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Recommended “Order of Draw” for Collecting Blood Specimens Into Additive-Containing Tubes

To the Editor:

The problem of interferences in laboratory methods is well documented (1), as is the importance of correct procedures for collecting and handling blood specimens (2–5).

Here, we direct attention to a problem that can occur when blood is collected into a tube containing an additive just before blood is collected into a tube containing no additives, and we emphasize the need to adhere to the correct “order of draw” when different tubes are used for multiple blood sampling from a single venipuncture.

Becton Dickinson and Co., Rutherford, NJ 07070, already includes the following recommendations as part of their Vacutainer Tubes package insert: first draw, sterile blood culture tubes; second draw, nonadditive tubes; third draw, coagulation tubes; last draw, tubes with additives. Our observations prompt us to recommend further that, when several different additive-containing tubes are used during multiple blood collection, these tubes also be filled in a specific order.

We observed in a patient’s chemistry profile (SMAC; Technicon Instruments Corp., Tarrytown, NY 10591) two results that were spuriously abnormal: potassium 14.3 mmol/L, and calcium 20.0 mg/dL. The low calcium result suggested the presence of a calcium-activating anticoagulant in the blood; the increased potassium suggested hemolysis, but there was none present. The phlebotomist assured us that the blood had been collected in the correct tube (10-mL Vacutainer Serum Separator Tube, SST; Becton Dickinson); however, a blood tube for a complete blood count and cell morphology had been filled just before the tube containing the specimen for the SMAC determination. In addition, the phlebotomist had difficulty in collecting this blood, the specimen being “difficult to draw.” In our laboratories, a 5-mL tube containing tripotassium EDTA (EDTA-K3, 150 g/L; Becton Dickinson) is used for the complete blood count specimen.

Subsequently, we have documented four additional cases, three more by the outpatient laboratory and one by the hospital laboratory. In each, an additive tube (EDTA-K3) had been drawn before the nonadditive tube (SST) used for the SMAC sample, and the phlebotomist had difficulty in collecting the specimens. When repeat blood specimens were collected, potassium and calcium results were within normal limits for three of the five cases.

To examine the effects of anticoagulant on the SMAC profile when the blood sample used had been collected into an EDTA-K3 tube, we had two blood specimens drawn sequentially from a single venipuncture site from a control subject. The first tube, an SST, was immediately followed by an EDTA-K3 tube. Next we reversed the order of draw for a second venipuncture and a second pair of specimens from the control. As expected, the results for the two EDTA-K3 tubes had the potassium increased and the calcium suppressed. Reversing the order of draw had no apparent contaminating effect on the results for the SST tube, which suggests that contamination is most likely when there is difficulty with the venipuncture, as was noted in our five cases. Nevertheless, we recommend that specimens should always be drawn in nonadditive tubes before additive tubes, to obviate possible contamination.

If additives in one tube can contaminate a specimen collected into a nonadditive tube, then it can also contaminate blood collected into a different additive tube. For example, incorrect potassium results can occur when an EDTA-K3 tube is drawn before a heparinized blood specimen intended for the determination of electrolytes (6). Collection into an oxalate–fluoride tube before an EDTA-K3 tube could obscure the accuracy of a cell morphology determination because of the disruptive effects of oxalate on cell membranes. Also, loss of cell-membrane integrity would not be favorable to an accurate potassium assay if oxalate–fluoride contaminated a heparinized tube. The potassium oxalate would also falsely increase the potassium result.

The citrate additive tube requires its own set of guidelines. Blood for coagulation testing is never the first tube collected because tissue thromboplastin can contaminate the initial venipuncture, invalidating the results. When a citrate tube is the only tube to be drawn, a nonadditive tube should be filled first—a procedure referred to as the “two-tube” technique (7). The literature documents coagulation assay invalidation by cross contamination from a heparin-containing collection device when the latter was drawn before a citrate tube (8).

Therefore, we recommend that when there is a single venipuncture and multiple specimens are to be drawn into additive tubes, the tubes should be filled in the following order: first draw, citrate-containing tube; second draw, heparin-containing tube; third draw, EDTA-K3-containing tube; last draw, oxalate–fluoride-containing tube.

Our observations emphasize the need for continually appraising specimen collection and handling procedures, an important pre-analytical component of total quality control.

References


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