Nonoperative Management of Adult Blunt Splenic Trauma

Criteria for Successful Outcome

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Nonoperative management of blunt splenic trauma in adults is controversial despite numerous reports advocating this mode of therapy. Blunt splenic trauma is frequently managed without operation at our institution and, to define criteria that may predict a successful outcome, a retrospective review (1980 to 1988) of all adult splenic injuries was undertaken. Splenic injuries were documented by scintillation studies, CAT scanning, or at laparotomy. Sixty of 252 (24%) splenic injuries were initially treated without operation, which included bed rest, ICU monitoring, frequent physical exams, nasogastric tube, serial hematocrits, and follow-up splenic imaging. Five patients (5 of 60) failed nonoperative management and required interval laparotomy. Reasons for failure included blood loss greater than four units, enlarging splenic defect, or increasing peritoneal signs. Parameters predicting a successful outcome were localized trauma to the left flank or abdomen, hemodynamic stability, transfusion requirements less than four units, rapid return of GI function, age less than 60 years, and early resolution of splenic defects on imaging studies. No morbidity or deaths resulted from delayed operative intervention. In carefully selected adult patients, blunt splenic trauma may be successfully managed without operation.

THE MANAGEMENT OF SPLENIC trauma has changed dramatically in the past decade. Until recently total splenectomy was considered the only treatment for the patient with an injured spleen. This procedure eliminated the risk of postoperative splenic hemorrhage and was believed to pose no further detriment to the patient. Recent studies have shown, however, that asplenic patients are at an increased risk from a number of postoperative complications such as pulmonary and wound infections, thromboembolic sequelae, overwhelming postsplenectomy sepsis, and possibly fatal coronary artery disease.[1-4] The risk for fatal postsplenectomy sepsis, initially described in children and patients with hematologic disorders, is now recognized to include the adult patient as well. Postsplenectomy sepsis may occur in the absence of underlying disease and may occur several years after splenectomy.[5] Within the past decade techniques of splenic preservation (including segmental resection, splenorrhaphy, autotransplantation of splenic fragments, and nonoperative management) have been introduced to avoid these potential problems.

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The concept of selective, nonoperative management of blunt splenic injuries is now widely practiced among pediatric surgeons.[6,7] Most surgeons, however, have been reluctant to consider this approach in adults for fear of such complications as delayed splenic rupture, traumatic splenic cyst formation, failure to identify other serious intra-abdominal injuries, and the development of post-traumatic splenosis. Several investigators have recently examined the role of nonoperative therapy for splenic injuries in adults (Table 1). These reports suggest that a high success rate for nonoperative treatment may be achieved if criteria are established that can help predict which patients are suitable candidates. In addition guidelines for deciding when a patient has failed nonoperative therapy have yet to be established. To better define such criteria, we have retrospectively reviewed our 8-year experience with operative and nonoperative management of blunt splenic trauma in adults.

Patients and Methods

Two hundred fifty-two adult patients (16 years or older) were treated at the Yale New-Haven Hospital with documented blunt splenic injuries during the 8-year interval from 1980 to 1988. Patients with penetrating abdominal trauma and splenic injuries were not considered as candidates for nonoperative management. Sixty patients with documented splenic injuries after blunt trauma initially treated without operation are the subject of this report. The diagnosis of splenic injury was suggested by the mechanism of injury and/or the physical examination.

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TABLE 1. *Nonoperative Management of Splenic Injuries in Adults*

Source	Year	Number of Patients	Delayed Splenectomy (%)	Percentage of all Splenic Injuries (%)
Strauch	1979	2	0	N/A
Lutzker	1981	9	0	N/A
Hebeler	1982	32	1 (4)	19
Morgenstern	1983	17	0	31
Zucker	1984	14	1 (7)	29
Johnson	1984	11	3 (27)	18
Malangoni	1984	10	7 (70)	13
Johnson	1986	11	3 (27)	18
Andersson	1986	13	0	25
Moss	1987	7	2 (29)	23
Wiebke	1987	10	3 (30)	N/A
Wiig	1987	32	0	33
Nallathambi	1988	10	7 (70)	21
Resciniti	1988	27	10 (37)	31
Buntain	1988	10	0	28

N/A, information not available.

Injuries were subsequently confirmed by liver–spleen scintillation scanning, computed tomography (CT), or laparotomy.

The management protocol for patients with suspected splenic trauma was as follows: (1) patients with hemodynamic instability or who had diffuse peritoneal findings underwent emergency laparotomy; (2) patients suspected of sustaining other intra-abdominal injuries, who had equivocal physical findings, or altered mental status, underwent immediate peritoneal lavage; and (3) patients who were stable and had a high clinical suspicion of isolated splenic injury underwent immediate liver–spleen scintillation studies or CT scanning. The ultimate decision regarding the method of treatment for each patient was made by the attending surgeon.

After the decision to treat a patient without operation was made, absolute bed rest was instituted along with nasogastric tube decompression, cardiac monitoring, blood pressure and urine output, frequent physical examinations, serial hematocrits, and follow-up splenic imaging studies. Blood was transfused as necessary to maintain a hematocrit level greater than 30%. Generally transfusion requirements of more than four units of blood, persistent leukocytosis, increasing peritoneal irritation, hemodynamic instability, or an enlarging splenic defect on imaging studies were considered as indications for surgical intervention.

Patients were instructed to refrain from participating in vigorous exercise and contact sports for 2 to 3 months after splenic trauma. Follow-up scintillation scans were obtained 3 months after discharge to assess splenic healing.

Results

The age range of the 252 patients was 16 to 74 years, with a mean age of 34.5 years. Sixty (24%) adult patients with documented blunt splenic trauma were initially treated without operation. Mechanisms of injury are shown in Table 2. More than one half (61%) of the patients who were treated without operation sustained a low-velocity deceleration injury or direct blow to the abdomen. The remaining patients were passengers in automobiles or motorcycles, or were pedestrians struck by vehicles. In 43 patients (17%) splenic preservation was accomplished with operative splenorrhaphy and the remaining 149 operated patients (59%) were managed by total splenectomy. None of these patients were treated with procedures involving angiographic splenic embolization, splenic autotransplantation, or splenic artery ligation alone. Splenic injuries were documented by liver–spleen scintillation scan in six patients (10%) and by CT scan in 54 patients (90%). The average age of patients treated without operation was 29.8 years (range, 16 to 79 years). The mean length of hospitalization was 10.4 days in the operative group and 8.5 days in the nonoperative group. In the nonoperative group, 36 patients had one or more nonfatal extra-abdominal injuries (Table 3).

TABLE 2. *Mechanism of Injury (Nonoperative Management)*

Mechanism	Number	Per Cent
Motor vehicle	20	33
Fall	13	22
Assault	9	15
Contact sports	8	13
Motorcycle	5	8
Auto–pedestrian	3	5
Bicycle	2	3

Five patients (of 60) initially treated without operation underwent delayed splenectomy during the same hospitalization and were considered to be failures of nonoperative management. Four of these patients required more than four units of transfused blood. The mean transfusion requirement was 7 units (SEM ±1.4) of packed cells or whole blood in those patients who failed nonoperative management *versus* 3.1±1.1 units in those treated successfully without surgery. Three of five patients in the failure group were older than 60 years, and the mean age for this group was 54.4 years *versus* a mean age of 24.8 years for patients successfully treated without operation. Two patients underwent delayed splenectomy on the basis of increasing peritoneal signs on physical examination and one patient had a delayed splenectomy due to an enlarging splenic defect on CT scan. In all five patients who failed

TABLE 3. *Associated Injuries (Nonoperative Management)*

Injury	Number of Patients
Rib fracture	21
Long bone fracture	14
Major soft tissue injuries	9
Renal contusion	4
Pulmonary contusion	6
Pelvic fracture	2

a trial of nonoperative management, splenic injuries had occurred in motor vehicle crashes. Three of these patients had other extra-abdominal injuries such as long-bone fractures (3), pulmonary contusion (2), and pelvic fracture (3). The interval from injury to delayed operative intervention in the treatment failure group ranged from 6 to 94 hours. No other serious intra-abdominal injuries were found in those patients who underwent delayed laparotomy. One patient who underwent delayed splenectomy also had a renal contusion. There were no deaths in patients treated without operation or who underwent delayed splenectomy. The mean length of hospitalization for the treatment failure group was 11.2 days *versus* 8.2 days in those treated without surgery. The average length of follow-up in the nonoperative group was 26 months (range, 2 to 83 months). None of these patients have manifested any clinical evidence of splenic dysfunction (*i.e.*, sepsis) or rebleeding.

Discussion

During the past three decades our concept of the spleen as a vital organ has changed dramatically. Although in 1919 Morris and Bullock[8] reported experimental evidence that asplenic animals were at an increased risk of infection, these ideas were largely ignored and total splenectomy was considered the procedure of choice after injury. An awareness of the important immunologic function of the spleen was later suggested by King and Schumaker who, in 1952, reported five infants who developed fatal sepsis after splenectomy. Twenty years of controversy followed until the classic report of Singer in 1973, which reviewed the experience with postsplenectomy sepsis at the Texas Children's Hospital in Houston, as well as 23 other series from the literature. He found that the risk of developing postsplenectomy sepsis was increased, particularly in younger patients and in the presence of underlying hematologic disease.

It is well known that the spleen plays a major role in the clearance of particulate antigens and both humoral and cell-mediated immunity. The spleen is the site of production of opsonins, tuftsin, and properdin, which enhance phagocytosis, and is also the site of many fixed macrophages that remove particulate antigens from the bloodstream.[9,10] In addition B lymphocyte maturation and the production of both IgM and IgG occur in the spleen. It is also a site for maturation of T-helper, T-cytotoxic/suppressor cells, and natural killer cells.[12] Splenectomy has also been reported to be associated with a number of other perioperative complications such as pneumonia, intra-abdominal and wound sepsis, iatrogenic injury to the stomach and pancreas, thromboembolic complications, and even a potential delayed risk of ischemic heart disease.[2-4]

Coincident with the recognition of these problems, surgeons have developed a number of techniques for splenic conservation including partial resection, direct operative repair of splenic injuries (splenorrhaphy), autotransplantation of splenic fragments, as well as expectant, carefully monitored nonoperative management for isolated splenic injuries. Nonoperative therapy of selected cases of blunt splenic trauma was first advocated in 1968 by Upadhyaha and Simpson[12] who followed 12 children with suspected blunt splenic injuries. The lack of direct confirmation of these injuries, however, resulted in considerable criticism of their report. Shortly thereafter Werner and Boyle[14] described the reliability of the scintillation scan in the diagnosis of splenic injury. Since then an extensive experience with splenic injuries treated without operation has been reported by the Toronto group and this form of management has now become routine in many pediatric centers across North America.[15,16]

Nonoperative therapy in adults continues to meet with considerable resistance. Fears of possible delayed splenic rupture and hemorrhage, formation of post-traumatic splenic cysts, generalized splenosis, and failure to recognize other serious intra-abdominal injuries have led most surgeons to continue to support early operative intervention. Although numerous reports have appeared in the literature indicating that this form of therapy may be used with a high likelihood of success, failure rates as high as 70% have also been published (Table 1). This wide variation in results suggests that proper patient selection may be the most important parameter for successful outcome. Previous reports often have not documented criteria used to select those patients who may best benefit from nonoperative management. It is also important to establish guidelines for deciding early in the hospital course when a patient has failed such therapy.

Based on the excellent results obtained in the pediatric population, as well as earlier reports in adults, we developed a protocol for selecting adult patients with splenic injuries for nonoperative management. First only a minority of patients were suitable candidates for nonoperative therapy. Despite our interest in splenic preservation, only 24% of patients with blunt splenic trauma were included in this protocol. Other centers have reported similar results (Table 1). We also believe that patients with penetrating abdominal trauma are not suitable candidates for nonoperative therapy because of the high incidence of associated injuries.[17] Patients with altered mental status due to head trauma, alcohol or drug abuse, patients who were to undergo general anesthesia, or who were otherwise unable to participate in subsequent physical examinations (which are essential in the management of such patients) were also not considered candidates for nonoperative management. Patients suspected of sustaining other intra-abdominal injuries were also excluded from this protocol. Although hemodynamic stability was an important criteria for choosing nonoperative management, patients with brief episodes of mild hypotension that responded rapidly to fluid challenges generally were not excluded.

It should be emphasized that nonoperative manage-

ment did not imply a lack of therapy or care. Once the patient was deemed a suitable candidate for nonoperative management, resuscitation with crystalloid or blood products was continued as needed. In addition all patients with confirmed splenic injuries (CT scan or scintillation study) not undergoing immediate operative intervention were confined to strict bed rest and monitored in an intensive care unit with nasogastric tube decompression (to prevent gastric distension and minimize the effects of post-traumatic ileus). In our experience changes in the physical exam have been the most reliable indicator of continued splenic hemorrhage. Follow-up imaging was performed three to five days after injury and if evidence of healing was present, nonoperative therapy was continued. Although earlier reports[18] emphasized the superiority of scintillation studies in the evaluation of the injured spleen, our recent experience indicates that with the current technology CT scanning is as accurate and sensitive as scintillation studies but also allows for the evaluation of other abdominal and extra-abdominal injuries. Patients were instructed to avoid physical straining or contact sports for a minimum of 3 months. Compliance and follow-up was good with nearly 75% of patients returning 3 months later for follow-up splenic imaging studies.

Although our number of management failures thus far has been small (5 of 60 patients), we have tried to establish early diagnostic parameters that indicate when nonoperative therapy may be failing. Mean blood transfusion requirements were twice as great (7.1 ± 1.4 *versus* 3.1 ± 1.1 units) in the treatment failure group as in patients treated successfully without surgery. Therefore we continue to advocate that patients requiring more than four units of packed red blood cells or whole blood should undergo laparotomy. Three of the five management failures were also older than 60 years and the mean age for this group was 54.4 years *versus* 24.8 years for those treated successfully. This finding of treatment failure in older patients has been reported previously.[19] Although our group and others have reported successful outcomes with nonoperative management in patients in their fifth, sixth, and even seventh decades, it is important to recognize that these patients may be more vulnerable to treatment failure. Two of these five patients were operated on due to recognition of increasing signs of peritoneal irritation alone. The fifth patient showed signs of increasing peritoneal irritation as well as an enlarging splenic defect on CT scan. At operation all three patients had actively bleeding splenic injuries. These results confirm our initial impression that the physical examination is a reliable indicator of continued intra-abdominal bleeding. In addition these three patients had prolonged post-traumatic ileus secondary to the hemoperitoneum. Although only one patient was found to have an enlarged defect on subsequent splenic imaging, we continue to obtain routine follow-up imaging studies 48 to 72 hours after admission to assess splenic bleeding.

By strict observance of these objective criteria, we have treated without operation many patients with splenic injuries. Our failure rate (8%) seems acceptably low and thus far has not resulted in serious additional morbidity or increased the number of deaths. All nonoperative management failures were detected during the initial hospitalization and there were no splenic complications occurring after discharge. The parameters that seemed to predict success of nonoperative therapy in our series were as follows: (1) hemodynamic stability after initial fluid challenge, (2) transfusion requirements of less than four units of blood, (3) age less than 50 years, (4) early resolution of splenic defects on imaging studies, (5) normal level of consciousness, and (6) rapid resolution of post-traumatic ileus. Identification of these parameters have enabled the surgeons in our institution to better predict those patients who are appropriate candidates for nonoperative management. In addition these criteria have guided our trauma service in determining much earlier when patients have failed this form of therapy and should undergo abdominal exploration.

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