

Assessment of the accuracy of blood drawn from peripheral venous cannula used for infusing intravenous fluids / drugs versus direct venepuncture to analyse full blood counts in febrile children

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(Index words: blood sampling, venepuncture, cannulae sample, full blood count)

Abstract

Introduction: Blood sampling is a common occurrence in current paediatric practice. Dengue and other febrile illnesses are the main disease entities attributable to admissions. These admissions warrant repeated blood sampling especially with regard to full blood counts. Repeated direct pricking for sampling or having an in-situ cannula for bleeding purposes both have their own disadvantages and undesirable effects.

Objectives: Compare the accuracy of parameters of full blood count of a blood sample taken from a cannula in use against a full blood count from a direct prick.

Method: Nine parameters of the full blood count were compared in 38 paired blood samples from each subject of a cohort of febrile children aged 1-14 years admitted to Professorial Paediatric Unit of Colombo South Teaching Hospital, Kalubowila, Sri Lanka. Samples were taken when medically indicated only.

Results: The mean values of MCV and MCHC from direct venepuncture vs cannula sample were statistically different. Other parameters did not show a statistically significant difference between the samples collected by the two methods.

Conclusion: Blood sampling from a cannula in use for intravenous fluids or medications is favourable for majority of parameters of the full blood count and an advantageous alternative for fresh venepuncture bleeding in febrile children.

Introduction

Febrile illnesses account for the majority of paediatric admissions to hospitals. At our local setting with a high prevalence of dengue fever, any child admitted with fever without localizing signs are being monitored and managed

as for dengue fever. This necessitates daily or more frequent venepunctures for the purpose of full blood counts. Even for other febrile illnesses full blood counts yield valuable diagnostic as well as monitoring information. Venepunctures are not easy to perform in children, but unavoidable during hospital stay.

The blood samples for full blood counts will be obtained either by having a separate “blood cannula” in situ or by repeated venepunctures. Both these manures carry their complications and disadvantages [1]. Frequent pricking for blood drawing is a distressing situation for the patient [1, 2], the parent as well as the health staff. It leads to pain, anxiety as well as noncompliance with medical care [1]. Children have limited bleeding sites due to the smaller size of veins and restricted distribution of the vascular plexus. Repeated punctures as well as restraining during bleeding can lead to bruising in children as well as nerve damage and vasovagal reactions [3]. This further hinders the bleeding sites. To overcome the limitations of repeated venepunctures, a “blood cannula” is inserted in some centres which itself carries own disadvantages such as poor flow, clotting of the sample, distress, discomfort and increased risk of infections. Having cannulae in both hands and legs restricts movement, feeding as well as creates enormous fear and stress in the child.

To overcome these problems, several studies have been carried out comparing direct venous samples and blood drawn from peripheral venous cannula (PVC) which are used for intravenous fluid and drug administration. Most of these studies were done on adults. First study done in children by Sivan Berge- Achitiv *et al* 2010 concluded that the peripheral cannula blood sampling is a reliable method to analyse blood counts and basic biochemical studies except glucose irrespective of the

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gauge of the cannula [4]. Fincher RK *et al* concluded that PVC blood samples taken after discarding 3cc of fluid is a reliable alternative for venepuncture for haemoglobin measurement but not for the potassium levels [5]. However, they also showed that larger gauge catheters are better than smaller gauge catheters to obtain blood [5]. Biological factors differ among different races and geographical regions. Up to date similar study has not been carried out on Sri Lankan children. Author's hypothesis is that peripheral cannula blood sampling will be an alternative for direct venepuncture or sampling from blood cannula for blood count analysis in children and this will reduce the complications of both manures.

Objective

To assess the accuracy of blood drawn from peripheral venous cannula used for infusing intravenous fluids/ drugs versus direct venepuncture to analyse full blood counts in febrile children.

Method

Descriptive cross-sectional study was carried out on 38 children aged 1-14 years admitted to the University Paediatric Unit of the Colombo South Teaching Hospital with fever and who required peripheral venous cannulation for intravenous fluid and/ or medications. It was carried out in a time frame of 1st of May 2020 to 31st July 2020. The admissions due to fever were markedly reduced during the COVID outbreak in 2020. We included all 38 patients admitted to selected paediatrics wards during these three months who fulfilled the inclusion criteria. Ethical clearance for the study was obtained from the research council of the Sri Lanka College of Paediatricians. Informed written consent was obtained before enrolling patients to the study by one of the investigators. Bleeding was decided only with medical indication and samples each from the direct venepuncture and the venous cannulae were taken. Anaesthetic local applications were used at least 30 minutes before the direct venepuncture. Intravenous drip was clamped for at least 3 minutes and 2 ml of blood drawn and discarded during bleeding from the cannula.

Samples were taken within a 10-minute time gap. Samples were labelled as 1 and 2 with patients' name to represent venous sample and cannulae sample respectively. Both samples were analysed by Minray 6200 analyser. Only venepuncture results were taken for patient management. Majority of the samples were drawn from gauge 23 cannulae and none were reported clotted.

Results

Nine parameters in the full blood counts of both samples were compared.

- Total White blood cell count (WBC)
- Neutrophil (NEU) percentage
- Lymphocyte (LYM) percentage
- Haemoglobin (HGB) value
- Mean corpuscular volume (MCV)
- Mean concentration of haemoglobin (MCH)
- Mean corpuscular haemoglobin concentration (MCHC)
- Platelet count (PLT)

Using SPSS paired T-tests were conducted to determine the significance of the difference between the means of the two types of blood tests. Tests has been conducted at 95% confidence level.

Our sample consisted of 38 paired samples from febrile children and the mean age was 9.7 years (min = 2 years, max = 14 years).

For all nine parameters the hypothesis for the paired T-test are;

H_0 : There is no significant difference between the blood count components of two results ($M_D = M_C$)

H_1 : There is a significant difference between the blood count components of two results ($M_D \neq M_C$)

M_D = Mean of the count directly from the child

M_C = Mean of the count from the cannula

Group Statistics

Paired sample T-test results

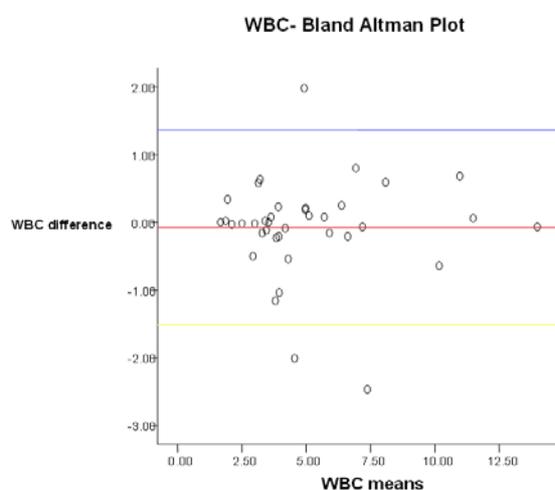
| Test type | Sample size | Mean | Std. deviation | Significance |
|-----------|-------------|-------|----------------|---|
| WBC | | | | |
| Cannula | 38 | 5.11 | 2.8410 | t = - 0.643, df = 37, p > 0.05, r = 0.967 |
| Direct | 38 | 5.04 | 2.8424 | |
| NEU | | | | |
| Cannula | 38 | 32.94 | 16.5947 | t = - 0.413, df = 37, p > 0.05, r = 0.905 |
| Direct | 38 | 32.47 | 15.0504 | |

Continued

| Test type | Sample size | Mean | Std. deviation | Significance |
|-------------|-------------|-------|----------------|---|
| LYM | | | | |
| Cannula | 38 | 57.29 | 16.3199 | t = 0.173, df = 37, p > 0.05, r = 0.902 |
| Direct | 38 | 57.49 | 14.7468 | |
| HGB | | | | |
| Cannula | 38 | 12.21 | 1.3422 | t = - 1.880, df = 37, p > 0.05, r = 0.950 |
| Direct | 38 | 12.08 | 1.4039 | |
| HCT | | | | |
| Cannula | 38 | 36.92 | 3.3298 | t = - 0.686, df = 37, p > 0.05, r = 0.935 |
| Direct | 38 | 36.78 | 3.4465 | |
| MCV | | | | |
| Cannula | 38 | 79.86 | 6.2970 | t = 2.810, df = 37, p < 0.05, r = 0.970 |
| Direct | 38 | 80.56 | 6.3260 | |
| MCH | | | | |
| Cannula | 38 | 26.41 | 2.1693 | t = - 0.575, df = 37, p > 0.05, r = 0.974 |
| Direct | 38 | 26.36 | 1.9889 | |
| MCHC | | | | |
| Cannula | 38 | 33.04 | 1.1747 | t = - 3.230, df = 37, p < 0.05, r = 0.906 |
| Direct | 38 | 32.75 | 1.3027 | |
| PLT | | | | |
| Cannula | 38 | 93.45 | 69.1347 | t = - 2.256, df = 37, p > 0.05, r = 0.938 |
| Direct | 38 | 84.66 | 65.7692 | |

The p value for the differences of the means of the two samples taken from the PVC and venepuncture were more than 0.05 for components of the full blood count such as haemoglobin, haematocrit, platelets, total white blood cells, neutrophils, lymphocytes and MCH. Only the differences of means of the red cell indices of MCV and MCHC were statistically significant. Yet these two parameters are not much important for the management of febrile illnesses.

The Bland-Altman plots for different components of the full blood count as follow.



B value = - 0.051, p

Conclusion

38 paired samples of blood, each from direct venepuncture and peripheral venous cannula were analysed with regard to 9 parameters in the full blood count. Blood sampling from an in-situ PVC is an accurate and effective as well as trouble-free alternative to direct venepuncture and sampling from bleeding cannulae.

Discussion

Blood sampling from PVCs for children was an appreciably shorter procedure than sampling through venepuncture and was associated with less distress and pain. These benefits are not limited to children and their families but also apply to the medical staff, in terms of effective time management as well as in terms of job satisfaction. Sparing the patient from another painful procedure, reducing the risk of cellulitis, thrombophlebitis and bleeding, ease of redrawing another sample in the event of non-suitability of the previous sample, feasibility of collecting more timely samples and obtaining more timely results, preservation of future bleeding sites in patients with limited sites and possibility of recruiting less skilled and less experienced phlebotomists for bleeding purposes are some other advantages.

Samples were analysed with paired t-test with regard to parameters of the full blood count. Majority of the parameters analysed between two samples did not show any statistically significant difference between vene-

puncture and cannulae samples, other than statistically significant difference observed in MCV and MCHC components. This study proves that the blood can be drawn from peripheral cannulae used to infuse/ inject fluids or drugs to analyse component of the FBCs, provided that the sample taken after discarding a small amount of blood as such as 2 millilitres.

The findings in our study leads a new path in minimizing frequent skin pricks in febrile children. This will invariably improve patient as well as parent satisfaction, in addition to minimizing numerous physical as well as psychological disadvantages of frequent pricking in an already compromised child. This approach will lead to a better compliance with medical care. However, staff education regarding aseptic handling of the cannulae is of utmost importance to prevent the rare risk of infection.

Limitations

As our study is an initial study in a local scenario, we need future studies putting the emphasis on the gauge of the cannulae used for sample collection, type of fluid that has been running previously, lag time between discontinuation of fluid and bleeding, amount of blood discarded against different age groups of children.

Author contributions

All authors have contributed equally for data collection, analysis and manuscript writing. Concept of the study from Dr Ruwanthi Perera.

Conflicts of interest

None

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Ethics approval

Ethics review committee, Sri Lanka College of Paediatricians.

Patient consent

Informed written consent from parents and assent from guardians obtained.

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None

Abbreviations

PVC: peripheral venous cannulae

WBC: Total White blood cell count

NEU: Neutrophil percentage

LYM: Lymphocyte percentage

HGB: Haemoglobin value

MCV: Mean corpuscular volume

MCH: Mean concentration of haemoglobin

MCHC: Mean corpuscular haemoglobin concentration

PLT: Platelet count

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