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Case Report
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Liver Transplantation for Hepatic Trauma: Case Report and Literature Review

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Abstract

Background: Liver transplantation can be offered to selected patients following sever liver trauma as a possible life-saving procedure after all other treatment modalities have been exhausted. Authors present a case of severe liver trauma followed by liver transplantation due to total liver necrosis as a result of initial damage-control surgery and embolization with literature review.

Case Report: Compression of the right side of the body of a 64-year-old male resulted in hemodynamic instability due to major liver trauma and serial rib fracture. Damage-control surgery was unsuccessfully attempted at the regional hospital. After transfer to a tertiary centre embolization and definitive hemostasis was achieved. The patient developed acute liver failure and was transferred to a transplant centre where liver transplantation was successfully performed. Due to many complications patient died ten days after transplantation.

Conclusion: There are no widely established guidelines for the selection of the patients after severe liver trauma for liver transplantation. When facing a critically injured patient with severe hepatic trauma, an early referral to a specialized centre, where liver transplantation could be offered, should be a priority.

Keywords: Severe liver trauma; Liver transplantation; Injury severity score

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Background

Liver injury is one of the most common injuries to the abdomen and can cause significant morbidity and mortality [1]. Due to changes in the treatment paradigm, hemodynamically stable patients are now treated with non-operative management, which has greatly improved survival rates in patients suffering from abdominal trauma [1-6]. Furthermore, the focus on damage control surgery, rather than prolonged definitive procedures, has increased the survival in the initial period after surgery, allowing for more complex surgery to be performed later, when the patient is better able to withstand it [1,2]. In exceptional cases, Liver Transplantation (LT) can be offered as the last possible life-saving procedure for the treatment of severe liver trauma. There are no established guidelines to follow when facing decision making and considering trauma patients for LT [2,5].

In this article, we present a patient with severe liver trauma (American Association for the Surgery of Trauma, AAST, grade V), with an Injury Severity Score (ISS) 45, who underwent LT due to acute liver failure following initial damage-control surgery and embolization.

Case Presentation

A 64-year-old male was injured in the work place when heavy machinery compressed the right side of his body. He was brought to a regional hospital and due to hemodynamic instability; he was immediately taken to the operating theatre for explorative laparotomy. During the procedure, an extensive liver laceration was found (AAST grade V), causing massive bleeding. Pringle manoeuvre and perihepatic packing were attempted, but control of hemorrhage could not be obtained. With liver packing in place and occluded hepatoduodenal ligament of 186 min in total, the patient was transferred to a tertiary hospital for further care. Second look operation with liver mobilization, liver parenchyma suturing and perihepatic packing was immediately performed. Additionally, several lacerations to the diaphragm were noted and repaired by direct suture. Intraoperatively, the patient received massive blood, plasma and, platelet transfusion in accordance with the massive transfusion protocol, coagulation factors I, II, VII, IX, IX and X, protein C, protein S and tranexamic acid. Despite the supportive care, surgical hemostasis, and packing, complete control of bleeding could

Figure 1: Abdominal CT, axial plane: Large infarcted area of right liver with embolization material seen in the right hepatic artery course.

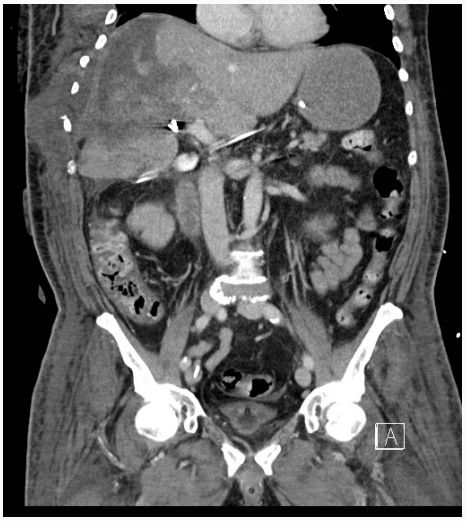

Figure 2: Abdominal CT, coronal view: Large infarcted area of the right liver.

Figure 3: POD 14, situation in the abdomen before total hepatectomy and LT: extensive liver necrosis, ischemic segment of the transverse colon.

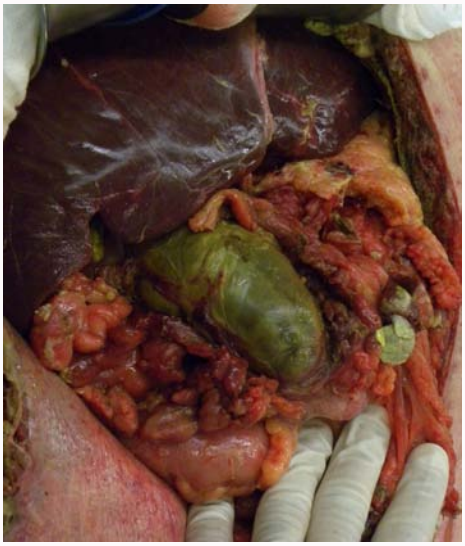

Figure 4: Second look procedure, PODT2: Vital transplanted liver, gangrenous area of the right part of the transverse colon.

not be obtained. The patient was taken to CT and angiography which showed active bleeding from the right hepatic artery originating from the superior mesenteric artery, and a segmental branch of the left hepatic artery. Embolization of the right hepatic artery and middle hepatic artery for segment 4 originating from the left hepatic artery was successfully performed. Inadvertently embolization material partially occluded also artery for segment 2. Following the embolization procedure patient was hemodynamically stable ad transferred to ICU after stabilization other injuries were addressed: A thoracic drain was placed for the right-sided hemato-pneumothorax and the right for ear m was splinted for an ulnar fracture. ISS was calculated at 45 (AIS5 liver trauma, AIS4 flail chest and AIS2 extremity fracture). On the first Postoperative Day (POD) packing was removed and the abdominal wall was closed with the drain in place. On POD4, the patient's condition deteriorated and due to severe acute kidney failure, hemodialysis was initiated.

On POD 9, the patient developed acute liver failure with clinically manifest encephalopathy and jaundice. Liver enzymes and ammonia were rising; CT showed mild cerebral edema, GCS was 3 with no sedatives used. Abdominal CT showed a large area of infarcted parenchyma in the right liver and part of the left (Figure 1, 2). The patient was transferred to a transplant centre and placed on high urgency Eurotransplant list for LT.

After transfer, transient stabilization of liver function and decrease in hyperammonemia was observed, along with a resolution of cerebral edema, but the patient remained unresponsive. On POD12, the patient became febrile, vasopressors requirement was progressively increasing. Beta-D-glucan was positive, but blood cultures showed neither bacterial nor fungal pathogens. Due to the worsening clinical condition, the patient was prepared for an emergency LT in spite of the beta-D-glucan results. In spite of intensive treatment, the patient's condition continued to deteriorate, and total hepatectomy with portocaval shunt was considered to treat evolving liver toxic syndrome and as a bridge to LT. On POD14 suitable liver was offered and the patient was transplanted. Extensive liver necrosis and an unexpectedly ischemic but not frankly gangrenous segment of the transverse colon were found (Figure 3). Total hepatectomy and LT with preserved caval flow with piggy-back technique and aorto-arterial anastomosis with iliac artery conduit was performed. The decision for the second-look procedure was made due to the wall changes of the segment of the transversal colon and the possible need for resection. Temporary vacuum-assisted abdominal closure with Abthera™ (KCI, Austin, Texas, USA) and negative pressure of 125 mmHg was done. The early postoperative course was uneventful but on the Post-Transplant Day (PODT) 2 during the second-look procedure (Figure 4), a gangrenous area of the colon led to a right hemicolectomy. Due to the absence of intestinal edema and adequate blood flow in the intestinal resection margins, primary anastomosis

was performed although ileostomy was considered. During the ICU stay the patient developed *Enterobacter cloacae* pneumonia; this was later complicated by superinfection with *Aspergillus fumigatus*. Copious non-serous discharge led to exploration on PODT 4. Two perforations in the remaining left colon with diffuse fecal peritonitis were found, leading to completion colectomy with terminal ileostomy. Continuous bleeding in spite of satisfactory coagulation laboratory results was observed after completion colectomy. On PODT7, the patient was taken back to the OR. No apparent acute bleeding was found in the abdominal cavity, but approximately 2 liters of coagulated blood were removed. After the procedure, the patient was hemodynamically stable but liver function deteriorated. On PODT8, the patient experienced yet another episode of massive bleeding with loss of measurable blood pressure. Immediate laparotomy revealed active bleeding from the aorto-arterial anastomosis and reanastomosis with synthetic graft and patch aortoplasty using CorMatrix™ (Cormatrix Inc, Roswell, Georgia, USA).

Postoperatively patient's condition on PODT9 deteriorated rapidly with kidney and liver failure. The patient died on PODT10.

Discussion

The authors report a case of a 64-year-old male with severe liver trauma (AAST grade V), with ISS of 45, who was initially treated with damage control surgery and embolization followed by LT due to liver necrosis with acute liver failure. The role of LT in the settings of liver trauma is very limited. Consequently, the re-exists neither extensive clinical experience nor strong evidence from clinical trials on which to ground clinical decision-making in the most critically injured patients who may require LT [3-5]. Sometimes, in severe liver trauma with extensive destruction of liver parenchyma and uncontrollable bleeding, for example in case of liver avulsion or total crush injury, immediate total hepatectomy with portocaval shunt and consequent LT is the only possibility to save a patient [7]. The anhepatic phase should not exceed 72 h [8]. According to the literature, in the settings of severe liver trauma, LT is mostly indicated due to complete liver necrosis which develops as a complication after initial salvageable procedures [2-5,7,9,10]. As in our case, this kind of complication necessitating LT is expected to occur 7 to 14 days after initial trauma [4]. In comparison to patients undergoing LT for end-stage liver disease patients after severe liver trauma are younger and otherwise healthy individuals with no prior liver disease and associated co-morbidities [2,4]. While LT is the only opportunity for survival in these patients, decision making in the light of organ shortage, to avoid futile LT, is very demanding. Robust evidence on which patients should be considered for LT or are beyond salvage is lacking and decision making is based on clinical experience derived from elective LT [2-5].

One of the largest studies performed up to date is a retrospective analysis conducted by Krawczyk et al. on the data of the European Liver Transplant Registry evaluating the short and long-term outcomes of LT after severe hepatic trauma. A total of 73 patients were included in this study with a median follow-up of 5-years with a detailed analysis performed on a subgroup of 24 liver recipients assaying the influence of ISS on the outcomes [2]. Results of Krawczyk's study can be of aid but not used as a guideline in decision-making procedure regarding the patients after severe liver trauma in need of LT. The reported overall 5-year patient and graft survival rates were 51% and 45%, respectively. In comparison, according to the European Liver Transplant Registry, when analyzing results of LT in Europe, reported 5-year patient and graft survival rates were 71% and 65%, respectively [11]. The more detailed reported 5-year patient survival rate in acute liver failure was 64% [11]. The 5-year survival of 50% in settings of LT in major liver trauma must be kept in mind when allocating organs to this lost cause patient.

For better patient selection one of the factors that can be of use is ISS. According to the results of Krawczyk's study, the best cut-off value for predicting survival after LT for hepatic trauma is 33, and therefore they suggest using it as a guideline for determining eligibility for LT [2]. Although statistical significance was not achieved, the authors discovered high postoperative mortality of 75% in the subgroup of patients with ISS scores greater than 33 [2]. As the number of included patients in the analysis was only 24 and no detailed information on the combination of the sustained injuries was offered, the results of Krawczyk study on the impact of the ISS on the survival of the trauma patients after LT should not be used as a sole indicator for rejection of LT in patients with liver trauma. The authors also discovered a statistically significant association between the grade of liver trauma and 90-day mortality. A grade of liver trauma V or more was related to a statistically significant increase in 90-day mortality and graft-loss (p=0.005 and 0.018, respectively). When scaling the liver injury AAST liver injury grade V contributes 25 points to the ISS [12]. If one would strictly consider Krawczyk's criteria of cut-off 33 for ISS only patients with isolated liver injury and minor injuries to other regions would be considered for LT [2]. Therefore ISS should be just one of the rough indicators against LT in the settings of the critically injured liver patient especially as the presence of concomitant injuries did not influence outcomes in Krawczyk's study [2].

When reviewing the literature, one concludes that the main cause of death after LT for hepatic trauma is infection leading to sepsis with multiorgan failure which was also the case in our patient [2,4,5]. As suggested by some authors, the inflammatory effect of trauma can contribute to the mortality rate in the critically injured patient [13-15] and the presence of inflammatory response in patients with acute liver failure is a negative prognostic factor [14-16]. Pneumonia following chest trauma occurs in up to 25% of patients after chest trauma and can lead to sepsis and hemodynamic instability which also happened in our patient [17]. Furthermore, gangrene of the colon could, as liver necrosis, represent the complication of embolization or could be a result of hypoperfusion as the sequel of hemodynamic instability. As the hepatic artery in our patient arose from the superior mesenteric artery embolization material could get carried in one of the arterial branches for the transverse colon, causing hypoperfusion leading to ischemia and consequently gangrene. One would presume that visceral injury due to initial trauma would be demarcated upon the second-look operation in the tertiary centre and not seen for the first time 14 days after the initial trauma.

On a final note, when risk factors for unfavorable outcomes were analyzed by the Krawczyk group, a statistically important difference in 90-day graft loss was observed regarding the surgical technique used for LT [2]. Better results were noted if a technique with preserved caval outflow and portocaval shunt was used during transplantation. Authors recommend that the use of conventional techniques without venovenous bypass should therefore be avoided [2]. Moreover, as well described in the literature, aorto-hepatic arterial revascularization is, compared to conventional arterial reconstruction technique, an independent risk factor for the development of hepatic artery thrombosis with potential graft loss and should be only used when the recipient's hepatic artery is not suitable for a direct anastomosis [18].

Since the anatomical circumstances in our patient were unfavorable for direct arterial anastomosis, an aorto-arterial anastomosis with iliac artery conduit was performed and fortunately, no arterial thrombosis occurred. At the site of anastomosis, bleeding occurred due to partial disruption of aorto-arterial anastomosis, and the second reconstruction with additional ischemic damage to the graft due to temporary clamping of arterial flow to the liver was performed. Supraceliac aorto-arterial anastomosis with or without iliac conduit is an alternative option that can be used successfully in difficult cases but surgeons should be aware of the potential and also lethal complications [19,20].

To conclude, patients suffering from severe liver trauma and acute liver failure should be referred to the tertiary centre with a liver transplant unit as soon as possible. Reports from the literature are showing great importance on the management of a critically injured patient with severe liver trauma, with the aim of prevention of acute liver necrosis that would possibly necessitate LT [3]. If the LT is the only mean of survival for the hepatic trauma patient, one must take into account the relatively good long-term survival rates of approximately 50% in patients that would otherwise be condemned to certain death. Although some guidelines can already be extrapolated from recent studies, more comprehensive analysis on a larger pool of patients is needed. Until then indications for LT will remain personalized for the majority of patients after severe liver trauma.

Conclusion

In patients after severe liver trauma, LT is the therapeutic modality that can be offered to the critically injured patient after all other treatment options are exhausted. The main indication for LT in these patients is complete liver necrosis with acute liver failure that follows the initial life-saving procedures. There are no widely established guidelines that would help in decision making. The ISS score can be of help in selected patients. In patients with severe liver trauma, the aim should be an early referral to a specialized centre, where an LT could be offered to selected patients as a last resort of treatment.

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