

Original Research Article

Correlation between the prothrombin time values obtained by point-of-care prothrombin time meter and clinical laboratory in paediatric intensive care unit of a developing country

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ABSTRACT

Background: Monitoring of prothrombin time (PT) is essential for adequate management of children in pediatric intensive care unit (PICU) who require serial and repeated PT measurements. In contrast to laboratory testing, point-of-care (POC) PT meters have been configured especially for bedside that are cost effective with rapid turnaround time. Our study aimed to assess its feasibility for routine use in PICU by assessing the correlation between PT values obtained through the POC PT meter and those acquired from the laboratory.

Methods: A total of 200 children of either gender aged between 1 month to 12 years, admitted to PICU of Indus hospital Karachi Pakistan from February to August 2023 were analysed in this cross-sectional study. Venous blood samples were collected in PT bottles and transported to the pathology department within a time frame of 20-30 minutes for analysis. Concurrently, a drop of blood was obtained via finger prick and promptly assessed using the POC device-Coaguchek INRange system, (Roche diagnostics Ltd, USA). Pearson's correlation was applied.

Results: 200 children (96 males, 104 females) having a mean age of 6.42 ± 3.55 years. The mean PT values with POC meter and Laboratory were 2.588 ± 1.299 and 2.574 ± 1.304 respectively ($p=0.100$). Very strong correlation of PT between POC PT meter and laboratory evaluation was observed ($r=0.996$, $p<0.001$).

Conclusions: The strong correlation observed between POC PT meter and laboratory supports the use of these devices for timely coagulation monitoring, potentially improving patient outcomes in PICUs.

Keywords: Laboratory, PICU, Plasma, POC, PT

INTRODUCTION

Childhood sepsis, a life-threatening condition with significant morbidity, stands as a precipitating factor for the development of severe complications, including disseminated intravascular coagulation (DIC).¹ Active management of DIC requires timely administration of

correct dosage of vitamin K and fresh frozen plasma and monitoring with repeated PT measurements.² Achieving balance of anticoagulation is vital as either excess or under dosage of anticoagulant can lead to devastating effects.³ Monitoring of PT which is a measure of the extrinsic pathway of coagulation is critical for any patient who is suffering from unexplained thrombosis. The standard laboratory PT test typically takes approximately

25-30 minutes for completion.⁴ This measurement of PT in plasma has been a preferred method for a long time.

The introduction of portable PT meters has revolutionized the monitoring of PT values, enabling accurate assessments at the bedside in intensive care units and outpatient clinics.^{5,6} This method is notably less invasive, requiring only a finger or heel prick, and its user-friendly design has contributed to its widespread popularity. The use of this device is time saving and blood saving, utilizing reduced number of pricks, cost effective in many ways, rapid turn-around time as done in few minutes.^{5,6}

The “Coaguchek XS” by Roche is a PT meter configured especially for bedside testing and it is readily available in Pakistan. Numerous studies have demonstrated that the PT meter's results are comparable to laboratory values, exhibiting a strong correlation coefficient (r).⁷⁻⁹ No previous study has been carried out in PICU settings. Shakil et al has carried out a similar study in neonates.¹⁰ Their study recommended further need to study its usage among older children to see the results. There is also limited data available specially for its use in children with septic shock. Our study aimed to provide essential data regarding its feasibility for routine use in the PICU settings. The objective is to assess the correlation between PT values obtained through the Roche “Coaguchek INRange system” and those acquired from the laboratory in the PICU at a tertiary care hospital in Pakistan.

METHODS

This cross-sectional study was conducted at PICU of Indus hospital and health network, Karachi, Pakistan, from February 2023 to July 2023. PASS-15 software was used to calculate the sample size by taking baseline correlation ($p=0$); 0, power 80%, level of significance 95% and expected correlation as 81% between PT values by PT meter and laboratory estimation. Sample size calculated was calculated to be 9.⁸ As the sample size calculated by software is small, so we involved 200 children for this study using non probability consecutive sampling technique. Inclusion criteria were children of either gender aged between 1 month to 12 years, admitted to PICU with diagnosis of sepsis requiring PT measurements and whose parents/guardians were willing to participate in this study. Children having haematocrit beyond the normal range (25-50%) as estimated by blood serology were excluded.

The study was conducted after the approval of institutional review board. Informed and written consents were obtained from the parents/guardians of the children. Blood samples were aseptically collected from all study participants through a peripheral vein. Venous blood samples were drawn into PT bottles containing citrate under strict aseptic conditions. The collected samples were properly labelled for identification and subsequently

transported to the pathology department of our hospital. Transportation was carried out physically by a designated member of the research team to ensure that the sample reaches laboratory within 20 to 30 minutes after collection and no degradation of the sample took place. The plasma extracted was analysed by “Sysmex coagulation analyzer CA-1500”. Concurrently, a small drop of blood was obtained through a finger prick and promptly assessed using the POC device Coaguchek INRange system, developed by Roche diagnostics Ltd, USA. This device is already present in our PICU but its use is still limited owing to the lack of availability of data and authenticity of the results when compared to standard laboratory results. Either as one time or serial tests was done from patients depending upon the requirement for each patient. We used standard method of needle prick and used firm pressure on pin prick site to avoid hematoma formation. A special proforma was designed to record all study data. Name, age, gender, and PT values were recorded.

Data analysis was done by “IBM-SPSS statistics”, version 26.0. For qualitative variables such as gender, percentage and frequency were shown. For quantitative variables like age and PT values, mean and standard deviation were computed. The paired sample t-test was employed to compare PT values among genders, different age groups, and between the two PT methods. Pearson's correlation analysis was conducted to assess the correlation between PT values obtained from the PT meter and those from the laboratory. Correlation coefficient was determined applying Pearson correlation. Area under curve was also estimated applying receiver operating characteristics (ROC) curve analysis. $P<0.05$ was taken as significant.

RESULTS

In a total of 200 children, 96 (48%) were males and 104 (52%) females. The mean age was 6.42 ± 3.55 years ranging between 3 months to 12 years (Figure 1).

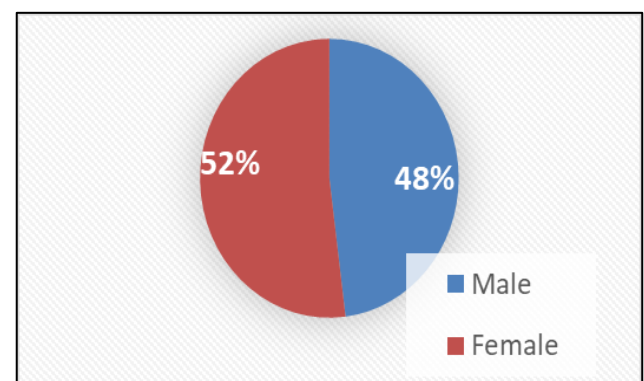


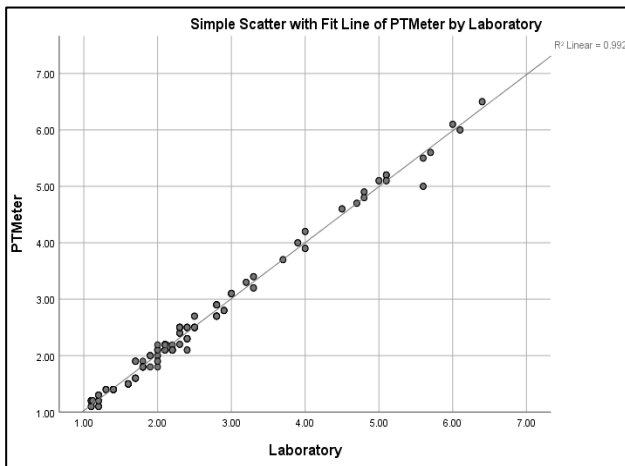
Figure 1: Gender distribution.

The mean PT values with PT meter and laboratory method are shown in Table 1 ($p=0.100$).

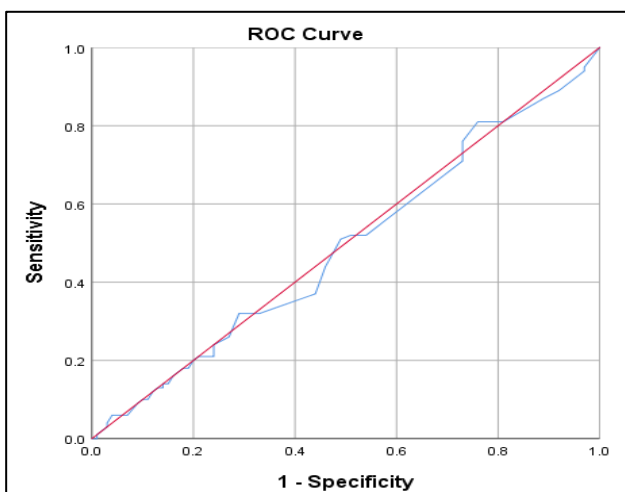
Table 1: Paired samples statistics, (n=200).

Variables	Mean	Std. deviation	Std. error mean
PT meter	2.5877	1.29944	0.09188
Laboratory	2.5738	1.30437	0.09223

Scatter plot diagram showed that PT meter and laboratory serum PT estimation were having a very strong correlation as plotted (Figure 2) ($r=0.996$, $p<0.001$).

**Figure 2: Scatter plot comparing PT meter and laboratory serum PT estimation.**

ROC curve analysis showed area under cover as 0.490 (0.433-0.547) which showed nearly little to no difference in terms of sensitivity and specificity between both methods of PT estimation (Figure 3).

**Figure 3: ROC curve analysis of PT estimation between 2 methods.**

DISCUSSION

This study focused on assessing the correlation between PT values obtained using a POC PT meter and the

clinical laboratory method in a PICU setting. The high correlation observed in our study is in line with the growing evidence supporting the clinical utility of POC PT for monitoring. This is particularly valuable in PICUs, where rapid decision-making is often crucial. A meta-analysis involving 22 studies indicated that the preciseness of POC INR coagulometers, while not exceptionally robust, is generally sufficient for clinical use.¹¹ In standard laboratory settings, the analytical imprecision for conventional PT measurements using automated instruments is typically less than 3% coefficient of variation which seems excellent.¹² However, data from a meta-analysis has shown that POC INR precision shows a range of 1.4% to 8.4% CV, indicating somewhat higher variability.¹¹

A study conducted by the “Canadian agency for drugs and technology in health” revealed that the diagnostic accuracy of POC INR, in comparison to laboratory PT/INR, was generally acceptable, with discrepancies typically within 0.5 INR units within the standard therapeutic range (INR 2-3.5).¹³ Some researchers have indicated that discrepancies between laboratory and POC INR measurements are minimized in patients on stable therapeutic warfarin. It is essential to acknowledge that POC INR systems are not validated for the precise measurement of patients with markedly elevated warfarin levels. These instruments are typically calibrated using plasma INR values ranging from 1.5 to 4.5.^{14,15} Clinically significant differences between POC INR and laboratory PT/INR measurements are more likely to occur when the INR exceeds 3.0.¹⁶ Experts advise retesting patients with INR results ranging between 4-8 using the POC device to confirm that prolonged results are not attributed to sample quality issues or analytical errors. If the repeated value is either greater than 8.0 or exhibits a difference of more than 0.5 units from the initial result, it is recommended to opt for a laboratory determination of PT/INR from a venous sample.¹⁷ Verification of POC INR values exceeding 5.0 through central laboratory testing has been shown to prevent adverse treatment events in some patient populations.¹⁷ A study by Ryan et al revealed that POC testing for PT evaluation proved dependable, safe and sound alternative to laboratory monitoring but there is a need to practice quality control when these devices are being used.¹⁸ Most important aspects of POC Instruments are the reliability, consistency and affordability. The present study showed excellent correlation between the POC meter and laboratory evaluation for PT.

It is noteworthy that our study included a diverse age range of pediatric patients admitted in PICU. Previous local data had established that PT meter did not disagree significantly from the PT estimates of clinical laboratory method.¹⁰ POC testing systems allow for the swift execution of a variety of tests directly at the bedside, garnering growing interest, especially in ICU settings. The strong correlation observed in our study implies that POC PT meters can be a valuable tool for monitoring

coagulation status in PICUs. This aligns with the trend toward POC testing for critical care patients.¹⁹⁻²¹

Some strengths of this study include its clinical relevance as it was conducted at a PICU setting, rigorous methodology, strong correlation findings, and potential to improve POC in a critical care setting. There were some limitations of this research as well. Relatively modest sample size and a single study setting of a tertiary care PICU restricts the generalizability of our findings. The inclusion of patients in a PICU setting might introduce selection bias, as these patients may have specific medical conditions that differ from those in other hospital departments. The accuracy and precision of PT measurements may depend on the calibration and maintenance of the POC PT meter. Variety of POC meters for PT measurements are available and the results of this study cannot be generalized to other portable devices. While our study focused on PT values, clinical practice often uses the INR to standardize PT results.

CONCLUSION

Our findings align with existing literature and contribute valuable insights into the use of POC PT meters in pediatric critical care setting of a tertiary care hospital of Pakistan. The strong correlation observed between POC PT meter and laboratory evaluation supports the use of these devices for timely coagulation monitoring, potentially improving patient outcomes in PICUs. However, it's important to stay updated with the latest research in this field, as technology and guidelines may evolve over time, influencing clinical practice.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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