Checking Accuracy of Hematological and Biochemical Tests of Blood Samples Taken from Venous Catheter Infusion Fluids after Stop Infusion Fluids for a Minute

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The most common method of blood sampling is vein puncture.Therefore, according to the vein puncture technique is invasive and painful,This question is still raised whether intravenous lines can be used for sampling blood?Therefore, this study was carried out with the aim of determining and comparing the experimental values of complete blood cell count and biochemical through taking blood samples from peripheral vein infusion line and routine blood sampling procedure. This quasi-experimental intervention study was done on 60patients hospitalized in the internal medicine ward who were selected for blood sampling.Two samples were taken from each patient through peripheral intravenous line after stopped infusion fluid of peripheral catheter(case)for one minute and through the routine blood sampling procedure (control).Then all the samples were analyzed in terms of the number of white blood cells, red blood cells, platelets,hemoglobin ,Hematocrit,sodium,potassium,urea and creatinin using SPSS software19,paired t-test and Pearson correlation. Differences of hemoglobin and hematocrit contents,sodium and potassium through IVand vein puncture methods were significant. It can be used to blood samples taken from a peripheral vein infusion line in order to measuring the amount of white blood cells,red blood cells,platelets,urea and creatinin levels after stopping one minute of flow infusion in vulnerable patients.

Key words: Biochemical, Complete blood cell count, Peripheral catheter, Phlebotomy

It is necessary that hematological and biochemical testes be done several time in some vulnerable patients such as leukemia patients, GI bleeding, trauma, hospitalized in special unit[1]. Currently vein puncture is common method for blood sampling And Veins are the first sites for blood collection[2].

Fear of needling at time of blood sampling in hospital and surgical process may be caused fear, lack or decrieses of patient cooperation, un success in treatment process , retrying for blood sampling, extra pain and over all duration of treatment process[3].

In additional, almost all damage that occurred by sharp instrument in hospital are included nurses. Although in all of the world there isn't many information about statistical injury of sharp instrument and it may be reported un really[4]. As 60 to 80 % of nurses don't report

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damages of sharp instrument formally[5]. Although blood sampling is a painful procedure for patients also its difficult for nurses when patients don't have clear vein[1.]

It is more than three decades that researchers discuss sampling through venous catheters and many relevant unanswered questions[6]. According to the researches, today more than 80 to 90% of hospitalized patients need vein treatments at duration of treatment and annually more than 500 million peripheral catheters are inserted[7]. Despite these peripheral catheters for blood collection, typically, nurses and laboratory staff use vein puncture[8] because it is believed that the injection of medication and fluid changes the results[9]. But this method is associated with pain and discomfort, damage to peripheral veins, phlebitis and bleeding, which may hinder using blood vessels in future[10].

To obtain accurate laboratory data for hematology and biochemical samples, it is necessary that blood sample collection be done properly by nurses. Several factors can affect hematology measurement, one of which is the standard method of sampling by nurses before any analysis to reduce unwanted changes[11]This question is still raised whether intravenous lines can be used for sampling?[6] Yet, only a few studies have compared biochemical and hematological parameters in blood samples obtained from vein puncture and peripheral catheter while the patient is receiving intravenous fluids—and most of the few existing studies[12, 13] end with the researchers' emphasis on the need for more research with more samples[14-18]

This study was conducted to determine and compare laboratory values of cell blood count and biochemical that be collected through the peripheral venous infusion line and venipuncture in patients admitted to the internal medicine department in Shohadaye Khalije Fars Hospital, Bushehr, in 2014,To We be com near to this hypotheses that we can use blood samples that taken from peripheral vein catheter for cell blood count and biochemical test and by it we will prevent patients from repeated injury that cussed by vein puncture , save time , take result of laboratory test faster and reduce risk of infection.

MATERIALS AND METHODS

This research is a quasi-experimental study with a control group conducted on patients admitted to the internal medicine department in Shohadaye Khalije Fars Hospital, Bushehr. The sample size was determined as 60 considering confidence interval of 95%, study power of 90% and the standard difference 0.8 using Altman normogram. Blood samples were taken after providing necessary information about the objectives and methods of the study and obtaining written informed consent of qualified patients (patients requiring fluid therapy, patients receiving at least 100 cc of fluid, patients without peripheral venous infusion line in other hand, patients over 18 years of age, patients capable of giving written consent). Two samples of blood were drawn from each patient, one through the peripheral venous infusion line with fluid intake and another from patient's hand through venipuncture with 10 cc syringe and needle gauge 20. To do so, at first, both areas were disinfected with betadine by a skilled nurse and then were washed with alcohol to ensure that betadine did not remain on the area. Then, the peripheral venous infusion line was disconnected for 30 seconds and a tourniquet was fastened above and near it and another tourniquet was also fastened in vein puncture area in another arm. Thirty seconds after fastening the tourniquet on the arm with peripheral venous infusion line, the infusion set was replaced with a 10-cc syringe, and was used to draw 5 cc blood. The peripheral vein infusion fluid was discontinued for one minute until sampling was done. For vein puncture, after 30 seconds of fastening the tourniquet, 5 cc of the blood sample was drawn with a 10-cc syringe and needle gauge 20. Both samples were poured into two separate containers for performing the tests. The container with samples obtained from the peripheral venous infusion line was labeled "A" and the container with samples obtained from vein puncture was labeled "B". In order not to determine how the samples were prepared, the samples were sent to the laboratory with false names to be analyzed, where the complete blood count test was done by sysmex Xs800i, Biochemical tests of urea and creatinine were conducted based on the enzymatic method with Selectra XL model, and the

tests on sodium and potassium were conducted based on atomic absorption, with the flame photometer. Demographic information of participants including age, gender, type of disease and also the type and amount of intravenous fluids and the laboratory results of blood samples were analyzed by descriptive statistics method (frequency and mean) and inferential statistics (paired t-test and Pearson's correlation coefficient) using SPSS software 19. Significance level was considered 0.05.

RESULTS

Sixty percent of participants were male and four percent were female and they aged between 19 and 91 years (46.95 ± 20.73). The most common cause of admission to hospital for patients participating in the study was cellulites (10%). 58.3% of participants received 1/3,2/3 serum and 41.70% of them received 0.9% sodium colored through the peripheral venous infusion line. The lowest amount of fluid received until taking blood sample was 2000 liters and the maximum was 9000 liters (5008.33 ± 1923.65).

Comparison of the hematology test results in two blood samples obtained from the peripheral venous infusion line and venipuncture (Table 1) using paired t-test showed that there was statistically significant difference between the value of hemoglobin and Hematocrit in the samples (p-value = 0.00) . Also a direct and positive correlation was found between the values of both the hematological blood samples by Pearson correlation coefficient (WBC = 0.97, RBC = 0.52, Hb = 0.97, Hematocrit = 0.97, and platelets = 0.91) that the correlation was statistically significant ($P = 0/00$).

Comparison of the biochemical test results in two blood samples obtained from the peripheral venous infusion line and vein puncture (Table 2) using paired t-test showed that there was only a statistically significant difference between the value of sodium and potassium in the samples (p-value = 0.00) .Also a direct and positive correlation was found between the values of biochemical samples by Pearson correlation coefficient. (Na = 0.83, K= 0.86, BUN = 0.84, Cr = 0.71) that the correlation was statistically significant ($P = 0/00$).

Table 1. The mean and Standard Deviation of cell counting tests for blood sample which was drawn through peripheral vein infusion (PVI) line and through The usual method (vein puncture)

Sampling method	(Mean ±STD)		T(59)	p value
Variable	PVI line sample	The usual method		
RBC($\times 10^6$)*	4.31($\pm$ 0.84)	4.59($\pm$1.23)	2.02	0.05
WBC($\times 10^2$)*	95.60($\pm$39.41)	95.87($\pm$38.29)	0.21	0.83
Hb***	12.32($\pm$2.37)	12.68($\pm$2.41)	4.94	0.00
Hct**	37.78($\pm$7.35)	38.96($\pm$7.30)	4.84	0.00
Plt($\times 10^3$)*	244.50($\pm$92.13)	244.80($\pm$89.63)	0.06	0.95

cell/µl = unit*   %/µl = unit**   gr/dl = unit ***

Table 2. The mean and Standard Deviation of biochemical tests for blood sample which was drawn through peripheral vein infusion (PVI) line and through vein puncture

Sampling method	(Mean ±STD)		T(59)	p value
Variable	PVI line sample	The usual method		
Na*	132.58($\pm$ 4.66)	133.37($\pm$5.27)	2.08	0.04
K*	4.25($\pm$0.78)	4.52($\pm$0.81)	4.90	0.00
BUN**	13.18($\pm$8.74)	14.68($\pm$11.18)	1.91	0.06
Cr**	1.17($\pm$0.84)	1.32($\pm$1.31)	1.29	0.20

*meq/l; ** mgr/dl.

DISCUSSION

Blood sampling from venous system is one of the necessary skill in nursing especially in occasion that patients are vulnerable and have a few suitable vessel such as Patients with chronic diseases, patients with a history of intravenous drug users, Addicts, patients in intensive care, scar tissues, Tissue destruction due to various injuries and other factors[19], but this method is associated with pain and discomfort, damage to peripheral veins, phlebitis and bleeding, which may hinder using blood vessels in future[10].

The results showed that, except for hemoglobin , hematocrit, sodium and potassium value, there were no statistically significant differences between the test values of white blood cells, red blood cells, platelets, urea and ceratenin in blood samples taken through intravenous infusion line and vein puncture.

The study by Roberts Herr *et al.* (to determine the validity of blood samples that were aspirated through PVI catheter and vein puncture for testing blood cell counting and biochemistry on 38 patients was performed) concluded that there were significant differences between hemoglobin, hematocrit, sodium and potassium amount in two samples through IVC, and vein puncture, while there was no statistically significant differences between the amount of WBC, RBC, and platelets[7] that their findings were consistent with our research. Berger's study (that was performed on 47 children in 2004 to examine the possibility of replacing the common method of blood sampling with taking blood samples from peripheral intravenous infusion catheter) and himberger's study (that was performed on 64 patients to determine accuracy of results biochemical tests and complete blood count in samples that were taken from peripheral intravenous infusion catheters and by vein puncture in1998) and the results of researches of Zlotowskie's study & *et al.* (to compare several experimental parameters from the analysis of blood samples which were obtained from Vein puncture and Saline Lock after injection of 200 ml of normal saline bolus on 30 patients in Emergency Department) similarly showed that there were no significant differences in terms of WBC, RBC, hemoglobin, hematocrit, and platelet contents, which were obtained by peripheral catheters and

vein puncture[8, 17, 20]. These findings were consistent with our results in terms of all values, except for hemoglobin and hematocrit contents. the researches of Zlotowski *et al*, as our study showed that there were statistically significant differences between the amount of potassium in blood samples taken from the peripheral vein catheter and vein puncture, but in contrast to our study, there were no significant differences between the amounts of sodium in the samples[8]. also Berger's study, Himberger's study[17, 20], Mohler's study (that was performed to examine the reliability of the blood samples were taken through peripheral intravenous infusion lines, saline lock and vein puncture from 55 patients for complete blood count and electrolytes in 1998)[21], and Watson's study (that performed to compare the laboratory results of blood samples that were taken from the peripheral intravenous infusion line after was stopped the infusion fluids for 2 minutes with blood samples were taken from the opposite patient's arm in 1983)[13], were contrast with our results in terms of sodium and potassium.

CONCLUSION

It is noteworthy that we tested on 5 cc of blood that taken from IV catheter at first without discarding but other studies were done on amount of blood after discarding (2cc or 5 cc) of it.The slight difference in the results may be due to different numbers of participants, receiving different amounts of infusion fluid, difference in amount of blood that discarded from peripheral catheter at first and the difference in the duration of discontinuation of infusion fluid before drawing blood sample through catheter in the mentioned studies which shows the need for further research in this regard.

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REFERENCES

1. Kohestani, H., K. Zand, and N. Baghcheghy, Comparison of hematological parameters in blood sampling by venipuncture and salin lock. Phiez. *Journal of kashan university of medical sciences*, 2009; **13**(1): p. 25-30.
2. Pagana K and Pagana T, Mosby's manual of diagnostic and laboratory tests. *Elsevier Health Sciences.* 2013; 16-35.
3. Faisal, M., A. Syed, and A. Pierce, the influence of aEutectic mixture of lidocaine and prilocaineon minor surgical procedure:A Randomized controlled Double-Blind Trial. *Dermatologic surgery*, 2009; **35**: 1-4.
4. Pedro L, Epidemiology of needle sticks and other sharps injuries and injection safety practices in the dominican republic. *American journal of infection control,* 2007; **35**(8): p. 552-559.
5. Serinken, M., A survey of needle sticks and sharp instrument injuries in emergency health care in turkey. *Journal of Emergency Nursing,* 2009; **35**(3): 205-210.
6. Malki, A., S. Kaviani, and K. Mansoorie, Quality control in hematology laboratory., Tehran: Andishe Rafie. 2009; 11-13.
7. Herr Robert D, *et al.*, Intravenous catheter aspiration for obtaining basic analytes during intravenous infusion. *Annals of Emergency Medicine*, 1990; **19**(7): p. 789-792.
8. Zlotowski Steven J, Kupas Douglas F, and Wood G Craig, Comparison of laboratory values obtained by means of routine venipuncture versus peripheral intravenous catheter after a normal saline solution bolus. *Annals of emergency medicine*, 2001; **38**(5): p. 497-504.
9. Ohnishi H, Side effects of phlebotomy: pathophysiology, diagnosis, treatment and prophylaxis. *Rinsho byori,* 2005; **53**(10): p. 904-10.
10. Timby, B., Fundamental nursing skills and concepts, ed. 9. philadelphia: Lippincott williams& wilkins. 2009; 329.
11. Razavi, M., *et al.*, Easy interpret CBC. Tehran: *Boshra*. 2011; 9-43.
12. Lindley Celeste, *et al.*, Comparison of PT, aPTT, and factor VII values obtained by concurrent sample collection by direct venipuncture and peripheral venous catheters. Pharmacotherapy: *The Journal of Human Pharmacology and Drug Therapy,* 1994; **14**(2): p. 224-228.
13. Watson, K.R., R. O'Kell, and J.T. Joyce, Data regarding blood drawing sites in patients receiving intravenous fluids. *Am J Clin Pathol,* 1983; **79**(1): p. 119-121.
14. Baker Rachel B, *et al.*, Determining Optimal Waste Volume From an Intravenous Catheter. *Journal of Infusion Nursing,* 2013; **36**(2):92-96.
15. Bowen Raffick AR, *et al.*, Impact of blood collection devices on clinical chemistry assays. Clinical biochemistry, 2010. **43**(1): p. 4-25.
16. Heiligers-Duckers Connie, *et al.*, Low vacuum and discard tubes reduce hemolysis in samples drawn from intravenous catheters. *Clinical Biochemistry,* 2013; **46**(12): p. 1142-1144.
17. Himberger John R and Himberger Laura C, Accuracy of drawing blood through infusing intravenous lines. Heart & Lung: *The Journal of Acute and Critical Care*, 2001; **30**(1): p. 66-73.
18. Lippi Giuseppe, Cervellin Gianfranco, and Mattiuzzi Camilla, Critical review and meta-analysis of spurious hemolysis in blood samples collected from intravenous catheters. *Biochemia Medica*, 2013; **23**(2): p. 193-200.
19. Nicravan mofrad, M., Emergency nursing., Tehran: nordanesh. 2001; 69.
20. Berger-Achituv Sivan, *et al.*, Blood sampling through peripheral venous catheters is reliable for selected basic analytes in children. *Pediatrics,* 2010; **126**(1): 179-186.
21. Mohler, M., *et al.*, The reliability of blood sampling from peripheral intravenous infusion lines: complete blood cell counts, electrolyte panels and survey panels. *Jintravein nurs*, 1998. **21**(4): 209-214.