

Autotransfusion In Penetrating Chest War Trauma With Haemothorax: The Keysaney Hospital Experience.

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Background: In 1991 civil war broke out in Somalia and Mogadishu was divided into two areas, occupied by different clans. No hospital facility was available in Mogadishu North to take care of the war wounded. The International Committee of the Red Cross (ICRC), together with the Somalia Red Crescent Society found a new building, 7 km North of the town, intended to be a prison: Keysaney Hospital was thus inaugurated in February 1992. It was soon established as The War Surgery Hospital in Somalia.

Methods: This was a retrospective study. From 1992 to 2001, 45,900 war-wounded patients were admitted and treated; among whom 13770 had chest injuries. Due to lack of a blood bank, insufficient number of donors, continuous need in emergency, life threatening situations and following previous positive experiences, a system was set up for immediate auto transfusion in patients with massive haemothorax from penetrating chest war wounds. To reduce the risk of the 2 major complications of sepsis and coagulopathy, each patient received antibiotic prophylaxis and only cases with a maximum delay of one hour were subjected to this form of management.

Results: 137 patients had this kind of auto transfusion. There were five deaths (3.6% Mortality rate) No major complications were detected in the auto-transfused patients that survived.

Introduction

Chest wounds represent 15-20% of all combat injuries. Many patients die from cardiac or major vascular injuries before receiving medical assistance. In an established hospital, chest injuries account for 7-10% of all the war wounds¹. In most cases, penetrating chest injuries cause haemothorax or haemo-pneumothorax, with or without fracture of thoracic cage bones. Less frequently the result is pneumothorax alone, pulmonary and mediastinal

haematoma, pulmonary contusion, heart, oesophageal, tracheal or major vessels injuries. More than 90% of all penetrating chest injuries can be managed initially by chest drain¹. One major problem, related to haemothorax, is the massive blood loss requiring urgent blood transfusions to stabilize the patient. Apart from the need of a special laboratory set up and technical knowledge for safe blood transfusion, under war conditions, several other constraints make it practically impossible to perform

routine blood transfusions. Contributory restrictive factors include absence of a blood bank, shortage of donors, influx of casualties requiring blood transfusion, and, in some areas of the world, high rate of rejection of donated blood infected with hepatitis or human immunodeficiency viruses.

In most cases of blood transfusion the donor is a different person (allogeneic transfusion). but sometimes the patient is transfused with his own blood (autologous transfusion).

Allotransfusion bears several risks for the recipient patient^{2,3} :

- HIV type 1 and 2: due to the window period, tested blood is not 100% safe.
- Hepatitis B and C.
- Human T Lymphocyte Virus 1 and 2 and other viruses.
- Malaria.
- Syphilis.
- Other bacterial/parasitic infections.
- Haemolytic reactions, fatal ones occurring in the range of 1 in 250,000 to 1 in 1 million transfusions in USA. Half of them are caused by ABO incompatibility, as a result of administrative errors².
- "Minor" haemolytic reactions: approximately 1 in 1000 patients has clinical manifestations of a delayed reaction to blood transfusion and 1 in 260,000 patients has an haemolytic reaction related to antibodies to minor red-cell antigens that were not detected by a routine antibody assay before transfusion².
- Contamination of red cells: in the USA a contamination rate lower than 1 per 1 million red cells units has been reported. The organism most often implicated in bacterial contamination of red cells is yersinia enterocolitica².
- Transfusion-related acute lung injury: it is an acute respiratory distress syndrome (ARD) that occurs within 4 hours after transfusion and is characterized by dyspnoea and hypoxia due to non cardiogenic pulmonary oedema. The estimated frequency is about 1 in 5000 transfusions. The pathogenesis seems related to potent leucoagglutinating antibodies in the donor's plasma³.
- Transfusion mediated immunomodulation: immunosuppressive effect of allogeneic blood

related to exposure to leukocytes and subsequent sensitisation².

Autologous transfusion can take different forms⁴ :

- Pre-donation of red blood cells units for planned elective surgical procedures.
- The use of acute normovolemic dilution. This technique involves the removal of whole blood from the patients, immediately replaced by crystalloids or colloid solution, just before the operation.
- The salvage of shed blood, either intraoperatively or postoperatively by collecting the blood with special suction units or drains, to be then re-infused into the patient.

In emergency situations and under war constraints, the first 2 forms of auto transfusion cannot be applied, the patients presenting already anaemia and shock. Vice versa the last technique permits to recuperate important amounts of shed blood from operative fields or body cavities thus reducing significantly the need of allotransfusions. The authors describe

Keysaney Hospital experience in treating with this kind of auto-transfusion, patients with penetrating war chest injuries resulting in massive haemothorax.

Patients and Methods

A retrospective study of patients with penetrating chest war injuries managed by auto transfusion in Keysaney Hospital was undertaken. From 1992 to 2001, 45,900 war-wounded patients were admitted to Keysaney Hospital; among them 13,770 had chest injuries, 5322 of which were penetrating. Due to lack of heterologous blood in situations that demanded life saving blood transfusions a system was set up for immediate auto transfusion in 137 cases presenting with massive haemothorax reporting within a maximum of 1 hour after injury.

Immediately on arrival at the hospital, all the patients were clinically evaluated, a large bore IV line was inserted and crystalloids and colloids infusion was immediately started to stabilize the blood pressure. The haemoglobin, haematocrit and blood grouping tests were done. There was usually no time for x-rays. Anti-tetanus serum, tetanus toxoid and benzylpenicillin 5 Mega 6 hourly IV for 5 days were given. If no compatible allogeneic blood was available, a system was set up for collecting and re-infusing the

blood from pleural cavity.

Under local anesthesia and aseptic technique, a large bore Argyle thoracic drain (No. 36) was inserted and fixed in the 5th intercostal space, mid axillary line, on the affected side. The drain was connected to an under-water valve system (a 1 litre sterile glass bottle) and with a standard blood collection bag containing an anticoagulant (CPDA=citrate phosphate dextrose adenine). Once the container was full of blood, it was replaced by a similar. The full one was connected to a blood transfusion set (with a 200 micron filter) and the blood immediately re-infused

Once stabilized, and when necessary, the patient put under general anaesthesia for exploration and debridement of the entry and exit wounds. Pleural cavity communicating wounds were closed either by a direct suture of the muscular layer or through a muscular flap. The skin was left open, to be closed later when the wound became clean.

The patient was then nursed in a semi sitting position and encouraged to start chest physiotherapy from the first post-operative day. Due to chronic shortage of x-ray films, the lung expansion was assessed using clinical examination. Once blood drainage was less than 100 ml in 24 hours or when water seal drain age stopped bubbling air when the patient was asked to cough, the drain was clamped. After 24 hours a control chest x-ray was taken.

If no problem was noted, the drain was then removed. The patient was observed for a further 24 hours before discharged if clinically well.

Results

During the period 1992-2001, 137 patients presenting at Keysaney Hospital with massive haemothorax and whose life was threatened blood had their blood collected from the pleural cavity and immediately re-infused. There were 107 males and 30 females. Their ages ranged between 18 and 50 years with a mean of 26 years.

Table 1. Complications seen in 5322 patients with penetrating chest injury.

Complication	No of patients	Percentage
Significant bleeding requiring thoracotomy	90	1.7%
Pneumonia	102	1.9%
Empyema	164	3.1%
Septicaemia	60	1.1%

Table 1 shows the complications observed among the 5322 patients seen with penetrating chest injuries. Empyema and pneumonia were the commonest complications. There were 267 deaths (5.0% mortality rate).

The only complications observed among the auto-transfused patients were pneumonia (2 cases) and significant bleeding (2 cases). Five deaths occurred in the auto transfusion group, (3.6% mortality rate). No complications related to blood auto transfusion such as septicaemia, intravascular disseminated coagulopathy or kidney failure were observed.

Discussion

Auto transfusion is a life saving procedure. Three methods have been described to avoid allotransfusion⁴. They include:

- Pre-donation of red blood cells before elective surgery.
- The use of acute normovolemic dilution, immediately before elective surgery and
- The collection of shed blood either intra-

operatively or postoperatively.

The first two methods are not applicable in emergency situations and in anaemic, shocked patients. Intra-operative blood salvage involves the collection and re-infusion of autologous blood bled at the operative site. In developed countries, it is used during vascular, cardiac, and orthopaedic surgery. The blood is aspirated from the surgical wound using a double lumen suction line. Anticoagulant flows through one lumen and mixes with the blood suctioned into a collection reservoir. The collected, filtered blood can be re-infused directly or after centrifugation and washing with saline⁵. However, the equipments required are expensive and sophisticated and need specialized staff to use them. Postoperative blood salvage involves collection of blood from drains, usually after cardiac, vascular or orthopaedic surgery.

The practice of transfusing autologous blood collected from a chest drain is a safe and quick way of giving transfusions when life is threatened by blood loss. Delays for typing and cross matching are eliminated. Blood compatibility is guaranteed and risk

of exposure to pathogens like HIV or hepatitis virus eliminated. Being fresh blood, its oxygen-carrying capacity is also superior to that of stored blood. It's cheaper than collecting, processing and storing donors' blood.

Contraindications to auto transfusion include:

1. Coagulopathy (disseminated intravascular coagulation),
2. Lungs or pleural cavity infection,
3. Massive contamination of shed blood,
4. Renal failure and
5. Pleural cavity malignancy⁶.

Blood collected from pleural cavity is defibrinated by a combination of mechanical factors (contact with functioning heart and lungs) and biochemical interactions with serosal surfaces. With the fibrinogen removed, anticoagulation before re-infusion is not required. Clinical coagulation appears to be unaffected by re-infusion of unwashed blood drained from mediastinal cavity⁵. In our case, we used standard units already provided with anticoagulant (CPDA) for blood collection. The effects of re-infusion of unwashed blood appear to be minimal, most often febrile reactions⁵.

In developing countries simple methods of collecting blood from peritoneal cavity when operating a ruptured ectopic pregnancy or closed injuries of liver or spleen are well known and described⁷. Very few reports have been published on salvage and re-infusion of blood after penetrating chest wounds causing haemothorax^{6,8,9}, probably because this blood is considered contaminated. Our decision to manage with auto transfusion 137 patients presenting with penetrating chest war injury depended on two factors; the absence of any alternative (absolute need of blood and lack of heterologous blood) and a previous positive experience with this technique of an ICRC surgeon during the Lebanon war in the '80s.

During the Afghanistan war, the Russian military surgeons treated 1314 penetrating chest injuries and in some cases, being often short of blood or blood preparations, practised blood re-infusion. In case of haemothorax not older than 24 hours, the blood collected from the pleural cavity was examined for the criteria of haemolysis and contamination and, if acceptable, re-infused. In some instances they performed blood re-infusion as late as 72 hours after injury, without problems⁸.

Conclusions

- These preliminary reports suggest that collection and re-infusion of blood from

injury with haemothorax can be a relatively safe procedure.

- Due to the fact that the blood in the pleural cavity is defibrinated, some authors suggest that there is no need to add any anticoagulant to the blood container.
- Large spectrum antibiotic prophylaxis is strongly recommended as this kind of haemothorax is considered contaminated.

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