Female Lizard Reproductive Surgery: Margaret A. Wissman

With the continued popularity of green iguanas (*Iguana iguana*), bearded dragons (*Pogona vitticeps*) and water dragons (*Physignathus cocincinus*), as well as interest in the smaller lizards, such as geckos and anoles, veterinarians are being called upon more and more to provide accurate husbandry, nutrition and behavioral information to interested owners. As veterinarians, we should be able to perform a complete physical examination, appropriate diagnostic tests and advise owners about correct care, as well as be knowledgeable about their medical conditions.

It is heartening that so many owners are now taking such good care of their pet lizards. While this is very good news for the reptiles, it does create a whole new set of medical issues for both herp veterinarians and herp owners. Healthy adult lizards may become reproductively active, even without the presence of a conspecific male. This seems to be the biggest problem in mature, female green iguanas, although any healthy lizard may go through a reproductive cycle under the right conditions.

For the dedicated herpetologist who wants to breed lizards, an in-depth knowledge of what's involved is vital. Green iguanas and water dragons, lizards that thrive in fresh air, sunshine and clean water, should be bred outdoors, if at all possible. Smaller lizards, such as bearded dragons, geckos and anoles, can be bred indoors by providing them with correct caging, lighting, heating and diet. Problems can arise with an iguana that has begun a reproductive cycle, unbeknownst to the owner, and it has no appropriate substrate for digging. More on that later.

Lizards reach sexual maturity based on size, more than chronological age. Factors such as nutritional plane, preventative veterinary care and physiological stress will affect sexual maturity. Small lizards may become reproductively active at one to two years of age, while larger lizards may be three or four years old prior to becoming physiologically able to reproduce. Green iguana females are capable of egg production when they are over 500 grams. Females may become reproductively active when between two to four years of age, however large yearlings are often capable, as well.

Since green iguanas, among the lizards, usually have the most problems related to reproduction, we will use them as a model. A working understanding of reproductive biology is necessary in order to assess the reproductively active reptile. There is a breeding season for wild green iguanas, and like most lizards, it is usually determined by cycles of photoperiod, temperature, rainfall and availability of food. In Panama, the reproductive season occurs in late fall through spring. In captivity, they often begin a cycle in February through May, and will oviposit in June through August, although it is possible for them to cycle at any time of the year when conditions are favorable.

Male lizards possess two hemipenes that are sac-like and do not have erectile tissue. They are usually contained within a pouch in the base of the tail, and they are inverted. In adult males, these hemipenes may produce noticeable bulges ventrally, distal to the cloaca. During copulation, one hemipenis at a time is usually everted resulting in internal fertilization of the female. Urination does not occur through the hemipenes. Corresponding to the breeding season in females, there is often a fluctuation in the size of the paired testes.

Determining the sex of a mature lizard is usually quite simple as the hemipenal bulges are obvious. Femoral and precloacal pores, when present, are much larger in adult males. Many lizards are sexually dimorphic as adults. They may have larger dorsal spines, larger dewlaps and larger operculum scales. Males may have erectable dewlaps, bigger crests, larger heads, or head ornamentation consisting horns, crests or plates, or

brighter colors than females. Males may be larger in size than females. Male bearded dragons develop a dark colored beard. In some male monitors, the hemipenes calcify and may be seen radiographically. Sexing may be accomplished by using sex probes to measure the depth of the pockets distal to the cloaca. The pocket is much deeper in males (as the probe enters the inverted hemipenis). Endoscopy may be employed to visualize the internal gonads.

Female lizards have paired ovaries and oviducts. Ovaries vary in size depending on the stage of oogenesis. The oviducts possess both an albumin-secreting function and a shell-secreting function. There is no true uterus. The oviducts connect to and open directly into the cloaca through papillae. Some females lay eggs (oviparous), while some bear live young (ovoviviparous). If the yolk provides the source of nutrition for the developing embryo, this is called lecithotrophy. Matrotrophy is where nutrients are provided by an alternate means such as a placenta. The degree of matrotrophy is variable, with some skinks (*Mabuya spp.*) providing over 99% of the neonatal mass through a chorioallantoic placenta. For clarity, I use the term gravid for egg-layers and pregnant for those lizards that produce live young. Both sexes possess a cloaca, the orifice located ventrally, at the base of the tail, which is used for urination, defecation and reproduction. With the onset of a breeding cycle, the female will begin to undergo vitellogenesis. The reptilian follicle begins to mature as yolk accumulates around the ovum. Vitellogenesis occurs as estrogen stimulates the liver to convert lipid from the body's fat stores to vitellogenin. During vitellogenesis, the liver enlarges dramatically and it takes on a characteristic orangish color. The follicles selectively absorb the vitellogenin from the bloodstream, plumping the follicle with yolk. Blood drawn from an iguana undergoing vitellogenesis will appear lipemic from the circulating vitellogenin. Once the ovum has ovulated, it will have albumen and the shell added in the oviduct, and at this point, it becomes an egg. Prior to ovulation, the mature follicles will appear as a cluster of grapes and are of soft-tissue density on radiographs. Once the female has ovulated and the eggs have been completed by the addition of the shell, the eggs will be visible on radiographs due to their calcification.

It is very important for the herp veterinarian to be able to discern between pre-ovulatory follicles and actual eggs, as the course of treatment will vary according to the different conditions. Gravid iguanas requires a suitable nesting site, as females engage in specific nesting behaviors, including digging a rather deep hole in order to oviposit their eggs. Many pet green iguana owners may not realize that their female is preparing to go through a breeding cycle, and therefore will not provide her with a suitable nest box with a minimum of one to two feet of a substrate (clean potting soil, or construction sand mixed with potting soil and vermiculite, or sphagnum moss, vermiculite and peat). Lack of a suitable area for digging, which stimulates oviposition, is a major reason why many gravid females develop dystocia.

In addition to the female green iguana retaining her eggs because she does not have an adequate location and substrate for digging, there can be many other causes of dystocia. Non-obstructive dystocias, where the eggs appear to be of normal size and shape and the female appears to have normal anatomy, usually are the result of poor husbandry (including not having an appropriate nesting site). Other causes of non-obstructive dystocia are malnutrition, improper temperature, dehydration, poor physical condition and possibly oviductal infection. In some cases, a female suffering from malnutrition or poor physical condition will begin oviposition and will lay the majority of the clutch, but may retain one or more eggs.

Obstructive dystocias occur due to an anatomic inability to pass one or more eggs through the oviduct and cloaca. Eggs may be oversized, malformed or possessing an irregular surface, making expulsion difficult. The female may have a misshapen pelvis,

oviductal stricture, or masses such as abscesses or cystic calculi. Other causes of obstructive dystocias can be a malpositioned or damaged egg. In rare cases, a female may develop eggs before she has grown to a sufficient size to be able to successfully pass them. This seems to be a more common problem in rock iguanas (*Cyclura ssp.*)

Surgery for dystocia is straightforward. However, deciding when a gravid lizard is suffering from dystocia is most often the hard part! A normal, gravid female iguana will develop an extremely swollen abdomen and individual eggs may actually be outlined. Prior to making a decision to perform surgery, it must be ascertained if the female does indeed have a suitable place to oviposit. A healthy gravid female will often cease eating as her belly fills with eggs. This is normal. Some gravid females will continue to eat minimal amounts of favorite foods right up until oviposition.

It takes about eight weeks for a female to go from beginning production of enlarged follicles to actual egg laying. Most iguanas will cease eating during the last four weeks of being gravid. Normal iguanas go off food approximately 65 days after copulating. Some females will develop large follicles, then resorb them if the conditions are not favorable for oviposition. This cycle may then repeat in subsequent seasons. It is very important for you to ascertain if the follicles have been ovulated or not, as medical therapy, including calcium injections and oxytocin, will be ineffective. If the ova in the follicles do not ovulate, and do not resorb, the mature follicle membranes will adhere and coalesce, resulting in a large agglomeration of friable yolk. This mass may rupture, and the free yolk mass in the coelom can cause severe inflammation and peritonitis, resulting in severe illness and death.

Post-ovulatory eggs will have albumin, membranes and shell applied in the oviducts. These are usually visible on radiographs. If eggs are visible and the female has been anorexic for four weeks, she should be close to oviposition. At that time, she should be kept at the high end of her temperature range, in the mid-nineties (degrees F) and she should be provided with an appropriate nesting box for oviposition. Hopefully, she will already have been on an excellent diet and she will have received additional calcium (calcium glubionate, Neocalglucon™) at 1 ml/kg PO BID or calcium carbonate (Tums™) at an equivalent dosage during at least the last four weeks of her "pregnancy" to provide her with enough calcium to produce eggshells (which are soft-shelled and less radiodense than parrot eggs) and to contract her oviducts when the time comes. She should also have a full-spectrum fluorescent light, replaced every 6 months, in order to mobilize her calcium more efficiently.

Your challenge, when presented with a female green iguana that is eating less or acting differently, is to determine if: 1. she is normal and pre-ovulatory 2. she was pre-ovulatory and resorbed her yolks 3. she is pre-ovulatory and there is follicular stasis 4. she is gravid with post-ovulatory eggs and is not yet ready to oviposit or 5. she is gravid with eggs and the eggs are retained (for some reason, she has not oviposited).

The conditions requiring your care are pre-ovulatory stasis and retained eggs (dystocia). Of course, all females should be receiving full-spectrum lighting, calcium supplementation and an excellent diet. If radiographs or ultrasound shows that a female has shelled eggs in the oviducts and that she should be able to physically pass her eggs, treatment can be attempted with injectable calcium (100 mg/kg 10% calcium gluconate IM q 6 hr) and oxytocin (1-10 IU/kg IM one hour after the calcium injection). The dose for oxytocin may be repeated in increasing increments 20-60 minutes apart, until oviposition is achieved. Arginine vasotocin is more effective at stimulating a female to oviposit, but this drug is difficult to acquire and is expensive. As in cats and dogs, if there is an obstructive dystocia, oxytocin should not be given. The iguana should be maintained at optimum temperature (mid-90's) during treatment.

Surgery should be considered if there is pre-ovulatory follicle stasis or if eggs are in the oviduct for an extended period of time. A gravid female that has not eaten for four weeks is normal, and most healthy females can tolerate this anorexia quite well. So when does a gravid female become a surgical candidate? I usually recommend surgery if a female has been off feed for at least four to six weeks, medical therapy has failed after four or more weeks of anorexia, or if a gravid female suddenly crashes. Once I have ascertained that the female should be at term, I will usually attempt to induce oviposition in the hospital for 24 hours. If her condition hasn't changed during that time frame, I consider surgery. A normal, gravid female is active and alert. If she suddenly becomes depressed, lethargic or unresponsive, this should be an indication that she may require surgery as soon as possible (I will still attempt medical therapy for 24 hrs. if the conditions warrant it). Tremors, a change to a dull skin color or weight loss are also indications for surgery.

Time permitting, running a CBC and chemistry panel is valuable pre-op. For pet iguanas, I recommend that I perform an ovariosalpingectomy, which will preclude any further reproductive problems. If a female is to be salvaged for breeding, multiple salpingotomies are usually necessary, as a female green iguana may produce as many as 20-30 eggs or more. However, often a female that has had one dystocia is predisposed to having it happen again.

With retained follicles, the cluster of ovulated ova and the ovary should be surgically removed. In the case of an owner wanting to preserve reproductive capabilities, it might be possible to salvage the ovary, however, I usually urge the owner to consider spaying the female. If the female is a pet, it is best to remove both ovaries and oviducts to prevent future problems. Never leave an ovary and remove the oviduct, as with future ovulations, coelomitis, often fatal, can occur.

Surgery is usually performed under isoflurane anesthesia. Clear drapes are advantageous for assessing the patient intraoperatively. Keeping the patient warm during and after surgery is important for the immune system. Fluid support via intraosseous, subcutaneous or (rarely) intravenous routes helps maintain hydration. There is a large single abdominal vein located on the midline just under the skin that must be avoided. The ventral abdominal vein is suspended from the linea alba by a short mesovasorum. Some vets prefer to make a midline incision, through the linea alba, being careful to carefully dissect around the central vein. Others prefer to make an incision just off the midline to one side or the other. The disadvantage to this approach is that muscle is being transected, which may result in more bleeding than cutting through the linea alba. Iguanas lack an obvious coelomic membrane, and one must be careful to not mistake the thin bladder wall for the coelomic membrane. In chameleons, a paralumbar incision provides excellent exposure for ovariosalpingectomy.

Once the coelomic cavity is entered, if there are eggs in the oviducts, the oviduct is exteriorized, and the mesovarium vessels are ligated with two absorbable sutures (or vascular clamps). It must be noted that the shell gland and oviduct are richly supplied with large blood vessels that are most easily ligated with hemostatic clips, transecting between two closely applied clips. Begin at the infundibulum, ligating and transecting vessels, progressing caudally towards the junction of the shell gland and the cloaca. Two clips are used to ligate the shell gland, which is then transected and removed. Any diagnostic sampling can be performed on the excised tissue.

If the procedure is to be a C-section, salpingotomy incisions are repaired using an inverting suture pattern of an absorbable synthetic suture material. It may be necessary to perform several incisions into the oviduct to remove all of the eggs.

The ovaries are located under the oviducts full of eggs, so removal of the oviduct and shell gland will make removal of the ovaries simpler. The right ovary is in close proximity to the vena cava. The right ovary is elevated and clips are applied between the ovary and the vena cava. The ovary is removed after transection between the ovary and the clips. The artery and vein that supply the left ovary are adhered to the left adrenal gland, so care must be taken to not injure the gland during removal. Clips are applied between the ovary and the underlying tissue and vessels, and then the tissue is transected between the clips. If preovulatory follicles are present, the ovaries are removed using the same technique for ovariectomies in dystocia surgery. Depending on the wishes of the owner (and the condition of the lizard) the oviducts and shell glands may also be removed or left intact.

Once the procedure has been completed, the muscle layer is closed with 2-0 or 3-0 absorbable suture in a simple interrupted pattern. The skin must be closed using an everting suture pattern, the horizontal mattress, with appropriate size non-absorbable suture, or with skin staples, also in an everting pattern. Sealing the incision site with a surgical tissue glue helps prevent post-operative infection.

Sutures should remain for approximately six weeks before removal. For at least 10-14 days post-op, the lizard should remain in a warm and dry environment. Swimming should be prevented during this period of time, as well. Fluid therapy may be necessary to prevent dehydration after surgery. If the patient is anorectic, it may require force-feeding to prevent weight loss and nutritional deficiencies.

The actual surgical procedures for a C-section, ovariosalpingectomy and pre-ovulatory ovariectomy are straightforward, as long as you take into account the unique anatomical differences found in the many lizard species. However, performing the diagnostics necessary to ascertain whether the reproductive problem is pre-ovulatory or post-ovulatory is very important, as the medical and surgical treatment varies according to which condition the lizard is suffering from. The rewards gained by successfully treating a female lizard with reproductive problems are well worth the challenges involved in correctly diagnosing a case.

Copyright © 2006 Margaret A. Wissman, D.V.M., D.A.B.V.P.
All Rights Reserved
ExoticPetVet.net
www.exoticpetvet.net