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Ultrasound-guided transcutaneous glue embolization resolved bilateral temporo-orbital aneurysms in a bearded dragon (*Pogona vitticeps*) after anatomical characterization via computed tomographic angiography

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History and Physical Examination Findings

A 7-year-old 735-g intact male bearded dragon (*Pogona vitticeps*) was presented for evaluation of a swelling on the head. The bearded dragon husbandry and diet were adequate. The bearded dragon was overweight, had a dark discoloration at the distal end of the tail, and exhibited a soft swelling in the left temporo-orbital area **(Figure 1)**.

Diagnostic Findings and Interpretation

A veterinary Doppler flow detector (Model 811-b; Parks Medical Electronics Inc) with a flat 8.9-MHz infant probe detected a pulse matching the heart rate (72 beats/min). A presumptive diagnosis of arterial aneurysm was made. Complete blood count and biochemistry were normal. An echocardiogram was normal. Computed tomographic angiography and color flow ultrasound were used to characterize the aneurysm. Sedation was achieved with dexmedetomidine (0.035 mg/kg), midazolam (0.5 mg/kg), and ketamine (10 mg/kg) IM, and a tail vein catheter was placed.[1] Two milliliters of iohexol (350 mg/mL) was administered through the catheter, and images were obtained at 5, 10, 15, 115, 300, and 390 seconds. Computed tomographic angiography revealed a dilated arterial vessel, the temporo-orbital artery, fed by a single vessel, the stapedial artery **(Figure 2)**, within the swelling. Color and continuous-wave Doppler ultrasound identified the feeder vessel as a high-velocity jet (49.4 cm/s) entering the aneurysm **(Figure 3)**. Considering the risk of bleeding reported in

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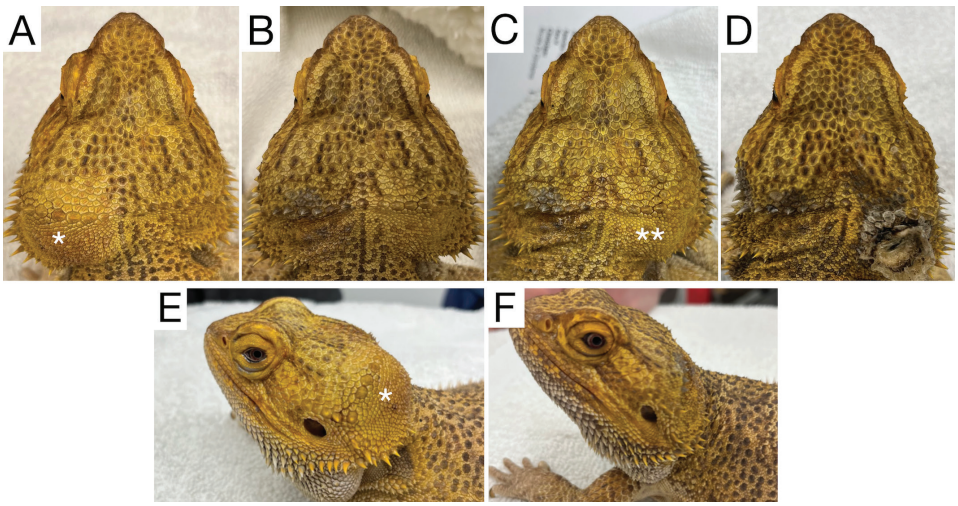

Figure 1—Gross aspect of the left and right temporo-orbital areas upon initial presentation (A and E), 5 months (B and F), 7 months (C), and 12 months (D) after initial presentation. On presentation, an approximately 2-cm swelling was present in the left temporo-orbital area (asterisk; A and E). The glue embolization was performed, and 5 months later the left temporo-orbital area was normal (F). Seven months from initial presentation, an approximately 1-cm swelling was noted on the right temporo-orbital area (C; 2 asterisks). At 12 months after presentation, the appearance of the right temporo-orbital area is shown after 2 glue-embolization procedures and bleeding that was managed conservatively. A small portion of transparent dressing covers the area.

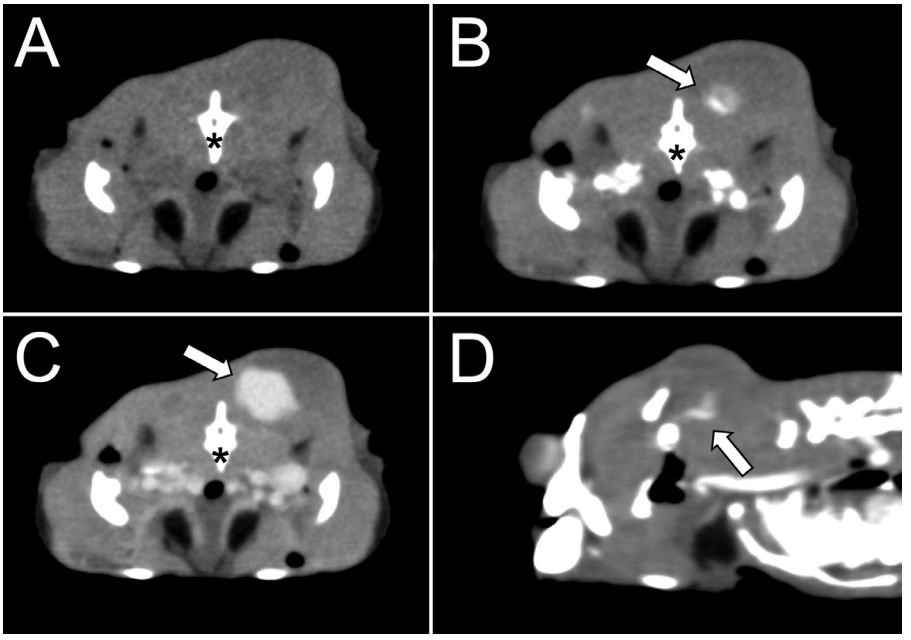

Figure 2—A through C—Transverse CT images acquired in a soft tissue window before contrast, 10 seconds after contrast, and 300 seconds after contrast, respectively. These 3 images were acquired at the level of the C2 vertebra (asterisk). The right of the patient is to the left of the image. There is a bulge of the left dorsal temporo-orbital region. There is a faint ovoid, fluid-attenuating (54 HU) mass in this region. Notice the progressive increase of contrast (arrow) within the mass. D—A parasagittal oblique image acquired at 10 seconds after contrast. The head is facing to the left of the image. A small amount of contrast is identified extending from caudal to the paraoccipital process of the otooccipital bone into the mass.

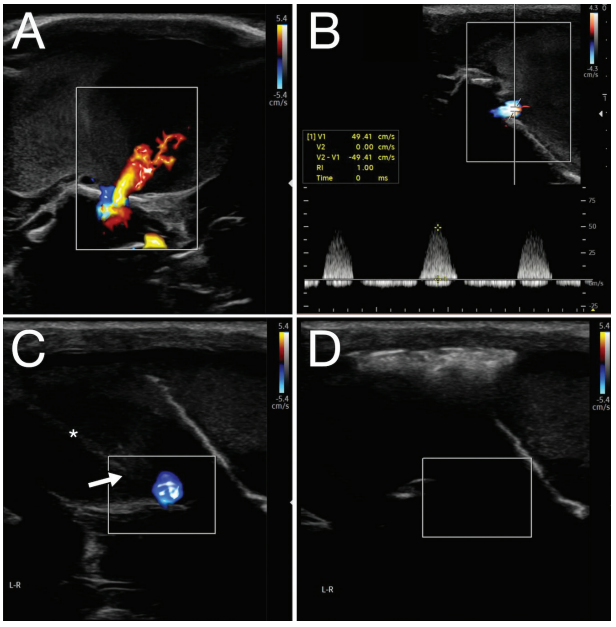

Figure 3—A and B—Color Doppler ultrasound of the left temporo-orbital mass. There is swirling hyperechoic fluid within the mass. A vessel with a high-velocity, pulsatile jet (49.4 cm/s) is identified feeding the mass. C—A needle (asterisk) is inserted into the mass and advanced toward the feeder vessel, with the tip of the needle (arrow) as close as possible to the identified jet. D—After injection, the jet is interrupted. Gas and cyanoacrylate cause acoustic shadowing.

previous published cases undergoing surgical treatment[2,3] and personally experienced by the attending clinician (ND), glue embolization, a technique used in other species to occlude small vessels,[4] was chosen after consultation with cardiologists. The owner was informed of the technique's untested safety and efficacy in this species and consented to the procedure, which was scheduled 3 weeks later.

Treatment and Outcome

At recheck, the aneurysm had grown slightly. Chemistry was unchanged. Sedation was repeated with the prior protocol, plus hydromorphone (0.5 mg/kg, IM). A catheter, intended for the tail vein as before, was accidentally placed in the ventral tail artery, as confirmed via fluoroscopic angiography. The arterial catheter was used to monitor blood pressure. An unopened vial of N-butyl cyanoacrylate glue (Vetbond; 3M) was used to fill 0.2 mL of glue in a 1-mL syringe. A 22-MHz ultrasonographic transducer (LA3-22AI Hockey-Stick transducer; Samsung) was used to measure the size of the aneurysm, and color flow was used to identify the feeder vessel. The width of the aneurysm was 23.6 mm, compared to 20.9 mm at previous evaluation. Upon ultrasound guidance, a 23-gauge, 1-inch needle connected to the syringe containing cyanoacrylate was passed through the skin and slowly advanced until its tip was pointing at the jet from the feeder vessel (Figure 3). The first injection of 0.05 mL of cyanoacrylate had no visible effect on the blood flow. A second injection of 0.15 mL was administered while the radiologist maintained the needle in the desired position, with another operator rapidly injecting the content of the syringe **(Supplementary Video S1)**. Ultrasound revealed cessation of blood flow into the aneurysm. The animal recovered uneventfully and was monitored in hospital. Doppler checks twice daily confirmed no residual flow. Mean arterial pressure ranged between 32 and 58 mm Hg. By day 8, ultrasound revealed blood stasis in the aneurysm. A 1.5-mL sample of dark-red fluid was drained via a butterfly needle to reduce swelling. The animal was discharged with amlodipine (0.25 mg/kg, PO, q 24 h) as a precaution in case the aneurysm formed as a consequence of systemic hypertension.

Three months after treatment, the swelling had resolved and palpation revealed no abnormalities

(Figure 1). Doppler and color ultrasound confirmed no residual blood flow. Discoloration and stiffness in the tail were attributed to arterial catheterization and consequent vascular necrosis. Amputation versus antimicrobial cover and watchful waiting were discussed, and the owner chose the latter.

Two months later, a similar swelling appeared on the right side of the head (Figure 1). Treatment mirrored the previous procedure, but during ultrasound, blood flow in the aneurysm ceased spontaneously before injection. Injection of cyanoacrylate (0.3 mL) was performed at the site where blood flow was seen before sedation. The distal tail was amputated during this anesthetic event. The animal recovered uneventfully.

Two months later, ultrasound detected minimal blood flow in the right aneurysm, deemed subclinical. The left side remained stable. The patient was discharged without further treatment.

Twenty days later, the owner noticed a sudden increase in the size of the right aneurysm. Another glue embolization (0.3 mL of cyanoacrylate) was performed, halting blood flow. The animal was discharged.

Two months later, the dragon presented for transient abnormal gait. The right temporo-orbital area was discolored, minimally swollen, and hard on palpation. Doppler ultrasound confirmed no blood flow. A transient ischemic event was suspected, and the animal was discharged.

Three days later, the owner presented the dragon emergently for bleeding from the right temporo-orbital area. Under sedation, a thin crust and clump of glue were removed. Bleeding was controlled with surgical glue and a bandage. The PCV was 7%. Two blood transfusions were administered through a tail vein catheter in the following days during hospitalization. Amlodipine, which was administered to the bearded dragon since the initial embolization event, was discontinued. The animal was discharged upon being able to eat unassisted and after a thick crust had formed over the area (Figure 1). Two subsequent rechecks showed continued healing of the right side. Despite evidence of regeneration in the CBC, the PCV remained static.

Approximately 4 months after the bleeding episode, 1 year after initial presentation, the bearded dragon was found dead by the owner. Because of distance, a postmortem examination was not performed.

Comments

In this case report, we describe for the first time the use of glue embolization for the treatment of 2 aneurysms in a bearded dragon. Aneurysms are a relatively common occurrence in bearded dragons, being the second most common cardiovascular condition.[2] In the literature, there are 2 reports[2,3] of bearded dragons undergoing surgery for dorsal cephalic aneurysms and both had significant bleeding. The treatment described herein is minimally invasive and can be performed with technology commonly available in many veterinary practices.

While 2 recent retrospective studies[2,3] described 5 bearded dragons (over a total of 28) having aneurysms on the dorsal aspect of the head, the exact morphological characterization of these aneurysms has not been described. Exact localization and characterization of the anatomy of the aneurysm affecting this bearded dragon was possible through CT angiography. The contrast could be seen entering the swollen area from a single feeder vessel, providing confidence that sealing that feeder vessel would have cut off the supply to the aneurysm. The ultrasound that was performed following the angiography reached similar conclusions. Considering the simple anatomy of the temporo-orbital aneurysms observed here, for clinical management of similar cases of temporo-orbital aneurysms, an ultrasonographic evaluation of the feeder vessel is likely to be sufficient. The use of CT angiography should be considered to better understand the vascular involvement of aneurysms in different locations.

Treatment of the first aneurysm was uneventful, and no recurrence of the aneurysm was observed until death, 12 months from the initial treatment. Treatment of the second aneurysm was less straightforward and required multiple interventions. This difference may have been due to several reasons. The objective of glue embolization is to use embolic agents to occlude the feeder vessels supplying blood to a pathological structure.[4] In the case of temporo-orbital aneurysms, this objective is achieved by injecting glue at the base of the temporo-orbital artery, where it arises from the stapedial artery.[5] This objective can be hindered by the characteristics of the individual aneurysm as well as operator-dependent factors. Anatomical features that prohibit proper access to the feeder vessel and a particularly strong jet flow velocity could make treatment of aneurysms with this procedure unfeasible. In terms of operator-dependent factors, proper positioning of the needle (to have the tip of the needle abutting the stapedial artery) and injecting the glue in a moment that blood is not actively flowing through the artery could be important for a successful embolization. In the aneurysm that developed on the right side of the patient, the first treatment was limited by an unexplained cessation of pulse in the artery after sedation, which resulted in a less precise administration of cyanoacrylate. The cyanoacrylate solidified and accumulated in the area, making future treatments more complex by the lack of a clear path to the feeder vessel. At this stage, it was unclear whether the development of 2 temporo-orbital aneurysms in this bearded dragon was because of an individual predisposition or whether the occlusion of one temporo-orbital artery led to pressure changes and dilation of the other.

In conclusion, herein we describe the anatomical characterization and treatment of 2 temporo-orbital aneurysms in a bearded dragon. The glue embolization procedure was successful in resolving the first aneurysm in one treatment but required multiple sessions to resolve the aneurysm that developed on the opposite side. The treatment described in this report is relatively inexpensive and does not require specialized equipment. A current ongoing

case series will help clarify the safety, effectiveness, and complications of this procedure.

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Disclosures

The authors have nothing to disclose. No AI-assisted technologies were used in the composition of this manuscript.

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Supplementary Materials

Supplementary materials are posted online at the journal website: avmajournals.avma.org.