

## Serum separator tube, a useful application of evacuated blood collection system

วิโรจน์ ไวนิตกิจ<sup>1</sup>

### Abstract:

Serum separator tube, a useful application of evacuated blood collection system

Wiwanitkit V.

Department of Laboratory Medicine, Faculty of Medicine,

Chulalongkorn University, Bangkok, 10330, Thailand

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*A serum separator tube is a useful application of the evacuated blood collection system. These tubes have gained widespread acceptance due to the advantage of the barrier gel that facilitates rapid separation of serum from cellular constituents of blood and thus reduces hemolysis. It can reduce the pre-analytical turnaround time without significant clinical effect on routine clinical chemistry test. However, it has a serious considerable interference on some special tests.*

**Key words:** serum separation tube

### บทคัดย่อ:

หลอดแยกน้ำเหลืองเป็นการประยุกต์ใช้การเจาะเลือดด้วยระบบสุญญากาศที่เป็นประโยชน์ ปัจจุบันหลอดชนิดนี้เป็นที่ยอมรับอย่างกว้างขวางเนื่องจากประโยชน์ในการเร่งการแยกน้ำเหลืองออกจากเม็ดเลือดและช่วยลดการแตกทำลายของเม็ดเลือดแดง

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<sup>1</sup>M.D., Lecturer, Department of Laboratory Medicine, Faculty of Medicine, Chulalongkorn University, Bangkok, 10330, Thailand

รับต้นฉบับวันที่ 26 มิถุนายน 2545 รับลงตีพิมพ์วันที่ 31 ตุลาคม 2545

หลอดชนิดนี้ใช้ลดระยะเวลาการรอคอยในขั้นตอนก่อนการตรวจทางห้องปฏิบัติการได้เป็นอย่างดี และไม่ส่งผลกระทบต่อผลการตรวจทางเคมีคลินิกโดยทั่วไป แต่อย่างไรก็ตาม หลอดดังกล่าวยังส่งผลกระทบต่อผลการตรวจพิเศษต่างๆ

**คำสำคัญ:** หลอดแยกน้ำเหลือง

### Some introduction to evacuated blood collection system

The evacuated blood collection system is a method of venipuncture used worldwide nowadays. Evacuated tubes, needles and holders are used together as a system for the collection of venous blood. On the basic principles of fluid mechanics, venipuncture can be easily done following the recommendations and universal precautions<sup>1</sup>. In Thailand, this system has been used for a decade, with the first laboratory using this technique being King Chulalongkorn Memorial Hospital.

The three main parts of the evacuated blood collection system are the holder, needle and vacuum tubes. The vacuum tube is a specific part of this system. There are various vacuum tubes with several stopper colors. Also, there are a number of applications of the system from various tubes<sup>2</sup> such as the microbiology tube and erythrocyte sedimentation rate tube<sup>3</sup>. Here, we present some data on another application of the vacuum tube, the serum separator tube.

### Serum separator tube (Figure 1)<sup>4-5</sup>

Serum separator tubes were introduced in 1976 and are widely used in the clinical laboratory today for routine collection of blood. These tubes have gained widespread acceptance due to the advantage of the barrier gel that facilitates rapid separation of serum from cellular constituents of blood and thus reduces hemolysis<sup>4</sup>. Silica Clot Activator and Polymer Gel are applied inside the tube. These two additives play an important role for this tube. The polymer gel, upon centrifugation, this gelatin forms a barrier between the cell and serum layers, thus making it easier to pour-off and reducing reactivity between cell and serum components. The silica activator, increases the speed of clot formation.

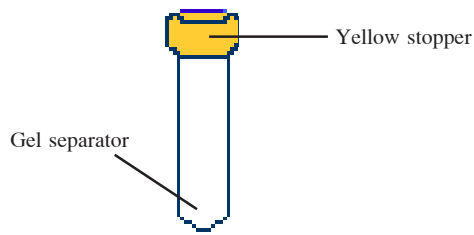
The serum separator tube is now considered an additive tube. According to National Committee for Clinical Laboratory Standards (NCCLS), although it is classified as an additive tube, it should be collected before other additive tubes because of the potential for additive contamination. Due to the Order of Draw<sup>1</sup>, other additive specimens are next and serum specimens are last.

At present, its main indication is to isolate serum from suspended blood cells. There are several sizes of tube, 4.0 mL, 9.5 mL and micro for capillary puncture. With only a few exceptions, it can be used whenever serum is required for testing.

### Advantages and limitations of serum separator tube<sup>4-5</sup>

Whenever possible, especially when there is to be a delay between sample collection and submission to a laboratory, serum or plasma should be separated from cells as soon as possible after sample collection. Sometimes, it takes a long turnaround time for this process. At present, the serum separator special tubes can cope with this problem. These contain a silicon gel that allows separation of serum from the clot. In addition<sup>6</sup>, storage of serum in this manner provides the laboratory with specimens for reanalysis or additional analyses while eliminating manipulative steps, including serum removal, tube relabeling, and intertube transfers, and reducing errors due to misidentification and/or contamination.

However, if these tubes are used, the serum should be still withdrawn and placed into a new clot tube. The other specific contraindication is that it is not applicable for Blood Bank use, since both serum and cells are required for performing testing. A very limited number of highly specialized therapeutic drug levels may require the use of plain red top tubes.



a. diagram of SST



c. SST filled with blood after evacuated blood collection



b. Cut away view of the SST stopper



d. SST after specimen preparation, ready for further analysis

Figure 1 Serum separator tube

Table 1 Summary of some important studies on serum separator tube (SST)

Authors	Year	Important findings
Laessig et al <sup>6</sup>	1976	Using SST as an intermediate storage device can cause significant changes of blood glucose and some electrolyte.
Devine <sup>13</sup>	1986	Using SST in drug specimen processing might cause decreases in some drug levels.
Mauro and Mauro <sup>14</sup>	1994	SST causes decreases on free and total phenytoin and carbamazepine serum concentrations.
Holodniy et al <sup>11</sup>	1995	SST has no effect on stabilities of quantitative human immunodeficiency virus RNA.
Lin et al <sup>15</sup>	1999	There is a significant different of serum eosinophil cationic protein level in samples collected by SST comparing to the other tube types.
Wiwanitkit <sup>4</sup>	2001	SST does not cause more hemolysis than simple plain tube.

## Studies on the serum separator tube usage in laboratory medicine (Table 1)

### 1. General clinical chemistry test

After the first launch of the tube, Laessig et al<sup>6-7</sup> reported their study of the effect of serum separator tube in blood collection for 18 routine clinical chemistry tests. Statistically significant changes were observed for bicarbonate, calcium, chloride, cholesterol, glucose, and sodium, however, no clinically significant serum separator tube-induced changes were observed when compared to conventional blood drawing tubes. Similar findings were reported from de Graeve et al<sup>8</sup> as well.

Recently, Hill et al<sup>9</sup> evaluated a plastic serum separator tube, by direct comparison with a glass counterpart. According to this study, the plastic tube demonstrated no differences when compared for common clinical chemistry analytes with multiple types of instruments and systems. In addition, Wiwanitkit<sup>4</sup> has reported that the serum separation tube produced no significant different hemolysis rate from the plain tube. In conclusion, the serum separator tube has no significant clinical effect on routine clinical chemistry tests<sup>10</sup>.

### 2. Immunological test

Holodniy et al<sup>11</sup> reported that HIV RNA equivalents in other types of plasma were significantly higher than in serum separator tubes. In order to minimize the variability of quantitative HIV RNA test results, they suggested that samples collected for a particular assay should be processed at the same time postdraw using a particular tube type throughout a given study. On the other hand, Gobin et al<sup>12</sup> reported no changes of diagnostic activity for the anti-HIV, anti-HTLV, anti-HCV, anti-HBc, anti-HBs, anti-CMV antibodies, HBs or HIV P24 antigen, when comparing between serum separator and plain tubes.

The results of these studies lead to the conclusion that because of the specificity of each laboratory, a change of tube type, as with any other material or reagent, requires a close monitoring of the first results to confirm the absence of negative effects.

### 3. Therapeutic drug monitoring

In 1986, Devine<sup>13</sup> reported that the serum separa-

tor tube is shown to cause decreases in some drug levels, which were dependent upon blood volume and time of contact with the gel. He also noted that the tubes with a silicone interior gave results differing from those tubes with polyester interior because of the different construction of these tubes. Lidocaine, pentobarbital and phenytoin were decreased in the tube with polyester interior but only lidocaine was reduced in the tubes with silicone interior. Mauro and Mauro<sup>14</sup> reported similar findings, namely a reduction of serum phenytoin and carbamazepine in blood collection using the serum separator tubes. Therefore, the serum separator tubes are not appropriate for the therapeutic drug monitoring for the phenytoin.

### 4. Allergic test

Lin et al<sup>15</sup> have recently reported the effect of serum separation tube on reduction of serum eosinophil cationic protein (ECP), compared to plain tubes. They concluded that ECP levels obtained from SST samples and glass tube samples, though reliable, should not be directly compared, especially in asthmatic children with eosinophilia.

## Conclusion

**The serum separator tube is a useful application of the evacuated blood collection system. It can reduce the pre analytical turnaround time without significant clinical effect on routine chemistry tests. However, it has a serious considerable interference on some special tests especially for therapeutic drug monitoring and allergy test.**

## References

1. Wiwanitkit V, Siritantikorn A, Charuruks N. Evacuated blood collection system. *Chula Med J* 1998; 42: 417-30.
2. Wiwanitkit V. Principle, procedure and application of evacuated blood collection system. *J Med Tech Assoc Thai* 1998; 26: 31-45.
3. Wiwanitkit V, Siritantikorn A. Comparative study between the classical Westergren and the new sealed vacuum extraction methods for erythrocyte sedimentation rate

- determination. *J Med Assoc Thai* 2001; 84: 577-580.
4. Wiwanitkit V. Comparison of blood specimens from plain and gel vacuum blood collection tubes. *J Med Assoc Thai* 2001; 84: 723-726.
  5. Chan KM, Daft M, Koenig JW, Ladenson JH. Plasma separator tube of Becton Dickinson evaluated. *Clin Chem* 1988; 34: 2158-2159.
  6. Laessig RH, Hassemer DJ, Westgard JO, Carey RN, Feldbruegge DH, Schwartz TH. Assessment of the serum separator tube as an intermediate storage device within the laboratory. *Am J Clin Pathol* 1976; 66: 653-657.
  7. Laessig RH, Carey RN, Westgard JO, Hassemer DJ, Habig R. Field evaluation of the Becton-Dickinson SST. *Health Lab Sci* 1976; 13: 209-217.
  8. De Graeve J, Duplaquet Y, Bressan MF, Valdiguie P, Douau MA, Moussard C, et al. Evaluation of the Vacutainer SST tube. *Ann Biol Clin (Paris)* 1982; 40: 335-336.
  9. Hill BM, Laessig RH, Koch DD, Hassemer DJ. Comparison of plastic vs. glass evacuated serum-separator (SST) blood-drawing tubes for common clinical chemistry determinations. *Clin Chem* 1992; 38: 1474-1478.
  10. Bush VJ, Janu MR, Bathur F, Wells A, Dasgupta A. Comparison of BD Vacutainer SST Plus Tubes with BD SST II Plus Tubes for common analytes. *Clin Chim Acta* 2001; 306: 139-143.
  11. Holodniy M, Mole L, Yen-Lieberman B, Margolis D, Starkey C, Carroll R, et al. Comparative stabilities of quantitative human immunodeficiency virus RNA in plasma from samples collected in VACUTAINER CPT, VACUTAINER PPT, and standard VACUTAINER tubes. *J Clin Microbiol* 1995; 33: 1562-1566.
  12. Gobin E, Desruelle JM, Vigier JP. Evaluation of the analytic performance of blood collection tubes (BD Vacutainer SST) for the screening of anti-HIV, anti-HTLV, anti-HCV, anti-HBc, anti-CMV antibodies, and of HBs, P24 HIV antigens, and of alanine aminotransferase. *Transfus Clin Biol* 2001; 8: 44-50.
  13. Devine JE. Assessment of the Corvac blood collection tube for drug specimen processing. *Ther Drug Monit* 1986; 8: 241-243.
  14. Mauro LS, Mauro VF. Effect of serum separator tubes on free and total phenytoin and carbamazepine serum concentrations. *Ther Drug Monit* 1991; 13: 240-243.
  15. Lin SJ, Chao HC, Yan DC, Huang JL. Serum eosinophil cationic protein determination in asthmatic children-effect of different collecting tubes used for blood sampling. *Asian Pac J Allergy Immunol* 1999; 17: 269-273.