

# Management of spleen injuries in the adult trauma population: a ten-year experience

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**Background:** Increasing awareness of the postoperative risks associated with splenectomies has led physicians and surgeons to use an alternative nonoperative strategy in handling traumatic spleen injuries. Our primary objective was to compare clinical outcomes between operative and nonoperative managements in adult patients with blunt splenic injuries. The secondary objective was to assess the changes in the patterns of managing splenic injuries in the past 10 years. **Methods:** We performed a retrospective chart review on 266 adult patients with a spleen injury who were admitted to a tertiary trauma centre in Ontario between 1992 and 2001. We grouped and compared the patients according to the treatment received, either operative or nonoperative. Frequencies and confidence intervals are reported. Categorical variables were compared with chi-square or Fisher's exact tests. Continuous variables were reported as median and quartile (Q) and were compared with the nonparametric Mann-Whitney *U* test. **Results:** Of 266 patients, 118 had surgery and 148 were managed nonoperatively. The mortality rate was similar between operative and nonoperative groups (9.3% v. 6.8%,  $p = 0.49$ ), respectively. The rate of any complication was 47.9% for the operative group and 37.9% for the nonoperative group. The median length of stay in hospital was significantly higher in the operative group than in the nonoperative group (21.0 [Q 11.0–40.5] v. 14.0 [Q 7.0–31.5] d,  $p < 0.001$ ), respectively. This difference was more likely related to a higher proportion of patients having injury severity scores greater than 25 in the operative group. The rate of nonoperative management of spleen injuries was significantly increased from 48.5% to 63.1% between 1992–1996 and 1997–2001 ( $p = 0.02$ ). **Conclusion:** The present study has shown that nonoperative management of blunt spleen trauma has increased over time and has acceptable mortality and complication rates in selected patients. Additional prospective studies are needed to assess the feasibility and safety of nonoperative management in adult spleen injuries. Furthermore, the management of traumatic spleen injuries with respect to associated injuries, such as head injuries or intra-abdominal injuries, needs ongoing evaluation.

**Contexte :** Une sensibilisation croissante aux risques postopératoires associés aux splénectomies a incité les médecins et les chirurgiens à utiliser une stratégie non chirurgicale pour traiter des traumatismes de la rate. Nous visons principalement à comparer les résultats cliniques entre les traitements chirurgicaux et non chirurgicaux de patients adultes ayant subi un traumatisme fermé de la rate. Notre objectif secondaire consistait à évaluer les changements des tendances du traitement de traumatismes de la rate au cours des dix dernières années. **Méthodes :** Nous avons procédé à une étude rétrospective des dossiers de 266 patients adultes ayant subi un traumatisme de la rate et admis dans un centre de traumatologie tertiaire de l'Ontario entre 1992 et 2001. Nous avons regroupé et comparé les patients en fonction du traitement reçu, c'est-à-dire chirurgical ou non chirurgical. Les fréquences et les intervalles de confiance sont indiqués. On a comparé les variables de chaque catégorie aux résultats de tests du chi carré ou de la méthode exacte de Fisher. Des variables continues ont été signalées comme médiane et quartile (Q) et comparées au test *U* non paramétrique de Mann-Whitney. **Résultats :** Sur 266 patients, 118 ont subi une intervention chirurgicale et 148 ont reçu un traitement non chirurgical; le taux de mortalité était semblable entre les sujets des deux groupes (9,3 % c. 6,8 %, respectivement;  $p = 0,49$ ). Le taux de complication de n'importe quelle nature s'est établi à 47,9 % chez les sujets qui ont subi une intervention et à 37,9 % chez ceux qui n'en ont pas subi. La durée médiane du séjour à l'hôpital était beaucoup plus élevée chez les sujets qui ont subi une intervention que chez les autres (21,0 [Q 11,0–40,5] c. 14,0

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[Q 7,0–31,5] j,  $p < 0,001$ ), respectivement. La différence était attribuable plus probablement au fait qu'un pourcentage plus élevé de patients présentaient un indice de gravité de la blessure de plus de 25 chez les sujets qui ont subi une intervention. Le taux de traitement non opératoire des traumatismes de la rate a augmenté considérablement pour passer de 48,5 % à 63,1 % entre 1992–1996 et 1997–2001 ( $p = 0,02$ ). **Conclusion :** L'étude a démontré que le traitement non chirurgical des traumatismes fermés de la rate a augmenté au fil du temps et présente des taux acceptables de mortalité et de complication pour certains patients. D'autres études prospectives s'imposent pour évaluer la faisabilité et la sécurité du traitement non chirurgical des traumatismes de la rate chez l'adulte. De plus, une évaluation continue s'impose du traitement des traumatismes de la rate en ce qui a trait aux lésions connexes comme les traumatismes du crâne ou les lésions intra-abdominales.

The preservation of the spleen and the shift from conventional operative management (OM) to selective nonoperative management (NOM) of blunt splenic trauma injuries has shown a noticeable trend in the past decade.<sup>1,2</sup> Increasing awareness of the risk of post-splenectomy sepsis and postoperative complications were the major incentives for NOM.<sup>3,4</sup> Pachter and colleagues<sup>1</sup> stated that "NOM of blunt spleen injuries is more likely to replace splenorraphy as the most common method of splenic conservation." Similar conclusions are also found in other studies.<sup>5–8</sup> Some studies have reported that as many as 70% of patients with blunt trauma to the spleen are now managed nonoperatively with excellent survival rates.<sup>1,9</sup> Hence, we aimed primarily to compare clinical outcomes between operative and nonoperative managements in adult patients with blunt splenic injuries. Secondarily, we assessed the changing patterns of managing splenic injuries in the years 1992–2001.

## Methods

This retrospective study was performed in accordance with a protocol that prescribed eligibility criteria, search strategy, objectives and statistical analyses. We retrospectively identified patients with a spleen injury, using the Hamilton General Hospital trauma database between March 1992 and March 2001. Hamilton General Hospital, as a tertiary care trauma centre, receives trauma patients either from the scene of injury or from another hospital in Southwestern Ontario. We used the

following key words for the search strategy: "spleen," "trauma" and "age 18 years or more." To ensure we included all traumatic spleen injuries, we also consulted the Hospital's decision support database, using the same key words. We then retrieved the patients' charts in order to review and extract the required information. Hemodynamic status and presenting symptoms determined the initial course of treatment (OM or NOM) for patients in the emergency department. Suspicion of an abdominal injury or other internal injury was followed up with computed tomography (CT) or, in a small number of cases, diagnostic peritoneal lavage (DPL). The number of surgeons and fellows varied over the study period, from 3 in 1992 to 6 in 2002, with a mean of 4.5. The difference was due to an increase in the number of fellows who attended the surgery under the supervision of an attending surgeon.

The Injury Severity Score (ISS) is an anatomic scoring system that provides an overall score for patients with multiple injuries. Each injury is assigned an Abbreviated Injury Scale (AIS) score that is allocated to 1 of 6 body regions (head, face, chest, abdomen, extremities [including the pelvis] and external). Only the highest AIS score in each body region is used. The scores of the 3 most severely injured body regions are squared and added together to produce the ISS. The ISS is a calculated number ranging from 0 to 75. Greenspan and colleagues<sup>10</sup> conducted a study on multiple injury trauma patients in Canada and found that, when ISS is below 25, the

mortality risk is minimal, and when it is above 25, there is an almost linear increase. We have chosen this cut-off point as our base analysis, with respect to the ISS scores.

We defined a systolic blood pressure of less than 90 and a diastolic blood pressure of less than 60 as hypotensive, and we defined a heart rate greater than 100 beats per minute as tachycardia.

Patients who were treated medically and who did not receive operative intervention for their spleen injuries at initial diagnosis were considered "nonoperative management (NOM)" patients. We used the term "cross-over" to describe the process of patients undergoing splenectomy subsequent to the initial decision to treat them nonoperatively.

We documented any medical conditions before admission, including hypertension, diabetes, asthma, allergies, and coronary artery disease.

We extracted information (data collection) from patients, including demographics, presenting blood pressure, heart rate, ISS score, length of stay, death, in-hospital complications and number of blood transfusions, both in the emergency department and throughout the course of their hospital stay. Other collected information included time to operation, length of stay in a special care unit and whether the patient was received from the scene of injury or from a referring hospital. We excluded patients who died for reasons entirely unrelated to their spleen injury. We also excluded patients with a lack of adequate information regarding management of the splenic injury.

### Data analysis

Patients were classified into 2 groups, OM or NOM, based on the respective treatments they received for their spleen injury. We reported categorical data as frequencies and 95% confidence intervals (CI) and compared the data, using chi-square or Fisher's exact tests. Continuous variables are reported as median and quartiles (Q) and are compared with the nonparametric Wilcoxon Rank test. We selected a cut-off point of 25 for ISS scores, to categorize our patients for data analysis. All tests were 2-sided, with a *p* value of less than 0.05.

### Results

We identified 318 patients with a spleen injury between March 1992 and March 2001. Of these, we excluded 15 because they were younger than 18 years of age and 12 because they provided inadequate information; 25 patients died before starting any type of management. Of the 25 patients who died before any spleen management, 11 had a head

injury, 7 had absent vital signs on admission, 4 had multiple injuries, 1 had a transected aorta, 1 had a pulmonary injury and 1 had disarticulated sacroiliac joints.

A total of 266 patients were entered into the study (OM = 118 and NOM = 148). The median age was similar between OM and NOM groups (37.0 [Q 24.0–53.5] v. 39 [Q 24.2–54.0] yr, *p* = 0.62), respectively. The baseline characteristics are presented in Table 1. The prevalence of ISS scores less than 25 and tachycardia (heart rate > 100) was significantly higher in the OM group, compared with the NOM group. There were no significant differences between the 2 groups with regard to other characteristics at baseline.

Of 266 patients, 21 (11 OM and 10 NOM) died during the study period. The rate of mortality was 9.3% for patients in the OM group and 6.8% for those in the NOM group (*p* = 0.49). The rate of complications was similar between the 2 groups (47.9% v. 37.9%, *p* = 0.13), respectively. The median number of transfusions received was 6 (Q 3–9) units for the OM group and 1 (Q 0–4)

unit for the NOM group (*p* < 0.001). The median length of stay in hospital was significantly higher in the OM group than in the NOM group (21.0 [Q 11.0–40.5] v. 14.0 [Q 7.0–31.5] d, *p* < 0.001), respectively. This difference disappeared when we adjusted for ISS score (Table 2).

Ten patients (6.8%) initially allocated to NOM subsequently failed this treatment strategy and underwent OM. All of these patients survived and were discharged from hospital. The primary reason for failure was hemodynamic instability (6 patients) and rupture of the spleen (4 patients).

### Discussion

The pattern of changes in the management of spleen injury was evident during the study period (Table 3). The frequency of NOM increased from 48.5% in 1992–1996 to 63.1% in 1997–2001 (*p* = 0.02). For both time periods, the mortality rate was similar between both groups (Table 3).

Preservation of the spleen was first practiced in the pediatric population; however, in the last decade, there has been a widespread increase in the acceptance of NOM as a suitable means of treatment<sup>7,8,11–13</sup> for spleen injuries in adults. Our study supported this trend, showing an increase in the number of patients who were managed conservatively in the latter 5 years of the study, compared with the first 4 years of the study (1992–1996 = 43.6% v. 1997–2001 = 56.4%). Other studies reported similar findings in both adults and children with blunt spleen injuries. The increased rate of nonoperative management of spleen injuries varied from 15% to 30% in 1992–1996.<sup>8,14,15</sup>

Our results showed that the rate of mortality and complications was slightly higher in operative patients (9.3% and 47.9%), compared with those who were managed medically (6.8% and 37.9%). Garber and

**Table 1**

#### Baseline characteristics by type of management

Characteristics	Type of management; no. (and %)			<i>p</i> value
	Total ( <i>n</i> = 266)	Operative ( <i>n</i> = 118)	Nonoperative ( <i>n</i> = 148)	
ISS score > 25	153 (57.5)	93 (78.8)	60 (40.5)	< 0.001
Male gender	183 (68.8)	84 (71.2)	99 (66.9)	0.506
Tachycardia	101 (38.0)	59 (50.9)	42 (28.4)	0.001
Referral — scene	111 (41.7)	53 (44.9)	58 (39.2)	0.61
Hypotension	25 (9.4)	15 (12.7)	10 (6.8)	0.09
Comorbidities	87 (32.7)	35 (29.7)	52 (35.1)	0.20

ISS = Injury Severity Score

**Table 2**

#### Length of stay by type of management and Injury Severity Score (ISS)

ISS score	Type of management; median length of stay (Q)		<i>p</i> value
	Operative ( <i>n</i> = 118)	Nonoperative ( <i>n</i> = 148)	
< 25	14.0 (9.0–19.5)	10.0 (6.0–18.0)	0.215
> 25	25.0 (12.5–51.0)	21.0 (11.0–45.5)	0.512

QR = quartile range

Table 3

Trend of admission and mortality by type of management			
Trend	Type of management; no. (and %)		p value
	Operative (n = 118)	Nonoperative (n = 148)	
Admission			
1992-1996	70/118 (59.3)	66/148 (44.6)	0.02
1997-2001	48/118 (40.7)	82/148 (55.4)	
Mortality			
1992-1996			
Died	6/70 (8.6)	5/66 (7.6)	0.831
Survived	64/70 (91.4)	61/66 (92.4)	
1997-2001			
Died	5/48 (10.4)	5/82 (6.1)	0.497
Survived	43/48 (89.6)	77/82 (93.9)	

colleagues<sup>16</sup> reported a similar pattern, with a higher rate of mortality in a single-centre study (22% in OM v. 15% in NOM patients). These differences are more likely related to the differences in ISS score, which were significantly higher in the OM group. Garber and colleagues found similar results in their studies, with OM patients having lower ISS scores and decreased transfusion requirements.<sup>16</sup> Other studies support these results, suggesting that “operative intervention was significantly associated with severity of the patients’ injuries.”<sup>8,17</sup> Longer hospital stays were also related to ISS score rather than type of management.<sup>17</sup>

In our study of 148 patients who underwent NOM for their traumatic spleen injury, 10 (6.8%) failed observation and underwent subsequent splenectomy. Eight of 10 patients were injured early in the study period (1992-1996). This may reflect a notable trend in 1992-1996 toward using more invasive management strategies to treat blunt spleen injuries. The most common reason for failure was the low hemoglobin level (less than 85 g/L). No deaths were reported among those patients who failed NOM. In their study, Garber and others<sup>16</sup> reported that 11% of patients failed NOM and no patients died. In a multicentre retrospective study in patients allocated to NOM, Cogbill and colleagues<sup>7</sup> reported a

failure rate of 11.6%. Over 90% of the failures were due to ongoing hemorrhage, which became apparent through hypotension, sudden hematocrit decrease or abdominal tenderness. The failure rate of NOM of spleen injuries varied from 9% to 30%.<sup>5,18</sup> No patients in our cohort had splenorraphy. This too may reflect the management strategy employed at our institution. Garber and others<sup>16</sup> also noted that splenorraphy was rarely performed at an Ottawa institution during a similar timeframe (1991-1995). Other studies have demonstrated similar indicators for operative intervention in patients who failed NOM, specifically, decreasing hematocrit, change on CT scan, hypotension and abdominal pain.<sup>16</sup> Survival rates of NOM vary tremendously across studies, with rates as low as 7% and as high as 100% being reported.<sup>1,2,4</sup> Our study showed a survival rate of 93.2% in the nonoperative cohort, which was higher than in the operative group (90.7%).

Despite the limitations of retrospective studies, the present study has demonstrated that NOM of blunt spleen trauma has increased over time and has acceptable mortality and complication rates in selected patients. Additional prospective studies are needed to assess the feasibility and safety of NOM in adult spleen injuries over a long-term period, to

assess the impact of complications such as delayed hemorrhage. Further, the management of traumatic spleen injuries, with respect to associated injuries (i.e., head injuries, intra-abdominal injuries) needs to be further explored.

**Competing interests:** None declared.

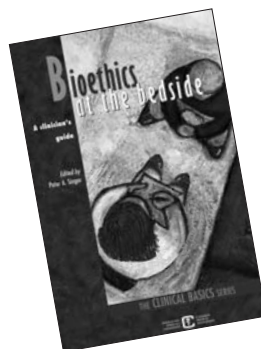
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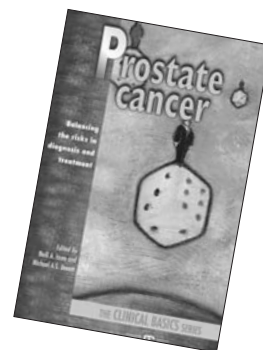


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