Cardiac Output in the Australian Bearded Lizard – Case Study

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USCOM Case Study

Cardiac Output in the Australian Bearded Dragon

Rob Phillips[1], Julie Sloniger[2], Jennifer Hess[3] Dr Martinez[3]

1. Department of Medicine, University of Queensland, Brisbane, Australia.
2. USCOM Ltd, Clinical Applications Specialist, Tucson, USA.
3. Texas A and M, Dept of Veterinary surgery, Austin, USA.

Background:

Circulation is an almost universal phenomenon in living organisms functioning to deliver the substrates for cell and tissue performance and removing the metabolic wastes from these biochemical reactions. Our understanding of circulation is substantially based on invasive assessments such as thermodilution, a method which presents a delayed, damped and time averaged representation of circulation, or single snapshot methods such as Fick. USCOM is a noninvasive ultrasound device specialized for beat to beat serial and accurate measurement of flow with very high sensitivity, and is currently used across multiple clinical and research applications in humans. The device is also being adopted in animal research and veterinary applications because of an increased focus on therapeutic veterinary haemodynamics and ethical animal experimentation. The device is currently being used to evaluate circulation in rats, dogs, pigs, sheep and foals. This study was to determine the feasibility of evaluating the central circulation of a reptile, the Black Bearded Lizard.

Method:

Two captive Bearded Dragons were examined using the USCOM device and central haemodynamics measured. The Lizards were held in the erect position (figure 1), and the ultrasound transducer placed approximately midline on the ventral aspect of the thorax and directed from a parasternal access toward the dorsum and the dominant flow profile was detected and optimized (figure 2). Velocity time flow profiles were

acquired and measured using the conventional ultrasound method while the USCOM algorithm was applied for calculation of flow volume. Flow profiles are demonstrated in figures 3 and 4. Cardiac Output (CO), stroke volume (SV), and heart rate (HR) were measured and values indexed to the mass of the reptiles for comparison. The lizards were returned to their pen after examination and were without obvious distress. Observations were made at 30.6°N of the Equator, at a temperature of 18°, on the 27th Julian day, at 15hrs past midnight.

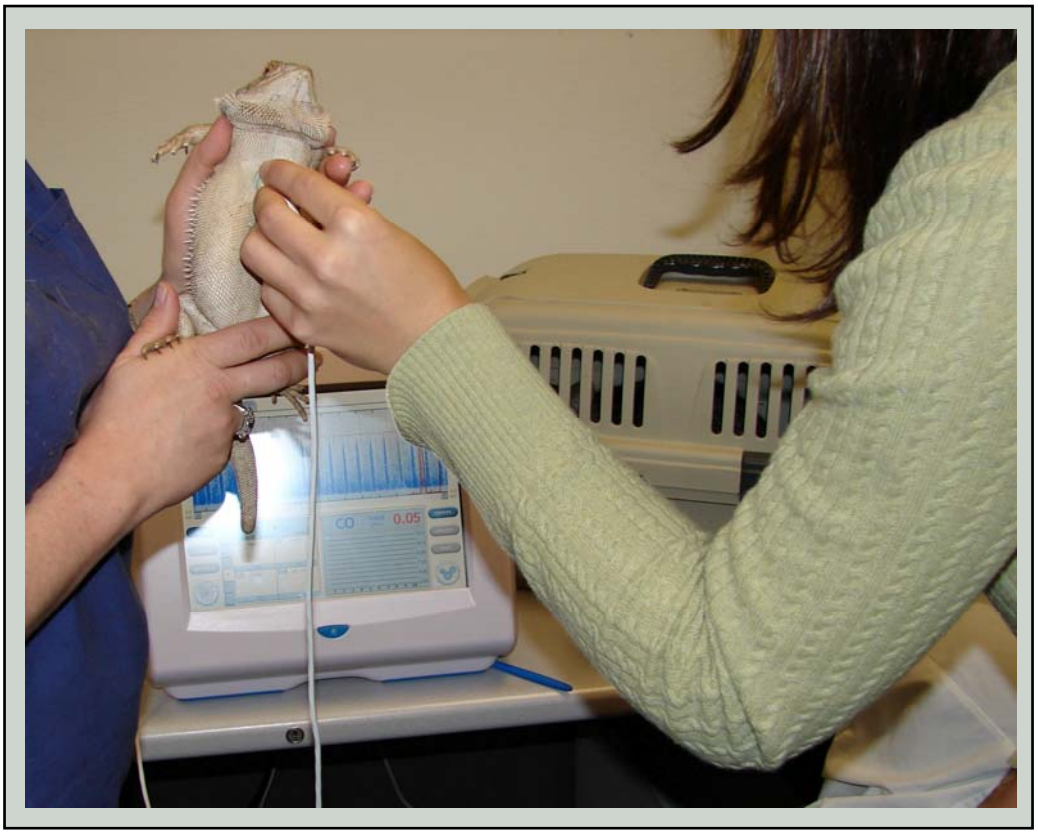

Figure 1. Bearded Dragon undergoing USCOM examination during support in the erect position.

Figure 2. Bearded Dragon comfortable and at rest during a non-invasive USCOM examination via the parasternal acoustic access.

Results:

USCOM examinations

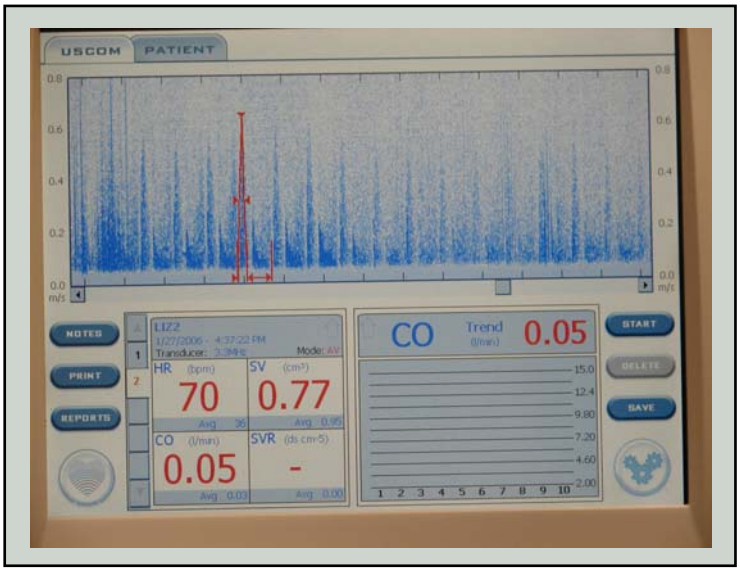

Figure 3. USCOM screen from lizard 1 (150 gms) demonstrating an SV of 0.77 cm3, a HR of 77 bpm and a CO of 50 cm3/min.

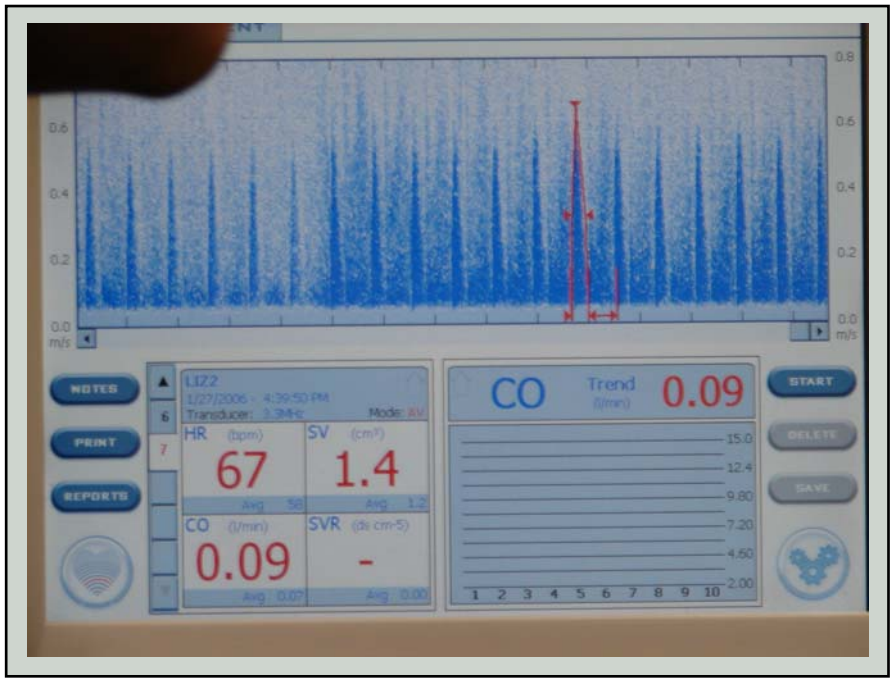

Figure 4. USCOM screen from lizard 2 (250 gms) demonstrating an SV of 1.4 cm3, a HR of 67 bpm and a CO of 90 cm3/min.

Lizard 1 (150 gms): SV = 0.77 cm^3, HR = 77 bpm, CO = 50 cm^3/min.

Lizard 2 (250 gms): SV = 1.4 cm^3, HR = 67 bpm, CO = 90 cm^3/min.

CO indexed to mass = 333cm^3/min/kg for lizard 1 and 360c m^3/min/kg for lizard 2.

SV indexed to mass = 5.1 cm^3/min/kg for lizard 1 and 5.6 cm^3/min/kg for lizard 2

Discussion:

USCOM demonstrated easily accessible circulatory information in two small reptiles without the need for intervention or post examination euthanasia. The lizards showed no signs of distress throughout and resumed normal captive activities after the examination. While data on central Bearded Dragon haemodynamics is scant, the results measured by USCOM were not considered unreasonable and the mass indexed values of CO and SV showed close agreement for the two lizards. The flow volumes were derived from the USCOM neonatal algorithm and may not be transposable to the Lizards. However the values seem feasible, and even without the

algorithm the flow data will accurately demonstrate changes in flow. The impact of orthostasis was not tested in these examinations.

Conclusion:

It is a feasible using USCOM to non-invasively access central circulation in Australian Bearded Dragons. Validation of normal values remains problematic but the presented values do not seem exceptional and the mass indexed values remarkably consistent. USCOM may provide an ethical insight into the circulation of small reptiles.

Teaching Points:

USCOM provides insight into central circulation of many animals, including small reptiles.

USCOM is a noninvasive, simple and ethical method with multiple veterinary and zoologic applications including animal research.

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