

Comparative validation of manual and automated method for mixing of blood samples

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- Objective** : *To compare the quality of specimens obtained from manual and automated blood mixing.*
- Study Design** : *Prospective analytic study.*
- Setting** : *Department of Laboratory Medicine, Faculty of Medicine, Chulalongkorn University.*
- Subject** : *2,757 specimens collected in anticoagulant-added blood collection tubes sent to the Clinical Chemistry Unit, Division of Laboratory Medicine, King Chulalongkorn Memorial Hospital between November and December 1998.*
- Method** : *Quality examination of each specimen was done. All data were collected, categorized and analyzed.*
- Results** : *There were 1,673 specimens mixed by automatic mixer and there were 1,084 specimens mixed by the manual method. The incidence of improper quality specimens was 27 (0.97 %) - 8 hemolysis specimens and 19 clotted specimens. There was no significant difference of ratio of improper specimens in quality between two mixing methods. Comparing automated mixing to manual mixing, the relative risk for improper specimens was 0.5 - for hemolysis specimens 1.94 and for clotted specimen 0.30*

Conclusion : *The ratios of improper specimens from the automated and manual blood mixing methods were to different in general. However, although automated blood mixing can help decrease clotted specimens, there is the risk of hemolysis specimens. The suggestion is for using the automatic mixer in large settings due to the fact that it can save time and personnel effort.*

Keywords : *Specimen quality, Blood mixing.*

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วิโรจน์ ไววนิชกิจ. การวิเคราะห์เปรียบเทียบคุณภาพสิ่งส่งตรวจทางห้องปฏิบัติการที่ผ่านการผสมด้วยบุคลากรและเครื่องอัตโนมัติ. *จุฬาลงกรณ์เวชสาร* 2546 มี.ค; 47(3): 163 – 8

วัตถุประสงค์ : เพื่อเปรียบเทียบตัวอย่างสิ่งส่งตรวจที่ผ่านการผสมด้วยบุคลากรและเครื่องอัตโนมัติ

รูปแบบการศึกษา : การศึกษาเชิงวิเคราะห์แบบไปข้างหน้า

สถานที่ทำการศึกษา : ภาควิชาเวชศาสตร์ชั้นสูง คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

กลุ่มที่ทำการศึกษา : ตัวอย่างสิ่งส่งตรวจที่บรรจุในหลอดบรรจุเลือดผสมสารกันเลือดแข็งที่ส่งตรวจยังหน่วยเคมีคลินิก ห้องปฏิบัติการเวชศาสตร์ชั้นสูง โรงพยาบาลจุฬาลงกรณ์ จำนวน 2,757 ตัวอย่าง ระหว่างเดือนพฤศจิกายนถึงธันวาคม 2541

วิธีการศึกษา : ตรวจสอบคุณภาพสิ่งส่งตรวจแต่ละสิ่ง ทำการรวบรวม จัดกลุ่ม และวิเคราะห์ข้อมูลทั้งหมด

ผลการศึกษา : มีตัวอย่างเลือด 1,673 ตัวอย่างที่ผ่านการผสมด้วยเครื่องอัตโนมัติ 1,084 ตัวอย่างที่ผ่านการผสมด้วยบุคลากร อุบัติการณ์ของสิ่งส่งตรวจที่คุณภาพไม่เหมาะสมเท่ากับ 27 ตัวอย่าง (0.97 %) โดยแบ่งเป็นตัวอย่างที่มีการแตกทำลายของเม็ดเลือด 8 ตัวอย่าง มีการแข็งของเลือด 19 ตัวอย่าง ไม่พบความแตกต่างอย่างมีนัยสำคัญทางสถิติของอัตราส่วนของสิ่งที่มีคุณภาพไม่เหมาะสม ระหว่างการผสมทั้งสองวิธี เมื่อเปรียบเทียบการผสมด้วยเครื่องอัตโนมัติกับการผสมด้วยบุคลากร พบอัตราเสี่ยงของสิ่งส่งตรวจที่คุณภาพไม่เหมาะสมเท่ากับ 0.52 โดยอัตราเสี่ยงสำหรับการแตกตัวของเม็ดเลือด 1.94 และสำหรับการแข็งตัวของเลือด 0.30

สรุป : อัตราส่วนของสิ่งส่งตรวจที่คุณภาพไม่เหมาะสมจากวิธีการผสมทั้งสองวิธีโดยรวมไม่แตกต่างกัน แม้ว่าการผสมด้วยเครื่องจะช่วยลดการแข็งตัวของเลือดได้ แต่มีความเสี่ยงที่เกิดการแตกตัวของเม็ดเลือด ได้เสนอขอแนะนำให้ใช้เครื่องอัตโนมัติในการผสมตัวอย่างเลือด เนื่องจากประหยัดทั้งเวลาและแรงงานในการผสม

คำสำคัญ : คุณภาพของสิ่งส่งตรวจทางห้องปฏิบัติการ, การผสมตัวอย่างเลือด

Specimen collection is an important step in laboratory procedures.⁽¹⁾ There are many laboratory tests requiring blood specimens.⁽²⁾ When blood specimens are set in vitro, clotting will occur. Therefore, when a plasma specimen is required, anticoagulant is added blood to the collection tube. After collection, if the anticoagulant tube is used, mixing must be performed.⁽²⁾ Presently the major methods to mix blood specimens are manual and automatic mixing. Manual mixing is the conventional method and automatic mixing is new method that makes use of an automatic mixer.

The quality of blood specimens is important because poor quality specimens cannot result in accurate laboratory results.⁽³⁾ Improper quality specimens can be divided into categories such as hemolysis and clotted. Although automatic mixers have been used in Thailand for years, there has been no report about their efficacy. This study was set intended to compare the quality of specimens from both manual and automatic mixing. The results of this study may help physicians select appropriate methods for blood specimen mixing.

Materials and Methods

This study was a prospective analytic study. The subjects in this study were 2,757 specimens collected in citrate anticoagulant-added blood collec-

tion tubes and sent to the Clinical Chemistry Unit, Division of Laboratory Medicine, King Chulalongkorn Memorial Hospital between November and December 1998. As the services of the laboratory are the same in each month, only specimens for two months were included in this study. Manual method means mixing by medical personal following inversion mixing technique (inversion of blood collection tube up and down about 8 to 10 times). Automated method bases on inversion mixing technique but makes use of automated blood mixer in stead of medical personnel. The quality of each specimen was examined and then categorized as proper or improper by a medical technologist. The results of each investigation were recorded in tabular collective form. All results were collected, analyzed and interpreted. Analytic statistical analysis was used when appropriate. A two-tailed test was used in comparisons. P-value less than 0.05 was accepted as having statistical significance.

Results

From the total of 2,757 specimens included in this study, there were 1,673 specimens mixed by automatic mixer and 1,084 specimens mixed by the manual method. The number of improper specimens was 27 specimens - 8 hemolysis specimens and 19 clotted specimens (Table 1). There was no significant difference of ratio of improper specimens between

Table 1. Specimens included in this study.

Method of mixing	Total specimens	Improper specimens in quality	
		Hemolysis	Clot*
Manual mixing	1,084	2	13
Automatic mixing	1,673	6	6

*There was significant difference between ratio of that type of specimen between two mixing methods.

the two mixing methods. There was no significant difference of ratio of hemolysis specimens but there was a significant difference between ratio of the clotted specimens between the two methods. Comparing automatic mixing and manual mixing, the relative risk for improper specimens is 0.52 - 1.94 for hemolysis specimens and 0.30 for clotted specimens.

Discussion

Mixing is an important procedure required in collection of anticoagulant-added blood specimens. The major aim of mixing is producing homogeneity of blood and anticoagulant to prevent clot formation.^(1-2,4) Mixing should be proper so that the laboratory procedures will be successfully performed.

Although the percentage (0.97 %) of improper specimens in quality were small, each improper specimen implies lost time and money.⁽³⁾ The quality of specimens from manual mixing was not different from automatic mixing. But the ratio of clotted specimens from manual mixing was greater than from automatic mixing. There was no statistical difference in the ratio of hemolysis specimens from both mixing methods but there was statistical difference in the ratio of clotted specimens from the two methods.

Concerning relative risk, automatic mixing is considered to be useful in prevention of clot but it adds the risk of hemolysis. This can imply that automatic mixers can result in better homogeneity of the mixture but with less control of mixing force.

A study of Follea G, et al⁽⁵⁾ showed that no significant advantage could be expected from the use of automated blood mixing as compared to manual blood mixing. This matches the results of this study where there was no statistical difference in improper

specimen ratios between the two mixing methods. Although automated blood mixing is subject to practical difficulties involving transport and battery loading. But the automatic machines can help save time and personnel, therefore, they should be used in the large settings. The conclusion is that automatic mixers should be used if available. In cases where there is a chance of hemolysis, as for specimens from hematology or oncology wards, manual mixing is advised.

This study design was a prospective study. Therefore, bias in finding causes of improper specimens could be controlled. The subjects in this study were not living subjects so no problems of exclusions occurred. Anyway, only citrate-anticoagulant added blood specimens were studied. Therefore, there may be some differences in other anticoagulant added blood specimens.

Conclusions

A prospective analytic study to compare the quality of blood specimens from manual and automatic mixing methods was performed. The study revealed that the automatic mixer can reduce the number of clotted specimen but it increases the risk of hemolysis.

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