A COMPARATIVE ASSESSMENT BETWEEN GEL CARD AND CONVENTIONAL TUBE METHOD FOR BLOOD CROSS MATCHING AT BLOOD BANK OF TERTIARY CARE HOSPITAL LAHORE

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ABSTRACT

Background and Objective: Blood grouping and Cross match is a critical procedure in blood banks with significant implications for patient safety during blood transfusions. Cross match plays a pivotal role in safeguarding patients undergoing blood transfusions, ensuring that the transfused blood is compatible, and minimizing the risk of adverse reactions. The Gel card technique, a recent innovation in blood bank practices, is distinguished by its exceptional sensitivity and accuracy in delivering results. The aim of this study was to compare the sensitivity and specificity of the Gel card technique with the traditional saline tube method in the context of blood bank cross matching.

Methods: A cross sectional study was performed at blood bank of Shalamar Hospital Lahore from January 2021 to June 2021. Cross match of 500 samples was performed using both the traditional tube method and the advanced gel card technique. Data were entered in SPSS and the results of both tests were compared.

Results: In this study, 500 blood samples from patients were analyzed. The frequency distribution among males and females showed 42.6% (n=213) and 57.4% (n=287), respectively. ABO blood group distribution revealed B-positive in 38% (n=190), O-positive in 24% (n=120), A-positive in 20% (n=100), AB-positive in 7.6% (n=38), and B-negative in 1.8% (n=09), A -negative in 1.2% (n=06) and O-negative in 7.4% (n=37)of the blood samples submitted to blood bank for cross match . During the cross-match procedure using both Conventional Tube Test (CTT) and gel card technique, 497 recipient samples were found compatible with the donor, while 3 samples were incompatible with the recipient sample. Both the manual cross-match technique (CTT) and the gel card cross-match technique demonstrated 100% sensitivity and 100% specificity, indicating perfect concordance in correctly identifying all compatible and incompatible cases

Conclusion: The Conventional Tube method for cross-match is comparable to the gel card technique in terms of sensitivity and specificity while performing pre transfusion testing in blood bank .However, Conventional Tube testing is economical and can still be utilized in low-budget; resource-limited laboratories with good results, provided performers are trained and skilled.

Keyword: Gel card technology, Conventional tube technique, Blood grouping and Cross match, Blood transfusion

How to cite: *Saeed N, Akhtar A, Fakhra H, Muzaffar A, Mughal Z, Tariq TM. A comparative assessment between gel card and conventional tube method for blood cross matching at blood bank of Tertiary care Hospital Lahore. JAIMC. 2024; 22 (2) :54-58*

In 1901, Landsteiner discovered the ABO blood grouping system. Moreschi introduced the concept of using anti-human globulins in 1908, but it wasn't until 1945 that Robin Coombs introduced it to clinical medicine. Initially, it was employed to demonstrate red blood cell agglutination in the presence of what was then considered an "incomplete" or "blocking" antibody within the context of the IAT.[1] Subsequent advancements have led to the development of more sophisticated serological methods, primarily aimed at preventing ABO and Rh incompatibilities between

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Submission Date: 11-04-2024
1st Revision Date: 07-05-2024
Acceptance Date: 04-06-2024

blood donors and recipients.[1,2] The objective is to identify antibodies in the recipient's serum that could potentially react with donor red cells, posing serious complications after blood transfusion.[7] The cross-match procedure is integral in routine pre-transfusion testing to ensure the safety of transfusion therapy. While the terms "cross-matching" and "compatibility test" are at times used interchangeably, both play a crucial role in averting immune-mediated hemolytic transfusion reactions resulting from the transfusion of incompatible donor red blood cells.[2] Two types of cross match are employed in blood compatibility assessments. Major cross-match involves detection of antibodies in recipient serum that can react with donor RBCs while minor cross-match checks for antibodies in donor serum that can cause to hemolysis recipient RBCs. Two commonly employed cross matching techniques include the Conventional test tube (CTT) method and the Gel card method.[3]

Over the past four decades, the CTT has served as the foundation of compatibility testing. Despite its reliability, it is time-consuming and demands skilled personnel for meticulous washing of red blood. In contrast, the Gel Card Technique, introduced by Lapierre and Rigal in 1990, employs a micro typing method where the reaction between the recipient's serum and the donor's cells occurs in a micro tube containing Sephadex gel.[4] This gel, within a semi-solid medium, enables clear visualization of agglutination. The plastic card, with its six micro columns, streamlines handling, testing, reading, and disposal, offering a distinct advantage over the conventional tube method.[5] This study aims to assess and compare the sensitivity and specificity of the gel card and conventional test tube techniques, evaluating their performance suitability and adoptability for cross matching.

METHODS

A cross-sectional study was conducted at the Blood Bank of Shalamar Hospital Lahore from Jan - Jun, 2021. Approval of the institutional ethics committee was obtained before research project. The study included 500 blood samples submitted for cross match at Blood Bank during the mentioned period. Clotted and hemolysis samples were excluded from the study. The pre transfusion testing involved ABO blood grouping on both recipient and donor blood samples and cross match procedure. To compare the results of two techniques Compatibility testing was performed using CTT and Gel card Method.

In CTT, 5% suspension of red donor RBCs was prepared. In glass tube 50µl of donor RBC suspension is added in 100µl of recipient plasma with the help of micropipette. The mixture was incubated for 30 min at 37◦C and washed three times with 0.9% saline, followed by centrifugation at 2500 rpm for 1 min and observed for agglutination. In the Gel Card technique, Gel Cards are utilized, each containing Sephadex gel incorporated with AHG reagent, with six microtubes per card. To prepare a 5% donor red cell suspension, 10µl of the donor sample is added to 1ml of Diluent (LISS) in a clean test tube using a micropipette.

Then we add 50µl of 5% donor RBC suspension to the micro tube, followed by 25 µl of the patient's serum. The gel card was incubated at 37°C for 15 minutes in ID incubator , then centrifuged in ID centrifuge for 10 minutes at 910 rpm? After centrifugation result were noted. Gel card in which pellets of RBCs settled at the bottom of micro tube were noted as compatible results (absence of agglutination) which means donor blood is compatible with the recipient and suitable for transfusion. The presence of agglutination indicated incompatibility between donor and recipient blood samples. A proforma was used for data entry. Data collected were analyzed using SPSS 20.0 version and frequencies were calculated for qualitative variables.

RESULTS

In present study, a comparative analysis was performed between CTT and gel card technique for cross match procedure on 500 patient samples received in six month period in the blood bank of tertiary care hospital. Among 500 patients samples received for cross match in blood bank 57.4% (n=287) were females and 42.6% (n=213) were males. Regarding ABO blood group distribution of patients, B-positive was noted

in 38% followed by O- positive (27.4%) and A- positive blood group (23.4) (Figure 1). Among the 500 cross-matches performed by CTT technique, 497 recipient blood samples were found compatible with donor blood (97.3%), while 3 recipient samples (2.7%) were incompatible with donor blood. These findings were comparable to results obtained by the gel card technology. Both the manual cross-match technique (CTT) and the gel card cross-match technique achieved 100% sensitivity and 100% specificity, accurately identifying all compatible and incompatible cases. (Table 1).

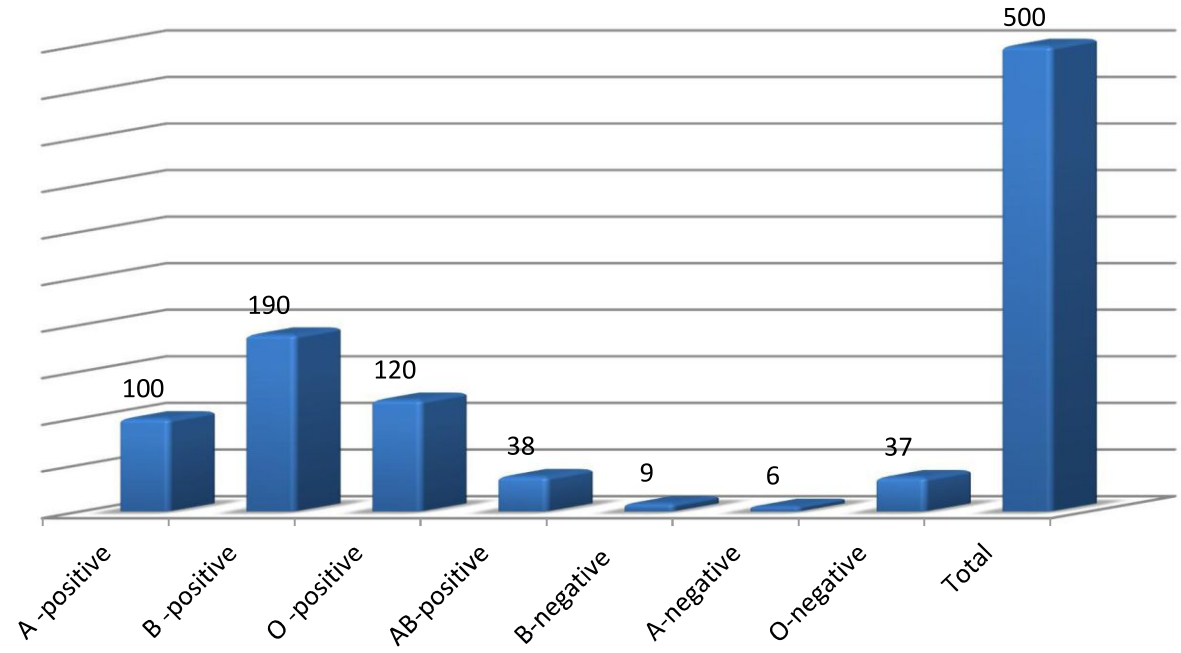

Figure 1: *Shows frequency of ABO Blood group distribution*

Table 1: *Comparison between results of Cross Mach performed by Manual and Gel card technology*

	Gel Card Compatible	Gel Card Incompatible	Total
Manual Cross-Match Compatible	497	0	497
Manual Cross-Match Incompatible	0	3	3
Total	497	3	500

A 2x2 contingency table was constructed to compare the agreement between the Manual Cross-Match (CTT) and Gel Card Cross-Match methods based on their compatibility results. In this study, 500 samples were tested using both techniques.

Out of the 500 samples, both methods classified 497 samples as compatible (true positives), showing complete agreement in these cases. Similarly, both methods identified 3 samples as incompatible (true negatives), again with full concordance. Importantly, there were no discordant results between the two methods, meaning no cases were classified as compatible by one method and incompatible by the other.

Sensitivity, specificity, positive predictive value and negative predictive value of gel card method were 100% as compared with manual cross match method.

DISCUSSION

Blood grouping and cross-matching are crucial procedures performed in blood banks to ensure the safe and effective provision of blood products to recipients. Cross-matching is conducted prior to a blood transfusion to confirm compatibility between the donor's red blood cells (RBCs) and the recipient's serum, thereby ensuring the safety and efficacy of transfusion practices. This is a key component of hemovigilance in blood

transfusion practices.[6] While the conventional tube test (CTT) remains the primary method for pre-transfusion compatibility testing, it has notable drawbacks, particularly being labor-intensive, time-consuming, and dependent on the expertise of the personnel performing the procedure. These limitations are addressed by the gel card method or automation techniques, which are less labor-intensive, more robust, and offer higher sensitivity and specificity. To compare the sensitivity and specificity of both methodologies, we conducted a pilot study at the Blood Bank of Shalamar Hospital, Lahore.

In our study, 497 out of 500 samples showed cross-match compatibility with the conventional tube test (CTT) and gel card technique, while 3 samples were found to be incompatible. Both the CTT and the gel card method demonstrated 100% sensitivity and specificity. Similarly, a study by Gawande et al. in India tested 2,300 blood samples using both the traditional test tube method and the gel card technique. Their findings also revealed that the sensitivity and specificity of both methods were equivalent, confirming that CTT and and the gel card technique approach are equivalent in terms of sensitivity and specificity.[7]

The findings of our study contrast with those of Bhagwat et al., who compared the conventional tube test (CTT) and automated techniques for blood grouping and cross-matching using 1,000 samples. Bhagwat et al. utilized the Mann-Whitney test to evaluate the differences in reaction strength among 55 incompatible cross-match results when comparing column agglutination technology (CAT) with the CTT. The analysis of mean ranks revealed a statistically significant P-value of 0.014 ($p < 0.05$), indicating that the automated gel card method demonstrated greater sensitivity compared to the CTT.[2] Whereas studies conducted by Ranjitha et reported sensitivity and specificity of conventional tube technique (CTT) as 97.9% and 100% respectively. Sensitivity and specificity of matrix gel card method was found to be 100%[1]. Gond et al and Ahmad et al also reported 100% Sensitivity and specificity of gel card technique, whereas saline tube test specificity is 99.6% for performing cross match in blood bank.[4,6] Throughout the techniques employed in these studies, they observed that the gel card method proved to be more user-friendly with fewer variables influencing the results. These differences in studies can be attributed to the technical expertise of personals performing the CTT.

The tube method for cross-matching, while demonstrating similar sensitivity and specificity to the gel technique, remains a practical choice, especially in laboratories with limited budgets and resources, yet still achieving commendable results. The expertise of the technical staff performing the procedure plays a pivotal role in its success.

The limitation of the study is small sample size therefore it cannot be an adequate representative of the population.

CONCLUSION

Results of cross match performed by Convention Tube Technique are comparable with gel card technology in blood bank. Tube method is still useful and it is recommended in low budget, under resource laboratories with good results, provided performers are trained skilled.

Ethical Approval:

The ethical Approval was obtained vide letter no. SMDC-IRB/AL/124/2021

Conflict of Interest: *None*

Funding Source: *None*

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