Nonoperative management of splenic injury grade IV is safe using rigid protocol

Tratamento não operatório de lesão esplênica grau IV é seguro usando-se rígido protocolo

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ABSTRACT

Objective: To demonstrate the protocol and experience of our service in the nonoperative management (NOM) of grade IV blunt splenic injuries. **Methods**: This is a retrospective study based on trauma registry of a university hospital between 1990-2010. Charts of all patients with splenic injury were reviewed and patients with grade IV lesions treated nonoperatively were included in the study. **Results**: ninety-four patients with grade IV blunt splenic injury were admitted during this period. Twenty-six (27.6%) met the inclusion criteria for NOM. The average systolic blood pressure on admission was 113.07 ± 22.22 mmHg, RTS 7.66 ± 0.49 and ISS 18.34 ± 3.90. Ten patients (38.5%) required blood transfusion, with a mean of 1.92 ± 1.77 packed red cells per patient. Associated abdominal injuries were present in two patients (7.7%). NOM failed in two patients (7.7%), operated on due to worsening of abdominal pain and hypovolemic shock. No patient developed complications related to the spleen and there were no deaths in this series. Average length of hospital stay was 7.12 ± 1.98 days. **Conclusion**: Nonoperative treatment of grade IV splenic injuries in blunt abdominal trauma is safe when a rigid protocol is followed.

Key words: Kidney. Wounds and injuries. Wounds, penetrating. Wounds, gunshot. Critical pathways.

INTRODUCTION

Abdominal injury due to trauma occurs in 30% of multiple trauma patients, with a frequency of 13 and 16% of spleen and liver injuries, respectively[1]. Spleen blunt trauma management has changed during recent decades. To date, Non-operative management (NOM) has increased, reaching 80% of the cases in some series. AAST-OIS[2] splenic grade of injury has become a major decision making factor for NOM treatment and is an important predictor for failure of NOM.[3,4]

The paradigm of NOM in adults was broken after the observation of the management of spleen trauma in children. It has proven to have advantages, such as low hospital costs, avoidance of non-therapeutic laparotomies, low rates of intra-abdominal complications, low rate of blood transfusions and low mortality rate.[5,6]

NOM is currently not recommended in institutions other than those with full capabilities, including multi-slice Computerized Tomography (CT) scan, Trauma Intensive Care unit (TICU) staff and in-house surgery team.[5] NOM is not a hundred percent safe and is deemed to fail in 2% to 33% of cases[1,3,7]. The presence of multiple splenic lesions, large amount of free fluid, age greater than 55 and high ISS are important risk factors associated with treatment failure.[1,7,8]

Although NOM in blunt splenic abdominal trauma is the treatment of choice for AAST-OIS grades I, II, and III, controversy for grade IV still remains. The primary objective of this paper was to retrospectively evaluate the experience of a Level I trauma center with NOM of AAST-OIS splenic grade IV injuries. As a secondary objective, we propose a NOM protocol for AAST-OIS grade IV injuries.

METHODS

The University of Campinas Clinical Hospital is a prominent trauma center, located in a metropolitan area of approximately 2.8 million people. This study analyzed patients admitted to our trauma center from 1990 through 2010. This study was aproved by the Ethics in Research Committe of UNICAMP.

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Patients were eligible for this analysis if they were adult (14 years or more), sustained grade IV splenic injury according to the American Association for the Trauma Organ Injury Scale (laceration involving segmental or hilar vessels producing major devascularization in more than 25% of the spleen)[2] and were initially treated non-operatively as per our institution's guidelines for spleen injury. Data, including clinical and surgical information, were collected from patient records. All patients who did not meet the aforementioned inclusion criteria were excluded.

Advanced Trauma Life Support (ATLS®) protocol was routinely applied and all patients meeting the criteria were submitted to CT scan examination. Selection criteria for non-operative spleen injury management were hemodynamic stability after initial resuscitation with crystalloid and no need of blood transfusion, absence of clinical signs of peritonitis, no bowel injuries (pneumoperitoneum) and no intestinal injuries shown on CT scan.

The NOM protocol for splenic injuries adopted by the Division of Trauma of this Institution is described in Table 1.

We analyzed age, gender, cause of injury, systolic blood pressure (SBP), Revised Trauma Score (RTS), Injury Severity Score (ISS), Ultrasound (US) and CT scan findings, presence of associated abdominal injuries, need for surgical intervention, hemoglobin level on admission, need for blood transfusions, splenic and non-splenic complications (pneumonia, empyema, atelectasis, Adult Respiratory Distress Syndrome, kidney failure, intestinal fistulae, urinary tract infections, sepsis and brain injury), mortality and length of hospital stay.

Descriptive variables were summarized as frequencies and percentages. Summary data for continuous variables were presented as means and standard deviations, or medians and ranges depending on the distribution.

RESULTS

Ninety-four patients with grade IV blunt splenic injuries were admitted during the period studied. Twenty-six patients (27.6%) presented the criteria for non-operative treatment.

The mean age of patients was 30 ± 13.18 years, ranging from 17 to 64; nineteen (73%) patients were men. The causes of injury were distributed as follows: four (15.37%) patients were involved in motor vehicle crashes, nine (34.61%) in motorcycle collisions and one (3.85%) in a bicycle accident. Three (11.56%) were pedestrians hit by cars, three (11.56%) were victims of assault and six patients (23.07%) were involved in other types of blunt trauma.

The average systolic blood pressure on admission was 113.07 ± 22.22 mmHg, RTS 7.66 ± 0.49 and ISS 18.34 ± 3.90. Hemoglobin level on admission was 10.76 ± 1.90 g/dl. Two patients (7.7%) had head trauma, with GCS 10. One patient (3.85%) was pregnant.

Table 1 - Protocol of non-operative treatment in AAST-OIS grade IV blunt splenic trauma - Division of Trauma Surgery - University of Campinas.

NOM Protocol: Inclusion criteria

1. Abdominal blunt trauma
2. Hemodynamic stability after initial resuscitation with maximum 2 units of red blood cells:
   a. Systolic blood pressure > 90 mmHg
   b. Initial hemoglobin level > 8 g/dL
3. CT scan:
   a. Absence of associated injuries to hollow viscera and/ or pneumoperitoneum
   b. Absence of splenic contrast blush
4. Clinical evaluation with no signs of peritonitis

NOM Protocol: Monitoring

1. Hemoglobin/ Hematocrit measurement every 6 hours in the first 24 hours or more frequently in the case of clinical deterioration
2. Arterial Blood Gas measurements every 12 hours in the first 24 hours (grade>II) or more frequently in the case of clinical deterioration
3. Intensive Care Unit admission

NOM Protocol: Failure criteria

1. Need for surgical intervention determined by:
   a. Hemodynamic instability
   b. Progressive fall of hemoglobin/hematocrit levels, with recurrent blood transfusion
   c. Clinical signs of peritonitis

CT scans showed seven patients (26.9%) with splenic lesion and 18 patients (69.3%) with splenic lesion plus free fluid. Ten patients (38.5%) required blood transfusion, with a mean of 1.92 ± 1.77 packed red cells per patient.

The non-operative treatment failed in two patients (7.7%), who were sent to the OR due to worsening of abdominal pain and hypovolemic shock. Patients who failed treatment had the following measured parameters: admission systolic blood pressure was 90 and 110 mmHg respectively, RTS and ISS were the same for both patients, 7.84) and 16, respectively. Hemoglobin levels on admission were 12.6 and 10.6 mg/ml, blood transfusions were 5 and 3 packed red blood cells, hospital stays were 8 and 5 days. Neither of them had associated lesions. Both were vaccinated after the surgery and did not develop any postoperative complications or hemodynamic instability.

Associated abdominal injuries were present in two patients (7.7%). The kidney was the affected organ in one patient, with a grade III AAST-OIS injury, and the liver was affected in another, with a grade I AAST-OIS injury.

No patients developed complications related to the spleen trauma. General complications unrelated to the spleen occurred in two patients (7.7%), both developing pneumonia. None of the patients deceased. The average length of hospital stay was 7.12 ± 1.98 days.

DISCUSSION

This was a retrospective trauma database analysis of a university trauma center. In this paper authors demonstrate their 11-year experience in non-operative management of grade IV splenic injuries and present their institution's current protocol. This protocol for this grade of spleen injury has been followed since the year 2000.

The management of blunt trauma to the spleen in children has become routine, with 90% of them being successfully treated non-operatively[4]. Early reports of selected adults with blunt splenic trauma managed by observation had varying degrees of success, suggesting that either there were intrinsic differences between the spleens of adults and children or there were other factors that determined the success of non-operative treatment[7-10]. Frequently-cited concerns were that success rates in adults would not parallel those reported in children, since there are differences in both the sizes and textures of spleens. In adults the transfusion requirements would be excessive (due to the greater severity of the injury), the risk of infection would increase, and there would be a greater incidence of associated intra-abdominal injuries[4].

The clinical exam still remains an important criterion for inclusion in the NOM protocol for high grade spleen injuries. The criteria for non-operative treatment of splenic injuries in adults have traditionally included hemodynamic stability after minimal fluid

Table 2 - Evaluated aspects of patients with grade IV blunt splenic trauma undergoing non-operative treatment.

Demographics and severity	Frequency / mean (no. or SD) N = 26 cases
Male	73% (19 casos)
Age	30 ± 13.18
Systolic Blood Pressure on admission	113.07 ± 22.22
RTS	7.66 ± 0.49
ISS	18.34 ± 3.9
Hemoglobin admission level	10.76 ± 1.90
Blood transfusion	38.5% (10 casos)
Associated abdominal injuries	7.7% (2 casos)

SD: Standard Deviation.

Table 3 - Outcomes of patients with grade IV blunt splenic trauma undergoing non-operative treatment.

Outcomes	Frequency / mean (no. or SD) N = 26 casos
Complications related to the spleen	0
Non-splenic related complications	7.7% (2 casos)
Failure of non-operative treatment	7.7% (2 casos)
In-hospital mortality	0
Length of hospital stay	7.12 ± 1.98

resuscitation, no altered level of consciousness that might interfere with serial abdominal examinations, no physical findings or any associated injuries requiring laparotomy, documentation of splenic injury by imaging techniques, and no recurrent blood transfusion due to fall of hemoglobin/hematocrit levels.[9,11]

The management of blunt splenic trauma in adults has slowly evolved over the past three decades from a mandatory laparotomy and splenectomy to a non-operative approach. This has resulted, in part, from an increased understanding of splenic function and its relationship to host immune status. Two factors altered the treatment of splenic injury in favor of splenic salvage: the increased diagnostic accuracy of splenic injury by CT scanning and the recognition of early postoperative and late septic complications in the splenic patient[5,12,13]. Meguid *et al*[14] reported that the percentage of patients treated non-operatively since the original report has increased to 69% from an initial 36%, which reflects the gradual acceptance of non-operative treatment. At our institution, non-operative splenic salvage in adults has been practiced since 1994 for spleen injuries grades I, II and III. The first NOM for a grade IV splenic injury was in 2000, followed by a trend to indicate non-operative splenic salvage according to a pre-established protocol[11]. In the early years, NOM was only indicated for cognizant patients, but recently it has also been indicated for patients with head trauma or mechanical ventilation, and in these cases attention to the patient has to be much greater for eventual transition to surgical treatment.

Peitzman *et al*[15] reported that non-operative treatment of blunt splenic injury clearly has become the standard of care in pediatric trauma and that 75% to 93% of splenic injuries in children can be treated successfully. However, appropriate management of blunt injury to the spleen in adults is less clear. Powell *et al*[16] stated that the failure rates in children were only 2 to 5%, whilst in adults it ranges from 8% to 24%. Curiously, this superior success rate of initial non-operative treatment of children with blunt splenic injury has never been rigorously explained. Proposed explanations for improved hemostasis in the spleens of children include a higher proportion of myoepithelial cells, a more efficient contraction and retraction of splenic arterioles, and more elastic splenic capsule and rib cages, with a resultant transmission of less direct force to the spleen.

The inclusion criteria for traumatic patients with lesion of the spleen is not consensus in the literature, with the exception to hemodynamic stability on admission or after initial resuscitation with two liters of crystalloid infusion. Hemodynamic instability, unresponsiveness to fluid resuscitation, and recurrence after initial stabilization are predictors of the need for surgical or angiographic follow-up, and patients presenting such symptoms are not candidates for non-operative treatment.[6-8,10,11] Also, patients who respond to blood resuscitation after a brief episode of non-recurring hypotension can also be treated non-operatively.[8]

Elderly patients have previously been excluded from recommendations for non-operative treatment of splenic injuries, according to various authors.[17] These treatment algorithms were advocated by studies that reported high failure rates in patients over the age of 55. Albrecht *et al*.[17] recommend close observation, with admission to a monitored unit, serial clinical evaluations and serial hematocrit, as wells as the embolization of splenic pseudoaneurysms. They also warn that patients with high-grade splenic injuries who are not amenable to angiographic therapy and who have free fluid in the pelvis have a higher failure rate. Bhullar *et al*.[9] and Cocanour *et al*[18] reported that age should not be part of the criteria for non-operative treatment for traumatic lesions to the spleen. Tsugawa *et al*[19] observed that selecting the optimal non-operative treatment of blunt splenic injury in elderly patients remains a difficult task. An aggressive initial operation is thus recommended in elderly patients due to the difficulty in estimating the specific fragility of the spleen and their decreased physiologic reserve. Furthermore, performing emergency splenic angiography and treating embolisms in small hospitals is especially difficult[20,21]. The NOM protocol used in this research and currently utilized in our institution does not have age as an exclusion criterion. In this study, 12 patients were more than 55 years old and the success rate for them was 83.33%.

CT has been proven to be an excellent imaging tool for evaluating hemodynamically stable patients with blunt abdominal trauma. The rapid diagnosis capability offered by CT has contributed to a decrease in morbidity and mortality from traumatic abdominal injuries[22]. The ability of the abdominal CT scan to determine not only the pattern and degree of splenic injury but also an estimate of the volume of free intra-abdominal blood has led to a greater acceptance of its use in diagnosing blunt splenic trauma. It seems to us that the increased use of CT in evaluating blunt abdominal trauma has led to the correct diagnosis of splenic injury in patients who might not have had their injuries previously detected due to minimal findings on examination[23].

Active hemorrhages can be diagnosed on CT on the basis of increased radiodensity compared with surrounding tissue, which results form the extravasation of intravascular contrast agent[13]. The exact bleeding rate required for this finding is unknown, but extravasation of IV administered contrast agent in a patient with blunt abdominal trauma represents a significant finding that may require immediate surgical or interventional therapy[24].

Angiography with embolization of the splenic artery should be performed in hemodynamically stable patients with serious splenic injuries, since the risk of NOM failure is high and the absence of contrast extravasation does not reliably exclude active bleeding[25]. Patients included

in this study were not managed with angiography/ embolization, since in the period studied the protocol did not foresee the realization of interventional radiology, something that has been considered for selected cases only from 2011 on.

Pather *et al*[26] and Powell *et al*[27] reported that patients with ISS > 15 present a larger probability of failure of non-operative treatment. Hunt *et al*[28] experienced better results in both non-operative treatment and in the preservation of the spleen during celiotomy on patients with ISS below 15. In this research the average ISS was 18, with low rates of complications and zero percent mortality rate. A prospective, randomized clinical study may be necessary for further conclusions to be drawn.

Failure rates for non-operative treatment, as demonstrated in literature, generally run between 2% and 33%[7,29]. According to Velmahos *et al*.[29], the failure rate for grade IV injuries was 33,3%. In Brazil, João XXIII Hospital in Belo Horizonte has an extensive experience in NOM for traumatic lesions of the spleen. In the period from 2004 to 2010 a total of 446 patients were submitted to NOM of splenic injury, 44 cases of grade IV injury, with a failure rate of 20.5%. This study presents a grade IV failure rate of 7,7%. The reason for such discrepancy is perhaps the strict selection of patients for NOM, creating a possible selection bias, since in our experience, by 2010 the presence of a grade IV splenic injury with contrast blush was an indication for laparotomy. Regarding mortality of all grades of splenic lesions, indices vary from 1.5% to 5.8%[6,14,26,30]. In our study there was no death in patients with grade IV spleen lesions; we believe this good result is due to the rigid selection protocol.

In the proposed protocol of the non-operative handling of spleen injuries, the repetition of CT is not expected in patients who become asymptomatic or have no evidential signs of bleeding. We suggest a second CT scan for patients with a change in clinical evolution, in case of worsening of the abdominal pain and suspicion of ongoing bleeding shown by clinical signs and/or decrease in hemoglobin levels.

It is also worth mentioning that since 2011 changes have been applied to this Protocol, including blood transfusions in the emergency room, following the newly instituted massive transfusion protocol, and the possibility of arteriography with embolization, although there is a preference by most surgeons for indicating surgical treatment in the presence of contrast blush in grade IV splenic injuries.

Recently, the meeting "Evidence-Based Telemedicine - Trauma and Emergency Surgery" (TBE-CITE) was held with the involvement of Brazilian surgeons and those from abroad, making a critical analysis of three articles about severe spleen traumatic injuries[5,13,25,30]. The authors' conclusions generated recommendations that can be followed by services which have human and material resources to carry out NOM for severe splenic injuries, including: angiography with embolization of the splenic artery should be performed in hemodynamically stable patients with serious splenic injuries, since the risk of failure of NOM is high and the absence of contrast extravasation does not reliably exclude active bleeding[30]. It is noteworthy that such conduct does not currently apply to the vast majority of hospitals in Brazil which treat traumatized patients.

Currently, due to lack of available literature, there are no recommendations on practical aspects of the treatment of severe splenic lesions, such as: the duration of hospitalization and the frequency of abdominal exams, periodic measurements of hemoglobin, the moment for starting thromboembolism prophylaxis, the duration and intensity of activity restriction, and the ideal period for staying in the intensive care unit and in the hospital.[30]

In conclusion, non-operative treatment of splenic injuries in blunt abdominal trauma is safe for patients admitted to trauma reference hospitals, following a rigid protocol and treatment selection.

R E S U M O

Objetivo: *demonstrar o protocolo e a experiência do serviço no TNO de lesões esplênicas contusas grau IV (classificação da Associação Americana de Cirurgia do Trauma).* ***Métodos:*** *estudo retrospectivo baseado em registro de trauma de hospital universitário no período de 1990 a 2010. Prontuários de todos os pacientes com lesão esplênica foram revisados e os doentes tratados de modo não operatório com lesão grau IV foram incluídos no estudo.* ***Resultados:*** *noventa e quatro pacientes com lesão esplênica contusa grau IV foram admitidos neste período. Vinte e seis (27,6%) apresentaram os critérios para o TNO. A média de pressão arterial sistólica na admissão foi de 113,07 ± 22,22mmHg, RTS = 7,66 ± 0,49 e ISS = 18,34 ± 3,90. Dez pacientes (38,5%) necessitaram de transfusão sanguínea, com uma média de 1,92 ± 1,77 concentrado de hemácias por paciente. Lesões abdominais associadas estavam presentes em dois pacientes (7,7%). O TNO falhou em dois pacientes (7,7%), operados devido à piora da dor abdominal e choque hipovolêmico. Nenhum paciente desenvolveu complicações relativas ao baço e não houve óbito na presente casuística. A média de dias de internação foi 7,12 ± 1,98 dias.* ***Conclusão:*** *o tratamento não operatório de lesões esplênicas grau IV no trauma abdominal contuso é seguro seguindo-se rígido protocolo.*

Descritores: *Ferimentos e lesões. Abdome. Hemorragia. Baço. Terapêutica.*

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