Liver Transplant Pathway v7.0: Table of Contents

Stop and Review

Inclusion Criteria
- Patient admitted for liver transplant surgery

Exclusion Criteria
- Kidney or intestine transplant

Liver Transplant Care

- Admission
- Intra-Op
- Post-Op Critical Care
- Post-Op Acute Care

Appendix

- Version Changes
- Approval & Citation
- Evidence Ratings
- Bibliography
Liver Transplant Pathway v7.0: Admission

Inclusion Criteria
• Patient admitted for liver transplant surgery
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Exclusion Criteria

Drawing Labs (high priority)
• Nurse draw or contact lab or VAS team to draw lab ASAP
• If VAS team unavailable, contact shift administrator to request assistance from ICU or ED
• Hand-deliver blood samples to lab, do NOT use tube system
• See here for lab schedule
  • OK to exceed maximum daily draw volume for admit labs (patient can receive blood products in OR if necessary)
  • Call transplant surgery with concerns.

Admitting Procedure
• Schedule: patient and family will arrive at Seattle Children’s Hospital after being notified by the Transplant Coordinator of the available donor organ
• Transplant Coordinator notifies
  • Shift administrator to create preadmit encounter
  • VAS team to be prepared to draw stat labs and start peripheral IV (regardless of current access)
• Charge nurse on receiving unit at least 60 minutes before patient arrives
• Also PICU charge, ED com nurse, ED security, main lab, HLA lab, pharmacy, blood bank
• Patient
  • Goes to River C 6 surgical unit for height, weight, labs, and admission
  • Will be admitted to a single room on River 6 whenever possible

For questions or clarification, contact Transplant Nurse Coordinator On-Call via paging operator (do not contact OR or Transplant Nurse Coordinator to request surgery time or for inpatient orders)

Surgical Team
• APP weekdays; surgical hospitalist or attending surgeon on call after hours, weekends, and holidays
• Orders Liver Transplant Pre-procedure Admission including
  • OR antibiotics, blood products, lab, and radiology
  • Case request
  • Orders Liver Transplant Thymoglobulin (or Basiliximab) Immunosuppression
  • Completes required forms
    • H&P note
    • Consent to Operation Form 45101
    • Informed Consent for Transfusion Form 51365
  • Completes HSCT_Organ Transplant form in EHR
  • Surgeon will estimate OR time
  • Contact transplant surgery team for questions about orders

Anesthesiologist
• Sees patient and completes pre-procedure anesthesia documentation

Nursing Preprocedure
• Obtain height and weight; enter into EHR immediately
• Sign and release pre-procedure admission orders in EHR
• Draw labs (see Drawing Labs box above)
• After lab draw, send patient to radiology for chest x-ray
• Verify labs are being processed
• Check EHR for results. If uncertain, contact lab for clarification.
  • Confirm lymphocyte cross match and HLA typing (if ordered) have been sent and received at BloodWorks Northwest (BWNW) HLA Lab 206-689-6525
• Complete nursing documentation on preprocedure tab
• Confirm the following forms are in chart and completed by Surgical Team
  • H&P note or addendum
  • Consent to Operation Form 45101
  • Informed Consent for Transfusion Form 51365
• Ensure patient is NPO and has IVF/TPN infusing
• Check Blood Admin Navigator to confirm blood is available
  • ≤30 kg: 5 units RBC, 3 units plasma
  • >30 kg: 10 units RBC, 6 units plasma
• Bathe patient with chlorhexidine
  • See Pre-Operative P&P 10854 (SCH only)
• OR notifies floor when they are ready (do not contact transplant coordinator or OR to request surgery time)
• Orient family to surgical floor, PICU Waiting Area, and PICU Front Desk. Obtain pager for updates from operating room staff

Phase Change
• To Intra-Op

Stop and Review

To Table of Contents
Liver Transplant Pathway v7.0: Intra-Op

**Inclusion Criteria**
- Patient admitted for liver transplant surgery

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**Phase Change**
- From Admission

**Operating Room**
- **Circulating Nurse**
  - Complete Organ Chain of Custody Form in EHR
  - Pre-Transplant ABO Verification by licensed healthcare professional, if recipient’s surgery starts before organ arrives

- **Anesthesiologist**
  - Confirm interoperative antibiotics ordered, and release orders
  - Check for blood availability
  - Release Liver Transplant Thymoglobulin (or Basiliximab)
  - Order hydromorphone, D5LR, vasoactive infusions as needed
  - Complete preprocedure anesthesia documentation

- **Operative Team**
  - In addition to standard surgical checklist:
    - ABO Verification
    - Blood products ordered
    - Organ status

**Close of Case**
- **Circulating Nurse**
  - Document graft reperfusion time in surgical record in EHR
  - Follow process for vessel storage P&P
  - Send donor lab sample to lab for HLA crossmatch
  - Call consult PICU charge nurse when surgeon is closing

- **Surgical Signout**
  - Complete ABO Verification
  - Extubation plan

**Phase Change**
- To Post-Op Critical Care

**Phase Change**
- From Admission

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Liver Transplant Pathway v7.0: **Post-Op Critical Care**

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**Phase Change**
- From Intra-op

**OR to PICU Handoff**
- Surgeon and anesthesiologist handoff to PICU
  - Use Postoperative Handoff Template (OR/IR to ICU)
  - Clarify pain management plan

**Postoperative Management**

**Transplant Team Orders**
- Liver Transplant Post-procedure Order Set
- PICU RN to release orders

**Medications**
- Immunosuppression, refer to patient-specific roadmap, found in media tab in EHR, based on Immunosuppression for Liver Transplant P&P 10536 (*SCH only*)
- Surgical antibiotic prophylaxis x 24 hours
- Trimethoprim-sulfamethoxazole
- Ganciclovir based on recipient/donor CMV status P&P 10652 (*SCH only*)
- Nystatin
- Pantoprazole
- Thrombosis prevention, Liver Transplant Anticoagulation GOC 12548 (*SCH only*)
- Acetaminophen
- ICU Team manages pain/sedation per Comfort and Sedation in the ICU GOC 10270 (*SCH only*)

**Investigations**
- Labs see appendix GOC Post Liver Transplant 10842 (*SCH only*)
- Ultrasounds post-operative day 1, 2, 4

**Hematology**
- Keep 2 units of RBC cross-matched for 24 hours post-op
- Plasma transfusion 5 mL/kg IV over 4 hours, every 12 hours for 4-6 total doses
- Dextran infusion x 3 days

**Guideline of Care (GOC) and Clinical Policy and Procedure (P&P)**
- Post Liver Transplant GOC 10842 (*SCH only*)
- Liver Transplant Anticoagulation GOC 12548
- Comfort and Sedation in the ICU GOC 10270
- Intubated/Mechanically Ventilated GOC 10198 (*SCH only*)

**To Table of Contents**

For questions concerning this pathway, contact: [LiverTransplantPathway@seattlechildrens.org](mailto:LiverTransplantPathway@seattlechildrens.org)

If you are a patient with questions contact your medical provider, [Medical Disclaimer](#)
Liver Transplant Pathway v7.0: Post-Op Acute Care

Stop and Review

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Exclusion Criteria
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Phase Change
• From Critical Care

Postoperative Management – Surgical Floor

Guideline of Care (GOC) and Clinical Policy and Procedure (P&P)
• Post Liver Transplant GOC 10842 (SCH only)
• Infection Prevention for Organ Transplant Patients P&P 10559
• Liver Transplant Anticoagulation GOC 12548 (SCH only)
• Liver Biopsy GOC 10632 (SCH only)
• If gastric tube: Gastric Suction P&P 10460 (SCH only)
• Peripheral Intravenous (PIV) Management P&P 12664
• Central Venous Catheter (CVC) Management P&P 12665

Labs:
• See appendix Post Liver Transplant GOC 10842 (SCH only)

Medications - See Patient-Specific Roadmap in EHR
• Immunosuppression, refer to patient-specific roadmap, found in media tab in EHR, based on Immunosuppression for Liver Transplant P&P 10536 (SCH only)
• Thrombosis prevention OR aspirin 12548 (SCH only)
• Valganciclovir based on recipient/donor CMV status P&P 10652 (SCH only)
• Trimethoprim-sulfamethoxazole
• Nystatin
• Magnesium if needed
• Acetaminophen and/or oxycodone PRN

Consults
• Child Life
• Social work

Discharge Criteria
• Good graft function
• Therapeutic immunosuppression at target goals
• Afebrile
• Stable nutritional status
• Tolerating fluid goals and enteral medications
• Completed teaching: nursing, pharmacy, dietitian, social work
• Follow-up appointment scheduled

Discharge Instructions
• Follow up appointment(s) and blood draws communicated to patient and family
• If applicable: PE1262 Bile Drainage Tube (Catheter)

! Draw tacrolimus levels as trough at 0830h Administer AM tacrolimus at 0900h

! No ill care providers or visitors. No flowers or plants.

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### Liver Transplant Pathway v7.0: Admit Labs

#### Hematology:
- CBC/diff
- PT/INR
- PTT
- Thrombin Time
- Fibrinogen
- TEG (must be sent stat)

<table>
<thead>
<tr>
<th>Normal volume:</th>
<th>Micro volume:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 lavender = 1 mL</td>
<td>1 lavender microtainer = 0.5 mL</td>
</tr>
<tr>
<td>2 lt blue citrate = 1.8 mL in each</td>
<td>2 lt blue citrate = 1.8 mL in each</td>
</tr>
</tbody>
</table>

#### Chemistry:
- Basic Metabolic Panel
- Magnesium
- Phosphorus
- Hepatic Function Panel
- GGT
- Liver Transplant Listing
- Bilirubin Levels
- + HCG for female ≥ 12 years

**CA - ionized**

<table>
<thead>
<tr>
<th>Normal volume:</th>
<th>Micro volume:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 gold = 1 mL</td>
<td>Heparanized syringe = 0.5 mL</td>
</tr>
<tr>
<td>+ Female ≥ 12 yr: 1 gold = 1 mL</td>
<td></td>
</tr>
</tbody>
</table>

#### Virology (if ordered):
- CMV IgG/IgM, EBV IgG/IgM
- Hep B Battery
- Hep C Antibody, PCR Quant
- HIV Antigen and Antibody

<table>
<thead>
<tr>
<th>Normal volume:</th>
<th>Micro volume:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 red top = 6 mL</td>
<td>1 red top = 4 mL</td>
</tr>
<tr>
<td>1 lavender = 3 mL</td>
<td>1 lavender = 3 mL</td>
</tr>
</tbody>
</table>

#### Other:
- ABO/Rhd and Antibody Screen (Type and Screen) for Liver Pack blood order
  - If incompatible transplant, ABO Incompatible Liver Titers, Anti-A or Anti-B
- *HLA Lymphocyte Crossmatch
- *HLA Typing and HLA antibody detection (if not already done)
- Urinalysis and culture
- COVID-19 test (nasal swab)

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#### Patient Weight Sample Requirements (no serum separator)

<table>
<thead>
<tr>
<th>Weight Range</th>
<th>Normal volume:</th>
<th>Micro volume:</th>
</tr>
</thead>
<tbody>
<tr>
<td>9-13 kg:</td>
<td><strong>ACD = 10 mL</strong></td>
<td>1 red top = 5 mL</td>
</tr>
<tr>
<td>14-21 kg:</td>
<td><strong>ACD = 20 mL</strong></td>
<td>1 red top = 5 mL</td>
</tr>
<tr>
<td>22+ kg:</td>
<td><strong>ACD = 30 mL</strong></td>
<td>1 red top = 7 mL</td>
</tr>
</tbody>
</table>

**Note:**
- Call BloodWorks Immunogenetics Lab (206) 689-6580 for HLA sample requirement questions and for patients less than 9 kg
- **ACD** tubes. Attach Bloodworks Northwest form.
Summary of Version Changes

- **Version 1.0 (4/29/2014):** Go live.
- **Version 2.0 (11/13/2014):** Reduced plasma dose, clarified line placement requirements upon admit, removed link to blood draw limits.
- **Version 3.0 (1/22/2016):** CSW Value Analysis completed, changes include to recommend core labs over ePOC (use ePOC when speed is more important than accuracy).
- **Version 4.0 (4/4/2016):** Added additional information for Admit Labs.
- **Version 4.2 (9/25/2017):** Renamed email address.
- **Version 5.0 (1/10/2019):** Updated anticoagulation recommendations.
- **Version 6.0 (4/6/2021):** Full approval go live with new formatting style and some content changes: updated anesthesia protocol and aligned verbiage to correspond with Epic.
- **Version 7.0 (9/21/2022):** Full approval go live with content changes
  - Updated policy and guideline names and links
  - Updated workflow including postop ultrasound schedule
  - Removed reference to standard immunosuppression protocol with dosing
Approval & Citation

Approved by the CSW Liver Transplant Pathway team for September 21, 2022, go-live

CSW Liver Transplant Pathway Team:

Transplant, Surgery Co-Owner          Patrick Healey MD
Transplant, Nurse Practitioner Co-Owner Christine Lundberg, ARNP
Transplant, VP Surgical Services      Andre Dick, MD
Transplant, Anesthesiologist          Agnes Hunyady, MD
Acute Care, CNS                       Kristine Lorenzo, MSN, ARNP-CS, ACCNS-P, CPN
Transplant, Hepatology                Pamela Valentino, MD MSc
Critical Care, CNS                    Roberto Alanis, DNP, ARNP-CS, ACCNS-P, CPN
Transplant, Quality Manager           Susan Stockemer, BA
Transplant, OR Service Lead           Stella Suan, RN

Clinical Effectiveness Team:

Consultant & Literature Reviewer      Jennifer Hrachovec, PharmD, MPH
Data Analyst                          Eka Utama
Librarian                             Susan Klawansky, MLS
Literature Reviewer                   Eileen Reichert, ARNP
Program Coordinator                   Ann Yi, MPA

Clinical Effectiveness Leadership:

Medical Director                      Darren Migita, MD
Operations Director                   Jaleh Shafii, MS, RN, CPHQ

Retrieval Website:                   https://www.seattlechildrens.org/pdf/liver-transplant-pathway.pdf

Please cite as:
Evidence Ratings

This pathway was developed through local consensus based on published evidence and expert opinion as part of Clinical Standard Work at Seattle Children’s. Pathway teams include representatives from Medical, Subspecialty, and/or Surgical Services, Nursing, Pharmacy, Clinical Effectiveness, and other services as appropriate.

When possible, we used the GRADE method of rating evidence quality. Evidence is first assessed as to whether it is from randomized trial or cohort studies. The rating is then adjusted in the following manner (from: Guyatt G et al. J Clin Epidemiol. 2011;4:383-94, Hultcrantz M et al. J Clin Epidemiol. 2017;87:4-13, Klugar et al. J Clin Epidemiol. 2021 Nov 11;S0895-4356(21)00361-9.):

Certainty of Evidence
- High certainty: The authors have a lot of confidence that the true effect is similar to the estimated effect
- Moderate certainty: The authors believe that the true effect is probably close to the estimated effect
- Low certainty: The true effect might be markedly different from the estimated effect
- Very low certainty: The true effect is probably markedly different from the estimated effect

Guideline: Recommendation is from a published guideline that used methodology deemed acceptable by the team
Expert Opinion: Based on available evidence that does not meet GRADE criteria (for example, case-control studies)

Deductions labeled 1=risk bias, 2=indirectness, 3=imprecision, 4=inconsistency, 5=publication bias
Literature Search Methods
Studies were identified by searching electronic databases using search strategies developed and executed by a medical librarian, Susan Klawansky. Searches were performed in July and September, 2013. The following databases were searched – on the Ovid platform: Medline (2002 to date), Cochrane Database of Systematic Reviews (2005 to date), Cochrane Central Register of Controlled Trials (2002 to date); elsewhere – Embase (2002 to date), Clinical Evidence, National Guideline Clearinghouse, TRIP (2002 to date) and Cincinnati Children’s Evidence-Based Care Guidelines. Retrieval was limited to humans 0-18 and English language. In Medline and Embase, appropriate Medical Subject Headings (MeSH) and Emtree headings were used respectively, along with text words, and the search strategy was adapted for other databases using their controlled vocabularies, where available, along with text words. Concepts searched were liver transplantation and any of the following: immunosuppression, immunosuppressive agents, human herpesvirus 4, Epstein-Barr virus infections, cytomegalovirus, cytomegalovirus infections, pneumocystis pneumonia, pneumocystis carinii, lymphoproliferative disorders, steroids. All retrieval was further limited to certain evidence categories, such as relevant publication types, Clinical Queries, index terms for study types and other similar limits.

Literature Search Results
The search retrieved 529 records. Once duplicates had been removed, we had a total of 528 records. We excluded 377 records based on titles and abstracts. We obtained the full text of the remaining 152 records and excluded 142. We included 10 studies. The flow diagram summarizes the study selection process.

Flow diagram adapted from Moher D et al. BMJ 2009;339:bmj.b2535
Included Studies


Medical Disclaimer

Medicine is an ever-changing science. As new research and clinical experience broaden our knowledge, changes in treatment and drug therapy are required.

The authors have checked with sources believed to be reliable in their efforts to provide information that is complete and generally in accord with the standards accepted at the time of publication.

However, in view of the possibility of human error or changes in medical sciences, neither the authors nor Seattle Children’s Healthcare System nor any other party who has been involved in the preparation or publication of this work warrants that the information contained herein is in every respect accurate or complete, and they are not responsible for any errors or omissions or for the results obtained from the use of such information.

Readers should confirm the information contained herein with other sources and are encouraged to consult with their health care provider before making any health care decision.