

# Anaesthesia and intensive care for adult liver transplantation

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## Abstract

This review describes the preoperative assessment and listing of the patient for liver transplantation and some of the specific perioperative challenges this group of patients present to the anaesthetist. The principles of the early postoperative management in the intensive care unit are discussed as well as some of the signs of early graft dysfunction. Increasingly unwell patients receiving grafts that may come from more marginal donors present significant challenges to the transplant team. The anaesthetist and intensivist play a vital role in determining outcome in the perioperative period.

**Keywords** End-stage liver disease; liver; liver failure; perioperative care; preoperative assessment; transplantation

**Royal College of Anaesthetists CPD matrix:** 2A03, 2A04, 2A05, 2A07, 2C04

## Introduction

Liver transplantation (LT) is currently the only effective treatment for acute and chronic liver failure. Since the first LT was performed in 1967, advances in immunosuppression, surgical techniques, donor management and perioperative care have dramatically improved patient outcomes. One-year survival for adult patients transplanted for the first time in the UK for acute and chronic liver failure is now more than 85% and 90% respectively. Five-year survival is more than 70% for both groups.<sup>1</sup>

As demand increases, more patients die awaiting LT. This has led to grafts from marginal donors, split liver and live donor grafts to maximize the donor pool.

The combination of higher risk patients that may receive more marginal grafts and increasing numbers (more than 600 per year in UK) present increasing challenges to transplant services.

## Indications

Indications for LT include acute and chronic liver failure and a number of other liver related conditions. A UK 'National Appeal' panel may approve listing outwith standard criteria. The most common indications are shown in [Table 1](#).

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## Learning objectives

After reading this article, you should be able to:

- understand the preoperative issues surrounding adult liver transplantation (LT)
- understand the principles of perioperative care of an adult patient undergoing LT
- appreciate the principles of intensive care of the LT patient

## Listing and patient prioritization

Patients may be registered as 'super urgent' (this carries highest priority) or may be listed on a regional 'chronic' waiting list. Placement on the super urgent waiting list is usually reserved for patients with fulminant hepatic failure or where there has been early failure of a graft. The decision to list a patient in the UK is usually based on the severity of the underlying liver disease. A number of mathematical models are used to assess severity of disease objectively. Model for end-stage liver disease (MELD) and a UK model for end-stage liver disease (UKELD) are two examples. The MELD score is based on bilirubin, serum creatinine and international normalized ratio (INR). UKELD includes serum sodium. These models try to predict the patient's risk of death such that the sickest patients get priority.<sup>2</sup>

## Indications for LT

### Chronic liver failure

Viral hepatitis  
Alcoholic liver disease  
Non alcoholic fatty liver disease  
Primary biliary cirrhosis  
Primary sclerosing cholangitis  
Autoimmune hepatitis  
Cryptogenic cirrhosis  
Haemochromatosis  
Wilson's disease

### Acute liver failure

Cancer Hepatocellular carcinoma  
Other Budd chiari  
Graft failure (hepatic artery thrombosis, primary non function, rejection)

### Variant syndromes

Diuretic resistant ascites  
Hepatopulmonary syndrome  
Chronic hepatic encephalopathy  
Persistent and intractable pruritus  
Familial amyloidosis  
Primary hyperlipidaemia  
Polycystic liver disease  
Recurrent cholangitis

**Table 1**

## Preoperative assessment

All patients considered for LT should have a multidisciplinary assessment by hepatologist, surgeon, anaesthetist and psychiatrist (where appropriate) before listing. Assessment should focus on establishing the correct diagnosis and severity of liver disease, ensuring there are no alternative medical or surgical therapies, excluding absolute contraindications (including severe concomitant disease) and on optimizing conditions prior to LT if indicated.

### Cardiovascular

In many LT candidates, symptoms may be multifactorial in origin (anaemia, deconditioning, ascites, effusions) and cannot be attributed to cardiovascular disease alone. It is important to identify risk factors for ischaemic heart disease that may help stratify risk and guide investigations. Coronary disease and cirrhotic cardiomyopathy are common in some groups presenting for LT. Electrocardiograph (ECG) and transthoracic echocardiogram (TTE) are performed along with a non-invasive stress test (e.g. stress echocardiography, myocardial perfusion scan or cardiopulmonary exercise test). A cardiologist with an interest in LT is useful to optimize existing condition and to consider further patient specific investigations. Surgical revascularization or valve replacement is a high-risk undertaking and requires careful consideration.

Portopulmonary hypertension (mean pulmonary artery pressure greater than 25 mmHg with portal hypertension) may occur in end-stage liver disease and can be identified on TTE. Patients with systolic pulmonary artery pressures of greater than 35–50 mmHg on TTE may be considered for right heart catheterization. Mean pulmonary artery pressure greater than 50 mmHg or right ventricular dysfunction has traditionally been considered a contraindication to LT; however, these patients may respond well to vasodilator therapy.<sup>3</sup> A number of agents may be used, including sildenafil, prostacyclin and endothelin receptor antagonists (e.g. ambrisentan). Serial TTE can assess disease progression.

### Respiratory

Respiratory comorbidity is common. Assessment should establish respiratory reserve. Pleural effusions and diaphragmatic splinting because of gross ascites may be identified on chest X-ray. Pulmonary function tests may reveal reduced transfer factor and arterial blood gases may identify hypoxaemia requiring investigation. Hepatopulmonary syndrome (HPS) is one cause of hypoxaemia and results from intrapulmonary vasodilatation and shunting in the presence of portal hypertension. This may be confirmed with transthoracic bubble echocardiography. HPS generally resolves following LT.<sup>4</sup> Patients should be offered counselling to stop smoking.

### Renal

Renal dysfunction is common in patients being assessed for LT and serum creatinine is a component of both MELD and UKELD. Renal dysfunction is multifactorial and may improve with volume expansion, discontinuation of nephrotoxic drugs, modifying diuretic therapy and in some cases treatment with synthetic splanchnic vasoconstrictors (e.g. terlipressin).<sup>5</sup> Hepatorenal syndrome carries a poor prognosis without LT. Electrolyte

disturbance and marked hyponatraemia (<125 mmol/l) is an adverse prognostic factor and perioperatively carries risk of central pontine myelinolysis. Electrolyte disturbance should be corrected preoperatively where possible.

### Central nervous system

Hepatic encephalopathy (HE) may have a very variable presentation. Newer therapies such as rifaximin, an antimicrobial agent have been used with success. HE will improve with transplantation but may take a variable period of time.

### Gastrointestinal

Patients should undergo endoscopy and enter a variceal banding programme or start carvedilol to reduce portal pressures risk of variceal haemorrhage.

### Haematological

Anaemia, marrow suppression, thrombocytopenia and coagulopathy are all common. Standard laboratory tests correlate poorly with bleeding. Most indices are not corrected preoperatively unless patients are symptomatic.<sup>6</sup>

### Metabolic and nutritional status

Malnutrition is common in liver disease and is a significant perioperative risk factor that should be addressed preoperatively. Patients should be seen by a dietician and counselled on maintaining low salt diets with sufficient calorie intake to cope with increased catabolism.

Non-alcoholic fatty liver disease is increasing as a cause of liver failure. While some of these patients are obese many present late and are malnourished by the time of assessment. Dietician input is crucial in these patients before and after transplant.

Body mass index (BMI) below 18.5 or greater than 40 is associated with increased perioperative risk.<sup>7</sup> Patients still demonstrate survival benefit following LT and should not be excluded from assessment.

Diabetes mellitus (DM) or impaired glucose tolerance should be identified and optimized during the LT assessment process. Poorly controlled or longstanding DM is an independent cardiovascular risk factor for adverse outcomes.

### Infection

Patients must be free of extrahepatic sepsis in order to tolerate LT and immunosuppression.

### Acute liver failure

Acute liver failure results from loss of hepatocellular function producing a clinical syndrome of jaundice, hepatic encephalopathy and hypoglycaemia.<sup>8</sup> It is commonly classified according to the time from onset of jaundice to encephalopathy with a period of less than one week considered 'hyperacute', less than one month 'acute' and less than 6 months 'subacute'. The majority of hyperacute presentations require intubation for encephalopathy, cardiovascular support, renal replacement therapy, dextrose replacement and coagulation management if bleeding. Cerebral oedema and intracranial hypertension may occur with a hyperacute presentation most frequently following paracetamol overdose. Measurement of ammonia may help

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