

Rapid testing of returned blood units using matrix-assisted laser desorption ionization time-of-flight (MALDI-TOF) mass spectrometry (MS): Can we modify the policy in low-resource setting?

Thesis

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by

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Summary

Wastage of all blood components, including RBCs, platelets (PLT), and plasma, is an important issue for hospitals worldwide. Waste is not limited to blood products and is present throughout the health care system. Storage and transportation of RBCs outside the specific defined temperatures leads to hemolysis via blood biochemical changes and bacterial contamination. Infusion of these RBCs can be fatal due to severe symptoms that may occur.

Matrix-assisted laser desorption ionization time-of-flight (MALDI-TOF) mass spectrometry (MS) is an accurate method for the routine identification of bacterial isolates in microbiology laboratories. According to the 30-minutes rule, if a blood product is placed out of refrigerator longer than 30 minutes it must be taken out of use cycle. In our study we directly applied the MALDI-TOF method to bacterial detection in donated packed RBCs units returned to the blood bank after their issuing for more than (30 minutes).

Our aim in this study was to evaluate the returned blood units by rapid detection of bacterial contamination, detection of hemolysis and assess the role of MALDI-TOF MS in blood bank to avoid unnecessary discarding of returned blood units and to develop a new policy on how returned blood units are handled by extending the re-use period of returned blood beyond 30 minutes after issuance in low-resource settings.

We randomly selected 2% of packed RBCs units returned to the blood bank after their issuing for more than (30 minutes) from Cairo University hospitals blood transfusion center for 6 months started from February 2022 to August 2022 were included in this cross-sectional study.

By the end of 6th month, 200 returned blood units were examined by measuring the percent of hemolysis and chemical analysis by measuring Potassium level and lactate dehydrogenase. For detection of bacterial contamination returned units were examined using manual culture method, BacT/ALERT alert automated blood culture method and MALDI-TOF MS.

Throughout this study:

- 1- The mean return duration of blood units was (1.99 ± 2.1) hours ranged between 0.5 and 12 hours. The temperature was (7 ± 1.3), with mean storage duration of (16.7 ± 5.5) days. Most of blood units (158 units) returned between 0.5 and 2 hours (79%), and 28 units (14%) were returned between 2 and 6 hours and only 14 units (7%) were returned after more than 6 hours.
- 2- All returned blood units show no visual signs of bacterial contamination (discoloration or foam formation), hemolysis or particulate matter (clots, masses) by visual inspection.
- 3- The mean hemolysis percentage in returned blood units was (0.429 ± 0.416) with 175 units (87.5%) showed normal percentage of hemolysis versus 25 units (12.5%) showed elevated percentage.
- 4- The mean potassium level in returned blood units was (29.7 ± 12.9) with 170 units (85%) showed normal level versus 30 units (15%) showed elevated level.
- 5- The mean LDH level in returned blood units was (1184.8 ± 671.9) with 168 units (84%) show normal level versus 32 units (16%) had elevated level.
- 6- Three units (1.5%) of returned blood were contaminated when tested by MALDL- TOF MS, versus two units (1%) by BacT/ALERT and one unit (0.5%) by manual method.

- 7- There was a statistically significant difference with p-value <0.05 between different returned blood units' groups as regard percentage of hemolysis and its level with a higher mean percentage of hemolysis and its elevated level among group III, also a lower mean of hemolysis percentage was in group I.
- 8- There was a statistically significant difference with p-value <0.05 between different returned blood groups as regard levels of (Potassium and LDH) with a higher mean and higher percentage among group III, also a lower mean and percentage was in group I.
- 9- There was a statistically significant difference with p-value <0.05 between bacterial contamination detection if diagnosis was done by both MALDL-TOF MS and BacT/ALERT methods with negative contamination founded in group I blood unit. On the other hand, there was no statistically significant difference with p-value 0.07 as regards bacterial contamination if diagnosis was done by manual method.
- 10- There was no statistical significance difference with p-value 0.9 between each of MALDL-TOF MS and manual method used for diagnosis of bacterial contamination in comparison to BacT/ALERT method.
- 11- The sensitivity and specificity test for MALDL-TOF MS in comparison to BacT/ALERT illustrated a sensitivity of (100%) and a specificity of (99.5%). It is significant to use MALDL-TOF MS in diagnosis as it shows a high sensitivity, specificity and It's a rapid tool for direct detection of bacterial contamination as it only requires 8-hours incubation for detection.

However further studies with larger number of returned blood units are needed to confirm the findings of this study.