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The Treatment of Sever Juxtahepatic Venous Injury

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Abstract The crucial factors in the operative management of juxtahepatic venous injuries are early identification and urgent control of bleeding. Adequate resuscitation after hepatic packing is fundamental. Failure to control bleeding after Pringle maneuver and hepatic packing confirms a retrohepatic venous injury. Total vascular isolation of the liver with veno-veno bypass or not provides an effective techniques for juxtahepatic venous injury.

Key words: Juxtahepatic venous injury, Pringle maneuver, Total vascular isolation of the liver with veno-veno bypass or not, Atrio-caval shunt

Introduction

Injuries to the retrohepatic veins, that is, the retrohepatic vena cava or the major hepatic vein are highly fatal and represent a huge challenge due to the surgically inaccessible location of these vessels as well as the difficulty of controlling the bleeding in this area. More than half of these patients are pronounced dead on arrival to the hospital. 15% of patients with blunt liver trauma sustain hepatic venous injuries and more than 80% die from uncontrollable hemorrhage [1, 2]. Major juxtahepatic venous injuries demands vascular control of both porta hepatis and retrohepatic venous segments.

First of all, hepatic manual compression and hepatic packing will be suitable procedure for severe liver injuries (grade IV – V). The

Pringle maneuver is the second procedure in case of persistent bleeding after hepatic packing. If hepatic packing and Pringle maneuver fail to control bleeding, bleeding persists from behind the liver, a retrohepatic caval or hepatic vein injury is present [3].

The surgeon must consider more extensive procedure. This requires mobilizing the right lobe and occasionally the left lobe and vascular isolation of the liver. The preferred method for caval and hepatic vein injury is total vascular isolation [4].

This article review perihepatic packing, Pringle maneuver and the treatment of injuries of retrohepatic vein.

Pringle maneuver

The compression of the hepatic pedicle via the foramen of Winslow is known as Pringle's maneuver for life-threatening hemorrhage from the liver trauma. In the hemodynamically stable patient, Pringle's maneuver could be performed for up to an hour. In the shocked patient, Pringle's maneuver should be performed for about 15 minutes at a time. In theory, Pringle's

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maneuver stop hemorrhage from branch of the hepatic artery or portal vein.

Perihepatic Packing

Gauze packing is easy to use and has the potential for rapid hemorrhage control, it is the most commonly used method for patients with severe liver injuries. Liver packing was initially described by Feliciano *et al.* [5] for the control of bleeding, and to date, it is the standard approach for the control of damage in liver injuries.

Packing is initially performed using large flat abdominal packs, placed laterally, anteriorly, medially and around the livers. Perihepatic packing is capable of controlling hemorrhage from almost all hepatic venous injury.

The treatment of injuries of retrohepatic vein

In case of major juxtahepatic venous injury, this necessitates a modification in the subsequent surgical approach.

The current operative techniques for vascular isolation of the injured liver use either internal atriocaval shunting or multiples clamp with or without veno-veno bypass.

Atrio-caval shunt (ACS)

The atrio-caval shunt (ACS), introduced by Schrock in 1968 [6], by pass the retro-hepatic caval blood with a chest tube put into the inferior vena cava, up the liver, through the right atrium. In brief, a 36 French chest tube (or a 9mm endotracheal tube) with an extra side vent hole is inserted through the right atrium into the IVC after incision of the atrial appendage and secured with a purse-string stitch. The shunt is then secured with tourniquets at the intrapericardial and suprarenal vena cava. In theory, if performed correctly and combined with a Pringle's maneuver, the ACS should control almost all bleeding (hepatic vein, inferior phrenic vein and r-adrenal vein). The introduction of ACS, the Houston group reported 81% mortality in 31 patients with major juxtahepatic venous injuries treated with ACS due to the

complexity of the lesions and the difficulty of the procedure [7]. Similarly, in a result of 34 patients treated by Cogbill *et al.*, with ACS an operative mortality of 90% was reported [8]. Kudst *et al.*, reported the use of the ACS in 18 patients of which only 4 survived (22%) [9]. The atriocaval shunt has been advocated for isolation of bleeding retrohepatic vena cava, but above reports suggest that mortality might be even higher in patients selected for shunting, perhaps owing to ongoing hemorrhage because of indecision and delay prior to insertion, or to technical difficulty with insertion. This procedure is also time-consuming, much more than total vascular isolation using a temporary veno-veno bypass. Consequently, alternative avenues have been explored.

Total hepatic venous isolation

Therefore, simpler alternative techniques are needed. Total hepatic venous isolation without shunting using occluding clamps on both the suprahepatic and suprarenal vena cava with a Pringle's maneuver was devised by Heany [10] and later by Huguet [11] during complex elective liver resections. This technique was suitable surgical procedure for juxtahepatic venous injury. Superiorly, the inferior vena cava can be isolated just below the diaphragm or through the pericardium by extending the incision to a median sternotomy and inferiorly, just above the renal vein. This approach allows direct repair of the vascular injury. Aortic clamping is not recommended for vena caval or hepatic vein injury [12]. Adequate volume resuscitation before caval clamping is essential to avoid cardiac arrhythmia due to complete caval occlusion. If hypotension persists, venous bypass (femoral to axillary or jugular bypass) in liver transplantation is an option. Khaneja *et al.*, [13] reported consecutive series of 10 patients with penetrating injuries to the juxtahepatic inferior vena cava at an urban, university-affiliated Level I trauma center. A rapid and direct approach was used along with isolation techniques similar to those used in liver transplantation and elective

resection for neoplasm. As resuscitation continued, repair of the inferior vena cava was accomplished in a bloodless field, created by manual compression of the liver, wide exposure, portal inflow occlusion, and proximal and distal control of the inferior vena cava. Nine patients survived surgery, and seven of nine survived to hospital discharge. One postoperative death was a result of multiple organ dysfunction syndrome, and the other of necrotizing bacterial pneumonia. The overall mortality was 30%.

Total vascular isolation with or without venovenous bypass has been used in liver transplantation and complicated liver resections. In addition to liver transplantation, many liver resections, especially non-anatomic large resections, are done with vascular isolation of the liver and selective use of venovenous bypass. There have been two other reports in the literature on the use of venovenous bypass in major liver trauma. Baumgartner *et al.*, [14] reported on the use of venovenous bypass for five patients with major hepatic and caval trauma, four of whom survived (80%). Horowitz *et al.*, [15] used venovenous bypass successfully to control a missed retrohepatic venous injury in a pediatric patient. Including the patient reported in this case report, venovenous bypass has been used in a total of seven trauma patients with an overall survival of 88%.

Above data say the vascular isolation technique has reported a better survival rate compared to ACS.

Liver transplantation

In the last two decades liver transplantation has been reported as an extreme measure in massive hepatic venous and retrohepatic caval injuries followed by uncontrolled bleeding despite repeated previous surgery and acute or progressive liver failure following repair of injury [16,17]. The biggest series was reported by Delis [17] in which three out of four patients survived after liver transplantation.

Conclusion

Adequate resuscitation after packing is fundamental. Failure to control bleeding after Pringle's maneuver confirms a retrohepatic venous injury. Total vascular isolation of the liver provides an effective alternative techniques for juxtahepatic venous repair. The basic principle of operation is to control the trauma and choose the optimal operative method according to the general condition informed by surgical exploration. Meanwhile, surgeon's experiences and technical skill have great influence on the prognosis of the patients.

Authors' Contribution

NH: conceived and designed the study carried out the literature search and prepared and edited the draft.

Ethical consideration

None applicable

Conflicts of Interests

The author declares that there are no conflicts of interest.

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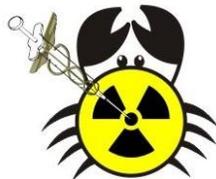
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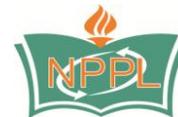
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