Original Article

Evaluation of agreement between point-of-care and blood gas analyzers for lactate measurement in critically ill dogs

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Abstract

This study aimed to evaluate the analytical agreement between a handheld point-of-care (POC) lactate meter (StatStrip Xpress®2 Lac/Hb/Hct, Nova Biomedical) and a standard blood gas analyzer (Stat Profile Prime Plus® VET, Nova Biomedical) for measuring plasma lactate concentrations in critically ill dogs. Fifty-seven client-owned dogs were admitted to the Emergency Unit and Critical Care Unit (CCU) of the Small Animal Hospital, Chulalongkorn University, enrolled. Blood samples were analyzed using both a handheld POC meter and a blood gas analyzer. To evaluate analytical agreement across a wide concentration range, data were categorized into low (1–4 mmol/L; n = 17), moderate (4–10 mmol/L; n = 28), and high (10–20 mmol/L; n = 12) lactate groups. Spearman's correlation, Passing-Bablok regression, and Bland-Altman analysis were performed to assess the agreement between the two devices. One-way ANOVA was used to analyze differences among the three groups. A strong positive correlation was observed between the two devices (r = 0.99). Passing–Bablok regression demonstrated acceptable agreement, with slopes of 1.02, 0.94, 1.01, and 1.38 for the overall dataset, low, moderate, and high lactate groups, respectively. Bland–Altman analysis showed mean biases of 0.07, 0.02, 0.26, and –0.57 mmol/L for the overall dataset, low-, moderate-, and high-lactate groups, respectively, indicating that the mean differences between the instruments were within acceptable analytical limits across most lactate ranges. In contrast, one-way ANOVA revealed a significant difference between the high-lactate group and the others. In conclusion, the handheld POC lactate meter demonstrated a high degree of agreement with the standard blood gas analyzer, particularly in the low- and moderate-lactate groups.

Keywords: blood gas, handheld point-of-care, plasma lactate

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Introduction

Lactate is a metabolic byproduct of anaerobic glycolysis that reflects the balance between its production and clearance and thus serves as a marker of tissue hypoxia and perfusion mismatch. In healthy states, a small amount of lactate is also produced under aerobic conditions and is efficiently cleared by the liver and kidneys (Gillespie *et al.*, 2017; Rosenstein *et al.*, 2018).

Plasma lactate concentration is a well-established prognostic biomarker in critically ill dogs and cats. An elevated initial lactate concentration at admission is associated with poorer outcomes. For instance, dogs with gastric dilatation–volvulus (GDV), initial lactate < 4 mmol/L predicted better survival, while values > 4 mmol/L indicated gastric necrosis (Mooney *et al.*, 2014). Similar prognostic trends were reported in immune-mediated hemolytic anemia, babesiosis, and septic peritonitis, where sustained hyperlactatemia correlated with poor prognosis and greater lactate clearance with survival. (Holahan *et al.*, 2010; Blutinger *et al.*, 2021).

Persistent hyperlactatemia is also a key indicator of tissue hypoxia and has been strongly associated with increased mortality. In humans, a decrease in lactate of at least 10% during early resuscitation or normalization within 24 h correlates with improved survival, whereas delayed clearance beyond 48 h indicates a poor prognosis (Jones, 2013). Studies in dogs have shown that persistent hyperlactatemia 6 h after admission or an increase exceeding 4.5 mmol/L during the same period is highly specific for mortality (Zollo *et al.*, 2019; Saint-Pierre *et al.*, 2022). In a large retrospective study in dogs and cats of over 4,800 cases, both elevated lactate at admission and poor lactate clearance within the first few hours were independently associated with higher mortality (Saint-Pierre *et al.*, 2022).

In general, blood gas analyzers are widely regarded as the standard references for lactate measurement in both human and veterinary medicine. These instruments rely on enzymatic assays, most commonly lactate oxidase or lactate dehydrogenase reactions, which convert lactate into quantifiable products. This enzyme-based methodology has long been considered the gold standard because of its high analytical accuracy, reproducibility, and validation across both clinical and research applications (Hadjiioannou *et al.*, 1976). Consequently, blood gas analyzer results are widely accepted as reliable benchmarks for patient assessment and prognostication.

Handheld, point-of-care (POC) lactate analyzers have been developed to provide rapid, bedside measurements, thereby improving clinical practicality in emergency and resource-limited settings. Depending on the device, POC instruments may employ enzymatic assays similar to those used in blood gas analyzers or utilize ion-selective electrode (ISE) technology to directly detect lactate ions (Rathee *et al.*, 2015; Indrasari *et al.*, 2019). Although these devices offer portability and faster turnaround times, analytical agreement with the standard references cannot be assumed. Thus, it is essential to determine whether POC analyzers yield results sufficiently consistent with blood gas analyzers to permit their interchangeable use in clinical practice.

Previous veterinary studies have used POC lactate analyzers in healthy as well as critically ill animals. For instance, the study compared two POC lactate devices with a laboratory analyzer in healthy cats and dogs (Thorneloe *et al.*, 2007; Tynan *et al.*, 2015). A study assessing Lactate Plus™ against blood gas analyzers in swine animal models (Gaeth *et al.*, 2024). In terms of hospitalized dogs, the studies were compared between blood gas analyzer and POC lactate analyzers (Acierno and Mitchell, 2007; Nye *et al.*, 2017). However, this specific handheld POC lactate meter (StatStrip Xpress®2 Lac/Hb/Hct, Nova Biomedical) has not previously been directly compared with a standard blood gas analyzer (Stat Profile Prime Plus® VET, Nova Biomedical) for measuring plasma lactate concentrations in critically ill dogs. Therefore, the aim of the present study was to evaluate the analytical agreement between these two devices and to assess their potential interchangeability for lactate measurement in critically ill and emergency veterinary patients.

Materials and Methods

Animals: The Institutional Animal Care and Use Committee (IACUC) of the Faculty of Veterinary Science, Chulalongkorn University, approved the experimental protocol (Protocol review No. 2431026). Client-owned dogs presented to the Emergency Unit and Critical Care Unit (CCU) of the Small Animal Hospital, Faculty of Veterinary Science, Chulalongkorn University, were prospectively enrolled after obtaining informed owner consent. A total of 57 dogs were included for comparison of lactate concentrations measured using a blood gas analyzer (Stat Profile Prime Plus® VET, Nova Biomedical) and a handheld POC meter (StatStrip Xpress®2 Lac/Hb/Hct, Nova Biomedical). This sample size was considered appropriate based on Clinical and Laboratory Standards Institute guideline EP09-A3 (CLSI EP09-A3) recommendations, which suggest a minimum of 40 paired samples for user-performed method-comparison verification (Serdar *et al.*, 2021). Inclusion criteria were based on hospitalization in the CCU, with no restrictions on the animal's underlying condition. Signalment factors such as age, sex, and breed were not restricted. The exclusion criteria were the inability to obtain paired lactate measurements from the same sample and failure to analyze blood within 15 min of collection, due to the known instability of lactate concentrations in stored whole blood.

Blood collection: Blood samples were obtained from the cephalic or saphenous vein into an arterial blood gas sampler (SyringeABGTM, 15 IU/mL Balanced heparin) for lactate measurement. To minimize pre-analytical variation, paired lactate measurements by the POC device and blood gas analyzer were performed within 15 min of sample collection at room temperature (Reich *et al.*, 2017).

Plasma lactate concentration analysis: After blood collection, the samples were promptly analyzed using

a POC meter (StatStrip Xpress®2 Lac/Hb/Hct, Nova Biomedical), which employs an enzymatic lactate assay to quantify lactate levels in whole blood. Briefly, after the meter was prepared, a drop of blood was transferred to parafilm and measured directly by touching the tip of the test strip to the edge of the blood drop. The meter began its analysis and displayed the lactate concentration within a few seconds. Simultaneously, the remaining blood sample in the syringe was introduced into the blood gas analyzer (Stat Profile Prime Plus® VET, Nova Biomedical), which measures lactate using an enzymatic/amperometric assay method. For analysis, the syringe tip was placed into the sample port, which is designed to automatically draw the correct volume. The Prime Plus® VET analyzer was systematically and continuously quality-controlled each day according to both the manufacturer's and laboratory standards. Daily performance verification was conducted using the manufacturer's internal quality control (QC) materials, and automatic calibration was performed every two hours. QC results were recorded daily before testing, during testing, and on the following day to ensure consistent monitoring of instrument performance. For each QC lot, the coefficient of variation (CV) for all parameters remained below 3.0%, confirming high analytical precision and reliability throughout the study period (Nelson *et al.*, 2021). The data were statistically analyzed to assess the degree of agreement between the two devices.

Lactate level classification: To compare plasma lactate levels, data were collected across a range of lactate concentrations, including low (lactate level 1-4 mmol/L, n=17), moderate (lactate level 4-10 mmol/L, n=28), and high (lactate level 10-20 mmol/L, n=12) levels to verify agreement across the different levels of variation.

Statistical analyses: The agreement on lactate concentration between two automated machines was assessed. Normality of data distribution was first evaluated using the Shapiro-Wilk test. Because the data were not normally distributed, the Wilcoxon signed-rank test was done for evaluation of the difference in lactate from the two automated machines, under the null hypothesis of no difference in mean lactate between the two machines from 0. Spearman's correlation coefficient was used to evaluate the correlation between lactate concentration obtained from two machines. Passing-Bablok regression was used for the identification of constant difference and proportional difference between results from two machines by observing the regression equation. In addition, if 95% confidence interval (95% CI) of the slope from the regression equation contained 1, there was no proportional difference between the two machines. Method agreement was further assessed using Bland–Altman analysis. The mean difference (bias) between the two analyzers was calculated, along with the 95% limits of agreement (LoA). Bland–Altman plots were used to visually assess agreement across the range of lactate concentrations. A one-way ANOVA and post hoc test were conducted on the mean differences in lactate values between the StatStrip Xpress®2 Lac/Hb/Hct and Stat Profile Prime Plus® VET analyzers across low-, moderate-, and high-lactate groups.

Results

Comparison of plasma lactate level with two different equipment between StatStrip Xpress®2 Lac/Hb/Hct, Nova Biomedical and Stat Profile Prim Plus® VET, Nova Biomedical: The complete raw dataset for this study presents all lactate levels obtained from both the StatStrip Xpress®2 Lac/Hb/Hct meter and the Stat Profile Prime Plus® VET analyzer. Each entry reflects an unprocessed individual observation, including values across the low-, moderate-, and high-lactate ranges (Table 1). This dataset serves as the foundational source for all subsequent statistical analyses, including correlation assessment, Passing–Bablok regression, and Bland–Altman agreement evaluation.

The dot plot illustrating individual lactate measurements from both devices demonstrated a comparable distribution pattern across the entire analytical range (approximately 1–17 mmol/L). Most data points clustered within the low to moderate lactate range (1–8 mmol/L), with only a small number of observations exhibiting markedly elevated concentrations. The vertical spread and overall dispersion of values showed substantial overlap between the two analyzers, supporting the statistical finding that no major systematic differences existed between them and confirming the strong agreement in lactate measurements. However, greater dispersion was observed at higher lactate concentrations (Fig. 1).

The strong positive correlation between lactate values obtained from the StatStrip Xpress®2 Lac/Hb/Hct and the Stat Profile Prime Plus® VET analyzer was observed ($r = 0.99$). Passing–Bablok regression showed a slope of 1.02 (95% CI, 0.978–1.081), including 1, indicating no proportional bias, and an intercept of −0.20 (95% CI, −0.633–0.049), including 0, suggesting no constant bias. For this analysis, Stat Profile Prime Plus® VET values were plotted on the X-axis and StatStrip Xpress®2 Lac/Hb/Hct values on the Y-axis. (Fig. 2).

Bland–Altman analysis revealed a mean bias of 0.07 mmol/L with a standard deviation of 0.93 mmol/L. The 95% LoA ranged from −1.75 to +1.89 mmol/L, indicating minimal systematic difference between the two analyzers. Differences exceeding ±3 SD (2.80 mmol/L) were considered outliers and excluded from the analysis (Fig. 2).

Agreement and bias across three concentration groups: To further evaluate performance across clinically relevant lactate ranges, data were categorized into three concentration groups: low (1–4 mmol/L), moderate (4–8 mmol/L), and high (10–20 mmol/L) lactate groups. In the low-lactate group ($n = 17$), Passing–Bablok regression yielded a slope of 0.94 (95% CI, 0.80–1.11) and an intercept of 0.15 (95% CI, −0.14 to 0.46), with both confidence intervals including 1 and 0, respectively, suggesting no proportional or constant bias (Fig. 3). Bland–Altman analysis demonstrated a mean bias of 0.02 mmol/L (95% CI, −0.11 to 0.16) with

LoA from −0.49 to +0.53 mmol/L, indicating strong agreement at lower lactate concentrations (Fig. 3). In the moderate-lactate group (n = 28), the slope was 1.01 (95% CI, 0.87–1.22) and the intercept −0.41 (95% CI, −1.58 to 0.45), again indicating no significant proportional or constant bias (Fig. 4). Bland–Altman analysis showed a mean bias of 0.26 mmol/L (95% CI, −0.01 to 0.53) and LoA from −1.12 to +1.63 mmol/L, demonstrating acceptable agreement within this clinically relevant range (Fig. 4). In contrast, in the high-lactate group (n = 12), Passing–Bablok regression revealed a slope of 1.38 (95% CI, 1.03–1.59) and an intercept of −3.98 (95% CI, −6.65 to 0.02), indicating proportional bias at higher concentrations (Fig. 5). Bland–Altman analysis showed a mean bias of −0.56 mmol/L (95% CI, −1.01 to −0.11) with LoA from −1.94 to +0.83 mmol/L, suggesting a tendency for the POC meter to report slightly lower values at elevated lactate concentrations (Fig. 5). Similarly, one-way ANOVA followed by post hoc analysis demonstrated the mean differences in lactate values between the StatStrip Xpress®2 Lac/Hb/Hct and Stat Profile Prime Plus® VET analyzers across low-, moderate-, and high-lactate groups. Specifically, the high-lactate group showed significantly higher differences in mean lactate levels compared with the low-lactate group (mean difference = 0.58, $P = 0.036$) and the moderate-lactate group (mean difference = 0.82, $P < 0.001$). In contrast, no significant difference was observed between the low and moderate-lactate groups ($P = 0.427$) (Table 2).

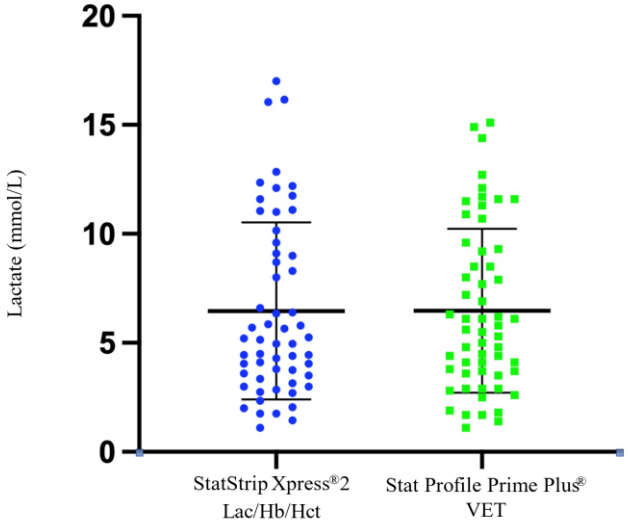

Figure 1 Dot plot comparing blood lactate concentrations measured by the StatStrip Xpress®2 Lac/Hb/Hct and the Stat Profile Prime Plus® VET analyzer. Blue circles represent lactate values obtained using the StatStrip Xpress®2 Lac/Hb/Hct, and green squares represent values measured by the Stat Profile Prime Plus® VET analyzer. Each point corresponds to an individual lactate measurement from the same blood sample, illustrating the distribution and variability of lactate concentrations across both devices.

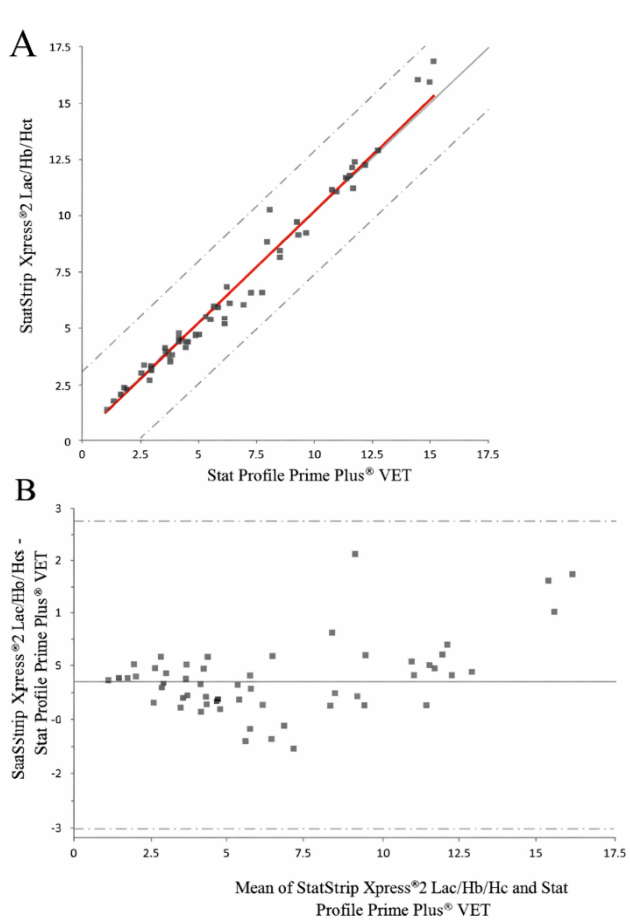

Figure 2 (A) illustrates the Passing-Bablok regression analysis of two analyzers for lactate concentration (N = 57); Spearman's correlation coefficient (r = 0.9). The point-of-care (POC) analyzer (StatStrip Xpress®2 Lac/Hb/Hct, Nova Biomedical) and the blood gas analyzer (Stat Profile Prime Plus® VET, Nova Biomedical) were compared. Scatter plot showing the regression line and confidence bands. The identity line is dashed. Regression equation: y = -0.2452 + 1.041x. (B) illustrates the Bland-Altman plot comparing two analyzers for lactate concentration (N = 58). The Y-axis represents the difference in lactate concentration values between the two analyzers, while the X-axis represents their average.

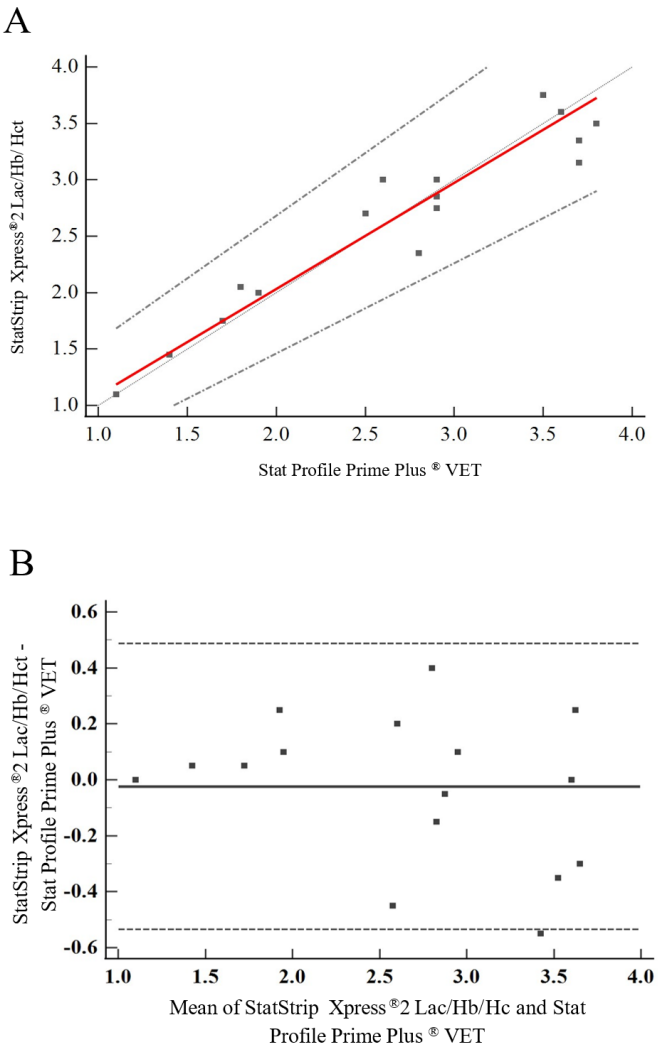

Figure 3 (A) Passing–Bablok regression plots comparing lactate concentrations obtained from the handheld StatStrip Xpress®2 Lac/Hb/Hct (Y-axis) and the Stat Profile Prime Plus® VET blood gas analyzer (X-axis) of low lactate group (1–4 mmol/L, n = 17): Regression equation: y = 0.15 + 0.94x (95% CI for slope, 0.80–1.11; intercept, −0.14 to 0.46). Both confidence intervals include 1 and 0, indicating no proportional or constant bias. (B) Bland–Altman plots showing agreement between lactate values measured by the StatStrip Xpress®2 Lac/Hb/Hct and the Stat Profile Prime Plus® VET analyzer of low lactate group (1–4 mmol/L): The mean bias was 0.02 mmol/L (95% CI, −0.11 to 0.16), with 95% LoA from −0.49 to +0.53 mmol/L, indicating strong agreement.

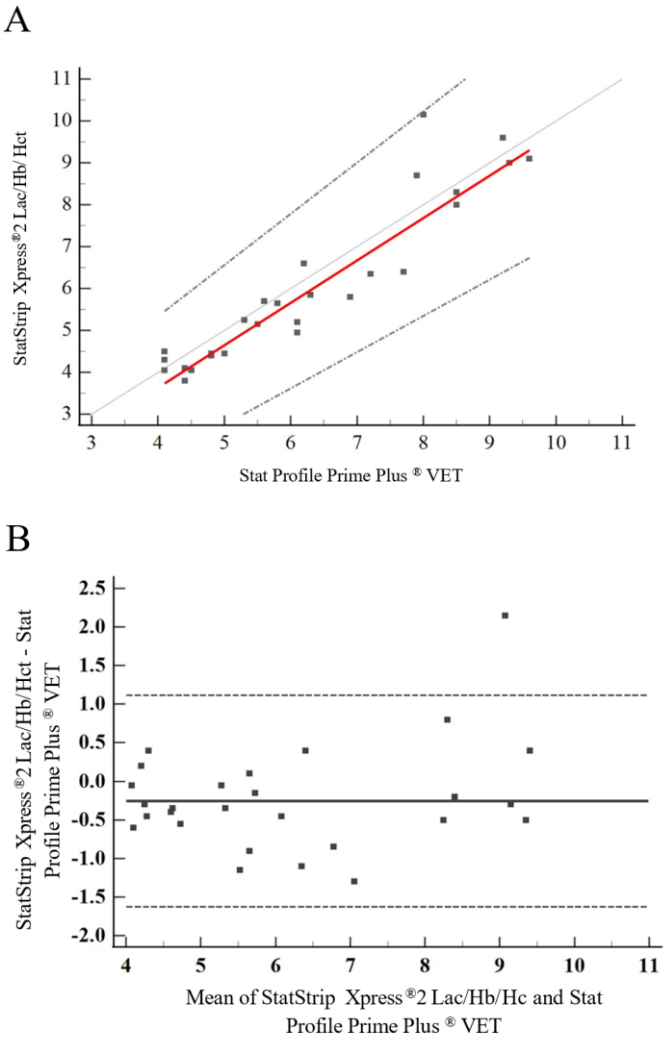

Figure 4 (A) Passing–Bablok regression plots comparing lactate concentrations obtained from the handheld StatStrip Xpress®2 Lac/Hb/Hct (Y-axis) and the Stat Profile Prime Plus® VET blood gas analyzer (X-axis) of low lactate group (1–4 mmol/L, n = 17): Regression equation: y = 0.15 + 0.94x (95% CI for slope, 0.80–1.11; intercept, −0.14 to 0.46). Both confidence intervals include 1 and 0, indicating no proportional or constant bias. (B) Bland–Altman plots showing agreement between lactate values measured by the StatStrip Xpress®2 Lac/Hb/Hct and the Stat Profile Prime Plus® VET analyzer of low lactate group (1–4 mmol/L): The mean bias was 0.02 mmol/L (95% CI, −0.11 to 0.16), with 95% LoA from −0.49 to +0.53 mmol/L, indicating strong agreement.

Table 1 Lactate concentrations measured by the StatStrip Xpress®2 Lac/Hb/Hct and Stat Profile Prime Plus® VET analyzers, and the differences in lactate levels between the two devices across low-, moderate-, and high-lactate groups.

Group	Sample number	Lactate level of StatStrip Xpress®2 Lac/Hb/Hct (mmol/L)	Lactate level of Stat Profile Prime Plus® VET (mmol/L)	Differences of Lactate level (StatStrip – Stat Profile; mmol/L)
Low	L1	1.10	1.10	0
	L2	1.45	1.40	0.05
	L3	1.75	1.70	0.05
	L4	1.75	1.70	0.05
	L5	2.00	1.90	0.1
	L6	2.05	1.80	0.25
	L7	2.35	2.80	-0.45
	L8	2.70	2.50	0.2
	L9	2.75	2.90	-0.15
	L10	2.85	2.90	-0.05
	L11	3.00	2.60	0.4
	L12	3.00	2.90	0.1
	L13	3.15	3.70	-0.55
	L14	3.35	3.70	-0.35
	L15	3.50	3.80	-0.3
	L16	3.60	3.60	0
	L17	3.75	3.50	0.25
Moderate	M1	3.80	4.40	-0.6
	M2	4.05	4.10	-0.05
	M3	4.05	4.50	-0.45
	M4	4.10	4.40	-0.3
	M5	4.30	4.10	0.2
	M6	4.40	4.80	-0.4
	M7	4.45	5.00	-0.55
	M8	4.45	4.80	-0.35
	M9	4.50	4.10	0.4
	M10	4.95	6.10	-1.15
	M11	4.95	6.10	-1.15
	M12	5.15	5.50	-0.35
	M13	5.20	6.10	-0.9
	M14	5.25	5.30	-0.05
	M15	5.65	5.80	-0.15
	M16	5.70	5.60	0.1
	M17	5.80	6.90	-1.1
	M18	5.85	6.30	-0.45
	M19	6.35	7.20	-0.85
	M20	6.40	7.70	-1.3
	M21	6.60	6.20	0.4
	M22	8.00	8.50	-0.5
	M23	8.30	8.50	-0.2
	M24	8.70	7.90	0.8
	M25	9.00	9.30	-0.3
	M26	9.10	9.60	-0.5
	M27	9.60	9.20	0.4
	M28	10.15	8.00	2.15
High	H1	11.00	10.90	0.1
	H2	11.05	10.70	0.35
	H3	11.10	11.60	-0.5
	H4	11.60	11.30	0.3
	H5	11.75	11.50	0.25
	H6	12.10	11.60	0.5
	H7	12.20	12.10	0.1
	H8	12.35	11.70	0.65
	H9	12.85	12.70	0.15
	H10	16.05	14.90	1.15
	H11	16.15	14.40	1.75
	H12	17.00	15.10	1.9

Table 2 Comparison of the mean differences in lactate values between the StatStrip Xpress®2 Lac/Hb/Hct and Stat Profile Prime Plus® VET analyzers across low-, moderate-, and high-lactate groups using one-way ANOVA with post hoc analysis.

Group Comparison	Mean Difference	95% CI Lower	95% CI Upper	*p*-value
Low and Moderate	0.23361	-0.2153	0.6825	0.427
Low and High	-0.58	-1.1323	-0.0314	0.036
Moderate and High	-0.82	-1.3192	-0.3117	<0.001

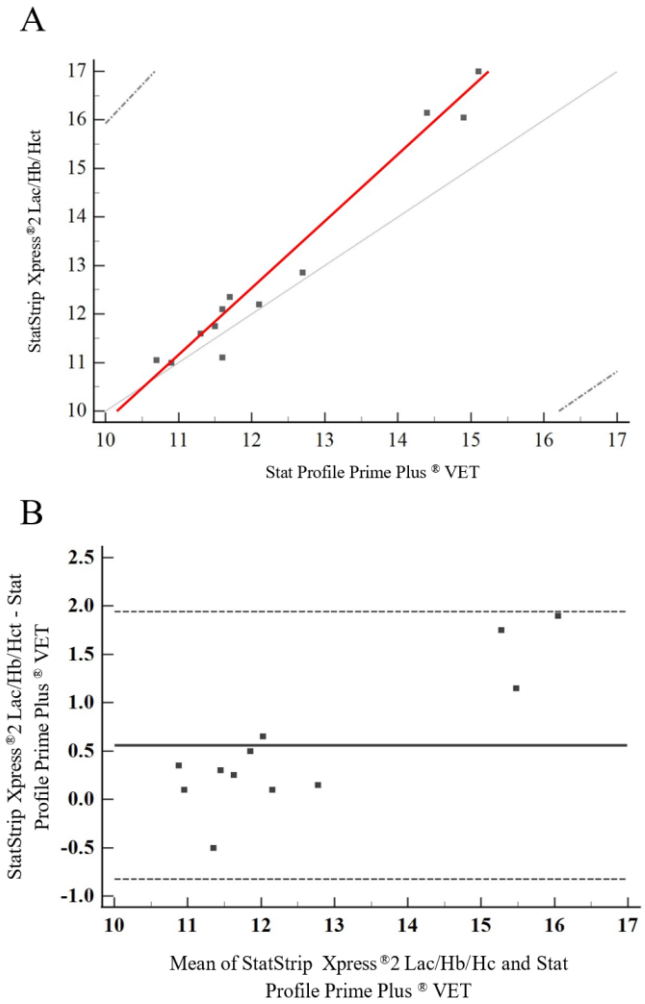

Figure 5 (A) Passing–Bablok regression plots comparing lactate concentrations obtained from the handheld StatStrip Xpress®2 Lac/Hb/Hct (Y-axis) and the Stat Profile Prime Plus® VET blood gas analyzer (X-axis) of high lactate group (10–20 mmol/L, n = 12): Regression equation: y = −3.98 + 1.38x (95% CI for slope, 1.03–1.59; intercept, −6.65 to 0.02), suggesting proportional bias at higher lactate concentrations, where the POC analyzer tends to yield slightly lower readings than the blood gas analyzer. (B) Bland–Altman plots showing agreement between lactate values measured by the StatStrip Xpress®2 Lac/Hb/Hct and the Stat Profile Prime Plus® VET analyzer of high lactate group (10–20 mmol/L): The mean bias was −0.56 mmol/L (95% CI, −1.01 to −0.11), with LoA from −1.94 to +0.83 mmol/L, reflecting increased variability and a tendency for the POC analyzer to underestimate lactate at higher concentrations.

Discussion

This study evaluated blood lactate concentrations obtained using two commonly available clinical devices: POC and blood gas analyzers. The POC device required only 0.6 µL of whole blood and yielded a result in approximately 13 sec, whereas the blood gas analyzer required 135 µL of whole blood and needed around 60 sec for analysis. Both devices utilize advanced biosensor technology. The Stat Profile Prime Plus® VET employs Nova Micro Sensor Card™ technology, miniaturized, maintenance-free sensor cartridges that integrate multiple biosensors and reagents in a single-use format. In contrast, the StatStrip Xpress®2 Lac/Hb/Hct uses a pre-calibrated, disposable biosensor designed for rapid POC measurements. A strong positive correlation was significantly observed between the two devices, with a correlation coefficient approaching 1, indicating high analytical agreement and consistency.

Both devices utilize enzymatic methods, which are considered the gold standard for lactate measurement. This shared methodology likely contributed to the high level of agreement observed in this study. While blood gas analyzers may provide slightly more precise results under controlled laboratory conditions, the differences were not considered clinically significant (Indrasari *et al.*, 2019).

Previous investigations comparing the Stat Profile Prime Plus® VET with the Stat Profile Nova pHOx Ultra®, another laboratory blood gas analyzer, reported a mean bias of 0.22 mmol/L and limits of agreement ranging from –0.77 to 2.22 mmol/L, demonstrating good concordance between high-precision analytical systems (Nelson *et al.*, 2021). Consistent with these findings, our study comparing the Stat Profile Prime Plus® VET analyzer with a handheld POC device showed a mean bias of 0.07 mmol/L and limits of agreement of –1.75 to 1.89 mmol/L, further supporting the reliability of the Stat Profile Prime Plus® VET analyzer as a reference instrument for evaluating POC lactate meters. Similarly, a previous study comparing a blood gas analyzer with a portable lactate meter reported strong agreement between the two methods, with a

correlation coefficient of r = 0.906 and acceptable Passing–Bablok regression characteristics (slope 1.109; intercept 0.342) (Fujita *et al.*, 2025). These findings are in line with the present study, which demonstrated excellent correlation (r = 0.99) and acceptable agreement, as reflected by a Passing–Bablok slope of 1.02 and an intercept of –0.20. Collectively, these observations highlight the reliability of handheld lactate analyzers when compared with standard laboratory blood gas analyzers.

Here, the observed bias in lactate measurements between analyzers was less than ± 2.8 mmol/L. Although small, fixed biases are unlikely to change clinical interpretation when lactate concentrations are clearly above or below commonly used thresholds, wider limits of agreement may influence decision-making for values close to clinically important cut-offs. In veterinary emergency and critical care, lactate concentrations > 4 mmol/L were used as indicators of poor perfusion or a worse prognosis in dogs with gastric dilation and volvulus (Holahan *et al.*, 2010; Green *et al.*, 2011). Therefore, even modest analytical variation may affect classification when results lie near this threshold. Based on these findings, clinicians should use caution when interpreting lactate values close to established decision limits and consider confirming borderline results with a validated laboratory chemistry analyzer using an enzymatic spectrophotometric reference method (Hadjiioannou *et al.*, 1976).

The POC meter offers several advantages, particularly in emergencies or resource-limited settings. These devices are portable, easy to use, and provide rapid results at the bedside, making them highly suitable for time-sensitive clinical decision-making. Their practical utility is especially evident in situations where access to complex laboratory infrastructure is limited (Gaeth *et al.*, 2024).

Nonetheless, timely sample analysis is crucial for obtaining accurate lactate measurements, as whole blood lactate concentrations are susceptible to both time and temperature. Previous studies have demonstrated that lactate levels in heparinized whole blood rise significantly when samples are left at room temperature (~20 °C) for extended periods. Specifically, Seymour *et al.* (2011) reported that lactate concentrations can increase by an average of 0.36 mmol/L within 30 min, with more rapid rises occurring after just 5–10 min at room temperature. Conversely, samples stored on ice remain stable for up to 30 min under the same conditions (Seymour *et al.*, 2011). Similarly, Reich *et al.* observed that in canine heparinized venous blood, lactate concentrations remain relatively stable for short intervals (15–25 min) when kept under controlled storage conditions, but increase significantly thereafter if stored aerobically at room temperature (Reich *et al.*, 2017).

These findings emphasize the importance of prompt analysis to avoid artifactual increases in measured lactate concentrations. Therefore, lactate measurement should ideally be performed within 5–15 min of sample collection. If immediate analysis is not feasible, samples should be refrigerated to preserve accuracy. This rationale supports the 15-minute processing window adopted in the present study to ensure reliable and reproducible lactate results.

This study has several limitations. First, detailed demographic and clinical information for the enrolled dogs was not collected. Because the study was designed as a method-comparison analysis using paired measurements obtained under identical conditions, each dog served as its own control. Nevertheless, the absence of population-level data limits the assessment of external validity, and future studies incorporating well-defined patient characteristics are warranted. Second, the relatively small number of dogs in the high-lactate group may have reduced the ability to accurately evaluate analyzer performance at markedly elevated lactate concentrations. Although all samples were analyzed within 15 minutes of collection, minor variations in handling time or temperature could still have influenced lactate stability.

In addition, the study was conducted at a single institution using only one handheld point-of-care device and one blood gas analyzer, which may limit the generalizability of the findings to other clinical settings or analyzer models. Finally, although blood gas analyzers are widely used in routine clinical practice, they are not considered definitive reference methods for lactate determination. Therefore, the results should be interpreted as an assessment of analytical agreement between two commonly used devices rather than as validation against a reference standard.

In conclusion, based on the results of this study, the POC device and the blood gas analyzer show similar correlations in lactate measurements and can be used interchangeably in clinical practice, particularly within low-to-moderate lactate concentrations. However, greater variability and proportional bias may occur at higher lactate levels. Both devices offer appropriate accuracy and can be used in situations requiring rapid lactate measurements. Therefore, the POC device is a good option for lactate testing in the field or situations requiring quick responses, while the blood gas analyzer still plays a role in settings where high accuracy in test results is needed.

Conflicts of interest: None of the authors of this paper has a financial or personal relationship with other people or organizations that could inappropriately influence or bias the content of the paper.

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