Review Article

Substitution of the "group-and-screen" for the full crossmatch in elective operations

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For many years, the crossmatch has served as the pretransfusion determinant of compatibility between recipient and donor. The majority of units of blood crossmatched for elective surgical procedures are not used and many antibodies detected in the crossmatch are not of clinical significance. Motivated by the need to eliminate testing that does not significantly enhance the provision of a safe product, the necessity for doing crossmatches has been questioned. Recent studies indicate that the substitution of the "group-and-screen" for the complete crossmatch represents an acceptable approach to the provision of blood for many elective surgical procedures. The benefit of this approach is significant: blood is utilized more efficiently and the blood bank has a reduction in workload. The risk is very minimal: only one of several thousand transfusions will be given to patients with previously undetected alloantibodies; and recent evidence indicates that such incompatibilities have little clinical impact.

Keywords
TRANSFUSION: stored blood, crossmatch techniques.

Canadians can be justifiably proud of their blood transfusion services. Adequate supplies of blood to provide for patients' use have been derived entirely from volunteer donors for approximately 35 years. Over this period, significant improvement has taken place in the techniques used for blood collection, testing and distribution. In addition, considerable progress has been made in the isolation of specific blood components, allowing the physician to target particular blood products to a patient's specific needs.[1]

Progress has also been made in lowering the risk associated with the transfusion of blood. As might be expected, the manoeuvres used to reduce risk require increased technologist or physician time, often necessitating the performance of additional laboratory tests. Sometimes the potential "gain" in risk reduction may not be worth the effort or cost required. In this review we will provide information indicating that the complete crossmatch is not required for most routine surgical procedures. The routine crossmatch can be replaced by simpler procedures with minimal increased risk for the patient, but allowing significant cost reductions.

The transfusion of blood is not without risk: the

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two most important being blood-borne viral infections and transfusion reactions due to incompatibilities. To reduce the risk of viral hepatitis, certain high risk groups (e.g., drug addicts) are not used as blood donors. In addition, all units are screened for hepatitis B surface antigen.

Pretransfusion testing, including the crossmatch, is intended to ensure that alloantibodies are detected and incompatible blood not given. Meticulous attention is paid to the determination of both the donor and recipient's blood group. The recipient's serum is also screened for the presence of antibodies that could react with donor red blood cells. This is accomplished in several ways. The blood bank "groups" the recipient by determining his ABO and Rhesus red blood cell type using standard reagent antisera and cells. His serum is then "screened" against group O red blood cells from several (usually two) different donors that carry most clinically relevant blood group antigens. In this way, almost all of the red cell alloantibodies in the recipient's serum will be detected.

Traditionally, as a further check to ensure that the donor red blood cells are compatible with the recipient, a "crossmatch" is performed by testing the potential recipient's serum with red blood cells from each donor unit. A sample of donor red blood cells and recipient's serum are incubated together, and antigen-antibody interactions are assessed by observing the mixture for agglutination or lysis of the red blood cells. This serves as a double check for ABO compatibility between the donor and recipient and also identifies any antibody in the recipient's serum that was not detected by the antibody screen. Many modifications of these techniques have been made. For example, the treatment of the red cells with enzymes or the performance of tests in low ionic strength solutions (LISS) can demonstrate antigen–antibody interactions (red cell agglutination) that might otherwise have remained undetected by less sensitive methods.

The improvement in techniques, particularly when used as automated procedures, results in the detection of alloantibodies that have little clinical significance. If antibody screening is performed at low temperatures, antibodies can be detected in virtually every individual, irrespective of whether that individual has had a previous pregnancy or blood transfusion. Antibodies detectable only using room temperature techniques usually pose no risk to that individual. The diligent investigation and characterization of such antibodies is of no clinical benefit to the recipient. On this basis, a strong case can be made that certain antibody investigations are unnecessary and represent a misuse of resources. Further refinements in crossmatch techniques are therefore not likely to be useful in reducing the risk of accelerated red cell destruction. In addition, the majority of deaths associated with transfusion are attributable to the administration of ABO mismatched blood as a result of clerical or procedural errors.[2] Better serological testing will not reduce these deaths, nor the other major cause of death – posttransfusion hepatitis.[2]

There is another problem faced by many blood banks, particularly in these times of financial restraint. A significant proportion of transfusion requests are for patients scheduled for elective surgical procedures. These requests are appropriate since it is the anaesthetist's and surgeon's responsibility to ensure that blood is available should it be required urgently. However, with improved surgical techniques and attention to haemostasis, the majority of blood crossmatched for elective surgery is not administered. For example, at McMaster University Medical Centre, approximately 80 per cent of the blood crossmatched for elective surgical procedures is not utilized either in the operating room or after the patient has returned to the ward.

It is important to emphasize that this does not represent under-utilization of blood, as blood products should never be given unless absolutely required. It has been reported that each unit of blood administered carried a three to five per cent risk of posttransfusion hepatitis even when unpaid volunteer donors are used.[3] Most cases of posttransfusion hepatitis, however, are subclinical, with only approximately 20 per cent of patients symptomatic.[3] It is likely that the risk of posttransfusion hepatitis for Canadian blood products is somewhat lower than the study quoted above, from the United States; however, no comparable data exist for Canada. Based on reported cases of posttransfusion hepatitis, the risk of clinically evident posttransfusion hepatitis using Canadian blood products is 3.3 per 100,000 units of blood transfused (Dr. D. Wrobel, personal communication).

Requests for compatible blood that are not administered require that the blood be held in a status that reduces its chance of being used. Thus,

the crossmatching of blood for many surgical procedures is an inefficient use of technologists' time and may result in the waste of blood. Blood banks are thus faced with two questions: whether the performance of crossmatches is necessary for patients who probably will not be transfused, and whether the full crossmatch procedure is necessary to minimize the risk of transfusion-related morbidity. The solution to these apparently unrelated questions may be the same. The ratio of the crossmatch requests to the frequency of transfusion (the C:T ratio) can be determined for each surgical procedure.[4,5] Not surprisingly, the C:T ratio for a particular procedure is virtually identical between institutions. For example, seldom is blood required for patients undergoing cholecystectomy, but blood is usually required for patients needing hip replacement. Therefore, one can predict, with a high degree of certainty, which procedures will require blood and also the approximate number of units that will be needed for each procedure.[4,5]

The recognition that the quantity of blood required for a particular surgical procedure is constant among surgeons even in different institutions has permitted a more rational approach to blood orders for surgical procedures. A graded application of blood banking resources, depending upon the likelihood that a patient will require transfusion, can be used. For example, blood is neither grouped and screened nor crossmatched for such procedures as a routine delivery or appendectomy; these procedures virtually never require blood transfusion. Should blood be urgently needed for such patients, blood group compatible blood can be provided within minutes of receiving a suitably collected blood specimen. For procedures such as hip surgery that almost invariably require blood transfusion, several units of blood can be crossmatched prior to surgery. For the majority of elective surgical procedures, however, the requirement for blood is between these two extremes. To aid anaesthetists and surgeons in ordering blood, suggested blood orders can be drawn up for most procedures (Figure). For such procedures, a sample of blood can be taken from the patient for a "group-and-screen" preoperatively; the full crossmatch need not be done. If a clinically significant alloantibody is identified in the patient's serum, compatible blood can be specifically identified and set aside for that patient.

Most potential recipients will not have an alloantibody in their serum and further procedures, such as the crossmatch, are probably not necessary. Should the patient urgently need blood during surgery, the blood bank is notified and several units of ABO-Rh compatible blood are selected by referring to the results of the patient's "group-and-screen." As a further check on ABO compatibility, the patient's serum is "crossmatched" with donor red cells. The serum is mixed with the red cells, centrifuged and examined for agglutination. This approach allows the provision of compatible blood for the patient within minutes after receiving a request. More importantly, it ensures a second check on the ABO compatibility of the unit, the most important aspect of the routine crossmatch.

The "group-and-screen" approach offers major economic advantages; however, does it represent an increased risk to the patient? The transfusion of "group-and-screen" compatible blood means that some patients may receive blood against which they have an alloantibody that may not have been detected by the "group-and-screen" procedure. This may occur when a recipient has an antibody against a red blood cell antigen not present on the screening cells, but present on donor red blood cells. If the full crossmatch had been performed, this antigen–antibody interaction would have been detected and the incompatible blood not issued. It is important to know how frequently this could happen, and the potential consequences. If the crossmatch is eliminated, the likelihood of transfusing blood into a patient with a clinically significant alloantibody is low. Estimates of this risk range from 1/1,000 to less than 1/10,000.[6–9]

Does an approximately 1/5,000 probability of a red blood cell antibody reaction represent an unacceptably high risk? This is a difficult question, but there is evidence that many such reactions occur with little clinical impact. Delayed transfusion reactions may occur as often as 1/1,500 units of blood transfused or one in 400 patients.[10] The majority of these transfusion reactions pass unnoticed, as most occur after the patient has been discharged from the hospital. They do not represent significant clinical problems for the patient.

In conclusion, at this time it appears that the substitution of the "group-and-screen" procedure for the complete crossmatch, for most hospitals, represents an acceptable and appropriate approach to the provision of blood for many elective surgical

STANDARD BLOOD ORDERS FOR ELECTIVE SURGICAL PROCEDURES AT McMASTER MEDICAL CENTRE

The following guidelines represent standard Blood Bank orders for common surgical procedures and are applicable for the majority of elective operations. The attending surgical staff has the option of increasing the orders for a patient when increased blood needs are likely.

	NONE	G & S	CROSS MATCH (UNITS)
CARDIOTHORACIC SURGERY			
Arterial bypass procedures			
Aorto-femoral & ileo-femoral		X	
Aortic (abdominal) aneurysm			4
Femoral popliteal		X	
Bronchoscopy mediastinoscopy	X		
Lobectomy, pneumonectomy			2
Lung biopsy		X	
Pacemaker insertion	X		
Thoracotomy			2
GENERAL SURGERY			
Anal fissure, abscess (ischio-rectal)	X		
Appendectomy	X		
Breast - biopsy, lumpectomy	X		
mastectomy		X	
Cholecystectomy		X	
Colon/rectum resection		X	
Colostomy		X	
Common bile duct exploration		X	
Esophageal myotomy		X	
Gastrectomy, gastroplasty			2
Gastrostomy		X	
Hemorroidectomy	X		
Hernia repair (hiatus, incisional)		X	
Hernia repair (inguinal)	X		
Laparotomy		X	
Liver resection			6
Lumbar sympathectomy		X	
Lymph node biopsy	X		
Porto-caval shunt			6
Splenectomy		X	
Thyroidectomy, parathyroidectomy		X	
Vagotomy & pyloroplasty		X	
Whipple's procedure			6
GYNECOLOGY			
Cesarian section		X	
Conization of cervix	X		
D & C	X		
Hysterectomy-vag. or abdominal		X	
Hysterectomy-Wertheim			6
Laparoscopy (colposcopy)	X		
Oophorectomy		X	
Tubal ligation	X		
Vaginal repair/Marshall Marchetti		X	

	NONE	G & S.	CROSS MATCH (UNITS)
NEUROSURGERY			
Burr Hole +/- needle biopsy		X	
Carotid endarterectomy		X	
Cranioplasty		X	
Craniotomy (tumor or aneurysm)			2
Discectomy		X	
ECIC bypass		X	
Hypophysectomy			2
Laminectomy (cervical or lumbar)		X	
Ventriculo-peritoneal shunt		X	
OPHTHALMOLOGY			
All procedures	X		
OTOLARYNGOLOGY			
Laryngoscopy	X		
Mastoidectomy	X		
Parotid tumor		X	
Tonsillectomy, adenoidectomy	X		
ORTHOPEDIC SURGERY			
Amputation - below knee		X	
- above knee		X	
Arthroscopy	X		
Bone tumor resection			3
Discectomy		X	
Hip replacement (total)			3
Knee replacement (total)		X	
Laminectomy (cervical or lumbar)		X	
Meniscectomy	X		
Patellectomy	X		
Putti-Platt procedure	X		
Scoliosis surgery			4
Spinal fusion			2
PLASTIC SURGERY			
Head or neck surgery		X	
Skin graft	X		
Skin or muscle flap			2
UROLOGICAL SURGERY			
Bladder tumor - fulguration	X		
Cystectomy			4
Cystoscopy	X		
Ileal conduit		X	
Nephrectomy - simple		X	
Nephrolithotomy (anatrophic)			4
Orchidectomy	X		
Prostate needle biopsy	X		
Prostatectomy - TUP		X	
- retropubic			2
Pyeloplasty		X	
Retroperitoneal lymph node dissection (radical)			4
Ureteral reimplantation		X	
Ureterolithotomy	X		
Urethroplasty		X	
Vasectomy	X		
MEDICAL PROCEDURES			
Kidney biopsy		X	
Liver biopsy		X	

**NOTE - G & S stands for "Group and Screen" and includes a Blood Group, antibody detection, and storage of serum for crossmatch.*

FIGURE Suggested blood orders for elective surgical procedures used at McMaster University Medical Centre. These recommendations are printed on a pocket-sized card.

procedures.[11–13] The experience of the blood bank personnel should be considered prior to introducing such a system. In smaller hospitals, where full-time technologists are not in the blood bank, a complete crossmatch may continue to be preferable.[11–13]

Physicians who provide and administer blood will make a greater impact on transfusion-related morbidity and mortality by ensuring that clerical errors and improper procedures do not occur. The more difficult issue is whether all crossmatches with donor red blood cells can be omitted when the serum of the potential recipient has been tested for the presence of red cell alloantibodies. This will be answered only on further study and when reliable and effective methods for predicting the consequences of the transfusion of red blood cells are developed. It is possible that the recent introduction of automated techniques for crossmatching may preclude the necessity to eliminate the manual crossmatch.[14] These techniques, however, require further evaluation.

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Résumé

Depuis plusieurs années l'épreuve de compatibilité complète a servi à déterminer la compatibilité entre le receveur et le donneur avant la transfusion. La majorité des unités de sang pour laquelle on fait l'épreuve de compatibilité complète pour chirurgie élective ne sont pas utilisées et plusieurs anticorps ainsi détectés n'ont pas de signification clinique.

Cherchant à éliminer les tests qui n'augmentent pas de façon significative la sécurité des produits sanguins, la nécessité de l'épreuve de compatibilité complète a été remise en question. Des études récentes indiquent que la détermination du groupe sanguin et la recherche d'anticorps au lieu de l'épreuve de compatibilité complète constituent une alternative acceptable pour plusieurs interventions électives.

Cette approche permet l'utilisation plus rationnelle du sang et réduit le travail de la banque de sang. Le risque est minimum, car une transfusion sur plusieurs milliers sera donnée à un patient ayant des alloanticorps non détectés auparavant et des études récentes montrent que ces incompatibilités ont peu de conséquences cliniques.