Approaches to axolotl gastrotomy

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Brigitte Lord discusses a case where surgery provided a satisfying outcome for an axolotl that had ingested substrate from its enclosure

A FIVE-YEAR-OLD, male axolotl (*Ambystoma mexicanum*) presented with a onemonth history of increasing coelomic distension.

The diet consisted of earthworms, waxworm larvae and crickets, dusted with a vitamin and mineral powder offered on forceps once a week.

It was housed alone, in a large aquarium (100cm × 50cm × 50cm), with a temperature range of 15°C to 20°C. A 12-hour photo period was provided by broad-spectrum ultraviolet light. Gravel substrate and a floating log hide were available. Water quality was checked regularly and was within normal limits.

Clinical examination

On clinical examination, the axolotl was found to be in good body condition and had a bodyweight of 124.5g. On visual inspection, marked mid-coelomic distension with dark grey discolouration was seen (Figure 1). No other clinical or historical abnormalities were found. Differential diagnoses of coelomic distension can include the following factors.

• Gastrointestinal

– Foreign body ingestion and obstruction.

– Neoplastic obstruction.

– Gastric or intestinal dilation and torsion.

– Alimentary tract rupture.

– Constipation.

• **Hydracoelom due to lymphatic occlusion**

– Oxalate crystals.

– Uric acid crystals (gout).

– Protazoal cysts.

– Abscesses.

– Neoplasia.

• **Hydrocoelom due to lymphatic heart abnormalities**

– Trauma.

– Toxins.

– Exposure to water with low dissolved solutes.

– Cardiac disease – such as cardiac lethal mutation gene in the axolotl (*Ambystoma mexicanum*[1]), endo, myo and pericarditis secondary to septicaemia).

– Renal failure.

– Liver failure.

– Neoplasia.

• **Obesity**

• **Neoplasia**

– Gonadal tumours.

– Hepatic neoplasia.

Diagnostic investigation and treatment

Conscious dorsoventral full-body radiography was performed, with the axolotl in a plastic tank containing 5L of water.

Approximately 17 to 18 radio-opaque foreign objects were visible in the coelomic cavity. The objects had a greater density than bone, an irregular surface and shape and were varied in size (average 10mm x 15mm; Figure 2).

The foreign bodies were of a similar appearance to the gravel used in the axolotl's aquarium. The location of the foreign bodies suggested they were primarily in the stomach, although further distribution in the intestinal tract or coelomic cavity could not be ruled out. Therefore, an exploratory celiotomy was carried out.

Induction of anaesthesia was achieved by bubbling five per cent vaporised isoflurane in 2L/ min oxygen through a 5L isoflurane bath, made using 4ml/L unvaporised isoflurane liquid.

The axolotl was removed from the solution immediately after the loss of the righting reflex. Anaesthesia was maintained by intermittently syringing the anaesthetic solution over the gills, and oxygenated water was provided throughout the procedure. Anaesthetic monitoring included a Doppler probe positioned over the heart, response to stimuli and observation spontaneous gill movement. Relative arterial oxygen haemoglobin saturation was measured with a pulse oximeter attached to the forelimb.

Preoperative enrofloxacin 10mg/kg was given intramuscularly. The axolotl was placed in dorsal recumbency and a 4cm para-median incision through the skin and underlying body wall was made, taking care to avoid damaging the midline abdominal vein.

Stay sutures were placed through the coelomic wall, and were used as retractors to allow full exploration of the coelomic cavity. Moderate bruising was identified in the proximal region of the large distended stomach. The stomach was isolated by packing coelom with sterile saline soaked swabs. Stay sutures were placed prior to a 1cm incision being made into the avascular region of the stomach (Figure 3). Twenty-one stones, with a total weight of 14.6g, were removed. Routine gastrotomy closure was performed using an absorbable synthetic monofilament suture material (two metric polydioxanone) in a simple interrupted pattern. The same suture material was used to close the muscle layer in a continuous pattern. The skin was closed in an everting interrupted horizontal mattress pattern using a non-absorbable synthetic monofilament suture material (two metric nylon).

Anaesthetic recovery was unremarkable, withdrawal reflex and spontaneous gill movement

resumed within 15 minutes of being placed in clean oxygenated water. Postoperative radiographs confirmed all the foreign bodies previously visible had been removed. Enrofloxacin was continued orally at 10mg/kg, once daily for 14 days. Food was with held for seven days and then an earthworm was offered weekly, with gradual increase in the size of prey after four weeks. The axolotl made a good recovery and conscious suture removal was carried out at four weeks postoperatively.

Discussion

Stones and other substrates are commonly ingested in amphibians that display voracious feeding behaviour, including tiger salamander (*Ambystoma tigrinum*), horned frogs (*Ceratophrys ornata*), White's tree frog (*Pelodryas caerulea*) and Tschudi African bullfrog (*Pyxicephalus adspersus*)[2,3,4].

This has also been previously reported in an axolotl (*Ambystoma mexicanum*)[5]. Small foreign bodies may be regurgitated or pass through the gastrointestinal tract; however, in this case a large number of small foreign bodies were ingested. As such, this was unlikely to occur. In two previously reported axolotls with gastric foreign bodies, anorexia and vomiting were reported; these signs were not present in this clinical case. One of these cases had only ingested two pebbles[5].

Gentle gavage of the stomach has been described as a technique to flush out small foreign bodies from amphibians. Per os retrieval of a small number of foreign bodies, with the aid of endoscopy or fluoroscopy, has been successful in some cases[5]. However, these techniques were not considered appropriate in this case due to the large number of stones present in an unconfirmed location within the coelomic cavity, some of which appeared sharp.

Oesophageal and gastric perforation were considered a high risk with endoscopic removal, and gastrotomy allowed both mucosal and serosal surfaces of the gastric wall to be inspected – as well as retrieval of possible intestinal foreign bodies.

Isoflurane has been described as a suitable anaesthetic agent for amphibia[6,7,8] and was used in this case as an experiment to gain further experience with a different anaesthetic protocol. This case demonstrated that although a smooth and stable anaesthetic was achieved, longer induction (40 minutes) and recovery times emphasised why tricaine methanesulfonate was considered the anaesthetic of choice for amphibians[7]. Wright (2001) reports less than 30-minute induction times are seen with 1g/L buffered solution of tricaine methanesulfonate used in adult amphibians; this is much longer than is seen with this agent in fish. Malik and Goodwin (1988), using the same concentration of tricaine methanesulfonate, reported a 15-minute induction time in an axolotl.

Anaesthetic-induced apnoea was seen in this case, but intubation was not considered necessary, as 100 per cent oxygen was continuously bubbled into the maintenance anaesthetic solution, which should ensure clinical hypoxia is prevented by cutaneous respiration.

Prevention of further stone ingestion was achieved by replacing small aquarium gravel with large pebbles.

Conclusion

This case demonstrates a typical presentation of foreign body ingestion, with a successful surgical resolution and a good prognosis. As the substrate in the aquarium was replaced the risk of recurrence of foreign body ingestion is low.

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