Reducing adverse events in blood transfusion

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Summary

Against a background of ever increasing expenditure on blood safety, less attention has been paid to improving the safety of the transfusion chain within hospitals. Based on reports to the Serious Hazards of Transfusion (SHOT scheme) between 1996 and 2003, the risk of an error occurring during transfusion of a blood component is estimated at 1:16 500, an ABO incompatible transfusion at 1:100 000 and the risk of death as a result of an ‘incorrect blood component transfused’ (IBCT) is around 1:1 500 000. There are opportunities for error at a number of critical points in the transfusion chain, starting with the decision to transfuse, prescription and request, patient sampling, pretransfusion testing and finally the collection of the component from the blood refrigerator and administration to the patient, consistently the commonest error in successive SHOT reports. Successive ‘Better Blood Transfusion’ initiatives and the 2003 Annual Report of the Chief Medical Officer for England have drawn welcome attention to the importance of safe and appropriate transfusion and the National Patient Safety Agency has now set a target of reducing the number of ABO incompatible transfusions by 50% over 3–5 years.

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A safe, secure blood supply is a prerequisite for 21st century medical, surgical and haematological treatment, and is provided at a cost to the National Health Service (NHS) of £500 m per annum. This cost, which has doubled over the past decade, could be further increased by implementation of additional precautions against the uncertain risk of transmission of variant Creutzfeldt–Jakob disease (vCJD). Concerns have recently been expressed as to whether such large increments in safety can be justified (McClelland & Contreras, 2005), and a reappraisal of priorities in transfusion safety appears timely.

In contrast to the large resources allocated to ensuring the availability and assuring the quality of the blood supply, less attention has been paid to improving the safety of the transfusion chain within hospitals, where, for example, avoidable fatalities and major morbidity due to ABO incompatible transfusions continue to occur. Between 1996 and 2003, 226 instances of ABO incompatible transfusion were reported to the Serious Hazards of Transfusion (SHOT) scheme. During this period, 23 million blood components were issued by the UK blood services and 2087 adverse events analysed, of which 1393 (67%) were reports of ‘incorrect blood component transfused’ (IBCT) where a patient received a blood component intended for another patient or that did not meet appropriate specifications. The risk of an error occurring during transfusion of a blood component is estimated at 1:16 500, an ABO incompatible transfusion at 1:100 000 and the risk of death as a result of an IBCT is around 1:1 500 000 (SHOT, 2003). These may be underestimates, as adverse events may be under recognised and not every hospital reports to SHOT.

The error rate based on SHOT data is consistent with that in other studies, although the methodologies differ. A study of 10 years experience of transfusion errors in New York State (Linden et al, 2000) calculated an error rate of one per 19 000, but differed from SHOT in that it excluded ‘processing and preparation errors’, such as failure to irradiate or to provide antigen-negative or cytomegalovirus-safe blood, and used only red cell issues as the denominator. The French haemovigilance system does not record ‘no-harm’ events, but estimated the risk of death caused by ABO-mismatched transfusion to be 1:1 800 000 allogeneic red cell units transfused (Andreu et al, 2002).

What can go wrong?

The catastrophic event of acute intravascular haemolysis due to ABO incompatibility is the end result of system failures, such as patient misidentification, sample mislabelling, prescribing errors, laboratory errors, and collection and administration of the wrong component. Process mapping of the task of ordering and supplying blood components reveals that it is a complex chain, with opportunities for error at a number of critical points (McClelland, 1998). Moreover,
transfusion errors can cause patient harm in other ways than ABO incompatibility, including failure to provide blood of the appropriate specification, RhD sensitisation of women of child-bearing potential, or overtransfusion based on erroneous laboratory results. Paediatric patients have been shown to be particularly vulnerable to transfusion errors; 166/1393 (12%) of reported IBCT events related to patients under 18 years old, who, in an epidemiological survey were shown to receive 4.2% of red cells issued (Wells et al., 2002). Lack of knowledge on the part of clinical and laboratory staff regarding the British Committee for Standards in Haematology (BCSH) transfusion guidelines for neonates and older children (British Committee for Standards in Haematology Transfusion Taskforce, 2004) is an important contributory factor.

Analysis of IBCT events reported to SHOT reveals two striking and consistent findings; first that in approximately 50% of events there are multiple errors in the process, and secondly, that approximately 70% of errors occur in clinical areas, the most frequent error (27% in 2003) being a failure of the pretransfusion ‘bedside’ check to ensure that the right blood is given to the right patient.

**Weak links in the transfusion chain**

**The decision to transfuse: request and prescription errors**

SHOT does not currently encompass inappropriate transfusion because of wrong clinical decision-making, but erroneous, mis-documented or misinterpreted laboratory results are an important cause of ‘wrong blood’ events. A decision to transfuse should be based upon clinical symptoms and signs supported by a laboratory result. Caution must be exercised if the laboratory report does not match the clinical picture, as incorrect results may arise from unsuitable samples or analytical errors. Telephoned reports may be wrongly transcribed or assigned to the wrong patient.

Adverse events may also result from failure to provide the transfusion laboratory with crucial information regarding the patient’s transfusion history or special blood requirements, such as a previously detected allo-antibody or an indication for irradiated blood components. Increasing mobility of patients, shared clinical care and the increasing use of purine analogues that predispose to transfusion-associated graft-versus-host disease (TA-GVHD), make robust communication systems essential. Fortunately, SHOT has yet to receive a report of TA-GVHD resulting from failure to provide irradiated components, although over 80 patients were put at risk of this universally fatal complication in 2003 (SHOT, 2003).

The blood prescription provides instruction regarding the rate and volume of transfusion. Particular care must be exercised when prescribing for infants, children and small adults, in whom over-transfusion can result in serious morbidity or mortality.

**Sample errors**

The next critical stage of the transfusion process is that of blood sampling for pretransfusion testing. Only 10 of the 348 IBCT cases analysed by SHOT in 2003 involved samples taken from the wrong patient, but five of those patients received ABO incompatible blood as a result; of whom one subsequently died and four suffered major morbidity.

Sample errors may be detectable by the laboratory, as is evident from SHOT data on ‘near-misses’ and by prospective audit. The frequency of samples in which the blood group differed from that obtained previously (wrong blood in tube) was assessed in an international study of nearly 700,000 samples in 10 countries by the Biomedical Excellence for Safer Transfusion working party of the International Society of Blood Transfusion (Dzik et al., 2003). The median rate of wrong blood in tube, similar across nearly all of the participating countries, was approximately 1:2000. Comparable rates were found in a national study in England (Murphy et al., 2004) and in an error log in a single institution (Galloway et al., 1999).

Practices resulting in ‘wrong blood in tube’ include labelling of sample tubes away from the bedside, failure to check patient identity and the use of preprinted labels, which are proscribed by the British Committee for Standards in Haematology Guidelines on Administration of Blood and Blood Components (British Committee for Standards in Haematology Transfusion Taskforce, 1999). Banning of preprinted labels results in a higher rate of samples rejected due to minor discrepancies, but a reduction in the incidence of ‘wrong blood in tube’ (Cummins et al., 2000).

Poor techniques in blood sampling for diagnostic investigations may give rise to inappropriate transfusion, sometimes with disastrous consequences. Successive SHOT reports include cases where blood has been taken from a ‘drip arm’ or allowed to settle in a syringe, resulting in an erroneous haemoglobin result and an inappropriate decision to transfuse contributing to the deaths of two patients during 2001–2002 (SHOT, 2002).

To reduce the risk of sampling errors, all staff undertaking phlebotomy must receive training and competence assessment. Hospital policies should state that blood samples must be taken from a free flowing venepuncture site, the tube filled to capacity and adequately mixed. The phlebotomist must complete the tube label before leaving the patient, checking that the identification details are correct verbally with the patient and against the identification wristband or equivalent.

**Laboratory errors**

Approximately 30% of ‘wrong blood’ events reported to SHOT arise in the laboratory and this figure is remarkably consistent with that of data from New York State (Linden et al., 2000). A disproportionately high number of laboratory errors take place outside of ‘core hours’, when staff are fewer in number, and
may be relatively inexperienced and working under pressure. A survey of laboratory workload in the UK (D. Asher, personal communication) indicated that approximately 20% of pre-transfusion testing takes place ‘out-of-hours’, as defined by the laboratory, while 40% of laboratory errors reported to SHOT occur during this time. Manual techniques for urgent blood grouping are inherently unsafe and have the potential for errors in interpretation and documentation. Unless the transfusion laboratory is appropriately staffed throughout the 24-h period, requests for transfusion at night should be restricted to those that are clinically imperative. This should be noted when planning implementation of the ‘Hospital at Night’ initiative.

Errors in blood collection and administration

The stage of greatest risk in the transfusion chain is the collection of the component from the blood bank or satellite refrigerator and its administration to the patient. Errors at these stages constituted 40% of ‘wrong blood’ events reported to SHOT in 2003 and resulted in 12 ABO incompatible transfusions. Anecdotal case reports provide insights into the system failures contributing to collection errors, such as inaccurate verbal instructions and the common pitfall of similar patient names.

Of cases reported to SHOT in 2003, 10/45 patients for whom the wrong blood was collected from the blood bank and subsequently administered at the bedside were undergoing urgent or massive transfusions in critical care environments, such as operating theatres, recovery suites, emergency departments, intensive care units or delivery suites. Lack of denominator data makes interpretation of such figures speculative, but it is tempting to conclude that there is a greater risk of error in situations of extreme clinical urgency.

Adverse events reported to SHOT are analysed to identify individual contributory errors. Consistently, the commonest error in successive reports (27% in 2003) is a failure to carry out an adequate pretransfusion ‘bedside’ check. In the majority (87%) of adverse events in which the bedside check failed, a previous error might have been detected at this stage but was not, while in the remainder, the first and only error resulting in blood being given to the wrong patient was made at this final and most critical stage in the process. Contributory factors are checking of blood against a compatibility form away from the bedside, distraction of nursing staff during the checking process, patient identification wristbands missing, defaced or hidden under theatre drapes.

The National Comparative Audit of Blood Transfusion (2003) carried out in England and Wales under the auspices of the Royal College of Physicians and the National Blood Service found that, of 5014 patients observed during a blood transfusion, 10% were not wearing an identification wristband, and of these, 10% were unconscious.

A ‘wet’ ABO compatibility check at the bedside is relied upon in some European countries to prevent incompatible transfusion, and resulted in a reduction in incidence when implemented by law in France in 1965 (Juron-Dupraz et al., 1982). The reliability of this technique was evaluated by Ingrand et al. (1998), who concluded that ‘it should not be considered a reliable supplemental safety procedure in the hands of inexperienced and insufficiently trained operators’.

What can be done?

The Department of Health report ‘An organisation with a memory’ (Donaldson, 2000) emphasised the importance of reporting and investigating adverse events and near-misses within an open, learning culture, and in England and Wales this philosophy has been taken forward by the National Patient Safety Agency (NPSA). Safety in health care is a relatively young field internationally and it will be some time before its full potential is understood. The NPSA recognises the need for the promotion of patient safety at all levels of the healthcare system and the importance for staff of being able to assess the progress they make towards delivering safer care. The Agency has developed guidance on the steps that organisations should take to achieve these objectives and effect the necessary change in culture (National Patient Safety Agency, 2004).

All too often in the past, investigation of an adverse event has gone no further than the member of staff unfortunate enough to be at the ‘sharp end’ when the mishap occurred, without looking at the underlying factors. These were described by Reason (2001) as ‘latent failures’, and may include inadequate staff numbers, poor working environment, unclear guidelines, unsafe or over-complex processes, insufficient attention to training and education, and lack of respect for human limits. The NPSA has also developed educational material and undertaken an extensive training programme for NHS staff to develop techniques in Root Cause Analysis, a process of incident investigation that systematically identifies the underlying factors that need to be addressed (National Patient Safety Agency, 2004).

Guidelines should be clear, unambiguous and translated locally into simple, safe protocols, readily accessible when required. Education and clinical audit are essential quality improvement tools, but interventions vary in their relative effectiveness, with educational outreach and feedback of local audit shown to be more effective than didactic lectures and published guidelines (Davis et al., 1992). The 2003 Annual Report of the Chief Medical Officer (CMO) for England drew welcome attention to the importance of safe and appropriate transfusion, emphasising that training and education of all staff groups involved in the transfusion chain are integral to the safety of the process (Donaldson, 2003).

There is an important role in hospitals for Transfusion Practitioners, dedicated members of staff with a remit of improving transfusion safety and appropriate use of blood, equipped with the necessary expertise and resource to implement and monitor good practice (A. Gray, S. Buchanan & D.B.L. McClelland, unpublished observations). Hospital transfusion committees and teams, if properly constituted and adequately
resourced as outlined by the Department of Health (2002), can be a powerful force for improving transfusion safety. Hospitals should have systems in place for recognising, reporting and investigating adverse events and near misses, and using these experiences to promote learning.

The CMO’s National Blood Transfusion Committee (NBTC) and counterparts in Scotland, Wales and Northern Ireland provide a potentially useful framework to support regional and local hospital transfusion committees in achieving safe and effective transfusion practice.

**What practical steps can be taken to make transfusion safer?**

The NPSA, in a joint initiative with SHOT and the CMOs NBTC, has set a target of reducing the number of inadvertent ABO incompatible transfusions by 50% over 3–5 years from 1 January 2005, as measured by the SHOT database. A first step towards achievement of this target was a workshop held at the Royal College of Pathologists in December 2004 to investigate local safety improvement initiatives in patient identification and ‘bedside’ checking that are already implemented in UK hospitals.

Presentations described a variety of technological and non-technological solutions, of which four were selected by an expert panel for further evaluation and possible development. These are listed below:

**Barcoding**

Barcode technology is currently being used and developed as a tracking system to varying extents in several trusts to improve blood safety. It can be used in sample collection, compatibility testing and blood administration and includes the use of handheld computers that can be linked to hospital patient administration systems.

**Red label system**

A simple, long established but not widely used positive identification method to improve safety through a unique set of numbered labels used each time a patient is bled for transfusion. The system forces an additional bedside check.

**Photo identification for transfusion dependent patients**

Transfusion-dependent patients (e.g. those with thalassaemia) who receive blood regularly may need a more durable means of identification than a standard wristband. A photo identification card is an alternative that merits evaluation.

**Continuing education and training**

A strong theme throughout the workshop was the need for formal education and training of all hospital staff involved in the transfusion chain, to underpin all blood safety initiatives. A structured and sustained education and training programme implemented by one large acute hospital was considered to be a model that could be shared as best practice by others.

Each of these initiatives will be further assessed during 2005–2006 for effectiveness and applicability on a national basis. This will include risk assessment of implementation and likely impact, experience and sustainability of systems to date, cost, applicability to neonates and paediatrics and transferability to other clinical situations where patient identification is a safety concern, such as imaging and pathology specimen collection. One anticipated outcome will be the generation of a national standard specification for barcoding systems.

**Management of adverse events**

Finally, the human consequences of errors, both for patients and for the healthcare workers involved, must not be forgotten. Every medical accident has at least two victims, both of whom require support. Errors must be openly acknowledged to the patient and/or relatives, with an honest explanation and an indication of actions taken to prevent a recurrence. Such an approach limits further trauma caused by the suspicion of a ‘cover-up’, and lessens the likelihood of a subsequent complaint or litigation (Vincent, 2001). Errors are, by definition, unintentional, and disciplinary action is counter-productive except in the thankfully rare instances of blatant professional misconduct or criminal intent.

**References**


