Comparison between external jugular vein diameter, and morphologic and physiologic variables in dogs towards developing an external jugular vein collapsibility index for healthy dogs

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Introduction

New techniques for the determination of cardiac output and assessment of the hemodynamic status of the patients have been proposed towards making more precise diagnosis and reducing the subjectivity associated with the current ways of assessing blood dynamics. The accurate quantification of fluid depletion will contribute to the reduction of possible iatrogenic damages that may be caused, for example, by excess fluid administration in volume resuscitation.

Alternatively to the vena cava, researches have been proposed using the jugular vein to evaluate the hemodynamic status of human patients (Bilgili *et al.*, 2017; Guarracino *et al.*, 2014; Unluer & Kara, 2013). The location outside the abdominal cavity, the possibility of being evaluated in several recumbencies and the ease of localization through ultrasonography make the external jugular vein an also possible viable alternative in veterinary medicine.

Interindividual morphologic and physiologic variation in dogs is very large. The development of a normalized external jugular vein (EJV) collapsibility index (CI) as a quantitative tool for identifying normovolemia in every dog, regardless breed, body weight and morphological structure, is challenging. Nevertheless, it would allow veterinarians to objectively direct intravenous fluid administration towards a quantitative normovolemic goal.

Objectives

Comparison between external jugular vein diameter, and morphologic and physiologic variables in dogs towards developing an external jugular vein collapsibility index for healthy dogs.

Figure 1 – Probe positioning for evaluation of the external jugular vein

Methods

Twenty-six client-owned mixed breed healthy dogs were studied during clinical routine. With the animals in the right lateral recumbency, the maximum and minimum ventrodorsal diameters of the EJV were measured during inspiration and expiration, respectively, using an ultrasound transducer with a linear probe placed perpendicularly over the EJV, at the middle third of the cervical region (Figure 1).

In addition to anatomical positioning, a temporary tourniquet was maintained in the cervical area on until the EJV was ingurgitated to confirm that the structure evaluated was the external jugular vein (figure 2).

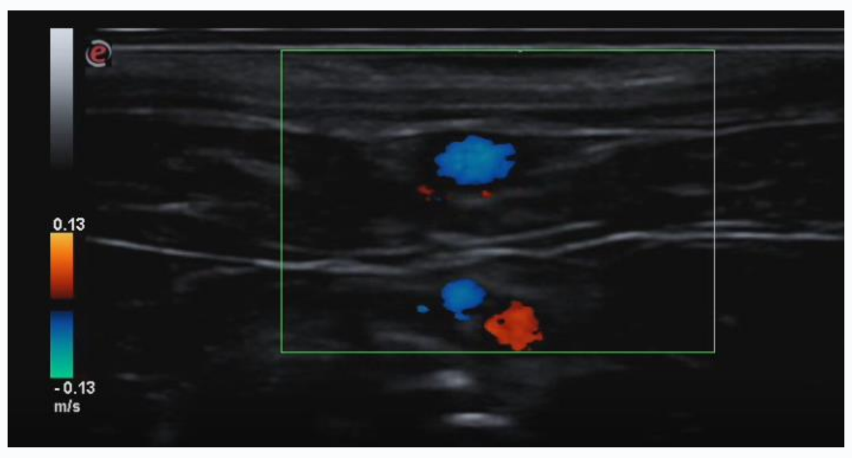
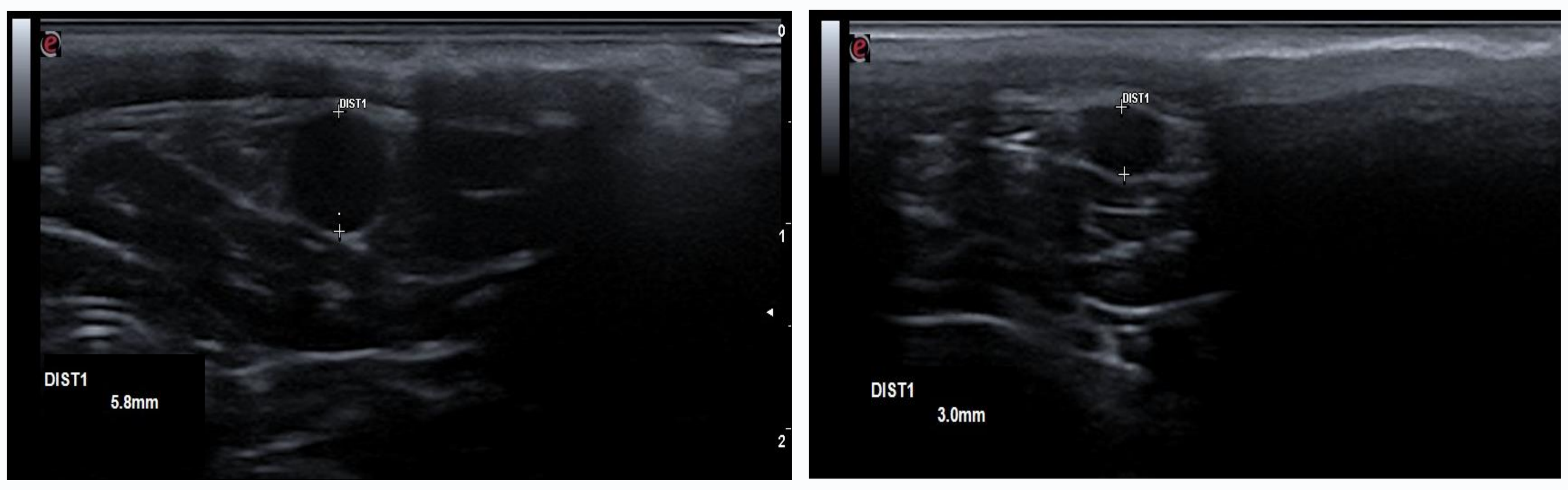


Figure 2 – Ecodoppler visualization of the EJV (upper blue circle), carotid artery (red circle) and internal jugular vein (smaller blue circle)

All the ultrasonographic exams were performed in B mode. Once the external jugular vein was identified, the position was adjusted so that the sectional image was as circular as possible. Images in which the jugular vein appeared in ellipsoid form were excluded (Figures 3 and 4). Avoiding non-respiratory cycle changes in the images, little pressure was applied to the transducer, ensuring no occlusion of the vein. In addition, a large amount of conduction gel was used.



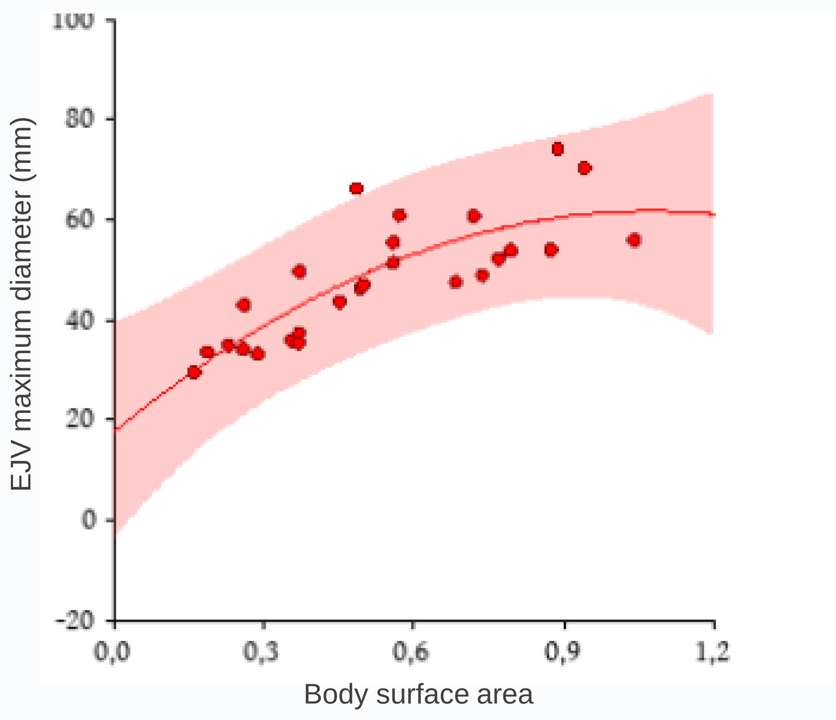
Figures 3 and 4– Examples of two images of the EJV collected from the same animal. The left one was used in the study and the right one was excluded.

Cervical circumference measurement, weight and heart rate were also registered. Body surface area (BSA) was calculated. Spearman's Rank correlation was used for comparing the variables with EJV maximum and minimum diameters, and polynomial regression equations were used for better curve fit for variables with significant Spearman's Rank correlation. Data are mean±SD and significance P<0,05.

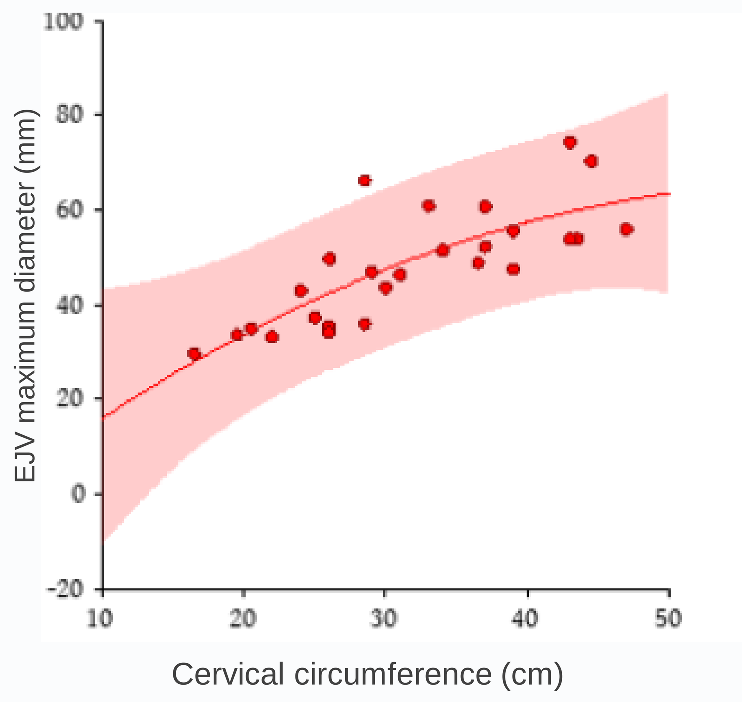
Results

Fifteen females and eleven males were studied. Weight 13,1±8,8 kg, age 5,3±3 years, BSA 0,54±0,25 m^2, cervical circumference 31,9±8,5 cm and heart rate 123±18 bpm. The EJV maximum and minimum diameters were 4,84±1,21 mm and 4,50±1,18 mm, respectively.

Correlations were observed between EJV maximum diameter and cervical circumference (rho= 0,816; P<0,0001), and BSA (rho= 0,848; P<0,0001); and between EJV minimum diameter and cervical circumference (rho= 0,79; P<0,0001), and BSA (rho= 0,833; P<0,0001). Significant polynomial regression correlations were observed between EJV maximum diameter and BSA (R^2= 0,66), and cervical circumference (R^2= 0,61) (Figures 5 and 6).



Figures 5 - Polynomial regression correlation between EJV maximum diameter and BSA (R2= 0,66).



Figures 6 - Polynomial regression correlation between EJV maximum diameter (R2= 0,61).

Discussion

The external jugular vein was easy to identify; however, care should be taken with its easy collapse during the evaluation, which may cause changes in the measurements. It is recommended to apply the lowest possible pressure in the region and a large amount of conduction gel.

These preliminary results observed in this study are promising because it was possible to achieve interesting correlations between a group of animals with huge individual intervariability.

The large SD observed in the morphologic variables studied is very high. The future use of other different morphologic and physiologic variables measurements with less interindividual variability, associated to different polynomial regressions should contribute to reducing the SD and improve the curve fit.

Conclusion

EJV measurements using ultrasounds was easy and swiftly performed. Data suggest that it is possible to develop a standardized EJV CI for normovolemic dogs by increasing the number of dogs, and by using multiple regression analysis with additional morphologic data, in order to improve the curve fit.

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