Validation of a point-of-care haemoglobin meter (Avie Total Hb™) for canine and feline blood samples

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BACKGROUND

In veterinary medicine, PCV (packed cell volume) is the most common clinical test used to estimate the oxygen carrying capacity of blood and detect anaemia. However, PCV determination requires the use of a centrifuge, generates sharp waste and takes several minutes. In human medicine, haemoglobin (Hb) measurement is considered superior to PCV for monitoring anaemia because of the availability of international reference standard preparations. Several point-of-care (POC) haemoglobin meters are now commonly used in medical practice. Validation of these POC instruments for veterinary practice is needed to ensure the accuracy of results.

OBJECTIVE

To validate a POC device (Avie Total Hb™) for canine and feline blood samples.

METHODS

The meter was first tested for precision and reproducibility by

measuring 5 samples (3 dogs and 2 cats) with varying Hb values 5 times each. The effect of storage on samples was tested by measuring 4 samples (3 dogs and 1 cat) stored at 4°C every day for up to 6 days. Haemoglobin concentration was then measured using the POC meter and a reference laboratory analyser (Siemens Advia 120) in a total of 81 blood samples from 65 dogs and 57 samples from 41 cats, stored for a maximum of 5 days. Co-efficients of variation were calculated for the precision and storage analyses. Pearson correlation coefficients were calculated and Bland Altman analysis was used to compare the 2 methods of measuring haemoglobin.

RESULTS

The meter was found to be easy to use and faster than a traditional PCV measurement by a range of operators. Precision and stability studies showed acceptable coefficients of variation for within-batch precision and for storage. Coefficient of correlation showed a high degree of correlation between the 2 methods ($r = 0.935$ for canine samples, $r = 0.95$ for feline samples, $p < 0.001$ for both). Bland Altman analysis revealed good absolute agreement with the laboratory analyser with estimated bias of -0.8 g/dl for canine samples and -0.5 g/dl for feline samples.

CONCLUSION

Results suggest that Avie Total Hb™ device had good precision and reliability when compared to the standard laboratory analyser for measurement of haemoglobin in canine and feline blood samples. Samples could be measured for up to 5 days without significant deterioration. The Avie Total Hb™ POC meter is a safer, faster and reliable alternative to traditional PCV measurement.

Serum cardiac troponin I concentrations decrease following treatment of primary immune mediated haemolytic anaemia

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Serum cardiac troponin I concentrations (cTnI) have been measured in many species to non-invasively assess for the presence of myocardial damage. The measurement of cTnI in dogs with a range of non-primary cardiac illnesses has

revealed that cardiac myocyte damage is commonplace. Increased serum cTnI concentrations have been demonstrated in dogs with Ehrlichia and Babesia infections and in anaemic cats. Serum cardiac troponin I concentrations have also recently been demonstrated to be increased in dogs with primary immune mediated haemolytic anaemia (IMHA) at the point of diagnosis.

However, it remains unknown whether the increase in serum cTnI concentrations and therefore myocyte damage is sustained or responds to treatments or whether the increase in cTnI concentrations is due to dogs with IMHA having a high incidence of concurrent primary cardiac disease.

OBJECTIVES

To investigate the response of serum cTnI concentrations after treatment, in dogs with primary IMHA. We hypothesised that serum cTnI concentrations would decrease with improvement of anaemia in these dogs.

METHODS

A haematology profile was performed and serum cTnI concentrations were measured in 19 dogs with primary immune mediated haemolytic anaemia before and after treatment.

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Other causes of IMHA were excluded with history, physical examination, serum biochemistry, haematology and imaging before inclusion into the study.

RESULTS

The packed cell volume significantly increased following treatment of primary IMHA (median pre 0.13 L/L, median post 0.33 L/L) ($p=0.0001$). The serum cardiac troponin I concentrations significantly decreased after treatment (median pre 0.26 ng/ml, median post 0.16ng/ml) ($p<0.05$). Dogs with an improvement in PCV of ≥ 0.14 L/L had a significantly larger median reduction of serum cTnI concentrations (0.51 ng/ml) compared to a median reduction of 0.01ng/ml in dogs whose PCV had increased by less than 0.14 L/L ($p=0.04$).

CLINICAL SIGNIFICANCE

This study demonstrates that evidence of subclinical myocyte damage decreases following the successful treatment of primary IMHA. It also demonstrates that dogs with a greater improvement in packed cell volume had the greatest reduction in cTnI. This suggests that the improvement of anaemia was likely to be the driving force for the reduction in the evidence of myocardial damage.

This study advances knowledge of the cardiovascular complications which occur in anaemic dogs and may lead to future investigations into the prognostic significance of serum cardiac troponin I concentrations before and after treatment in dogs with primary IMHA.

Does pulse CO-oximetry yield accurate and precise haemoglobin measurements in conscious dogs?

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INTRODUCTION

Anaemia is a common problem in dogs and cats presenting to veterinary practices, but diagnosis currently relies on collection of blood samples by venepuncture. In human medicine, recent advances in pulse CO-oximetry permit non-invasive estimation of haemoglobin concentration using a multi-wavelength sensor probe. The aim of the current study was to test the hypothesis that haemoglobin measurements obtained from the Masimo Radical 7 pulse CO-oximeter would yield accurate and repeatable values when compared to conventional CO-oximetry on contemporaneous blood samples.

METHOD

Pulse CO-oximetry measurements were made from dogs presenting consecutively to a single tertiary referral institute for medical investigations or surgical procedures. Measurements were made by holding the probe of the Masimo Radical 7 pulse CO-oximeter in the interdigital web of conscious dogs until a haemoglobin measurement was obtained. Duplicate measurements were made from a subset of dogs, with an

interval of five minutes between readings. All measurements were made by a single operator. Owners gave informed consent for the pulse CO-oximeter to be used on their dogs, and the study received approval from an ethical review committee.

The pulse CO-oximetry measurements were made within thirty minutes of venepuncture for collection of blood samples. Haemoglobin concentration was measured in heparinised blood samples using the NOVA Biomedical pHox Ultra CO-oximeter, which utilises multi-wavelength spectrophotometry.

RESULTS

Haemoglobin was measured 17 times by pulse CO-oximetry in 10 different dogs. A further 51 measurements were attempted unsuccessfully, so that 25.0% of attempts resulted in haemoglobin measurement. Duplicate readings were obtained in 7 dogs, for which the intra-class correlation coefficient was 0.541 (95% confidence interval -0.21 to 0.90).

Values obtained by the two CO-oximetry methods were correlated (R^2 0.656, $p<0.001$). Bland Altman analysis was constructed to determine whether measurements from the pulse CO-oximeter agreed with those obtained by conventional CO-oximetry. The mean difference between pulse CO-oximeter measurements from the pooled measures was 1.48 g/dl, with upper and lower limits of agreement of 4.21 and -1.25, respectively.

CONCLUSION

This pilot study shows that pulse CO-oximetry may be used to estimate haemoglobin concentration in conscious dogs, but limits of agreement were wide when compared to a conventional method and readings could not be obtained from a large proportion of the dogs in which the procedure was attempted.

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