Blunt abdominal trauma: changing patterns in diagnostic and treatment strategies
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Introduction and outline of the thesis
Trauma is the most common cause of death in people younger than 45 years of age and accounts for more years of life loss than cancer, heart disease, and stroke combined.\textsuperscript{1} In the Netherlands, yearly 2.5 millions people sustain any kind of injury leading to 980,000 Emergency Department visits, 170,000 hospital admissions, and 5100 deaths.\textsuperscript{2} One of the main causes of death after trauma, with numbers ranging from 40 to 80\%, is exsanguination due to injuries from abdominal organs. Blunt trauma (i.e. motor vehicle accidents and fall from heights) is still the most common mechanism of injury in the Netherlands although penetrating injuries are becoming more common due to increasing violence.

The spleen, liver and kidney are the most commonly injured abdominal organs\textsuperscript{3-5} as a result of blunt trauma and a missed splenic injury is the most common cause of preventable death in trauma patients.\textsuperscript{6}

The management of patients with blunt abdominal injury has evolved greatly over the last few decades. Historically, surgical management was the preferential treatment for most blunt abdominal injury, because nonoperative management (NOM) was associated with a high mortality rate and significant risk of delayed rupture.\textsuperscript{7} However, a significant amount of the laparotomies were non-therapeutic and therefore possibly unnecessary.\textsuperscript{8}

Furthermore, as the severity of postsplenectomy infection became better understood, a trend from splenectomy towards splenic conservation has emerged.

Although initially controversial, NOM of patients with blunt abdominal injury is currently the treatment of choice in hemodynamically stable patients.\textsuperscript{9-13} NOM can be divided in either observation (OBS) alone or angiography and embolization (AE) followed by close observation. Observational management involves admission to a unit with monitoring of vital signs, strict bed rest, frequent monitoring of haemoglobin concentration, and serial physical exams.\textsuperscript{14} In 1995 Sclafani described the first successful use of angiography and embolization in a patient with splenic injury.\textsuperscript{15} Many studies support the use of embolization as an adjunct to observation. AE has increased the success rate of nonoperative management both by stopping ongoing bleeding as well as by preventing delayed rupture.\textsuperscript{16-20} Success rates up to 97\% are described in the literature. Improved imaging techniques and advances in interventional radiology have helped to better differentiate patients who can be observed versus those needing AE. However, a lot of issues regarding the diagnostics and therapeutic management of patients with blunt abdominal injuries after trauma are still debated.

The present study was initiated to answer the following questions:

\begin{itemize}
  \item What are the results in the Netherlands of NOM in blunt abdominal injury (liver, spleen and kidney)?
  \item What is the impact of AE on the success rate of nonoperative management?
  \item What is the failure rate of NOM in children with blunt splenic or liver injury when a contrast blush is present on Computed Tomography (CT)?
  \item What (CT) characteristics and what patient characteristics are associated with failure of NOM?
  \item What are the complications of AE in patients with blunt abdominal injury?
\end{itemize}
Chapter 1

OUTLINE OF THE THESIS

In this thesis several aspects of nonoperative management of patients with blunt abdominal injury are discussed. An overview of the literature regarding the changing patterns in diagnostic strategies and the treatment of blunt injury to solid abdominal organs is described in Chapter 2. Various aspects of diagnosis and treatment of patients with traumatic injury to the liver, spleen and kidney are described. Furthermore, future perspectives regarding diagnostics and treatment modalities are discussed.

In Part 1 of this thesis several modalities and current aspects of the diagnostics of patients with blunt abdominal injury are reviewed and discussed. In Chapter 3 a review of the literature assessing the significance of detection of a contrast blush on Computed Tomography in children with splenic and liver injury is described. In adults, it has been well established that the presence of an arterial blush on CT scan is a risk factor for failure of NOM. Therefore, adult treatment algorithms often include the presence of a contrast blush as an indication for AE or even surgical intervention.

Prior studies assessing whether or not the presence of a contrast blush is associated with failure of NOM presented controversial results. This chapter describes a systematic review in which the results of these prior studies were sampled to obtain a higher level of evidence for the significance of a contrast blush in children.

Chapter 4 describes three patients with seatbelt signs following a car accident are presented. The trauma mechanism, incidence and awareness of a seatbelt sign and the diagnostic workup and treatment options in these patients are described.

The most widely used grading system for blunt splenic injury is according to the organ injury scale of the American Association for the Surgery of Trauma (AAST). A few years ago a new grading system, incorporating vascular injuries, has been developed. This ‘Baltimore’ grading system was reported to be superior to the AAST system in predicting the need for angiography and embolization or surgery in patients sustaining blunt splenic injury. In Chapter 5 the inter- and intraobserver reliability between radiologists in classifying splenic injury according to both grading systems are described.

The spleen is the second most frequently injured organ following blunt abdominal trauma. Presently, nonoperative management of splenic injury is the most common management strategy in hemodynamically stable patients. Chapter 6 gives an overview of the diagnostic strategies and the role of AE in patients with blunt splenic injury.

In Part 2 of the thesis the focus lies on the outcome of treatment of patients with blunt abdominal injury treated in the Dutch level-1 trauma centers.

Current opinions with respect to treatment outcome following NOM in blunt abdominal injury are predominantly based on large volume studies from level-1 trauma centers in the United
States (US).9-13, 16-20 Trauma patient volumes in European centers are often considerably lower than in the US. Therefore, it is questionable whether these results can be translated to centers with lower volumes of patients with blunt abdominal injury.

In Chapter 7 a retrospective cohort study has been performed on consecutive patients with blunt splenic injury admitted to the Academic Medical Center of Amsterdam to analyse results of NOM in a relatively low volume level-1 trauma center. The results are described and compared with the literature. Furthermore, the impact of AE on the success rates of nonoperative management is presented.

Chapter 8 presents the results of a multicenter cohort study of patients with blunt splenic injury treated nonoperatively in three level-1 trauma centers. The results of nonoperative management and the influence of AE are analysed. Secondly, the identification of risk factors for failure of NOM is investigated with uni- and multivariate logistic regression analysis.

In Chapter 9 a retrospective cohort study has been performed on consecutive patients with blunt hepatic injury admitted to the Academic Medical Center of Amsterdam. Aim of the study was to compare the failure rate of primary treatment before and after the introduction of angiography. Furthermore, the effects on clinical outcomes and complication rates are assessed.

In 2005 the European Association of Urology (EAU) has published the guidelines on urological trauma.21,22 In daily practice, however, guidelines are often not followed. Earlier research showed that only half of the urologists in the United Kingdom utilizes the guidelines in the management of renal trauma and furthermore, that there was variable adherence to the recommendations.23 Therefore, we performed a study comparing the diagnostics and treatment of patients with blunt renal injury applied in a Level-1 trauma center to the recommendations of the EAU guidelines. The results of this study are presented in Chapter 10.

Angiography and embolization have become the treatment of choice for (arterial) internal hemorrhage after abdominal trauma or pelvic injury in hemodynamically stable. Some studies however, report a high incidence of rebleeding (failure) and other complications. The type and incidence of the complications and failure rate in trauma patients undergoing such procedures are described and discussed in Chapter 11.

Finally, in Chapter 12 and 13 the findings of the preceding chapters are summarized and discussed.
REFERENCES