

Transoesophageal echo in liver transplantation: setting up a new service

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INTRODUCTION

Liver transplantation is a life-saving procedure for patient with end stage liver failure not responding to medical treatment. A substantial proportion of patients requiring a liver transplant are affected by a complex cardiac condition known as cirrhotic cardiomyopathy. These patients have impaired ventricular response to volume overload, haemorrhage, vascular clamping, vasoactive drugs and reperfusion. Transoesophageal echo (TOE) can provide irreplaceable help in the intraoperative management of patient undergoing liver transplantation by providing a rapid visualization of dynamic cardiac function, volume status, overall contractility, regional wall motion, embolization of large vessels, intra cardiac thrombus and pericardial effusion.

METHODS

At Cambridge University Hospitals (CUH) transoesophageal echo was not routinely used as a monitoring tool during liver transplantation. Moreover, as the Cardiothoracic Unit is separate from the General Hospital a cardiac anaesthetist and the required equipment was never readily available unless it was a semi-elective procedure or a crashing emergency. For this reason, and being aware of the evidence supporting TOE for liver transplantation, we have been building a program since 2016 that is now allowing us to provide TOE for most patients undergoing liver transplantation. The program is also designed to eventually develop training in TOE education tailored to transplant anaesthetists on the use of basic intraoperative TOE. The steps of our journey have been as follows:

- A survey on use of TOE during liver transplantation and training resources availability was sent to all transplant units in the UK
- A successful business case was presented in order to obtain the necessary equipment
- A protocol was developed with expert consultation consisting of: the recommended examination sequence, a report template, guidelines on handling, cleaning and storing the probe and the TOE machine and instruction on storage of the imaging has been published on intranet .
- CUH staff training and consultation with the CUH cardiology department and Papworth Hospital anaesthetic department are in place and ongoing.

RESULTS

- Results of the survey were as follows:
- 36 transplant anaesthetists responded to the survey from Freeman Hospital in Newcastle, Kings College and Royal Free in London, Queen Elizabeth Hospital in Birmingham, St James University Hospital in Leeds, the Edinburgh Royal Infirmary and Addenbrooke's Hospital in Cambridge.
 - For the vast majority (30 out of 36 responses) the only anaesthetist present during a liver transplant is a Consultant.
 - 25% of the responders use a TOE as an intraoperative monitoring tool
 - 60% of the responders consider TOE either desirable or essential during liver transplant surgery but the 86% of responders state that their institution does not provide a formal training program focused on TOE for transplant anaesthetists.

Recommended examination sequence currently in use at CUH is shown below. The suggested views are the result of a consensus between liver transplant anaesthetists, cardiac anaesthetists and cardiologists.

View	Probe	Assessment	View	Probe	Assessment
	Insert: 30-35 cm Slight retroflexion Angle: 0-20 degrees Depth: > 12 cm	Midoesophageal 4 chamber view: RV and LV - Size, systolic function, wall motion Normal RV size approx 2:1 LV size MV and TV - Inlet motion and regurgitation (color) Pericardial space - effusion Insert: 8-11 cm; Moderate: 1-2 cm; Large: >2 cm		Insert: 20-30 cm Angle: 90-110 degrees	Midoesophageal bicaval view: Interatrial Septum - PFO/ASD (color - reduce velocity scale) SVC and IVC - insertion and position of invasive lines; presence of pacing wires
	Insert: 30-35 cm Angle: 80-100 degrees	Midoesophageal 2 chamber view: LV - global and regional function MV - function (color) LA appendage - presence of thrombi		Insert: advance to stomach and anterflex Angle: 0 degrees	Transgastric Mid Short Axis view: Pericardial effusion LV function - regional motion Calculation of Endocardial Fraction (shortening in M-Mode) LV volume - normal LV end diastolic diameter 4-5 cm Monitor for changes from baseline exam: 4LVEDD 4LVESD 4Volume 4LVEDV 4LVESV 4Stroke Time 4LVEED 4LVESD 4Ejection Fraction
	Insert: 30-35 cm Angle: 120-160 degrees	Midoesophageal Long Axis view: LV - qualitative function and wall motion MV - regurgitation (color) AV - regurgitation, stenosis LVOT - obstruction, septal hypertrophy, SAM Interventricular Septum - Thickness		Insert: 15-20 cm (withdraw from ME view) Angle: 20-40 degrees	Midoesophageal Ascending Aorta Short Axis view: Ascending aorta Pulmonary artery - PAC position, thromboembolus
	Insert: 20-30 cm Angle: 60-75 degrees	Midoesophageal RV inflow-outflow view: RV - qualitative function TV and PV - function and regurgitation (color) Estimated PAPs - normal values 16-30 mmHg Could guide insertion of PA catheter		Insert: 20-30 cm (view LEFT from ME 4 chamber view) Angle: 0 degrees	Descending Aorta Short Axis view: Descending Aorta Left Pleural Space - effusions

CUH staff now have various training opportunities. Amongst the transplant anaesthetists there are several members either accredited or in the process of obtaining full TOE accreditation under cardiology supervision. Honorary training contracts are available for transplant anaesthetic consultants at Papworth Hospital under the supervision of a group of cardiac anaesthetists. Two cardiology TOE lists are available for the transplant consultants to attend. A basic internal TOE course for transplant anaesthetists is held periodically in order to allow all the members of the team to attend/refresh knowledge. The TOE machine and probe are readily available and are now utilised as an intraoperative monitoring tool for all liver transplants.

DISCUSSION

The national survey showed, in our opinion, the need for TOE training focused on liver transplant anaesthesia. Most centres in the UK don't routinely use TOE during liver transplantation and those that do, often have support readily available from their cardiac anaesthetic colleagues. In the last three years, the transplant team at CUH has been working towards getting a TOE service started in Addenbrooke's Hospital for all patients undergoing liver transplantation. Our service is focused on adopting TOE as an intraoperative, non-diagnostic monitoring tool as recommended by the ASE (American Society of Echocardiography) guidelines. Our aim in this process is to fully train our transplant anaesthetic team and eventually offer specific training to transplant anaesthetists in the UK. Moreover, once appropriately trained, the members of the transplant team could provide an emergency TOE service for other speciality that would be particularly useful especially in those centres, like ours, where cardiac support is not immediately available.

CONCLUSION

The Addenbrooke's transplant anaesthetists are particularly proud of the new program as this is the result of a joined effort of multiple teams with the aim of providing the best possible service for our patients. Our final aim is to provide a focused TOE service for the entire Anaesthetic Department and offer training opportunities to transplant anaesthetists from other centers.

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