Anesthetic considerations for Abdominal trauma

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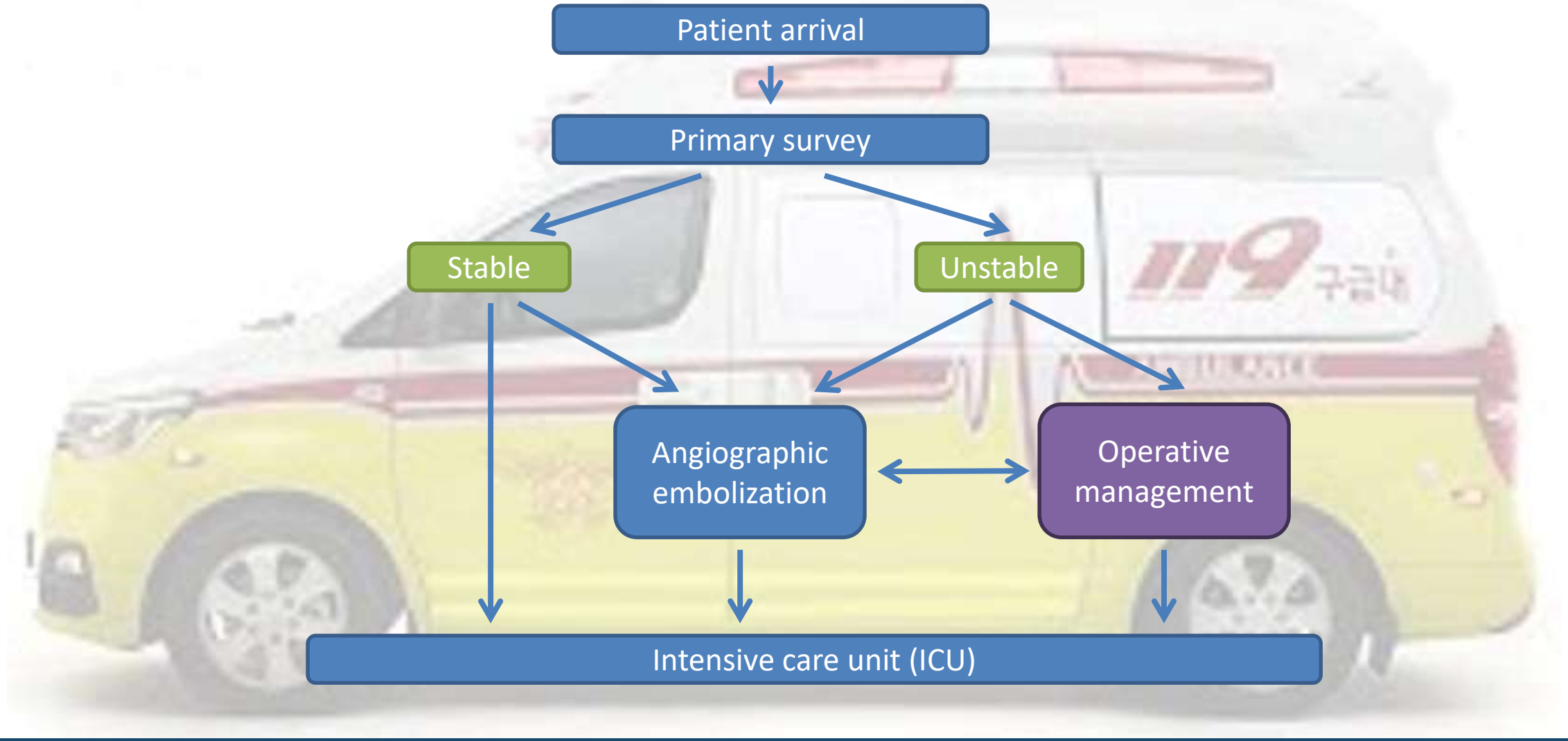
Management flow for Trauma patients



Classification of abdominal injuries

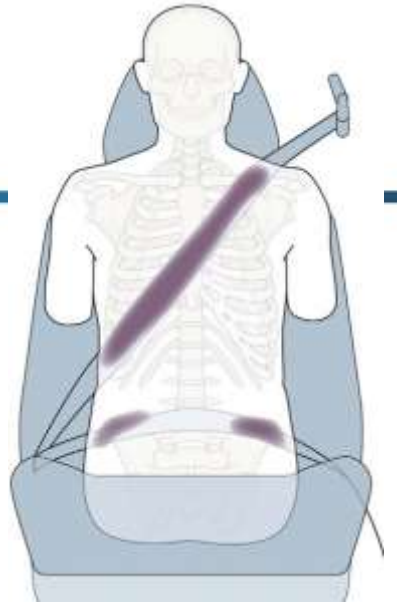
- Knowledge of the trauma mechanism

➔ Prediction of the pattern and the severity of injury to abdominal organs and vascular structures

Blunt trauma

Penetrating trauma

1) Blunt abdominal trauma



- Mechanism of injury
  - Compression by fixed object (ex. safety belt, steering wheel)
  - Deceleration result in injury to mesentery, large vessels, and solid organ capsule
- Diaphragm rupture and major pelvic fractures are associated with increased risk of intraabdominal organ injury
- **Incidence of organ injury** : spleen > liver

2) Penetrating abdominal trauma

- Magnitude of injury related to its kinetic energy
  - Stab wounds, low velocity
  - Gunshot wounds, high velocity

- **Incidence of organ injury**
  - Liver is the most commonly injured solid organ
  - Related to the volume occupied by the organ

Hospital resuscitation

- Prehospital personnel reports are helpful including mechanism of injury, vital signs, Glasgow Coma Scale (GCS) score.
- Once the patient arrives at the hospital, the “primary survey” is initiated to identify and treat life-threatening injuries.
- Laboratory studies, chest x-ray, pelvic x-ray, FAST, CT, DPL, etc.

Preoperative preparation

- ✓ Operating room setup
- ✓ Establishing or confirming a definitive airway
- ✓ Intravenous access
- ✓ Review of preoperative diagnostic evaluations

1) Operating room setup

- Properly functioning anesthesia machine, oxygen supply source, and various types of prepared airway
- Suction with Yankauer tip, pressure bags, and nasogastric/orogastric tubes
- Preassembled kits for intravenous catheters, arterial lines, and central venous lines
- Equipment for blood transfusion
- Rapid transfusion device with fluid warming
- Convective forced air warming blankets and warming pads

1) Operating room setup - Monitoring

- Patient's oxygenation, ventilation, circulation, and temperature should be continually evaluated.
  - — Pulse oximetry, non-invasive blood pressure monitoring, capnography, electrocardiography, core temperature monitoring

- Arterial and central venous access

- Dynamic monitors of fluid bolus responsiveness
  - — Systolic pressure variation (SPV), pulse pressure variation (PPV), stroke volume variation (SVV)

1) Operating room setup - Monitoring

- Exhaled gas CO_2 and nitrogen concentration for screening of air emboli
- Awareness monitoring – bispectral index (BIS)
- Transesophageal echocardiography (TEE)
  - Hemodynamic monitor and a diagnostic device (e.g., to detect pericardial tamponade)

2) Securing airway

- Establishing a definitive airway is the first priority
- Rapid sequence induction (RSI) and intubation
  - — Generally indicated due to the high risk of aspiration
- If predictably difficult, consider awake intubation
  - — Preferably utilizing a fiberoptic bronchoscope

3) Intravenous access

- Significant bleeding requiring large-volume resuscitation is common in abdominal trauma

- Placement of two large-bore upper-extremity intravenous (IV) catheters

➔ Located in venous systems drain into the superior vena cava (SVC)

- Administration of IV fluid to maintain a systolic blood pressure of 90-100mmHg
  - Mean arterial pressure (MAP) 80mmHg in patients with traumatic brain injury (TBI) or spinal cord injury

3) Intravenous access – Central line

- **Subclavian vein**
  - Can be cannulated in patients wearing a cervical collar
  - Lowest infection rate

- **Internal jugular vein**
  - Helpful for both volume administration and central venous pressure monitoring
  - Cannot be accessible in a patient with a cervical collar

- Femoral vein
  - Avoids the potential for pneumothorax, hemothorax, or arrhythmias
  - Unsuitable if there are extensive abdominal or lower extremity injuries

4) Review of preoperative diagnostic evaluations

- Hematocrit, serum chemistry, coagulation studies
- Chest and cervical spine radiographs should be reviewed prior to induction
- Evaluation of preoperative volume status by measuring blood pressure, heart rate, and systolic pressure variability (SPV)

➔ Determination of anesthetic technique, monitoring, and postoperative plans for the traumatized patient

Anesthetic considerations

- Anesthetic plan ; based on knowledge of the patient's injuries, age, known preexisting conditions, response to initial resuscitation, and surgical interventions.

- Communication with the surgeon is key with regard to how the surgery is progressing.

- Anesthesiologist should expect and be prepared for damage control procedure based on injury pattern and patient hemodynamics.

Induction of anesthesia

- Comatose patients in severe shock, and especially in complete cardiopulmonary arrest on admission

➔ Require nothing more than oxygen and possibly a neuromuscular blocking drug

— until the patient's blood pressure and heart rate rebound

- Analgesia and amnesia should be provided once the hemodynamic status becomes stable enough to tolerate anesthetic drugs
  - To prevent recall
  - Amnestic drugs include midazolam and scopolamine

Induction of anesthesia

- Etomidate is the best induction drug in awake traumatized hypovolemic patients
- Ketamine is also a suitable induction drug
- Propofol and thiopental are available if hemodynamically stable
- Succinylcholine and rocuronium (or vecuronium) for neuromuscular blockade

- Spinal and epidural anesthesia are contraindicated in the unstable abdominal trauma patient
  - — Impractical, takes time to set up, can result in several deleterious side effects

Maintenance of anesthesia

- Maintained with inhalational agents or with intravenous drugs such as propofol, with opioid supplementation

- Depending on the degree of hemorrhage, minimum alveolar concentration (MAC) may be decreased by as much as 25%
- All volatile anesthetics produce dose-dependent depression of myocardial contractility
  - Desflurane, isoflurane, and sevoflurane maintain cardiac output better than older agents
- Sevoflurane : best in the multiply injured trauma patient
- Nitrous oxide (N_2O) : avoided to limit bowel and closed-space gas accumulation

Replacing blood loss

- Utilization of high-capacity fluid warming devices for the rapid administration of blood products into tributaries of the SVC can be life-saving

- **Massive transfusion protocol (MTP)**
  - To insure rapid and timely administration of blood products, including coagulation factors
  - With rapid infusion system (RIS)
- Use autologous blood salvage devices (cell saver) with non-contaminated intra-abdominal blood

- Adverse consequences of massive transfusion
  - Coagulopathy, hypothermia, hypocalcemia, hyperkalemia, and hemolysis

Thermal management

- *Hypothermia increase morbidity and mortality* in severely injured patients
  - Affects the platelet coagulation process, promotes platelet sequestration
  - Reduces drug metabolism
  - Induces vasoconstriction
  - Combined hypothermia and acidosis, reflect a decrease in cardiac output and tissue perfusion.

- Moderate hypothermia (35.5-34.5℃) is neuroprotective.
  - Tolerated in certain conditions, especially when clinical manifestations of bleeding are absent

Neuromuscular blockade

- Muscle relaxation facilitates exposure during exploratory laparotomy.

- Rocuronium is often used in trauma patients due to its rapid onset.
- Vecuronium is often used because of its minimal effects upon the hemodynamic system.

Acid-base management

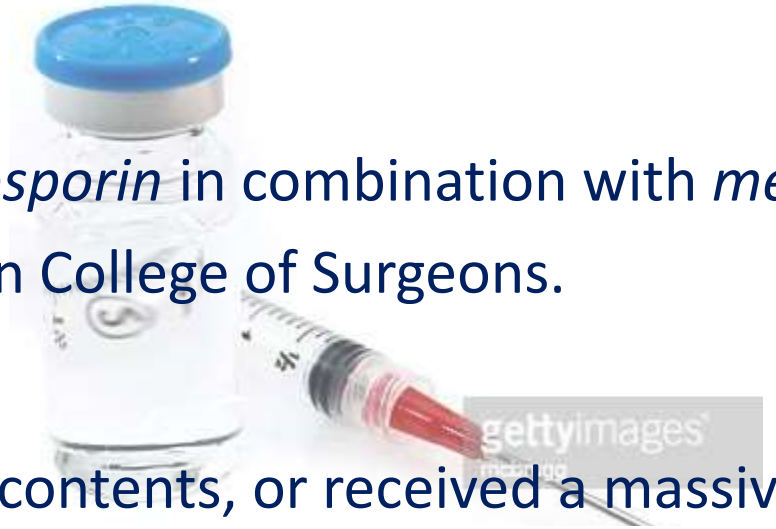
- Acidosis impairs myocardial contractility in response to both endogenous and exogenous catecholamines.

- Lactic acidosis should be treated by improving oxygen delivery including fluid replacement.

Antibiotics

- Preoperative (empiric/prophylactic) antibiotic therapy

  ➔ Broad-spectrum coverage of both Gram-positive & Gram-negative bacteria



- *3rd- or 4th-generation cephalosporin* in combination with *metronidazole* is recommended by the American College of Surgeons.

- Sustained gross spillage of gut contents, or received a massive transfusion,

  ➔ Antibiotics should be repeated more frequently.

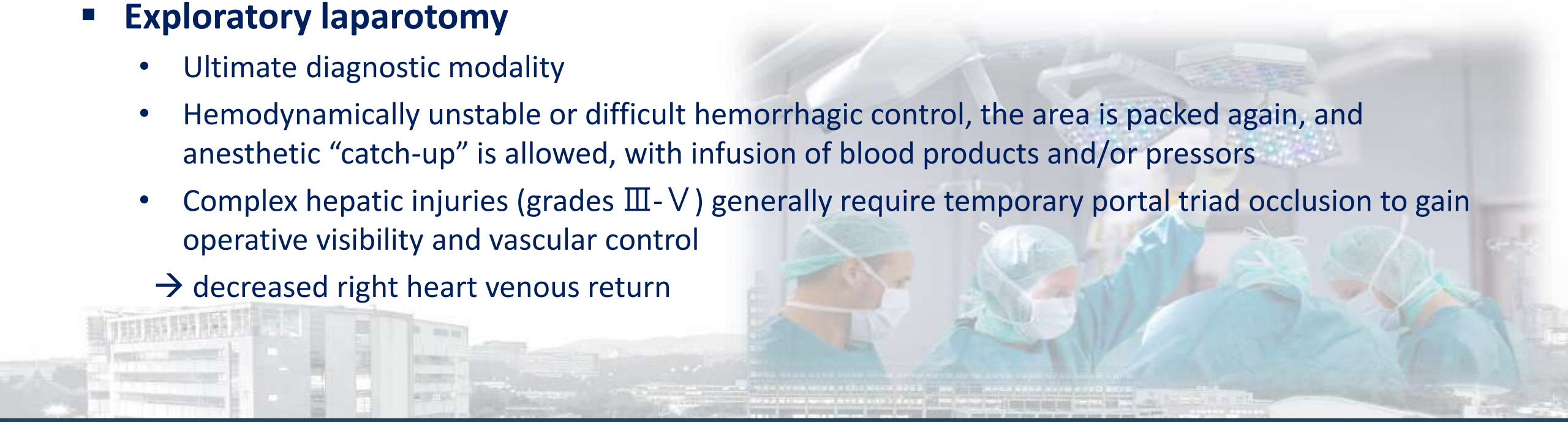
- Tetanus prophylaxis must be considered in every trauma patient.

Considerations related to the surgical approach

- **Diagnostic laparoscopy**
  - Less invasive, but limited visualization
  - Complications related to pneumoperitoneum ; tension pneumothorax, decreased venous return and cardiac output

- **Exploratory laparotomy**
  - Ultimate diagnostic modality
  - Hemodynamically unstable or difficult hemorrhagic control, the area is packed again, and anesthetic “catch-up” is allowed, with infusion of blood products and/or pressors
  - Complex hepatic injuries (grades Ⅲ-Ⅴ) generally require temporary portal triad occlusion to gain operative visibility and vascular control

  → decreased right heart venous return



Resuscitation for Damage control surgery

- In unstable, severely injured patients with metabolic derangements

- Hypotensive resuscitation:
  - Give warm IV fluid or blood with close attention to the rate of surgical bleeding
  - Maintain systolic blood pressure (SBP) at 80–90 mmHg until major bleeding has been controlled in patients without head trauma.

- Maintenance of blood composition and chemical equilibrium:
  - Initiate MTP with PRBCs, plasma, and platelets in a ratio close to 1:1:1.
  - Reduce the volume of crystalloids; avoid colloids
  - Target Hb of 7-9 g/dL; platelets >$50x10^9$/L

Resuscitation for Damage control surgery

- Preservation of homeostasis:
  - Restoration of end-organ perfusion:
    — pH >7.25, arterial carbon dioxide <50 mmHg and decreasing lactate level
  - Maintaining normothermia

- Analgesia and sedation should be continued in spite of hemodynamic instability:
  - Analgesia can be achieved with incremental doses of fentanyl.
  - Small boluses of ketamine and midazolam are also advocated.
  - Tracheal extubation is not expected at the end of surgery.

Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA)

- Inflation of the endovascular balloon : similar to aortic cross-clamping

➔ Increasing afterload and maintaining perfusion above the balloon, most importantly, to the heart and brain

- Anesthesiologist must be familiar with the physiologic implication of REBOA and be prepared to provide general anesthesia, neuromuscular blockade, and resuscitation.

Considerations related to the surgical approach

- **Abdominal compartment syndrome**
  - Increased intraabdominal pressure results in impairment circulation, decreased tissue perfusion, and organ dysfunction.
  - ↓Thoracic venous return, cardiac output, and renal function
  - ↓Tidal volume, ↑ventilatory pressures, and atelectasis
  - Cause venous hypertension and elevate intracranial pressure

➔ Post-decompression,

- Release of lactate and subsequent hypotensive hemodynamic changes
- IV fluid loading before abdominal decompression
- Vasopressors ; phenylephrine, norepinephrine, vasopressin
- Sodium bicarbonate, calcium chloride

Postoperative ICU considerations

- Focus is on ; continued fluid resuscitation, aggressive warming measures, control of coagulopathic bleeding, and normalization of acidosis

- Prevention of ongoing bleeding and shock, coagulopathy, hypothermia, abdominal compartment syndrome, acute lung injury, deep venous thrombosis and pulmonary emboli, and sepsis.

Goals for anesthetic management for abdominal trauma patient

- ✓ **Limit complications to other systems**
  - Monitor intracranial pressure, maintain cerebral perfusion pressure > 70mmHg
  - Monitor peak airway pressure and tidal volumes
  - Employ protective lung ventilation strategy
  - Measure urine output
  - Monitor peripheral pulses

Goals for anesthetic management for abdominal trauma patient

- ✓ **Re-establish and maintain normal hemodynamics**
  - For hypotension, fluid first, then vasopressors
  - Frequent evaluation of base deficit, hematocrit, urinary output
  - Titration of additional anesthetics if robust blood pressure

- ✓ **Maximize surgical exposure and minimize bowel edema**
  - Limit fluids according to needs
  - Limit blood loss by allowing anesthetic catch-up
  - Muscle relaxation should be optimized
  - Nasogastric or orogastric tube to decompress bowel
  - Avoid nitrous oxide (N_2O)

Goals for anesthetic management for abdominal trauma patient

- ✓ **Limit hypothermia**
  - Monitor core temperature
  - Warm all intravenous fluids and blood
  - Keep patient covered and warm the operating room (>28℃)
  - Apply convective warming blanket and warming mattress

- ✓ **Help limit blood loss and coagulopathy**
  - Encourage surgeon to stop and pack if blood loss excessive
  - Frequently monitor hematocrit, ionized calcium, coagulation studies
  - Provide calcium for large citrated product administration
  - Administer plasma, platelets, cryoprecipitate, and factor VIIa or prothrombin complex concentrate (PCC), as clinically indicated.

THANK YOU ☺