Massive Obstetric Hemorrhage
The Team Approach

RECC - Update in Obstetric Anesthesia
Wednesday June 15, 2011
Declarations

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  – GPA, Northern Health Authority

• No disclosures or conflicts
Massive Obstetric Hemorrhage

Goals

• Definitions
• Etiology, Epidemiology and Risk factors of OB Hemorrhage
• Team approach to Massive Hemorrhage
  – Prevention
  – Medical / Surgical / Interventional
  – Point of Care / Rapid Turnover Testing
• Massive Transfusion Protocols
Definitions

- Obstetric / Antepartum Hemorrhage
- Post Partum Hemorrhage (PPH)
  - > 500 mL of blood loss following vaginal delivery
  - > 1000 mL of blood loss following Caesarean delivery


- Massive Transfusion
  - replacement of one blood volume (equivalent to 10 units of blood) in any 24-hour period
  - half of the blood volume (five units of blood) in any 4-hour period

American Association of Blood Banks (AABB)
Antepartum Hemorrhage

- Incidence 2 – 5% of all pregnancies > 24 weeks
  - Unknown origin (~ 50%)
  - Placental Abruption
  - Placenta Previa
  - Abnormal Placentation (Morbidly adherent)
  - Uterine Rupture

BJA 2009; 103(suppl): i47–i56
Placental Abruption

- Separation of the placental bed prior to delivery of fetus
- Vaginal blood loss, uterine tenderness, increased uterine activity
- Coagulopathy in 10%
- Coagulopathy increases to 50% when associated fetal demise

Anesthesiology Clin 2008;26:53-66
Placenta Previa

- Placenta implants in advance of the fetal presenting part
- Painless vaginal bleeding, fetal compromise
- Occurs in 0.5% of pregnancies
- Usually associated with a previous uterine scar

Anesthesiology Clin 2008;26:53-66
Amniotic Fluid Embolus

- Incidence 1:10,000 pregnancies
- Rapid and severe coagulopathy
- Coagulopathy worsened with fetal demise
Abnormal Placentation

- **Accreta**
  - abnormally adherent without myometrial invasion
- **Increta**
  - invades myometrium
- **Percreta**
  - invades uterine muscle and serosa or adjacent structures (bladder)

Can J Anaesth 1987;34:613–7
Abnormal Placentation

- Incidence increasing with increasing C/S rates

- ≥ 1 Risk Factor is present in 94% of cases
  - Placenta Previa
  - Previous Cesarean Section(s)
  - Previous Uterine Surgery

  *Eur J Obstet Gynecol Reprod Biol 1993;52:151–6*

- > 90% require hysterectomy due to massive bleeding

  *Obstet Gynecol 2010;115:65–9*
Abnormal Placentation

- Risk of Adherent Placenta increases when associated with Placenta Previa:
  - Unscarred uterus: 5% incidence
  - Previous C/S: 10% incidence
  - >1 C/S: > 50% incidence

- Ultrasound and MRI can be used for screening but they are poorly sensitive

Uterine Rupture

- Most significant risk factor is previous Cesarean Section
- Incidence 0.2% with previous uterine scar
- Pain and bleeding are more common and severe with rupture of an unscarred uterus
- Scarred vs unscarred uterine ruptures have equivalent maternal-fetal morbidity

Postpartum Hemorrhage

- Uterine Atony
- Retained Products of Conception
- Genital Tract Trauma
- Coagulation Abnormalities
Epidemiology

• 2004 incidence of PPH (all cause) 2.93 per 100 deliveries in the USA
• Incidence of PPH (all cause) requiring transfusion 0.26 per 100 deliveries
• Uterine atony accounted for 79% of cases of PPH
• Uterine atony accounted for 0.19% of transfusions

Anesth Analg 2010;110:1368–73
Epidemiology

Figure 1. Trends in the rate of overall postpartum hemorrhage and hemorrhage by underlying etiology: 1995 to 2004.

Anesth Analg 2010;110:1368–73
Epidemiology

Rates and 95% confidence intervals of postpartum hemorrhage (all types combined) and hemorrhage from atony, stratified by annual hospital delivery volume, in quartiles (2004).

Anesth Analg 2010;110:1368–73
Rates and 95% confidence intervals of postpartum hemorrhage (all types combined) resulting in transfusion and hemorrhage from atony resulting in transfusion, stratified by annual hospital delivery volume, in quartiles (2004). Anesth Analg 2010;110:1368–73
PPH Risk Factors

- Maternal age < 20 or >/= 40
- Caesarean delivery (+/- labour)
- Hypertensive disorders of pregnancy
- Polyhydramnios
- Chorioamnionitis
- Multiple Gestation
- Retained Placenta
- Antepartum Hemorrhage
## Complications of PPH

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>7.8</td>
</tr>
<tr>
<td>Renal Failure</td>
<td>13.8</td>
</tr>
<tr>
<td>Acute Respiratory Failure</td>
<td>10.9</td>
</tr>
<tr>
<td>Prolonged Ventilation</td>
<td>6.5</td>
</tr>
<tr>
<td>Coagulopathy</td>
<td>4.7</td>
</tr>
</tbody>
</table>
Myocardial Ischemia in PPH

• Association of myocardial injury with:
  – Severe Hemorrhagic Shock
  – Use of catecholamine infusions
  – SBP ≤ 88
  – DBP ≤ 50
  – HR > 115

• NO association between myocardial ischemia and use of uterotonics or arterial embolisation

Anesthesiology 2004;100(1)
Summary- Prevention

- There are many cases of OB Hemorrhage that we can try to identify
  - Placenta Previa in the setting of a previous scar
  - Morbidly adherent placenta and screening
  - Known RF’s for PPH
- Good communication between Primary Care, OB, Anesthesia, Surgeon locally
- Determine best plan and location for delivery
Summary - Prevention

• What might you want in your centre to deliver?

  – Surgeon comfortable doing a cesarean hysterectomy?
  – Complete blood bank
  – Informed Consent
Summary - Management

• Many cases of OB Hemorrhage that can not be predicted

• Maternal morbidity and mortality associated with Massive Hemorrhage

• Treatment must be initiated locally
How to plan for a Major Obstetrical Hemorrhage?

• Pre-determined, practical definitions to trigger the prompt diagnosis
• Simultaneous and multidisciplinary management
• Pre-planned step-management protocol for management of massive hemorrhage

Anesthesiology Clin 2008;26:53-66
Massive Obstetric Hemorrhage
The Team Approach

RECC - Update in Obstetric Anesthesia
Team Approach to the Management of Massive Obstetric Hemorrhage

• Goals
• Prevention and Team approach
• Management
  – Medical
  – Surgical/Invasive/Interventional
  – Resuscitation and Transfusion Treatment
    • Coagulopathy
    • Factor VIIa
    • Rapid turnover Testing/Point of care testing
Goals of Management

Minimize morbidity and mortality

- Developing a coordinated, multidisciplinary approach
- Effective Guidelines
  - Maternal Hemorrhage protocol
  - Massive Transfusion protocol
- Prompt recognition and response to Hemorrhage
Antenatal Prevention of Morbidity

Screening and Identification high risk patients

- AbN placentation, previous C/S, previous Placenta previa and PPH, multiple gestation and clotting disorders

- Rural Hospital
  - Referral of high risk pt to tertiary care facility for appropriate perinatal intervention

- Tertiary care Hospital
  - Multidisciplinary pre-delivery planning for appropriate perinatal intervention occurs
Perinatal Prevention of PPH

Active management of the third stage of labor be offered to all women during childbirth, to ↓ risk of PPH

Active management should include:

1. Prophylactic uterotonic drugs (oxytocin) after delivery
2. Early clamping of the cord once uterine contraction noted
3. Delivery of the placenta by controlled cord traction, followed by uterine massage.
Prevention of Morbidity & Mortality

Co-ordinated Multidisciplinary approach

– Primary care, Obstetrics, Anesthesia, Blood Bank, Hematology/Lab as well as Referral centers

– Referral centers – Radiology, Urology and ICU

WHO Guidelines for management of PPH 2009
States New York, California and Illinois developed MHP
Prevention of Morbidity

Effective Guidelines:

**Maternal Hemorrhage Protocols**
- predetermined, practical definitions designed
- trigger prompt diagnosis + clear actions
- multidisciplinary management plan
- avoids treatment delays

Massive Transfusion protocol

Maternal Hemorrhage Protocols

Emphasizing the importance of:

- effective, prompt communication
- ability to rapidly mobilize resources
- prioritize and delegate tasks
- simultaneously assess and treat patients
- predetermined practical referral guidelines for smaller centers
- prevention secondary injury
Prompt recognition and response to Hemorrhage

Most maternal morbidity in Massive Hemorrhage

- Underestimation of blood loss
- Delay in intervention in face clinical signs
- Inadequate volume replacement

Major Obstetric Hemorrhage  Mercier et al, Anesthesiology Clinics 2008

- Duration of *down-time* directly related to poor outcome.
Management of Massive Maternal Hemorrhage

- Medical
- Surgical/Invasive
- Interventional
- Resuscitation and Transfusion Treatment
# WHO Guidelines for Management of PPH

**Evidence based stepwise algorithm**

## Medical
1. Uterine massage
2. Uterotonic drugs
   - Oxytocin
   - Ergometrine
   - Prostaglandin
   - Tranexamic acid (if trauma)

## Non-operative/Operative Mx
1. Bimanual uterine compression
2. Intrauterine balloon tamponade
3. Uterine artery embolization
4. Uterine compression suture
5. Arterial ligation
6. Subtotal Hysterectomy

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WHO guidelines for the management of postpartum haemorrhage; 2009
## Medical Management of Massive Maternal Hemorrhage

Pharmacological treatment of uterine atony

<table>
<thead>
<tr>
<th>DRUG</th>
<th>DOSAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxytocin Bolus/Infusion</td>
<td>0.5–1 unit, infusion 20 units/litre</td>
</tr>
<tr>
<td>Methergine</td>
<td>0.1–0.2 mg i.m. repeat in 15mins, then 4hrs</td>
</tr>
<tr>
<td>15-methyl PGF2α (Hemabate)</td>
<td>250 mcg i.m. every 15 min, maximum 2 mg</td>
</tr>
<tr>
<td>Misoprostol (prophylactic)</td>
<td>200 mcg inserted in buccal space Q15m</td>
</tr>
<tr>
<td>Misoprostol (Cytotec)</td>
<td>1000 mcg rectally</td>
</tr>
<tr>
<td>Prostaglandin E2 (ProstinE2)</td>
<td>20 mg rectally</td>
</tr>
</tbody>
</table>

Side Effects & Controversies

• **Oxytocin**
  - WHO guidelines - no bolus
  - Bolus - 10u significant hypotension (Svanstrom et al 2008)
  - Bolus - 1u 100% response (Carvalho et al 2004)

• **Ergot alkaloids**
  - $\alpha$ adrenergic receptors agonist caution
    - Pre-eclampsia
    - Hypertension
    - Heart disease

• **PGF2$\alpha$**
  - Hypertension, diarrhea, $\uparrow$bronchial tone
  - Caution in asthma
  - Not for IV use
Tranexamic Acid

Antifibrinolytic

May be offered as a treatment for PPH if:

• administration of oxytocin, followed by second-line treatment options and prostaglandins, has failed to stop the bleeding

or

• if it is thought that the bleeding may be partly due to trauma

Quality of evidence: very low
Strength of recommendation: weak

WHO guidelines for the management of postpartum haemorrhage; 2009
Invasive/Surgical Management

Success Rates of Invasive Options

- Intrauterine Balloon Tamponade 84%
- Uterine Compression Sutures 92%
- Arterial Ligation 85%
- Angiographic Embolisation 91%
- Hysterectomy

Arterial Ligation
Uterine, Internal Iliac Arteries

- Useful when other measures failed
- Requires laparotomy
- Technically challenging
- Time consuming
- Significant complications
  - Incorrect vessel ligation
  - Ureteric injury
- Study of 103 patients, found uterine devascularization in face of uncontrolled hemorrhage, was 100% effective and hysterectomy was not needed in any case

Hysterectomy

• Estimated 0.8 per 1000 deliveries
• Definitive treatment for PPH once alternative interventions failed
  – Subtotal hysterectomy recommended
  – Life saving
  – Offered early to those who refuse blood transfusions
  – Technically difficult risks include:
    • Bladder and ureteric injury
    • Possibility ↑ bleeding

Interventional Management
Requires fluoroscopic guidance and interventional expertise

- Angiographic Balloon occlusion
  - Prophylactic use in elective/semi urgent CS for abnormal placentation

- Angiographic Embolisation
  - Uterine arteries are branches of Internal iliac arteries, (ovarian arteries)
  - Requires stabilization of patient prior to transfer to facility with interventional radiology
  - Several studies have noted that clotting disorders improve rapidly after embolization possibly due to the facilitation of uterine contraction that leads to a secondary liberation of procoagulant factors into circulation

Transfusion / Resuscitation Therapy

Caveats for the Pregnant Patient

- Blood loss almost always underestimated
- Masking of hemodynamic signs due to physiological adaptations of Pregnancy
- Pregnant patient can lose up to 40% blood volume before showing any signs of hemodynamic instability (c/t 25% in non pregnant females)

• DO NOT DELAY TRANSFUSION WHILE AWAITING
  - HEMODYNAMIC INSTABILITY
  - LAB RESULTS
Maternal Blood Volume

- Non pregnant female 3600ml
- Pregnant female (near term) 5400ml
- Uterine Blood Flow 700 ml/min
How Much Blood has she lost?

### Symptoms related to blood loss with postpartum hemorrhage

<table>
<thead>
<tr>
<th>Blood loss, percent (mL)</th>
<th>Blood pressure, mm Hg</th>
<th>Signs and symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 to 15 (500 to 1000)</td>
<td>Normal</td>
<td>Palpitations, dizziness, tachycardia</td>
</tr>
<tr>
<td>15 to 25 (1000 to 1500)</td>
<td>Slightly low</td>
<td>Weakness, sweating, tachycardia</td>
</tr>
<tr>
<td>25 to 35 (1500 to 2000)</td>
<td>70 to 80</td>
<td>Restlessness, pallor, oliguria</td>
</tr>
<tr>
<td>35 to 45 (2000 to 3000)</td>
<td>50 to 70</td>
<td>Collapse, air hunger, anuria</td>
</tr>
</tbody>
</table>

Management of Massive Maternal Hemorrhage

• Essential for resuscitation
  • Large bore IV access
  • Invasive hemodynamic monitoring - Arterial line, ?CVP
• Warming blanket
• Rapid infuser/ fluid warmer
• Cell saver if available
Management of Massive Maternal Hemorrhage

- Essential for resuscitation
  - Warm crystalloids (+/- colloids) until blood and blood products available
  - Inotropic support if needed (should not replace adequate volume resuscitation)
  - Optimize medical and surgical Mx of bleeding
  - **Prevent / correct coagulopathy**
- Targets
  - Hb >80 – RBCs
  - Plts > 50 - Platelets
  - INR < 1,8 - Plasma
  - Fibrinogen > 1 - Cryoprecipitate.
Available Evidence

- Coagulopathy is common
- Once present, it is difficult to correct
- Early, intensive plasma and platelet therapy = better outcomes.
Lethal Triad of Death

- Coagulopathy
- Hypothermia
- Acidosis
Prevention of Secondary Injury by avoiding:

- **Coagulopathy**: early intensive resuscitation
- **Hypothermia**: ++ contributes to coagulopathy
- **Acidosis**: maintain tissue perfusion (BE, Lactate)
- **Hypocalcemia**
- **Hypofibrinogenemia**
- **Transfusion reactions**: clerical errors
- **Awareness**: check anesthesia depth
- **Surgical misadventures**
Etiology of Coagulopathy in Massive Transfusion

Multifactorial: 6 interacting mechanisms

1. Tissue damage
   - activation of cellular and humeral mediators
   - placental release of tissue factor stim extrinsic coag cascade
   - activation and depletion of clotting factors

2. Shock

3. Inflammation

4. Hemodilution

5. Hypothermia

6. Acidemia
   - inhibit coagulation factor function
   - decreases platelet function
Transfusion Therapy

Therapy at present is guided by:

– Clinical judgement -
  • Often underestimates blood loss (esp vag delivery)
  • Causes delay in instituting appropriate treatment
  • End up behind and playing catch up

– Lab results
  • Slow Turn around Time (TAT)
  • not useful for guiding therapy in Massive Hx

– More recently by Formula driven MTP
  • Advocate empirical early use of plasma and platelets with RBCs
    – 1:1:1 RBC:plasma:platelets
    – 1:1 RBC:plasma
Formula Driven Massive Transfusion Protocol Debate

• Definitive data is not yet out

Pro’s

– ↓ overall blood usage
– ↓ mortality rate from exsanguination, improved survival
– ↓ dependency on lab during acute resuscitation phase
– Prevent coagulopathy rather than use reactive strategy to treat it

Con’s

– ↑ risk of TRALI by ↑ exposure to unnecessary plasma and platelets.
– ↑ use of inappropriately triggered Formula driven MTP where RBC’s alone would have been sufficient.
– ↑ wastage of plasma
– Trauma literature thought to have a survivor bias
– Retrospective studies with inherent limitations

Recombinant Factor VIIa

- Off label use of this product
- Dose 90mcg/kg,
  - second identical dose if no response in 20mins
- Retrospective cohort study 43 patients
  - Use of rFVIIa was associated with a reduction in Maternal mortality from Massive Hemorrhage
  - Thrombotic events have been reported
Recombinant Activated Factor VII in Obstetric Hemorrhage:
Experiences from the Australian and New Zealand Haemostasis Registry

• Included 110 cases of administration of rFVIIa in obstetric patients
• Concluded that the reported effect of rFVIIa in many, but not all, obstetric cases was positive.
• There was no mortality as a result of thromboembolic complications.
• Randomized, controlled trials are required to confirm its safety and efficacy and to assess the possibility that use at an earlier stage in treatment of severe postpartum hemorrhage may avoid the need to resort to postpartum hysterectomy for control of bleeding, thus preserving fertility.

A high rate of thrombotic events (185 events in 165 treated patients) has been reported in patients receiving rFVIIa for off-label use.


Recommendation

Not enough evidence to make any recommendation regarding the use of recombinant factor VIIa for the treatment of PPH.

Recombinant factor VIIa for the treatment of PPH should be limited to women with specific haematological indications.

Remark

Use of rFVIIa could be life-saving
Side-effects may be significant
FVIIa is expensive

WHO guidelines for the management of postpartum haemorrhage; 2009
Lab Results and TAT

Blood transfusion labs

• Consider unmatched or group specific RBCs
  – Unmatched: 10 min
  – Group specific: 15 min (if specimen in TML)
  – Crossmatched: 45 min

Rapid laboratory testing for trauma patients: where a perfect result may not be in the best interests of the patient Jeannie L. Callum, TRANSFUSION 2010;50:2529-2532
Lab Results

“Where a perfect result may not be in the best interests of the patient “

• Coagulation Labs
  • Turn around times (TAT) still too slow

• Emergency Hemorrhage Panel
  – Standard coagulation test  30-60 min
  – Modifications to Coagulation Tests to ↓ TAT 20 min
    » shortening centrifuge time for INR
    » not checking for clots
    » critical results are reported before being repeated

• Develop Rapid Metabolic profile
  – ABG, Hb, Na, K, Ca+,lactate (from single blood gas syringe)

Rapid laboratory testing for trauma patients: where a perfect result may not be in the best interests of the patient Jeannie L. Callum, TRANSFUSION 2010;50:2529-2532
Point of Care Testing (POC)

Thromboelastography TEG

» Evaluates overall hemostatic status
» Superior to standard INR /PT/Plt monitoring
» Significant time to perform
» Interpretation complex
» Impractical as clinician taken away from pt care to perform test

Point of care coagulation testing for PT or INR

» Available not optimal yet
Hemocue

- POC Hb testing
- very useful
- easy to use
- accurate
Summary

• Facility specific plan (MHP & MTP)
• Appropriate risk assessment, referral
• Early recognition and aggressive treatment
• Optimise medical and surgical Mx
• Early blood products (RBC, FFP, Platelets, cryoppt) and transfer if needed
• Adequate resuscitation avoiding hypothermia, acidosis and coagulopathy
• ? rFVIIa
Massive Obstetric Hemorrhage
The Team Approach

RECC - Update in Obstetric Anesthesia
Massive Transfusion Protocol

• Case study, what went well, what didn’t
• Implications of a MTP
• Components of a MTP
• Examples of MTP
Case MF

- I’m in ER, busy....
- 22 yr female
- G1P1, 2h post delivery
- Call from floor: Pt in far bed in room
- “Bleeding to death”
Case MF – my MTP

- “Oh S*#%!!!”
- Inform ER RN, Floor RN – More OB RN ;-
- Inform Lab – 2u O-PRC
- Inform GPS/O – “I’m going to resus her in the OR”
Case MF – Outcome

- More OB RN - Hemabate
- 2u PRC, numerous Saline
- Manual compression
- No GPS/O
- Bleeding stopped
Case MF

• What went well?
• What didn’t go well (where can we improve)?

  – Could we do better by having a MTP?
New developments in massive transfusion in trauma
Sarah E. Greer\textsuperscript{a}, Kurt K. Rhynhart\textsuperscript{a}, Rajan Gupta\textsuperscript{a} and Howard L. Corwin\textsuperscript{b}

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Current Opinion in Anaesthesiology 2010, 23:246–250

Purpose of review
Trauma patients requiring massive transfusion represent a population at high risk for potentially preventable death. This review describes recent advances in the early recognition and treatment of the coagulopathy of trauma, as well as ongoing work to define optimal resuscitation strategies.

Recent findings
Damage control resuscitation involves the rapid correction of hypothermia and acidosis, direct treatment of coagulopathy, and early transfusion in trauma patients. Recent evidence demonstrates improved mortality and lower overall blood product usage with higher ratios of plasma and platelets to red blood cells transfused. Adjuncts to damage control resuscitation such as factor VIIa may also be beneficial. Thrombelastography and advances in point-of-care testing may provide timely measurements to help guide massive transfusion in patients based on their individual needs.

Summary
As optimal resuscitation strategies continue to evolve, recent efforts have focused on early and aggressive treatment of coagulopathy, with higher ratios of plasma and platelets to red blood cells transfused. Early evidence suggests that such strategies have a beneficial outcome in regards to trauma-related mortality.
Implications of a MTP

- Reduce chaos
- Reduce blood bank delays
- Reduced mortality
- Reduction in organ failure, sepsis & Abdominal Compartment Syndrome
- Increased blood products early, less total
- Less use of crystalloids
Treatment Goals

• Restore circulating volume/control bleeding
• Restore oxygen carrying capacity
• Avoid Coagulopathy (incl. Dilution)
  – FFPs, Platelets, (formula vs. lab)
  – Hypothermia, Hypocalcaemia, Ischemia/Acidosis
Purpose of a MTP

• Mobilization of resources
• Prioritization, delegation
• Simultaneous assessment and treatment
• Effective communication
Components of a MTP

• Information
  – Initiation Trigger
  – Who
  – What: PRBC, FFP, Platelets, Cryo, labs
  – Reminders: Hypoxia, Acidosis, Hypothermia, Hypocalcaemia

• Paperwork
  – Guide, Consent, Lab recs, recording documentation, (work sheet, critique form, Information booklet for patients)
Components of a MTP – The Who

- MDs, RNs, Clerk, Porter
- Lab, blood bank, Hematologist
- Ambulance/OR
Components of a MTP – The Who (BCWH)

Declare Massive Hemorrhage - BCWH OR
1. Hematology lab
2. Transfusion Lab
3. 2\textsuperscript{nd} call Anesthesiologist
4. LDR charge Nurse
5. 2\textsuperscript{nd} call Obstetrician; General Surgeon
6. Anesthesia Assistant
7. Perfusionist
8. Interventional Radiologist
9. Critical Care / Internal Medicine Physician
10. Hematologist on call
11. Ward Clerk
Massive Transfusion Step-By-Step Guide

Activation of MTP:

STEP 1: Initiate Massive Transfusion Protocol
- Physician orders MTP & obtains informed/emergency consent.
- MTP package obtained from standards of care filing bin.

STEP 2: In-Charge assigns 1 person to communicate with Blood Bank/Lab:
- Designated as MTP Nurse (usually Primary Nurse)

STEP 3: MTP Nurse Immediately notifies Blood Bank of MTP & of Trauma Bay II Phone #2547

STEP 4: NUC phone Lab Accessioning for MTP STAT specimen collection or tube specimens to Lab:
- CBC, E7, PT, PTT, Type & Crossmatch (MTP tubes located in MTP bin Trauma Bay # 2)

STEP 5: NUC tubes to Blood Bank all Crossmatch Reqs: stamped with patient name & # (Reqs in MTP Package)

STEP 6: Initiate MTP "Working Page".

Administration of Blood Products:

STEP 1: NUC immediately sends Porter to pick up blood in Blood Bank (Porter to wait there until blood is ready)
- Unmatched O neg available in 15 minutes or less of MTP activation
- Unmatched Group Specific available in 30 minutes of MTP activation

STEP 2: MTP Nurse to administer blood:
- Level 1 Rapid Infuser (change Q3hrs or if clogged)

STEP 3: MTP Nurse orders blood work (standing orders / Reqs in MTP package):
- CBC, PT, APTT, ET, Fibrinogen (Q30mins)
- D-Dimer as per Physician (usually after 6 units of PRBC's)
- Calcium & ABG’s as per Physician (monitor acid/base disturbances)

STEP 4: Maintain correct temperature of Blood Products:
- Platelets & Cryoprecipitate at room temperature

STEP 5: MTP Nurse communicates with Physician & Blood Bank Q30 - 60 mins to confirm continuation of MTP

STEP 6: Consider FFP after 6 units of blood (allow 15-30 mins thawing time)
- Aim for PTT < 1.5 x mid - normalDosage 10 - 15 ml/kg (4 units/70 kg)

Transferring MTP Patient:

STEP 1: MTP Nurse must inform Blood Bank of patient's transfer to new department & name of new MTP Nurse

Termination of MTP:

STEP 1: Physician determines MTP complete

STEP 2: MTP Nurse immediately notifies Blood Bank of MTP termination

STEP 3: Complete MTP Critique form # 11- 020- 2010 and forward to Lab: C/O Charge Technologist Transfusion Services

*PATHOLOGIST WILL BE ON CALL TO SUPPORT THE MTP TEAM DURING ITS PROGRESS
Massive transfusion and coagulopathy: pathophysiology and implications for clinical management

[Transfusion massive et coagulopathie : physiopathologie et implications cliniques]

Jean-François Hardy MD FRCP®, Philippe de Moelooose MD,† Marc Samama MD PhD,‡ and members of the Groupe d’Intérêt en Hémostase Périopératoire

Purpose: To review the pathophysiology of coagulopathy in massively transfused, adult and previously hemostatically competent patients in both elective surgical and trauma settings, and to recommend the most appropriate treatment strategies.

Methods: Medline was searched for articles on “massive transfusion,” “transfusion,” “trauma,” “surgery,” “coagulopathy” and “hemostatic defects.” A group of experts reviewed the findings.

Principal findings: Coagulopathy will result from hemodilution, hypothermia, the use of fractionated blood products and disseminated intravascular coagulation. The clinical significance of the effects of hydroxyethyl starch solutions on hemostasis remains unclear. Maintaining a normal body temperature is a first-line, effective strategy to improve hemostasis during massive transfusion. Red cells play an important role in coagulation and hematocrits higher than 30% may be required to sustain hemostasis. In elective surgery patients, a decrease in fibrinogen concentration is observed initially while thrombocytopenia is a late occurrence. In trauma patients, tissue trauma, shock, tissue anoxia and hypothermia contribute to the development of disseminated intravascular coagulation and microvascular bleeding. The use of platelets and/or fresh frozen plasma should depend on clinical judgment as well as the results of coagulation testing and should be used mainly to treat a clinical coagulopathy.

Conclusions: Coagulopathy associated with massive transfusion remains an important clinical problem. It is an intricate, multifactorial and multicellular event. Treatment strategies include the maintenance of adequate tissue perfusion, the correction of hypothermia and anemia, and the use of hemostatic blood products to correct microvascular bleeding.

Objectif: Revoir la physiopathologie de la coagulopathie chez les adultes transfusés massivement et auparavant compétents sur le plan hémostatique, à la fois dans le contexte d’une intervention chirurgicale régnée ou à la suite d’un traumatisme. Recommander les stratégies thérapeutiques les plus appropriées.


Constatations principales : La coagulopathie résulte de l’hémodilution, l’hypothermie, l’usage de produits sanguins fractionnés et la coagulation intravascularo-disséminée. La portée clinique des effets des solutions d’hydroxyéthyl-aminon sur l’hémostase n’est toujours pas claire. Le maintien d’une température corporelle normale est une stratégie de première intention efficace pour améliorer l’hémostase pendant la transfusion massive. Les globules rouges sont importants dans la coagulation et des hémocytories supérieures à 30 % pourraient être nécessaires à une hémostase adéquate. Chez les patients en chirurgie régnée, une baisse de la concentration de fibrinogène est observée précocement tandis que la thrombocytopenie est plus tardive. Chez les traumatisés, le trauma tissulaire, le choc, l’anoxie et l’hypothermie contribuent au développement d’une coagulation intravascularo-disséminée et du saignement microvasculaire.

L’utilisation de plaquettes et/ou de plasma frais conséquences dépend du jugement du clinicien ainsi que des résultats des tests de coagulation. La transfusion devra surtout viser le traitement d’une coagulopathie clinique (saignement microvasculaire).

Conclusion : La coagulopathie associée à la transfusion massive demeure un important problème clinique. C’est un événement complexe, multifactoriel et multicellulaire. Le traitement comprend le maintien d’une perfusion tissulaire adéquate, la correction de l’hypothermie et de l’anémie et l’usage de produits sanguins hémostatiques pour corriger le saignement microvasculaire.

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How we treat: management of life-threatening primary postpartum hemorrhage with a standardized massive transfusion protocol

Matthew Burkelow, Ed Riley, Maurice Druzin, Magali Fontaine, Maureen Viele, and Lawrence Tim Goodnough

Management of massive, life-threatening primary postpartum hemorrhage in the labor and delivery service is a challenge for the clinical team and hospital transfusion service. Because severe postpartum obstetrical hemorrhage is uncommon, its occurrence can result in emergent but variable and nonstandard requests for blood products. The implementation of a standardized massive transfusion protocol for the labor and delivery department at our institution after a maternal death caused by amniotic fluid embolism is described. This guideline was modeled on a existing protocol used by the trauma service mandating emergency release of 6 units of group O D- red cells (RBCs), 4 units of fresh frozen or liquid plasma, and 1 apheresis unit of platelets (PLTs). The 6:4:1 fixed ratio of uncrossmatched RBCs, plasma, and PLTs allows the transfusion service to quickly provide blood products during the acute phase of resuscitation and allows the clinical team to anticipate and prevent dilutional coagulopathy. The successful management of three cases of massive primary postpartum hemorrhage after the implementation of our new massive transfusion protocol in the maternal and fetal medicine service is described.

Postpartum hemorrhage is an important and often preventable cause of maternal mortality and morbidity worldwide. Primary postpartum hemorrhage is defined as hemorrhage occurring within 24 hours of delivery. At term, the uteroplacental circulation receives an estimated 700 mL of blood per minute, so it is not surprising that failure of the normal hemostatic mechanisms after delivery can result in life-threatening hemorrhage. Major causes of postpartum hemorrhage include uterine atony, pathologic placentation, retained products of conception, uterine rupture, birth trauma, and existing or acquired coagulopathy.

In the modern era of fractionated blood component therapy, optimal management of massive hemorrhage is an evolving concept. Resuscitation of a patient with postpartum hemorrhage is conceptually similar to resuscitation after traumatic injury, where the goal is to establish rapid control of bleeding and restore systemic oxygen delivery. The trauma literature defines two phases of resuscitation: an immediate phase directly after injury with ongoing hemorrhage and a maintenance phase after stabilization. Modern trauma resuscitation protocols advocate sequential administration of therapeutic components, beginning with colloid-crystalloid solutions infused to replace lost intravascular volume. Second, red blood cells (RBCs) are transfused to restore oxygen-carrying capacity. Third, clotting factors and platelets (PLTs) are delivered to restore physiologic hemostasis. Rapid restoration of the components of the blood is essential for ensuring adequate tissue perfusion and preventing acidosis, coagulopathy, and hypothermia. Adequate replacement of plasma components is particularly important for avoiding dilutional coagulopathy in the massively bleeding patient.

Massive transfusion protocols have been adopted by many hospitals with accredited trauma centers. The trauma center certification process administered by the American College of Surgeons Committee on Trauma (ACS-COT) stipulates that individual institutions address
RCH Emergency Department MASSIVE TRANSFUSION PROTOCOL (MTP)

Goal: Initiate early, aggressive therapy with Multiple Blood Products

Patient arrives hemodynamically unstable (SBP <70 or SPB < 90 and HR > 110) with suspected or known hemorrhage

2 U PRBC given rapidly
*‘Trauma 911’ blood work ordered by EP/TTL (TIME 0)*
(Enter Trauma 911 labs: For any TTL activation or Autolaunch)

Transfusion Medicine (TM) calls ED and asks if MTP is being initiated? UC checks with EP/TTL

- Yes - MTP initiated and continued until stopped by EP/TTL
  - Designated ED UC communicates with TM
  - Designated Trauma RN/ MD communicates with UC

- No - Continue usual ED treatment

Transfusion Medicine (TM) calls ED and asks if MTP is being initiated?

- Yes - UC enters MTP Order set
  - Blood work drawn 30, 60, 90 & 120 min from Time 0
  - Exact times added by Trauma RN and/or Lab Assistant
  - Lab Assistant available for drawing and/or labeling

- No - Continue usual ED treatment

Within one hour identify and correct causes of bleeding.
- Warfarin induced coagulopathy – give Octaplex and/or Vitamin K immediately
- Pelvic binding
- Surgery
- Angioembolization
- Endoscopy
- Splinting

Until bleeding stopped, allow permissive hypotension.

2 U PRBC given – 1 U FFP will be sent and repeated to maintain a ratio of 8 U PRBC: 1 U Platelets

If Fibrinogen < 1g/L - Cryoprecipitate issued by TM. After 2nd dose discuss with hematopathologist

Bleeding stopped? (Goal is 1 hour)

- Yes - Repeat Blood work as per MD order
- No - Consider Factor VIIa

Factor VIIa dosing:
- 40 µg/kg, repeat in 30 min and as 5 hrs if necessary
- Round to nearest vial size (i.e. 1.2, 2.4, 3.6, 4.8 mg vials)
# Laboratory Guide to Massive Transfusion

**Definition:** Anticipated loss of 90% or more of a patient’s total blood volume in 3 hours or less and/or anticipated need for more than 10 units of blood in a 24 hour period.

<table>
<thead>
<tr>
<th>Early recognition</th>
<th>Prompt action</th>
<th>Good Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective</strong></td>
<td><strong>Main Points</strong></td>
<td><strong>Comments</strong></td>
</tr>
<tr>
<td>Restore circulating volume</td>
<td>1. Inset wide-bore IV</td>
<td>-14 G or larger</td>
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<tr>
<td></td>
<td>2. Give adequate volumes of warmed crystalloid (+/- colloid)</td>
<td>-Monitor CVP</td>
</tr>
<tr>
<td></td>
<td>3. Aim to maintain normal BP and urine output of &gt;30 ml/hr</td>
<td>-Blood loss often underestimated</td>
</tr>
<tr>
<td>Initiate massive transfusion protocol</td>
<td>1. Designate one person to communicate with Transfusion Lab.</td>
<td>-Unmatched O Neg – 10 minutes</td>
</tr>
<tr>
<td></td>
<td>2. Call Transfusion Lab to initiate massive transfusion protocol.</td>
<td>-Unmatched ABO group specific – 15 minutes</td>
</tr>
<tr>
<td></td>
<td>3. Confirm the availability of crossmatch specimen and estimated delivery time for blood, plasma and platelets.</td>
<td>-Fully crossmatched – 45 minutes*</td>
</tr>
<tr>
<td></td>
<td>4. Order crossmatch for 6 units of packed red cells.</td>
<td>*Excluding collection and delivery time for crossmatch specimen. A stat crossmatch can be performed in 10 minutes if a pre-operative group and screen has been done and the patient does not have alloantibodies.</td>
</tr>
<tr>
<td></td>
<td>5. Consider unmatched or group specific red cells.</td>
<td></td>
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<tr>
<td></td>
<td>6. Consider blood salvage if available and appropriate.</td>
<td></td>
</tr>
<tr>
<td>Transfusion Laboratory protocol activated</td>
<td>1. Notify Hematopathologist.</td>
<td>-Transfusion lab staff empowered to issue blood components without waiting for lab data or pathologist approval.</td>
</tr>
<tr>
<td></td>
<td>2. Notify Hematology lab to optimize turn around time of stat blood work.</td>
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<td></td>
<td>3. Issue multiple units of red cells in the most expeditious fashion possible.</td>
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<td></td>
<td>4. Assess platelet stores and order enough to have 10 units available.</td>
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<td></td>
<td>5. Thaw 2 units of FFP.</td>
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<tr>
<td></td>
<td>6. Issue up to 6 units of FFP and one adult dose of platelets without requirement for supporting lab data or pathologist approval.</td>
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<tr>
<td></td>
<td>7. Keep 6 units RBC crossmatched on hand.</td>
<td></td>
</tr>
<tr>
<td>Avoid hypothermia</td>
<td>1. Pre-warmed crystalloid</td>
<td>-Hypothermia impairs coagulation and platelet function.</td>
</tr>
<tr>
<td></td>
<td>2. Rapid infusion blood warmer</td>
<td>-Most under recognized cause of coagulopathy.</td>
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<tr>
<td></td>
<td>3. Warm ambient room temp</td>
<td>-Common in massive transfusion.</td>
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<tr>
<td></td>
<td>5. Warm saline for irrigation</td>
<td>-Prophylactic FFP contributes to hypothermia.</td>
</tr>
<tr>
<td></td>
<td>6. Warm &amp; humidified anaesthetic gases</td>
<td>-Aim for temp &gt; 35°C.</td>
</tr>
<tr>
<td>Achieve hemostasis</td>
<td>1. Treat any surgical source of bleeding.</td>
<td></td>
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<tr>
<td></td>
<td>2. Correct coagulopathy with judicious use of blood components.</td>
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<tr>
<td>Order lab tests</td>
<td>1. CBC, INR, PT, CBC, Fibrogen after 6 units packed cells.</td>
<td></td>
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<tr>
<td></td>
<td>2. Repeat as required to guide component therapy.</td>
<td></td>
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<tr>
<td>Request platelet</td>
<td>1. Not always available on site.</td>
<td></td>
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<tr>
<td></td>
<td>2. Allow 1-2 hours for delivery from blood centre.</td>
<td></td>
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<tr>
<td></td>
<td>3. Expect count-50 with 2 x blood volume replacement.</td>
<td>-Target: &gt;50 x 10^9/L (&gt;100 is desirable for multiple or CNS trauma, however &gt;75 is more realistic)</td>
</tr>
<tr>
<td></td>
<td>4. Initial adult dose-1uffy coat or 1 apheresis unit (Child &lt;20kg: 10-15 ml/kg)</td>
<td></td>
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<tr>
<td>Request FFP</td>
<td>1. Consider after 6-10 units red cells or 1:2 x volume replacement.</td>
<td></td>
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<td></td>
<td>2. Ideally based upon INR/PTT results.</td>
<td></td>
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<tr>
<td></td>
<td>3. Allow 30 minutes thawing time.</td>
<td>-Aim for PT and PTT &lt;1.5 x mid normal</td>
</tr>
<tr>
<td>Request cryoprecipitate</td>
<td>1. Primarily to replace fibrinogen if &lt; 1.0 g/L.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Expect &lt; 1 g/L with 1.5 x volume replacement.</td>
<td>-Doseage 1-1.5 units/10kg (10 units/70 kg)</td>
</tr>
<tr>
<td></td>
<td>3. If time permits, measure fibrinogen first.</td>
<td>-Limited on site supply.</td>
</tr>
<tr>
<td></td>
<td>4. Allow 30 minutes to thaw and pool.</td>
<td>-For continued non-surgical bleeding despite plasma and platelet transfusion</td>
</tr>
</tbody>
</table>

References:
- LA County & UCLA Trauma Surgery and Critical Care Protocols

Appendix 11.1 Laboratory Massive Transfusion Protocol SOP # 3015
Date: 3 September 2004
GOOD COMMUNICATION IS KEY*

- Suspect Massive Hemorrhage

Notify Transfusion Medicine Laboratory (7388)
- Notify Hematology Lab (2938)
- "Massive Hemorrhage BCW OR"
  (Ensure that group and screen is in place – 30 mins) then additional 20 mins for stat x-match

Designate 1 person to communicate with blood bank

Order: 6 units RBC, 2 units FFP
Options: O negative unmatched vs group specific unmatched vs stat match vs full match (see sheet re times)

Assess situation

Order more product & prioritize it
- Suggest subsequent RBC transfusion followed by FFP 1:1 ratio

For platelets order 5 units as a starting adult dose
- If time is critical, inform TML that platelets do not need to be pooled

For Fibrinogen: Cryo takes 30 mins, 60 min for Fibrinogen
- Cryo dose 10 units, fibrinogen dose 4 gm initially - give to maintain fibrinogen level >1.5

Remember to check ionized calcium:
- *It takes time to issue blood product. Inform Transfusion Medicine laboratory of urgency. There may only be one tech TML and in Hematology lab and they will be doing their best.

Communicate urgency:
- AFTER: Notify clinical hematologist to follow up

Contact SAP** in Ottawa if have used fibrinogen; notify TML that this has been done

**SAP program - Health Canada
Office Hour Number 0800 - 1700 Eastern Time 1 - 613 - 941 - 2108
After Hour Number 1700 - 0800 Eastern Time 1 - 613 - 941 - 3061

Information required:
- Product Required (Fibrinogen)
- Quantity Required (4 g usual dose)
- Patient's Initials
- Hospital (C&W, Vancouver, BC)
- Patient's age
- MD ordering (attending anesthesiologist)
- Diagnosis (massive hemorrhage)
- Has patient used this product previously (usually NO)
MTP: New developments

• FFP:PRBC – 1:2 (evolving)
• Recombinant Activated Factor VII
• Improved turn around times (TAT)
• Point of care testing incl. TEB
Massive Transfusion Protocol

• Rural questions:

  – FFPs and Platelets; send Patient or send Products?

  – Call a Hematopathologist / Transfusionist
MTP: Take home

- Risk assessment, avoidance
- Early recognition
- Facility specific plan (MTP)
- Early blood products (PRBC, FFP, Platelets) or transfer
- Avoiding hypothermia & cellular hypoxia and acidosis