PREOPERATIVE CARDIOPULMONARY ASSESSMENT FOR LIVER TRANSPLANTATION
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Introduction

Liver transplantation (LT) has gone from being a high-risk high mortality undertaking to a more routinely performed surgery. It remains, however, a major intra-abdominal vascular procedure with the potential for great physiologic derangement. In addition there is a considerable discrepancy between supply and demand for organs. Both issues come into play in the preoperative assessment of candidates for LT.

Routine evaluation

At the Mayo Clinic all LT candidates undergo a protocolized assessment. A routine history and physical examinations is performed including a cardiac risk assessment. Testing specific to cardiorespiratory function includes arterial blood gases, chest radiograph and ECG and resting echocardiography for all patients. Specific concerns are discussed below.

Cardiovascular

Coronary Artery Disease

Published data report a very high perioperative mortality (50%) and morbidity (80%) for patients with CAD undergoing LT (Plotkin 1996). Although the data can be criticized it is the best currently available. For this reason identifying CAD in LT candidates is seen as important. A routine history and examination can be helpful but some symptoms suggestive of CAD (eg dyspnea, limited exercise capacity) are not uncommon findings in any patient with end-stage liver disease. There has, therefore, been a search to identify an appropriate test and testing strategy to identify CAD in LT candidates.

Dobutamine stress echocardiography (DSE) has been the most widely accepted screening test for both theoretical reasons (the high cardiac output low SVR stress may best reflect conditions encountered during LT) and clinical experience in risk stratification for vascular surgery. Published assessments of the utility of DSE in identifying CAD in LT candidates are difficult to interpret as a group due to differences in selection criteria and outcome measures. A near perfect predictive value has been reported, however other studies have found a high false positive rate (positive DSE but no significant CAD on coronary angiography) and a poor predictive value of positive DSE for cardiovascular events during LT. Our own studies at Mayo Clinic found the majority of positive DSE were false positives (6/7) and had no significant relationship with intraoperative myocardial injury assessed by troponin elevation. Troponin
elevation was related to the occurrence of intraoperative events (hypotension, arrhythmia, etc).
Before abandoning DSE it should be noted that the population who are referred for and then undergo LT are extremely selected and results in this group may not be generalizable to all patients with ESLD. It may be that a more selective approach to testing functional testing is appropriate, as is recommended in other non-cardiac surgeries. The current AHA/ACC guidelines may provide an initial starting point for this.
Currently our practice is to perform DSE in those patients who meet criteria under the ACC/AHA guidelines. If the DSE suggests ischemia the patient is referred to cardiology for consideration of coronary angiography and, potentially, correction. Patients who have corrected CAD and no evidence of inducible ischemia are considered satisfactory candidates for LT. Questions that merit answering in this area are the risks associated with corrected CAD given recent information on CAD management during surgery (eg beta blockade) and whether successful management of such patients in the perioperative phase translates into equivalent long-term survival to those without CAD.

Structural Heart Disease

There is a very scant literature on structural heart disease and OLT. Valvular and other cardiac lesions are either known about prior to OLT candidacy or are discovered during assessment either clinically or on the screening echo. What is clear from the literature is that patients with ESLD who undergo cardiopulmonary bypass have high mortality so an approach based on surgical correction prior to OLT is of limited applicability. Preliminary reports suggest that dynamic intracavitary gradients can be successfully managed during OLT. There are case reports of 2 patients with HOCM successfully managed. In absence of clinical evidence individual cases should be reviewed with the knowledge of the physiology of lesion and expected physiology of LT. Individual decisions should be made based on these considerations.

Amyloid Heart Disease

When LT is undertaken for familial amyloidosis assessment of the candidates’ cardiac function for significant amyloid heart disease (both cardiomyopathy and conducting system) is necessary.

Pulmonary

A wide range gas exchange abnormalities have been reported in OLT candidates. The aim of testing, in addition to providing baseline information, is to identify conditions which may influence transplant outcome and timing, particularly
hepatopulmonary syndrome and portopulmonary hypertension.
Preoperative screening for pulmonary disease in OLT candidates should include a routine history. However, as noted in the section on cardiac disease, symptoms of shortness of breath, reduced exercise tolerance and fatigue are common so routine testing is advisable.
Currently we obtain resting oximetry, arterial blood gases, a chest radiograph and a resting echocardiogram on all OLT candidates.

Arterial blood gases

Arterial blood gases are often abnormal. Respiratory alkalosis is frequent. Increased alveolar-arterial oxygen gradients are present in 30-50% of candidates but actual hypoxemia is less prevalent. Hypoxemia should initiate an investigation of the cause.
An abnormal DLCO is reported in approximately 50% of candidate. Gas exchange abnormalities typically improve after transplantation, although DLCO has been reported to remain diminished.

Hepatopulmonary Syndrome

This syndrome is characterized by the triad of chronic liver disease, arterial hypoxemia and intrapulmonary vascular dilations. Its reported prevalence is 10-20% of LT candidates. Patients may exhibit orthodeoxia and platypnea, oximetry or arterial pO2 measurements made in standing versus lying positions reflect these symptoms. Diagnosis is made by demonstrating intrapulmonary vascular dilation by either contrast echocardiography (delayed contrast appearance in the left heart) or by radiolabeled albumin macroaggregate scanning.
Most patients at diagnosis have markedly improved PaO2 with 100% O2 inhalation, but this may not be true in advanced HPS.
Identification of HPS is important firstly for perioperative management and secondly for transplant planning. As the condition progresses the hypoxemia worsens and it appears that transplant outcomes are worse the greater the hypoxemia (at least historically), therefore early transplant is recommended. Post transplantation the A-a gradients resolve gradually.

Portopulmonary Hypertension

Portopulmonary hypertension (portoPH) is pulmonary hypertension associated with portal hypertension. Elevated pulmonary artery pressures are not uncommon in LT candidates (up to 20%) but only 4% of candidates have portoHT. Identifying portoPH in LT candidates is important as severe portoPH (mean PAP > 50mmHg) is associated with a reported perioperative mortality of 100% and moderate portoPH (MPAP 35-50mmHg) is associated with a 50% mortality if the PVR is high (> 250 dynes.s/cm5).
We screen all candidates with a resting echocardiogram with estimation of PA
systolic pressure by doppler. If estimated PA systolic is > 50mmHg a right heart catheterization with measurement of hemodynamics is performed. Patients with severe or moderate portoPH and elevated PVR are deferred for transplantation and treatment for pulmonary hypertension initiated with epoprostenol. Such patients are followed up with serial echocardiography, once pulmonary hemodynamics improve to the “safe” range (moderate PH, SVR<250 dynes.s/cm5) they are again considered for OLT. Unfortunately mortality is high in this group during the treatment period. If acceptable hemodynamics are achieved the risk of OLT is acceptable, but still higher than that of patients without portoPH. Post OLT the epoprostenol can be eventually weaned.

Candidates who remain on the waiting list for some time should have repeat doppler measurement of PA pressure every 6-12 months as portoPA can be rapidly progressive. For this reason we are also reluctant to perform OLT without a PA catheter.

References

Coronary Artery Disease


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Structural Heart Disease


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Portopulmonary Hypertension

