Anesthesia for liver transplantation

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Over the past two decades advances in anesthesia and perioperative care have contributed greatly to the safety and success of liver transplantation. Nonetheless, the anesthetic management of these patients remains complex and challenging. Preoperative evaluation and optimisation are more demanding than ever, first since more patients are extubated immediately following surgery and second, since assessment of perioperative risk in the sickest patients often determines whether or not the patient is listed. Intraoperative mortality remains at 2-4% and preventable deaths related to complications of vascular access, rapid hemorrhage, hyperkalemia and air embolism continue to occur. Despite decreasing transfusion requirements and improving overall results throughout the 1990s, major bleeding, coagulopathy, electrolyte disturbances and cardiovascular instability still occur more frequently than in any other routine surgical procedure, and the potential for disaster to befall the inexperienced or inadequately supported clinician should not be underestimated.

The success of liver transplantation has led to a widening of indications and more potential recipients. Over the past 10 years this has resulted in longer waiting times, a greater degree of liver decompensation at the time of surgery and a higher proportion of older patients, particularly males with alcoholic liver disease. Nonetheless, it has become clear that many patients may be safely extubated at the end of surgery and managed postoperatively at an intermediate level of nursing care. Mandell and colleagues have proposed criteria for early extubation, and data from our own unit will be presented. Patients are considered suitable if they are free of significant extra-hepatic disease, including encephalopathy, if they are neither nutritionally compromised nor morbidly obese, and if they have had no previous major abdominal surgery. Intraoperative criteria must also be met, and these include a dry surgical field, hemodynamic stability, good gas exchange and evidence of satisfactory graft function. In our experience neither age >50, a previous history of encephalopathy nor a body mass index >30, providing obesity is predominantly pelvic in distribution, are in themselves contra-indications to a fast-track approach. The use of remifentanil (1000-3000 ug/hr, with air/oxygen/isoflurane and atracurium) has facilitated this approach. Rapid recovery of consciousness is assured and morphine (0.1 mg/kg, then titrated) is given to provide a smooth emergence. However when in doubt a conservative approach, with a period of postoperative ventilation, is always indicated.

Preoperative conditions needing careful assessment include ischemic heart disease, pulmonary hypertension, and hepatopulmonary syndrome. Data from the University of Pittsburgh has shown that patients with IHD have a three year survival of 50%, even with aggressive preoperative investigation and management. This matches the minimum acceptable survival odds now proposed by some authorities for candidacy for liver grafting. Patients with known IHD should probably have stress-radionuclide myocardial perfusion imaging or dipyridamole stress echocardiography, followed by coronary angiography if reversible hypoperfusion is demonstrated. Angioplasty or bypass grafting should be considered if the patient is symptomatic, although evidence that this is beneficial in survival terms is limited. Global left ventricular dysfunction has a poor long term outlook even disregarding the substantial perioperative risks, although published data in liver recipients is lacking.

Pulmonary hypertension (“portopulmonary hypertension”) is seen infrequently (<4% of adult recipients) but affects prognosis only when severe (mean PAP >40, about 0.2% of recipients). Its cause is uncertain although clinically and pathologically it resembles primary pulmonary hypertension. It is often first diagnosed at induction since clinical signs are typically absent.
Electrocardiographic signs of right bundle branch block and tricuspid regurgitation on echocardiogram should raise suspicion, and pulmonary artery catheterization to assess severity and response to treatment may be indicated. As yet there is little data on prognosis and best management, but if right ventricular function is well preserved perioperative mortality appears to be low. An international database has been established, which should provide valuable information on this condition over the next few years. Hepatopulmonary syndrome, characterised by marked pulmonary shunting and orthostatic arterial desaturation (orthodeoxia), occurs in 2-5% of adults and children with end-stage hepatic disease. The central pathophysiological feature is the “perfusion-diffusion” defect of gravity dependent pulmonary vasodilatation. A preoperative PaO₂ <50 mmHg is associated with a 30% 90-day mortality. Intraoperative problems with oxygenation are rarely observed, but weaning from mechanical ventilation may be prolonged and these patients are more vulnerable to sepsis. Successful transplantation is curative.

Intraoperative management has seen an increasing trend toward selective use of venovenous bypass. Our criteria include severe portal hypertension causing difficult surgical dissection, preoperative renal or cardiac disease, signs of inadequate systemic perfusion (vasopressor dependency, acidosis) and hypotension on trial clamping. This selectivity exposes fewer patients to the hazards of the technique, particularly local complications of surgical access and air embolism. Percutaneous cannulation for bypass is now widely practiced, although fatal extravascular placement and perforations have occurred when these relatively rigid large bore cannulae have been placed via the left internal jugular route. While caval cross-clamping during conventional liver grafting causes severe renal hypoperfusion and rapid extravasation of plasma water, there is no evidence that the consequences of this in hemodynamically robust patients with good preoperative renal function are significant. The prevention, evaluation and treatment of coagulopathy remains a central theme in the perioperative care of the liver recipient. Early correction of coagulopathy and thrombocytopenia, monitoring of prothrombin time and fibrinolytic indices in the operating room, and close observation of the surgical field are the basic tenets of management. The antifibrinolytic agents tranexamic acid and aprotinin have both now been shown in randomized controlled trials to reduce operative blood loss significantly, without evidence of increased thrombotic complications. Again, selective use seems reasonable. Intraoperative mortality related to hyperkalemia at reperfusion is still described. A recent multivariate analysis of our series, assessing all factors potentially contributing to hyperkalemia, showed preoperative beta-blockade (for prevention of variceal bleeding) and fatty infiltration of the donor liver to be the most powerful independent predictors of this complication. Patients with both factors had a mean reperfusion potassium of 8.2 mmol/l (range 6.5 – 11.7). Although beta-blockade also seems to protect against ventricular arrhythmias, treatment of a high or rising potassium during the anhepatic phase should always be aggressive. Use of a cell-saver to wash bank blood before transfusion may be life-saving. The use of dopamine or dopexamine to preserve renal and splanchnic perfusion remains controversial. Studies to date have lacked statistical power or adequate controls, although any benefits or drawbacks appear marginal and large studies will be needed to establish the place, if any, of these agents.

Future developments in anesthesia and intensive care for liver transplantation will include the multidisciplinary application of epidemiological techniques to more accurately define perioperative risk and to facilitate the most appropriate use of the limited supply of donor organs. Refinement of techniques of monitoring graft perfusion and function, and the manipulation of existing drugs and techniques to optimise these, are also likely to yield benefits in the next few years. Possibly even more important are improvements in donor management and organ preservation. Although these fields are still relatively under-researched, advances here could contribute greatly to the conduct and outcome of the transplant procedure. Finally, it should be emphasized that the perioperative care of the liver recipient is still very much a specialist’s role. It remains a complex and sometimes
unpredictable undertaking and the involvement of clinicians, nurses and technicians with significant experience in the field is vital to its continued success.