KEYWORDS: BLOOD TRANSFUSION, BLOOD SAFETY, BLOOD TRANSFUSION REACTIONS

BLOOD SAFETY IN THE OR: THE BLOODY TRUTH

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ABSTRACT:

Blood transfusions are lifesaving and life-sustaining treatments given to patients in many clinical areas of a hospital with a large proportion occurring in the Operating Room (OR).[6] Transfusion related errors are rare events in the OR but they do occur and are often severe enough to cause patient morbidity and mortality.[6] Therefore, care must be taken in all elements of the transfusion process. The purpose of this article is to build awareness around the potential for critical errors during the blood transfusion process in the OR and ways in improving the safety of blood transfusion for all surgical patients.

INTRODUCTION:

Transfusions, when given immediately in life-threatening situations and following hospital protocols, can be life-saving treatments. The 'bloody truth', however, is that transfusions are not risk free and it is important to ensure that meticulous care is taken during the entire transfusion process. Healthcare providers must be able to recognize and understand the potential risks and utilize prevention strategies to mitigate these risks.

In 1995 the Canadian Federal Government initiated the Commission of Inquiry on the blood system of Canada. Justice Horace Krever led this initiative after the tainted blood tragedy, a time in which more than 1,000 Canadians, who received blood in the late 1970s and 1980s, were infected with human immunodeficiency virus (HIV) and thousands of Canadians contracted the Hepatitis C Virus (HCV) as a result of contaminated blood products.[3] The Commission of Inquiry released the Krever Report detailing 50 recommendations for changes to the Canadian blood system. Recommendations focused not only on increasing the safety of our national blood supply but also increasing accountability and public confidence and ensuring that adequate funding and research and development activities were maintained in order to prevent another similar tragedy.[3]

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According to an article published in Anaesthesiology approximately 50% of blood products transfused take place in the OR setting.[6] It is this author's opinion that adverse transfusion events are, however, rarely discussed in the surgical culture. Discussion of transfusion matters relating to perioperative care can, however, help improve transfusion practices which can lead to decreasing risk and healthcare costs. Most importantly, these dialogues lead to the best quality of care provided to patients.

Transfusions in the OR

In the perioperative environment blood products are required for several emergent situations including trauma, surgical hemorrhage, gastrointestinal bleeds, organ transplants, etc.

The table below illustrates major uses with the signs and symptoms patients may be experiencing to receive a blood transfusion.[15]

Transfusion Reactions and Transfusion-Related Errors

A patient can potentially experience several adverse reactions from receiving a transfusion or as a result of errors made during the transfusion process. These reactions include:

Anaphylaxis (1 in 40 000)[4]

Anaphylaxis is a rare but life threatening complication that has a rapid onset. Anaphylaxis accounts for approximately 3% of fatalities associated with transfusion5 and the reasons for these reactions are often unknown. This type of reaction does, however, have some possible etiologies including:[5]

1. An IgA deficient recipient has formed an anti-IgA antibody that reacts with the IgA in the donor product;
2. The recipient may also develop an antibody to another plasma protein that is present in the donor unit; or
3. Transfusing an allergen present in the donor unit to a sensitized recipient. Some examples of this are penicillin, ASA, or peanuts.

The preventative measures for an IgA deficient recipient with anti-IgA include avoiding products containing IgA by, for example, ordering washed RBC or platelets or obtaining IgA deficient blood products for IgA deficient donors available from CBS.[5]

Transfusion Associated Circulatory Overload (TACO) (1 in 100)[4]

TACO presents as respiratory distress following a transfusion and is the result of a transfusion rate that was too rapid for the specific patient. Those at most risk include the elderly, small patients, cardiovascular patients, or patients with renal dysfunction. The reaction usually occurs within 6 hours of transfusion, but can occur up to 12 hours post-transfusion. According to the Serious Hazards of Transfusion (SHOT) report,[6] from the UK, and a 2014 FDA report,[2] from the US, this reaction is one of the top two reported causes of transfusion-related morbidity and mortality. In the Annual Summary for Fiscal Year 2014 report published by the FDA, it states that the number of fatalities from the combined reports from Fiscal Years 2010 through 2014 was 38 cases out 176 reported transfusion related fatalities by complication or 22%.[2]

BLOOD PRODUCTS	MAJOR USES
Red Blood Cells (RBC)	Bleeding or anemic non-bleeding patients with signs and symptoms of impaired tissue oxygen delivery. • Tachycardia • Shortness of breath • Dizziness
Plasma	• Liver disease coagulopathy • Massive transfusion • Plasma exchange procedures for Thrombotic Thrombocytopenic Purpura/Hemolytic Uremic Syndrome (TTP/HUS) – when cryosupernatant plasma not available
Platelets	Control or prevent bleeding in patients with: • Low platelet counts (Thrombocytopenia) • Congenital platelet dysfunction • Platelets not functioning due to the effects of medications (ASA, Clopidogrel - Plavix®) • Platelet dysfunction following cardiopulmonary bypass
Cryoprecipitate	To replace: • **Fibrinogen**: In patients actively bleeding who have a low fibrinogen level. • **Specific Coagulation Factors**: Only when specific factor concentrates are not available.

According to TTISS-ON from 2008 through 2012, 3 cases out of 12 reported or 25% were transfusion related deaths.[16] Recommended methods of prevention are avoiding transfusing more than one unit at a time, to transfuse over longer periods (up to maximum of 4 hours), to administer diuretics as per physician's orders, and to split components to decrease the rate of transfusion.

Transfusion Related Acute Lung Injury (TRALI) (1 in 12,000)[4]

TRALI can occur with RBC, platelets, and plasma transfusions. The number of fatalities reported by the FDA from the combined Fiscal Years 2010 through 2014 is 72 cases out of 176 cases reported.[2] TTISS-ON report from 2013 through 2014 shows that 2 deaths were probable TRALI cases out of the 6 deaths reported from transfusion related deaths in Ontario.[16] One of the causes of TRALI has been linked to the presence of human leukocyte antigen (HLA) antibodies in the donor. Female plasma is more likely to contain HLA antibodies which are often acquired during pregnancy due to exposure to small amounts of baby's blood.[5] This reaction occurs within the first 1 to 2 hours after the start of transfusion but can be delayed for up to 6 hours.

In Canada, as a preventative measure, frozen plasma is exclusively from male donors and buffy coat platelet pools are suspended in plasma from one male donor.[5]

Sepsis (RBC 1 in 250 000 / platelets 1 in 10 000)[4]

Sepsis is caused by the bacterial contamination of blood products. This is more commonly seen in platelets, which are stored at room temperature.[4] Sepsis related deaths are reported at 1 in 500,000 from RBC transfusions and 1 in 60,000 from platelet transfusions. Specific control measures are in place to prevent sepsis. These include the manufacturers adherence to strict donor screening, pre-transfusion detection for all platelet products, the application of skin disinfection just before the needle insertion, and improved blood processing and storage processes.[7]

Acute Hemolytic Transfusion Reaction (AHTR) (1 in 40,000)[4]

AHTR is linked with ABO and other blood group incompatibilities.

The ABO blood system is the principle blood group, along with Rh, that identifies the blood group to be negative or positive. There are also 34 minor blood groups identified and 339 known blood group antigens.[13] The presence, or absence, of A and B antigens in the RBCs determines the patient and donor's ABO group. Table 1 outlines the ABO blood group and antigens, as well as the compatible blood products for each ABO blood group system.

AHTR occurs as a result of ABO incompatible RBC being transfused. These reactions may occur with just a few milliliters of blood. Patients who have developed antibodies from a previous transfusion or pregnancy may also experience this type of adverse reaction from antibodies outside the ABO system.[5] Incompatible fluids mixed with RBCs may cause AHTRs, like

Right Patient Wrong Blood

The following stories are from Canadian cases that were informally shared with the author. They have been provided as examples of transfusions gone wrong.

Case 1:

Two patients in the same unit had orders for a transfusion. The orders were placed electronically and received by the lab simultaneously. Blood for both were released to a porter to deliver to the unit. One of the units of blood was administered to the patient who was going to the OR When the patient was received by the OR nurse she checked the unit and noticed it was a unit intended for another patient. The unit was stopped and the lab was notified.

Case 2:

Two trauma patients were admitted to emergency room (ER) simultaneously. Blood was ordered for both patients and received by ER staff. The patients had different ABO blood groups. One patient needed to go to the OR immediately for surgery and a cooler was placed on patient's stretcher that contained blood components which were not checked at the bedside by ER nurses. The wrong cooler was sent with the wrong patient. The unit was subsequently transfused to the patient but the bedside check was also not done. The unit transfused was intended for the other patient. The patient who received the wrong unit developed DIC and renal failure as a result the patient died.

Ringer's Lactate. In addition, mechanical or heat destruction due to inappropriate or malfunctioning infusion devices may also produce this type of reaction. For example, a blood warmer that may be too hot may cause a patient to experience AHTR.

What happens?

Early on in life, all individuals produce antibodies against the ABO antigens that they lack (anti-A or anti-B). These antibodies do not affect the patient's own RBC but attack and quickly destroy donor RBC containing the relevant antigen. For instance, anti-A in the patient will attack donor RBC of blood from groups A or AB or anti-B will attack RBC of groups B or AB. If ABO incompatible RBC are transfused into a patient, the RBC are immediately attacked and destroyed by the antibodies in the patient's plasma which results in intravascular hemolysis.[7]

Signs and Symptoms of AHTR

Severe complications can occur, even when just a small amount of blood has been transfused, so early recognition of symptoms is significant.[7] The most common presenting signs are fever and chills. The patient may also experience pain, hypotension, nausea, vomiting, dyspnea, renal failure, and disseminated intravascular coagulopathy (DIC).[5] Red/dark urine can also indicate hemoglobinuria in an anaesthetized patient.[13]

Response to Adverse Reactions:

If the patient experiences an adverse reaction of any kind the healthcare team should:

1. STOP the transfusion;
2. Maintain IV access;
3. Check for clerical errors at the bedside and chart (ie confirm that the identity of patient matches the blood bag label, informed consent, business sheet, patient identification band, etc.? Does the donor unit number match the one listed on the patient label?)
4. Notify the physician and the transfusion medicine laboratory (TML) that a patient could be showing signs of an adverse transfusion reaction.
5. Send recipient blood samples and the blood bags used during the transfusion, along with non-transfused blood bags, to re-check the ABO group.
6. A post-transfusion urine sample if required.

Mild transfusion reactions like hives may not require blood and urine samples but more severe reactions will. Always follow physician's orders as well as the organization's protocol.

Root Causes of Errors

In the November 2005 issue of Transfusion Cliniquet Biologique a study was performed by Stainsby,[8] to identify the weak links that contributed to ABO incompatible transfusions. The weak links included the collection of the patient's blood sample for pre-transfusion testing. Wrong blood in tube errors resulted from labelling the sample tubes away from the patient's bedside, failure to check patient identity, and use of pre-printed labels. Another identified risk in the transfusion chain was at the point of retrieval of blood from the blood bank or refrigerator and resulted from checking the blood bag against the compatibility form away from the patients' bedside, distraction of nursing staff during the checking process, and patient identification bands that were missing or hidden under surgical drapes.

This study recognized that young children were particularly vulnerable to patient identification errors. This is

Table 1
ABO Blood Groups & Compatible Blood Products[4]

ABO group of patient	Antigens on RBCs	Antibodies present in Plasma	Compatible RBC transfusion	Compatible Plasma transfusion	Cryoprecipitate
A	A	Anti-B	A, O	A, AB	Any Group
B	B	Anti-A	B, O	B, AB	Any Group
AB	A,B	None	A, B, AB, O	AB	Any Group
O	None	Anti-A, Anti-B	O	A, B, AB, O	Any Group

especially true in the neonatal unit where some patients may share the same date of birth or may not have been named yet. But even young children are often unable to confirm their personal details. The study mentioned one case where an incident was reported involving two brothers with thalassemia major, who were both undergoing a simultaneous transfusion, and decided to play a joke by switching beds.[8]

In the AORN Journal, in 2003, Beyea and Majewski14 listed the root causes for blood transfusion errors as:

- Incomplete patient blood transfusion verification at all phases of the process;
- Failure to recognize the signs and symptoms of a transfusion reaction;
- Lack of informed consent for a transfusion;
- Multiple samples being cross-matched at the same time or a cross-match being started before the transfusion order is received;
- Insufficient staffing levels;
- Storing blood for multiple surgical patients in the same refrigerator;
- Incomplete communication among health care providers; and
- Patient identification, specimen label, or blood bag label errors.

Who is Accountable?

It is important to understand that the transfusion process requires a multidisciplinary approach involving medical laboratory technologists, physicians, perfusionists, nurses, and operating room attendants or porters. Teamwork and effective communication plays an important role in patient safety. All team members must be accountable for the transfusion process even if they are not involved in the preparation or administration of blood or the ordering the transfusion itself. All healthcare professionals play an essential role in ensuring that all necessary steps of the transfusion process are followed to the safest possible standard.

A study performed from 2005 to 2010, at Sunnybrook Health Sciences Centre,[9] concluded that errors occur at every point in the transfusion process, with the highest risk of harm to the patient resulting from inappropriate ordering of blood products and errors in sample labelling.

Barriers in the OR

In the OR there are several barriers to the prevention of transfusion errors. They include the high level of stress, communication, breakdown in collaboration between team members, and multiple distractions that are inherent to the OR setting.[10,12] Distractions can include surgeons and/or anaesthesia staff requesting supplies that require the circulating nurse to leave the OR; music, phone calls or pages

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Errors can be Fatal! Perioperative Registered Nurse (RN) with a Red Blood Cell (RBC) Unit for Transfusion.

that may need to be answered; and changeover of staff (both anaesthesia and/or nursing) that can result in breakdowns in communication from incomplete hand-over reports. It is very important to report the name of the patient and procedure on the hand-over reports as items such as identification stickers or patient ID bracelets and cards may have been left behind in the OR from previous cases. Difficulties in the verification process have been reported due to the patient identification band being inaccessible, removed, or on a body part that is within the sterile surgical field. Staff, in these cases, might assume that all documentation belongs to the patient on the surgical table.[9]

A study published in 2009[10] studied the impact of OR interruptions in a scenario where twelve anaesthetists were interrupted when requesting blood in a simulated bleeding patient scenario. This study noted that two administering anaesthetist did not do pre-transfusion checks when they were distracted by an interruption. The result of the study displayed additional anaesthetists who were in the OR did engage in the interruption – those anaesthetists noticed that the pre-transfusion checks were not done and therefore the omission was avoided. Although some interruptions can provide valuable information to the person being interrupted they can also compromise patient safety.[10]

Good communication is an important part of patient safety. Communication, according to the articles by Runy[11] and Makary et al,[12] is an integral component of safety and a breakdown in communication can lead to tragic outcomes in the OR. Both articles discuss wrong-site operations and mismatched organ transplants or blood transfusions that resulted when communication breakdowns occurred among the OR team members.

Preventing Errors

The following can prevent transfusion errors and have a significant impact on patient safety:[14]

- When extremities are not accessible an identification bracelet may be placed on the patient's forehead;
- Use of bar code scanners to scan the patient, sample, and blood;
- Use of "smart" refrigerators where staff will have to login to obtain access to the blood;
- Ensure that all identification bands, patient identification cards, labels, blood bags, and coolers are removed from the OR theatre when a surgical case is over;
- All healthcare facilities should have a policy and guidelines in place for different transfusion-related procedures;
- Use a pre-surgical checklist and ensure that the patient identification bracelet is accessible during the checklist process;
- Ensure all staff receive in-service training on procedures related to transfusion practices (e.g. simulation sessions that include the multidisciplinary team);
- When providing a hand-over report to relief staff use a checklist that includes the patient identification and details about whether blood has been ordered or is in the room;
- Never send blood products/components with patient to the unit room or recovery room unless infusing (ie blood left in a cooler under a stretcher after a patient has been transferred); and
- Evaluate staffing models. Ensure there is adequate nursing staff in the room. If, for instance, the team is in a trauma situation and a circulating nurse has to step out of the OR there should be another circulating nurse in the OR to assist the surgical team, anaesthesia team, and other situations. When blood products arrive into the operating room a nurse should be available to receive the blood product and do the positive patient identification checks with the anaesthetist.[14,17]

Conclusion

By following all safety protocols, we ensure that transfusions are life-saving treatments for our patients. One of the

main elements in safe and effective transfusion is good clinical practice. Perform positive patient identification at specimen draw. Ensure to label the specimens while at the patient's bedside. Perform positive patient identification when blood products are requested for transfusion and before administration. After the bedside check, the blood must be transfused right away. Eliminating shortcuts and ensuring all healthcare professionals adhere to strict protocols also helps to promote safe transfusion. It is essential to ensure that team members do not assume that the blood component or product in the OR belongs to the patient on the surgical table but, rather, it is their responsibility to ensure that this is checked carefully.

Reporting every type of reaction to the transfusion medicine laboratory (TML), even if it has been easily managed, is important to ensuring a safe blood supply for all. This allows TML staff to maintain a detailed patient history and ensure the safest transfusion possible is provided to this patient. This reporting also allows for data collection that can lead to improvements in practice and can be used to further educate heath care professionals.

Having strong communication between staff in the OR and beyond as well as a good knowledge and understanding of transfusion protocols and guidelines developed can lead to safe and effective transfusion practices.

Standards pertaining to this article can be found in the Operating Room Nurses Association of Canada (ORNAC) Standards for Perioperative Registered Nursing Practice (12th Edition, October 2015), Section 5, p. 294, Standard 5.1.

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