Intestine Transplantation Protocol

Recipient

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<thead>
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</tr>
</thead>
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</tbody>
</table>

Intestine Transplantation (Recipient) CPT Code: 44135 (cadaver) 44136 (living)

This protocol is intended as a guideline only and may need modification according to the patient’s condition, surgical protocol, and clinical studies in progress. Please check with the attending transplant anesthesiologist.

General Information

In patients with intestinal failure (= inability maintain a sufficient nutritional, electrolyte and fluid balance for more than 1 month without TPN) secondary to Crohn’s disease, superior mesenteric artery or vein thrombosis, trauma, etc – a condition that can be complicated by progressive liver failure - small bowel transplantation may be the only remedy. Because of long-term TPN infusions central venous access may be complicated by central vein thrombosis. Patients undergoing intestinal transplantation may have concurrent hepatic disease due to hepatoxicity of long-term TPN. Therefore, the anesthesiology team should be set-up with vasopressors and infusion lines for possible larger blood losses.

The patient will usually arrive in the holding area with an iv-line in situ. Please check the proper function of this line. Other lines can be placed in the OR under sterile conditions after induction of anesthesia. Sterility in transplant patients is paramount because infection is the main cause of postoperative death after solid organ transplantation in the immune-suppressed patient!
OR set-up

- Transplant anesthesia cart
- Standard pre-filled syringe kit
- Cisatracurium, 20 mg, 5 vials
- Fentanyl, 1000 mcg, 1 vial
- Furosemide, 20 mg, 3 vials
- Calcium Chloride, 1000 mg, 10 ml syringe(s)
- Epinephrine, 10 μg/ml, 10 ml syringe
- Epinephrine, 100 μg/ml, 10 ml syringe
- NaHCO₃, 50 mmol, 50 ml syringe(s)
- Phenylephrine, 100 μg/ml, 10 ml syringe
- 2 Alaris peristaltic 4-channel infusion pumps + tubing
- 2 Alaris syringe pumps + tubing
- Epidural infusion pump + tubing

Infusion solutions for infusion pumps:

<table>
<thead>
<tr>
<th>Infusion solution</th>
<th>Baseline infusion rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dopamine, 400 mg, 250 ml D5W</td>
<td>3 – 20 mcg/kg/min (infuse 3 mcg/kg/min throughout operation)</td>
</tr>
<tr>
<td>NaCl 0.9%, 1000 ml</td>
<td>50 ml/hour (carrier fluid)</td>
</tr>
</tbody>
</table>

Infusion solutions for Alaris syringe pumps:

<table>
<thead>
<tr>
<th>Infusion solution</th>
<th>Baseline infusion rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisatracurium, 40 mg, 20 ml syringe</td>
<td>0.8 – 1 mcg/kg/min</td>
</tr>
<tr>
<td>Fentanyl, 1000 μg, 20 ml syringe</td>
<td>1 – 5 mcg/kg/hr</td>
</tr>
</tbody>
</table>

Blood products: 1000 ml 5% Albumin in OR, 2 units packed cells, 6 FFP (unthawed), 1 Cryoprecipitate (unthawed) should be available in house for the patient.

Plasmalyte is the preferred crystalloid i.v.-solution

Mannitol 20%, 1000 ml (see protocol for details).

Preoperative patient management in the holding area

The patient preparation for an intestine transplantation requires about 2 hours. When the patient has arrived in the holding area, give Midazolam, 2 mg, i.v., to lower anxiety, and apply oxygen by nasal prongs or mask, and a pulse oximeter. Start antibiotics to give the patient an additional cover for the insertion of lines in the holding area and in the OR.

Insert an epidural catheter for intra-operative nociception control and post-operative pain relief under sterile conditions, if clotting screen permits. The patient will undergo a laparotomy from the xiphoid to the pubic bone and will benefit from an epidural infusion. As soon as the epidural catheter has been inserted, order an epidural infusion (Bupivacaine 0.1% + Fentanyl 2 mcg/ml) from pharmacy.

The patient may arrive in the holding area with the following medication:

- Methylprednisolone 1000mg IV x 1 (repeat x 1 if OR > 12hrs or if > 10 units blood transfused).
- Anti-thymocyte globulin (ATG) 1.5mg/kg (dose rounded to nearest 25mg). To be infused towards the end of surgery. Ask surgeon for right timing.
- Pre-op Antibiotics (start infusion in holding area)
  - Ertapenem 1g iv x 1
  - Vancomycin IV x 2 doses given 6hrs apart. Weight-based dose: 50-70kg=1g, 71-100kg=1.5g, >100kg=2g.
  - Fluconazole 400mg iv
- Pre-op Antibiotics for hx of anaphylaxis or hives to PENICILLIN
  - Levofloxacin 750mg iv x 1
Metronidazole 1000mg x 1 then 500mg 8hrs later.
Vancomycin IV x 2 doses given 6hrs apart. Weight-based dose: 50-70kg=1g, 71-100kg=1.5g, >100kg=2g.

<table>
<thead>
<tr>
<th>Class</th>
<th>Methylprednisolone</th>
<th>Thymoglobulin (ATG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contraindications</td>
<td>Hypersensitivity to drug, Systemic fungal infections</td>
<td>Allergy to rabbit proteins, Acute viral or bacterial illness</td>
</tr>
<tr>
<td>Adverse Effects</td>
<td>Hyperglycemia, Hypertension, Leukocytosis, Edema, Itching, Psychosis/hallucination</td>
<td>Fever, chills, HA, Hyper or Hypotension, Anaphylaxis, Pulmonary edema, SOB, Tachyarrhythmia</td>
</tr>
</tbody>
</table>

### Preoperative patient management in OR

Patients for intestinal transplants are usually on long-term TPN so that nil-by-mouth time shouldn’t be an issue.

After the patient is anesthetized, insert:
- Nasogastric tube (if not already in situ)
- 1 Triple-Lumen CVP line preferably into the right internal jugular vein. Use Site Rite because patients on long-term TPN infusions may have developed venous thrombosis!

After all lines have been placed, connect:
- the hotline to the brown port of the Triple Lumen CVP line
- the infusion pumps to the white port of the Triple Lumen CVP line
- the CVP line to the blue port of the Triple Lumen CVP line

Draw baseline arterial blood gas sample (blood gas syringe) and ThrombElastoGraph (TEG) blood sample (blue topped vial & lavender topped vial, don’t forget to label the tubes).

Start epidural infusion at ~10ml/hr (depending on patient size).

### Intraoperative patient management

**Removal of the recipient's intestine (dissection stage)**
- Removal of the recipient’s intestine may take many hours. The blood loss during the resection stage should be minimal, but can be higher secondary to oozing in case of progressive accompanying liver failure with abnormal clotting screens.

**Recirculation stage**
About 15-20 minutes prior to recirculation of the intestinal graft, infuse Mannitol 20%, 1g/kg bolus. After recirculation of the intestinal graft there may be a period of moderate hemodynamic instability, due to circulating oxygen free radicals and the release and accumulation of cytokines. Support patient with fluids (CVP = 12-14 mmHg) and, if necessary, vasoactive agents. Too little fluid load can impair the intestinal graft’s perfusion, while fluid overload may cause mucosal edema in the intestinal graft that can impede the grafts anastomoses. If Mannitol alone will not prevent fluid overload, give Furosemide boluses. Check blood gases and TEG as required and correct acidosis and coagulopathy.
Postoperative patient management

After surgery has finished, the patient will either get extubated in the OR or stays intubated and ventilated, and will be directly transferred to ICU.

Insulin infusion protocol

Start insulin infusion according to algorithm to keep serum glucose levels 70-100 mg/dl. If despite insulin infusion, serum glucose levels are > 300 mg/dl, give additional insulin boluses until serum glucose levels are 200 mg/dl or less.

**Insulin infusion**: 100 ml NACL with regular human insulin 100 units -> **Concentration of solution**: 1 unit / ml

<table>
<thead>
<tr>
<th>Blood Glucose (mg/dl)</th>
<th>Insulin Infusion Rate (units/hr)</th>
<th>IV-Infusion Rate (ml/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 70</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>70-109</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>110-119</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>120-149</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>150-179</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>180-209</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>210-239</td>
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<tr>
<td>240-269</td>
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<td>5</td>
</tr>
<tr>
<td>270-299</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>300-329</td>
<td>7</td>
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</tr>
<tr>
<td>330-359</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>&gt;359</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>
Intestine Transplantation Protocol

Recipient

FLOW CHART

OR set-up

- Transplant anesthesia cart in OR
- Cisatracurium, 20 mg, 5 vials
- Fentanyl, 1000 μg, 2 vials
- Furosemide, 20 mg, 3 vials
- Standard OR-syringe kit
  - Calcium Chloride, 1000 mg, 10 ml syringe(s) prepared
  - Epinephrine, 10 μg/ml, 10 ml syringe prepared
  - Epinephrine, 100 μg/ml, 10 ml syringe prepared
  - NaHCO₃, 50 mmol, 50 ml syringe(s) prepared
  - Phenylephrine, 100 μg/ml, 10 ml syringe prepared
- 2 Almris peristaltic 4-channel infusion pumps + tubing
- 2 Alaris syringe infusion pumps + tubing
- 1 CADD-Prizm® PCS II epidural infusion pump + tubing

Infusion solutions for IMED infusion pumps:

- **Infusion solution**
  - Dopamine, 400 mg, 250 ml D5W  
  - NACL, 1000 ml  
  - Mannitol 20%, 1000 ml

Baseline infusion rate:
- 3 mcg/kg/min (infuse throughout operation)
- 50 ml/hour (carrier fluid)
- (see protocol for details)

Infusion solutions for Alaris Syringe pumps:

- **Infusion solution**
  - Cisatracurium, 40 mg, 20 ml syringe
  - Fentanyl, 1000 μg, 20 ml syringe

Baseline infusion rate:
- 0.8 – 1 mcg/kg/min
- 2 – 5 mcg/kg/hr

Blood products:
- 1000 ml 5% Albumin in OR
- 2 units packed cells in house
- 6 units unthawed FFP in house
- 1 unit unthawed Cryoprecipitate in house
Preoperative patient management in the holding area

- **Ertapenem 1g iv x 1**
- **Vancomycin IV x 2 doses given 6hrs apart. Weight-based dose: 50-70kg=1g, 71-100kg=1.5g, >100kg=2g.**
- **Fluconazole 400mg iv**
- **Midazolam, 2 mg, iv, given**
- **1 arterial line (preferably right or left radial artery) inserted**
- **Epidural catheter inserted and epidural infusion ordered from pharmacy**

Preoperative patient management in OR

After the patient has been put to sleep:

- **Triple-Lumen CVP line in preferably right internal jugular vein** inserted. Use Site Rite if necessary!

After all lines have been placed:

- **Hotline connected to brown port of the Triple-Lumen CVP line**
- **Infusion pumps connected to white port of the Triple-Lumen CVP line**
- **CVP line connected to blue port of the Triple-Lumen CVP line**
- **Methylprednisolone 1000mg i.v., given after induction of anesthesia (if not already given on the floor)**
- **Baseline arterial blood gas sample** (blood gas syringe) and **ThromboElastoGraph (TEG) blood sample** (blue topped vial & lavender topped vial) taken, accompanying forms completed (see laminated sample forms in OR) and all sent to lab.

- **Epidural infusion started**

Intraoperative patient management

- **2 units packed cells** checked
- **5 blue topped vials** labeled
- **5 lavender topped vials** labeled
- **5 ThromboElastoGraph (TEG) forms** prepared (see laminated sample forms in OR-13)
- **5 blood gas forms** prepared (see laminated sample forms in OR-13)
- **Anti-thymocyte globulin (ATG) 1.5mg/kg (dose rounded to nearest 25mg).** To be infused towards the end of surgery. Ask surgeon for right timing.