Splenic injury diagnosis & splenic salvage after trauma
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General introduction
Trauma is globally the leading cause of death among people under the age of 45. In the Netherlands, the predominant trauma mechanism is blunt trauma, occurring in approximately 90% of the patients. The prevalence of intra-abdominal injury among patients presenting to the emergency department with blunt abdominal trauma (BAT) is approximately 13%. The most commonly injured organ after blunt trauma to the abdomen is the spleen. As the spleen is highly vascular, splenic injury can be potentially life-threatening due to bleeding.

A shift in the treatment of patients with blunt splenic injury has occurred over the last decades. Formerly, surgical management was the preferred treatment. It was a generally-held belief that the spleen served no function, that it could not heal on its own and had a tendency to rupture at a later stage. In the 1950s, the role of the spleen in immunocompetence was discovered when King and Schumacher described ‘overwhelming post splenectomy infection’ (OPSI), a disorder carrying a mortality rate of approx. 50-70%. The identification of the risk of OPSI and the discovery of the immunological function of the spleen stimulated the search for spleen-preserving strategies.

Two non-operative management (NOM) techniques exist: close observation of the patient (i.e. admission to a unit with bed rest and the strict monitoring of vital signs, including haemoglobin monitoring) and Splenic Artery Embolisation (SAE). SAE can be used as an adjunct to observation or as an initial treatment strategy in case of contrast extravasation on contrast enhanced Computed Tomography (CT) scanning, a large hemoperitoneum, a pseudoaneurysm or arteriovenous fistula, and high grade splenic injury (grade III-V). Nowadays, NOM is attempted in 60-90% of patients with splenic injuries.

Aim of the Thesis

The increased use of non-operative management techniques has created new (research) questions to be resolved. This thesis aims to further refine the diagnosis and the treatment of patients with blunt splenic injury. The following objectives are addressed:
PART 1 - Diagnostics of blunt abdominal injuries
- To evaluate inter- and intraobserver agreement of a recently developed grading system for splenic injury, incorporating the presence of vascular injury
- To assess diagnostic accuracy of a step-up imaging strategy, where a CT-scan is performed selectively, for diagnosing and treating abdominal injuries in paediatric patients

PART 2 - Management of splenic injuries
- To investigate whether variation exists in the treatment of splenic injuries in level 1 trauma centres in the Netherlands
- To define prognostic factors for failure of non-operative management
- To define the added value of SAE to observation alone in the treatment of patients with blunt splenic injury
- To compare time intervals between admission to the trauma room and start of intervention in patients receiving splenic surgery or SAE for splenic injury.
- To define the optimal follow-up strategy of patients with blunt splenic injury
- To assess immunocompetence of the spleen after embolisation

Outline of the Thesis

Chapter 1 provides a narrative review of the shift in diagnostic strategies and the treatment of blunt abdominal trauma over the past few decades. This introductory chapter is followed by two parts. PART 1 – Diagnostics of blunt abdominal injuries, as its name suggests, is about the grading systems used to classify splenic injury and diagnosing abdominal injuries in children. PART 2 – Management of splenic injuries refines the treatment of abdominal injuries in greater detail and examines follow-up strategies and immunocompetence of patients with splenic injuries.

PART 1 – Diagnostics of blunt abdominal injuries
In Chapter 2, the inter- and intraobserver reliability between radiologists for classifying blunt splenic injury according to two different grading systems
was assessed. The grading system of the American Association for Surgery of Trauma, the most widely-applied grading system for grading splenic injuries, was compared with a more recently developed grading system (Baltimore CT grading system), which integrates vascular injuries. Research showed that the Baltimore CT grading system was superior to the AAST system in predicting the need for angiography and embolization or splenic surgery in patients who had sustained blunt splenic injury; its use, therefore, may be preferable to the AAST grading system.14

Chapter 3 examines the diagnosing of abdominal injuries in children. The optimal imaging strategy for Blunt Abdominal Trauma (BAT) in children is still under research. Although CT is proven to be the most reliable tool for detecting abdominal injuries, caution should be applied as children are disproportionally at risk of developing radiation induced cancers.15 In this chapter, we investigate the diagnostic accuracy of an imaging guided strategy (a step-up Focussed Assessment for the Sonography in Trauma (FAST) in all children and selective CT-scanning) that is applied in the Academic Medical Center. To avoid any unnecessary harm caused by radiation, an imaging strategy that discriminates the (paediatric) patients who can safely be discharged home without further imaging from the patients who do need to be evaluated in more detail is required.

PART 2 - Management of splenic injuries
In Chapter 4 we investigated whether variation exists in the treatment of splenic injuries at five Level 1 trauma centers in the Netherlands, as variation in treatment management has been shown to influence splenic salvage.16,17 Chapter 5 is a systematic review of the prognostic factors for failure of NOM in patients with blunt splenic injury. Early identification of patients at high risk for failure of NOM is essential as any delay in the recognition and treatment of late splenic ruptures leads to increased morbidity and mortality.18,19 In Chapter 6 a propensity score technique was used to investigate whether SAE improves successful treatment compared to observation alone. The rationale behind this study was that studies demonstrating improved splenic salvage rates with SAE in the past have primarily compared SAE with historical NOM controls, as opposed to using contemporaneous controls or randomized controlled study designs. Therefore, it is unknown whether the improved
success rates of NOM can be attributed to the application of SAE or to an improvement in trauma care, in the use of standardized treatment guidelines, and/or an increase in the use of CT-scanning and the corresponding increased detection of relatively low grade injuries.\textsuperscript{20} The propensity methodology is a methodology that can be used to control for treatment selection bias, intrinsic to any observational study, to simulate a randomization process.\textsuperscript{21}

In Chapter 7 we aimed to reach a consensus of opinion (Delphi study) among 30 worldwide expert trauma surgeons and interventional radiologists concerning the optimal treatment and follow-up strategies of patients with splenic injury. As SAE is increasingly being applied worldwide and our level 1 trauma center has possible SAE start up times that are comparable to surgical start up times with 24/7 availability of an interventional radiologist, in Chapter 8, we compared time to surgery with time to embolization. In the final chapter, Chapter 9, the results of a prospective, clinical study assessing splenic function of patients who were embolised for blunt splenic injury are described. Because of the risk of severe infections, asplenic patients should be vaccinated against S. Pneumonia, Haemophilus influenzae type B and Neisseria meningitidis type C.\textsuperscript{22} However, it is unknown whether immunocompetence of the spleen is preserved after SAE. Different markers for testing splenic function have been used in the literature and a gold standard does not exist.
References