

# Common and Uncommon Exotic Companion Mammal Surgery

Peter G. Fisher, DVM  
Pet Care Veterinary Hospital  
Virginia Beach, VA

This lecture has been designed to familiarize the practitioner interested in exotic mammal surgery with the technical aspects of both routine and more sophisticated surgeries in ferrets, rabbits, guinea pigs and rodents. The following surgeries will be discussed:

- Ferret: adrenalectomy, insulinoma, anal saculectomy, GI surgery, nephrectomy, urethrostomy
- Rabbit: ovariectomy, neuter
- Guinea Pig: ovariectomy, neuter
- General Exotic Mammal: cystotomy
- Rat: mastectomy

When performing surgery in ferrets, rabbits, guinea pigs and rodents one must take into consideration the small size, rapid metabolic rate and unique physiology of these species. Perioperative supportive care including fluid therapy, prevention of hypothermia, and pain management are essential in ensuring the successful outcome of these small surgical patients. In general, ferrets are very hardy surgical patients and can withstand a high degree of surgical trauma, whereas rabbits and guinea pigs are sensitive surgical patients that require minimal tissue handling and close anesthetic and post operative monitoring.

## Ferrets

### Adrenal disease

Prior to ferret adrenal surgery a complete blood cell count and serum chemistry panel should be performed. Particular attention should be paid to the red cell count and blood glucose level, as anemia and insulinoma are frequently concurrent. As well, the ferret should be evaluated for the presence of cardiac disease.

A ventral midline incision is made 1-2 cm caudal to the xiphoid process and extended caudally beyond the umbilicus to allow good visualization of the cranial and mid abdomen. As in all ferret surgery, a complete exploration of the abdomen should be performed to rule out metastasis, insulinoma, or concurrent disease. It is ideal to visually and palpably inspect both adrenals before deciding on whether to resect either one or both. The appearance of the normal ferret adrenal gland is similar to other species being light pink to tan in color and measuring 6-8 mm long and 2-3 mm wide. Abnormal adrenal glands may be a normal pink color, brown or dark red with a variable texture; either firm or friable. Surrounding areas should also be examined for the presence of accessory adrenal tissue. Accessory adrenal tissue was found in 11 of 135 animals examined in one study. In light of the anatomic arrangement of ferret adrenal glands, a complete right adrenalectomy is difficult without vena cava resection and anastomosis.

The left gland is more accessible, and may be found embedded in the fat and connective tissue cranial to the left kidney. To visualize the left adrenal gland, the spleen and much of the small intestines must be gently exteriorized and kept moist with warm isotonic saline during the surgery. In cases of less obvious adrenal enlargement gentle manipulation will allow location by palpation. Careful blunt and sharp dissection around the adrenal gland will allow more complete visualization of the gland and its blood supply. Cotton tipped applicators may be used to tease the adrenal away from the surrounding fat. Ligation of the vasculature using vascular clamps [Weck Hemoclips®, Teleflex Medical, RTP, NC] aids in removal. In advanced cases, the enlarged gland may have a more complex blood supply and care must be taken to avoid hemorrhage.

The right adrenal gland is cranial and medial to the right kidney, and is more difficult to excise due to its location dorsal to the caudate liver lobe and frequent adherence to the vena cava. The hepatorenal ligament must be transected and the liver lobe elevated to expose the gland. Extreme care must be taken to avoid damage to the vascular lamina as the gland is essentially "teased" away from the vena cava. Cotton-tipped applicators can work well for this. The neonatal Statinsky or DeBakey cardiovascular clamp may be used to partially or totally occlude the caudal vena cava while the right adrenal is being resected. Even when performed by experienced surgeons, portions of the right adrenal or its capsule may remain, being tightly adhered to the vena cava. Debulking the adrenal or opening the adrenal capsule and shelling out the contents may be all that is possible without risking serious damage to the vena cava. Many times a hemostatic clip may be placed between the adrenal and the vena cava, thus allowing its removal. Each surgery will vary according to the size and position of the diseased adrenal gland. Some veterinarians (Driggers) advocate a 2-surgery technique when the right adrenal gland is affected. The first surgery uses a 5 mm Ameroid constrictor ring (Research Instruments NW INC, Lebanon, OR) placed just distal to the adrenal gland around the vena cava, which allows for slow constriction of the vena cava while stimulating gradual collateral circulation by the hepatic portal system. The second surgical procedure is performed 1-3 months later giving time for collateral circulation to develop. Careful dissection of the Ameroid ring, the vena cava and attached adrenal gland allow for en bloc removal.

For control of minor hemorrhage hemostatic material such as Surgicel® (Ethicon Inc., Somerville, NJ) or Vetspon® (Novartis Animal Health, Greensboro, NC) may be used. Small lacerations in the vena cava can be sutured with 7-0 or 8-0 nylon. Surgeons occasionally have been forced to ligate the entire vena cava because of severe lacerations or aggressive adrenal tumors. In one unpublished study, one third of the ferrets that had their vena cava resected died within 72 hours of the surgery from cardiovascular problems. The remaining two-thirds did well long term. The azygous vasculature can effectively bypass the vena cava in some ferrets. (Kelleher S.)

Pain medication should be employed for 48-72 hours post surgery. Postoperative resolution of hair loss may take 45 days or longer. Vulvar swelling in female ferrets will usually resolve in 7-14 days.

### **Anal saculectomy**

Position the ferret as you would for a feline perineal urethrostomy surgery and prep routinely. Take a pair of fine hemostats and grab the anal tissue (including opening) right where the anal sac opening is. Next, use a # 15 scalpel blade and carefully incise around this clamped tissue. Stay close to hemostats, but do not cut into anal sac duct. Then pull up on the hemostats and use side of scalpel blade to carefully “scrape” away muscular attachments that are particular strong as you first get started. Keep pulling hemostats in varying directions (up, down, side to side) so that the surgeon is continually working in a 360 degree fashion to isolate anal sac. Once you get beyond the ‘neck’ of the anal sac the dissection takes less effort and the remainder of sac tends to peel out more easily (except in older ferrets, in which case muscular attachments remain throughout the dissection). At times you have to reposition hemostats in order to get a good grasp as you are pulling up. Repeat on opposite side and let heal by second intention. Do not suture. Two large, somewhat disconcerting holes in perianal tissue remain but they contract and close in within a day or two. Hemorrhage is usually moderate and is usually controlled with pressure alone.

### **Insulinoma**

Clients need to be aware that it is unlikely that surgery will cure insulinoma, and to what degree it slows progression of clinical signs, and the need for additional medical therapy, depends on the degree of pancreatic involvement and metastasis. An indwelling IV catheter is placed preoperatively and the ferret is infused with maintenance fluids with added 5% dextrose.

The pancreas is an “L” shaped organ along the proximal duodenum and has a right (duodenal) and left (splenic) limb. When doing surgery, you must be careful to identify the duodenal papillae. The major duodenal papilla opens into the dorsal part of the descending duodenum about 3 cm from the pylorus. The minor papillae, if present, are not prominent.

For surgical approach a ventral midline incision, similar to that described above for adrenalectomy, is made. The pancreas is easily located adjacent to the duodenum. During surgery both lobes of the pancreas are examined visually and manually. Inspect the spleen and liver carefully for metastatic nodules. Palpate the entire pancreas gently between two fingers to detect very small nodules that may be single, multiple or diffuse, and range from grossly invisible up to 2 cm in size. Solitary tumors can be resected with blunt dissection. When infiltrative, multifocal carcinoma is suspected throughout the pancreas a partial pancreatectomy may be preferred. Iris scissors and cotton-tipped applicators are used to carefully dissect around the abnormal tissue. A 4-O or 5-O absorbable suture material or hemostatic clips may be used to ligate larger vessels in the pancreas. Absorbable hemostatic material [Surgicel® (Ethicon Inc., Somerville, NJ) or Vetspon® (Novartis Animal Health, Greensboro, NC)] may be used to control minor hemorrhage. Partial pancreatectomy of the left (splenic) pancreatic limb is recommended in cases where a distinct insulinoma nodule cannot be found and micro-metastasis throughout the pancreas is suspected. Hemostatic clips [Weck Hemoclips®, Teleflex Medical, RTP, NC] or several crushing ligatures are effectively used to separate the left and right pancreatic limbs. Close mesentery defects to prevent visceral entrapment. The liver, spleen, adrenal glands and mesenteric lymph nodes are examined for abnormalities before closing. Biopsy of the liver is recommended if evidence of suspected metastasis or irregularities are noted.

### **Gastrointestinal surgery**

Indications include GI foreign body or hairball removal, neoplasia and inflammatory bowel disease (IBD). Gastrointestinal surgery is similar to the cat. Gastrotomy incisions are made in the greater curvature. Close gastric wall with 4-O absorbable suture (4-0 PDS or Monocryl, Ethicon Inc, Somerville, NJ) in a Cushing-Lembert pattern staying close to incision site so as not to incorporate an inordinate amount of tissue. Close enterotomy incisions using 4 to 5-O absorbable suture in a simple interrupted pattern- again try to incorporate a minimum of tissue so as not to narrow the intestinal lumen. Biopsies of stomach, duodenum, jejunum are indicated to make a diagnosis of Inflammatory Bowel Disease (IBD) and certain neoplasias. Stab incisions are made in the stomach great curvature and intestinal anti-mesenteric surface and 1-2 mm by 5 mm full thickness (make sure to include mucosa) samples are taken and close as for gastrotomy or enterotomy.

### **Nephrectomy**

Indications in ferret include hydronephrosis (most commonly secondary to inadvertent ligation of the ureter during OVH) and renal neoplasia. With hydronephrosis ferrets are usually presented because owner notices the enlarged kidney pressing against body wall. Most ferrets are clinically normal as problem is unilateral. Treat via nephrectomy. A mid abdominal midline incision is made. The kidney is isolated and the peritoneum over the caudal pole of the kidneys is grasped with forceps and incised with scissors. The surgeon expands this incision with combination of digital dissection and scissors to peel away the peritoneal adhesions over the kidney. Dissection is continued until the kidney is free except for attachment of renal artery, vein and ureter. These are ligated individually or together with Hemaclips or 4-O absorbable monofilament suture. The kidney is then removed. Incised retroperitoneum is usually left open. Check for hemorrhage and close abdomen routinely.

### **Urethrostomy**

Permanent urine diversion via surgical urethrostomy is required periodically in the male ferret. The most common indications are certain neoplasms of the preputial gland and total urethral obstruction of the penile urethra. The surgical technique is similar to that in a dog and is not technically difficult. The ferret is placed in dorsal recumbency and the urethra is palpated just caudal to the os penis. A 1-1.5 cm skin incision is made directly over the urethra and a combination of sharp and blunt dissection is used to isolate the urethra. The ventral midline of the urethra is incised, taking care to avoid the cavernous tissue on either side. Sectioning of the cavernous tissue may cause significant hemorrhage. Tenotomy scissors are used to enlarge the incision to its 1-1.5 cm length. This length may seem excessive, but after complete healing, the stoma is approximately 1/3 to 1/2 its original length. At this point, a urinary catheter can be inserted into the bladder to drain urine. 4-O or 5-O nonabsorbable monofilament suture material (such as nylon) is chosen for the urethrostomy because this material incites little inflammatory reaction and has minimal tissue drag. Simple interrupted sutures are placed at the corners of the incision to appose the urethral mucosa to the skin at the 11 and 1 position and again at the 5 and 7 position. A simple interrupted pattern is placed between the corner sutures. In ten days the sutures are removed. The urethra stoma tends to heal nicely and stricture is not a common problem.

## **Rabbits and guinea pigs**

### **Rabbit ovariohysterectomy**

Rabbits can be spayed any time after 5 months of age. Immature females have very tiny uterine horns and ovaries making identification difficult. Ovariohysterectomy is indicated in all female rabbits to prevent pregnancy, control territorial aggression associated with sexual related behavior, and prevent uterine neoplasia (very common) or other uterine disorders such as pyometra or endometrial venous aneurysms.

A 2-3 cm midline incision is made approximately one-third of the way between the umbilicus and the pubic symphysis. The linea is identified and gently grasped and elevated with thumb forceps as a stab incision is made into the abdomen. Great care is taken when entering the abdomen as the thin-walled cecum often times lies directly against the ventral abdominal wall. Minimal handling of the GI and gentle technique throughout the procedure will help minimize likelihood of the post op adhesions rabbits are prone to. A spay hook is usually not necessary as the uterus lies dorsal to the cranial pole of the bladder and is easily identified and lifted through the incision using forceps. With gentle traction, the uterus is followed to the oviduct and infundibulum that are coiled in a large loop several times longer than that of the dog or cat. The mesometrium of the doe is a primary site of fat storage and many times the ovaries and oviduct are embedded in a large fat pad. Gentle digital manipulation and traction will allow identification of the ovary which is isolated with its vasculature for ligation. There are multiple vessels associated with the ovary which need to be identified and double-ligated (together) with transfixing and cerclage sutures of PDS or Monocryl. Care is taken to ensure all of the oviduct is removed as well. The procedure is repeated for the opposite ovary. The uterus is now isolated and the body can be ligated cranial or caudal to the cervixes. In older does, the uterine vessels may be quite large and can be double ligated separate from the uterine body. The author prefers to ligate and resect the uterus close to the cervix- just on the vaginal side of the cervix. Closure of the abdomen with 4-0 monofilament absorbable suture is routine: Simple interrupted pattern in linea, followed by simple continuous patterns in SubQ and intradermal.

### **Rabbit castration**

Indications for rabbit castration include the control of urine marking behavior, the control of and minimization of territorial aggressive behavior, prevention of reproduction and testicular tumors.

Both prescrotal and scrotal techniques have been described. The author prefers a prescrotal incision as it is neater and is not associated with the complication of scrotal edema. A 1.5 cm incision is made on the midline just cranial to the scrotum similar to a skin incision for canine castration. One of the testicles is manipulated toward the incision by applying digital pressure on the scrotum. If testicles are withdrawn into the abdomen, gentle pressure is applied to the abdomen to return testicles to their normal position. The connective tissue and fat are dissected away with hemostats to expose and isolate vaginal tunic. The vaginal tunic is lifted up and the caudal ligament of the testicle is carefully torn from its scrotal attachment, freeing the testicle and spermatic cord. Gauze squares and traction will aid this procedure. Gentle pressure is applied to the abdomen to ensure the testicle is isolated to the caudal aspect of the spermatic cord. The spermatic cord is clamped proximal to the testicle and close to the inguinal ring. The spermatic cord is double ligated, using 4-0 non absorbable suture, transfixed and resected. The procedure is repeated on the opposite side. Closure of the subcutaneous tissue with a simple continuous pattern is followed by a continuous intradermal skin closure.

### **Guinea pig ovariohysterectomy**

Indications include: female guinea pigs can become sexually active as early as 8-12 weeks of age, cystic ovaries of varying degrees of size and hormonal influence, pregnancy toxemia and dystocia are common in older females. Neoplasia and pyometra are uncommon but can occur.

Technically guinea pig ovariohysterectomy is similar to the rabbit with several exceptions: (1) The ovaries are supported by a short mesovarium making the ovary more difficult to exteriorize than rabbits or carnivores. Initial skin incision is ideally made over the umbilicus and extends caudally 2-3 cm. It may be necessary to extend the incision cranially to avoid accidentally tearing the fragile, fat-filled suspensory ligament. (2) Hemostatic clips versus suture may make for easier ovarian pedicle ligation. (3) It is recommended to ligate the uterus just cranial to the cervix. In most cases, 2 transfixing sutures incorporating the uterine blood vessels are adequate.

### **Guinea pig castration**

Castration can be performed by a closed or open technique. The author prefers a closed technique which will be described. In guinea pig castration, the testicles are removed through two separate incisions over each scrotum. If either testicle is in the abdomen, gentle abdominal pressure will return the testicle to the scrotum. A 1-2 cm incision is made through the middle of the scrotum parallel to the penis. Care is taken not to penetrate the tunica vaginalis. Keep in mind that an inadvertent incision into the tunic may occur while incising over the scrotum creating an open situation. If this occurs, the tunic surrounding the spermatic cord and vas deferens can be grasped more proximally and still double ligated in a closed fashion. Grasp the tunic and remove the testicle from the scrotum and gently dissect the tunic from its attachment circumferentially. When the testicle is isolated, apply traction and gently strip the fascial attachments using a gauze square. This allows the testicle to be exteriorized and the spermatic cord isolated proximally. Ligate the cord using a two or three clamp technique and double ligate with transfixing absorbable suture material. Sutures are placed close to the inguinal ring without excessive pulling of the spermatic cord. It is not necessary to remove the epididymal fat pad and leaving it in place may prevent herniation. The technique is repeated on the opposite testicle and the spermatic cords checked for hemorrhage. Several simple interrupted (or a short continuous) subcutaneous sutures are utilized to appose overlying tissue followed by an intradermal closure in each scrotum.

### **Cystotomy**

Calcium carbonate and calcium oxalate cystic calculi are most common in guinea pigs and rabbits. Magnesium ammonium phosphate calculi are most common in ferrets. Definitive causes of cystic calculi are largely unknown with nutrition, anatomy, genetics, water intake, environment, and infection all possibly playing a role. Clinical signs associated with cystic calculi include hematuria, stranguria, dysuria, incontinence, bruxism secondary to abdominal pain.

Cystotomy is similar in all small exotic mammals. If possible, place indwelling urinary catheter in males especially with multiple small calculi--Slippery Sam Tomcat Urethral Catheter (Smiths Medical, Waukesha, WI)). Approach is via a ventral midline incision just cranial to the pubis. Exteriorize bladder and isolate with saline moistened gauze squares. Make a 5-10 mm incision in ventral bladder wall, beginning at the apex. Samples are taken for culture and sensitivity (calculus itself, mucosal swab or piece of excised bladder wall). Remove calculi and flush bladder with warmed normal saline. If urinary catheter placed- flush retrograde. If urinary catheter not placed pre-op you may pass urinary catheter normograde and flush small stones back into bladder for removal. Close bladder wall with 4-0 to 5-0 absorbable monofilament suture in a continuous inverting pattern (author uses Cushing-Lembert) taking care not to penetrate mucosa. Flush surgical site. Keep in mind that the bladder wall of guinea pigs and rodents is particularly thin. Return bladder to abdomen and close abdomen routinely.

## **Rats**

### **Rat mammary tumors**

Anatomically, mammary gland tissue in the rat extends on either side of the ventral midline from the axillary to the inguinal regions, and mammary gland tumors may occur anywhere in this area. Mammary gland neoplasms are probably the most common spontaneous tumors found in the rat. Adenomas and cystadenomas are uncommon and carcinomas of varying types (adenocarcinomas, papillary carcinoma, comedocarcinomas, and squamous cell carcinoma) are said to comprise less than 10% of all spontaneous mammary gland tumors in the rat. Benign mammary fibroadenoma represents approximately 85-90% of all mammary tumors in the rat. These neoplasms are most common in older rats, though may also occur in young females and males. Overall, the biological behavior is benign; the neoplasms can become very large, ulcerate, and infiltrate locally, but they rarely metastasize. For this reason, surgical excision is generally curative, but additional fibroadenomas may develop in remaining mammary tissue. Anecdotally, ovariectomy has been shown to prevent recurrence.

Surgical removal is straightforward. Due to the size of the patient wide margins are not taken. An elliptical incision is made around the mass. The mass is undermined and resected without penetrating the tumor capsule. In general these tumors have limited attachments to surrounding tissue. In spite of their large size, the vascular supply to these tumors is limited and can easily be ligated with vascular clamps (hemoclips) or suture material. Once removed the dead space and subcutaneous tissue can be closed with 3-0 to 4-0 absorbable monofilament in a simple interrupted or continuous pattern (depending on size of space to be closed). The skin is closed in a continuous intradermal suture pattern using the same suture material. Tissue adhesive is added to seal any remaining gaps along the incision line.

### **Post op considerations**

All exotic mammals tend to leave intradermal skin closures alone therefore this suture pattern is preferred in the skin. Rabbits and guinea pigs are hind gut fermentors and it is important that both species return to eating soon after surgery in order to prevent GI motility problems and hepatic lipidosis. Post operative analgesics are recommended in all exotic mammals for several days.

### **Recommended reading**

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