RESEARCH ARTICLE / *Araştırma Makalesi*

The Use of the Electronic Cross-Matching in Transfusion Center

Transfüzyon Merkezinde Elektronik Çapraz Karşılaştırma Uygulaması

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Abstract

Purpose	To demonstrate the results obtained as an outcome of using electronic cross-match (ECM) procedure which shortens the last phase of the preparation of one or more blood components output only by checking the ABO compliance that the patient does not have an alloantibody in life and confirmed by antibody screening with in the last 72 hours through inquiring the database and might reduce the costs.
Materials and Methods	The patients transfused in whom ABO compatibility of the blood and blood component was investigated using ECM procedure in the hospital between the years 2014 and 2015 were included in the study. The prerequisites stipulated by American Association of Blood Banks, and indicated in its 2003 guideline were provided. The blood-typing and indirect Coombs (IC) tests have been analyzed by gel colon agglutination system.
Results	During the study period, 25989 units packed red blood cells (RBCs) and 16 units whole blood were ordered from the clinics, and reserved for them. But 11254 units RBCs and 15 units whole blood were used. Crossmatch transfusion rate would be 2,3 if serologic crossmatch was performed to all of the blood components instead of ECM in transfusion laboratory. The costs of both procedures differed 2.07 times. During two years incompatible or mismatched blood transfusion and acute hemolytic transfusion reaction were not observed.
Conclusion	The most important problem that can be experienced in the absence of blood component is the loss of human life which is beyond the limits of cost calculation. For this reason, it is thought that the advantages of the ECM model cannot be measured. It is thought that it will be beneficial to spread the usage of ECM in transfusion center laboratories without compromising quality standards and blood transfusion safety.
Keywords	packed red blood cells (RBCs), cross-match, electronic cross-match

Özet

Amaç	*Elektronik çapraz karşılaştırma (ECM) uygulaması, alıcının yaşamında bilgisayar kayıtlarına göre saptanmış alloantikoru bulunmaması ve son 72 saat içerisinde yapılan antikor tarama testinin negatif olması durumunda bir veya daha fazla sayıdaki kan ürünü çıkışının sadece ABO uyumluluğu kontrol edilerek yapılabilmesini sağlar. Kan ürünlerinin hazırlanmasının son aşamasını kısaltan ve maliyeti düşürebilen bu uygulama hastane veri tabanından elde edilen sonuçlar ile sunuldu.*
Gereç ve Yöntem	*Çalışmaya hastanemizde 2014-2015 yıllarında yatarak tedavi gören ve ECM uygulaması kullanılarak kan ürünü transfüzyonu yapılan hastalar dâhil edildi. ECM uygulaması yapılan hastaların, Amerikan Kan Bankaları Birliği tarafından belirlenen ve 2003 kılavuzunda belirtilen önkoşullara uygunluğu sağlandı. Kan grubu tespiti ve indirekt coombs (IC) testleri jel kolon aglütinasyon sistemi ile çalışıldı.*
Bulgular	*Transfüzyon merkezinden hastaları için 25989 eritrosit süspansiyonu (ES) ve 16 tam kan istemi yapılmasına rağmen, 11254 adet ES ve 15 adet tam kan kullanıldı. Çapraz karşılaştırma transfüzyon oranı 2,3 olacakken ECM sayesinde tüm istemlere serolojik çapraz karşılaştırma testleri yapılmamıştır. Testlerin maliyeti 2,07 kat azalmıştır. İki yıl boyunca hatalı / yanlış kan transfüzyonu ve akut hemolitik transfüzyon reaksiyonu gözlenmemiştir. Standartlardan ve kan transfüzyonu güvenliğinden taviz vermeden transfüzyon merkezi laboratuvarlarında yapılacak ECM uygulamasının yaygınlaşmasının faydalı olacağı düşünülmektedir.*
Anahtar kelimeler	*eritrosit süspansiyonu (ES), çapraz karşılaştırma, elektronik çapraz karşılaştırma*

INTRODUCTION

In Turkey all the blood banks and transfusion centers' activities are managed according to the "National guidelines for blood and blood components" (Ankara, 2016). In this guideline electronic cross-match (ECM) is defined as "a procedure where the blood typing is made using at least two different blood samples with results stored in an electronic environment. If antibody screening test performed with the blood sample of the recipient within the last 72 hours is negative, then electronic cross-match is performed, and blood is donated based on only ABO compatibility[1]. ECM is applied using specially designed computer software program which uses prior immunohematological records of the patient, and the donor[2].

Electronic cross-matching is the identification of correct ABO/D type blood using electronic information systems of the hospital or laboratory without performing serologic cross-matching (CM)[3]. Economical advantages gained thanks to the development and widespread use of software, and information processing systems, ECM has been used to a great extent in the USA, and Europe[4]. When the patient needs transfusion, the delivery or recall of the blood components reserved for the patient can be realized[4,5]. To use this system, antibody screening methods, information processing system, currently implemented guidelines, and national standards should be in accordance as a whole.

Effective and safe blood transfusion by using ECM procedure is being performed in our hospital by trained personnel, established Standard Operating Procedures, Quality Management Policies and a well-established computer software program since 2014. In Turkey, as far as we know, only two transfusion centers continue this practice, so we aimed to perform a proper assessment of the actual situation in Turkey. In the present study, instead of cross-matching where compatibility of patient's blood, and blood component is tested, we aimed to demonstrate the results obtained as an outcome of using ECM procedure which shortens the last phase of the preparation of the component through inquiring the database.

Materials and Methods

Study design: The approval of the local institutional review board was provided before the study (ASM-EK-17/70).

The patients in whom ABO compatibility of the blood component was investigated using ECM procedure in our hospital between the years 2014, and 2015 were included in the study.

To identify ABO incompatibility in patients who will be subjected to ECM the prerequisites stipulated by American Association of Blood Banks, and indicated in its 2003 guideline were provided (Table 1).

Table 1. The prerequisites in the 2003 guideline of American Association of Blood Banks for application of electronic cross-match.

1	The computer system should be evaluated in situ to guarantee its capability to select blood, and blood product components compatible with the ABO type of the patient for transfusion.
2	ABO group typing of the recipient should be performed using the presently valid sample, and one of the following methods: 1) Retesting of the same sample, 2) Testing of the second sample, 3) Comparison with the previously valid records.
3	The system should include the code number of the blood unit, the name of the component, ABO grouping, Rh typing of the component, confirmed ABO grouping of the blood unit, two unique identifiers of the recipient, ABO grouping, Rh typing, and antibody screening test results.
4	A method which will evaluate and verify correct entry of data into computerized system related to blood, and blood products before their delivery should be determined.
5	The system should have the logical structure to perceive and warn the user about the incompatibility between ABO blood group of the donor indicated on the label, Rh blood typing, confirmatory tests of blood groups, and ABO incompatibility between the recipient, and the donor.
6	ABO grouping should be defined by testing erythrocytes with anti-A, and anti-B reactive agents or testing serum or plasma with A, and B erythrocytes against possible antigens. If incompatibility is detected, and transfusion is required without solving the problem, only group O erythrocytes can be transfused.
7	The patient and the blood sample should be positively identified at the time of bloodletting.

Before the year 2014, serologic cross-matching (CM) was the primary testing method and, blood typing and indirect Coombs (IC) tests have been analyzed using gel colon ag-

glutination test system (Across Gel® Gel Centrifugal Cards, Dia Pro Medical Products Inc., Istanbul, Turkey).

Results

Starting from the beginning of 2014 up to the end of the year 2015, a total of 11269 components were processed. The number of ordered and used components are shown in Table 2. During the study period, 25989 units packed red blood cells (RBCs) and 16 units whole blood were ordered from our blood center, and reserved for the use of the requesting unit. Of the 25989 units RBCs, 8663 units were for elective surgeries. When we analyzed total use according to components of the product, a total 11254 units RBCs, and 15 units whole blood were used.

Table 2. Number of products ordered from the blood center, and amounts used

Blood product	Ordered (n)	Used (n)
Packed red blood cells (RBCs)	25989 (8663 were for elective surgery)	11254
Whole blood	16	15

We first calculated the total cost by considering the use of serologic CM procedure performed before the year 2014. Based on RBCs ordered from our transfusion center for non-elective surgeries (25989 – 8663 = 17326 units), 17326 CM would have been performed and each would have costed 1.9 USD (Total cost = 17326 * 1.9 = 32919 USD). Secondly, we calculated the total cost by considering the used RBCs which were subjected to ECM after the year 2014. As seen in Table 2, 11254 units RBCs were used from our blood center. For these RBCs, 9574 IC test were performed and each costed 0.6 USD (total cost = 5739 USD). As a transfusion center, we get RBCs from the Red Cross and compulsorily perform a donor blood group test for each RBCs (Total cost = 11254 * 0.9 USD = 10129 USD). The total cost for the ECM procedure was 5739 + 10129 = 15868 USD. The costs of both procedures differed 2.07 times. We get RBCs from the Red Cross and compulsorily perform a donor blood group test for each RBCs. Crossmatch/Transfusion rate (C/T) ratio was calculated as 1/1. During two years erroneous /mismatched blood transfusion and acute hemolytic transfusion reaction were not observed.

Discussion

In simulation modelings performed to manage inventories in blood centers of hospitals, harmful effects of the absence of blood components could not be measured, however, since costs of expired components can be measured, and it was detected that the highest costs occurred as a result of wastage of expired components. The period of reservation (crossmatch release period), and C/T were detected to be the most effective factors on these costs. C/T Herein, uncertainty, i.e. the variance in the number of a daily number of use rather than the average number of the daily use was found to be the most effective factor[6].

It has been reported that ECM caused 65 % decrease in processing load, and also decreased the amount of expired blood, and blood components from 90% down to 1 percent[7]. In an application in Hong Kong a 60% drop in the amount of blood supply reserved for surgical patients was detected, and also the amount of blood delivered to the services but returned from them without using decreased from 36% to 3 percent[8]. As a result of 12-years of a study performed in Sweden, a 65% decrease in workload in the test laboratory was reported[9]. In another study, a 25 % decrease in the ordered units of blood, and a 30 % drop in expired packed red blood cells (RBCs) with resultant 100 hours of reduction in the workload of the transfusion center were reported. Besides, as indicated in these studies, implementation of ECM decreased the stress on transfusion center personnel[7].

The financial burden of blood centers occupies 2-3 % in hospital budget. However, each of infection tests added in recent years has increased financial burden an extra 30-40 USD, thus cost of each blood unit doubled from 100 to 200 USD[10]. Adjustment of transfusion thresholds, decrease in C/T rates, and increase in organizational quality are recommended[11]. In studies where the factors effective on total

expenditures of blood centers have been investigated, it has been found that C/T ratios differed among hospitals, and various clinics in the same hospital or even physicians, while young physicians, and those who did not want to take risks ordered excess amounts of blood and/or blood components so as to stock them discretely as a reserve in case of need[12]. Clinicians who ordered "fresh blood "for emergency rooms disrupt the FIFO (First In, First Out) regimen recommended for rational management of stocks, and instead necessitate LIFO (Last In, First Out) regimen which leads to increase in the amount of discarded blood supplies. In our study, application of ECM decreased the cost of packed red blood cells (RBCs) ordered from our center at a rate of 2.7-fold.

The process of preparing the blood unit for the patient and evaluation of its appropriateness takes nearly one hour even if under emergency conditions appropriate blood component is found in the stock. Clinics' blood and blood products reservation habits significantly affect the transfusion centers' stock management. On the other hand, it is important for clinicians and especially surgeons to know that there will always be a sufficient PRBC stock in the transfusion center and will be ready within a very short time when necessary. In cases of emergency, if information about antigenic characteristics of the blood, and blood components in the stock is at hand, then the time consumed during antibody screening, and antigenic analysis, and subjecting patient's relevant information to ECM procedure with the blood and/or blood components in the stock drops down to seconds as an advantage of information processing, thus all blood and/or blood components suitable for the patient become usable. The advantage gained by ECM is clear, without compromising the safety of transfusion in emergency department and before the major surgical procedures. The most favorable feedback came from cardiovascular clinic of our hospital while using ECM.

Conclusion

The most important problem that can be experienced in the absence of blood components is the loss of human life which is beyond the limits of cost calculation. For this reason, it is thought that the advantages of the ECM model cannot be measured. It is thought that it will be beneficial to spread the usage of ECM in transfusion center laboratories without compromising quality standards and blood transfusion safety with the validated computer software programs.

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Compliance with ethical standards

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors. Anadolu Medical Center IRB approved the study.

Informed consent: Not applicable

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