

Long-Term Follow-Up After Non-operative Management of Blunt Splenic and Liver Injuries: A Questionnaire-Based Survey

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Abstract

Background Non-operative management (NOM) of blunt splenic or liver injuries (solid organ injury, SOI) has become the standard of care in hemodynamically stable patients. However, the incidence of long-term symptoms in these patients is currently not known. The aim of this study was to assess long-term symptoms in patients undergoing successful NOM (sNOM) for SOI.

Methods Long-term posttraumatic outcomes including chronic abdominal pain, irregular bowel movements, and recurrent infections were assessed using a specifically designed questionnaire and analyzed by univariable analysis.

Results Eighty out of 138 (58%) patients with SOI undergoing sNOM responded to the questionnaire. Median (IQR) follow-up time was 48.8 (28) months. Twenty-seven (34%) patients complained of at least one of the following symptoms: 17 (53%) chronic abdominal pain, 13 (41%) irregular bowel movements, and 8 (25%) recurrent infections. One female patient reported secondary infertility. No significant association between the above-mentioned symptoms and the Injury Severity Score, amount of hemoperitoneum, or high-grade SOI was found. Patients with chronic pain were significantly younger than asymptomatic patients (32.1 ± 14.5 vs. 48.3 ± 19.4 years, $p = 0.002$). Irregular bowel movements were significantly more frequent in patients with severe pelvic fractures (15.4 vs. 0.0%, $p = 0.025$). A trend toward a higher frequency of recurrent infections was found in patients with splenic injuries (15.9 vs. 2.8%, $p = 0.067$).

Conclusion A third of patients with blunt SOI undergoing sNOM reported long-term abdominal symptoms. Younger age was associated with chronic abdominal symptoms. More studies are warranted to investigate long-term outcomes immunologic sequelae in patients after sNOM for SOI.

Introduction

Over the past decades, non-operative management (NOM) of blunt splenic or liver injuries has become the standard of care in hemodynamically stable patients [1–4]. At our center, 80% of blunt liver and splenic injuries underwent successful NOM, including patients that required angioembolization [5, 6]. The risk of failed NOM in trauma patients with solid organ injuries (SOI), such as re-bleeding, increases with the injury grade, amount of hemoperitoneum, presence of an arterio-venous fistula, and contrast extravasation on the initial contrast-enhanced computed

This study been presented at the 103th Annual Congress of the Swiss Society of Surgery, Bern, June 1–3, 2016.

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tomography (CT) scan. Over time, the risk of failed NOM decreases [7].

Many studies have investigated short-term complications and outcomes of patients undergoing NOM for SOI as well as outcomes of patients that required emergent laparotomies for abdominal injuries [8, 9]. However, data on the long-term outcomes after successful NOM in patients with blunt liver or splenic injuries are scarce, although very important to appropriately inform patients regarding the consequences of the injury and treatment [10–12]. Furthermore, the effect of the amount of hemoperitoneum and potential peritoneal lesions on long-term outcomes in trauma patients with splenic or hepatic injuries treated non-operatively is currently not known.

The aim of this study was to assess long-term outcomes including the frequency of chronic abdominal pain, recurrent infections, and irregular bowel movements in patients that underwent successful NOM for blunt splenic or liver injuries.

Materials and methods

Ethical approval was obtained from the Institutional Revision Board of the Bern University Hospital (KEK 171/2014).

Patient selection

This is an observational study including adult trauma patients with blunt splenic and/or liver injuries undergoing successful NOM from January 1, 2009, to August 31, 2013. The Bern University Hospital includes a Level-I trauma center with a yearly admission rate of approximately 500 major trauma patients [Injury Severity Score (ISS) > 15]. All trauma patients were initially assessed according the advanced trauma life support (ATLS®) guidelines by the trauma team, including anesthesiologists, emergency physicians, and surgeons. Hemodynamically stable major trauma patients underwent a contrast-enhanced full-body CT scan. In patients with splenic and/or hepatic injuries, NOM was only performed in hemodynamically stable conditions.

Inclusion criteria were age ≥ 16 years and blunt splenic and/or liver trauma diagnosed on the initial CT scan and successful NOM. Successful NOM was defined as no surgical intervention related to the splenic and/or liver injury during the initial hospital stay. Successful initial arterial embolization was defined as successful NOM. Exclusion criteria were surgery related to splenic and/or liver injuries, death during the hospital stay, and patients with no contact information (e.g., tourists).

Data collection

Data were extracted from the Institution's prospective trauma registry [Trauma Audit and Research Network (TARN)] and electronic patient records. Data collection included patient characteristics (sex, age) and injury characteristics [Abbreviated Injury Scale (AIS; head, chest, abdomen, extremities, and external), Injury Severity Score (ISS), and amount of hemoperitoneum on abdominal CT scans (1–4 quadrants)]. A severe injury was defined as an AIS ≥ 3 . High-grade splenic or liver trauma was defined as an Organ Injury Scale (OIS) score ≥ 3 [13].

Patients that met the inclusion criteria were contacted by telephone (maximum three attempted calls on three different days). Patients that could not be reached by telephone were subsequently contacted by letter. Patients were interviewed using a specific questionnaire. The questionnaire included questions regarding abdominal pain (characteristics, frequency, intensity [visual analog scale (VAS) for pain 1–10], and use of analgesics), irregular bowel movements (constipation [less than three bowel movements in a week], diarrhea [more than 3 bowel movements in a day]), and recurrent infections (infections after hospital discharge and use of antibiotics).

Statistical analysis

Normality of distribution was assessed using histograms and the Shapiro–Wilk test. Results were reported as numbers and percentages, means and standard deviations (SD), or medians and interquartile ranges (IQR). *P* values ≤ 0.05 were considered statistically significant. Categorical variables were compared using Fisher's exact test and Pearson's Chi-squared test. Continuous variables were compared with the Mann–Whitney *U* test.

To identify a potential non-responder bias, baseline characteristics (gender, age, ISS, AIS of all body regions, grade of SOI, amount of hemoperitoneum on initial CT scan, and month of follow-up) of patients that responded to the survey (responders) versus patients that did not respond (non-responders) were compared by univariate analysis.

The association of patients' and injury characteristics on the subjective long-term symptoms (chronic abdominal pain, irregular bowel movements, history of repeated infections) was compared by univariate analysis. The following variables were analyzed: sex, age, ISS, AIS of all body regions, grade of SOI, amount of hemoperitoneum on initial CT scan, and month of follow-up.

All statistical analyses were performed using SPSS statistics (Version 22, IBM Corporation, Armonk, NY).

Results

Included patients and baseline characteristics

A total of 181 adult trauma patients with blunt liver and/or splenic injuries were admitted during the 57-month study period. In total, forty-three patients were excluded for various reasons. The remaining 138 patients with successful NOM, including 8 patients with successful angioembolization (7 splenic injuries, 1 liver injury), were contacted by telephone or letter. Eighty (58.0%) patients responded to the survey (Fig. 1).

Patients that responded to the survey were older (mean age 44.8 ± 19.5 vs. 34.9 ± 16.7 ; $p = 0.003$), had more severe (AIS ≥ 3) limb injuries (21.3 vs. 8.6%; $p = 0.045$), and did not undergo angioembolization for splenic or hepatic injuries (0.0 vs. 10.3%, $p = 0.005$). Of note, the presence of a severe (AIS ≥ 3) head, abdominal, pelvic, or chest injury, as well as the amount of hemoperitoneum or the frequency of high-grade SOI, was not significantly different between the responders and non-responders.

Baseline characteristics of the responders are shown in Table 1. Patients were predominately male (65.0%), had a mean age of 44.8 ± 19.5 years, and had a mean ISS of 24.0 ± 11.9 . Median follow-up time was 48.8 (IQR 28.0) months. Fifty-three patients (66.2%) reported no long-term symptoms related to the trauma. The remaining 27 patients (33.8%) complained of at least one of the following long-term symptoms at the time of the survey: 17 (53.1%) chronic abdominal pain and 13 (40.6%) irregular bowel movements. Furthermore, 8 patients (25.0%) had a history

of recurrent infections requiring antibiotic treatment. One female patient reported secondary infertility.

When comparing the 27 patients with complaints to the remaining 53 patients without any symptoms, no statistical significant differences in gender were found (66.7 vs. 64.2% male gender, $p = 0.823$). Moreover, when comparing the overall ISS or the presence of a high-grade splenic or liver injury, again, no statistically significant differences were found between patients with and without complaints (24.5 ± 11.1 vs. 23.8 ± 12.4 , $p = 0.756$; 25.9 vs. 22.6% , $p = 0.744$; 29.6 vs. 20.8% , $p = 0.378$). However, the patients with symptoms were significantly younger compared to the patients without any complaints (39.3 ± 18.6 vs. 47.6 ± 19.5 years, $p = 0.049$).

Eight out of the 27 patients (29.6%) with complaints reported more than one symptom. When comparing the same variables as listed above between these 8 patients and the remaining 72 patients, no statistically significant differences were found.

Chronic abdominal pain

A total of 17 (21.2%) patients reported chronic abdominal pain with a median VAS of 6 (IQR 3). Of these, 6 patients were taking analgesics on a regular base. Patients with chronic pain were significantly younger and had a significantly shorter follow-up time than the asymptomatic patients [mean age 32.1 ± 14.5 vs. 48.3 ± 19.4 years, $p = 0.002$; median follow-up 34.0 (IQR 18.0) vs. 54.5 (IQR 28.0) months, $p = 0.001$]. Injury characteristics including the ISS, AIS of all body regions, grade of SOI, and amount of hemoperitoneum were not significantly

Fig. 1 Study outline

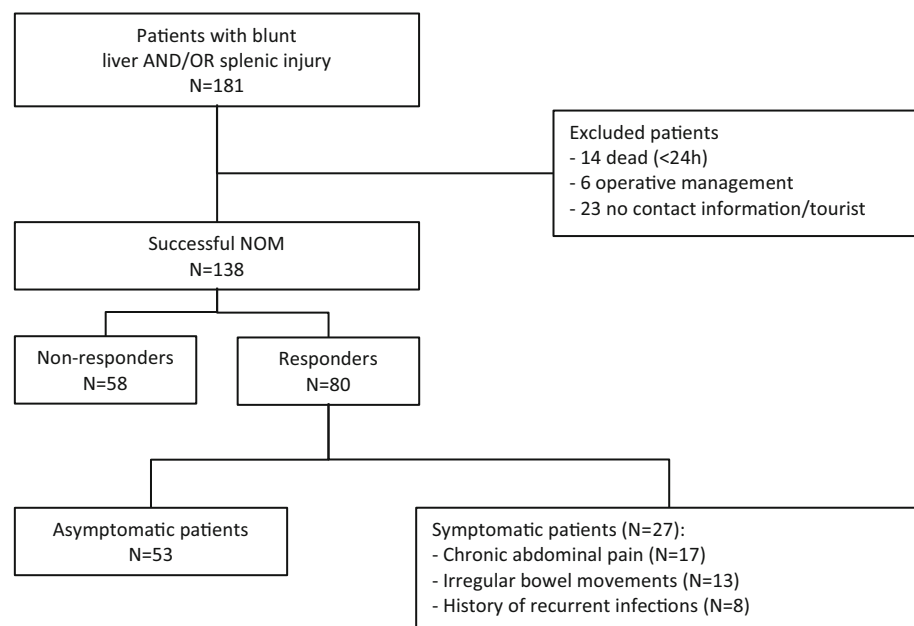


Table 1 Demographics and injury characteristics of the study population

	Total (<i>n</i> = 80)	Chronic abdominal pain (<i>n</i> = 17)	No abdominal pain (<i>n</i> = 63)	<i>P</i> value	Irregular bowel movements (<i>n</i> = 13)	No irregular bowel movements (<i>n</i> = 67)	<i>P</i> value
Age (years; mean ± SD ^a)	44.8 ± 19.5	32.1 ± 14.5	48.3 ± 19.4	0.002***	50.1 ± 18.4	43.8 ± 19.7	0.306***
Gender male (<i>n</i> , %)	52 (65.0%)	11 (64.7%)	41 (65.1%)	1.000*	7 (53.8%)	45 (67.2%)	0.362*
ISS ^b (mean ± SD)	24.0 ± 11.9	23.5 ± 11.5	24.2 ± 12.1	0.786***	26.2 ± 10.6	23.6 ± 12.2	0.399***
AIS ^c head ≥ 3 (<i>n</i> , %)	20 (25.0%)	3 (70.6%)	17 (27.0%)	0.540*	2 (15.4%)	18 (26.9%)	0.500*
AIS chest ≥ 3 (<i>n</i> , %)	47 (58.8%)	10 (58.8%)	37 (58.7%)	1.000*	8 (61.5%)	39 (58.2%)	1.000*
AIS abdomen ≥ 3 (<i>n</i> , %)	43 (53.8%)	11 (64.7%)	32 (50.8%)	0.413*	10 (76.9%)	33 (49.3%)	0.078*
AIS spine ≥ 3 (<i>n</i> , %)	5 (6.3%)	1 (5.9%)	4 (6.3%)	1.000*	2 (15.4%)	3 (4.5%)	0.184*
AIS limb ≥ 3 (<i>n</i> , %)	17 (21.3%)	5 (29.4%)	12 (19.0%)	0.340*	3 (23.1%)	14 (20.9%)	1.000*
AIS pelvis ≥ 3 (<i>n</i> , %)	2 (2.5%)	1 (5.9%)	1 (1.6%)	0.382*	2 (15.4%)	0 (0.0%)	0.025*
High-grade ^d spleen (<i>n</i> , %)	19 (23.8%)	6 (35.3%)	13 (20.6%)	0.216*	3 (23.1%)	16 (23.9%)	1.000*
High-grade liver (<i>n</i> , %)	19 (23.8%)	5 (29.4%)	14 (22.2%)	0.534*	4 (30.8%)	15 (22.4%)	0.496*
Amount of hemoperitoneum:							
None	36 (45.0%)	7 (41.2%)	29 (46.0%)		6 (46.2%)	30 (44.8%)	
1 quadrant	17 (21.3%)	4 (23.5%)	13 (20.6%)		3 (23.1%)	14 (20.9%)	
2 quadrants	11 (13.8%)	1 (5.9%)	10 (15.9%)	0.666**	1 (7.7%)	10 (14.9%)	0.663**
3 quadrants	11 (13.8%)	3 (17.6%)	8 (12.7%)		3 (23.1%)	8 (11.9%)	
4 quadrants	5 (6.3%)	2 (11.8%)	3 (4.8%)		0 (0.0%)	5 (7.5%)	
Follow-up [months; median (IQR) ^e]	48.8 (28.0)	34.0 (18.0)	54.5 (28.0)	0.001***	42.1 (29.0)	50.6 (29.0)	0.653***

* Fisher exact test, ** Pearson's Chi-squared test, *** Mann–Whitney U test

^aStandard deviation

^bInjury Severity Score

^cAbbreviated Injury Scale

^dOrgan Injury Scale grade ≥ 3

^eInterquartile range

different in patients with and without chronic abdominal pain (Table 1).

Irregular bowel movements

Thirteen patients (16.2%) reported irregular bowel movements, mainly constipation. None of these patients required hospital admission due to this symptom. Severe pelvic fractures were significantly more frequent in patients with irregular bowel movements compared to patients without severe pelvic fractures (15.4 vs. 0.0%, $p = 0.025$). A trend toward a higher number of patients with high-grade SOI

was found in patients with irregular bowel movements (76.9 vs. 49.3%, $p = 0.067$). The ISS and amount of hemoperitoneum were not significantly different between these two groups (Table 1).

History of recurrent infections

Eight patients (10.0%) reported repeated infections. These included pneumonia ($n = 4$), pharyngitis ($n = 4$), tonsillitis ($n = 1$), cystitis ($n = 1$), and middle ear infection ($n = 1$). Similar variables as shown in Table 1 were compared in patients with ($n = 8$) or without ($n = 72$) a

history of recurrent infections. No significant association of these variables and recurrent infections was found. However, a trend toward more frequent recurrent infections was found in patients with successful NOM of splenic injuries ($n = 44$) compared to patients without splenic injuries ($n = 36$) (15.9 vs. 2.8%, $p = 0.067$). Of note, no significant difference of the rate of recurrent infections was observed when comparing patients with high-grade splenic injuries ($n = 19$) to patients with low-grade splenic injuries ($n = 25$) (10.5 vs. 20.0%, $p = 0.395$).

Discussion

In this study, long-term symptoms of patients with splenic and/or liver injury that underwent successful NOM were investigated using a questionnaire focusing on abdominal pain, irregular bowel movements, and recurrent infections. A third of these patients suffered from a variety of chronic symptoms. The median follow-up time was 4 years. So far, this is the longest follow-up time reported in the literature for patients that underwent successful NOM of their blunt splenic or liver injury.

Years after the initial injury, it is notoriously difficult to follow patients. Current questionnaire-based surveys in trauma patients have reached response rates of 30–50% [14–16]. With a response rate of 58% ($n = 80$), the current study achieved a reasonable sample size. Nevertheless, to rule out any non-responder bias, patient and injury characteristics were compared between responders and non-responders. It was found that responders were significantly older and had more often concomitant severe limb injuries. However, the comparable grade of splenic and liver injuries, as well as the comparable amount of hemoperitoneum in both groups, reduces the risk of a non-responder bias, as the current study focused on abdominal symptoms.

Chronic abdominal pain

Chronic abdominal pain was the most commonly reported symptom in this study population. Interestingly, younger patients reported significantly more frequent chronic abdominal pain compared to older patients. More efficient coping strategies in older patients, but higher expectations regarding outcomes after abdominal injury and increased exposure to, e.g., work-related activity in younger patients may explain this finding. In addition, the group of patients with chronic abdominal pain had a shorter overall follow-up time. It seems therefore that symptoms may decrease even years after trauma.

Irregular bowel movements

Irregular bowel movements occurred in 16% of patients, including mainly episodes of constipation. Posttraumatic occult peritoneal adhesions may be an explanation for this finding. However, in the current study, no association of the amount of hemoperitoneum and irregular bowel movements was found. Likewise, no statistically significant relation of the grade of the splenic and/or liver injury and irregular bowel movements was found. This supports the assumption that an accumulation of blood in the peritoneal cavity alone does not result in adhesions and that associated peritoneal lesions are required to develop clinically relevant adhesions [17–19]. Occult peritoneal lesions after blunt trauma and NOM of SOI may occur, e.g., due to undiagnosed concomitant mesenteric tears. This may also be the explanation for the more frequent irregular bowel movements in patients with associated pelvic fractures as high-energy trauma leading to pelvic fractures may also cause intra-abdominal occult injuries. However, as there were only two patients with severe pelvic fractures included in the current study and neurogenic dysregulation, e.g., due to lesions to the sacral plexus, may also contribute to irregular bowel movements, these results should be interpreted with care.

History of recurrent infections

It has been shown that in contrast to patients that underwent successful NOM for splenic injuries, patients that required splenectomy have a significantly higher rate of early in-hospital systemic infectious complications [20, 21]. However, long-term follow-up in patients undergoing successful NOM for SOI is currently lacking in the literature. Therefore, in the current study, patients were asked about their history of recurrent infections. Interestingly, a trend toward more recurrent infections in patients with splenic injuries compared to patients suffering from other injuries was found. More studies are warranted to further investigate the long-term immunologic sequelae in patients after successful NOM of splenic injuries.

Limitations

The major limitation of the current study is the relatively low number of patients and a potential non-responder bias of the survey. However, the comparable severity of splenic and/or liver injuries and amount of hemoperitoneum in both groups reduces the risk of a non-responder bias. Moreover, the prevalence of constipation in healthy Swiss people is not known. This limits the relevance of the finding regarding the frequency of posttraumatic irregular bowel movements. As none of the responders initially

underwent angioembolization of their splenic or hepatic injury, no conclusion can be drawn on the long-term symptoms in this subgroup of patients.

Conclusion

The current study revealed a considerable number of patients (34%) with trauma-related long-term abdominal symptoms. Chronic abdominal pain was significantly more frequent in younger patients. Furthermore, a trend toward more recurrent infections was found in patients with splenic injuries. More studies are warranted to further investigate long-term immunologic sequelae in patients after successful NOM of splenic injuries.

Compliance with ethical standards

Conflict of interest Peter Moreno, Matthias Von Allmen, Tobias Haltmeier, Daniel Candinas, and Beat Schnüriger have no conflicts of interest or financial ties to disclose.

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