

Portal Vein Injuries: A Review

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Received: July 05, 2017; Accepted: July 26, 2017; Published: July 31, 2017

Citation: Phillips B, Mirzaie M, Turco L (2017) Portal Vein Injuries: A review. J Emerg Trauma Care Vol.2:No.2:4

Abstract

Portal vein injury, while one of the more uncommon forms of trauma, is certainly one of the most lethal forms of trauma. Of the thousands of trauma cases admitted into hospitals each year portal vein injury accounts for far less than 1% of all trauma cases. Most patients with an injury to the portal vein often die of haemorrhage before reaching the hospital. For those patients that can be transported into the operating room, mortality is in the 50% to 70% range. The causes of such high mortality rates are related to the difficulty in controlling haemorrhage and the degree of associated injuries that usually accompany an injury to the portal vein. In the setting of portal vein injuries, the type of trauma either penetrating or blunt affects outcome. According to the literature, survivability nearly doubles when the trauma is from a blunt rather than a penetrating mechanism. There is some controversy related to the "best treatment" of patients with portal vein injuries. The major point of contention is whether ligation or tenorrhaphy should be employed in hemodynamically stable patients. Both surgical techniques are options for controlling portal vein haemorrhage. However, it has been reported by some authors that ligation might be more beneficial in patients that are hemodynamically stable.

Keywords: Portal vein trauma; Operative management; Retroperitoneal hematoma; Zone I hematoma

Pringle Manoeuvre. The Pringle Manoeuvre, as described first by James Hogarth Pringle in 1908 [2], is accomplished by clamping the porta hepatis to decrease blood loss. While the Pringle Manoeuvre is commonly employed as an immediate but temporizing solution, the question of when to repair an injured vein versus ligating creates a challenging scenario for the trauma surgeon.

Literature Review

Comparison of portal vein ligation and portal vein repair is one of many discussions regarding treatment options for patients that have sustained portal vein injury. Patients who are hemodynamically stable after sustaining portal vein injuries usually have tenorrhaphy employed as the preferred surgical approach [3]. Tenorrhaphy has shown to lead to a lower overall mortality rate at 14% to 67% compared to portal vein ligation [4]. However, in hemodynamically unstable patients with complex injuries, ligation of the portal vein is the most common surgical approach [5]. This approach leads to a rapid fall of systemic arterial blood pressure and a rise in portal venous pressure with an added risk of bowel infarction. Thus, portal vein ligation typically is associated with a higher mortality rate 16% to 64% [6].

Patients with an injury to the portal vein often present in haemorrhagic shock. The extent of shock can lead to advanced circulatory collapse to where emergent surgical intervention is the only chance at survival. Often, a resuscitative thoracotomy and aortic cross clamp are necessary [5] for patients requiring resuscitative thoracotomy and aortic cross clamping the rate of survival is 12.5% [7].

Introduction

Portal vein injuries present some of the most difficult cases to surgically manage. Current approaches for the surgical treatment of portal vein injury are reconstruction via end to end anastomosis, repair via lateral tenorrhaphy, placement of an interposition graft, superior mesenteric vein to splenic vein anastomotic reconstruction, ligation of the portal vein followed by a portosystemic shunt, and ligation of the portal vein itself [1]. These treatment options cover a wide range of circumstances based on the actual extent of injury. Of these options, two of the most common treatment options are portal vein repair (tenorrhaphy) and ligation. Immediate control of portal vein bleeding can be attempted with the

There are also methods of portal vein injury treatment that are more case specific. Such treatment methods have been developed as not only a way to treat the immediate portal vein injury but also to prevent complications. Case specific treatments are most often related to treating blunt portal vein injuries. With especially blunt trauma associated with the portal vein, the range of additional complications can become extensive so defensive care becomes essential. Motor vehicle collisions or falls most often cause blunt portal vein injuries, therefore, patient observation upon admission becomes important to understand the extent of the trauma over time to prevent re-haemorrhaging after initial treatment and the possible complication of thrombosis. In a case report presented by Gopal et al. [8] a 26-year-old patient with a liver

laceration associated with a motor vehicle accident resulting in blunt abdominal trauma was treated for a slightly lacerated portal vein and had mesenteric vein thrombosis. The patient was treated with a prophylactic dose of heparin, which enabled him to remain stable. After a repeat CT scan his portal vein thrombosis had regressed and the mesenteric thrombosis was resolved. Heparin infusion is the most usual form of treatment for portal vein thrombosis portal vein thrombosis is a rare complication in patients with blunt abdominal trauma associated with liver injury; however, if not treated the impending and growing thrombosis can be detrimental to the patient's health.

In another case displaying the importance of heparin infusion into the portal vein a case report by Young et al. reveals one of the first cases in literature noting the use of direct heparin infusion into the portal system to avoid portal vein thrombosis. A 20-year-old man was presented to the emergency room with abdominal pain 30 minutes after a motorcycle accident [9]. The patient underwent emergency laparotomy, which evacuated 2 L of blood from the peritonea cavity. Bleeding from the portal vein was soon encountered after the evacuation. To prevent re-thrombosis direct heparin infusion through the inferior mesenteric vein was implemented. Although the portal vein injury did not present initial thrombosis the decision to include a heparin infusion was preventative against any possible complication of portal vein thrombosis post operatively based on the amount of evacuated blood encountered and the discovery of the portal vein injury.

There are also situations in literature that show quite the opposite view to using anticoagulants to treat patients that have blunt abdominal trauma. In a clinical case presented by Gonzalez et al. a 69-year-old female was presented to a trauma centre after a motor vehicle crash sustaining blunt trauma to her abdomen from her seatbelt [10]. A CT scan confirmed that she had free fluid around the porta hepatis and had ruptured the portal vein. Despite preference for non-operative approach 'red flags' (such as increases in para-pancreatic fluid, an increase in bilirubin as well as a drop-in haemoglobin) advised against such action because giving the patient an anticoagulant like heparin would unquestionably increase the risk of bleeding⁶. Therefore, anticoagulant therapy would not be beneficial for the patient despite what may seem like an unremarkable non-operative blunt trauma case.

Due to the highly internalized nature of blunt abdominal trauma the importance of proper tomographic assessments is critical to assessing patient health. In an article written by Fu et al. a comparison of patients with blunt abdominal trauma eligible for non-operative management was done to compare the effectiveness of imaging through Computed Tomography Arterial Portography (CTAP) vs. Reperfusion Computed Tomography Arterial Portography (rCTAP) vs. Computed Tomography (CT) scans for blunt abdominal trauma that had resulted in portal vein injury [11]. In the study of 254 patients CTAP proved to be superior to angiography and conventional CT in evaluating blunt trauma portal vein injuries. Overtime, as is commonplace, the evolution away from using solely CT

scans to diagnose and treat patients shows the progressive nature of the technological aspects of medicine.

Discussion and Conclusion

Penetrating portal vein injuries are caused mainly by gunshot wounds and stabbings and oftentimes produce more fatal outcomes than blunt portal vein injuries. Treatment approaches for penetrating portal vein injuries are very like those of blunt portal vein injuries. However, penetrative damage of the portal vein is accompanied with damage to other important aspects of the portal triad. In an article written by Coimbra et al. [12] a retrospective analysis of 18 patients with abdominal trauma over a 5-year period were analysed; 8 patients had portal vein injuries. Shock was the main cause of death in this group of patients.

This study reported that patients with penetrating portal vein injuries had a 10% chance of survival after portal vein ligation in contrast to a 42% chance of survival after portal vein repair. The authors concluded that when possible portal vein repair is the better treatment alternative for portal vein injuries [12]. The conclusion of this article greatly disagrees with the consensus of using portal vein ligation in hemodynamically unstable patients with blunt abdominal injury.

In another article by Ivatury et al. [13] the same general conclusion was made over the preferred method of management of penetrating portal vein injuries. These authors reported 14 patients that had sustained penetrating portal vein injury due to gunshot wounds and stabbings. Of the 10 patients who had tenorrhaphy (repair) 6 survived while of the remaining patients treated with ligation 3 died.

However, in terms of studies that specifically consider methods preferred for penetrating portal vein injury Pearl et al. [3] supports ligation as the best form of treatment for hemodynamically unstable patients with portal vein injury. Pearl et al. describe the overall survival rates for 15 patients with portal vein injury presented out of 18,900 trauma cases over a 10-year period [3]. Despite the higher survivability for patients with tenorrhaphy in the study ligation was concluded to be the more effective method of treatment for patients that are hemodynamically unstable. For those patients that are hemodynamically stable it was concluded that the best method of repair to be tenorrhaphy.

The portal vein, 2 cm in diameter, is formed because of the union of the superior and inferior mesenteric veins with the splenic vein behind the liver. Damage to the portal vein is traumatic due to its high flow rate at about a litre a minute [3]. The portal triad structures (portal vein, hepatic artery, and extrahepatic bile ducts) run in a close anatomical proximity to the portal vein. Injury of the portal vein is oftentimes accompanied by subsequent injury to the portal triad leading to major secondary injury and impending complications. Such complications can be detrimental to patient survivability because there is such a substantial risk associated with the penetrative damage that can be caused by a bullet.

As described in a case study by Yates et al. [14] a shotgun pellet injury to the abdomen for a 26-year-old man proved fatal after embolization of the portal vein led to refractory shock during surgery and death [14]. The patient had two 2 mm shotgun pellets lodged in his liver along with numerous injuries to the abdomen. The patient was taken to the operating room for an emergency laparotomy and removal of shotgun pellet remnants in the soft tissue and portal vein. A week an exploratory surgery found the patient had a liver that had variegated into a pale green and yellow color, indicating liver necrosis [14]. Despite even a seemingly stable period after penetrating portal vein injury the resulting organ failure shows the truly damaging power of a gunshot injury to this area.

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