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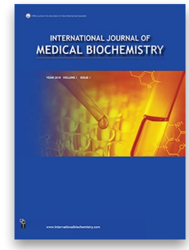

Research Article

Comparison of SST and RST tube biochemistry parameter results in emergency laboratory

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Abstract

Objectives: The goal of the hospital emergency laboratory is to provide quick and accurate test results. With the permission of emergency department patients who required laboratory test results, blood samples were collected in 2 different types of tubes: the standard serum separator tube (SST) and the rapid serum tube (RST) (SST Advance II and Vacutainer RST; Becton Dickinson and Co., Franklin Lakes, NJ, USA) and the results were compared.

Methods: Blood samples were collected from 75 adult patients into RST and SST tubes via routine phlebotomy. Both tubes were centrifuged according the instructions for obtaining serum, and then each tube was tested for the level of alanine aminotransferase, alkaline phosphatase, amylase, aspartate aminotransferase, gamma-glutamyl transferase, lactate dehydrogenase, lipase, total creatinine kinase, creatinine kinase-muscle/brain enzyme, albumin, glucose, calcium, chloride, creatinine, potassium, sodium, total and direct bilirubin, total protein, and urea with an Abbott Architect c16000 (Abbot Diagnostics, Inc., Lake Forest, IL, USA) analyzer and biochemical methods. Statistical calculations were performed with the NCSS 2007 program for Windows (NCSS, LLC, Kaysville, UT, USA).

Results: When compared with the SST tube sample results, the RST sample results were clinically equivalent or clinically acceptable. The results were evaluated within a 95% confidence interval. The level of statistical significance was established at $p<0.05$.

Conclusion: RSTs do not require a waiting period for clotting, thereby decreasing the turn-around time by nearly 30 minutes. This can lead to increased laboratory efficiency and improved patient management in emergency departments.

Keywords: Emergency laboratory, rapid serum tube, standard serum tube, Vacutainer

Most laboratory errors occur in the pre-analytical phase [1]. The pre-analytical phase has a wide range of controllable (such as, sample type, smoking, exercise) and uncontrollable (such as race, age, gender) parameters. One of the important parameters for the pre-analytic phase is the specimen quality and the time required to provide a suitable specimen, such as serum or plasma [2,3]. Studies have indicated that most errors during the pre-analytical phase are due to incorrect collection of blood specimen and delay due to blood specimen delivery efficiency. Pre-analytical system manufacturers have a wide range of blood collection tubes for the assessment of blood. Among these tubes, the standard serum separator tube (SST) is the most commonly used. These advanced tubes require a minimum clotting time of 30 minutes prior to centrifugation. During centrifugation, the gel separator works as a barrier between the supernatant and the blood cells, due to their specific gravities. Without having the aliquot of the samples, the supernatant can be directly used for clinical assays. Another type of tube is the rapid separator tube (RST) containing thrombin. Adding thrombin promotes rapid clotting of the blood. An RST can be centrifuged 5 minutes after collection at 4500 rpm to provide a high-quality serum specimen, which can be sampled

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directly from the primary tube and can be used to measure a wide range of biochemistry parameters in routine and emergency laboratories [4,5].

Materials and Methods

After 12 hours of fasting, all of the patients (n=75) remained seated for 15 minutes before blood samples were collected using routine phlebotomy into BD RST Vacutainer and BD SST II Advance tubes (Becton Dickinson and Co., Franklin Lakes, NJ, USA) [5]. The SST tubes require a minimum of 30 minutes clotting time prior to centrifugation to obtain serum. They were then centrifuged at 4500 rpm for 10 minutes (Hettich Rotofix 32 A; Andreas Hettich GmbH & Co., KG, Tuttlingen, Germany). The RST tubes (with thrombin) require a clotting time of 5 minutes, and were then centrifuged at 4500 rpm for 3 minutes (StatSpin; StatSpin, Inc./Iris Sample Processing, Westwood, MA, USA). Serum from each tube was then analyzed for the levels of alanine aminotransferase, alkaline phosphatase, amylase, aspartate aminotransferase, gamma-glutamyl transferase, lactate dehydrogenase, lipase, total creatinine kinase, creatinine kinase-muscle/brain, total and direct bilirubin, albumin, glucose, calcium, creatinine, chloride, potassium, sodium, total protein, and urea using an Abbott Architect c16000 analyzer (Abbot Diagnostics, Inc., Lake Forest, IL, USA) with biochemical methods. All measurements were repeated 3 times. Statistical calculations were performed with the NCSS 2007 program for Windows (NCSS, LLC, Kaysville, UT, USA). In addition to the standard descriptive statistical calculations (mean, SD), a paired t-test was used in the comparison of the 2 blood-tube groups, and an intraclass correlation coefficient was used to confirm the reliability of the blood results. All of the results were evaluated within a 95% confidence interval (CI). The level of statistical significance was established at $p<0.05$.

Results

When compared with the SST tube sample results, the RST samples were clinically equivalent and acceptable. The data are provided in Table 1. The results were evaluated within a 95% CI and the intraclass correlation coefficient of the biochemical parameters was between 0.961 and 1. The level of statistical significance was established at $p<0.05$. When we compared the tubes with regard to turn-around time (TAT), we found a statistical difference ($p=0.001$). We did not find any difference in the rate of hemolysis between groups ($p=0.5$).

Discussion

The main task of all clinical chemistry laboratories is to deliver correct test results with the shortest TAT. To avoid the clotting time, a plasma specimen may be used for clinical chemistry

Table 1. Comparison of biochemical parameters between RST and SST tubes

n=150	SST	RST	t	p
Glucose (mg/dL)	137.46±68.79	137.62±68.53	-0.82	0.415
Urea (mg/dL)	31.86±17.54	31.88±17.79	-0.21	0.838
Creatinine (mg/dL)	0.74±0.24	0.75±0.25	-1.17	0.244
AST (U/L)	35.95±71.76	36.1±73.17	-0.48	0.633
ALT (U/L)	43.08±128.69	42.96±127.6	0.76	0.449
GGT (U/L)	35.96±75.39	35.8±74.75	1.59	0.115
LDH (U/L)	261.4±230.01	257.47±237.36	0.83	0.406
CK (U/L)	86.55±61.73	87.25±61.75	-1.58	0.116
CK-MB (U/L)	21.19±27.91	21.25±26.95	-0.08	0.938
ALP (U/L)	92.11±109.2	91.28±109.02	0.64	0.521
Total protein (g/dL)	7.12±0.68	7.12±0.69	-0.41	0.685
Albumin (g/dL)	4.24±0.57	4.24±0.58	1.07	0.287
Total bilirubin (mg/dL)	0.95±2.34	0.92±2.21	1.42	0.159
Direct bilirubin (mg/dL)	0.49±1.78	0.48±1.7	0.72	0.471
Amylase (U/L)	83.7±208.45	85.07±205.66	-1.35	0.179
Lipase (U/L)	162.31±1040.79	167.04±1077.81	-1.32	0.188
Calcium (mg/dL)	9.21±0.68	9.21±0.69	0.47	0.642
Sodium (mmol/L)	138.53±3.76	138.69±3.87	-1.45	0.150
Potassium (mmol/L)	4.19±0.73	4.17±0.75	1.16	0.248
Chloride (mmol/L)	105.16±7.39	105.23±7.46	-0.56	0.580

Data are presented as mean±SD or median (interquartile range). Level of significance was tested using paired t-test (*Wilcoxon matched-pairs rank test).
ALP: Alkaline phosphatase; ALT:Alanine aminotransferase; AST: Aspartate aminotransferase; CK: Creatinine kinase; CK-MB: Creatinine kinase-muscle/brain; GGT: Gamma-glutamyl transferase; LDH: Lactate dehydrogenase; RST: Rapid serum tube; SST: Serum separator tube

analyses. But plasma is not an adequate specimen for some clinical tests, such as potassium, lactate dehydrogenase, and cardiac markers [6-8]. Due to the limitations of plasma samples, many laboratories prefer to use a serum specimen for clinical biochemistry tests. Clot activator serum tubes are known to have a significantly reduced time for reporting results in comparison with gel separator tubes [6,9]. RST tubes do not require a waiting period for clotting, thereby decreasing TAT by nearly 30 minutes. As a result of the shorter TAT and similar results, many laboratories prefer to use RSTs instead of using plasma [10,11]. These tubes also prevent the blood from being hemolyzed, which means the physician does not need to take blood repeatedly from the patient [12,13]. Though our comparison of hemolysis between RST and SST tubes did not demonstrate any statistical significant difference, Koseoglu et al.[13] reported effects of hemolysis interference on routine biochemistry parameters in their study, and Lippi et al. [14] demonstrated that the rate of hemolysis in serum samples taken from the emergency department was higher than that of outpatients. So this is another reason to reduce the TAT. This can lead to increased laboratory efficiency and improved patient management in emergency departments [14].

In summary, the RST sample results were clinically equivalent to the SST sample results for some of the most common biochemical tests ordered in emergency departments. Considering the meaning of emergency, it is very important to provide fast and accurate test results, and RSTs would be very helpful to achieve short a TAT for serum specimens requiring urgent reporting.

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