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Reducing Blood Sample Hemolysis at a Tertiary Hospital Emergency Department

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Abstract

Blood hemolysis is one of the major problems encountered in hospitals. The purpose of the study is to determine the causes for sample hemolysis and measure the effect of an intervention to reduce sample hemolysis in the emergency department of a large hospital. Here they have used a phased, prospective, interventional study. In phase 1, factors associated with urea and electrolyte sample lysis were studied. Based on the results an educational program consisting of a 15-minute presentation and discussion was implemented. In phase-2, questionnaires were distributed to the doctors and medical students regarding blood sampling and data analysis done after the samples were processes. In phase 1(n=227), it was found that the percentage of lysis is more with the use of vacutainer (35.8%) than without the use of it (11%). While in phase-2 (n=204) after the implementation of educational programme it was found that there is an increase rate of lysis with the use of syringe rather than vacutainer. They were able to attain a reduction in sample hemolysis from 19.8%to 4.9% through the change in operator behaviour which was brought by the educational interventions. Finally, with the introduction of an educational program they were succeeded in bringing reduction in sample hemolysis.

Keywords: sample hemolysis, venipuncture, Emergency department, Vacutainers, Educational programme, chemistry testing.

Introduction

Hemolysis of blood sample is a common problem encountered in medical practice. It leads to inaccurate results and often necessitates a repeat sample. Most of the hospitals are meant to known for heavy workloads and finite resources. In such environments the need of accurate and quick blood results is very important. Erroneous blood results lead to unnecessary delays and additional costs by obligatory repeat samples. Repeat blood sampling also causes unnecessary pain to patients.

In the emergency departments, inaccurate potassium levels can lead to potential misdiagnosis and dangerous management as treatment protocols for hyperkalemia and hypokalemia are drastically different. The factors that causes increased sample hemolysis include pressure differences, needle sizes, time interval between sample collection and analysis, size of collection tubes, difficulty of blood drawing and the use of vacutainer system.

The purpose of their study was to determine the causes for sample hemolysis and to measure the effect of an intervention to reduce sample hemolysis in the Emergency Department.

Methodology

Study setting and design

The emergency department of Singapore general hospital (SGH) was used to carry out their study, which is one of the oldest and largest acute teritiary hospital. The time frame between January 2006 to November 2006 involved to carry out the study. They have conducted a phased prospective, interventional study at their emergency department.

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Study sample

All the patients coming to emergency department requiring blood urea and electrolyte analysis was selected as target population. And the blood sampling is carried out by doctors and medical students. They served as operators for the study.

Study instrument

A structured questionnaire was designed and distributed among the blood sampling operators (doctors and medical students). This recorded their personel method of sampling the blood samples with reference to the following variables.

- Mehod (venipuncture or intravenous cannulation)
- System (arterial bloodgas sampling or arterial puncture, syringe, vacutainer)
- Size of the needle (for cannula 24G-16G, for needle 23Gor 21G)
- Operator (senior attending, junior attending, resident or student)
- Blood flow (fast, moderate or slow)
- Difficulty of venipuncture/cannulation (easy, moderate or hard)
- Source (venous or arterial)
- Samle volume(milliliters)
- Time sample taken
- Time sample processed by the laborator

One questionnaire was completed for every blood sample collected. The patients label was included in the questionnaire for the identification of sample. Figure 1 shows the sample questionnaire of the study.

Data collection

The study was conducted in 2 phases. In phase 1 a total no of 227 blood samples and complete questionnaire were collected. And in phase 2 204 samples and questionnaires were collected. The time sample was drawn was recorded by the attending doctor or student. The time sample was processessed was automatically entered by the biochemistry laboratory's computer system. Sample lysis was determined by the biochemistry laboratory with the use of standardized validated quality control processes integrated with the laboratory equipment.

Based on the data collected in phase 1 by using the questionnaires, an educational program consisting of a 15-minute presentation and discussion was implemented. During the educational program, the factories causing sample lysis were reviewed with the help of phase 1 results. In phase 2 questionnaires were re-distributed to the operators and datas are collected.

Data analysis

All analysis was done using SPSS 15.0 (SPSS Inc., Chicago, iii). Unadjusted and adjusted logistic regression was performed on the various factors related to blood sampling, sample volume, and processing interval with regard to hemolysis rates for phase 1. Differences in qualitative outcomes between phase 1 and phase 2 were determined using chi-squared/Fischer's exact tests.

Results

It was found that the education intervention successfully changed operator behaviour. Table 1 shows the characteristics of study samples in both phases. The table shows the comparison between the 2 phases in terms of reduction rate with the use of different parameters. From the table it was clear that the lysis rate is more with the use of syringe than the vacutainer(before64.3%;after 98.5%). Also, there is increase rate of lysis with the use of venipuncture (26% to 36.8%), reduced rate in arterial sampling (3.1%-0%). The increased sample volume leads to the reduction (4.5ml-5.2ml).

The change in the operator behaviour brought about by the educational intervention reduced rate of hemolysis. Finally, they were able to attain a reduction in sample hemolysis from 19.8%to 4.9%.

Discussion

In this study, they found the introduction of an educational program at the emergency department was able to significantly reduce rated of sample hemolysis. The emphasis of the educational program was based on observations from an initial survey about the possible causes of sample hemolysis.

They believe this study also highlights the limitations of the vacutainer system with regards to causation of sample hemolysis. This can indicate a need to re-engineer the system to reduce the occurrence of this problem, which might be related to the vacuum pressure in the tubes or other design factors.

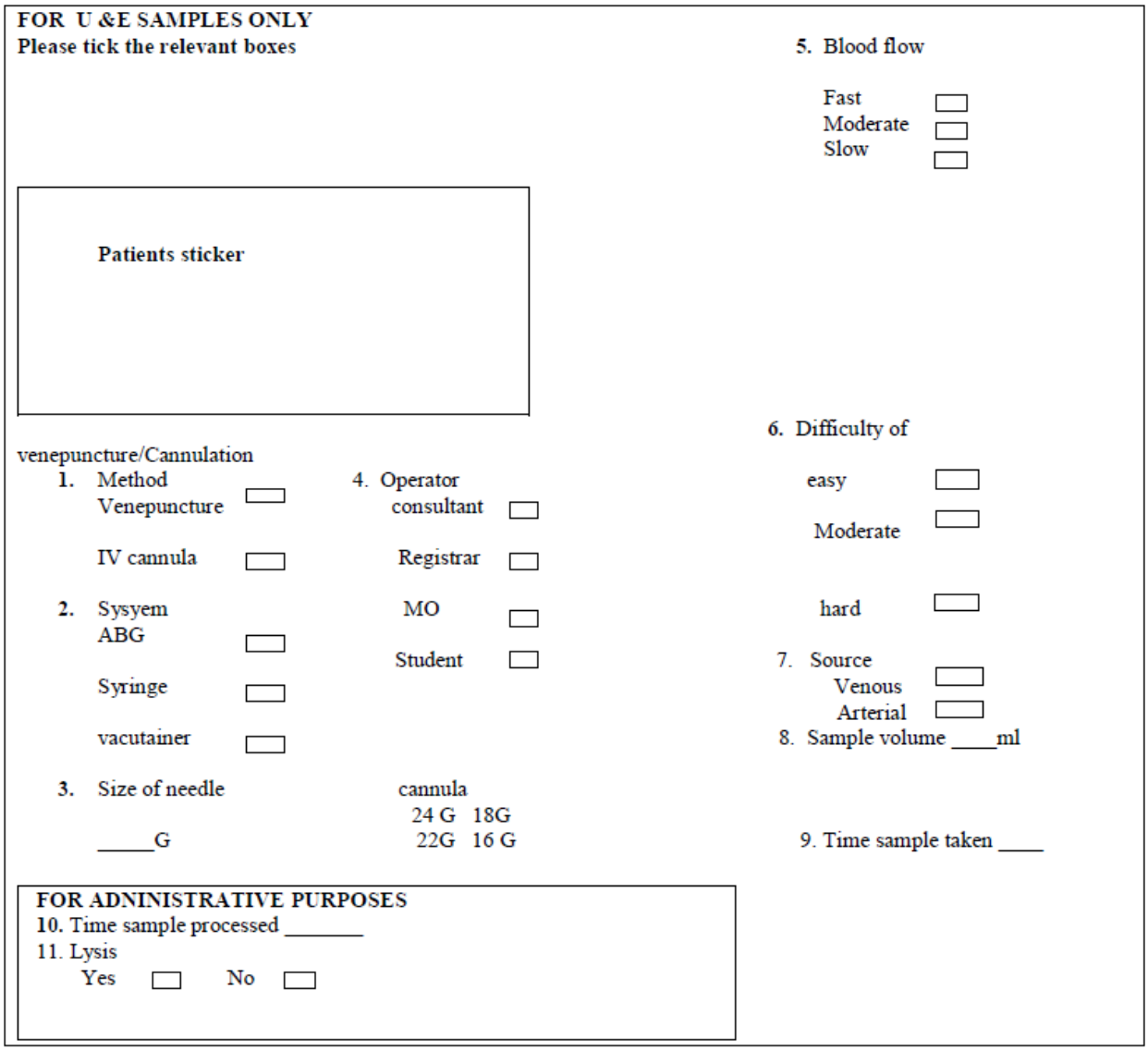

Figure 1 Sample questionnaire used in the study

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Table 1. characteristics of study samples in both cases

Characteristic	**Option**	**Phase1(n=227)**	**Phase 2 (n=204)**	**p-value**
Method	Iv cannula	168(74.0%)	129(63.2%)	.016
System	Venipuncture	59(26.0%)	75(36.8%)	<.001
Size of needle	Syringe	146(64.3%)	201(98.5%)	.081
Operator	vacutainer	81(35.75%)	3(1.5%)	<.001
Blood flow	≤ 21G	86(37.9%)	61(29.9%)	.005
Difficulty of venipuncture/cannulation	>21G	141(62.1%)	143(70.1%)	.159
Source	Senior attending	18(7.9%)	2(1.0%)	.016
Sample volume(ml), mean (SD)	Junior attending	18(7.9%)	6(2.9%)	.004
Interval (minutes), mean (SD)	Resident	13760.4%)	196(96.1%)	.001
Sample hemolysis	Student	54(23.8%)	0(0.0%)	<.001
	Fast	92(40.5%)	113(55.4%)	
	Moderate	102(44.9%)	63(30.9%)	
	Slow	33(14.5%)	28(13.7%)	
	Easy	146(64.3%)	115(56.4%)	
	Moderate	52(22.9%)	51(25.0%)	
	Hard	29(12.8%)	38(18.6%)	
	Venous	219(96.9%)	204(100%)	
	Arterial	7(3.1%)	0(0.0%)	
	Yes	4.5(2.9)	5.2(2.3)	
		60.8(26.2)	48.4(25.5)	
		45(19.8%)	10(4.9%)	

Limitations

The limiting factors of this study was the subjective assessment of the rate of blood flow and difficulty of phlebotomy. They did not have a standard objective measure to gauge blood flow and difficulty of phlebotomy, therefore these parameters were determined subjectively by the operators.

Another limitation is that the study was conducted only during office hours, and this might account for the lower proportions of sample recorded compared with the actual emergency department turnover. In a busy emergency department, it was not easy to get physicians to fill in forms after every blood flow. Thus the sample represented here does not account for all the blood tests done over the period of the study.

Conclusion

In this study, we can come into conclusion that the introduction of an educational program in a hospital emergency department was able to significantly reduce rates of sample hemolysis. This could potentially reduce unnecessary repeat blood sampling, reduce medical errors, and lead to cost savings for the patients in similar settings.

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