The injured liver: management and hepatic injuries in the traumapatient

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Chapter 1

INTRODUCTION AND OUTLINE OF THIS THESIS

INTRODUCTION

Trauma is a global problem, and carries a high price that is paid by individuals, communities, and nations. Road traffic accidents, industrial injuries, farming accidents and interpersonal violence account for traumatic injuries with varying prevalences throughout the world.[1,2,3,4]

Globally the liver is the most frequent injured intra-abdominal organ following trauma.[5,6,7,8,9] The spectrum of liver injuries ranges from minor lacerations with minimal bleeding that stop spontaneously and require no intervention, to major lobar crush injuries and lacerations of the retrohepatic vena cava and hepatic veins that are often lethal and tax the skill, and resources of experienced surgical teams.[10,11] The magnitude of the liver injury and the complexity of the operative intervention required depend on the trauma mechanism, the anatomical location of the injury, the extent of parenchymal and vascular damage, and the type and severity of the additional injury present.[12] Overall the mortality of liver injuries ranges from 10% to 42% and is largely dependent on the type of injury and the associated injuries.[13] Exsanguination causes more than half of the deaths, and if three major organs are injured, mortality approaches 70 %. [14,15]

Selection of patients with liver injuries for nonoperative management, definitive surgical repair or a damage control laparotomy is the topic of ongoing debates. [16,17,18,19]

The surgeon, who encounters a severely injured patient with a liver injury, will rapidly need to make several critical decisions. This thesis on management of liver injuries focusses on preoperative assessment and selection of patients who require an urgent laparotomy, the surgical techniques to achieve hemostasis, the treatment of liver related complications, and the surgical strategy in order to manage associated perihepatic injuries.

OUTLINE OF THIS THESIS

In hemodynamic stable patients with a liver injury presenting without an acute abdomen, nonoperative management (NOM) of blunt liver injuries (BLI) has become the standard of care. Optimal treatment of patients with penetrating wounds of the liver is a topic of debate, and nonoperative management of penetrating liver injuries is infrequently practiced. Selective nonoperative management (SNOM) of abdominal stab wounds is widely accepted. Conversely, the SNOM of gunshot wounds of the abdomen is slowly gaining momentum in patients without peritonitis or sustained hypotension. Concern has been expressed about the potential overuse of NOM and the fact that failed NOM is associated with higher mortality rate. In the first part of **Chapter 2** the management of BLI in 134 severely injured patients was analysed, and the second part validated the

feasibility and safety of the SNOM of penetrating liver injuries in order to find answers to the following questions:

- Which factors might indicate the need for a surgical intervention in patients who sustained blunt liver trauma?
- How efficient is NOM in patients who sustained blunt liver trauma?
- How often do patients who sustained penetrating wounds of the liver require a delayed laparotomy?
- What is the incidence of liver related complications in patients undergoing SNOM?

The majority of liver injuries stop bleeding spontaneously. Lethal exsanguination and delayed bleeding are feared complications in patients who have sustained severe liver trauma. Operative techniques that are available for the surgeon dealing with liver injuries include simple drainage of a non-bleeding liver, temporary packing, Pringle maneuver, suture ligation, finger fracture, balloon tamponade, therapeutic perihepatic packing, non-anatomical resection, anatomical liver resection, total hepatic isolation and the atriocaval shunt. In **chapter 3** the methods of control of liver bleeding were examined, answering the following questions:

- Is direct suture repair, perihepatic packing and selective use of angiography a safe strategy and efficient in order to control liver bleeding?
- What is the optimal time of pack removal, in order to minimise the risk of rebleeding and lower the risk of septic complications?

Biliary leak secondary to blunt or penetrating hepatic trauma and damage to the intrahepatic biliary tree presents a challenging problem. The management of traumatic bile leaks was studied in **chapter 4**. In the first part the incidence and management of bile leaks following operative management was examined. In the second part of this chapter a cohort of 412 patients who sustained liver trauma was studied and bile leaks were classified as minor or major. Minor leaks were managed conservatively, and major leaks underwent endoscopic retrograde cholangiogram and endoscopic biliary stenting. This study was initiated in an attempt to formulate answers to the following questions:

- What is the incidence of bile leaks following liver trauma?
- Is conservative management of traumatic intrahepatic bile leaks successful?
- Do all patients with a traumatic bile leak require endoscopic internal drainage?

Mortality in severe hepatic injury is 10 % when only the liver is injured, but if three major organs are injured, mortality approaches 70 %. Simultaneous treatment of the most

severe injuries in a multidisciplinary trauma team is mandatory to optimise survival chances. The surgical members of the trauma team therefore require skills and knowledge also of the organs surrounding the liver. An occult cardiac injury may be present in patients with an acute abdomen after thoracoabdominal trauma. In **chapter 5** patients with complex patterns of injuries are studied. In the first part we evaluate the selection criteria for damage control laparotomy in severely injured patients. In the second part the role of a subxiphoid window to exclude occult cardiac injury in patients sustaining penetrating thoracoabcominal trauma has been studied. These studies were initiated aiming to answer the following questions:

- Which criteria dictate the need for a damage control laparotomy in patients with a complex pattern of thoracoabdominal injuries?
- Is the subxiphoid window an efficient and safe manoeuvre to perform in patients with thoracoabdominal injuries?

Chapter 6 presents two clinical illustrations of the treatment challenges that have been studied in this thesis. The two cases reflect the challenges that one may experience in presentation of severely injured patients and the resourcefulness and flexibility that a well-trained multidisciplinary team needs to bring patients with the worst prognosis to a successful outcome.

Chapter 7 presents a general discussion and future perspectives. The final discussion focusses on preoperative assessment and selection of patients, the surgical techniques and strategies to achieve hemostasis, and the treatment of liver related complications.

Chapter 8 summarises the findings and the answers presented in this thesis.

Chapter 9 presents a Dutch and German summary of the contents.

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