

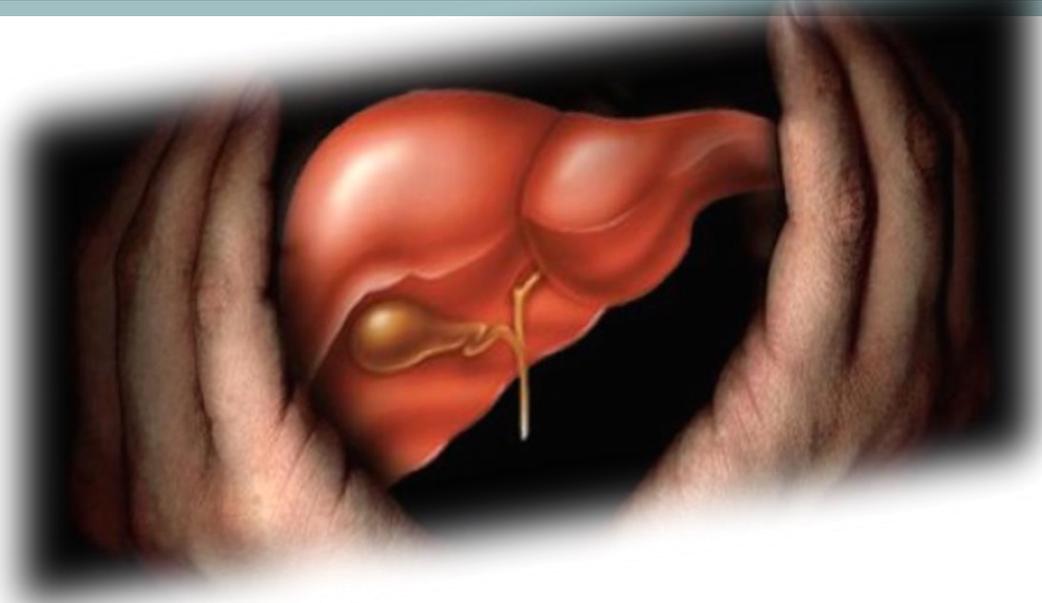
# The Edge of Unknown: Postoperative Critical Care in Liver Transplantation

**Heba Abdelazim Labib,MD**

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Faculty of Medicine

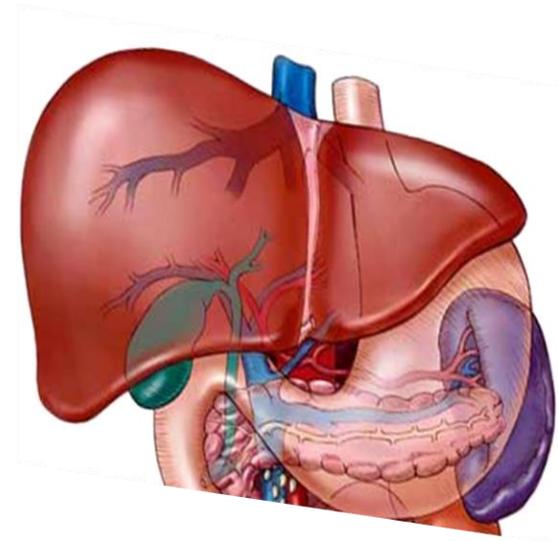
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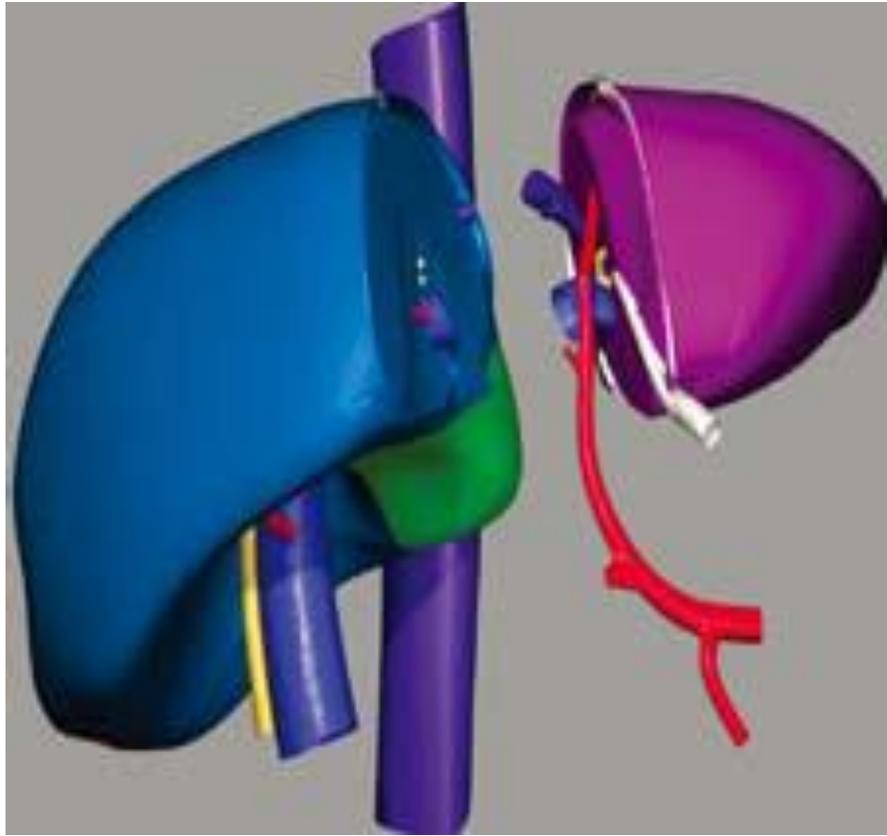


# Objectives:

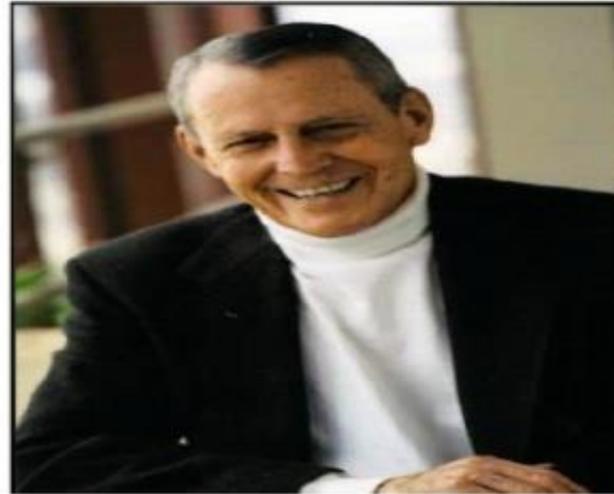
will principally discuss postoperative care in the ICU with a focus on:

cardio-pulmonary function,  
coagulation,  
and early allograft dysfunction.?





## Dr. Tom Starzl



**1<sup>st</sup>** orthotopic Liver  
Transplant  
(1963) **Denver**



# Introduction:

\*Liver transplantation (LT) may be **curative or life prolonging** for appropriately selected patients with acute liver failure, advanced cirrhosis, hepatic malignancy, or inborn metabolic disorders.

Approximately 140,000 LTs are performed per year, covering approximately 10% of the demand.

\*Globally, the 1- and 10-year survival rates have reached 96% and 71%, respectively

\*Metabolic derangements, hypothermia, coagulopathy and thromboses, severe infections, and graft dysfunction can affect outcomes.

In the last twenty years, the demographics of patients needing LT has changed. Candidates are now often older, more deconditioned, and frailer. A significant number of patients require care in an intensive care unit (ICU) before LT for preexisting.

Even when patients have been discharged from the ICU postoperatively, around 20% of patients require readmission to the ICU, primarily for cardio-pulmonary complications.

# Perioperative Challenges: Hemodynamics

\*It has been demonstrated that depending on the model of end-stage liver disease (MELD) score, **up to 60%** of LT candidates have a significant drop in mean arterial pressure (MAP), intraoperatively requiring treatment with vasopressors.

-\*nitric oxide production and activation of cGMP resulting in profound vasodilation

Review

## Enhanced recovery for liver transplantation: recommendations from the 2022 International Liver Transplantation Society consensus conference

Prof Joerg M Pollok PhD MD <sup>a d \*</sup>, Pascale Tinguely MD <sup>a \*</sup>, Prof Marina Berenguer PhD <sup>e</sup>, Prof Claus U Niemann MD <sup>f g</sup>, Dimitri A Raptis PhD MD <sup>a d †</sup>, Michael Spiro MD <sup>b c d †</sup>    
ERAS4OLT.org collaborative<sup>‡</sup>

\*judicious use of intravenous fluids and the prevention of hypervolemia.

Recent studies counter this assumption with a higher incidence of hepatic artery thrombosis in patients with a higher cumulative positive balance.

Normalising biochemical values like serum lactate and central venous saturation as evidence of normovolemia may also result in overfilling these patients.

**Restrictive Fluid Management**

# Hemodynamics



Central venous pressure (CVP) is frequently used to assess fluid status and is almost always elevated in cirrhotic patients.



CVP is directly related to hepatic venous pressure.



Dynamic parameters

Massive transfusion leads to increased hydrostatic pressure, which can result in liver congestion and pulmonary edema.

The prevalence of pulmonary edema after LT can be as high as 50%.

Ponnudurai et al. demonstrated that restrictive fluid management in combination with vasopressor support was associated with a reduction in re-intubation and ventilation-associated morbidity



Clinical Trial

**Vasopressor administration during liver transplant surgery and its effect on endotracheal reintubation rate in the postoperative period: a prospective, randomized, double-blind, placebo-controlled trial**

Rex N Ponnudurai et al. Clin Ther. 2005 Feb.

> [Clin Transplant](#). 2016 Dec;30(12):1552-1557. doi: 10.1111/ctr.12855. Epub 2016 Oct 14.

## **Myocardial injury in patients with hemodynamic derangements during and/or after liver transplantation**

Shun Huang <sup>1 2</sup>, Worapot Apinyachon <sup>3</sup>, Vatche G Agopian <sup>4</sup>, Christopher L Wray <sup>2</sup>, Ronald W Busuttill <sup>4</sup>, Randolph H Steadman <sup>2</sup>, Victor W Xia <sup>2</sup>

Affiliations + expand

PMID: 27653509 DOI: [10.1111/ctr.12855](#)

### **Myocardial Injury**

In a single-center study with 1386 LTs, 502 patients had an increased TnI within 30 days following LT. The prevalence of MINS in this group was 40%.

The 30-day mortality rate was higher in the MINS group (11.8%) compared to the non-MINS group (3.3%).

# Myocardial injury in patients with hemodynamic derangements during and/or after liver transplantation

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Affiliations + expand

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**Table 2.** Comparison between patients with and without myocardial injury

	Nonmyocardial injury (n=299)	Myocardial injury (n=203)	P
Age (y)	56.3±10.5	55.4±11.1	.384
Weight (kg)	79.6±20.5	77.8±22.3	.381
Height (cm)	169.7±10.8	169.2±11.1	.723
Gender (male, %)	63.0	61.6	.083
Etiology of liver disease (%)			
Hepatitis C	42.8	27.6	.001
Hepatitis B	4.8	8.1	.138
Alcoholic cirrhosis	21.5	23.8	.563
NASH	6.8	7.0	.907
Acute	3.2		
MELD score	32.5±7.5	34.4±7.5	.008
Hypertension (%)	38.7	31.7	.120

NASH, nonalcoholic steatohepatitis; MELD, model for end-stage liver disease.

**Table 2.** Comparison between patients with and without myocardial injury

	Nonmyocardial injury (n=299)	Myocardial injury (n=203)	P
Hypertension (%)	38.7	31.7	.120
History of coronary artery disease (%)	10.6	14.6	.193
Variceal bleed (%)	32.9	44.5	.012
Preoperative renal replacement therapy (%)	39.7	49.2	.043
Preoperative endotracheal intubation (%)	24.9	34.6	.022
Preoperative pressors (%)	18.6	26.0	.057

**Table 2.** Comparison between patients with and without myocardial injury

	Nonmyocardial injury (n=299)	Myocardial injury (n=203)	P
Baseline hematocrit (%)	29.4±6.1	28.2±5.3	.041
Baseline INR	1.8±0.6	1.8±0.5	.145
Baseline creatinine (mg/dL)	1.8±1.4	1.8±1.3	.736
Intra-operative dialysis (%)	13.5	14.0	.871
Pressor infusion (%)	69.9	87.6	<.001
Pressor bolus (in large quantity, %)	35.2	49.7	.002
Postreperfusion syndrome (%)	12.3	19.1	.046
Venovenous	44.6	56.6	.013

**Table 2.** Comparison between patients with and without myocardial injury

	Nonmyocardial injury (n=299)	Myocardial injury (n=203)	P
Venovenous bypass (%)	44.6	56.6	.013
Donor from donation after cardiac death (%)	4.2	5.6	.490
Cold ischemia time (min)	400.3±140.5	397.8±146.5	.855
Warm ischemia time (min)	44.4±12.3	42.7±10.9	.134
Surgery time (min)	357.6±142.3	363.4±148.5	.776
Red blood cell transfusion (in unit)	20.7±19.3	24.5±18.9	.032
Fresh frozen	25.5±21.9	28.0±19.4	.213

## Cardiomyopathy

\*3 and 7% in LT recipients.

management of heart failure in LT patients does not differ from typical management.

***Takotsubo syndrome (TTS)***, atypical myocardial ballooning development of acute, severe left ventricular dysfunction triggered by catecholamine excess and surgical stress

In a large cohort, TTS occurred in 1.7% of patients after LT .

> [Clin Transplant](#). 2021 Nov;35(11):e14463. doi: 10.1111/ctr.14463. Epub 2021 Sep 23.

### **Takotsubo syndrome after liver transplantation: An association with intraoperatively administered epinephrine and fentanyl**

Jun Yang <sup>1 2</sup>, Zhuqing Rao <sup>3</sup>, Fu Hong <sup>4</sup>, Vatche Agopian <sup>5</sup>, Jennifer Nguyen-Lee <sup>2</sup>, Randolph H Steadman <sup>6</sup>, Christopher Wray <sup>2</sup>, Victor W Xia <sup>2</sup>

Affiliations + expand

PMID: 34403157 DOI: 10.1111/ctr.14463

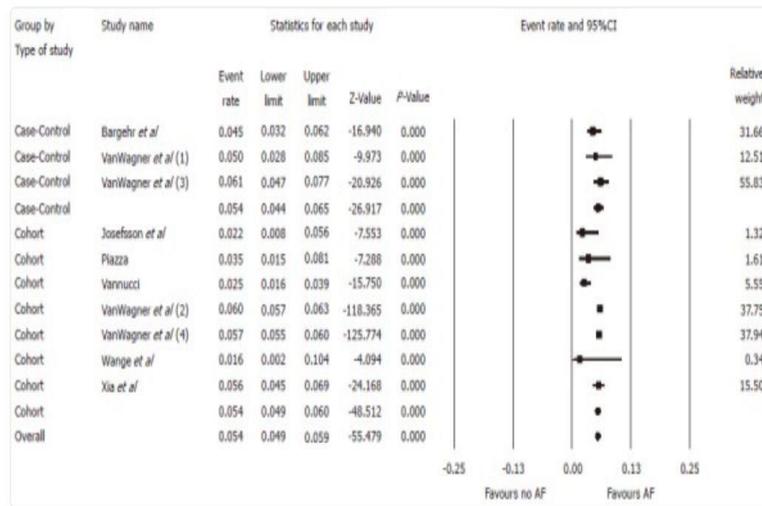
### Liver transplantation and atrial fibrillation: A meta-analysis

Ronpichai Chokesuwattanaskul<sup>1</sup>, Charat Thongprayoon<sup>2</sup>, Tarun Bathini<sup>3</sup>, Patompong Ungprasert<sup>4</sup>, Konika Sharma<sup>5</sup>, Karn Wijarnpreecha<sup>6</sup>, Pavida Pachariyanon<sup>7</sup>, Wisit Cheungpasitporn<sup>8</sup>

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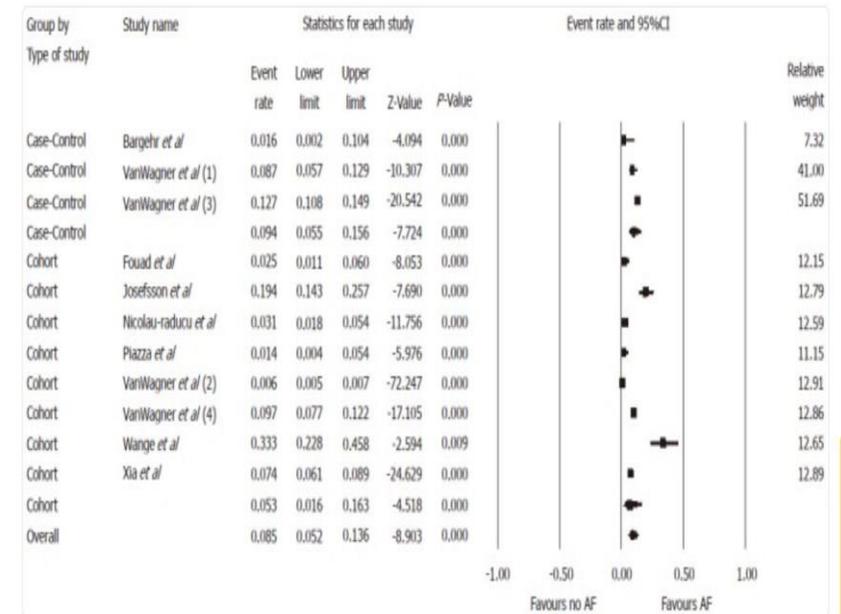
PMCID: PMC6206153 PMID: [30386469](https://pubmed.ncbi.nlm.nih.gov/30386469/)

Figure 2.



Forest plots of the included studies assessing prevalence of pre-existing atrial fibrillation in patients undergoing liver transplantation. AF: Atrial fibrillation.

Figure 3.



Forest plots of the included studies assessing incidence of atrial fibrillation following liver transplantation.

# Atrial Fibrillation:

World Journal of  
Hepatology

▶ World J Hepatol. 2018 Oct 27;10(10):761–771. doi: [10.4254/wjh.v10.i10.761](https://doi.org/10.4254/wjh.v10.i10.761)

**Liver transplantation and atrial fibrillation: A meta-analysis**

[Ronpichai Chokesuwattanaskul<sup>1</sup>](#), [Charat Thongprayoon<sup>2</sup>](#), [Tarun Bathini<sup>3</sup>](#), [Patompong Ungprasert<sup>4</sup>](#), [Konika Sharma<sup>5</sup>](#), [Karn Wijarnpreecha<sup>6</sup>](#), [Pavida Pachariyanon<sup>7</sup>](#), [Wisit Cheungpasitporn<sup>8</sup>](#)

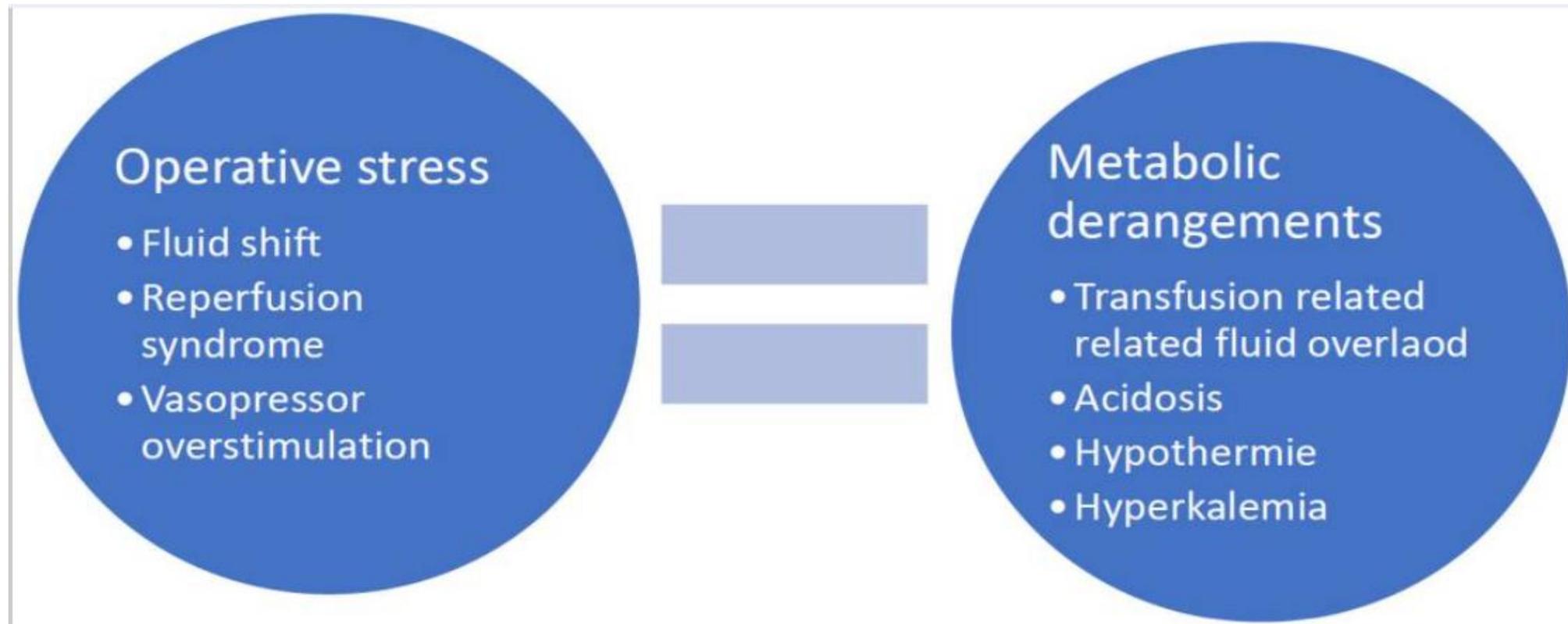
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PMCID: PMC6206153 PMID: [30386469](#)

In their study, nearly a third of patients with MELD scores of 32 or higher developed AF.

Overall mortality and graft failure were significantly higher in patients with postoperative AF.

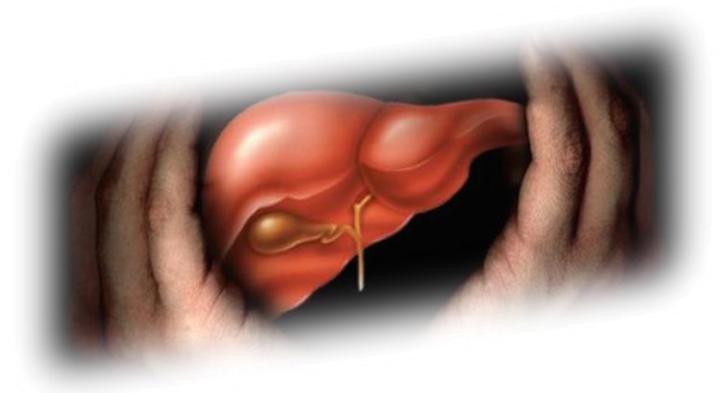
AF is not a contraindication for LT; however, the higher incidence of associated perioperative complications must be taken into consideration.



# Mechanical Ventilation after Transplantation

The patient is transferred to ICU intubated, ventilated & sedated ????

“Fast Track”



## Enhanced recovery after surgery programs improve short-term outcomes after liver transplantation—A systematic review and meta-analysis

Pascale Tinguely<sup>1</sup>, Nolitha Morare<sup>1</sup>, Alejandro Ramirez-Del Val<sup>1</sup>, Marina Berenguer<sup>2</sup>, Claus U Niemann<sup>3 4</sup>, Joerg M Pollok<sup>1 5</sup>, Dimitri A Raptis<sup>1 5</sup>, Michael Spiro<sup>5 6</sup>

Affiliations + expand

PMID: 34382235 DOI: [10.1111/ctr.14453](https://doi.org/10.1111/ctr.14453)

### Early Postoperative Extubation

\*They found that, overall, complications were reduced in the ERAS cohort versus controls (OR = 0.4 (CI 0.2, 0.7)), with no significant differences in mortality or hospital readmission rates.

ICU unit and hospital length of stay were shorter in the ERAS group.

**\*Not directly applicable for patients with more advanced  
ESLD:**

**Strategies to avoid reintubation**

**Non-invasive positive pressure ventilation (NIPPV)**

**High-flow nasal cannula (HFNC)**



## **Pulmonary Complications**



The incidence of pulmonary complications in the early postoperative period after LT has been reported to be up to 50%.



Risk factors for ARDS in LT patients include massive transfusion, fluid overload, sepsis, and aspiration.



The incidence of ARDS after LT varies between centers.



In one study, the rate of ARDS in LT patients was 4.1% (71/1726 patients).



\*There is strong evidence that lung protective ventilation with 6 mL/kg improves outcome.



Increased intrathoracic pressure due to high PEEP may impede venous outflow.

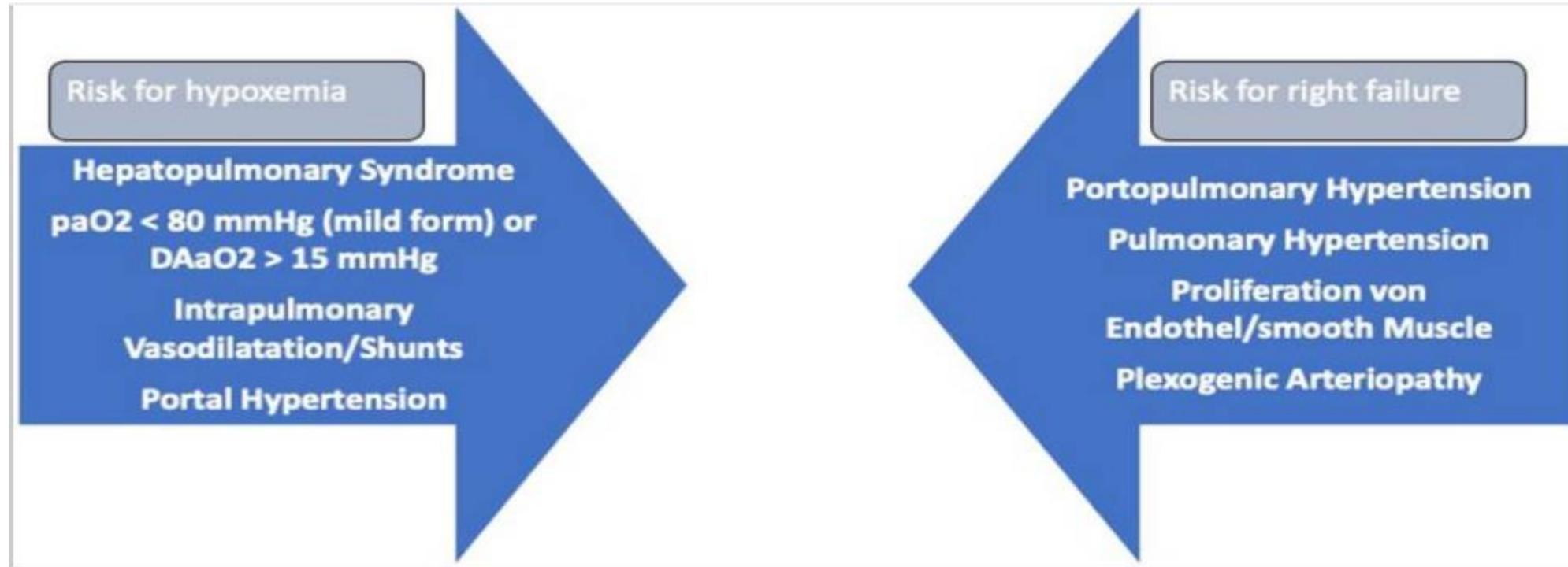


However, in 2006, a group from Essen published a cohort study of 65 LT patients assigned to three different PEEP levels (0, 5, and 10 mbar).



At all three PEEP levels, there was no change in flow velocities in the hepatic artery, portal vein, or hepatic veins.

# Hepatopulmonary Syndrome/portopulmonary hypertesion



The clinical diagnosis of HPS includes hypoxemia with cyanosis, clubbing of the fingers, P<sub>a</sub>O<sub>2</sub> < 80 mmHg, alveolo-arterial partial oxygen pressure gradient (AaDO<sub>2</sub>) ≥ 20 mmHg, and orthodeoxia

# HPS

HPS develops in up to 32% of cirrhotics and significantly increases the risk of death in patients undergoing transplant evaluation.double!

*"When the good neighbors go bad"*





There have been conflicting reports on the association between HPS and postoperative mortality .



In 2014, Goldberg et al. published the results of a UNOS database evaluation.



In this study, LT recipients with more severe preoperative hypoxemia had an increased risk for mortality. Unadjusted survival rates post-transplant were 84% for patients with a preoperative  $p_aO_2$  between 44.1–54 mmHg, and 68% for those with  $p_aO_2$  below 44 mmHg on room air.



There is still not an effective treatment .



\*methylene blue and extracorporeal membrane oxygenation (ECMO) ??i

# Porto-Pulmonary Hypertension

The prevalence of POPH in patients with ESLD is between 5–6% POPH •

## Portopulmonary Hypertension (PoPH)

*"When the good neighbors go bad"*



- Mean pulmonary artery pressure  $> 25$  mmHg
- Pulmonary vascular resistance  $> 240$  dyne·s·cm<sup>5</sup> ( $>3$  wood units)
- Pulmonary capillary wedge pressure (PCWP)  $< 15$  mmHg
- TPG  $> 12$  mmHg (mPAP-PCWP)

**AND**

- Clinical portal hypertension (Splenomegaly, Thrombocytopenia, Esophageal varices, portosystemic shunt) with or without

# Liver Transplant & PoPH

In-hospital Liver Transplant mortality in PoPH - 36%

A report of the multicenter liver transplant database. Liver Transpl 2004; 10: 174-82



The severity of POPH depends on the mean arterial pulmonary pressure (mPAP) assessed by right heart catheter.

POPH has more therapeutic options than HPS.

Prostacyclin analogues possess vasodilator and antithrombotic effects.

Phosphodiesterase inhibitors modulate the effect of NO. **Sildenafil**, the principal medication in this group, has been reported to improve hemodynamics, increase cardiac output, and decrease PVR .

Endothelin receptor antagonists (Bosentan), which are used to treat pulmonary arterial hypertension, are also associated with an improvement of hemodynamics in patients with cirrhosis and POPH [

The use of Macitentan was associated with a significant decrease in pulmonary vascular resistance without hepatic-related adverse effects .

## Intraoperative Versus Extended Antibiotic Prophylaxis in Liver Transplant Surgery: A Randomized Controlled Pilot Trial

Puja S Berry <sup>1</sup>, Laura H Rosenberger <sup>2</sup>, Christopher A Guidry <sup>3</sup>, Avinash Agarwal <sup>1</sup>, Shawn Pelletier <sup>1</sup>, Robert G Sawyer <sup>4</sup>

Affiliations [+](#) expand

PMID: 31063679 DOI: [10.1002/lt.25486](https://doi.org/10.1002/lt.25486)

### Infection Prophylaxis

Infection prevention is an important problem in the care of LT recipients. The incidence of infection after LT varies **from 53% to 79%** the first month.

\*A total of 102 patients were randomized as follows: 51 patients to the extended antibiotic group, and 51 to the intraoperative antibiotic group.

Rates of SSI and nosocomial infection were not different between groups. Moreover, ICU and hospital length of stay (LOS), 30-day mortality.

Intraoperative antibiotic prophylaxis alone is acceptable for LT without increased risk of infection.

There is a general recommendation to use antifungal prophylaxis in high-risk patients with a MELD score above 20.

Antifungal treatment is also recommended for patients needing reoperation (for bleeding or bile leak), on renal replacement therapy, receiving pulsed dose cortisone for rejection, or categorized as at high-risk for fungal infection.

# Viral infections:

are also a significant problem in the postoperative period, with human cytomegalovirus (CMV) being most common in LT recipients.

The main risk factor for developing CMV is a recipient's CMV-seronegative status.

\* **78–88%** ?

Oral valganciclovir and intravenous ganciclovir are used for both prophylaxis and treatment

# Management of Coagulopathy:



## **Coagulopathy Assessment**



The first attempts at human LT were associated with very high mortality.



Ewe et al. published a paper evaluating bleeding after liver biopsy.



\*The number of patients in this study with a completely normal coagulation profile had prolonged bleeding, whereas other patients with an international normalized ratio (INR) above 3 did not have significant bleeding.



Several patients with a platelet count above  $>100/nL$  had prolonged bleeding, and several patients with a platelet count below  $20/nL$  did not bleed.

Review

> [Br J Anaesth.](#) 2015 Feb;114(2):217-24. doi: 10.1093/bja/aeu303. Epub 2014 Sep 8.

## Usefulness of standard plasma coagulation tests in the management of perioperative coagulopathic bleeding: is there any evidence?

T Haas <sup>1</sup>, D Fries <sup>2</sup>, K A Tanaka <sup>3</sup>, L Asmis <sup>4</sup>, N S Curry <sup>5</sup>, H Schöchl <sup>6</sup>

Affiliations + expand

PMID: 25204698 DOI: [10.1093/bja/aeu303](#)

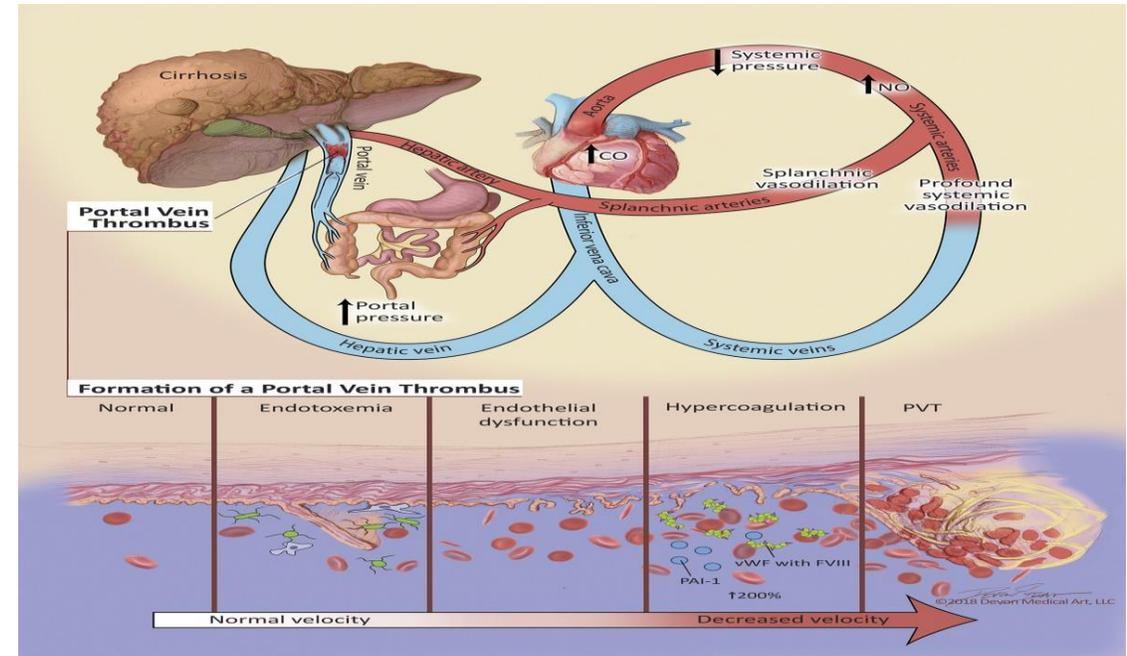
These observations were confirmed in a meta-analysis performed by Haas et al.

## Intraoperative transfusion management, antifibrinolytic therapy, coagulation monitoring and the impact on short-term outcomes after liver transplantation-A systematic review of the literature and expert panel recommendations

Uzung Yoon<sup>1</sup>, Justyna Bartoszko<sup>2,3</sup>, Dmitri Bezinover<sup>4</sup>, Gianni Biancofiore<sup>5</sup>, Katherine T Forkin<sup>6</sup>, Suehana Rahman<sup>7</sup>, Michael Spiro<sup>8,9</sup>, Dimitri Aristotle Raptis<sup>10,9</sup>, Yoogoo Kang<sup>1</sup>, ERAS4OLT.org Working Group

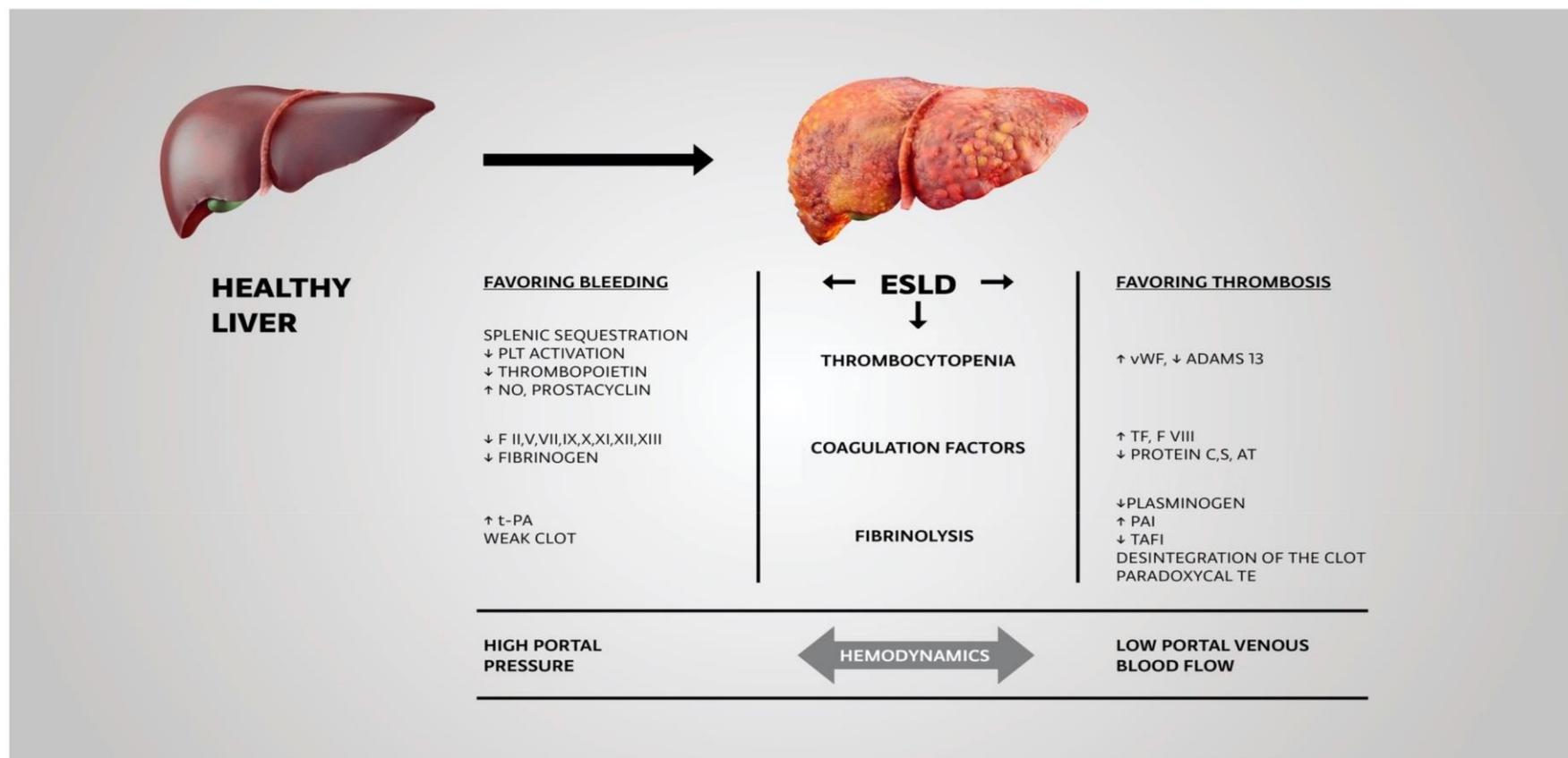
Collaborators, Affiliations + expand

PMID: 35249250 DOI: 10.1111/ctr.14637



VET for managing coagulopathy during LT was recommended in the ERAS project performed by the ILTS.

# Thromboembolism in ESLD



Observational Study  
Epub 2019 Sep 16.

> J Hepatol. 2020 Jan;72(1):85-94. doi: 10.1016/j.jhep.2019.09.008.

## Fresh frozen plasma transfusion in patients with cirrhosis and coagulopathy: Effect on conventional coagulation tests and thrombomodulin-modified thrombin generation

Amanda Bruder Rassi <sup>1</sup>, Elbio Antonio d'Amico <sup>1</sup>, Armando Tripodi <sup>2</sup>, Tânia Rubia Flores da Rocha <sup>1</sup>,  
Beatriz Yuri Migita <sup>3</sup>, Caroline Marcondes Ferreira <sup>3</sup>, Flair José Carrilho <sup>3</sup>, Alberto Queiroz Farias <sup>4</sup>

Affiliations + expand

PMID: 31536747 DOI: 10.1016/j.jhep.2019.09.008

## Preemptive Management of Coagulation

\*Prophylactic fresh-frozen plasma (FFP) transfusion should be avoided.

It has been demonstrated that transfusion of six units of FFPs will increase the portal pressure by 15 mmHg, which correlates well with increased bleeding risk.

\* In vitro, PCC has been demonstrated to improve thrombin generation in patients with ESLD significantly better than FFP

> [Anesth Analg.](#) 2017 Aug;125(2):609-615. doi: 10.1213/ANE.0000000000002106.

### Reduced Requirement for Prothrombin Complex Concentrate for the Restoration of Thrombin Generation in Plasma From Liver Transplant Recipients

Ezeldeen Abuelkasem <sup>1</sup>, Shaheer Hasan, Michael A Mazzeffi, Raymond M Planinsic, Tetsuro Sakai, Kenichi A Tanaka

Affiliations + expand

PMID: 28537975 DOI: [10.1213/ANE.0000000000002106](#)

Observational Study > [J Hepatol.](#) 2020 Jan;72(1):85-94. doi: 10.1016/j.jhep.2019.09.008.

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Affiliations + expand

PMID: 31536747 DOI: [10.1016/j.jhep.2019.09.008](#)

FFP transfusion has only a limited effect on either correcting factor deficiencies or improving thrombin generation .

# Thrombotic Microangiopathy:

\*Clinical signs of TMA include  
microthrombotic hemolysis,  
thrombocytopenia,  
and organ injury.

The most frequent manifestation of TMA is **thrombotic thrombocytopenic purpura (TTP)**.

Cyclosporine and tacrolimus may also induce TMA.

Stop?

\*98 LDLT patients who developed TMA soon after transplantation. The 1-, 3-, and 5-year survival were 66.9%, 64.6%, and 62.2%, respectively. The only independent risk factor for mortality was dialysis-dependent kidney failure.

> [J Hepatobiliary Pancreat Sci.](#) 2022 Feb;29(2):282-292. doi: 10.1002/jhbp.1032. Epub 2021 Aug 12.

## **The outcomes of thrombotic microangiopathy after liver transplantation: A nationwide survey in Japan**

Mitsuhisa Takatsuki <sup>1</sup>, Susumu Eguchi <sup>2</sup>, Masakazu Yamamoto <sup>3</sup>, Hiroki Yamaue <sup>4</sup>, Yasutsugu Takada <sup>5</sup>; [Japanese Society of Hepato-Biliary-Pancreatic Surgery](#)

Affiliations [+ expand](#)

PMID: 34355533 DOI: [10.1002/jhbp.1032](#)

# Allograft Dysfunction:

EAD and primary PNF are some of the most difficult complications to manage in a postoperative setting.

Both EAD and PNF are associated with hemodynamic instability, AKI, coagulopathy, and cardiac complications.

# Early Allograft Dysfunction

Clinical Trial > Liver Transpl. 2010 Aug;16(8):943-9. doi: 10.1002/lt.22091.

## Validation of a current definition of early allograft dysfunction in liver transplant recipients and analysis of risk factors

Kim M Olthoff <sup>1</sup>, Laura Kulik, Benjamin Samstein, Mary Kaminski, Michael Abecassis, Jean Emond, Abraham Shaked, Jason D Christie

Affiliations + expand

PMID: 20677285 DOI: 10.1002/lt.22091

Table 1. Description of Individual Components of the EAD Definition

INR > 1.6 at Day 7	Bilirubin >10 at Day 7	ALT or AST >2000 in Week 1	Number of Patients (N)	6-Month Mortality N (% [95% CI])	6-Month Graft Failure N (% [95% CI])
+	-	-	5	2 (40.0% [5.3, 85.3])	2 (40.0% [5.3, 85.3])
-	+	-	28	3 (10.7% [2.2, 28.2])	4 (14.3% [4.0, 32.7])
-	-	+	26	5 (19.2% [6.6, 39.4])	7 (26.9% [11.6, 47.8])
+	+	-	4	1 (25.0% [0.1, 80.6])	2 (50.0% [6.8, 93.2])
-	+	+	2	0 (0.0% [0, 84])	0 (0.0% [0, 84])
+	+	+	4	2 (50.0% [6.8, 93.2])	3 (75.0% [19.4, 99.4])

## Several definitions .....

All these definitions are static and do not include the assessment of the entire clinical picture.

Year	Author	Journal	Term	Lab Values	Others
1993	Ploeg	<i>Transplantation</i> [135]	Primary Dysfunction	AST > 2000 IU/L PT > 16 s NH3 < 50 µmol/L from POD 2-7	-
1998	Deschenes	<i>Transplantation</i> [134]	Early Allograft Dysfunction	Bilirubin > 10 mg/dL Prothrombin time (PT) ≥ 17 s	Hepatic Encephalopathy
2002	Nanashima	<i>Transpl. Proc.</i> [133]		AST or ALT > 1500 IU/L in two consecutive tests within first 72 h	-
2010	Olthoff	<i>Am. J. Transpl.</i> [130]	Early Allograft Dysfunction	AST/ALT > 2000 IU/L within 7 PODs Bilirubin ≥ 10 mg/dL INR ≥ 1.6 ON POD 7	-

# Graft dysfunction factors related to graft dysfunction:

## ***Donor related***

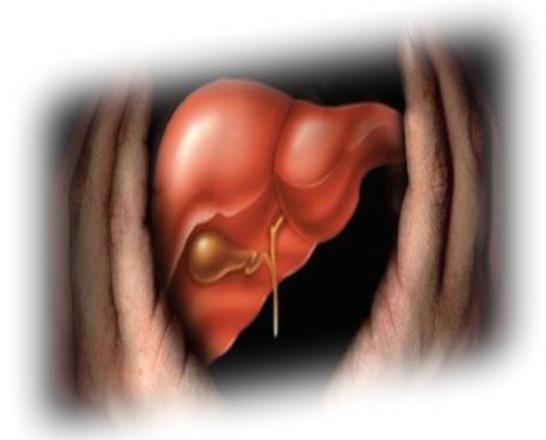
- Donor age
- Macrovesicular steatosis
- High dose inotropic drug
- Hypernatremia
- Prolonged ICU stay
- Graft weight/Recipient weight ratio < 0.8%
- Donation after cardiac death

## ***Procurement and Surgery related***

- Prolonged cold ischemia time
- Anhepatic phase time >100 min

## ***Recipient related***

- Impaired renal function
- Elevated bilirubin level
- Hemodialysis prior to transplantation
- Low weight (BMI < 18.5 kg/m<sup>2</sup>)



The prevalence of EAD after LT is between 6–35%.

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graph TD; A[The prevalence of EAD after LT is between 6–35%.] --> B[The association between decreased graft function and patient survival has been demonstrated in all clinical studies.]; B --> C[In addition to hemodynamic management and treating kidney failure and coagulopathy,]; C --> D[the role of liver-supporting systems, particularly, non-biologic liver support systems, are important in managing EAD.]; D --> E[Therapeutic plasma exchange should be decided on a case-by-case basis.];
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The association between decreased graft function and patient survival has been demonstrated in all clinical studies.

In addition to hemodynamic management and treating kidney failure and coagulopathy,

the role of liver-supporting systems, particularly, non-biologic liver support systems, are important in managing EAD.

Therapeutic plasma exchange should be decided on a case-by-case basis.



## **Primary Graft Non-Function**



In 1–7% of all LTs, the allografts never gain sufficient function, despite sufficient graft perfusion and without any technical problem. This condition is described as graft PNF and is clinically apparent within the first 7–14 PODs.



internationally accepted definition of PNF is lacking. Several studies pointed out that elevation of aminotransferases, INR, and bilirubin, as well as lactate levels and acidosis, are relevant in making the diagnosis.

It has been suggested to evaluate these blood parameters no earlier than POD 3 to avoid a diagnosis of PNF in error.

\*“high-urgency” status and need early re-transplantation.

Though the threshold levels of aminotransferases used in making the decision to relist range from 1000–10,000 U/L , data exists for the non-relevance of aminotransferase levels as a single parameter to base a decision to relist due to PNF.



# Complications in Post-Liver Transplant Patients

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**Abstract:** Liver transplantation (LT) is the treatment of choice for liver failure and selected cases of malignancies. Transplantation activity has increased over the years, and indications for LT have been widened, leading to organ shortage. To face this condition, a high selection of recipients with prioritizing systems and an enlargement of the donor pool were necessary. Several authors published

## REJECTION OF THE GRAFT:

By the onset time, the rejection is classified into

HYPERACUTE (within hours after LT),

ACUTE (within two to six weeks), and CHRONIC REJECTION.

The hyperacute rejection rate is very low, and it is the consequence of the presence of specific preformed recipient antibodies leading to low rates of graft survival.

Clinical manifestations are similar to ischemic graft injuries.

An urgent re-transplant is required .

# Complications in Post-Liver Transplant Patients

 Journal of Clinical Medicine

September 2023 · 12(19):6173

DOI:[10.3390/jcm12196173](https://doi.org/10.3390/jcm12196173)

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## Acute rejection

- About 15 to 25% of patients develop at least one episode of acute rejection in the first weeks after liver transplantation.
- Pt on tacrolimus develop this complication more rarely.
- The clinical picture is non specific.....\*
- A liver biopsy is required to confirm rejection.

# Complications in Post-Liver Transplant Patients

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## Acute rejection

*-The primary treatment of rejection is a short course of high-dose steroids.*

- When refractory or recurrent rejection occurs, conversion from cyclosporine to tacrolimus, or antilymphocyte therapy, have been successfully used. (Tannuri and Tannuri ,2014).

# pain management:

 Open access |    | Review article | First published online October 17, 2024

## Enhanced Recovery After Surgery (ERAS) Protocols in Liver Transplant Recipients—Challenges and Strategies for Implementation: A Review Article

[Vijay Shankar](#)  , [Chitra Chatterji](#), and [Subash Chawla](#) [View all authors and affiliations](#)

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The Lancet Gastroenterology & Hepatology  
Volume 8, Issue 1, January 2023, Pages 81-94



Review

### Enhanced recovery for liver transplantation: recommendations from the 2022 International Liver Transplantation Society consensus conference

Prof Joerg M Pollok PhD MD <sup>a d</sup> \*, Pascale Tinguely MD <sup>a</sup> \*, Prof Marina Berenguer PhD <sup>e</sup>,  
Prof Claus U Niemann MD <sup>f g</sup>, Dimitri A Raptis PhD MD <sup>a d</sup> †, Michael Spiro MD <sup>b c d</sup> †    
ERAS4OLT.org collaborative ‡

-\* .. Multimodal approach should be employed.

subcostal TAP block

# **-Nutrition and Mobilization**

Review

## Enhanced recovery for liver transplantation: recommendations from the 2022 International Liver Transplantation Society consensus conference

Prof Joerg M Pollok PhD MD <sup>a d \*</sup>, Pascale Tinguely MD <sup>a \*</sup>, Prof Marina Berenguer PhD <sup>e</sup>, Prof Claus U Niemann MD <sup>f g</sup>, Dimitri A Raptis PhD MD <sup>a d †</sup>, Michael Spiro MD <sup>b c d †</sup>    
ERAS4OLT.org collaborative†

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Recommended c

Implementation of recovery protocols  
Cirugía Española (Engli:  
Javier Briceño Delgado

Imaging Diagnosis  
Complications of A  
Transplantation Procee:  
Cheng-Kang Wang, ..., F

Anesthesia and enl

Implementation of early enteral nutrition and mobilisation are crucial to the success of any enhanced recovery programme.

Oral nutrition can be initiated within 12-24 hours post-transplant.

Parenteral nutrition should be started only as a last option when enteral nutrition fails to meet caloric requirements.

Mobilization should be encouraged when the patient is off vasopressor support with early goal-directed interventions.

Physical rehabilitation may be continued after discharge as well.

## -Nutrition:

-  The goal → ensure adequate protein & energy supply to avoid protein breakdown.
-  Hyper-metabolism has been found predictive of transplant-free survival and tends to persist for at least a year post-LT.
-  The starting total daily energy intake until postoperative day (POD) 3 is 10–15 kcal/kg and gradually increased to 25–35 kcal/kg .
-  Metabolic alkalosis and depletion of serum potassium, phosphorus, and magnesium levels in the acute post-LT period should be monitored. Also, refeeding syndrome should be taken as a risk factor for these disorders.
-  Glucose administration immediately after LT has been recommended in small quantities and without insulin in order not to suppress peripheral fat mobilization.

# Conclusion

Perioperative critical care of LT recipients presents a major challenge for anesthesiologists and ICU physicians. Managing these patients requires an in-depth understanding of the pathophysiology of ESLD.

The improvement in survival of patients after LT in the past 60 years is not only linked to better surgical expertise and improvements in immunosuppression, but also a better understanding and management of infections, hemodynamics, renal dysfunction, fluid administration, and coagulation.

Patient outcome depends on a well-functioning multidisciplinary team.

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# Quations



