UTILITY OF THE ULTRASONOGRAPHIC MEASUREMENT OF CAUDAL VENA CAVA ON AORTA RATIO FOR THE DIAGNOSIS AND THE THERAPEUTIC FOLLOW-UP OF NATURALLY-OCCURRING HYPOVOLEMIC SHOCK IN DOGS

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INTRODUCTION

The **ultrasonographic (US) measurement of caudal vena cava on aorta (CVC:Ao) ratio** was successfully used to **assess volume status** in experimental models of hypovolemia in dogs[1,2]. This technique has been shown to be **easy, quick, and non-invasive** with acceptable inter- and intra-operator variabilities.

The aim of this study was to determine the utility of the CVC:Ao ratio to detect naturally-occurring hypovolemic shock in dogs, to evaluate evolution of the ratio after fluid resuscitation and to evaluate if CVC:Ao ratio was correlated with blood lactates and physical parameters.

METHODS

Dogs with hypovolemic shock admitted in our ICU (SIAMU) between September 2018 and January 2020 were prospectively enrolled. Hypovolemic shock was defined as the **presence of at least 3 physical signs consistent with hypovolemia** (altered mentation, tachycardia, weak or absent femoral pulse, pale mucous membranes, capillary refill time (CRT) > 2 seconds and cold extremities).

CVC:Ao ratio was measured on the **spleno-renal view of the AFAST protocol** as previously described **(Figure 1).**[1]

All measures were performed before and after an **intravenous crystalloid fluid bolus** of Lactate Ringer solution at 10 mL/kg.

Reference intervals for CVC:Ao ratio were previously defined at our institution with the same US protocol as follows: **0.93-1.32**.[2]

Comparisons of physical parameters, ultrasonographic measurements and blood lactates concentrations among dogs before and after the bolus of fluids were performed using an one-way ANOVA. A linear approach was used to evaluate relationships between CVC:Ao ratio (predictor variable), and HR, RR, body temperature and blood lactates (dependent variable).

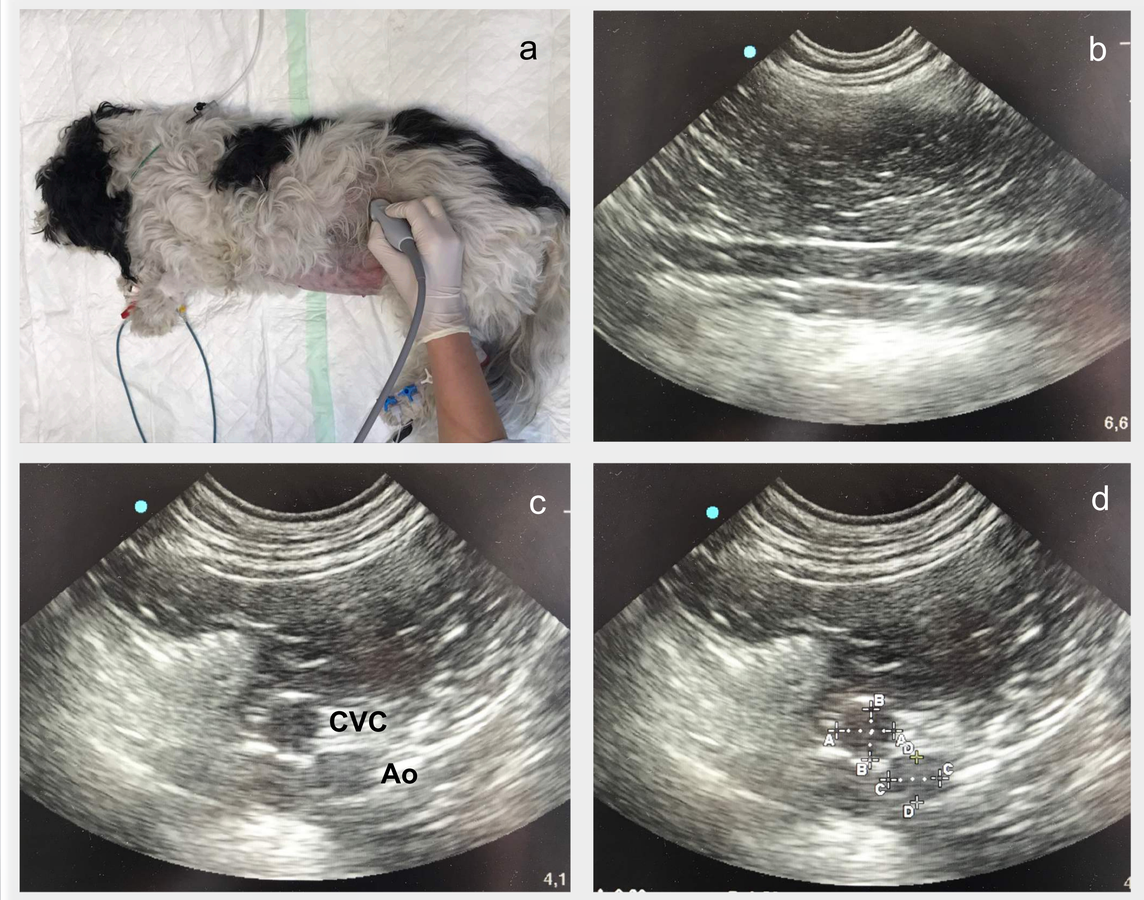

Figure 1. Ultrasonographic protocol
(a) The dog was positioned in right lateral recumbency and the probe placed over the left kidney area to allow visualization of the left kidney. The probe is moved dorsally and caudally to visualize CVC and Ao in sagittal views **(b)**; the probe is then shifted 90° clockwise to allow visualization of transversal views of both vessels **(c)** and measurements of two perpendicular diameters are performed **(d)**

RESULTS

Seventeen dogs were included in the study.

CVC:Ao ratios were below reference intervals at admission in 16/17 dogs and significantly **increased after the fluid bolus** (0.82 and 0.92, respectively; P = 0.007; **Figure 2**). Normalization of the CVC:Ao ratio after fluid bolus was observed in 6/17 dogs.

Blood lactates did not significantly change between before and after bolus (4.0 and 3.9 mmol/L, respectively; P = 0.273; **Figure 2**).

Heart and respiratory rates significantly decreased after the bolus (132 and 106 bpm, respectively; P = 0.002 ; 40 and 34 bpm, respectively; P = 0.032; **Figure 2**). **Capillary refill time** significantly shortened between before and after bolus as well (P = 0.003).

No significant linear correlation was observed between the CVC:Ao ratio and physical parameters or blood lactates before and after fluid bolus.

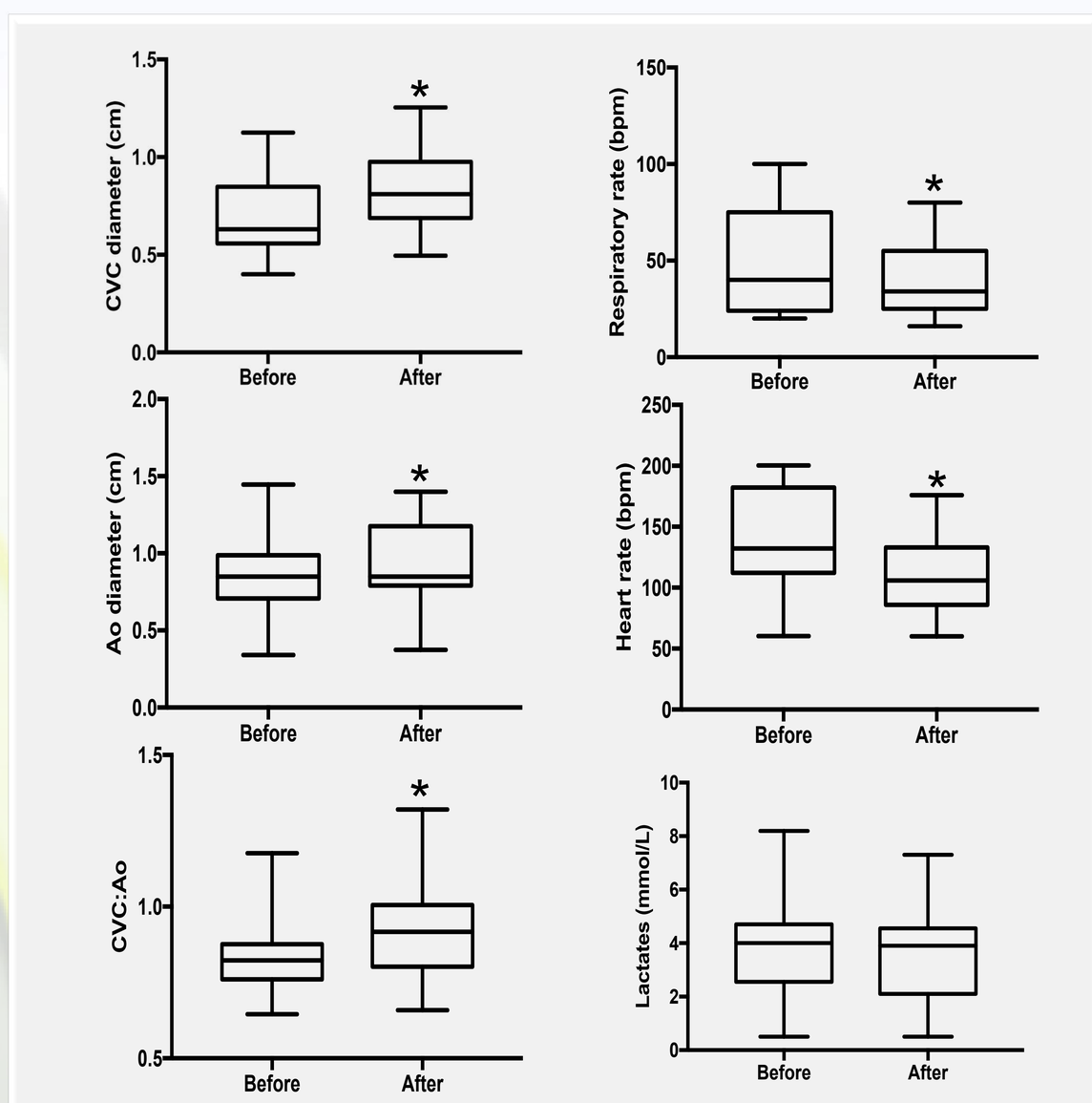

Figure 2. Comparisons of caudal vena-cava (CVC) diameter, Aorta (Ao) diameter, CVC/Ao ratio, heart rate, respiratory rate and blood lactates before and after fluid bolus
* P < 0.05

CONCLUSION

The US measurement of the CVC:Ao ratio appears as a valuable and promising tool for the **diagnosis and the therapeutic follow-up of naturally-occurring hypovolemic shock in dogs**. It appears to allow **earlier quantitative detection of changes in intravascular volume status** than blood lactates concentration in dogs.

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