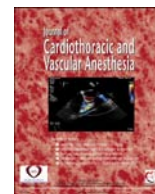




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## Case Report

## Unrecognized Esophageal Perforation After Liver Transplantation

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HEMODYNAMIC MONITORING during liver transplantation (LT) varies widely among transplant centers. Myocardial function during LT is currently monitored with a variety of devices including a pulmonary artery catheter, the PiCCO System (Pulsion Medical System, Munich, Germany), as well as less invasive systems such as FloTrac and Vigileo<sup>1</sup> (Edwards Lifesciences LLC, Irvine, CA). More recently, the use of transesophageal echocardiography (TEE) has gained popularity because of the ability to monitor cardiac output, volume status, valvular function, and the development of thromboses. Patients with end-stage liver disease (ESLD), cirrhotics in particular, are at risk for thromboses because of their imbalanced and unstable coagulation system, which can lead to either bleeding or clotting.<sup>2</sup> In addition to the risks of thromboses, there are several significant differences between patients undergoing cardiac surgical procedures with cardiopulmonary bypass and patients with ESLD undergoing liver transplantation. Patients undergoing cardiopulmonary bypass are, by necessity, completely anticoagulated and are, most often, cooled to temperatures as low as 18°C. In addition, perfusion is most often performed in a non-pulsatile manner.

Most studies evaluating the safety of intraoperative TEE use have been performed in the cardiac surgery setting and generally report a low incidence of complications. According

to guidelines from the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists, only active gastrointestinal bleeding was recognized as a contraindication for TEE probe placement. Esophageal varices are regarded only as a relative contraindication.<sup>3</sup>

Probe insertion and manipulation in patients with ESLD, however, and in particular those with cirrhosis and esophageal varices, should be performed with caution. The esophageal mucosae in these patients are more susceptible to injury. Although the overall incidence of significant complications related to TEE use is very low (1% and below),<sup>4-6</sup> physicians should be aware of the risks.<sup>4</sup> The authors present a patient who was successfully transplanted, but died due to presumed TEE-related mediastinitis.

### Case Report

A 69-year-old female patient with cirrhosis and hepatocellular carcinoma due to chronic hepatitis C infection was scheduled for LT. Prior to transplantation, the patient received transarterial chemoembolization of the lesion in segment 7. The calculated lab-MELD (Model for End-Stage Liver Disease) score was 9 and the match MELD was 22.

The transplant was performed with a cava replacement, and end-to-end anastomosis of both the portal vein and bile ducts. The donor hepatic artery was anastomosed to the recipient gastroduodenal artery. The graft used for this transplantation had a Donor Risk Index (DRI) of 2.04. Cold and warm ischemia times were 7 hours and 31 minutes, respectively. The

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surgical procedure itself was uneventful without blood transfusion or significant coagulopathy. Tacrolimus, mycophenolate mofetil, and corticosteroids were used for immunosuppression with the targeted tacrolimus level between 5 and 8 ng/mL.

After induction of general anesthesia, the trachea was successfully intubated by an attending anesthesiologist under direct laryngoscopy on the first attempt. A 14-French nasogastric tube was inserted into the esophagus atraumatically. Intraoperative monitoring included a TEE (Vivid i, GE Healthcare, Chalfont St. Giles, Buckinghamshire, United Kingdom). The TEE probe was covered with a lubricated protective sheath and inserted uneventfully by an experienced anesthesiologist on the first attempt. The probe was then advanced without any resistance. Probe temperature was monitored and the machine was set to automatically shut down if temperature exceeded 39°C. Manipulation of TEE probe during the case was minimal. TEE monitoring during the case was primarily performed using the midesophageal, four-chamber view. A short-axis transgastric view was used after graft reperfusion. At the end of the operation, the TEE probe was carefully removed without any signs of blood.

The initial postoperative course was uneventful. At the end of surgery, the patient was oxygenating normally (PaO<sub>2</sub> of 124 mmHg on an FiO<sub>2</sub> 0.3 and 5 mbar positive end-expiratory pressure). The patient was extubated and the nasogastric tube removed a few hours after surgery. Almost immediately after extubation, the patient complained of a severe sore throat. This was assumed to be related to the intubation and was not evaluated any further. The patient continued to oxygenate normally (PaO<sub>2</sub> between 85 and 130 mmHg on 2 L/min oxygen per nasal cannula). A norepinephrine infusion was used for a short period of time after surgery due to persistent low blood pressure. Postoperatively, laboratory studies reflective of hepatic buffering and synthetic function were all within the expected range. Lactate levels were at all times within normal range, aspartate transaminase (AST) and alanine transaminase (ALT) peaked the first postoperative day (POD) (2,217 U/L and 928 U/L, respectively) and by POD 3, the AST was 236 U/L and ALT was 539 U/L. Coagulation normalized on POD 2. Doppler ultrasound indicated that all vessels were patent with normal flow patterns.

On the third POD, the patient still complained of a significant sore throat to the point where she declined any oral intake. Late that afternoon, she developed subcutaneous emphysema, which was recognized during routine chest examination and confirmed by chest X-ray. Subsequently, a computed tomography (CT) scan demonstrated a pneumomediastinum with a small amount of air in the left pleural cavity (see Fig 1). Despite immediate chest tube placement, the patient's condition deteriorated to the point where she required intubation and inotropic support.

Emergency esophagogastroduodenoscopy demonstrated an esophageal transmural perforation close to the upper esophageal sphincter (approximately at 15 cm from the incisors). The mucosa close to the perforation appeared well perfused with no signs of ischemia or localized infection. It was not possible to determine the exact cause of injury based on either the



Fig 1. CT scan demonstrating a pneumomediastinum with a small amount of air in the left pleural cavity.

pathological or clinical findings. On the fourth POD, the patient's condition dramatically deteriorated and the patient died, presumably from mediastinitis related septic shock.

## Discussion

The authors present a case of fatal mediastinitis as a result of esophageal perforation likely related to TEE probe insertion. Complications related to the use of TEE, in general, are uncommon. Most studies evaluating the safety of intraoperative TEE use have been performed in the cardiac surgery setting and generally report a low incidence of complications. There is little information specifically related to complications associated with the use of TEE in patients with ESLD undergoing transplantation. In a retrospective evaluation of 116 patients undergoing LT with TEE monitoring, Markin et al demonstrated a complication rate, specifically related to the use of TEE, of 1.7% (primarily esophageal bleeding). None of the patients required any surgical intervention.<sup>5</sup> In another retrospective evaluation of 1,206 patients undergoing LT with TEE monitoring, Lu et al demonstrated a lower incidence of TEE related complications (0.33%, n = 4).<sup>6</sup> All 4 of these patients had different degrees of upper gastrointestinal bleeding; 2 patients were treated with endoscopic repair of ruptured varices and 2 with conservative treatment. An additional study evaluating patients with ESLD demonstrated that, in patients who were transplanted, esophageal perforation during their care occurred in 0.6% of cases and was specifically related to sclerotherapy treatment of esophageal varices.<sup>7</sup> In none of these cases was TEE used for intraoperative monitoring. The mortality rate in that study was 60%.

Insertion and manipulation of the probe have been identified as specific maneuvers associated with perforation of the hypopharynx, esophagus, or stomach.<sup>5,8</sup> An overall incidence of TEE-related esophagus perforation in this setting has been reported to be about 0.18% with a mortality rate of 0.0098%.<sup>4,9</sup> In another study of 10,000 consecutive cardiac surgical patients where intraoperative TEE monitoring was performed, hypopharyngeal and esophagus perforation was reported with an incidence of 0.01% and 0.02%, respectively,

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