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Egg retention in snakes

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EGG RETENTION is occasionally encountered by herpetologists and veterinarians as a cause of dystocia in oviparous reptiles. There is little information on its prevalence in practice, diagnosis, and treatment, although descriptions of surgical treatment of the condition in chelonians[1–4] and snakes[5–7] have been published.

The purpose of this report is to give examples of noninvasive and invasive techniques used for relieving egg retention in oviparous snakes, to speculate on the cause of this problem in reptiles, and to compare our methods with those described by others.

Anamnesis

Nine snakes with egg retention have been seen by the authors (Table 1). Five of the snakes were first seen after laying eggs from 24 hours to 2 weeks earlier. One of the snakes (No. 5) had the same problem in two successive years. The duration of gestation at the time of examination was known for only 2 of the snakes. In both cases, the duration of gestation was longer than would normally be expected. In 2 of the pythons (No. 1 and 2), brooding behavior (coiling around the eggs and muscle twitching) was evident after some eggs were laid, while retaining others.

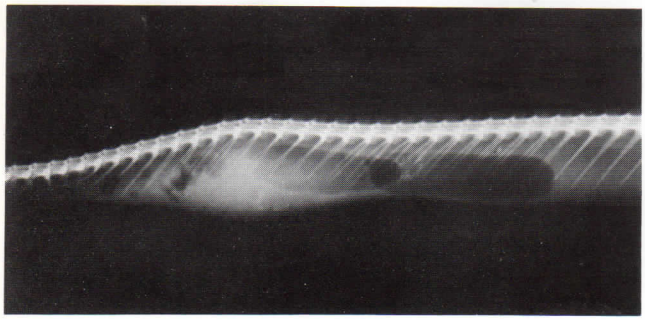

Fig 1—Case 7—Air injected into the cloaca provided contrast against which a retained yolk mass was seen.

Diagnosis

Egg retention was diagnosed from the history, the palpation of egg masses, and in some cases (Table 1) by plain or contrast radiography (Fig 1). In only 1 case (No. 7) was the diagnosis in doubt before surgery, because only 1 yolk mass was close to the cloaca and since there was no history that the snake was gravid.

Fig 2—Case 2—After inducing anesthesia, a python was intubated with a Magill endotracheal tube.

Treatment

Oxytocin was given to 5 of the snakes with egg retention. Dosages varied from 0.4 to 10.0 IU/kg, IM (Table 1). Only on one occasion (case 5) was this effective in causing oviposition without resort to surgery. In this instance, calcium borogluconate (10 ml of 1% solution/kg) was given at the same time. This was effective in treating the egg retention only in the first of two years that the snake had the problem. A sample of heart blood collected at that time had a calcium content of 12 mg/dl, which is within the normal range for snakes.

In all snakes, surgical treatment eventually was required to relieve egg retention (apart from the first year when the Corn snake, case 5, had this problem). Celiotomy and salpingotomy was performed on 7 of the snakes, and a noninvasive manipulative technique was used on the other 2 snakes.

Anesthesia

Anesthesia for both procedures was as previously described.[8–11] Anesthesia was induced either with a 2% to 4% halothane and oxygen mixture delivered by mask (cases 1, 2, and 4) or by direct intubation of the conscious snake (cases 8 and 9). In 4 snakes, anesthesia was induced with ketamine hydrochloride (50 to 60 mg/kg, IM) (cases 3, 5, 6, and 7). On the larger pythons, a No. 4 Magill endotracheal tube was used for maintenance of anesthesia (Fig 2). In the small snakes, uretheral catheters of appropriate diameter to fit the trachea were used. The ball python (No. 4)

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TABLE 1—Pertinent information from nine cases of egg retention in snakes

Case No.	Species	Snout-vent length (mm)	Weight (g)	Gestation (mo)	Eggs laid before onset of retention	Eggs retained	Oxytocin Dosage (IU/kg)
1	Burmese python *(Python molurus bivittatus)*	2,440	7,000	—	2	12	1.0
2	Burmese python *(P molurus bivittatus)*	2,700	12,000	5 to 6	2	5	—
3	Burmese python *(P molurus bivittatus)*	—	13,000	—	5	11	0.4
4	Ball python *(Python regius)*	1,200	3,500	4	0	6	1.4
5	Red-rat snake *(Elaphe guttata guttata)*	720 (1st yr)	60	—	3	5	10.0
		815 (2nd yr)	105	—	5	2	10.0
6	Red-rat snake *(Elaphe g guttata)*	—	543	—	14	2	1.0
7	Ribbon snake *(Thamnophis sauritus)*	—	52	—	0	1	—
8	Mexican milk snake *(Lampropeltis triangulum annulata)*	—	—	—	0	5	—
9	Florida king snake *(Lampropeltis getulus floridana)*	—	—	—	0	12	—

was maintained under anesthesia by mask, although this had the disadvantage of precluding effective intermittent positive pressure ventilation, if required. In all cases, anesthesia was maintained with a mixture of 1% to 2% halothane and oxygen. Induction times were from 7 to 12 minutes at ambient temperatures of 13 C to 21 C, and postoperative recovery times ranged from 14 to 30 minutes after discontinuing halothane, while breathing oxygen. The longest recovery times were in snakes in which anesthesia was induced with ketamine.

Righting, tail pinching, and tongue withdrawal reflexes were monitored as a guide to the depth of anesthesia, and the heart rate was recorded from the movements of the ventral celomic wall of dorsally recumbent snakes. In the 3 cases monitored (No. 1, 2, and 4), the heart rate remained steady at 30 to 36 beats/min throughout the procedure. Manual intermittent positive pressure ventilation was used at a rate of 2 to 3 respiratory cycles/min whenever respirations became erratic or shallow.

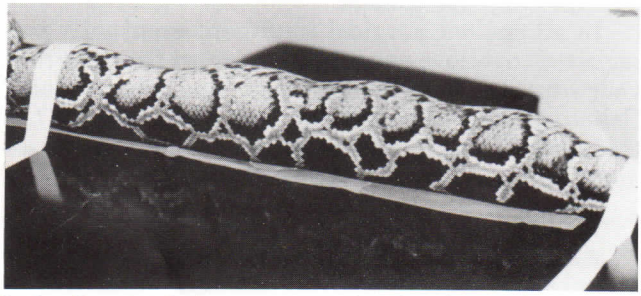

Fig 3—Case 2—Python maintained in dorsal recumbency with adhesive tape.

Celiotomy and Salpingotomy

Snakes were placed in dorsal recumbency and secured to the operating table. A heat pad was used on one occasion (case 5). Positioning was maintained where required with adhesive tape (Fig 3). The surgical site, centered over the egg mass, was cleaned with povidone iodine, and sterile drapes were placed around the area.

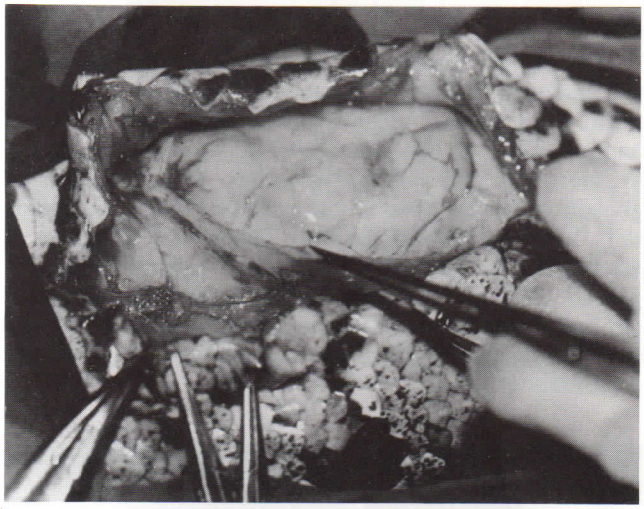

Fig 4—Case 2—Incision between first and second row of lateral scales revealed extensive celomic fat bodies.

Incisions of various lengths, depending on the size of the snake, the number of eggs, and eventually the ease with which they were removed, were made through the skin, subcutaneous fascia, and peritoneum. The position of the incision varied, being paramedian through the ventral scales in 3 cases (No. 1, 4, and 5), at the junction of the ventral and lateral scales (No. 3, 6, and 7), or ventrolaterally between the 1st and 2nd rows of lateral scales (No. 2) (Fig 4).

The celomic fat bodies, which were particularly well developed in the Burmese pythons, were bluntly dissected (Fig 5), taking care to avoid the large ventral abdominal vein. The oviduct, now exposed, was incised over 1 of the eggs (Fig 6). The egg directly beneath the incision was easily removed and, when possible, the remaining eggs were gently massaged along the oviduct, toward the incision site. This was

Fig 5—Case 2—Separation of the fat bodies exposed the oviduct.

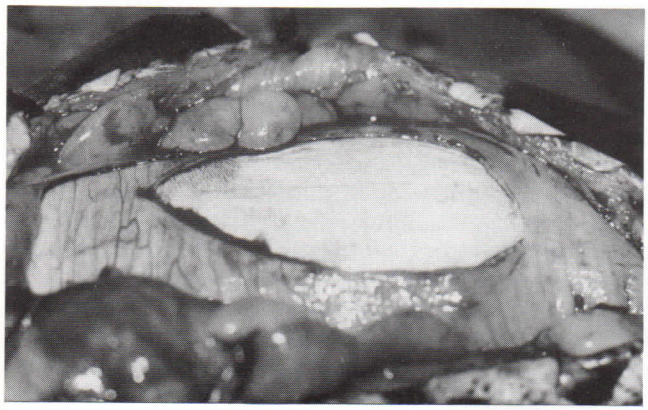

Fig 6—Case 2—Oviduct was incised over the egg.

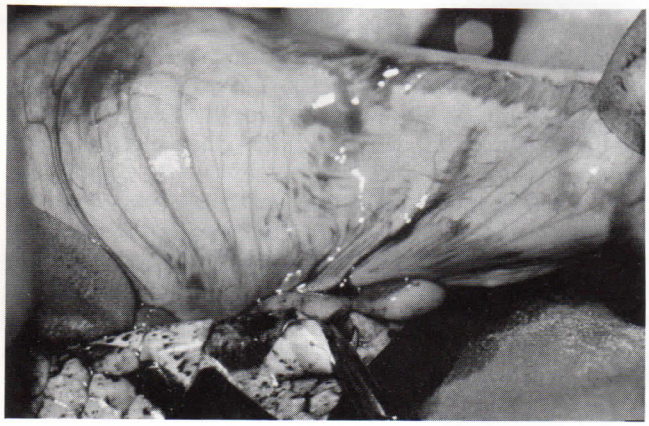

Fig 7—Case 2—Oviduct was tightly adherent to the egg shell and constricted between adjacent eggs.

Fig 8—Case 2—Oviduct was repaired, using ophthalmic instruments and ophthalmic suture material.

possible in 4 of the snakes (No. 1, 4, 5, and 7). In the remaining 3 snakes (No. 2, 3, and 6), it was necessary to make incisions over most of the eggs, as they were adherent to the oviduct. In 1 of these cases (No. 2), the oviduct was constricted between adjacent eggs (Fig 7), and the surface of the eggs appeared course and rough. Attempts to move 1 small egg along the duct (case 2) caused tearing of the friable serosal surface of the oviduct, making its repair more difficult.

The oviduct was sutured with a simple continuous and slightly inverting suture pattern, using 3:0 or 4:0 chromic gut. In case 2, ophthalmic surgical instruments were used to place continuous sutures of 6:0 polyglactin 910 in the oviduct (Fig 8), facilitating closure of the delicate tissue.

The skin and subcutaneous tissues were repaired with 3:0 or 4:0 monofilament nylon in cases 3, 5, 6, and 7 and with 2:0 silk for cases 1, 2, and 4, without differences being noted in the postoperative results. A plastic skin dressing was applied to the skin over the operative site in 1 instance (case 5).

Postoperative recovery was uncomplicated in all cases. Snakes 1, 2, and 4 were given ampicillin (10 mg/kg, IM) for several days after surgery. Snake 5 was given ceftazidine (20 mg/kg, IM) at 3-day intervals for 2 treatments. Isotonic dextrose-saline solution was given (5 to 6 ml/kg, IP) to snakes 1 and 2. Sutures were removed from 21 days to 6 weeks after surgery.

Manipulation To Relieve Egg Retention (Manipulative Technique)

Snakes 8 and 9 were treated for egg retention by a noninvasive method. A vaginal speculum was inserted into the cloaca, and the left and right openings of the oviduct were visualized (Fig 9). The eggs were massaged distally by digital pressure exerted through the body wall, then removed from the cloacal opening with Allis tissue forceps (Fig 10 and 11). A serosanguineous discharge was voided with the eggs from snake 9. Snake 8 had the oviducts cannulated after removing the eggs, and 3 ml of sterile phys-

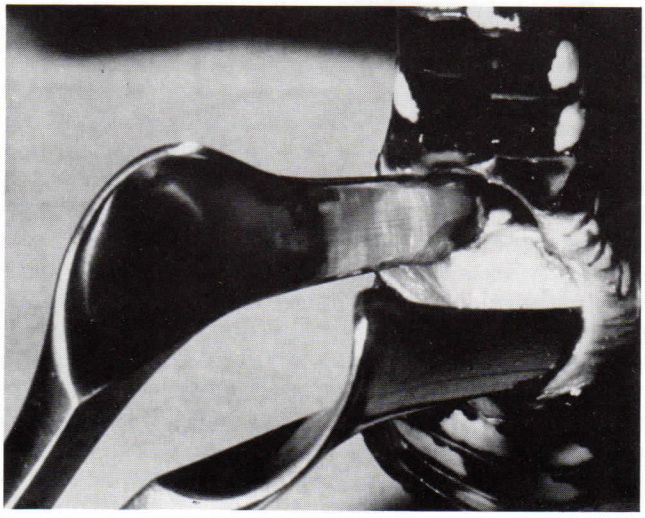

Fig 9—Case 9—Speculum inserted into the cloaca to see the oviduct openings.

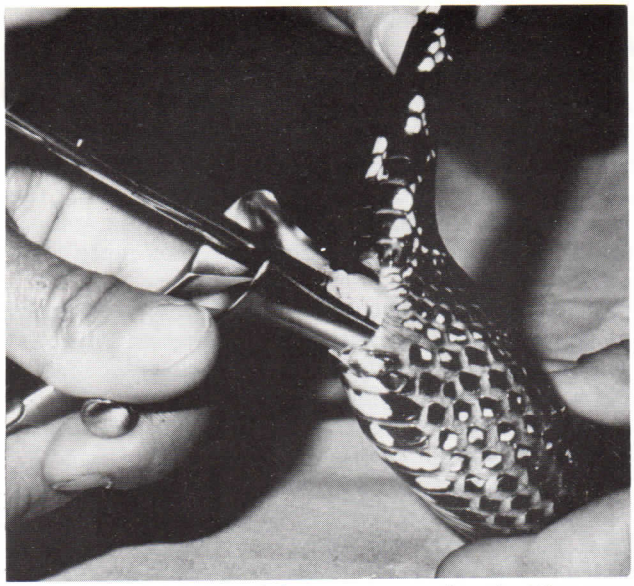

Fig 10—Case 9—End of the egg grasped with Allis tissue forceps.

Fig 11—Case 9—Egg gently removed from the oviduct opening.

iologic saline solution was infused into the oviducts. The snake was given chloramphenicol (50 mg/kg, IM) daily for 9 days. Recovery was uncomplicated.

Snake 9 was given gentamicin sulfate (4 mg/kg, IM) and 6 ml lactated Ringer's solution IP, but it died 3 days later. Although the snake was not necropsied, its death probably was due to oviduct perforation from the egg retention or the manipulative technique.

Discussion

Several investigators have reported on egg retention in reptiles.[1–4,6,7,12–16] The causes have been discussed by Frye,[12] and many factors may be involved. Environmental influences (eg, temperature during gestation, photoperiod, and diet) as well as endocrine abnormalities are potential causes.[3,12] There is no evidence to suggest that some species are more predisposed to egg retention than are others.

In the 9 cases of this report and in others previously described, infertile, dead, and decomposing eggs have been associated with egg retention. Swelling of the egg[8] and changes in the surface features of the egg shell (as seen in case 2) are probably secondary to egg retention, but no doubt exacerbate the problem.

Egg retention has been diagnosed in association with bacterial septicemia in snakes and chelonians. In a female ball python that was infected with *Aeromonas* and *Pseudomonas*, surgery was needed to remove 24 retained eggs found to be infected with both pathogens, and the snake died a few days later from bacterial septicemia.[16] Holt surgically recovered retained eggs from a Greek tortoise *(Testudo graeca)* and isolated *Pseudomonas* and *Proteus* species from them. The tortoise died 2 days later and *Pseudomonas* was isolated from its heart blood.[3]

Physical causes of egg retention in reptiles have included obstruction of the pelvis by eggs[3] and abnormalities in egg shape.[1] In this series, the size of eggs laid before retention was similar to that of those retained, suggesting that the size of eggs is not a major factor in causing egg retention.

A dietary imbalance of calcium to phosphorus, coupled with hypovitaminosis D, from lack of sunlight, has been shown to be a cause of infertility in lizards, resulting in weakness of the fetus and a failure of eggs to hatch.[17] In mammals, it has been suggested that calcium deficiency could render the oviduct muscle less responsive to the effects of pituitary hormones.[18] A deficiency of calcium in reptiles might similarly reduce the contractile response of the oviduct. Certainly, the use of calcium in case 5 did give a better response to exogenous oxytocin than when the latter was used alone (cases 1, 3, 4, and 6). Nevertheless, the blood calcium content in this snake was within normal limits.[19] Snakes, which are fed whole animals, would be less likely to develop a calcium to phosphorus imbalance than would lizards and chelonians, which are offered less-balanced diets. The effects of mammalian oxytocin on isolated lizard oviduct in vitro is considerably potentiated by magnesium ions added to the perfusing medium.[20] Perhaps magnesium should also be given with oxytocin and calcium for optimal effect in inducing oviposition.

It is known that mammalian oxytocin will induce egg laying in reptiles[20] and can even stimulate oviposition at early stages of embryonic development in chelonians.[21] Nevertheless, there is still doubt as to which neurohypophyseal polypeptides (oxytocin, arginine vasotocin, or mesotocin) are secreted in reptiles.[21] If arginine vasotocin is the naturally secreted hormone, this would partly explain the poor response achieved occasionally with mammalian oxytocin. In mammals, the effects of oxytocin are highly dependent on the presence of estrogen.[18] If the same were to apply to reptiles, eggs might be retained if blood estrogen content was low. Further, oviduct muscle might become refractory to the contractile stimulus from oxytocin, as apparently was the case when a 2nd ineffective dose of oxytocin was given in case 5.

It has been suggested that oxytocin is unlikely to be effective if the oviduct mucosa is dehydrated.[22] The eggs themselves might absorb moisture inside the oviduct. As the mucosa becomes more dehydrated, it would adhere more closely to the eggs and exacerbate the egg retention. Changes in the surface features of the egg shell (as seen in case 2) would further reduce the possibility of normal oviposition. An extreme case was observed by Mulder et al[5]: an anorexic king snake *(Lampropeltis gelutus)* had been losing weight and oviposition was overdue by 3 months. The retained eggs were so adherent that they could be removed only by blunt dissection. Thus, the greater the egg retention time, the less chance of effecting oviposition by use of oxytocin alone.

Deciding that the gestation period of a reptile is abnormally prolonged may be difficult, particularly so in snakes. Many reptile species mate on a number of occasions over a period of weeks, and there is no way at present, at least in most species, of deciding at which mating fertilization occurs.[23,24] Sperm retention in the females of some species and delayed fertilization further complicates the matter.[24,25] Also, the duration of gestation depends on the temperature at which development occurs, and few data are available regarding the gestation periods of particular species at given temperatures.[23,24] In this report, only 2 cases had histories indicating the gestation period at the time of examination. The ball python (case 2) had been pregnant for 4 months, which is comparable to what has been reported.[26] The Burmese python (case 3) had been gravid for at least 5 months. This is over one month longer than the longest accurately reported gestation period for this subspecies from which live young were produced.[24] In the latter report, low night temperatures probably accounted for the slow development.[24] A gestation period as short as 2 months has been reported for *Python molurus.*[23]

In most of these cases it was possible to make the diagnosis of egg retention with the prior knowledge that some eggs had been passed earlier in the gestation period. In our experience with snakes, it is unusual for eggs from the same clutch to be laid over a prolonged period unless these are infertile and associated with egg retention. If a number of eggs have been retained, they can easily be seen in outline against the body wall (Fig 3). Palpation of eggs or yolk masses reveals regular-shaped structures, usually movable in the oviduct beneath the body wall. Radiography can be used to outline the eggs. The value of air-contrast radiography in outlining small and indiscrete yolk masses was demonstrated in case 6 (Fig 1).

In some of the cases, medical treatment to induce oviposition was not attempted or, if performed, its failure led to surgical treatment. In spite of this, oxytocin has been used with some success by others; a variety of dosages has been used in chelonians, lizards, and snakes.[3,7,13,14,20,27] In snakes, reasonable results have been achieved with dosages 1.0 to 10.0 IU/kg. Although fatalities associated with the use of oxytocin in snakes have not been reported, it should be noted that, in mammals, high doses of the drug will put the uterus into a state of tetanic contraction,[18] which, if the same happened in a snake, would potentiate egg retention, complicate any surgery, and possibly increase the risk of oviduct rupture.

The manipulative method of massaging eggs from the oviduct as performed in 2 cases here, may well be the best initial approach to relieve egg retention in snakes. In neither instance was oxytocin used before attempting delivery. Indeed, it may be contraindicated if such an approach is considered. Oxytocin causes the oviduct to contract more tightly down around the eggs, and might cause tearing of the oviduct during manipulation of the eggs. The technique may be limited to early cases of egg retention, before the oviduct has became dehydrated or adherent to the eggs, and may be more beneficial in certain of the thinner bodies snakes (rat snakes and king snakes) than in the heavier bodied pythons. Semiinvasive methods have been tried in relieving egg retention. Peter and Coote[7] used a medical and surgical approach to deliver eggs from an everglades rat snake *(Elaphe obsoleta rossalleni.)* in which the eggs appeared to swell inside the oviduct. Partial aspiration of the egg contents through the body wall, with subsequent use of oxytocin, caused expulsion of 1 of 3 eggs, the rest having to be removed surgically.

Postoperative complications have been reported by Cooper[16] and Hime.[15] In the latter case, impacted eggs were surgically delivered from a reticulated python *(Python reticulatus).* The snake later died from peritonitis caused by a retained decomposing egg. We did not experience such problems in any snake undergoing celiotomy and salpingotomy. The position of the skin incision in the cases reported here had little influence on the ease with which the underlying structures were exposed. In no instance was hemorrhage from the ventral subcutaneous abdominal vein a problem. It is preferable to incise between the scales, as this aids healing,[13] although in cases 1, 2, and 5, the incision was through the ventral scales. A lateral approach is easier to keep clean after the operation. Further, in pythons and large vipers, which progress with rectilinear motion by use of muscles attached to the ventral scales, a ventral incision could put more stress on the sutures. Despite the variation in the site of the skin incisions, there was no wound dehiscence in any of the 7 surgical cases. Apart from the ventral abdominal vein, the inferior vena cava could also be damaged during surgery in some of the flatter bodied species and small colubrids,[28,29] although this was never a problem in the deeper bodied pythons.

Access to eggs in the oviduct depends on the size of the snake and the eggs, the length of the skin incision, and the extent to which the oviduct can be moved toward the incision. The latter is not great, and rather than traumatize the duct, either by tension exerted on it or by trying to massage adherent eggs along it, it is better to use multiple incisions in the duct and, if necessary, the skin to reach all of the eggs. Repair of the fine, friable oviduct is facilitated

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by the use of ophthalmic or other fine surgical instruments and suture materials.

The postoperative use of spray-on plastic surgical dressing, although only used in 1 case here (case 5), does seem of value in protection of the wound site.[30]

In none of the cases monitored postoperatively has it been possible to find out whether surgical intervention reduced fertility at subsequent matings.

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