

Liver Transplant Set-Up

[Julianne Mendoza, M.D.](#)

- 1) Anesthesia Machine, Monitors, and Equipment
  - a. Sonosite ultrasound machine x2 and Doppler for line placement
  - b. Three transducers – 2 arterial, 1 CVP
  - c. OR Table:
    - i. Circulating water blanket – TURN ON TO 38.5 DEGREE CELSIUS
    - ii. Underbody Bair Hugger <40kg, lower body bair hugger > 40kg
    - iii. Temperature probe: nasopharyngeal
    - iv. 2 pulse ox probes:
    - v. NIBP
    - vi. 5-lead EKG
  - d. Infusion Pumps x8
  - e. Hotlines x2. Belmont for all patients > 40kg and if anticipate massive transfusion in patient > 15 kg. NOTE: BELMONT MUST BE PLUGGED DIRECTLY INTO RED WALL OUTLET
  
- 2) Airway
  - a. Duoderm for securing ETT
    - i. Optional: Benzoin to help Duoderm stick
  - b. Cuffed ETT
  
- 3) Equipment for induction and lines: place at foot of bed
  - a. Peripheral intravenous lines  
IV caddy from anesthesia tech at foot of bed
  - b. Arterial line – always placed under sterile conditions  
Check vascular access guide sheet for sizes by age

c. "IV" boat with T pieces

Four 10 ml syringes filled with heparinized NS attached to 3-way stopcocks then attached to T-piece to hook up to IV's and arterial lines immediately after placement. Also used to remove air bubbles. You can get the heparinized NS from the transducer setup.

Make large bore "T-piece" by disconnecting short most distal connection from blood pumps to 10 ml syringe of saline

d. "IV" boat #4: Induction agents

Syringes with following:

1. Chosen induction agent – propofol or ketamine
2. Paralytic
3. Fentanyl
4. Optional: 10 or 20 ml syringe of NS or Albumin

e. "IV" boat #5: Sharps

Keep empty boat to discard sharps

**4) Equipment for Central Line**

Placement:

Place on separate Mayo stand. Scrub hands and use sterile gloves/gown/mask for all central lines.

- a. Appropriately sized line- discuss with attending. Patient < 1 yo (10 kg) = 4 Fr, 8 cm, double lumen. Patient > 1yo (10 kg) = 5 Fr, 8 or 13 cm, double lumen
- b. Sterile 10x30 drape with fenestration- use instead of opaque drape that comes in kit so you can see landmarks
- c. Site-Rite kit which includes sterile ultrasound gel and sleeve for probe
- d. 20 cc syringe of NS for flush
- e. 22 g IV angiocaths
- f. Extra 3-way stopcock to be connected to each lumen of CVP so there's a way to remove air bubble at last minute.
- g. Biopatch- infection prevention device or CHG-tegaderm

**5) Equipment for Femoral and Upper Extremity Arterial Lines Placement:**

Place on Separate Mayo stand. Sterile gloves/gown/mask

- a. Appropriately sized line for femoral or axillary- discuss with attending. Patient < 1 yo (10 kg) = 3 Fr 5 cm. patient > 1yo (10 kg) = 3Fr 8 cm, adolescents > 30kg = 20g single lumen central line
- b. 22g or 20g angiocatheters for radial or ulnar arter

## 6) Extra Equipment

- a. IV boat on anesthesia cart with blood gas supplies
  - i. EG-7 I-STAT cartridges and lactate cartridges
  - ii. Prepackaged pedi ABG syringes with heparin powder
  - iii. Order ABG slips on computer to have ready in room before transplant (need approximately 16 slips), also order DIC panel (blue top), and CBC (lavender top) slips to have for after reperfusion.
  - iv. TEG paper order slips and blue top vials for TEG samples
- b. Orogastric/nasogastric tube

## 7) "Tower of Power" IV pole:

To left of OR  
Table

- a. 8 Infusion syringe pumps with power cords
- b. Carrier: Glucose containing solution D5-D10 (concentration depends on underlying liver function)
- c. Dopamine start @ 3-5 mcg/kg/min
- d. Epinephrine start @ 0.03-0.05 mcg/kg/min
- e. CaCl start @ 10 mg/kg/h
- e. Fentanyl start @ 2-3 mcg/kg/h
- f. Optional
  - i. Rocuronium
  - ii. Ketamine
  - iv. Octreotide – for patients with portal hypertension, discuss with attending, turn off after reperfusion – notify surgeon when turning off  
1-2 mcg/kg/h for patients < 40 kg  
50-100 mcg/h for adult patients
  - v. Vasopressin – for all small bowel transplants, for patients > 40 kg with cirrhosis in whom you expect low SVR

## 8) "Metabolic cocktail" for patients with metabolic disease, discuss with attending

## 9) Drugs

- a. Hypnotic/Analgesics/Paralytics
  - i. Midazolam
  - ii. Ketamine – 1-4 mg/kg total dose for case
  - iii. Propofol
  - iv. Fentanyl – discuss with attending dosing goal, consider 25-50 mcg/kg total dose for case including IVP and infusion
  - v. NDMR – Rocuronium vs. pancuronium vs. vecuronium
- b. Resuscitation
  - i. Atropine Dose: 10-20 mcg/kg
  - ii. Glycopyrrolate
  - iii. Phenylephrine
  - iv. Ephedrine
  - v. Epinephrine – 10 ml syringes at 10 mcg/ml and 1 mcg/ml
  - vi. Calcium Chloride – 10 ml syringe of 100 mg/ml. Dose: 10 mg/kg
  - vii. Sodium bicarbonate – 3 unit doses available. Dose: 1 mEq/kg
  - viii. Albumin 5% - 20 ml and 10 ml syringes
  - vii. Vasopressin – for small bowel/liver transplants and consider if unstable on other pressors – adult dose 0.04

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units/min = 1 milliunit/kg/min. 1 unit = 2.5 mcg.

c. Hyperkalemia

- i. Insulin – Dose: 0.1-0.2 units/kg. Make 100 ml bag of 1 unit/ml insulin. (Discuss with attending whether to have in room or have drawn up)
- ii. Dextrose 50 – Dose: 0.5 gm/kg
- iii. Sodium bicarbonate
- iv. Calcium chloride
- v. Lasix Dose: 0.5-1 mg/kg

d. Steroid

- i. Hydrocortisone 20 mg/kg (most common), Confirm medication and dose with surgeon. Give when anhepatic.  
Note: surgeon may in rare instances request methylprednisolone 5-10 mg/kg instead of hydrocortisone – in which case please discuss with surgeon regarding timing of administration.

e. Antibiotics

- i. Consult with surgeon
  1. Zosyn 10 mg/kg every 8 hours OR
  2. Ceftriaxone 50 mg/kg every 12 hours OR
  3. Ampicillin (50 mg/kg) and Cefotaxime (40 mg/kg)

f. Dextran

5-10 ml/kg given over 30 minutes to 4 hours. Upon surgeon's request, discuss with surgeon dose and infusion time and when to give – usually after hepatic artery anastomosis if patient is hemodynamically stable

**10) Fluids:**

- a. Normal saline or Normosol – avoid LR in liver failure patients
- b. Albumin 5%
- c. Dextrose

**11) Veno-veno Bypass**

- a. Requirements – patient must be > 40 kg
- b. Indications – portal hypertension (decompresses splanchnic circulation), acute liver failure, to avoid loss of preload from lower cava, preserve renal vein drainage
- c. Cons: heat loss, risk of air embolism
- d. Cannulas – 15 French RIJ or left axilla, 17 French left femoral vein, 23-27 French portal vein.
- e. Goals: partial bypass (excluding portal vein - >1L/min flow), full bypass (>2L/min)
- f. Obtaining vascular access
  - i. Inflow catheter – Surgeon to place RIJ 15Fr catheter after anesthesiologists have placed other lines. If there is concern for cerebral edema or impaired venous drainage from head with large bore access in both IJs then attending anesthesiologist to discuss with attending surgeon left axillary vein access either percutaneous or cutdown to be done by surgeons.
  - ii. Outflow catheters – Anesthesiologist to place single lumen 18g 12 cm CVL in left femoral vein for surgeon to wire to 17 French cannula during surgery. Surgeons place portal vein cannula during dissection phase.



## Phases of Liver Transplantation

### 1. Dissection phase

- a. Temperature control - Keep patient warm because there is significant temperature loss with open abdomen and anticipate further loss upon reperfusion with cold liver.
- b. Consider correcting coagulopathy – This is uncommon except for fulminant hepatic failure, discuss with surgeon before giving product.
- c. Watch for hypocalcemia if transfusing or using albumin
- d. During dissection of porta hepatis may see decrease in venous return and hypotension when vena cave cross clamped – correct with volume or vasopressors
- e. Check potassium - consider measures to get K<sup>+</sup> level to <3-3.5 before reperfusion
- f. ABG hourly at least – send ABG and perform iSTAT for baseline.  
Limitations of iSTAT – hematocrit may be lower than reported in lab, no glucose result

### 2. Anhepatic phase

#### a. Expect:

- i. decreased venous return – consider vasopressors to correct blood pressure, avoid high CVP because may lead to congestion of liver allograft upon reperfusion
  - ii. worsening acidosis, hypothermia and hypoglycemia, hypocalcemia
- b. Goals: neutral pH, K < 3.5, iCa >1.2, check ABG every 15 minutes
- c. Give steroid when native liver out, at surgeon's request
- d. With 10 minutes warning until reperfusion:
- i. 100% FiO<sub>2</sub> and volatile gas off (consider ketamine IVP)
  - ii. pH neutral
  - iii. start epinephrine infusion at 0.03-0.05 mcg/kg/min
  - iv. Carrier for infusions with full syringe
  - v. Epinephrine boluses in line
  - vi. Full fluid bags
  - vii. Blood checked and ready to transfuse

### 3. Reperfusion stage

#### a. Expect:

- i. Decrease in MAP up to 30% with bradycardia and increased pulmonary vascular resistance secondary to infusion of metabolites from liver allograft.
  - ii. May see significant temperature drop with reperfusion of cold allograft.
  - iii. Potassium load on reperfusion – watch for peaked T waves, bradycardia to asystole.
- b. Consider bolus CaCl and/or epinephrine on reperfusion to avoid hypotension and bradycardia.
- c. Check ABG soon after reperfusion
- d. Watch resuscitation with CVP monitoring to avoid giving too much

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volume and causing allograft congestion (though expect high  
insensible losses)

- e. May see hyperglycemia after steroid bolus– consider insulin infusion if needed
- f. Hct 25-30 – Hct >30 risks hepatic artery thrombosis
- g. Avoid hypotension because increases risk of hepatic artery thrombosis  
–  
    treat with vasopressors rather than volume. Keep MAP > 60 in  
        infants.
- h. High insensible losses
- i. Consider long-acting opioid if hemodynamically stable

- j. Send coagulation panel and CBC from OR for ICU management
- k. Continue frequent ABG