Management of Adult Splenic Injury:

A 20-Year Perspective

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ABSTRACT

Objective: **To identify changes in the management of blunt splenic injury in adults.**

Methods: Hospital discharge abstract data from Maine were used to identify patients ≥16 years old discharged between 1/1/1981 and 12/31/2000 with ICD-9 codes indicating splenic injury. Incidence of operative intervention and outcomes for trauma hospitals and other hospitals were determined.

Results: The number of splenic injuries was about 75/year for the first 15 years, increasing to 96/year in the last 5-year period. The rate of operative intervention declined from 71% to 41%, and was lower at the trauma hospitals during the last two 5-year periods (41% vs. 53%). The rate of operative intervention > 24 hours after admission was 2.2% during last 10 years of study. The rate of splenorrhaphy remained stable at about 12% throughout the study period. Mortality rates were higher at the trauma hospitals, as were the number of patients with very severe injuries (ISS >25).

Conclusions: There has been a marked decrease in rate of operative intervention for splenic injury in adults, especially in the last 10 years. Rates of operative intervention were lower at the trauma hospitals despite higher injury severity. Frequency of delayed intervention was low, and did not increase with lower operative rate.

Introduction

The care of patients with blunt splenic injury has evolved significantly over the past few decades, first in children and subsequently in adults. Technological advances in pre-hospital care, resuscitation, critical care monitoring, and especially diagnostic imaging have facilitated the nonoperative management of splenic injury. Our goal was to identify trends in the treatment

of blunt splenic injury over the past 20 years in the largely rural state of Maine, and to evaluate any distinctions between treatment in trauma hospitals and treatment in non-trauma hospitals.

Methods

Hospitalization data for the twenty-year period from 1/1/1981 through 12/31/2000 were obtained from the Maine Health Data Organization (MHDO), and were utilized according to rules and confidentiality regulations established by Maine law for public health research. This data set includes admission and discharge dates, demographic information, diagnosis codes, procedure codes, and dates of procedures for all patients discharged from the approximately 50 non-federal hospitals in Maine. The initial study group requested from MHDO included all patients with a principal International Classification of Diseases, 9th Revision, Clinical Modification (ICD9-CM) diagnosis code indicating an acute injury (800-904.9, 910-929.9, 940-959.9). From this group of injured patients, we identified all patients age 16 or greater with principal or secondary ICD9-CM diagnosis codes for splenic injury (865.0 – 865.99). Transfers of inpatients from one facility to another may result in two discharge records, which cannot be reliably linked; therefore, any record indicating "other inpatient facility" as the discharge destination was excluded from analysis to avoid potential duplication.

For each discharge record, an approximate set of regional Abbreviated Injury Scores (AIS) and resultant Injury Severity Score (ISS) were calculated from the available ICD9-CM diagnosis codes, using the methods of Mackenzie et al.[1] For records before 1992, only five diagnosis codes were recorded, while up to ten diagnosis codes are available for later years. For

consistency across the study period, ISS estimates were calculated using only the first five codes throughout.

Patients were categorized by year of discharge, and grouped by 5-year periods as follows: Group 1: 1981-1985, Group 2: 1986-1990, Group 3: 1991-1995, and Group 4: 1996-2000. Frequency and type of operative intervention was identified by the presence of ICD-9-CM procedure codes for splenectomy (41.5), splenorrhaphy (41.95), other splenic operations (41.20, 41.42, 41.43, 41.95), or codes for general laparotomy (54.11, 54.12, 54.19, 54.21). Date of procedure was only available in the last 10 years of the database. Hospital mortality rates were also calculated.

Subgroups were analyzed based on age, overall injury severity as represented by estimated ISS, presence of severe head injury identified by estimated regional AIS, and by admission to a trauma referral hospital versus a community hospital. Maine has a voluntary inclusive trauma system that was initiated in 1997. The three largest hospitals in the state were designated as trauma centers after an external review process. Although they were not formally designated prior to 1997, admissions to these three hospitals were considered "trauma hospital" admissions for the entire study period.

Comparison between trauma hospital and non-trauma hospital groups was done using χ^2 analysis with statistical significance determined at the level of $p < 0.05$.

Results

There were 164,849 adult injury patients in the initial study group. 5,626 records (3.4%) were excluded because of discharge to another inpatient facility. Of the remaining 159,223 records, 1611 records (1%) with splenic injuries were identified. Prior to 1998, External Cause of Injury Codes (E-Codes) were available in only a minority of cases, but since that time the proportion of splenic injuries due to penetrating mechanisms has been less than 3%, so that we believe it is safe to assume that nearly all the splenic injuries over the twenty-year period were from blunt mechanisms. 693 cases were managed at the 3 trauma hospitals, while 918 cases were managed at community hospitals. These data are presented in Table 1.

The number of patients treated in community hospitals over the years has remained quite steady, while the number of patients treated in trauma hospitals increased, particularly during the last 5-year period. There been a decrease in the rate of operative intervention in both trauma and non-trauma hospitals. This trend started earlier and has been more pronounced in the trauma hospitals. Mean hospital length of stay was lower in the non-operative group (8.4 vs. 12 days) and mean hospital charges were lower in the non-operative group ($18,000 vs. $32,000).

During the initial 5-year period, there was a marked difference between the splenorrhaphy rate in trauma hospitals and that in community hospitals (21.7% vs. 11.9%, $p<0.05$), but these rates have much more closely approximated one another in the subsequent time periods, at about 12% (Table 2).

To examine the immediate failure rate of nonoperative treatment, we looked at the number of delayed operative interventions, which we defined as operations occurring greater than 24 hours after admission. Data are not available prior to 1991, as the data set did not include the time of operations until then. The number of patients undergoing delayed operation is low, and the rate is comparable between trauma hospitals and non-trauma hospitals (Table 2). For those patients undergoing delayed operation, the mean length of delay was 5 days.

Hospital case fatality rates have remained fairly constant over the years, but have been consistently higher in trauma hospitals (Table 3). To attempt to explain this difference in case fatality rate, patients with splenic injury were categorized by presence of age > 64, severe multi-system injury, defined as ISS > 24, and by presence of severe head injury, defined as Head/Neck AIS > 4. The data for these sub-populations are also shown in Table 3. Both injury-related groups have significantly higher mortality that the general population of splenic injuries, and both injury-related groups are more frequently treated at the trauma hospitals. This shift of more severely injured patients, especially severely brain injured patients, to trauma hospitals is most pronounced during the later years of the study.

Discussion

In the early 20th century, blunt splenic injury that went untreated was reported to carry a 90% mortality[2], compared to a 30-40% mortality reported with splenectomy for trauma[3]. Routine splenectomy was therefore the standard of management for all splenic injuries in adults well into the 20th century. An increasing appreciation for the immunologic importance of the spleen in children led to the rejection of mandatory splenectomy for pediatric splenic injuries

during the 1970's. Initially, splenic injury in adults and splenic injury in children were considered to be different diseases, requiring different approaches. However, the success of non-operative management in children led to the gradual adoption of this approach in adults as well.

The evidence of this trend is clear in our study data, with overall incidence of operative intervention in adults dropping from 71% to 41% over the 20-year period. A similar trend has been identified in several other studies in widely separated geographic areas.[4-10] The higher rate of non-operative management we observed in trauma hospitals compared to non-trauma hospitals has also been demonstrated in previous studies, both in adult and pediatric populations.[11-12]

It appears that the initial enthusiasm for splenorrhaphy at trauma centers faded quickly in the early 1980's, while the trend towards nonoperative management continued[13]. Splenic preservation is now most commonly achieved by non-operative management, with a small and relatively fixed percentage of patients undergoing splenic repair. The utilization of splenorrhaphy is similar to that reported elsewhere.[7,14]

Overall acute case mortality rates for patients with splenic injury remained essentially unchanged throughout the study period, despite a marked increase in rate of non-operative management. Therefore, a higher rate of splenic salvage was apparently achieved without increased mortality and without a high incidence of delayed operation during the initial hospital stay. Both hospital length of stay and total hospital charges were less for the non-operative group, indicating a probable financial benefit to non-operative care. Our study is limited,

however, by the lack of long-term clinical follow up. Does splenic salvage mean improved clinical outcome? Further data are required to answer this question.

While there is clear evidence of a shift in surgical philosophy, this evolution has also coincided with advances in imaging techniques, particularly computed tomography, which enable physicians to diagnose splenic injury more accurately and rule out other associated abdominal injuries that might require operative intervention, thereby facilitating non-operative management. The increasing use of CT scanning as an initial diagnostic study for blunt trauma patients has also probably resulted in the detection of splenic injuries that would not have been identified in the past. The potential for increased detection of previously undiagnosed splenic injuries may skew the data and increase the observed rate of non-operative management.

The increased mortality observed for patients with splenic injury treated at trauma hospitals is probably explained by the increased severity of injury of patients seen at trauma hospitals, including severity not measurable by the estimated ISS. This hypothesis is supported by the subgroup analysis, which shows an increasing trend for severely injured patients, especially those with head injury, to be treated at trauma hospitals. The discharge data do not allow us to determine which patients were transferred to a trauma center from other hospitals, but recent registry data suggest that transferred patients comprise approximately 35% of trauma hospital admissions in Maine [15].

Conclusions

There has been a significant decrease in the rate of operative intervention for splenic injury in Maine over a 20 year period, with current operative rate down to about 45% overall, and splenectomy rate down to about 30% overall. The downward trend began earlier, and is of greater magnitude at trauma hospitals. Splenorrhaphy has been utilized at a fairly constant rate over the study period. Despite lower rate of operation, the rate of delayed intervention (indicative of early failure) is low, and the case mortality rate is unchanged. Hospital length of stay and overall charges are both lower for patients undergoing non-operative management.

Table 1: Characteristics of Hospital Types

Hospital Type	N	Avg # of Injury Admissions per Year	Avg # of Splenic Injuries per Year
Trauma Hospital	3	738 (Range 490-958)	11.5 (Range 7.8-16.5)
Non-Trauma Hospital	46	125 (Range 36-408)	1.2 (Range 1–5)

Table 2
Splenic Injuries and Rate of Operative Intervention,
Patients with age > 15.

	1981-1985	1986-1990	1991-1995	1996-2000
Injury Patients, TH	11,528	11,418	9,978	11,353
Injury Patients, NTH	37,294	29,633	26,168	21,851
Injury Patients, Total	48,822	41,051	36,146	33,204
Splenic Injuries, TH	129	159	157	248
Splenic Injuries, NTH	244	219	223	232
Splenic Injuries, Total	373	348	380	480
Operative Intervention, TH	94 (73%)	91 (57%)	72 (46%) †	102 (41%) †
Operative Intervention, NTH	170 (70%)	137 (63%)	141 (63%) †	122 (53%) †
Operative Intervention, Total	264 (71%)	228 (60%)	213 (56%)	224 (47%)
Splenorrhaphy, TH	28 (22%) †	19 (12%)	29 (13%)	35 (14%)
Splenorrhaphy, NTH	29 (12%) †	29 (13%)	28 (13%)	28 (12%)
Splenorrhaphy, Total	57 (15%)	48 (14%)	57 (15%)	63 (13%)
Delayed Operation, TH			5 (3.2%)	4 (1.6%)
Delayed Operation, NTH			6 (2.7%)	4 (1.7%)
Delayed Operations, Total			11 (2.9%)	8 (1.7%)

TH = Trauma Hospital, NTH = Non-Trauma Hospital

† denotes statistical significance between TH and NTH at $p < 0.05$ by χ^2.
* denotes statistical significance between year categories at $p < 0.05$ by χ^2.

Table 3
Risk Factors and Mortality Data, Mortality rate in parentheses
Patients with Splenic Injury, age > 15

	1981-1985	1986-1990	1991-1995	1996-2000
All Splenic Injuries, TH	129 (13%) †	159 (8.2%) †	157 (13%) †	248 (9.7%) †
All Splenic Injuries, NTH	244 (4.9%) †	219 (3.7%) †	223 (4.0%) †	232 (1.3%) †
All Splenic Injuries, Total	373 (7.7%)	348 (5.5%)	380 (7.6%)	480 (5.6%)
Splenic Injuries, ISS > 24, TH	31 (32%)	40 (25%)	38 (32%)	68 (25%)
Splenic Injuries, ISS > 24, NTH	41 (9.8%)	41 (15%)	24 (17%)	27 (3.7%)
Splenic Injuries, ISS > 24, Total	72 (19%)	81 (20%)	62 (26%)	95 (19%)
Splenic Injuries, Head AIS > 4, TH	5 (100%)	11 (46%)	12 (75%)	26 (50%)
Splenic Injuries, Head AIS > 4, NTH	3 (67%)	2 (100%)	2 (100%)	1 (0%)
Splenic Injuries, Head AIS > 4, Total	8 (88%)	13 (54%)	14 (79%)	27 (54%)
Splenic Injuries, Age > 64, TH	13 (39%)	10 (50%)	20 (25%)	30 (30%)
Splenic Injuries, Age > 64, NTH	24 (20%)	25 (24%)	30 (17%)	31 (6.2%)
Splenic Injuries, Age > 64, Total	37 (29%)	35 (31%)	50 (20%)	61 (18%)

TH = Trauma Hospital, NTH = Non-Trauma Hospital

† denotes statistical significance between TH and NTH at $p < 0.05$ by χ^2.

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