Liver Transplant Pathway v6.0: Table of Contents

Inclusion Criteria
- Patient admitted for liver transplant surgery

Exclusion Criteria
- Kidney or intestine transplant

Liver Transplant Care
- Admission
- Intra-Op
- Post-Op ICU
- Post-Op Floor

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- Version Changes
- Approval & Citation
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Stop and Review
Liver Transplant Pathway v6.0: Admission

Stop and Review

Inclusion Criteria
- Patient admitted for liver transplant surgery

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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

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)

Surgical Team
- ARNP weekdays; surgical resident after hours, weekends, and holidays
- Orders Liver Transplant Pre-procedure Admission including
  - OR antibiotics, lab, and radiology
  - Case request
  - Orders Liver Transplant Thymoglobulin Immunosuppression
- Completes required forms
  - H&P note
  - Consent to Operation Form 45101
  - Informed Consent for Transfusion Form 51365
  - Surgeon will estimate OR time

Anesthesiologist
- Sees patient and completes pre-procedure anesthesia documentation

Nursing Preprocedure
- Confirm the following forms are in chart and completed by Surgical Team
  - H&P note or “add interval” addendum
  - Consent to Operation Form 45101
  - Informed Consent for Transfusion Form 51365
- Ensure patient is NPO and has IVF 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 Care Policy and Procedure
- 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

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Phase Change
- To Intra-Op
Liver Transplant Pathway v6.0: Intra-Op

Stop and Review

Inclusion Criteria
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Operating Room

Circulating Nurse
- Organ Check in
- Pre-Transplant Verification Form (if applicable)
- ABO Verification
- Confirm interoperative antibiotic orders
- Check for blood availability

Anesthesiologist
- Release Liver Transplant Thymoglobulin Immunosuppression
- Orders hydromorphone, D5LR, vasoactive infusions as needed
- Completes 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 on ABO Verification Form
- 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 ICU

To Table of Contents
Liver Transplant Pathway v6.0: Post-Op ICU

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

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**OR to ICU Handoff**
- Surgeon and anesthesiologist handoff to ICU
- In ICU, complete Checklist for OR to ICU Handoff

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**Postoperative Management**
(Order Liver Transplant Post-procedure Order Set)

- Follow Clinical P&P and Guidelines of Care (GOC):
  - Post Liver Transplant GOC
  - Intubated/Mechanically Ventilated GOC
  - Systemic Heparin P&P and Liver Transplant Anticoagulation GOC

- **Medications - See Patient-Specific Roadmap in EHR**
  - **Immunosuppression** (thymoglobulin or basiliximab, tacrolimus, methylprednisolone/prednisone/prednisolone)
  - Surgical antibiotic prophylaxis x 24 hours
  - Acetaminophen PRN fever and mild pain
  - Trimethoprim-sulfamethoxazole
  - Ganciclovir
  - Nystatin
  - Pantoprazole
  - Thrombosis prevention
  - ICU Team manages pain/sedation per Comfort and Sedation in the ICU GOC

- **Hematology**
  - For patients with red cell antibodies, keep 2 units of RBC cross-matched for 24 hours post-op
  - Order plasma transfusion 5 mL/kg IV over 4 hours, q 12 hours

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**Care Progression**

- **Patient/Family Education**
  - Medication teaching to be initiated by transplant pharmacist as soon as possible
  - Transplant NP or RN will arrange formal discharge education

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**Transfer Criteria**
- Not requiring ventilatory support
- Not requiring hemodynamic support
- Good organ function
- Intensity of care

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**Phase Change**
- To Post-Op Floor

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

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**Do not use vasopressin**

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**Call transplant team for concern of bleeding or hypotension**

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**Draw tacrol levels as trough at 0830h. Administer AM tacrol at 0900h**

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For questions concerning this pathway, contact: LiverTransplantPathway@seattlechildrens.org

If you are a patient with questions contact your medical provider. Medical Disclaimer

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Liver Transplant Pathway v6.0: Post-Op Floor

Inclusion Criteria
- Patient admitted for liver transplant surgery

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Postoperative Management – Surgical Floor

Follow GOC:
- Post Liver Transplant Guideline of Care (GOC)
- If biopsy performed: Liver Biopsy and Rejection GOC

Follow Clinical P&P:
- If NG Tube: Gastric Suction Policy and Procedure (P&P)
- Infection Control for Organ Transplant Patients P&P
- IV Line Maintenance
- Systemic Heparin

Labs:
- Daily labs as ordered, may require two labs daily (one for AM labs, another for timed tacrolimus trough)

Medications - See Patient-Specific Roadmap in EHR
- Thrombosis prevention OR aspirin
- Immunosuppression (tacrolimus, methylprednisolone/prednisone/prednisolone; if ordered, basiliximab day 4)
- Trimethoprim-sulfamethoxazole
- Valganciclovir
- Nystatin
- Magnesium if needed
- Acetaminophen and/or oxycodone PRN

Consults
- Child Life
- Social work

Discharge Criteria
- Good graft function
- Stable immunosuppression
- Afebrile
- Stable nutritional status
- Completed teaching
- Follow-up appointment scheduled

Discharge Instructions
- If applicable: PE1262 Bile Drainage Tube (Catheter)
Liver Transplant Pathway v6.0: Admit Labs

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

Chemistry:
- Chem 7
- AST/ALT
- GGT
- Alk Phos
- Bilirubin (conj/unconj)
- Magnesium
- PHOS
- ALB
- GLUCOSE
- TOTAL PROTEIN
- + HCG for female ≥ 12 years

Virology:
- CMV IgG/IgM
- EBV IgG/IgM
- Hep C Antibody
- HIV Serology (ELISA)

Other:
- ABO/RhD and Antibody Screen (Type and Screen) for Liver Pack blood order
- *HLA: Lymphocyte Crossmatch
- Pregnancy test (urine HCG)
- COVID-19 test (nasal swab)

Patient Weight Sample Requirements (no serum separator):

- 9-13 kg: **ACD = 10 mL + 1 red top = 5 mL
- 14-21 kg: **ACD = 20 mL + 1 red top = 5 mL
- 22+ kg: **ACD = 30 mL + 1 red top = 7 mL
- Post-transplant 9-21 kg: 1 red top = 5 mL
- Post-transplant 22+ kg: 1 red top = 7 mL

* Call BloodWorks Immunogenetics Lab for HLA sample requirement questions and for patients less than 9 kg
** Call main laboratory for **ACD tubes. Attach Bloodworks Northwest form.

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Liver Transplant Pathway v6.0: **Immunosuppression**

**Corticosteroid**
- **Dose**
  - POD 0 methylprednisolone 10mg/kg IV (max 1,000 mg) IV in OR
  - POD 1 methylprednisolone 2mg/kg (max 100mg) IV
  - POD 2 methylprednisolone 1mg/kg (max 100mg) IV
  - POD 3 methylprednisolone 0.5mg/kg (max 50mg) IV
  - POD 4-14 methylprednisolone 0.25mg/kg (max 25mg) daily
- **Switch from IV to oral per team. IV methylprednisolone to PO prednisone conversion is 1:1**

**Standard Immunosuppression**  
*If patient at standard risk for infection at time of transplant*

- **Thymoglobulin**
  - **Intraoperative POD 0:** 2 mg/kg
  - **Postoperative POD 1:** 3 mg/kg
  - **Doses may be rounded off, total dose will be 5mg/kg**

**Alternative Immunosuppression**  
*If indicated per clinical acuity, active infection, or recent thymoglobulin*

- **Basiliximab**
  - **Dose**
    - <20kg: 10mg/dose IV
    - >20kg: 20mg/dose IV
  - **Timing**
    - Intraoperatively POD 0
    - POD 4
  - **Must be diluted in 50ml of NS**
  - **Can be infused peripherally**

**Tacrolimus**
- **Dose**
  - **Initial tacrolimus dose 0.05-0.1mg/kg/dose orally every 12 hours (0900 and 2100). First dose of tacrolimus to be given greater than 12 hours after arrival in PICU following liver transplant.**
  - **Initial doses may be delayed if there is significant renal dysfunction.**
  - **Subsequent dosing dependent upon serum trough levels**
  - **Target trough levels:**
    - POD 2-90 10-12ng/dL
    - POD 91-180 7-10ng/dL
    - POD 181-365 5-7ng/dL
    - POD >365 3-5ng/dL
  - **In an attempt to minimize neuro-and nephrotoxicity of this medication, intravenous (IV) tacrolimus will NOT be used**

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**Individualizing Therapy:**
*See Patient-Specific Roadmap in EHR*

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**Screen for drug interactions with tacrolimus**
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.
Approval & Citation

Approved by the CSW Liver Transplant Pathway team for April 6, 2021, go-live

CSW Liver Transplant Pathway Team:

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Operations Director: Jaleh Shafii, MS, RN, CPHQ

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

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.):

Quality ratings are downgraded if studies:
- Have serious limitations
- Have inconsistent results
- If evidence does not directly address clinical questions
- If estimates are imprecise OR
- If it is felt that there is substantial publication bias

Quality ratings are upgraded if it is felt that:
- The effect size is large
- If studies are designed in a way that confounding would likely underreport the magnitude of the effect OR
- If a dose-response gradient is evident

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

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**Identification**
- Records identified through database searching (n=529)
- Additional records identified through other sources (n=0)

**Screening**
- Records after duplicates removed (n=528)

**Eligibility**
- Records screened (n=528)
- Records excluded (n=377)
- Articles excluded (n=142)
  - Did not answer clinical question (n=5)
  - Did not meet quality threshold (n=137)

**Included**
- Studies included in pathway (n=10)

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.

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