Effects of Blood Collection Tubes, including Pediatric Devices, on 16 Common Immunoassays

To the Editor:
The effects of different blood collection tubes on hormones and tumor markers, clinical chemistry, and therapeutic drug monitoring have been studied (1–4), and only serum triiodothyronine (T3) was found to be significantly affected by the types of blood collection tubes (4). One of the interferents for immunoassays has been identified as an organosilicone surfactant (5). Daae et al. (6, 7) investigated the difference of hematology values in capillary and venous blood samples collected in Microtainers and Vacutainers, respectively. Clinical differences were observed for some analytes (6, 7). We compared the results obtained by 4 immunoassays for specimens from 20 adult volunteers collected in red-top Microtainers and Vacutainers during the same venous draw and observed clinically significant differences (8). The objective of present study was to investigate effects of various types of Vacutainer and Microtainer tubes on 16 widely used immunoassays performed on the Immulite 2000 (Diagnostic Product Corporation) or Advantage (Nichols Institute Diagnostics).

Blood collection tubes were from BD Diagnostics. The Vacutainers were red-top (plain serum), gold-top (serum with cell separator), mint-green-top (lithium heparin with gel separator), and green-top (lithium heparin). The Microtainers were red-top, gold-top, and mint-green-top. Between October 2004 and February 2005, BD Diagnostics issued bulletins about the immunoassay interferences found in plastic vs glass tubes with various Vacutainers and Microtainers. The company subsequently started providing modified products. In this study, the red-top Vacutainers were glass, and the other 3 Vacutainers were plastic, whereas the gold-top Vacutainer and the red-top and gold-top Microtainers were recently modified products.

Laboratory personnel were invited to participate in the study by signing a consent form approved by Institutional Review Board at Children’s Memorial Research Center (Chicago, IL). All appropriate blood collection tubes were filled through the same venipuncture for each participant, with no specific sequence except that the Vacutainers were filled before the Microtainers.

The analyses studied were α-fetoprotein, β₂-microglobulin, cortisol, ferritin, follicle-stimulating hormone, free T₃ (FT₃), free thyroxine (FT₄), growth hormone (GH), insulin-like growth factor-1 (IGF1), insulin, lutestiminating hormone, prolactin, parathyroid hormone (PTH), T₃, T₄, and thyroid-stimulating hormone (TSH). IGF1 was analyzed on the Advantage, and the assays for the other 15 analytes were performed on the Immulite 2000. Each specimen was accessioned as a different patient, and the analyses were performed randomly as routine patient specimens. There were 20 participants, giving 20 data points for each analyte/tube type except for 19 data points in 3 groups, follicle-stimulating hormone (green-top Vacutainer) and GH and IGF1 (red-top Microtainers), because of insufficient sample. In addition, one person had TSH >100 mIU/L and was excluded from the data analysis for TSH. For these 4 groups, only the appropriate 19 data points in the red-top Vacutainers were included in the comparison analyses.

The test results from different tube types were compared with those from the red-top Vacutainer by Student paired t-test (two-sided). Statistical significance was defined as \( P < 0.05 \). Desirable performance requirements on analytical bias (\( B_A \)) were defined whenever possible as \( B_A < 0.250 (CV_Y^2 + CV_X^2)^{1/2} \), where CVₙ is the intraindividual variation and CVᵢ is the interindividual variation (9). The biological variations were taken from the Westgard QC (10).

Eleven of 16 analytes displayed statistically significant different results, with at least 1 tube type compared with red-top Vacutainer. The CVᵢ and CVᵢ data were available for 12 analytes, and we made assumptions on the bias requirements for FT₃, GH, IGF1, and PTH. We used the FT₃ requirement for FT₄ and 10% for the other 3. FT₃, FT₄, T₃, T₄, and PTH displayed differences exceeding the performance requirements for at least 1 tube type (Table 1). For FT₃ and FT₄, tubes with gel separator gave unacceptable differences, whereas heparin seemed to be the cause for T₃, T₄, and PTH (T₃ displayed a borderline difference for the gold-top Vacutainer). In comparison, the package inserts for the Immulite 2000 assays indicate that heparin samples are not recommended for FT₃ and FT₄ heparinized samples give slightly higher results for T₃ than serum, whereas tubes with gel separator give slightly higher results for T₃ and T₄ in serum. All analytes showed comparable results from the specimens collected in the red-top Microtainer and the red-top Vacutainer tubes in this study, indicating improved performance of the modified red-top Microtainer in comparison with the original one (8).

We conclude that all of the tube types could be used interchangeably for 11 analytes, whereas some restrictions must be applied for FT₄, FT₃, T₃, T₄, and PTH. The red-top Microtainer can be used interchangeably with the red-top Vacutainer for all of the immunoassays studied. To our knowledge, this is the first published study that has systematically evaluated various Microtainers and Vacutainers for immunoassays, using venous blood collected from the same venous draw.

The blood collection tubes were supplied by BD Diagnostics free of charge.

References
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ABCB1 (P-Glycoprotein/MDR1) Gene G2677T/A Sequence Variation (Polymorphism): Lack of Association with Side Effects and Therapeutic Response in Depressed Inpatients Treated with Amitriptyline

To the Editor:

Amitriptyline belongs to the class of tricyclic antidepressants (TCAs), which have been a cornerstone of antidepressive therapy for more than 4 decades. Despite being replaced by