Avian Soft Tissue Surgery Wet Lab

R. Avery Bennett, DVM, MS Diplomate ACVS

Prepare the bird for surgery by plucking the feathers on the ventral surface from the base of the skull to the tail extending laterally under the wing to dorsal midline on the left side. The left leg should be plucked distal to the stifle as the knee web will be incised. The right side need only be plucked to allow access for a ventral midline celiotomy. In a clinical setting, the bird should be positioned on a board such that the head may be elevated. With the bird in this position, fluid will run out of the abdomen instead of cranially into the lungs.

LEFT LATERAL CELIOTOMY

For this procedure the bird should be positioned in right lateral recumbency. Position the bird with its head pointed away from you, the wings to your right and the legs to your left. With both wings pulled dorsally and taped in place, using a tape stirrup on each leg, pull the left leg dorsally and caudally as far as possible (externally rotated at the hip) and the right leg ventrally at approximately 90^{o} to the spine. Again, the left leg should be pulled dorsally and caudally as far as possible.

With the leg in this position a web of skin extending from the left stifle to the sternum will be created. At that location the skin incision will be initiated. The incision will extend from the 6th rib to the pubic bone on the left side. The 7th and 8th ribs will be transected. The skin incision is initiated by gently grasping the skin with the bipolar forceps, activating the current and withdrawing to create a small nick in the skin of the web. Using jeweler's forceps in one hand and the bipolar cautery in the other hand, the incision is extended by inserting the straight pole of the bipolar forceps subcutaneously, lightly opposing, activating the current and withdrawing. This incision is extended craniodorsally to the 6th rib and caudally, parallel to midline, to the pubic bone. You will be able to extend the leg even farther dorsally and caudally after the skin has been incised, allowing access to the left lateral abdominal wall.

At this point you will see a small blood vessel running from approximately the area of the medial aspect of the coxofemoral joint perpendicular to the spine towards the ventral midline. You will also be able to visualize the 7th and 8th ribs. Also note that this incision is very large. It may seem that this is an excessively long incision but in order to accomplish the procedures, it is necessary to make a large incision.

The superficial branch of the medial femoral artery and vein described above will need to be coagulated prior to incising of the body wall. This can be done by grasping the vessels with the bipolar forceps, lightly opposing and activating the current in two locations along the vessels. One pole can be inserted into the body wall and the other one left external so when they are opposed the tissue between them including the blood vessels will be coagulated. This will help control hemorrhage from this rather sizable vessel during incision of the body wall.

Similarly, the intercostal blood vessels should be coagulated. If you follow the ribs from dorsal to ventral you will see a point where they make a sharp bend. This is the junction between the sternal and vertebral ribs. The ribs will be transected just dorsal to this junction and the vessels should be coagulated at that location. The intercostal vessels run along the cranial border of the ribs and can be coagulated by inserting the bipolar forceps under the rib, gently opposing the tips cranial to the rib, and activating the electrodes.

Once these vessels are coagulated, the ribs can be transected with heavy scissors and the abdominal wall incised using the bipolar forceps, as was described for making the incision through the skin. At this point the abdominal cavity is open from the level of the 6th rib to the pubis exposing the abdominal contents. The Heiss retractor is inserted between the cut ends of the ribs with the handle directed craniad to allow exposure to the cranial portion of the celiotomy. The retractor will keep the ribs separated and maintain their retraction while the procedures are performed.

PROVENTRICULOTOMY

The first procedure we will perform through the left lateral celiotomy is the proventriculotomy. The gizzard or ventriculus is identified as muscular organ in the middle portion of the incision. You will see thin tissue webs of air sacs and suspensory ligaments attached to that structure. These support structures are broken down either by blunt dissection or with the bipolar forceps. There are no major blood vessels within these supporting structures. Once these are broken down, the gizzard is retracted outside the abdominal cavity. To aid in exteriorization, two 4-0 stay sutures are placed in the white tendinous portion of the gizzard. Note that a triangular portion of liver lobe lays over the isthmus or junction between the ventriculus and the proventriculus. Once the gizzard is exteriorized using the stay sutures, that portion of the liver lobe is elevated to your left using a cotton-tipped applicator. Care must be taken to avoid tearing the blood vessels which lie beneath that portion of the liver lobe.

Once the liver is elevated you will see the isthmus. An incision is initiated at the isthmus in a nonvascular portion. This incision may be initiated using a blade or scissors. (Clinically the proventriculus should be isolated using moistened 2X2 sponges to prevent contamination of the abdomen. A mini-Fraizer tip suction would be used to evacuate the gastric contents following incision of the proventriculus.) Any hemorrhage and leakage is controlled and the incision is extended cranially as far as necessary. In most cases foreign bodies or biopsies can be performed through a small opening in the proventriculus. The proventriculotomy incision should be kept as small as possible.

If a ventriculotomy is required, the incision is initiated in the same location of the isthmus; however, it is extended abroad into the ventriculus and the ventricular lumen can then be explored for the presence of foreign bodies.

To close the incision, a two layer closure using the 6-0 Maxon is preferred. The first layer provides apposition of the incision. The second layer is an inverting pattern. In many cases the size of the incision is too short to allow a continuous pattern so interrupted is used. It is important to remember that in the absence of omentum, sealing of an intestinal incision in birds requires meticulous attention to detail. Sutures should be placed 1 to 2 millimeters apart thus providing a good seal. If possible, the small piece of liver lobe may be placed over the incision and tacked to try to provide a serosal patch over the gastrotomy.

SALPINGOHYSTERECTOMY

The next procedure we will perform through the left lateral celiotomy is a hysterectomy. In birds, it is not easy to remove the ovary. All that need be removed is the oviduct and the uterus (shell gland). The anatomy of the oviduct and the uterus in birds should be reviewed. There is a ventral suspensory ligament which is nonvascular and throws the oviduct and uterus into numerous folds. The ligament may be broken down bluntly either with bipolar forceps or other means allowing the oviduct to be stretched out into a more linear configuration providing exposure to the vessels in the dorsal suspensory ligament. A rather large blood vessel may be identified at the infundibulum emerging from beneath the ovary. Two Hemostatic clips are applied to the blood vessel as it emerges from behind the ovary. If this blood vessel is accidentally torn, you may pack a small piece of gel foam where the blood vessel emerges and allow it to coagulate. It is not necessarily a life-threatening circumstance. The dorsal suspensory ligament of the uterus may be identified extending from the dorsal body wall to the oviduct and uterus. You will see numerous branches supplying the oviduct and uterus. Each of these vessels may be coagulated with the bipolar forceps thus preventing any hemorrhage from them as the ligament is broken down. Clips may be applied to larger vessels.

Once all the blood vessels are coagulated, the uterus and oviduct can be exteriorized in a linear fashion extending completely outside the body wall such that only its junction with the cloaca is visible within the abdominal cavity. This is where the clips will be applied prior to the transection. A cotton-tipped applicator is inserted through the vent into the cloaca to help delineate its boundaries. Two clips are applied to the uterus near its junction with the cloaca. The uterus is then transected distal to the clips and discarded. Prior to closure, the abdominal cavity is extensively evaluated for any residual hemorrhage. If hemorrhage is found, the bipolar forceps is used to control it. Clips are an alternative for larger vessels that cannot be controlled with bipolar forceps.

Once all hemorrhage is controlled, the retractor is removed allowing the ribs to fall back into their original position. No effort is made to reattach the transected edges of the ribs. You will need to release tension from the leg so the muscle of the body wall can be opposed with suture. A single layer of a simple continuous pattern (4-0 Dexon) is used to close the muscles of the body wall. A second layer of continuous interlocking suture is placed in the skin completing the procedure.

ORCHIDECTOMY

Male birds may be castrated through this approach. The left testicle is identified and gently elevated to expose the short mesorchium. Each testicle is attached to the caudal vena cava by this structure. Hemostatic clips are applied to the mesorchium as far from the vena cava as possible. The testicle can then be removed by incising distal to the clip. In sexually active birds, the testicles are very large. Several clips may be required to control hemorrhage from the mesorchium. This is done by placing the a clip at the caudal extent of the testicle between the testicle and the vena cava. The tissue is cut along the clip distal to it. This allows the caudal portion of the testicle to be elevated farther and a second clip to be applied cranial to the first one. The tissue is cut along the second clip and a third is applied. This procedure is continued until the entire testicle has been removed. The procedure is repeated to remove the right testicle. Air sac tissue will prevent access to the right testicle. This must be bluntly dissect allowing the right testicle to be elevated to expose its mesorchium.

VENTRAL MIDLINE CELIOTOMY

The next procedure will be a ventral midline celiotomy. Through this approach we will evaluate the exposure and anatomy for performing a liver biopsy and cloacapexy. Because these birds do not have hepatomegaly or cloacal prolapse, you will probably not be able to perform these procedures. The bird is repositioned in dorsal recumbency with the head pointing away from you and the wings extended and taped into position. Using the tape stirrups, the legs are pulled caudally. The incision extends from the caudal apex of the sternum to the area of the vent along the ventral midline between the pubic bones. The technique for making the incision is as described earlier. You should make your incision slightly smaller than the anticipated length as the skin will stretch, so terminate the incision a few millimeters caudal to the apex of the sternum and cranial to the vent.

Once the incision is made, a thin layer of almost transparent fibrous tissue is identified as the linea alba. This is incised by picking the linea up with the jeweler's forceps and initiating an incision with the bipolar forceps. The incision is then extended to match the skin incision. The duodenal loop and pancreas lay directly below the ventral midline and great care must be taken not to accidentally incise these tissues.

CLOACAPEXY

The next procedure to be performed is a cloacapexy. A variety of techniques for cloacapexy have been described. In this lab, because the normal cloacal wall is very thin, we will perform the technique which involves incorporating the cloacal wall into the closure of the ventral body wall incision.

The first thing that must be done in performing the cloacapexy is to remove the fat pad along the ventral surface of the cloaca. This appears to be extremely important in allowing adhesions to form between the cloaca and the body wall. If this fat is not removed, the adhesions quickly break down and recurrence is common. To perform a rib cloacapexy, suture is passed around the 8th rib, then full thickness through the cloaca. Two sutures are placed on each side and tied securely. This will hold the cloaca in reduction. Though you will not be able to accomplish this procedure in a normal bird, you should evaluate the anatomy and technique for performing the rib cloacapexy. As an alternative, preplace 4 sutures through the cartilaginous border of the sternum and then full thickness through the cloacal wall. Place a cotton-tipped applicator into the cloaca to help stretch it to the sternum. Two sutures are placed on each side of midline. Be careful not to incorporate the cotton tip in the sutures.

The body wall incision is closed by incorporating the cloacal wall such that the suture passes through, first one side of the body wall, then full thickness through the cloaca, then through the other side of the body wall. In this manner, the cloaca is sandwiched within the linea alba which allows significant adhesions to form, hopefully preventing prolapse of the cloaca. The skin is closed over the body wall in a simple continuous pattern as a separate layer.

CLOACOTOMY

As an alternative to a cloacapexy, you may perform a cloacotomy. It is not feasible to perform both on the same bird in this laboratory. This procedure is indicated for a thorough evaluation of the internal structures of the cloaca as would be necessary in treating cloacal papillomatosis. Through this approach you will be able to visualize the coprourodeal fold and the uroproctodeal folds as well as the ureteral openings.

Insert a moistened cotton tipped applicator stick into the cloaca. Using the monopolar electrosurgical tip, incise through the skin, the muscle of the cloacal sphincter, and the mucosa of the cloaca from the vent to the cranial extent of the cotton tipped applicator. Using this technique you should not enter the coelomic cavity. Inspect the cloacal and on the dorsal surface you should be able to visualize the ureteral openings and urine/urates flowing into the cloaca. Closure is accomplished using 6-0 Maxon in a simple continuous pattern beginning at the cranial extent of the incision. The vent sphincter muscle is closed with a single mattress suture of 4-0 Dexon. Skin closure is routine.

TRACHEOTOMY

The last procedure we will perform is a tracheotomy. The bird is positioned in dorsal recumbency with the head pointing toward you. The shoulder area is raised to an angle appropriate for viewing into the thoracic inlet (at least 45°). An incision is made along the thoracic inlet. Following skin incision the crop is identified, bluntly dissected free and elevated to the right side. The fat surrounding the thoracic inlet is removed allowing access to the trachea. The interclavicular air sac must be entered. As dissection continues, the muscles attaching the trachea to the sternum (sternotrachealis) are identified and transected. These muscles are on the lateral aspects of the trachea, deep within the thoracic inlet. Additionally, stay sutures may be placed between the tracheal rings and used for retraction of the trachea in an effort to bring the syrinx into the thoracic inlet. Note that you will not be able to totally exteriorize the syrinx but you should be bale to visualize the syringeal membranes looking down into the tunnel of the thoracic inlet. Excessive traction will result in tearing the trachea. The trachea of pigeons is particularly fragile, more so than that of psittacines.

At this point you should be able to visualize the bifurcation of the trachea to the two primary bronchi. The syringeal membranes is visible at this bifurcation. A transverse tracheotomy is made between two cartilage rings near the bifurcation. It is best not to perform a complete transection, but merely to make an incision approximately halfway through the diameter of the trachea. This will allow the surgeon access to the syrinx to retrieve a foreign object or debride a granuloma.

Exposure can be increased a bit by performing an osteotomy of the clavicle. The skin incision must be extended along the keel about 1/4th its length. The clavicle is cut with a bone cutter on one side of its symphysis. The muscles are transected along their insertion on the keel and clavicle on the same side the clavicle was cut. The Heiss retractor is positioned between the cut ends of the clavicle and opened. Less traction is required on the trachea to visualize the syrinx using this approach.

Once the trachea is cleared, the incision in the trachea may be sutured using interrupted sutures. The sutures incorporate at least two rings on each side of the incision in the trachea. Sutures are placed at 45 degree intervals such that a 50 percent transection would contain about 2-3 sutures. A minimum number and size of monofilament, absorbable (6-0 Maxon) sutures is recommended. An excessive amount of suture causes a granulomatous reaction which may result in respiratory obstruction from the granuloma.

Once the incision in the trachea is closed, the pectoral muscle is sutured using an interrupted or continuous pattern. No attempt is made to secure the cut ends of the clavicle. The crop is repositioned and tacked in place. Skin closure is performed using a continuous pattern of absorbable suture.

ACKNOWLEDGMENT

We would like to thank Fort Dodge Animal Health for lending the microsurgical instruments and the Hemoclips; General Scientific Corporation for lending the Surgitel® loupes; and Ellman International for lending the Surgitron® radiosurgical units. Their generosity is greatly appreciated.