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Bioelectrical Impedance Analysis in dogs with right congestive heart failure before and after diuretic therapy: a pilot study

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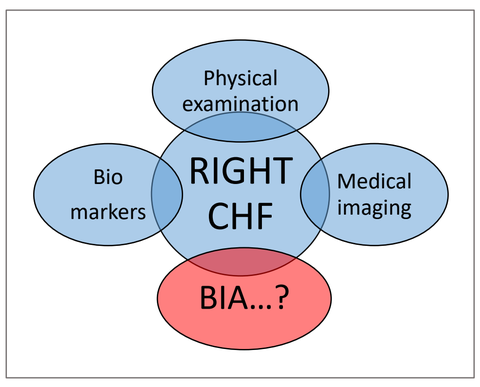
Background

Bioelectrical Impedance Analysis (BIA) is a simple, non-invasive, real-time diagnostic technique, validated and routinely used in human medicine, to assess body composition and hydration status [1].

BIA is based on measuring the electrical resistance that tissues oppose to the flow of a low-intensity alternating current applied to the body.
Body resistance is primarily and inversely affected by body water content [2].

Congestive heart failure (CHF) is a complex clinical syndrome characterized by body water retention. Signs of CHF are commonly evaluated and monitored by physical examination, medical imaging and biomarkers detection.



Aim

This study was conducted to evaluate if BIA could detect changes in body water content in dogs with right CHF after diuretic therapy.

Materials and Methods

Study population: 6 client-owned dogs prospectively enrolled

Inclusion criteria: dogs effected by ascites of cardiac origin

Study design: pilot study, longitudinal

BIA methodology: in each dog 3 consecutive whole-body BIA measurements were performed before and after resolution of the ascites, using a bi-frequency (50-100KHz) bioelectrical device (Biosmart ®) (fig.1), and bioelectrical variables of impedance, reactance, resistance and phase angle were recorded.

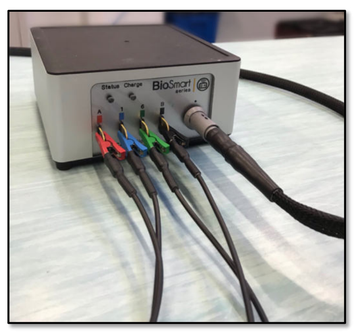


Figure 1:
Biosmart ®
Bioelectrical device

All measurements were obtained in non-sedated dogs, gently restrained in standing position using a standard tetrapolar electrode configuration [3] (fig.2).

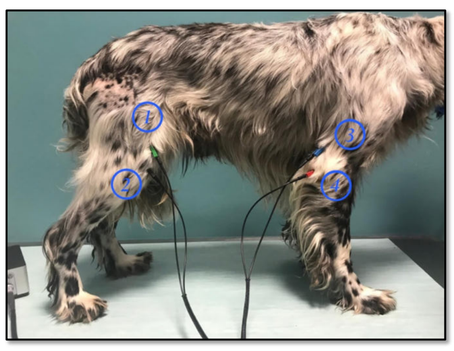


Figure 2: Standard tetrapolar electrode configuration for whole-body BIA.
2 emitting electrodes are applied by crocodile clips on the skin dorsal to the right elbow and dorsal to the patella of the right hindlimb (red and black).
2 receiving electrodes are positioned 3.5cm dorsally to their respective emitting electrodes (blue and green)

For each dog morphometric measurements including body weight, length, rib cage circumference and abdominal circumference were also recorded (fig.3).

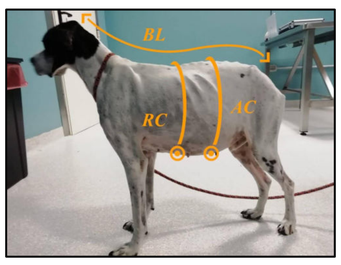


Figure 3: morphometric measurments.
BL = body lenght,
RC = rib cage circumference,
AC = abdominal circumference

Statistical analysis: bioelectrical and morphometric variables of each dog obtained before and after resolution of the abdominal effusion were averaged and compared using a Student's t-test for paired data.

Results

- All bioelectrical variables except reactance and phase angle measured at 100kHz showed a statistically significant increase ($p<0,05$), in accordance with an increase of whole-body impedance
- both body weight and abdominal circumference decreased ($p<0,05$).

Conclusions

BIA in dogs with CHF

- Is effective in detecting decreases in total body water after diuretic therapy
- could be a useful monitoring tool during treatment

Our preliminary results need to be confirmed by larger studies.

REFERENCES
[1] Khalil S.F. et al. The Theory and Fundamentals of Bioimpedance Analysis in Clinical Status Monitoring and Diagnosis of Diseases. Sensors 2014, 14:10895-10928. [2] Lukaski H.C. et al. Classification of Hydration in Clinical Conditions: Indirect and Direct Approaches Using Bioimpedance. Nutrients 2019, 11, 809. [3] Yaguiyan-Colliard L. et al. Indirect prediction of total body water content in healthy adult Beagles by single-frequency bioelectrical impedance analysis. AJVR 2015, 76(6): 547-553.