One of the most common pieces of advice I give less experienced veterinarians when it comes to working with unusual, exotic, and avian pets (UEAP) is to do what they always do! Trust the basics of veterinary medicine and surgery, and then learn the idiosyncrasies of the species with which you are currently working. When it comes to surgery in these species there are some important things that will help deliver better outcomes. Here are some lists of things (in no particular order) that have helped me become a better surgeon to my UEAP patients.

**General tips**

- **Analgesia** is fortunately rising in the consciousness of our profession to be one of our cardinal priorities - and that priority is applicable across the species divide. But for UEAP species it is even more important to the success of a surgical intervention. It is critical that a multimodal analgesic plan is initiated before surgery, and extend into the recovery period. The choice of narcotic does depend on the species involved, as different species have differing roles for the different receptor sites.

- **Local anaesthesia** is an important part of the multimodal approach to analgesia, but there are species that have acquired a reputation for sensitivity to the ‘caines. Chameleons, goats, and a host of small bird species have been anecdotally reported to suffer from reactions to these local anaesthetic agents. In my experience the problem is dose rate: if the 1-3mg/kg dose rate is not exceeded, I am unaware of any species having issue with these drugs. In very small animals I dilute 2% lignocaine 1:9 with sterile water to give a 0.2% solution which can be used to generate an adequate volume dose for birds like budgerigars. While I use tubes and tubes of EMLA cream for cats and dogs, I do NOT use it in small UEAP patients because it is almost impossible to deliver an accurate small dose.

- **Anaesthetic agents** were once a difficult part of UEAP practice - you once had to source exotic and unusual anaesthetic agents to contemplate this type of work. Now the drugs available in most small animal practices will be equally applicable to UEAP as they are to dogs and cats. We general premedicate with a narcotic possibly with a benzodiazepine, induce with alfaxan or isoflurane (by mask), and maintain on isoflurane. The purported benefits of sevoflurane are insufficient to justify its use over isoflurane.

- **Intubation** is not always possible, and should not take a significant time. But if possible, it is obviously safer to control airways, and allows more precise control or level of anaesthesia. Additionally artificial ventilation is not as easy to achieve without direct connection to the lower respiratory tract. A selection of small uncuffed endotracheal tubes, cut to a length to minimise deadspace are an essential investment.
• **Positioning** frequently requires some degree of lateral thinking when dealing with UEAP patients. Folded towels or clothes can allow restriction of movement of the body, and can help in birds to orient the oropharynx above the crop to limit passive drainage of inadvertently remaining crop contents to compromise the respiratory tract. Tape that is non-injurious to the feathers or scales can be used to precisely position the patient for surgery, as well as positioning the animal relative to the endotracheal tube, and other monitoring equipment.

• **Paddle-pop sticks** are an exceedingly useful tool to secure an endotracheal tube. Since most UEAP patients are of size or head shape that prevents “tying” a tube in being useful, taping the head and neck to a “paddle-pop” stick, and then taping the ET tube to the stick as well, will provide a very secure connection.

• **Retractors** used in human surgery for lower urinary tract access, such as the Lone Star® system, can dramatically improve access during surgery, and thereby help to limit incision size. The use of such retractors can take some practice, but the benefits are more than worth the effort.

• **Magnification with illumination** is important as many UEAP patients are very small, and without detailed observation it can be very easy to make serious, successful-surgery compromising errors. Good bright light and some magnification by way of a surgical loupe greatly facilitate surgical technique.

• **Hemaclips®** are small atraumatic stainless steel clips or clamps that are applied to blood vessels using special applicators. They dramatically speed the surgical process, and permit haemostasis in spaces that would be difficult to ligate.

• **Gelfoam®** is compressed sterile gelatin sponge that is water insoluble, and can be cut to any shape without fraying. It effects a haemostatic action by an unclear mechanism, but it appears to be a surface area acceleration of normal clotting mechanisms. It is particularly effective in fields where there is generalized ooze from a bed of capillaries, where it is difficult to control bleeding with other measures. In humans it is reported to be completely resorbed in a couple of months, but in some animal models it has remained for much longer. It is not clear whether this is deleterious.

• **Radiosurgery** utilizes high frequency alternating current, which generates focused intense heat which acts as a very local cauterity. Devices constructed to create this heat may be adjusted to provide cutting, or coagulation effects. The Ellman Surgitron® is a commonly used brand of radiosurgical unit amongst avian veterinarians.

• **Mechanical ventilators** provide a consistent delivery of oxygen and anesthetic gas over time. This is a huge advantage over allowing the animal to breathe on its own under a general anaesthetic, as there will inevitably be a decrease in respiratory excursions, which is very difficult to observe. A decrease in respiratory excursions leads directly to hypoventilation and hypoxia. Such ventilators are not fool-proof, and require close monitoring especially in birds when the coelom is breached. But their use in UEAP anaesthesia makes the procedures lasting more than 30 minutes measurably safer.

• **Hypothermia** is a very significant concern especially in very small UEAP patients. The dramatically higher surface area to volume ratio of small patients leads to a much higher rate of heat dissipation which routinely requires supplemental heating to correct. Recirculating water, or electric, heating pads and overhead heat sources can all help, but require monitoring to ensure patients are not burned. Heated forced air systems such as the Bair Hugger® system may be the best system for maintenance of body temperature even in very small patients.

• **Surgical instruments** for UEAP patients need to be of an appropriate size, and must handle tissue with minimal trauma. Microsurgical instruments and ophthalmological instruments provide a selection that these days are enhanced by instruments specifically designed for small UEAP patients.
Birds

- **Sterile surgical fields** are more difficult to create in birds since they have feathers. These should be carefully plucked to give a decent margin around the surgical site, but in some situations it is difficult to hold feathers out of the operative field. In these instances water-soluble lubricating gel can be used to moisten the feathers and hold them from contaminating the surgical site.

- **Clear adhesive plastic drapes** have the advantage of assisting in holding the bird in position, as well as permitting visualisation of the patient beyond the surgical field thereby allowing better patient monitoring.

- **Narcotics** are an important component of an analgesic plan for avian patients. The \( \mu \)- and \( \kappa \)-receptors both play a role in pain perception, and butorphanol at a dose of 1-4mg/kg will provide 12-24 hours of analgesia in most avian species. Practical experience informs us that there will be a variable suppression of ventilation with butorphanol which can be significant in patients that are not being ventilated externally.

- **Fasting** is important to ensure that the ingluvies (crop) is empty before a surgical procedure, to prevent regurgitation and aspiration. But birds have high metabolic rates and relatively low reserves of glycogen; so long periods without food are deleterious. For birds smaller then a galah we recommend 2-4 hours, and for birds larger we recommend 5-8 hours. Palpate the crop before induction of anaesthesia. Access to water is withdrawn 60 minutes before anaesthesia.

- **Positioning** of birds varies with the needs of the surgical approach, but lateral and dorsal recumbency are generally preferred, since the weight of a bird can seriously compromise ventilation if the patient is positioned in ventral or sternal recumbency. Surgeries which require access to the dorsal aspect of the bird, on the uropygial gland for example, mandate very particular arrangements to permit uncompromised ventilation.

- The **dive response** is a physiological response characterised by apnoea and bradycardia that occurs in diving birds such as ducks and pelicans, on induction of anaesthesia. It is understood that stimulation of trigeminal nerve receptors in the beak and nasal cavity triggers the response in susceptible species. If it occurs, cease administration of volatile inhalant anaesthesia provide positive pressure ventilation with 100% oxygen.

- A **cannulated air sac** can be used to attach the anaesthetic machine and free the oro-pharynx for surgical intervention. Air sac cannulation can be a life-saving manoeuvre for dyspnoeic birds that have tracheal obstruction – buying time for a curative intervention to be undertaken.

- **Sutures** of modern synthetic absorbable monofilaments (I use polydioxanone sutures) of 3/0 and 4/0 are suitable for most bird surgery. Despite being absorbable, they take an unreasonably long period to be broken down in bird skin, and generally need to be removed 2-3 weeks after the procedure. It is my experience that birds rarely attempt to remove their skin sutures.

- **Tissue cement** is an excellent adjunct to normal skin closure in birds, providing the cement is applied cautiously and in limited fashion, and does not entrap any feathers in the healing wound - the latter is likely to draw the bird’s attention to that location.

In birds, the most commonly performed surgeries at the Sugarloaf Animal Hospital are reproductive tract surgery (especially salpingectomy), infraorbital sinus irrigation, lipoma removal, fracture repair, and skin and feather biopsies.
Reptiles

- **Skin preparation** is difficult in reptiles due to the complex overlapping nature of the scales. Chlorhexidine has a wider spectrum of bacteriocidal activity than povidone iodine in herps, and anecdotally is reported to be less irritating. It must be scrubbed in and left in place for longer than we expect for mammals – we use 10 minutes as a minimum.

- **Fasting** is generally not an issue with herps, but certainly can be! In elective procedures we prefer to NOT anaesthetise a snake that has consumed a meal in the last 5 days. If we are working in the coelom or more specifically the GIT, we will usually fast a reptile for a week. As snakes can go weeks to months between normal meals, fasting may be a moot point!

- **Intranasal (IN) induction** using dexmedetomidine and ketamine has recently been reported in the Journal of Herpetological Medicine and Surgery, in Yellow-Bellied Sliders. This may become a viable route of sedation for minor procedures, or before induction with an intravenous agent.

- **Analgesia** provided by butorphanol and burprenorphine have not been established in reptiles by rigorous clinical studies. μ-agonist opioids such as methadone and morphine are effective in decreasing pain, but have to be used at relatively high doses (1.0-5.0mg/kg) to be effective.

- Paramedian incisions are generally used to enter the coelom, as there is a ventral midline vein of considerable size. There is some controversy amongst those that do a lot of reptile coeliotomies, weighing the risk of haemorrhage against the increase in pain due to incising the muscle layer, but, as a surgeon, I think it prudent to avoid the large blood vessels wherever possible. When making such paramedian incisions it is best, where it is possible, to cut between scales rather than through them. Such incisions heal more quickly and with less scarring.

- The **preferred optimal temperature zone (POTZ)** is that range of body temperatures in which herps will operate their metabolism optimally. As a consequence it is best to maintain reptile surgical candidates at their POTZ to permit the best possible recovery from surgery and anaesthesia.

- **Tongue** damage is a potential problem in cases of oral surgery, especially in snakes and varanids. The tapering thin tip of the forked tongue is critical to the function of the vomeronasal organ, and damage to this organ system can hugely impact the animal’s ability to find food. In a wild animal this in all likelihood will prevent a return to the wild. Ensure the tongue remains in the sheath, and that the tip is moistened with lubricant to prevent dessication.

- **Skin closure** is critical in reptile surgery, as the skin is the major source of strength in holding a wound closed in these species. The muscle wall maybe tissue thin in some species, and more damage may be done trying to close it than simply depending on the skin closure.

- **Everting skin closure** by using a horizontal mattress suture tied relatively tight gives a much better long term results in reptiles. Synthetic monofilament, as in birds, provides excellent closure. However, to an even greater extent than in birds, they are not absorbed by reptile skin. They should be left in place until the first ecdysis after the surgery, which may be several months. In many instances this shed will result in the sutures falling out, but on occasions the sutures will interfere with the shed, and need to be gently removed (and the abnormal shed facilitated).

- **Postoperative care** is critical, and surgical patients should be housed in clean paper that is changed daily. The enclosure should be maintained in the POTZ, and the herp should be kept hydrated. Many reptile patients will become anorectic, and will need to be force-fed during their recovery.
The most common surgical procedures we perform on reptiles include salpingotomy in the treatment of dystocia, coeliotomy in the treatment of gastrointestinal obstruction, surgical removal of mass lesions, dental COHATs, surgical management of prolapses, and fracture repair.

The most recent developments in reptile surgery are focussed around the increasing use of endoscopic techniques. There are a number of academic centres in the US and Europe where these techniques are heavily sued and increasingly refined. Such techniques are obviously less intrusive and permit a more speedy recovery in the reptile patient. As well endoscopy provides access to some sites that are normally very difficult to access, such as the coelom of the chelonians. As more endoscopic instruments become available for a reasonable price, and therefore are acquired by more practitioners in general practice, these techniques are likely to diffuse from their academic sources to the benefit of our reptile patients.