CHAPTER 8

Summary and answers to the questions

Chapter 1 provides a general introduction to the management of liver trauma and poses the questions to be answered in this thesis.

In general, for the management of patients with liver trauma three options exists: 1) nonoperative management; 2) operative management and primary definitive repair and 3) staged repair, also known as damage control surgery.

The safety and feasibility of nonoperative management of patients who sustained blunt and penetrating liver injuries was evaluated. To answer the question *„Which factors might indicated the need for a surgical intervention in patients who sustained blunt liver trauma?*" the first part of **chapter 2** presents 134 severely injured patients with a blunt liver injury. Physiologic parameters (haemodynamic instability, generalized peritonitis, and worsening metabolic acidosis during resuscitation) or CT-findings showing associated intraabdominal injuries requiring surgical repair, warrants early surgical exploration in 25 % of patients with a blunt liver injury. Seventy five per cent of the patients with blunt liver injuries could be managed nonoperative. Associated solid intra-abdominal and extra-abdominal injuries do not exclude nonoperative management. Nonoperative management should be considered irrespective of the grade of liver trauma. The conclusions of the evaluation provide an answer to the question *„How efficient is NOM in patients who sustained blunt liver trauma?",* and support the efficacy with a 95 % success rate of nonoperative management in patients who sustained blunt liver trauma. In the second part of **chapter 2,** 95 patients with penetrating liver injuries (54 gunshot wounds and 41 stabbed liver injuries) were analysed. Forty seven per cent of the patients with stabbed liver injuries, and 28 % of the patients with gunshot wounds of the liver were managed nonoperative irrespective the grade of liver injury. The results provide an answer to the question *„ How often do patients who sustained penetrating wounds to the liver require a delayed laparotomy?*". Three (6%) of 54 patients with liver gunshot injuries failed abdominal observation (suffering from peritonism and fever (2), or biliary peritonitis (1)) and underwent delayed laparotomy (non hollow-organ injuries were detected at laparotomy), and all (100%) 41 patients with stabbed liver injuries were successfully treated nonoperatively.

In view of the overall results, the answer to the fourth question, *„What is the incidence of liver related complications in patients undergoing NOM?*" is that the liver related complication rate is 7% and 11% for blunt and penetrating liver injuries respectively. Liver related complications contribute for 50% to failure of NOM.

Even in an era with computed tomography available in fairly every hospital, in 25 % (blunt) and 66% (penetrating) of the patients with liver injuries an explorative laparotomy is indicated. About 40% of the liver injuries stop bleeding spontaneously or do require simple drainage and a laparotomy is indicated for repair of associated injuries. But in 60% of the patients undergoing operative management a major liver bleeding is suspected. To diagnose a major liver injury or perihepatic injury as the main source of

bleeding is challenging. After haemorrhage control 40 % of the patients undergoing operative management with a concomitant liver injury had a perihepatic injury, which caused the major source of blood loss. In **chapter 3** the methods of haemorrhage control of liver injuries in patients undergoing operative management were studied. Answering the question *" Is direct suture repair, perihepatic packing and selective use of angiography a safe strategy and efficient in order to control liver bleeding?"* 82 patients with a major liver bleeding were analysed. Suture ligation, perihepatic packing and selective use of postoperative angiography to treat the liver bleeding is efficient and safe. In case of perihepatic packing for major hepatic and juxtahepatic venous trauma return to the operating theatre should be delayed. **Chapter 3** also provides an answer to the question *" What is the optimal time of pack removal, in order to minimise the risk of rebleeding and lower the risk of septic complications?"*. Retrospective analysis of 93 patients shows that the total duration of liver packing does not result in an increase in septic complications or bile leaks. The first re-look laparotomy should only be performed after 48 hours. An early re-look is associated with a re-bleeding and does not lead to early removal of packs. Prospective analysis of 63 patients confirmed that in the case of major hepatic injuries a return to the operating theatre after therapeutic packing should be delayed after 48 hours.

Nonoperative management and damage control surgery for liver trauma leaves severe parenchymal damage initially untreated and may potentially result in larger and more complicated bile leaks that may not resolve with simple drainage. **Chapter 4** focuses on what is the optimal treatment for patients presenting with a traumatic bile leak will be and provides answers to the questions *What the incidence of bile leaks following blunt and penetrating trauma is* and *whether conservative management of intrahepatic bile leaks in patients who sustained liver trauma is safe*. The incidence of bile leaks is about 10%, and developed more often following penetrating trauma, operative management, damage control surgery and high grade liver injuries. Most intrahepatic bile leaks can be managed conservatively without the need for a re-laparotomy. The question "*Do all patients with a traumatic bile leak require endoscopic drainage?"* was answered by classifying 40 patients with a biliary leak in the intrahepatic biliary tree. Bile leaks were classified as minor and major (>400mL/d or persistent drainage > 14 days). Sixty five per cent of the intrahepatic bile leaks following trauma are minor and easily managed conservatively. Endoscopic cholangiography and internal drainage should be reserved for major leaks.

Damage control surgery is well established surgical strategy in the management of the severely injured and shocked patient, but selection of patients for DCS remains controversial. Liver packing as a surgical technique to control liver haemorrhage and a delayed return to the operating theatre has been described in chapter 3**.** Isolated liver injuries in patients following abdominal trauma are not that common. Simultaneous treatment of the most severe injuries is mandatory to optimise survival chances. In

chapter 5 we describe the treatment of patients with major multiple injuries and concomitant liver injury in which mortality approaches 70%. A major abdominal injury was defined as two or more organs injured in the right upper quadrant of the abdomen in patients with an injury Severity Score (ISS) > 15 and Abbreviated Injury Scale (AIS) > 3. Patients were divided into two groups according to operative strategy; group I Definitive Repair (DR) and Group II Damage Control Laparotomy. Factors identifying patients who underwent DCL were analysed and evaluated in order to answer the question *"Which criteria dictate the need for a damage control laparotomy in patients with a major abdominal injury?"*. Onset of metabolic failure (BE<5), abdominal vascular injuries and major liver injuries in patients with major abdominal trauma and multiple organs injured require a damage control laparotomy. A specific group of trauma patients are those who sustain penetrating thoracoabdominal trauma and the risk of a cardiac injury. The diagnosis can be made by ultrasonography, but the sensitivity and specificity of the test is variable. Therefore we present the results of the use of a subxiphoid pericardial to exclude occult cardiac injury after penetrating thoracoabdominal trauma. To answer the last question *"Is the subxiphoid window an efficient and safe manoeuvre to perform in patients with thoracoabdominal injuries?"* we evaluated 50 patients with thoracoabdominal trauma and indication for a laparotomy. An occult cardiac injury was present in 14 patients mandating sternotomy. Nine cardiac injuries were identified including five tangential injuries and four perforations. The SPW is a useful technique at laparotomy to identify cardiac injuries in patients with penetrating thoracoabdominal injuries.

In **chapter 6** two clinical illustrations are presented: One patient sustained blunt liver trauma and one patient had a stabbed injury of the liver. The first patient with a grade V liver injury, sustained a contained intraparenchymal liver bleed without massive haemorrhage. This phenomenon supports the policy of nonoperative management of liver injuries in hemodynamic stable patients, regardless of the American Association for the Surgery of Trauma (AAST) grade of injury. The second illustration presents a desperate case where packing did not control a major liver bleeding in a patient with a penetrating grade V liver injury. Implantation of a retro hepatic endovascular stent in the inferior vena cava as adjuvant to perihepatic packing did control bleeding. While bile leaks are not uncommon and discussed in chapter 4, bilhemia is a rare complication following liver trauma. Our patient with complex liver trauma developed bilhemia; intravascular biliary leakage was successfully treated with temporary stenting of the bile duct, combined with sphincterotomy.