Surgical Complications
Part I
Intraoperative

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Disclosure Statement

I have no financial relationship regarding any products referenced in the presentation.
Objectives

- Recognition and management of common intraoperative complications.
  - Uncontrolled Bleeding
  - Ureteral or Bladder Trauma
  - Bowel Injury
Uncontrolled Intraoperative Bleeding

• Apply Pressure
  • Not just packing

• Notify Anesthesia
  • ?? Central Venous Catheter

• Identify the Etiology
  • Coagulopathy
  • Vessel/tissue trauma
  • Diffuse oozing

• Draw lab, initiate the Massive Transfusion Protocol if indicated.
Massive Transfusion Protocol
American College of Surgeons

• Draw fibrinogen, platelet count, PT/PTT
• RBC:Plasma in a ratio of 1:1 or 1:2
• Pheresis platelet pack 1: 6 units PRBC
• Additional aspects;
  • Tranexamic acid (TXA) 1 Gm IV over 10 minutes followed by 1 Gm infused over 8 hours.
  • Cryoprecipitate 10 Units ; to raise fibrinogen to 180 mg/dl
  • Role of recombinant Factor VIIa and Prothrombin complex concentrates is unclear and likelihood benefit from help from the Blood Bank Pathologist

https://www.facs.org/~media/files/quality%20programs/trauma/tqip/massive%20transfusion%20in%20trauma%20guidelines.ashx
Massive Transfusion Protocol
Obstetrics

An update on the use of massive transfusion protocols in obstetrics
Luis D. Pacheco, MD; George R. Saade, MD; Maged M. Costantine, MD; Steven L. Clark, MD; Gary D. V. Hankins, MD

Obstetrical hemorrhage remains a leading cause of maternal mortality worldwide. New concepts involving the pathophysiology of hemorrhage have been described and include early activation of both the protein C and fibrinolytic pathways. New strategies in hemorrhage treatment include the use of hemostatic resuscitation, although the optimal ratio to administer the various blood products is still unknown. Massive transfusion protocols involve the early utilization of blood products and limit the traditional approach of early massive crystalloid-based resuscitation. The evidence behind hemostatic resuscitation has changed in the last few years, and debate is ongoing regarding optimal transfusion strategies. The use of tranexamic acid, fibrinogen concentrates, and prothrombin complex concentrates has emerged as new potential alternative treatment strategies with improved safety profiles.

Key words: hemostatic resuscitation, massive transfusion, obstetrical hemorrhage

and new pharmacological agents have become available for the management of severe hemorrhage. The purpose of this review is to address new updates regarding the use of massive transfusion protocols and their applicability to obstetrical hemorrhage.

Fresh frozen plasma and platelets
Classically, resuscitation in hemorrhage has been centered on the administration of crystalloids and packed red blood cells (PRBCs). Use of other blood products like fresh frozen plasma, cryoprecipitate, and platelets was traditionally withheld.

Massive Transfusion Protocol
Obstetrics

<table>
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<tbody>
<tr>
<td>Massive transfusion protocol in obstetrics</td>
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<tr>
<td></td>
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<tr>
<td>Round 1</td>
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<td>Round 2</td>
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<td>Round 3</td>
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<td>Round 4</td>
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Consider activating the protocol when hemorrhage is expected to be massive (anticipated need to replace 50% or more of blood volume within 2 hours), bleeding continues after the transfusion of 4 U of packed red blood cells within a short period of time (1–2 hours), or systolic blood pressure below 90 mm Hg and heart rate is above 120 beats per minute in the presence of uncontrolled bleeding. Once activated, blood bank personnel will continue preparing blood products until the surgical team inactivates the protocol. After round 4, if not inactivated, the protocol will start again from round 1.

*FFP, fresh-frozen plasma. PRBC, packed red blood cell; Adapted from Pacheco et al.*

Uncontrolled Intraoperative Bleeding

Coagulopathy

• Blood Component Therapy - If not utilizing the MBT Protocol, replacement components include:
  • Packed RBC
  • Fresh Frozen Plasma
    • Contains most components including fibrinogen, factor VII, prothrombin, and factor II
  • Cryoprecipitate
    • Fibrinogen, factor VIII, factor XIII, and von Willebrand factor
  • Platelets

• Treat hypothermia and acidosis to enhance coagulopathy control.
Uncontrolled Intraoperative Bleeding

• Fluid resuscitation with a Balanced Salt Solution rather than NS to avoid hyperchloremic acidosis.
• Role of colloid therapy is unclear
• Define the extent of blood loss
  • > 50% of blood volume is considered massive loss.
• Frequent lab testing to assess patient status
Balanced Salt Solution vs. Normal Saline

- SOME patients need early and very aggressive fluid resuscitation
- MOST patients are over resuscitated and would benefit from a more even fluid balance or even negative fluid balance
- NORMAL saline is not normal
- HYPERchloremia is harmful
- WE should examine our choice of resuscitation/ maintenance fluids closely
Balanced Salt Solution vs. Normal Saline

- MORE fluid does not equal better perfusion
- GOAL directed resuscitation is the GOAL
- DRIER patients with ALI/ARDS do better
- Diluting the creatinine level doesn’t necessarily improve renal function
- Treat IVF like any other drug.
# Balanced Salt Solution vs. Normal Saline

**Electrolyte composition (mmol/l) of commonly available crystalloids**

<table>
<thead>
<tr>
<th>Electrolyte</th>
<th>Plasma</th>
<th>0.9% NaCl</th>
<th>Ringer’s lactate, Hartmann’s</th>
<th>Plasma-Lyte®</th>
<th>Sterofundin®</th>
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<td>Sodium</td>
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<td>154</td>
<td>131</td>
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<td>5</td>
<td>5</td>
<td>4</td>
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<tr>
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<td>154</td>
<td>111</td>
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<td>127</td>
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<td>Calcium</td>
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<td>2</td>
<td>0</td>
<td>2.5</td>
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<td>Magnesium</td>
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<td>1</td>
<td>1.5</td>
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<tr>
<td>Bicarbonate</td>
<td>24</td>
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<tr>
<td>Lactate</td>
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<td>0</td>
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<tr>
<td>Gluconate</td>
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<td>23</td>
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<td>Maleate</td>
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<td>0</td>
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Plasma-Lyte® from Baxter International (Deerfield, IL, USA), Sterofundin® from B Braun (Melsungen, Germany).

Guidet et al. Critical Care 2010; 14:325
Uncontrolled Intraoperative Bleeding
Vessel and/or Tissue Trauma

• Identify the source as midline pelvic structure (Uterus, bladder, sigmoid) or pelvic sidewall.
  • Control is easier if originating from a midline structure.
• Be realistic about your exposure/incision.
• Identify all vital structures within the retroperitoneum prior to clamping or suturing.
• Control arterial bleeding by direct clamping or isolation upstream from the bleeding.
• Hypogastric/internal iliac vein bleeding is the most difficult to control.
• If uncertain, consider an atraumatic clamp first. (Satinsky, DeBakey, Bull Dog)
Hypogastric Artery Ligation
Umbilical
Superior & Inferior Vesicle
Middle Rectal
Vaginal
Uterine
Hypogastric Artery Ligation
Hypogastric Artery Ligation
HEMORRHAGE
SURGICAL TREATMENT

EMBOLIZATION
Uterine/Hypogastric Artery Embolization
Uterine/Hypogastric Artery Embolization
Uncontrolled Intraoperative Bleeding

Diffuse oozeing

• Identify vital structures
• Avoid indiscriminant use of cautery
• If pressure does not control the bleeding, consider topical therapy with topical thrombin with gelatin (Floseal), or fibrin sealant (Tisseel, Evicel)
Surgical Complications
Urinary Tract Injury

• Incidence
• Location
• Etiology
• Repair
Surgical Complications

- Inadvertent
- Incidental
- Accidental
- Unintentional
- Unplanned
- **Unavoidable**
Avoidable
Major Intraoperative Complications

- 7.79% Abdominal Hysterectomy
- 2.26% Vaginal Hysterectomy
- 1.61% Laparoscopic Hysterectomy
- 1.59% Robotic Hysterectomy

Urinary Tract Injury

- 1.8 % Abdominal Hysterectomy
- 3.4 % Vaginal Hysterectomy
- 1.7 % Laparoscopic Hysterectomy
- 1.4 % Robotic Hysterectomy

Vaginal Abdominal Laparoscopic Uterine Excision
VALUE Study

- Prospective, nonrandomized
- 37,295 subjects
- BMJ, 2004;328:129
### Complications of Hysterectomy

**VALUE Study**

<table>
<thead>
<tr>
<th></th>
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<th>Lap. Hyst</th>
<th>TVH</th>
<th>LAVH</th>
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<tr>
<td>Hemorrhage</td>
<td>2.4%</td>
<td>4.6%</td>
<td>2.9%</td>
<td>5.1%</td>
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<tr>
<td>Bowel Injury</td>
<td>1.0%</td>
<td>0.2%</td>
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<td>Ureter Injury</td>
<td>0.0%</td>
<td>0.9%</td>
<td>0.0%</td>
<td>0.3%</td>
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<tr>
<td>Bladder Injury</td>
<td>1.0%</td>
<td>2.1%</td>
<td>1.2%</td>
<td>0.9%</td>
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<tr>
<td>Other</td>
<td>2.1%</td>
<td>2.4%</td>
<td>1.8%</td>
<td>3.9%</td>
</tr>
</tbody>
</table>
Hysterectomy Associated Ureteral Injury

• Adjacent to ovarian vessels at the common iliac artery
• As the uterine artery crosses the ureter
• At the insertion of the ureter into the bladder
Sites of ureteral injury
Intraoperative Ureteral Injury

• Etiology
  • Suture or needle injury
  • Crush injury
  • Transection
  • Thermal injury

• Type of repair will vary with location and extent of injury

• Cystoscopy and placement of a ureteral stent may be helpful depending on the location, extent of injury and type of repair.
Paravesical Space

• Between the obliterated Umbilical Ligament (Superior Vesical Artery) and the External Iliac Vein

• Important for mobilizing the ureter and ligating the Internal Iliac Artery

• Cardinal Ligament is the posterior boundary
Pararectal Space

• Between the ureter and Internal Iliac artery
• Useful for mobilizing the ureter and resection of the uterosacral ligament for endometriosis.
• The Cardinal Ligament is the anterior boundary
Paravesical Space

Pararectal Space
Avoiding Ureteral Injury

• Ureteral stent placement?? No Supporting Data
• Cystoscopy (after the fact)
• Identify the ureter and keep it in view
• Know the capabilities and thermal spread of your energy source
• All tissues contract with coagulation/thermal injury
Hemostatic = Well Done
Tissues Contract with Coagulation
All the potential spaces are contracted until the retroperitoneum is opened/developed.
Vessel Sealing Devices

Know your energy source
Vessel Sealing Devices
Intraoperative Ureteral Injury

• Minor injury, ie. Angulation/obstruction due to adjacent suture is relieved by removing the suture.

• Injury within 3 cm of the insertion at the trigone will usually require re-implantation.

• Injury at mid-ureter or pelvic brim is usually repaired or resected and repaired primarily without tension.
Ureteral Injury with primary repair
Ureteral Injury with re-implantation
Ureteral Injury with Psoas Hitch
Ureteral Injury with Boari Flap
Intraoperative Bladder Trauma

• Etiology
  • Injury on abdominal entry due to displaced bladder
  • Bladder dissection at hysterectomy
    • Associated with previous cesarean delivery and blunt dissection of the bladder.
  • Colpotomy incision at laparoscopic/robotic hysterectomy
    • Clean cut, tear injury, or thermal injury.
Bladder Dome Injury
Intraoperative Bladder Trauma

- Repair
  - Resect any thermal injury.
  - Two layer, water tight closure with absorbable suture.
  - Minimize tension on the closure.
  - Foley catheter for 7-14 days depending on the location of the repair.
Intraoperative Bladder Injury
Intraoperative Bowel Injury

• Etiology
  • Injury on abdominal entry
  • Injury during enterolysis
  • Laparoscopic trocar injury
  • Thermal injury during laparoscopic dissection or posterior colpotomy

• Type of repair will vary with location and extent of injury

• Attempt to isolate the defect and control bowel leakage.
Bowel Injury in Gynecologic Laparoscopy
Systematic Review

• 90 Studies from 1972 to 2014
• Overall Incidence 1 in 769 procedures
  • 1/3,333 for tubal sterilization
  • 1/256 for hysterectomy
• Small bowel injury is most common
• 55% of injuries occurred on entry (trocar/Veress needle)
• Mortality rate 1/125
• All deaths were associated with delayed diagnosis

Llarena NC, Shah AB, Milad MP. Obstet Gynecol 2015;125:1407-17
Intraoperative Bowel Injury

• Repair
  • Whenever possible, small enterotomy repairs are performed in two layers at a right angle to the axis of the intestine.
  • More extensive trauma or multiple enterotomies may require resection and primary anastomosis.
  • Thermal injury will require resection to healthy bowel wall prior to closure.
  • Colon defects are closed in two layers.
  • If a colon repair is adjacent to the sutured vaginal cuff, consider interposing omentum.
Intraoperative Bowel Injury
Conclusions

• The greatest risk to the patient, and liability to the physician, is not intraoperative complications, it’s the lack of recognition of intraoperative complications.

• Apply pressure and organize a plan.

• Keep Anesthesia and the Blood Bank informed.