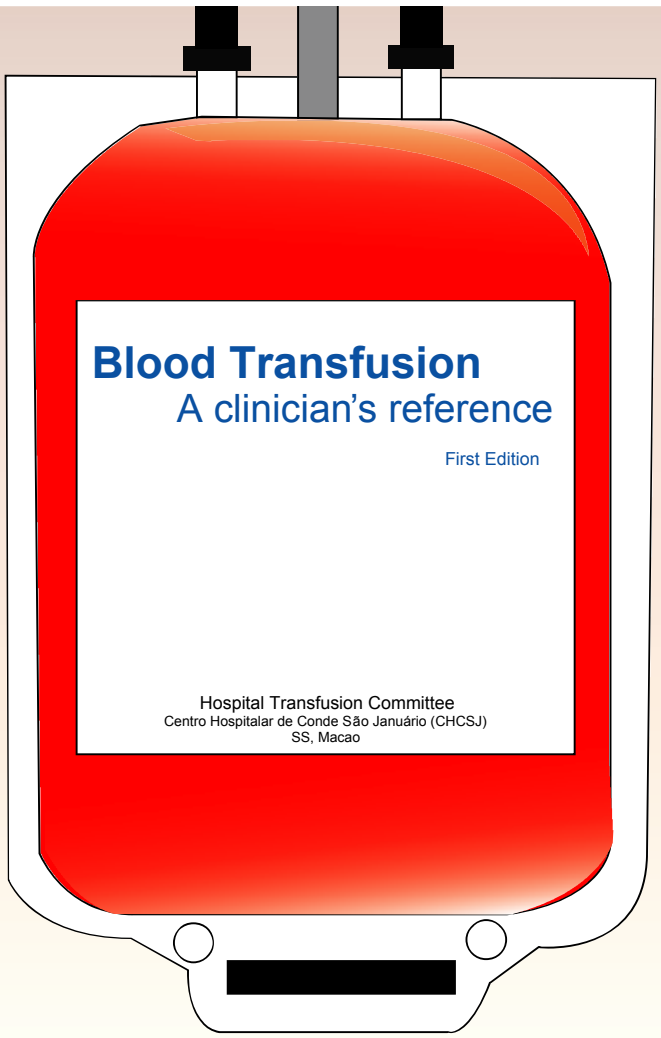


September 2005

Hospital Transfusion Committee
Centro Hospitalar de Conde São Januário (CHCSJ)
SS, Macao

BLOOD TRANSFUSION

A clinician's reference

Hospital Tranfsusion Committee
CHCSJ
Heath Bureau, Macau

Index

FOREWORD

The Hospital Transfusion Committee of Centro Hospitalar de Conde São Januário (CHCSJ) was formed in 2004 to promote the concept of safe transfusion. The chairman of the committee is the Director of CHCSJ. Other members of the committee come from various departments in the hospital and include members from the Macao Blood Transfusion Centre.

With the sole purpose in mind the Hospital Transfusion Committee has formulated and approved these Transfusion Guidelines as a reference to clinicians in the CHCSJ. This is the first edition. We envisioned that future editions will incorporate suggestions and recommendations from the users of the guidelines.

The committee would like to acknowledge the effort of Dr. David T Lopes and Dr. Hui Ping in formulating the guidelines since 1999.

Hospital Transfusion Committee , CHCSJ

July 2005

INTRODUCTION

Blood transfusion is an essential part of modern health care. Used correctly, it can save life and improve health. However, as with any therapeutic intervention, it may result in acute or delayed complications. In addition, it carries the risk of transmission of infectious agents, such as HIV, hepatitis viruses, syphilis, etc. It is also expensive and uses a scarce human resource.

The risks associated with transfusion can only be decreased by close collaboration between the blood transfusion service and clinicians in managing the components of the transfusion process for which they are each responsible:

1. an adequate supply of safe blood and blood products
2. the effective clinical use of blood and blood products

Considering the lack of transfusion medicine in the medical school and the rapid advance of this field since the last decade, we provide this booklet for serving as a convenient reference for issues relating to the clinical use of blood.

USEFUL CONTACTS

Hospital Blood Bank: 3903226, 3903219

Dr. David Lopes: 6807838

Blood Transfusion Centre: 752522

Dr. HUI Ping:

Office: 7914307

Emergency: 6892637

Laboratory Supervisor: Mr. Hoo Chai

Office: 752522/7914386

Hospital service Supervisor: Mr. Choi Sio Cheok

Office: 752522/7914361

ADMINISTRATION OF BLOOD AND BLOOD COMPONENTS

I. Request Form

Transfusion request form must be completely fulfilled and clinical details must be provided.

II. Filter

- All blood components must be administered through a transfusion standard filter (170-micron) to remove blood clots and other debris.
- Changing of blood filter every 4 hours.

III. Timing

All blood components which have been kept outside the blood bank should be transfused to the patient as soon as possible.

IV. Blood Warming

Never warm the blood and blood products outside the blood bank.

Warming blood only **restricted** to:

- Adult patients receiving rapid and multiple transfusions (rate >2000ml/hour).
- Children receiving large volumes (>15ml/kg/hour).
- Exchange transfusions in infants.
- Rapid infusion through central venous catheters.

V. Concomitant Use of Intravenous Solutions

Only normal saline (0.9 % saline) may be administered with blood components.

VI. Monitors during and after transfusion

In first 5 minutes of beginning transfusion and every 30 minutes during transfusion, CHECK:

- Blood pressure
- Pulse
- Temperature

Suspect the major acute transfusion reactions, when:

- A sudden rise in temperature > 1^0C
- Shortness of breath/chest pain
- Back pain/loin tenderness
- Profound hypotension

VII. Ordering and issuing

Red Cells/Whole Blood

- Routine transfusions should be requested at least 24 hours in advance during the working hours.
- ±60 mins must be allowed for the grouping and crossmatch testing for emergency order.
- Uncross-matched blood – can only be issued in an emergency. The blood bank staff will only release uncross-matched blood after he/she has received a request from a medical doctor, who has agreed to take responsibility for any ensuing complications.

Fresh Frozen Plasma (FFP)

- ± 45 mins should be allowed for the product to thaw before issuing.
- No cross-matched test needed, but an EDTA sample for blood grouping should be sent if the blood group is unknown.
- ABO compatible FFP should be used.
- The thawed FFP cannot be refrozen.
- The thawed FFP infusion should be used without delay within 2 hours to avoid loss of potency of coagulation factors.

Platelets

- Are only available after discussion with a Hematologist.
- Patient's blood group should be known before the product can be issued and the same ABO group as the patient should be used as far as possible.
- Should be transfused as soon as possible after reaching the ward.

Cryoprecipitate

- ±45 mins should be allowed for the product to thaw.
- Is available only after discussion with a hematologist.
- No cross-matched test needed, but an EDTA sample for blood group should be sent if the blood group is unknown.
- ABO-compatible cryoprecipitate is not required.

INFORMED CONSENT

I. POLICY

CHCSJ requires documentation that patients who receive non-emergent transfusions be informed of the procedures, alternatives, risks and benefits of blood and blood products. The patients must be given an opportunity to ask questions and it must be documented that they agree to receive the blood and blood products.

II. CURRENT RISKS, BENEFITS AND ALTERNATIVES TO TRANSFUSION

The CTS has created a patient information sheet 'What you should know about blood transfusion' to aid in the discussion of the risks, benefits and alternatives to transfusion.

III. MEDICAL EMERGENCIES AND TRANSFUSION INFORMED CONSENT

- Signed consent not absolutely required for emergency transfusion.
- Document emergent nature of problem and efforts to obtain consent in progress notes.

IV. PARTIES RESPONSIBLE FOR OBTAINING TRANSFUSION INFORMED CONSENT

- Ordering physician responsible for obtaining consent.
- Responsibility can be delegated, but the person obtaining the consent must be knowledgeable in the risks, benefits and alternatives to transfusion and must be conversant with clinical indications for transfusion and clinical consequences of refusal of permission to transfuse.

V. DURATION OF VALIDITY FOR INFORMED CONSENT

- Informed consent is valid for an entire named course of treatment.
- May span multiple admissions.
- Surgical patients typically consented once per admission.
- Consents should be renewed when there is a significant change in risk associated with the treatment.

VI. REFUSAL OF BLOOD TRANSFUSION

- We honor wishes of patients who refuse transfusion.
- Refusal Transfusion Consent should be obtained and must be documented in medical record.

GUIDELINES OF THE BLOOD COMPONENT TRANSFUSION

The following guidelines have been generally accepted by the well-recognized specialists in the world.

I. RED BLOOD CELLS

General guidelines

- Hb and Hematocrit:

  There is no an absolute acceptable level for all patients exists. But the concept of, transfusion is only indicated when Hb <7 g/dl, has been general accepted in most of the countries in the world.

- Clinical data:

  Clinical data like age, function of the end organs, sepsis, causes of anemia etc, should be evaluated first at all.

- Acute blood loss:

  Blood transfusion is indicated when adequate fluid resuscitation has failed to:

  a) correct intravascular volume depletion
  b) relieve symptoms
  c) stabilize vital signs

- Chronic blood loss:

  Blood transfusion is only indicated to relieve symptoms when appropriate medical measures to improve red cell mass have been inadequate.

- Patient under anesthesia:

  Blood transfusion should be based upon stability of vital signs.

Indications

- Acute blood loss (> 1000ml within few hours) ± symptoms of hypovolemic shock
- Per ioperative with intra-operative blood loss > 750ml
- Perioperative with Hb < 8g / dl
- Iron deficiency and megaloblastic anemia:

  Never transfuse, unless:

  a Fail to response to pharmacologic therapy like Iron, B12 or Folate
  b Severe decompensate symptoms, like tachycardia, dyspnea, severe dizziness, etc.
  c Hb < 5g /dl

Volume: 250ml / unit

Important to remember

- The only true indication for the blood transfusion is the need to improve the delivery of O_2 to the tissues within a short time.
- Patients with anaemia of undiagnosed cause should not be transfused until appropriate investigations have been performed.
- Routine or programmed transfusions should be requested at least 24 hours in advance during the working hours.

II. WHOLE BLOOD

Whole blood is the complete collection of a single donation of blood, which **contains**

1. red cells
2. antigenic granulocytes
3. platelets without function
4. all the plasma proteins, but as a result of storage there is loss of activity by the coagulant factors V and VIII:C and by complement.

Volume: 350ml/unit

Indication:

Autologous transfusion only.

III. PLATELET

Preparation of platelets

1. Platelets concentrates:
   Prepared from individual units of whole blood by centrifugation.
   Each bag **volume** ≈ 50-60 ml, platelet count: 5.5×10^{10}
   An adult therapeutic dose = 4 single bags
2. Apheresis platelets:
   Collected from an individual donor during 2-3 hours apheresis procedure.
   Volume: 200-300ml/unit
   Platelet count: 3×10^{11}

Shelf life and Storage

5 days' shelf life, at 22 $\pm2^0$C, under constant and gentle agitation in a special incubator.

Indications

The decision to transfuse platelets should not be based on low platelet count alone.

1. DIC with active bleeding (platetlet count < 20,000/ul) .
2. Severe thrombocytopenia (<10,000/ul) following chemotherapy.
3. Active bleeding with severe thrombocytopenia (platetlet count < 10,000/ul).
4. Thrombocytopenia, with scheduled invasive procedure.
5. Thrombocytopathy, bleeding time > 2 × normal with bleeding or scheduled invasive procedure.

Platelets should not be transfused

1. Immune thrombocytopenia.
2. Prophylactically in most patients with aplastic anemia.
3. Thrombotic thrombocytopenic purpura/Hemolytic uraemic syndrome or eclampsia.

IV FRESH FROZEN PLASMA

Containing all clotting factors, but factor V and VIII is minimal.

Volume of each unit: 200 ml

Dose

Generally accepted starting dose: 2 units (10ml/Kg for coagulation factor replacement)

Indications

1. Definite indications:
   - Replacement of single coagulation factor deficiencies, where a specific or combined factor concentrate is unavailable.
   - Immediate reversal of Warfarin
   - DIC- acute disseminated intravascular coagulation
   - Thrombotic thrombocytopenic purpura / Hemolytic ureamic syndrome
2. Conditional use:

   Only indicated in the presence of bleeding and disturbed coagulation:
   - Massive transfusion
   - Liver disease
   - Cardiopulmonary bypass surgery

FFP should not be transfused

- For volume expansion
- A nutritional supplement
- Prophylactically with massive blood transfusion
- Prophylactically following cardiopulmonary

V. CRYOPRECIPITATE

Contains

- Factor VIII : 80-100iu/unit
- Fibrinogen :150-300 mg/unit
- Factor XIII
- Fibronectin

Volume of each unit: 10 ml

Dose: 10 individual units is a standard adult dose.

Indications

- DIC with active bleeding or before invasive procedure and APTT > 1.5× normal
- Hypofibrinogenemia (<100mg/dl) or dysfibrinogenemia with active bleeding or before scheduled invasive procedure.
- Uremic thrombocytopathy unresponsive to DDAVP, with active bleeding or before scheduled invasive procedure.
- Von-willebrand's disease unresponsive to DDAVP with active bleeding or before scheduled invasive procedure.
- Factor XIII deficiency
- As fibrin glue

TRANSFUSION PRACTICE

I. MASSIVE BLOOD TRANSFUSION

Definition

Massive transfusion is defined as the replacement of one or more blood volumes within 24 hours (≈ 4500ml in 60-kg adult).

Management

- Minimum laboratory investigation in patients with acute hypovolaemic shock:
  - Pre-transfusion testing (10ml clotted blood): - ABO, Rh grouping
    - Crossmatch testing
  - Hematology (2ml in EDTA): Full blood count.
  - Coagulation (5ml in citrate): PT, APTT, Fibrinogen
  - Biochemistry: baseline urea and electrolyte concentration
- Priorities in massive transfusion:
  1) Replace and maintain blood volume
     Initially, crystalloid or colloid solutions may give for restoring the blood volume. Whole blood (first 4 units) should be followed while the compatible or suitable blood has been prepared by the blood bank.
  2) Maintain haemostasis
     Stored citrate blood:
     - clotting factors, mainly factor V and VIII loss activity
     - platelets in stored blood have no function at all after 48 hours storage.

     When:
     - platelet counts < 50×10^9/l, transfuse platelet
     - either PT or aPTT are prolonged to > 1.8 × the control value, fresh frozen plasma should be given (at least 4 units)
     - fibrinogen < 100mg/dl, cryoprecipitate is indicated.
     - Further, should be monitor by clinical response and laboratory test.
  3) Optimise oxygen carrying capacity
     - Maintain packed cell volume > 0.20 (≈ 6.0 g/dl)

- The 2, 3-DPG level in stored blood cells reduced significantly for up to 14 days after collection. It might be important for patients with pre-existing cardiac disease or severe anaemia to have blood that is less than 14 days old.

4) Correct or avoid metabolic disturbances

The stored blood is :

- Hypocalcemia
- Hyperkalemia
- Acidosis
- Hypothermia

- Hypocalcaemia and hyperkalemia combinate with hypothermia cause by rapid transfusion of blood stored at 4 ^{0}C, can cause cardiac irregularities – ECG monitoring is advisable.
- Prophylactically calcium supplement is not recommended.
- The correction of acidosis by alkalising agent should be provided only by the results of laboratory tests and not by the number of units of blood transfused.
- Warming blood by blood warmers.

5) Maintain plasma colloid osmotic pressure

Large volume of crystalloids and red cell preparation devoid of plasma for replacement of blood loss will lead to a fall in plasma colloid osmotic pressure.

II. OBSTETRIC HAEMORRHAGE

Obstetric haemorrhage caused 12 out of the 134 direct maternal deaths in the UK annually. The blood flow to the placenta is 70 ml/min at term, so bleeding is likely to be rapid. It is often unexpected and difficult to control. Disseminated intravascular coagulation is common in obstetric haemorrhage due to placental abruption, amniotic fluid embolism and intrauterine death.

Haemorrhage due to obstetric DIC is usually relieved only by treating the underlying disorder, which usually involves rapid delivery. Supportive treatment with platelets, FFP and cryoprecipitate may be required and should be guided by laboratory tests. Bleeding into the uterine cavity, the uterine wall or the abdomen may conceal the extent of the blood loss. As a result, the patient may decompensate suddenly in the post-delivery period.

The following management protocol is for reference:

Transfusion in obstetric haemorrhage

- Insert at least two large cannulas. Start saline infusion. Apply compression cuff to infusion pack. Monitor central venous pressure (CVP) and arterial pressure. Take samples for transfusion and coagulation screen. Order at least 6 units of red cells. Do not insist on crossmatched blood if transfusion is urgently needed.
- Warm the resuscitation fluids.
- Transfuse red cells as soon as possible. Until then:
  - crystalloid, maximum of 2 litres
  - colloid, maximum of 1.5 litres
- Restore normovolaemia as priority, monitor red cell replacement with haematocrit or Hb.
- Use coagulation screens to guide and monitor use of blood components.
- If massive bleeding continues, give FFP 1 litre, cryoprecipitate 10 units while awaiting coagulation results.
- Monitor pulse rate, blood pressure, CVP, blood gases, acid-base status and urinary output (catheterised).

III. NEONATAL TRANSFUSION

A RED CELL

1. Characteristics of newborn infants

- Small size
- Physiologic anemia
- Iatrogenic blood loss
- O_2 affinity of fetal hemoglobin
- Immature immune system
- Presence of maternal alloantibodies
- Variations in blood volume with age
- Shortened red cell survival
- Decreased erythropoiesis
- Cardiovascular adaptive capacity

2. Indications for red cell transfusion to neonates and premature infants

- Shock associated with acute blood loss.
- Hb<13g/dl, Hct < 40% and pulmonary failure, cyanotic heart disease, or congestive heart failure.
- Cumulative loss of 10% or more of the blood volume ≤ 72h if additional sampling is required.
- Hb< 8g/dl or Hct < 25% in a stable neonate with clinical manifestations of anemia, namely tachycardia, tachypnea, and poor feeding.

3. Pre Transfusion Testing

- ABO and Rh group of both mother and neonate
- DAT (Directed agglutinative test) of neonate
- Maternal blood for cross-match testing

4. Dose

Transfuse 3ml/kg packed red cell raise hemoglobin by 1g/dl.

B NON-RED CELL COMPONENT

Platelet:

- DIC secondary to severe sepsis
- Dose: 5-10 ml / kg raise platelet count 75 to 100×10^9/l

Plasma and cryoprecipitates

FFP and Cryoprecipitate may be required in DIC and consumptive states (see section IV and V), and therapy should be guided by the results of laboratory coagulation tests.

C MAIN TRANSFUSION SIDE EFFECTS IN NEONATE

- Hypocalcaemia
- Citrate toxicity
- Rebound hypoglycemia
- Virus infection
- Transfusional overload
- Hemolytic transfusion reactions in necrotising enterocolitis

D Component volumes to be transfused to children and neonates.

1. Red cell concentrates

A. Exchange transfusion

Volume: For a term infant: 80-160 ml/kg

For a preterm infant: 100-200 ml/kg

B. Top-up transfusion

Desired Hb (g/dl) – actual Hb × weight (kg) × 3 (usually 10-20 ml/kg)

2. Platelet concentrates

Children weighing <15 kg: 10-20 ml/kg

Children weighing >15 kg: standard dose

3. Fresh frozen plasma: 10-20 ml/kg

4. Cryoprecipitate: 5 ml/kg or 15-30 kg = 5 units, >30 kg = 10 units

E Suggested transfusion thresholds for infants under 4 months of age

1. Transfusion of red blood cells

Anaemia in the first 24 h	Hb 12 g/dl (Hct: 0.36)
Cumulative blood loss in 1 week, neonate requiring intensive care	10% blood volume
Neonate receiving intensive care	Hb 12 g/dl
Acute blood loss	10% blood volume
Chronic oxygen dependency	Hb 11 g/dl
Late anaemia, stable patient	Hb 7 g/dl

2. Transfusion of platelets

Preterm or term neonate, with bleeding	50×10^9/l
Sick preterm or term infant, not bleeding	30×10^9/l
Stable preterm or term infant, not bleeding	20×10^9/l

SPECIAL REQIREMENTS

I. LEUKODEPLETED BLOOD

Cellular blood components that contain less than $5x10^6$ leukocytes (white blood cells) are considered leukocyte depleted. The leukocyte content of blood components can be reduced to less than $5x10^6$ by filtration. Cryoprecipitate and fresh frozen plasma do not contain intact or viable leukocytes making leukodepletion unnecessary.

Indications

Leukodepleted blood and components are indicated:

- for patients who have experienced two or more non-hemolytic febrile transfusion reactions
- as a method of preventing transfusion transmitted CMV
- as a method of preventing platelet alloimmunization in certain patients

The purpose of transfusing leukocyte-depleted blood products is to:

- Reduce HLA alloimmunization to leukocytes in multiply-transfused patients
- Reduce the risk of cytomegalovirus transmission
- Decrease febrile transfusion reactions
- Other theoretical benefits remain speculative at this time

II. IRRADIATED BLOOD COMPONENTS

Irradiated blood products are exposed to approximately 2500 rads of Gamma radiation to destroy the lymphocyte ’s ability to divide. Transfusion-associated graft-versus-host disease (TA-GVHD) has not been reported from transfusion of cryoprecipitate or fresh frozen plasma (FFP), thus these components do not require irradiation. Fresh plasma (never frozen) for transfusion should be irradiated if the patient is at risk for TA-GVHD.

Indications

Absolute Indication:

- bone marrow transplant (BMT) recipients (allogeneic, autologous)
- BMT or stem cell donors if allogeneic transfusion must be given prior to completing the harvest

- Cellular (T-cell) Immune Deficiency (congenital or acquired)
- intrauterine transfusion
- transfusions from family members (any degree)
- directed donors (when not identified as family members versus friends)
- HLA-matched platelet transfusions

Appropriate Indication:

- hematologic malignancies (leukemias)
- Hodgkin's Disease
- non-Hodgkin's Lymphoma
- neonatal exchange transfusion
- premature infants
- certain solid tumors (neuroblastoma, glioblastoma)

Therapeutic Effect

Irradiation destroys the ability of transfused lymphocytes to respond to host foreign antigens thereby preventing graft vs. host disease in susceptible recipients. Patients with functional immune systems will destroy foreign lymphocytes, making irradiation of blood and blood components unnecessary.

III. AUTOLOGOUS DONATION

Preoperative autologous blood donation

Some patients can donate their own blood - up to 4 units in advance of their own planned operation. It can be stored for up to 5 weeks using standard hospital blood bank conditions. It must be tested, processed, labelled and stored to the same standard as donor blood. Before re-transfusion, autologous blood units must be ABO and Rh D grouped and compatibility checked.

- Preoperative donations are made at CTS two to five weeks before operation.
- Service available on prescription basis.
- Autologous donation does not guarantee patient will not need additional banked blood.
- Autologous donation can make donor anemic and can increase chance of getting banked blood.
- Autologous blood is subject to same risks of clerical error and bacterial contamination that affect banked blood.
- Donation must be scheduled at CTS. Contact the physicians at CTS at 7914337 or 752522.
- Appropriate forms is available from the physicians in CTS or print from the homepage of CTS http://www.ssm.gov.mo/cts/.

Patients suitable to predonate their own blood for surgery

- Operation scheduled is likely to need red cell transfusion.
- Date for surgery fixed, so the blood does not become outdated.
- Patient able to attend to have blood collected.
- Patient"s initial haemoglobin >100g/l (female) >110g/l (male).
- Sufficient time before surgery to donate at least 2 units of blood.
- Iron replacement is required during autologous donations.

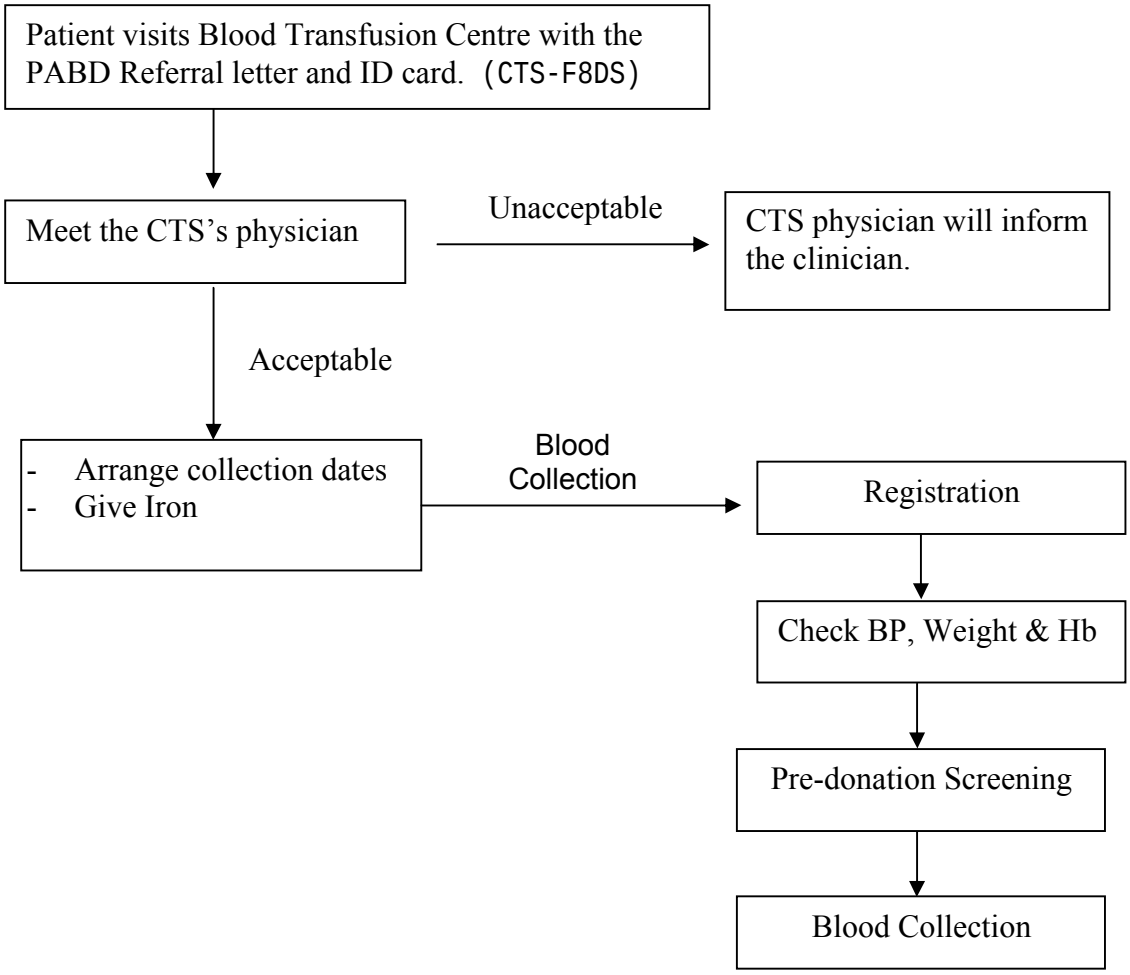
Procedure should be restricted to:

- Patients aged under 70 years
- Operations with a high blood loss

Not currently recommended in

Cardiac surgery patients (risk of thrombosis has not been excluded totally).

Flowchart for applying PABD



STANDARD SURGICAL BLOOD ORDER SCHEDULE (SSBOS)

Purpose

When using the SSBOS, the Hospital Blood Bank will initially provide no more than the designated amount of Red Blood Cells, although orders for fewer units will be followed. If transfusion is not anticipated but may still occur, the maximum order is a "type and screen."

Specimens should be submitted at least one day before surgery. Specimens for pre-transfusion testing can be collected up to 21 days prior to surgery when the patient has not been pregnant or transfused in the past 3 months, otherwise the specimen can be collected no more than 3 days before scheduled surgery.

Procedure

Adhere to the following guidelines:

T&C = Type and Cross.

T&S = Group/Type and antibody Screen.

NBR = No blood Required

NOTE: All the above orders and specimens are maintained in hospital blood bank for 7 days.

STANDARD BLOOD ORDERING SCHEDULES

GENERAL AND VASCULAR SURGERY

Amputation of limb A/K B/K	 2 units T&S
Aneurysm, abdominal Aortic Repair - elective Repair - emergent	 4 units 6 units
Appendectomy	No blood Required
Angiography	T&S
Angioplasty	T&S
Breast	NBR
Augmentation/Reduction Biopsy	NBR NBR
Mastectomy, simple or modified	NBR
Mastectomy, radical	T&S
Reconstruction	T&S
TRAM	2 units
Bile Duct Exploration	T&S
Bypass, vascular	
Aorto-iliac, aorto-femoral, aorto-renal, axillary-femoral	2 units
Carotid, Femoral-popliteal, Femoral-Femoral, iliac-femoral, iliac-popliteal	T&S
Carotid endarterectomy	T&S
Cholecystectomy, +/- CBDE	T&S
Colectomy	

Hematoma Evacuation	T&S
Hemorrhoidectomy	No blood Required
Hepatectomy	6 units
Hernia repair,	
Ventral Other types	T&S NBR
Hodgkin's or Lymphoma staging	T&S
Laparotomy, exploratory	T&S
Liver biopsy	T&S
Lymph node dissection	T&S
Pancreatectomy, partial or radical	3 units
Parathyroidectomy	NBR
Parotidectomy	NBR
Porto/mesocaval, splenorenal shunt (portal hypertension)	6 units
Pilonidal cyst or sinus resection	NBR
Rectal Fistula	NBR
Skin Graft, split thickness	T&S
Splenectomy	2 units

Subtotal	T&S
Total or abdominal-perineal (AP)	2 units
Colostomy, revision or closure	T&S
Embolectomy	T&S
Esophagectomy	3 units
Gastrectomy, subtotal or total, with or without vagotomy	2 units
Gastroplasty, Mason (Gomez)	T&S
Gastrostomy	T&S
Hemangioma Resection	T&S

Sympathectomy	T&S
Thyroidectomy	NBR
Tracheostomy	T&S
Tumor resection, other	T&S
Ulcer repair, perforated gastric	T&S
Vagotomy and pyloroplasty	T&S
Varicose vein stripping	NBR
Vascular Access Procedures	T&S
Wide excision, +/- skin graft	T&S

CARDIAC AND THORACIC SURGERY

Aneurysm, thoracic, resection	4 units
Angioplasty, coronary	T&S
Atrial septal defect repair	2 units
Arterial switch operation	4 units
Coarctation of aorta repair, Adult	3 units
Coronary bypass graft (CABG)	3 units
CABG Redo	3 units
Esophagectomy	3 units
Fontan Procedure	4 units
Hernia repair, all types, including primary & recurrent hiatal	T&S

Lobectomy /pulmonary resection	2 units
Lung Biopsy	T&S
Pericardectomy /pericardiotomy	2 units
Pneumonectomy	2 units
Tracheal reconstruction	4 units
Valve replacement	3 units
Ventricular septal defect repair	2 units
Wolf-Parkinson White Procedure	3 units
Yag Laser Bronchoscopy	2 units

PLASTIC SURGERY

Orthognathic procedure with major osteotomy	T&S	Otoplasty	NBR
Cleft palate repair	NBR	Rhinoplasty	NBR
Craniofacial procedure with intracranial component	2 units	Skin flap	T&S
Decubitus ulcer debridement/closure	T&S	Wide Excisions, +/- skin graft	T&S
Mammoplasty Augmentation Reconstruction Reduction	NBR		

NEUROSURGERY

Aneurysm, cranial	2 units	Laminectomy, lumbar, for disk	NBR
Anterior cervical diskectomy, +/- fusion	T&S	Laminectomy, cervical, thoracic or lumbar, for decompression	NBR
Carotid endarterectomy	T&S	Laminectomy, cervical, thoracic or lumbar, for tumor	2 units
Burr holes	2 units	Lumbar or cervical fusion, posterior	2 units
Carpal tunnel release	NBR	Lumbar peritoneal shunt	NBR
Cordotomy	T&S	Child	T&S
Craniectomy for synostosis (child)	2 units	Meningomyelocele repair	T&S
Craniotomy		Peripheral nerve exploration	T&S
For AV malformation	4 units	Stereotactic brain biopsy	NBR
For STA MCA or PICA bypass	T&S	Syringoperitoneal shunt	T&S
For intracranial hematoma	2 units	Child	T&S
For tumor	T&S	Subdural implants	T&S
Hypophysectomy	T&S	Tarsal tunnel release	NBR

Lobectomy, Temporal or Cranial	T&S
Head Trauma	2 units
Cranioplasty	No blood Required

Ulnar nerve transposition	NBR
Ventriculoatrial shunt	NBR
Ventriculoperitoneal shunt	NBR

OTORHINOLARYNGOLOGY

Acoustic tumor resection	T&S
An Angiogiofibroma, resection	2 units
Brachial cleft cyst, resection	NBR
Caldwell-Luc procedure	NBR
Carotid body tumor resection	2 units
Craniofascial resection	T&S
Cleft palate repair	NBR
Epistaxis	T&S
Ethmoidectomy	NBR
Glomus jugular tumor excision	2 units
Laryngectomy Simple	T&S
Laryngectomy with radical neck	T&S
Mandibulectomy, hemi or total	2 units

Ma Masttoidectomy, partial or total	NBR
Maxillectomy	2 units
Neurovascular reconstruction	T&S
Orb Orbital exploration	T&S
Par Parotidectomy	T&S
Pharyngeal flap	T&S
Radical neck dissection	T&S
Retrolabyrinthine vestibular nerve resection	T&S
Rhinoplasty	NBR
Temporal bone resection	T&S
Tonsillectomy-adenoidectomy Post or with Bleeding	NBR 2 units
Tracheostomy	NBR

ORTHOPEDIC SURGERY

Amputation	
Hemipelvectomy	4 units
Hip Disarticulation	3 units
BK (below Knee)	T&S
AK (above knee)	2 units

Fracture	
Acetabulum ORIF	2 units
Closed, any	NBR
Hip, ORIF	2 units
Hip, Hemiarthroplasty	2 units

BE (forearm)	T&S
AE (above elbow	T&S
Revision, any	T&S
Arthroplasty	
Hip, 1st operation	2 units
Hip, 2nd operation	4 units
Knee	2 units
Shoulder	2 units
Arthrotomy	
Hip	2 units
Other (Elbow, shoulder, Knee, etc	NBR
Arthroscopy	NBR
Biopsy, femur, pelvis, humerus, or hip	T&S
Bone graft	
Pelvis, femur	T&S
Radius, Fibula, Tibia	NBR

Humerus, ORIF	2 units
Radius, Ulna, Wrist	NBR
Tibia, ORIF	T&S
Fusion	
Spine 1 or 2 levels	2 units
Spine 3 or more levels	4 units
Spine Anterior and Post	4 units
Shoulder	2 units
Hip	3 units
Other	NBR
Hand surgery	NBR
Laminectomy, any	T&S
Meniscectomy	NBR
Pin Removal	T&S
Total Hip	2 units

UROLOGY

Adrenalectomy	3 units
Cystectomy Partial Radical	 T&S 4 units
Cystolithotomy	NBR
Cystoscopy	NBR
Ileal loop	T&S
Fistual repair, ves.-vag or uret.-vag.	T&S
Kidney biopsy, open	T&S
Lymph node dissection	T&S

ProProstatectomy	
Transurethral	T&S
Suprapubic	2 units
Perineal	2 units
Radical	4 units
Renal artery repair	3 units
Retroperitoneal lymph node dissection	2 units
Renal transplant	T&S

Meatotomy	NBR
Nephrectomy, Simple	T&S
Nephrectomy, Radical	4 units
Orchiectomy	T&S
Penile implant	T&S

TUR (Bladder Tumor)	T&S
Ureterostomy	T&S
Urethral excision, implantation	T&C
Urethral procedure, other	NBR
Vesicopexy (ALL)	T&S

OBSTETRICS-GYNECOLOGY

Abortion, spontaneous, or termination during first or second trimester	NBR
Cervical conization	NBR
Cesarean section	
Uncomplicated	T&S
Known/suspected placenta previa	2 units
Placenta percreta/accreta 3	units
After trial of forceps	T&S
With Hysterectomy	3 units
Cesium implant	NBR
Cystocele/Rectocele repair	T&S
Deliveries, multiple (vaginal or abdominal)	T&S
Delivery accompanied by marked anemia (Hb <10 gms) or shock	2 units
Ectopic pregnancy	2 units
Examination under anesthesia (EUA) for known/suspected placenta previa	2 units
High risk labor	T&S

Hysterectomy Any, except radical Radical	T&S 2 units
Laparoscopy	T&S
Lymphadenectomy, Pelvic	T&S
Oophorectomy or ovarian wedge resection	NBR
Pelvic mass resection	2 units
Placenta previa under observation	T&S
Tubal ligation	NBR
Tuboplasty	NBR
Vaginectomy	T&S
Vulvectomy, total or radical	2 units

TRANSFUSION REACTION

I. ACUTE HEMOLYTIC TRANSFUSION REACTION

Cause: ABO-incompatible transfusion

Incidence: 1 in 25000 transfusions in the developed countries.

Signs/symptoms

- Fever, chills and general uneasiness
- Back pain, hemoglobinuria
- Dyspnea, hypotension, shock
- Uncontrollable bleeding, hemoglobinemia and anemia

Management

- Stop transfusion
- Keep iv patent with normal saline (0.9% N.S) 1000ml/hour Give Frusemid (250mg by infusion over 4 hours)
- Dopamine, (infused at 3-5ug/kg/min)
  The aim of all above is to achieve a urinary output of 0.5-1ml/kg/hour
- Check blood bag, label and patient identification
- Notify blood bank staff or hematologist
- Send back the transfused blood bag
- Take new blood samples of EDTA, clotted, citrate and urine from the patient to blood bank

II. FEBRILE REACTION

Cause

1. Leucocyte antibodies in patients directed against donors leucocyte.
2. HLA antibody

Incidence: 0.5-1 in 100 transfusions

Signs/symptoms

The patient fell flushing in 5 minutes after beginning of the transfusion. Fell better soon and has severe rigor and high temperature 60 minutes after the start of transfusion (usually at the beginning of the second bag of the transfusion).

Treatment

Antipyretic medication like Paracetamol, etc.

III. ALLERGIC REACTION

Cause

1. Allergy to transfused plasma protein?
2. Effect of cytokine?

Incidence: 1-2 in 100 transfusions

Signs: localized urticaria, erythema, and itching

Treatment:

Stop transfusion → antihistamine (Hydroxyzine, etc.) p.o or im → restart the transfusion after symptoms have subsided (generally 15 – 30 minutes).

IV. BACTCTERIAL CONTAIMINATION

Mediators

Endotoxins produced by gram-negative bacteria

Signs/symptoms

Severe rigors, cardiovascular collapse, fever > 40 ^{0}C

Management

intravenous antibiotic; treat hypotension and DIC

V. DELAYED HEMOLYTIC TRANSFUSION REACTION (DHTR)

Cause

Incompatible red cells are transfused and red cell alloantibody, usually, other than anti-A and anti-B present in patient's serum, like anti-D, anti-c, anti-Jka, anti K, etc.

Incidence: 1 in 1500 transfusions

Signs/symptoms

- 4 –7 days post-transfusion
- the patient with history of pregnancy or transfusion
- fever
- a fall of Hb or no reasonable rise of Hb after transfusion
- jaundice and hemoglobinuria
- progressive renal failure

Laboratory

- Spherocytosis in peripheral blood film
- DAT positive
- Antibody screening test positive

Management

- Daily urine output and renal function monitor
- Sent clotted blood sample to CTS for antibody identify
- Subsequent blood products transfused should be antigen negative for the patient 's corresponding antibody

VI. TRALI (TRANSFUSION-RELATED ACUTE LUNG INJURY)

This is a severe , potentially fatal, transfusion reaction.

Cause: a leucocyte antibody in the donor 's plasma specifically attack the recipient 's lung tissues to produce inflammation.

Incidence: 1 in 5000 transfusion in western countries.

Signs/symptoms: 1 – 6 hours post-transfusion:

- Chill and fever
- Non-productive cough, dyspnea
- Hypotension and marked hypoxaemia

Radiography

Characteristically perihilar and bilateral lower zone infiltration.

Differential diagnosis

1. Fluid overload
2. Cardiogenic pulmonary edema

Management

- Ensure enough fluid to avoid dehydration
- Oxygen therapy and respiratory support
- High-dose corticosteroids

VII. PTT (POST-TRANSFUSION THROMBOCYTOPENIA)

Cause

Specific platelet antibodies in donor immune destruction of both patient's and donor's platelets.

Signs/symptoms

5-12 days post-transfusion: sudden onset of severe thrombocytopenia.

Management: high dose intravenous immunoglobulin, 1-2g/kg for 3-5 consecutive days.

VII. TR-GVHD (TRANSFUSION-RELATED GRAFT VS HOST DISEASE)

Cause

Donor's lymphoctes attack and destroy the recipient's organs and tissues, such as liver, bone marrow and gastrointestinal tract.

Incidence: 1 in 600 transfusions in Japan, rare in the other countries

Signs/symptoms

1-2 weeks post blood transfusion: - fever and diffuse erythematous rash
- diarrhea, bloody stool and liver dysfunction
- pancytopenia and marrow aplasia
- die

Mortality: very high

Management

- avoidance of 'fresh blood' transfusion
- avoidance of the transfusion from members of family
- gamma irradiation the blood cellular components
- chloroquine?
- Anti-CD3?

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