# Comparison of Blood Specimens from Plain and Gel Vacuum Blood Collection Tubes

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**Abstract**

This study was set in the Division of Laboratory Medicine, Chulalongkorn Hospital. All 2,000 blood specimens were randomly collected using evacuated blood collection by plain or gel vacuum tubes. After collection, each specimen was considered and judged using criteria of specimen rejection to determine how proper the specimen presentations were. All data were reviewed, collected and interpreted. It revealed that there were only 20 (1%) improper specimens and all were improper in quality. There was no significant difference between the ratio of improper specimens in both groups ($P > 0.30$). From this study, it revealed that efficacy of both types of vacuum tubes was not different. The new gel vacuum tube seems to be an effective tool in the evacuated blood collection system due to its advantage in reduction of time in specimen processing.

**Key word :** Blood Collection, Comparison, Plain & Gel, Vacuum Tube

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**J Med Assoc Thai 2001; 84: 723-726**

A number of laboratory tests are available in medical practice[1-3]. Main specimens for these tests are venous blood specimens obtained from venipuncture procedure. In the present day, the evacuated blood collection system is the modern method for blood collection[4-9]. Concerning the evacuated blood collection system, blood automatically flows into the vacuum tube.

Quality and quantity of the specimen for basic laboratory tests are very important[1]. Aberrance in quality and quantity of the blood specimen effects not only laboratory result pitfalls but also waste of time and money. In the worst case, patient complication is the result.

For the evacuated blood collection system, vacuum tubes play an important role in the genera-

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**Table 1. Criteria of specimen rejection.**

| Causes | Example |
|---|---|
| A. Improper in quantity | • Too much<br>• Too little |
| B. Improper in quality | • Hemolysis |

**Table 2. Specimens in this study.**

| | Plain vacuum tube | Gel vacuum tube |
|---|---|---|
| Proper | 995 | 985 |
| Improper | | |
| A. in quantity | 0 | 0 |
| B. in quality | 5 | 15 |

tion of blood collection. Vacuum tubes are evacuated blood collection tubes sealed with rubber called stoppers. A number of vacuum tubes with various additives or preservatives have been produced. In the present day, a new vacuum tube with a gel separator has been produced in order to serve the collection of serum. Therefore, this study was set to compare the final results of blood collection using the classical plain vacuum tube and the new vacuum tube with the gel - separator for collection of serum type specimens.

## MATERIAL AND METHOD

This study was set in the Division of Laboratory Medicine, Chulalongkorn Hospital. All 2,000 evacuated blood collections for serum type specimens were included in this study. All specimens were randomly collected using classical plain vacuum tubes (Beckton-Dickinson) or new vacuum tubes with a gel-separator (Beckton-Dickinson), by the same collectors. The same size of needle and tube were used in collection.

A classical plain vacuum tube is a vacuum tube without any additive inside, therefore, there is no need for specimen mixing after collection. The new vacuum tube has an $SST^R$ gel separator as additive to activate clot formation. After collection, mixing is required.

After collection, each specimen was considered and judged by the team of medical technologists. All observers in this study were blinded. All specimens were considered using the criteria of specimen rejection[5-10] (Table 1) determines how proper the specimen presentations were. Specimens within the criteria for specimen rejection were considered as improper specimens. The others were considered as proper specimens. Data from judgement of each specimen was recorded in the tabular form. All data were reviewed, collected and interpreted. Comparison between the two groups was done using descriptive statistical analysis. Difference was tested by *T*-test proportion. Statistically significant level was accepted at $P = 0.05$.

## RESULTS

Concerning the specimen rejection criteria, there were 20 (1%) improper specimens and 1,980 (99%) proper specimens (Table 2). Improper specimens' ratio in the plain vacuum tube group and new gel tube group were 5/1000 and 15/1000 respectively. It was found that all improper specimens were improper in quality. There was no significant difference between the ratio of improper specimens in both groups ($P > 0.30$).

## DISCUSSION

Blood specimens yielded from venipuncture should be proper because improper blood specimens can result in errors of this test. In the present day, evacuated blood collection is the common technique used[4]. Although there is much advantage of the equipment, in fact, observation of how proper the specimens are in real medical practice should be performed because specimens are the final results of the system.

The vacuum tube is an important part in the evacuated blood collection system. In the collection procedure, blood directly flows *via* the needle into the collection tube. Concerning the concept that no good results can be yielded from error specimen, quality proving of specimen collection instrument is necessary.

The serum type blood specimen is an important blood specimen. A number of tests must be based on this type of specimen. In general, a serum type blood specimen can be collected using a plain vacuum tube without any additive. But in the present day, the new vacuum tube with a gel separator has been produced and introduced. However, there was no report about its quality. This type of

vacuum tube with an olefin - based gel - separator is claimed to provide faster separation of serum and clot[10].

From this study, although improper specimens ratio in the plain vacuum tube group was lower than the ratio in the gel tube group, there was no significant difference between the two systems. This can imply that proper specimens can be yielded from both types of vacuum tubes.

When considering in each subtype of improper specimens, all were improper in quality. According to the principle of the equipment that the blood flow into the vacuum tube is mainly controlled by the pressure difference between intravenous pressure and tubular pressure and blood automatically ceases when the equilibrium of pressure is reached[4], therefore, the proper quantity of blood specimens can be expected. Furthermore, it revealed that there was no difference in the quality and (hemolysis) of the improper specimens. Although the new gel vacuum tube requires a mixing procedure in processing, no significant hemolytic effect was detected. This fact can imply that the vacuum effects in both types are good.

Every medical personnel should be aware of the fact that improper quality of specimens can result in false results, especially in the basic coagulation test which requires a strict amount of blood specimen[1-3]. Furthermore, a waste of time for consulting physicians to recollect a new specimen and waste of money in using a new set of equipment can be the result.

The new gel vacuum tube seems to be an efficacy tool in the evacuated blood collection system. Although the price of this new tube is more expensive than the plain tube, it seems to be useful in cases that require a short turnaround time.

## SUMMARY

The evacuated blood collection system is appropriate for collection of blood specimens for basic laboratory tests. Both classical and new vacuum tubes still produce improper specimens. However, the new gel vacuum tube seems to be an effective tool in the evacuated blood collection system due to its advantage in reduction of time in specimen processing. How to decrease improper specimens by decreasing human error needs to be considered.

(Received for publication on October 21, 1999)

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# การศึกษาเปรียบเทียบสิ่งส่งตรวจประเภทเลือดจากการใช้หลอดเก็บตัวอย่างเลือดด้วยระบบสูญญากาศแบบไม่ใส่สารกันเลือดแข็งและแบบใส่สารกระตุ้นการแข็งตัวของเลือด

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ได้ทำการศึกษาเปรียบเทียบสิ่งส่งตรวจเพื่อการตรวจเกี่ยวกับการตรวจทางห้องปฏิบัติการเบื้องต้นจากการเก็บตัวอย่างเลือดด้วยหลอดเก็บตัวอย่างเลือดด้วยระบบสูญญากาศด้วยหลอดสูญญากาศแบบไม่ใส่สารกันเลือดแข็งและแบบใส่สารกระตุ้นการแข็งตัวของเลือด โดยทำการศึกษาที่หน่วยเวชศาสตร์ชันสูตร โรงพยาบาลจุฬาลงกรณ์ โดยได้ตรวจสอบและพิจารณาสิ่งส่งตรวจจากการเก็บตัวอย่างเลือดทั้งสิ้น 2,000 ตัวอย่าง ด้วยเกณฑ์ปฏิเสธสิ่งส่งตรวจ รวบรวมข้อมูลที่ได้และทำการวิเคราะห์ทางสถิติ จากการศึกษาพบสิ่งส่งตรวจที่ไม่เหมาะสมเพียง 20 ตัวอย่างคิดเป็นร้อยละ 1 โดยเป็นความไม่เหมาะสมในเชิงคุณภาพทั้งสิ้น ไม่พบความแตกต่างอย่างมีนัยสำคัญระหว่างสัดส่วนของสิ่งส่งตรวจที่ไม่เหมาะสมของการเก็บตัวอย่างเลือดโดยใช้หลอดสูญญากาศทั้งสองชนิด จากการศึกษาพบว่าประสิทธิภาพของหลอดสูญญากาศทั้งสองแบบไม่แตกต่างกันอย่างไรก็ตามหลอดสูญญากาศแบบใหม่นับว่าเป็นสิ่งที่มีประโยชน์มากในการเก็บตัวอย่างเลือดด้วยระบบสูญญากาศเนื่องจากสามารถช่วยลดช่วงเวลาในกระบวนการตรวจทางห้องปฏิบัติการลงได้

**คำสำคัญ** : การเก็บตัวอย่างเลือด, การเปรียบเทียบ, ไม่ใส่สารกันเลือดแข็งและแบบใส่สารกระตุ้นการแข็งตัวของเลือด, หลอดสูญญากาศ

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