudal to the coelom and taped in place at the level of the tarsometatarsus. Check the alignment by assuring that the spine and keel are straight and the coxofemoral and scapulohumeral joints are superimposed over each other. The entire coelomic cavity should be included within collimation in most species of companion birds. Slight deviations from this ideal positioning may provide acceptable diagnostic images, but severely rotated views should be retaken.

To achieve the proper image of the mediolateral radiographic view of the wing, the bird is placed in the same position as for a VD whole-body radiograph. The wing is extended laterally and secured in position with tape to the cassette. Larger birds require shifting the body laterally with the with stretched across the cassette or positioning the wing diagonally across the cassette. A very long wing requires separate imaging of the proximal and distal portions.

To obtain the proper caudocranial radiographic image of the wing as directed by Silverman and Tell (2010), the bird is held in an inverted position with the head directed toward the floor and the long axis of the body is held perpendicular to the surface of the x-ray table with the leading edge of the wing laced on the cassette. The wing is extended manually while the body or legs are supported by the opposite hand while the handler pays careful attention to prevent radiographic exposure.

To obtain the proper craniocaudal radiographic image of the leg, the limb is positioned and secured in a similar manner to that of the VD whole body radiograph. The mediolateral radiographic image of the leg is obtained by positioning the bird in right lateral recumbency for the right leg or left lateral recumbency for the left leg depending upon the leg of interest. Positioning and securing the legs are performed in a similar manner to the lateral whole-body radiograph, except according to Silverman and Tell (2010), the contralateral leg should be rotated dorsally and pulled caudally to avoid superimposition of the legs.

Contrast radiography can often help in the identification of space-occupying lesions within the coelom of birds. Contrast radiography is performed following oral administration of a contrast medium, such as barium sulfate 30% weight to volume (w/v). Other guidelines for use of barium sulfate for radiographic contrast are provided by Carpenter (2005). Ideally, the ingluvies and proventriculus should be empty prior to delivery of the contrast medium. The contrast medium should be warmed to slightly above room temperature to avoid the gastrointestinal (GI) motility slowing as a reaction to the cold liquid. The contrast liquid is delivered via a rigid or soft, flexible feeding tube into the crop at a volume of 25-50 ml/Kg body weight as provided by the guideline given by Silverman and Tell (2010). These authors also recommend a slightly higher kVp (i.e. 2-4 kVp) above the survey radiographs are required for the contrast study. Because of the rapid GI transit time for most birds, the contrast study images are typically obtained 45-60 minutes following oral delivery of the contrast medium. Resulting radiographic images will reveal the outline of the entire GI tract in birds with normal, unobstructed gastrointestinal motility.

Interpretation of the Coelomic Cavity of Avian Radiographs

The VD radiographic image of a normal psittacine bird reveals what is often referred to as an "hour-glass" shape to the area located at the junction between the heart and the liver. The width of this cardio-hepatic waist or silhouette is used as a guideline to assess hepatomegaly or cardiomegaly. It should be noted that macaws and some cockatoos typically have small livers compared to other psittacine birds. Also, assessment of the "hour-glass" shape to the cardio-hepatic silhouette only applies to psittacine as other types of birds, such as raptors, waterfowl, and poultry, have a poorly defined junction between the heart and the liver. Assessment of liver size can also be made by drawing a pair of imaginary lines between the scapula and the acetabula on each side of the VD image. Hepatomegaly may be indicated if the lateral margins of the liver extend beyond these imaginary lines. The left side of the hepatic portion of the cardio-hepatic silhouette is represented by the proventriculus. Therefore, a unilateral left sided bulge in this area is suggestive of proventricular enlargement. A large mass in the caudal coelomic cavity will displace the GI tract cranially causing loss of the normal "hour-glass" shape to the cardio-hepatic waist creating the illusion of hepatomegaly. Contrast radiography will aid in the determination of the cause of the loss of the "hour-glass" shape in the psittacine bird.

The ventriculus normally lies just to the left of the midline at the level of the acetabulae on the VD radiograph; however, without contrast, either mineralized grit or contrast medium, it is generally not seen. The intestines are also not visualized without contrast as they typically are void of gas; this differs from mammalian patients. The cranial thoracic, caudal thoracic, and abdominal air sacs can typically be evaluated on either side of the cardio-hepatic silhouette and the intestines on the VD radiograph. Normal air sacs have a similar density as the background air.

Lateral radiographic images of birds are used to assess the lungs, airsacs, heart, liver, proventriculus, ventriculus, intestines, spleen, kidneys, and at times the reproductive tract. Normal avian lungs in this view have a honey comb appearance representing the openings of the parabronchi. Loss of the normal honey comb appearance is indicative of obliteration of the parabronchi with inflammatory material (such as granulomas) or neoplasia. Exaggeration of the parabronchi can be suggestive of interstitial pneumonia. The radiographic image of the caudal margin of the liver of normal adult birds generally does not extend beyond the keel. However, juvenile psittacine birds tend to have larger livers that will extend beyond the keel.

The radiolucent airsac space of the normal lateral radiographic image of a bird is surrounded by the lungs cranially, the proventriculus ventrally, the kidneys and gonad(s) cranially and caudally, and the intestines caudally. Obliteration of this space can represent hepatomegaly resulting in dorsal displacement of the proventriculus; proventricular enlargement; splenomegaly (usually represented by a round soft tissue mass); renomegaly; gonadal enlargement or reproductive tract mass; or caudal coelomic mass resulting in cranial displacement of the intestines.

The ventriculus is best observed if contrast material is present where it normally lies caudoventral to the proventriculus at the level of the acetabulae approximately ⅔ the distance from the spine and the body wall. The normal spleen, which is rarely visible on the lateral radiograph, appears as a round soft tissue structure cranial to the femur just above the proventriculus at the isthmus or junction between the proventriculus and ventriculus. A normal spleen is occasionally seen on the lateral radiographic images of macaws and raptors. The kidneys are located below the spine where the cranial division is typically seen below the lumbar spine and cranial to the acetabulum on the lateral radiograph. The gonads are not reliably visible on the lateral radiograph, but when they are, they are located cranioventral to the cranial division of the kidney.

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