



## Review

# Liver Transplantation for Severe Hepatic Trauma: Historical Review

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### Abstract

Liver transplantation (LT) is rare in the context of liver trauma. There are no clear indications on which patients may benefit from LT, and what are the factors that may reduce or increase the success rate of LT for a trauma patient. We performed a review of the literature in order to better recognize indications and results in this setting.

A comprehensive review of the literature involving LT in the context of trauma using Pubmed and Google Scholar up to Dec 2022. As this is an uncommon event, we included all publications including case reports.

A total of 19 case reports and one retrospective trial were included in the review. Most past cases were performed in two stages including resection of the native liver with an anhepatic phase followed by liver transplant within a few days with availability of the donor liver. However, one stage was also performed successfully in hemodynamically stable patients with the presence of a donor organ. Bridge to transplantation by portocaval shunt and piggyback anastomosis to native vena cava demonstrated the best results. LT under conditions of infection resulted in increased mortality but can be feasible if there is a possibility of achieving source control of the infection. Auto-transplantation is an accepted option in cases of severe vascular trauma without extensive damage to the liver tissue and bile ducts.

LT in a trauma patient is valid option with accepted success rates. When performed, it is usually in grade 4 or higher liver trauma in an unstable patient, which has failed other treatment options or if there is irreversible damage to the liver tissue and bile ducts. A decision should be based on a multidisciplinary team discussion in an experienced LT center which should consider the chances of saving the patient with an acceptable quality of life in the face of wasting a costly liver graft.

**Keywords:** Autotransplantation, Hepatic trauma, Liver transplantation, Portocaval shunt

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The liver trauma considered from the most common trauma and can reach up to 16 % from the total abdominal trauma.<sup>[1]</sup> The liver trauma can be divided by the mechanism to blunt and penetrating liver trauma, and by the severity according to the American Association for the Surgery of Trauma (AAST 2018 version) to five degrees.<sup>[2]</sup>

With the advancement of modern medicine techniques and the increase in therapeutic capabilities by means of intensive radiology, for example, the closure of a specific artery or vein to stop bleeding, operations of damage control strategies, perihepatic packing, and direct repair of vascular injuries, add to that an increase in understanding about

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the possibilities of giving blood components and giving appropriate clotting factors have significantly reduced the needs for major liver surgeries in order to stop bleeding, or to repair the damage resulting from the injuries, at a time when researches have shown the efficacy of these treatments may succeed in high rates and may reach 90%, also the failure of this treatment may not increase the risk.<sup>[3]</sup>

When the hepatic trauma was classified into grades 1-5 according to the AAST, it was mostly observed that the non-surgical treatment such as monitoring only or interventional radiology treatment may be more effective with a grade of 1-3, and this of course refers to hemodynamically stable patients, while in cases of Grades 4-5 and unstable cases of patients may complicate matters further and the urgent need to resort to surgeries for damage control strategies such as perihepatic packing, direct repair of vascular injuries, hepatectomies, and even liver transplantation.<sup>[4]</sup>

Over the past three decades, some case reports and retrospective trials have been published about liver transplantation in trauma situations. Despite this, there are no clear and explicit lines which patients may benefit from liver transplantation, and what are the factors that may reduce or increase the success rate of liver transplantation for a trauma patient. By looking at the history of liver transplantation in trauma cases, our aim is to mark important points that may help, and to consider future research for a better explanation.

### **The Beginning of Liver Transplantation in Trauma Setting**

For the first time in 1984, liver transplantation was done in patients who had suffered from liver trauma. It was published by Carlos O. et al in the case report in which he talked about two cases of blunt trauma, the first transplant for a patient at the age of 24 years, the transplant took place after nearly two months due to liver failure and injury to the unreparable bile ducts. The patient was discharged from the hospital after three weeks without significant complications. The second case, it occurred at the age of 17, and after three days from the injury only due to liver failure and damage to the bile ducts. He died after two weeks due to the CMV infection.<sup>[5]</sup> In all these cases in the 1980s, no long-term follow-up was mentioned.

### **The role of Two Stages Liver Transplantation, Anhepatic Phase and the Portocaval Shunt in Hepatic Trauma**

In 1987 was mentioned first time the possibility of two stages liver transplantation with anhepatic phase with the help of femoro-axial venous bypass. Severe lactate acidosis can be developed due to acute liver ischemia or due to reperfusion syndrome to prevent such cases, bicarbonate

hemodialysis or continuous hemofiltration arteriovenous with replacement fluids sodium bicarbonate-buffered was used prophylactically.

The possibility of liver transplantation with two stages hepatectomy and anhepatic phase which included bridge to transplantation by portocaval shunt also was described. The amounts of adrenalin and noradrenalin may increase in the anhepatic phase. It may decrease post-transplantation. By the substitution plasmatic coagulation was stabilized, showing higher values at 24 hours after transplantation than at 48 hours before transplantation. Under correct management the hepatic phase can be extended till 40 hours in some cases.<sup>[6-13]</sup>

### **Can Arterial Embolization or Surgical Packing in Liver Trauma setting lead to Liver Transplantation?**

Since the nineteenth century, we are talking about liver transplantation in trauma in cases of failure of all attempts, such as observation, invasive radiology, and packing. It has been mentioned about the efficacy of these treatments, which may protect the patient from the need for liver transplantation, excessive bleeding, infection, post reperfusion syndrome, etc.

On the other hand, late complication as hepatic artery to portal veins fistulas which may lead to cholangiopathy due to ischemia, also in acute setting complication may develop a post-reperfusion syndrome, was mentioned as a result of perihepatic packing removal. In some cases, the estimation of patient's situation, which can reach the maximum severity and may not be able to live for more than a few hours. Therefore, the liver should be removed and to perform a portocaval shunt. Also was mentioned a complete occlusion of hepatic artery proper, which resulted in irreversible liver ischemia, which also led to a relapse of the liver, but also to the bile ducts, which eventually led to the necessity of liver transplantation.<sup>[1, 14-16]</sup>

### **Is the Infection in Liver Trauma setting is Contraindication for Liver Transplantation?**

The subject of infection in the pre-transplantation stage of the liver has always been considered as a relative contraindication. But if we talk about trauma cases, the possibility of an infection inside the abdomen due to intestinal rupture injuries or through penetrating injuries is very likely, so the exciting question may arise, are we exaggerating the liver The donor or the patient's traumatic life. Therefore, if we go back to some cases that have mentioned this subject directly or indirectly, liver transplantation is possible in the presence of infection, if we can control the infection or eradicate its basis with good and appropriate coverage of antibiotics.<sup>[3, 5, 8, 17, 18]</sup>

## Liver Autotransplantation

In 2006, was mentioned for the first time in liver trauma about the attempt of extracorporeal repair and liver autotransplantation after total avulsion of hepatic veins and retro-hepatic Inferior vena cava injury. Liver transplantation in trauma is more susceptible to infection, especially after lowering immunity by immunosuppressing drugs, the chance of exposure to infection may increase, and since trauma is more of blood vessels without significant damage to the liver or bile ducts, the idea of removing the liver was mentioned while the patient is strapped on an extracorporeal bypass device between the left femoral vein and the left axillary vein using a centrifugal pump, the liver was transferred to the ex vivo team who washed the liver with 3 liters of the University of Wisconsin solution. Two liters through the porta and a liter through the main artery and liver transplantation again. It is true that the patient did not survive and died due to severe respiratory distress, but the liver from the data that was mentioned such as clotting factors, protein, liver enzymes and bilirubin was not liver failure, but rather the opposite. It was working and a significant improvement in its functions.<sup>[19]</sup>

## What is the Best Technique to Perform the Liver Transplantation in Trauma setting?

In the largest retrospective study so far, from the European Liver Transplant Registry raised a very important point about the different ways in which the liver can be implanted such as piggyback, conventional with or without veno-venous bypass technique.

Statistically have been showed significant advantage in patients implanted with piggyback or conventional with veno-venous bypass in terms of patient and graft survival after surgery, and this despite the fact that in the normal transplants performed in the conventional way and a decrease in preload and afterload by almost 30% that the patient can still survive, still in a trauma patients this may lead to morbidity and mortality incidences increases without VVB, but it is still a point for deeper investigation and looking at the age of the patient, the age of the donor and comorbidities can be a point for prospective research.<sup>[3]</sup>

## Discussion

There are around 30 case reports and series most of which spoke about the liver transplantation in trauma setting as a last option of treatment, and this is after all solutions have been tried or it will not be possible to offer them. It should be remembered that liver transplantation under conditions of infection showed a higher mortality according to the retrospective study, but we have witnessed several

case reports that showed liver transplantation can be offered if there is an ability to resect the source of the infection.<sup>[3, 5, 8, 16-18]</sup>

The auto-transplantation option can be possible there's a trauma of the blood vessels only without extensive damage to the liver tissue and bile ducts.<sup>[19]</sup>

Most of the liver transplants in trauma setting was performed in the past are in two stages but there is still an option for one stage, and it depends on some factors like hemodynamic stability and the presence of a graft or a donor.<sup>[6-13, 20]</sup>

Liver transplantation techniques such as piggyback and conventional with veno-venous bypass showing the safest techniques in trauma setting.<sup>[3]</sup>

## Conclusion

To summarize our words, liver transplantation in the context of trauma is supposed to be another option in the surgeon's pocket but considering the number of these cases and the high mortality, it is highly recommended to have a multidisciplinary committee for discussion and to consider a liver graft wasting in front of patient's life saving and the quality of life.

## Disclosures

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