Blood Gas Assay Performance on the IDEXX VetStat™ Electrolyte and Blood Gas Analyzer

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Introduction

The VetStat™ Electrolyte and Blood Gas Analyzer has been designed for veterinarian use on canine, feline and equine whole-blood samples. The analyzer provides species-specific reference ranges and reportable ranges that cover the three species. We investigated its performance on pH, PCO_2 and PO_2 by comparing VetStat analyzer results to results from an electrode system, which is a recognized reference methodology.

Material and Methods

Canine and feline samples were stored on ice for 23–27 hours and equine samples for 4–6 hours. They were then equilibrated at 37°C with various mixtures of N_2, O_2 and CO_2 gas using an IL237 Tonometer. Samples were removed from the Tonometer and immediately run on the VetStat and AVL995 pH/Blood Gas Analyzer. The analysis sequence was one AVL995 analysis, then one analysis on each of three VetStat analyzers, then one more AVL995 analysis. All of these analyses were performed within six minutes.

There were several sources of variability in this study:

- Two different VetStat cassettes were used: Fluid Therapy measures pH and PCO_2; Respiratory Therapy measures pH, PO_2 and PCO_2.
- The study was run over a one-year time period.
- Numerous cassette lots were used and there were various numbers of samples run on each lot.
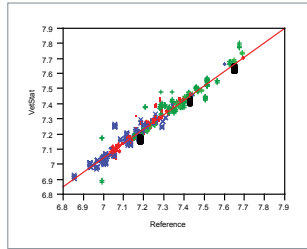
Table 1 gives other details of the study:

	pH	PO_2	PO_2 reduced range	PCO_2	HCO_3	Total CO_2
Number of Samples	184	196	166	198	180	180
Concentration Range	6.85–7.69	13–402	13–142	11–105	6.5–35	7.2–37.3
Number of Cassette Lots	16	11	11	16	16	16

Data was analyzed by standard linear regression.

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Results

pH

|	
Slope:	0.954
y-Intercept:	0.37
r^2:	0.955
Mean Bias:	0.03
Mean Result:	7.27
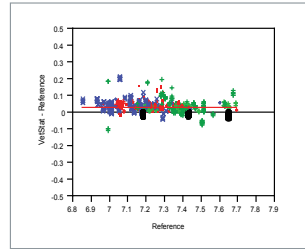
■ = Canine
X = Feline
+ = Equine
○ = Controls
□ = Outlier

The reportable range for pH is 6.6 to 7.8 and about 70% of that range was tested. The pH correlation was good, with slope and r^2 greater than 0.95 and the y-intercept 5% of the mean result. The mean bias is only 0.4% of the mean result.
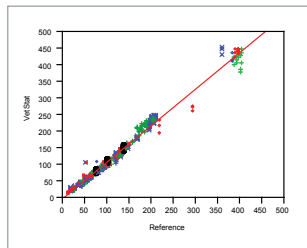
PCO_2
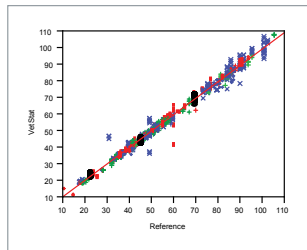
|	
Slope:	0.990
y-Intercept:	0.16
r^2:	0.988
Mean Bias:	-0.3 mmHg
Mean Result:	51.5 mmHg
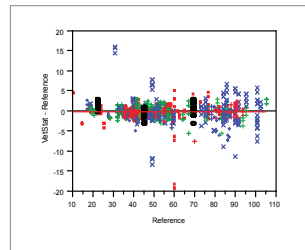
The reportable range for PCO_2 is 10 to 200 mmHg, so about 55% of the range was tested. The PCO_2 correlation was excellent, with slope and r^2 greater than 0.95 and the y-intercept 0.3% of the mean result. The mean bias is only 0.6% of the mean result.

PO_2

Slope:	1.103
y-Intercept:	-4.9
r^2:	0.988
Mean Bias:	5.0 mmHg
Mean Result:	102 mmHg
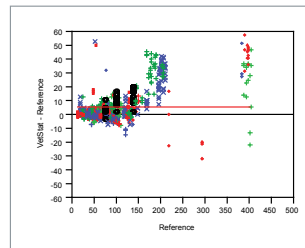
Regression over reduced range:

|	
Slope:	1.02
y-Intercept:	0.49
r^2:	0.977
Mean Bias:	-1.5
Mean Result:	69.1

The PO_2 reportable range is 10 to 700 mmHg, but only a range with clinical relevance was tested. The PO_2 correlation was acceptable, with slope at 1.103 and r^2 greater than 0.95 and the y-intercept 9.5% of the mean result. The mean bias is 4.9% of the mean result. Normal arterial PO_2 ranges go up to only 100 mmHg. Results were therefore regressed over a range of 0 to 150 mmHg.

Over this range, the correlation was excellent, with slope and r^2 greater than 0.95 and the y-intercept only 0.7% of the mean result. Mean bias was 2.2% of the mean result.

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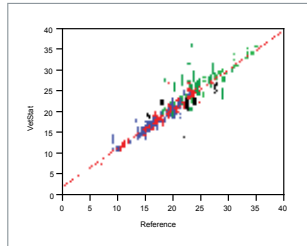
HCO$_3$

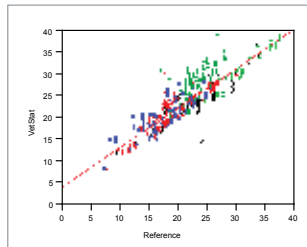| Slope:	0.946
y-Intercept:	2.2
r^2:	0.890
Mean Bias:	1.1 mmol/L
Mean Result:	21.4 mmol/L
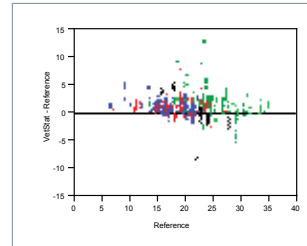
Bicarbonate concentration is calculated from pH and $P\mathrm{CO_2}$ according to:

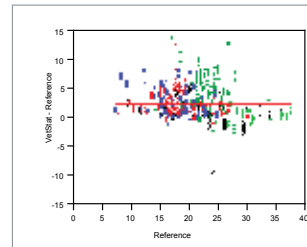$$HCO_3 = 0.0307 \times PCO_2 \times 10^{(pH-6.129)}$$

This calculation incorporates the variabilities of both measured values. Therefore, the regression statistics will usually not be as good as either measured value. The r^2 is most likely to be affected, since it measures scatter around the regression line.

The slope is good. The r^2 is acceptable, as is the y-intercept at 10.3% of the mean result. The mean bias is 5.1% of the mean result.

tCO$_2$

Slope:	0.915
y-Intercept:	4.3
r^2:	0.808
Mean Bias:	2.56 mmol/L
Mean Result:	23.3 mmol/L

Total CO_2 concentration is also calculated from pH and $P\mathrm{CO_2}$ according to:

$$tCO_2 = (0.0307 \times pCO_2) \times (1 + 10^{(pH-6.129)})$$

Again, the variabilities of both measured values were included and the regression statistics will usually not be as good as either measured value.

Regression statistics are acceptable. The mean bias is 11% of the mean result.

Conclusions

Measured VetStat analyzer results correlated well with those from the AVL995 electrodes. Correlations for bicarbonate and total CO_2, while not as good, were acceptable given that those two parameters are calculated from two measured components. Performance characteristics were considered acceptable for use with canine, feline and equine samples.

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