Type and screen of blood units at a teaching hospital

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The Type, Screen and Save Policy and the abbreviated crossmatch procedure for blood issue were instituted in May 1993 at the Queen Mary Hospital. These crossmatch policies were found to be safe, with only one haemolytic transfusion reaction occurring out of 21 524 units transfused (0.005%). These policies also significantly reduced blood wastage by more than 50 units monthly and improved the crossmatch/transfusion ratio from 2.42 to 1.67. They allowed for efficient utilisation of blood stocks and reallocation of manpower for the investigation of complex serological problems.

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Introduction

The indirect antiglobulin test (IAT) of the conventional Hong Kong crossmatch (HKC) has been the cornerstone of compatibility testing in Hong Kong. In many hospitals, blood units are fully crossmatched and reserved for patients even though many of them have a low probability of requiring transfusion. A significant number of these reserved units are held until expiry and therefore wasted. When these units expire, another crossmatch may have to be done, requiring additional manpower and expense. Since blood units are assigned to designated patients, they are not available for emergency transfusion to other patients. The blood bank must therefore stock additional units for emergency use, increasing the workload of the Hong Kong Red Cross Transfusion Service. In times of blood shortage, surgery may have to be cancelled for some patients, while blood is needlessly reserved for others. When additional blood units are urgently needed for patients who have used up their assigned units, at least one to two hours are required to complete the crossmatch, otherwise unmatched or partially matched blood will have to be issued.

For patients with irregular antibodies, the conventional HKC may not be sensitive enough to detect incompatibility because of antigen heterozygosity or poor stability of donor red cell antigens in storage. In patients with multiple alloantibodies, autoimmune haemolytic anaemia (AIHA) or antibodies against high frequency antigens, it will be very difficult to find compatible units using conventional methods. The patient may be issued the least incompatible units which are no less risky than any other units. These patients should have alloantibodies identified or excluded and should be transfused with phenotype-specific red cells. Because the HKC is inefficient, many hospital blood banks do not have the manpower to perform antibody investigation, elution and adsorption studies, or red cell phenotyping, and patients may not be transfused with the ideal blood units. The HKC has many deficiencies, all of which compromise patient care.

In 1984, the American Association of Blood Banks (AABB) recommended that the full crossmatch could be replaced by an abbreviated crossmatch in patients with negative antibody screen.[1,2] This policy gives more flexibility in blood usage and is safer.[3-7] However, Hong Kong has been very slow to adopt this procedure, with only one major hospital instituting such a policy by 1987.[8] Many surgeons and physicians still want to have crossmatched blood units on hand even though the probability of transfusion is very low and compatible units can be made available within minutes. At the Queen Mary Hospital (QMH), blood wastage was very high as a result of the conventional crossmatch and reserve policy. A lot of technical manpower was spent on performing unnecessary crossmatches. Nurses also wasted considerable time collecting and returning untransfused units to the blood bank. We decided to implement the Type, Screen and Save policy to correct these deficiencies.

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Subjects and methods

Antibody screening

The antibody screening procedure involved incubation of the patient's serum with three group O screening red cell types chosen for their expression in a homozygous state, of the clinically most significant antigen systems. These included: C, c, D, E, e, Fy^a, Fy^b, Jk^a, Jk^b, M, N, S, s, and k. The screening panel also included at least one cell with K antigen in the heterozygous state. The presence of irregular antibodies was detected by direct agglutination test at 37°C and an indirect antiglobulin test. A room temperature phase was omitted, to avoid detection of insignificant cold antibodies.

The Type, Screen and Save policy

Each patient's blood was ABO- and Rh D-grouped and screened for irregular antibodies. In the absence of irregular antibodies the serum was retained, but no blood was crossmatched for reserve. When patients with a negative antibody screen required blood, abbreviated crossmatching was carried out by immediate spin.

For patients with positive antibody screens, antibody identification against a comprehensive cell panel was carried out. When specific antibodies were identified, a reagent-typed antigen-negative blood unit was selected for crossmatching. A full crossmatch at 37°C, which included a direct agglutination test in normal ionic strength saline, and an indirect antiglobulin test in a one-tube procedure, was performed. Counterchecking of each patients' ABO serum group was also done. These compatible units were reserved for the patient for up to seven days.

For infants younger than four months, both baby and maternal blood samples were ABO- and Rh D-grouped, the maternal serum was screened for irregular antibodies, and a direct antiglobulin test (DAT) was carried out on the baby's cells. If the maternal antibody screen and the baby's DAT were negative, no blood was crossmatched for reserve. When the infant required blood, blood of appropriate ABO and Rh D groups was selected and issued without crossmatching, after counterchecking the ABO group of the infant and the donor units. When irregular antibodies were detected in the maternal serum, antibody identification against a comprehensive cell panel was carried out. A full crossmatch with appropriate reagent-typed antigen-negative units was performed using the maternal serum. If the baby's DAT was positive, and haemolytic disease of the newborn (HDN) was suspected, elution studies were done for antibody identification and the maternal serum was used for full crossmatching.

Maximum surgical blood ordering schedule

The maximum surgical blood ordering schedule (MSBOS) is a list which shows the number of blood units routinely crossmatched pre-operatively for elective surgical procedures. The schedule is based on a retrospective analysis of actual blood usage for various surgical procedures at the QMH. The aim is to exactly match the amount of blood crossmatched to the amount of blood transfused in various surgical procedures and in this way, reduce blood wastage.

Schedule of change

In March 1993, antibody screening using a three-cell panel was initiated at the QMH. Commencing May 1993, the IAT phase in conventional crossmatches was omitted in all patients with a negative antibody screen. The MSBOS was introduced in June 1993.

Results

Only one case of haemolytic transfusion reaction occurred of the 21 524 units transfused since the implementation of the Type, Screen, Save and abbreviated crossmatch policies. This reaction was due to the patient having rare antibodies against antigens in the Miltenberger (Mi) complex. This antigen is not present in the screening cell panels, and the donor blood transfused carried these Mi antigens.

We were able to reduce the daily reserve blood stock from 295 to 51 units (Table 1). Blood utilisation was more efficient, and no operative procedure had to be delayed or cancelled in the three months from January to March 1994, even though the stock of group O blood units had fallen to below normal levels.

The ratio of the amount of blood crossmatched to the amount of blood transfused (C/T ratio) decreased significantly from an average of 2.42 to 1.67 (Table 1). Considerable manpower was saved, mostly attributable to the reduced clerical work involved in recording and reporting results, as well as labelling blood bags for crossmatching. Staff members were reallocated to investigate complex serological problems, perform antibody identifications and type suitable donor blood units for crossmatch in patients with positive antibody screen and in infants suffering from HDN. Elution and adsorption studies were performed on patients with autoimmune haemolytic disease to identify autoantibodies as well as alloantibodies. Each patients' red cells were phenotyped for major antigen systems to establish the most suitable units for transfusion in these patients. Patients with positive antibody screens represent approximately 3.5% of our patient

population needing blood transfusion.

For patients with negative antibody screens, the issuing of additional blood units became much more efficient. Ten minutes or less was needed for completion of the immediate spin crossmatch.As many additional units as required may be issued to patients without the need of a new blood sample.

With the Type, Screen and Save policy, it is no longer necessary to earmark any blood unit for infants whose maternal serum has shown negative antibody screen. Because of this, newborns—especially premature ones—may be provided with the freshest blood units available when transfusion is required. In addition, should further blood be requested, there is no need to obtain another maternal sample.

Discussion

The Type, Screen and Save policy and the abbreviated crossmatch were instituted at the QMH with the objective of correcting the many deficiencies of the conventional crossmatch system.

There was only one case of haemolytic transfusion

Table 1. Comparison of the conventional crossmatch system with the Type, Screen and Save abbreviated crossmatch system

Item	Conventional crossmatch system (January to April 1993)	Type, Screen and Save policy system (June to December 1993)
Number of cross-matched units reserved daily (average over four-month period)	296	51
Crossmatched/ transfused ratio	2.42	1.67
Number of units cross-matched monthly but not transfused	3401	1415
Average number of antibody screens per month	nil	3042
Sensitivity of antibody detection	May miss a weak antibody when the donor blood is heterozygous for the antigen	May miss a rare antibody while the donor blood carries the antigen
Issue of additional blood units	Takes another one to two hours for full crossmatch to be completed for each request	Usually takes no more than 10 minutes for each request for the negative antibody screen patient
Issue of fresh blood for newborns	Standby fresh blood units reserved for the patient may become aged before being transfused	Usually no fresh blood unit has to be crossmatched for reserve. The freshest blood units can be issued for transfusion when they are actually required
Issue of blood units for patients with autoimmune haemolytic disease	Usually the least incompatible units are issued when no compatible unit can be found	Donor blood which was of suitable ABO group, similar Rhesus, Duffy and Kidd phenotype, and lacking the antigens to any alloantibodies, if present, was selected for transfusion after full investigation

reaction due to antiMiltenberger antibodies among 21 524 units transfused. Since the incidence of the MiIII phenotype among Chinese blood donors in Hong Kong is relatively high (6.28%), it would be advantageous to use a local screening cell panel which includes at least one MiIII positive cell.[9] This 0.005% risk in transfusion reaction might also have been prevented if IAT had not been omitted in the crossmatch. However, the inclusion of this in the crossmatch would have increased manpower needs and expense. More than 3500 full crossmatches would have to be performed each month, and there would be definite delays if blood was issued only after a full crossmatch. The Type, Screen, Save and abbreviated crossmatch polices have been applied to patients with negative antibody screens with 99.995% accuracy.

The C/T ratio has improved significantly. A smaller number of blood units can now serve the needs of QMH patients. Blood wastage has been reduced by over 50 units monthly. However, doctors are still quite reluctant to accept the MSBOS, probably because the wards and operating theatres are situated some distance from the blood bank laboratory. Many blood units are still reserved for minor procedures and are not used, being returned to the blood bank. With an improved portering service for urgent blood delivery to the operating theatres, and mandatory implementation of the MSBOS, blood wastage could be further reduced. If and when these polices are implemented in those QMH satellite hospitals that have very high C/T ratios, the large number of aged blood units redirected from them to the QMH blood bank could also be reduced. Clerical and technical workloads would also decline accordingly.

The Type, Screen, Save and abbreviated crossmatch policies have been shown to be safe, efficient and beneficial for the QMH in Hong Kong. They enable flexible utilisation of blood stock and reduce blood wastage due to ageing. They also allow manpower to be redirected to the investigation of complex serological problems, better transfusion management, and consultation services to other hospitals.

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