

# Pattern and Outcome of Splenic Injury in Children

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## Abstract

**Background:** The spleen is the most frequently injured organ in abdominal trauma. The aim of this study was to evaluate the pattern and management outcome of splenic injury in children in a tertiary hospital. **Methods:** This was a retrospective study of children treated for splenic trauma at the Pediatric Surgery Unit of Enugu State University Teaching Hospital (ESUTH) Enugu, Nigeria. The medical records of the patients over a 10-year period were evaluated. **Results:** There were 61 cases of splenic trauma of which 72.1% were male. Their ages ranged from 4 to 14 years with a median of 10 years. Road traffic accident and fracture were the most common mechanism of injury and associated injury respectively. The majority had grade III splenic injury and non-operative management was the predominant modality of treatment. Operative procedures included splenectomy

and splenorrhaphy. Mortality occurred in two (3.3%) patients. **Conclusions:** Splenic injury can be associated with significant morbidity and mortality. Road traffic accidents are a common cause of splenic injury and non-operative management is an effective modality of treatment.

**Keywords:** Children, splenic injury, tertiary hospital, outcome.

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## Introduction

Injury is regarded as a global health concern and in pediatric trauma patients the spleen is the most commonly injured solid organ which may follow accidental or non-accidental trauma (1, 2). The mechanisms of splenic trauma include: falling from a height, bicycle injuries, child abuse, sports-related injuries, and motor vehicle and pedestrian injuries (2). Traumatic injury to the spleen can be blunt or penetrating with the former being more common than the latter (3). In comparison to adults, children have an elastic rib cage which causes transmission of force into the abdominal compartment (4). Symptomatology of splenic trauma may include left upper quadrant abdominal pain with associated referred left shoulder pain. Patients who present late may be in a state of shock

with generalized abdominal pain (1). The evaluation of children with splenic injuries includes the use of ultrasound which is non-invasive and does not make use of radiation (5). The advantage of the use of ultrasound is its affordability and availability. The diagnostic yield of ultrasound is enhanced by Doppler and contrast enhanced ultrasound (6). Contrast-enhanced computed tomography (CT) scan is the gold standard for the evaluation of splenic trauma (7). However, because of the risk of radiation exposure, low-dose protocol (3–6 mSv) is preferred in children (1). The grading of splenic injury is usually achieved through a CT scan. Non-operative management of blunt splenic trauma is the mainstay in children and in pediatric trauma centers, splenic preservation approaches 100% (8). Treatment of

penetrating splenic injuries can be challenging: a significant number of penetrating splenic injuries require surgery. However, a certain number of patients may present without hemodynamic instability and non-operative treatment can be offered (9). Management of splenic injury should be multidisciplinary based on the physiology of the patient, anatomy of the injury and associated injuries (10). Initial evaluation of children with splenic injuries must follow the Advanced Trauma Life Support (ATLS) protocol to ensure that no associated injury is missed. There is paucity of data on splenic injury in Enugu, hence, the need for this study. The aim of this study was to evaluate the pattern and management outcome of splenic injury in children at a pediatric surgery unit of a teaching hospital in Enugu, Nigeria.

### **Materials and methods**

This was a retrospective study of children aged 15 years and younger who were managed for splenic injury between January 2008 and December 2018 at the pediatric surgery unit of Enugu State University Teaching Hospital (ESUTH) Enugu, Nigeria. All traumatized pediatric patients, involving an injury to the spleen, were included in the study. Patients with incomplete case records were excluded. ESUTH is a tertiary hospital located in Enugu, South East Nigeria. The hospital serves the whole of Enugu State, which according to 2016 estimates of the National Population Commission and Nigerian National Bureau of Statistics, has a population of about 4 million people and a population density of 616.0/km<sup>2</sup> (11). The hospital also receives referrals from its neighboring states. Information was extracted from the case notes, operation notes, operation register, and admission discharge records. The information extracted included the age, gender, interval between the incident and presentation, indication for surgical intervention, definitive operative procedure performed, complications of treatment, duration of hospital stay and outcome of treatment. The period of follow up was for 12 months. Ethical approval was obtained from the Ethics and Research Committee of ESUTH. The Statistical Package for Social Science (SPSS) for Windows version 23 (IBM Corp., Armonk,

NY, USA) was used for data entry and analysis. Data were expressed as percentages, median, mean, and range.

### **Protocol**

On presentation to the hospital, the patients were clinically evaluated and resuscitated using the Advanced Trauma Life Support (ATLS) protocol. Patients in a stable condition were sent for investigations such as urgent hemoglobin estimation and abdominal ultrasound for assessment of the grade of splenic injury and associated injuries. Patients who presented in shock were resuscitated and stabilized using crystalloids, colloids, and blood transfusion.

The treatment protocol adopted for each patient depended on the hemodynamic status of the patient. Stable patients were put on strict bed rest, serial hemoglobin estimation and ultrasound examination until there was ultrasound evidence of healing of the spleen. The frequency of serial ultrasound scan evaluations was based on the findings on clinical assessment. Patients in shock that failed to respond to blood transfusions underwent emergency splenorrhaphy or a splenectomy. Post operatively, patients who had surgery were placed on parenteral antibiotics and oral intake commenced when bowel function returned. Post splenectomy vaccines were not given to the patients due to its non-availability.

### **Results**

#### ***Patients' demographics***

Sixty-three children had splenic injury during the study period but only 61 cases had complete case records and formed the basis of this report. Thirty-one (50.8%) patients were referred from the peripheral hospital and half of these patients were in shock at presentation. There were 44 (72.1%) males and 17 (27.9%) females. The ages of the patients range from 4 years to 14 years with a median age of 10 years. The median interval between the incident and presentation was 3 days with a range of 1–6 days. Eight (13.1%) patients presented within 24 h, 12 (19.7%) patients presented between 24 and 48 h, and 41 (67.2%) patients presented after 48 h.

The mean duration of hospital stay was 16 days with a range of 10–26 days.

### ***Mechanism of injury***

Twenty-eight (45.9%) patients were involved in a road traffic accident [as a pedestrian, 19 (31.1%) and as a passenger, nine (14.8%)]. Falling from a height accounted for 17 (27.9%) cases, sports-related injuries occurred in six (9.8%) cases, bicycle handle injuries were responsible for five (8.2%) cases, child abuse was found in four (6.6%) cases, and gunshot injury accounted for one (1.6%) case.

### ***Associated injury***

Forty-two (68.9%) patients had no associated injury; six (9.8%) patients had a femoral fracture, five (8.2%) patients each had a liver injury and a hemothorax. Kidney injury occurred in three (4.9%) patients.

### ***Investigations performed and grades of splenic injury***

All the patients had an abdominal ultrasound for the assessment of grade of splenic injury and other possible associated intra-abdominal injuries. A CT scan was performed in 17 (27.9%) patients who could afford it. Grading of splenic injury was performed using the American Association of Surgery for Trauma (AAST) Organ Injury Scale. Thirty-four (55.7%) patients had a grade III, 22 (36.1%) grade II, three (4.9%) grade I and two (3.3%) had a grade IV injury.

### ***Modes of treatment and complications***

Fifty-five (90.2%) patients were managed non-operatively whereas six (9.8%) patients had a laparotomy for splenorrhaphy or splenectomy. The indications for laparotomy included failure of non-operative management in four (6.6%) patients, and associated intra-abdominal injuries in two (3.3%) patients. One (1.6%) patient each had post-operative bleeding, recurrent septicemia, and an intraperitoneal abscess.

### ***Treatment outcome***

Fifty-eight (95.1%) patients recovered and were

discharged home. One (1.6%) patient signed out against medical advice and two (3.3%) patients expired.

### **Discussion**

Child injury is a global health problem because of the worldwide associated morbidity and mortality (12). The spleen is a highly vascular lymphoid organ located in the left hypochondrium and its frequent injury in abdominal trauma can be attributed to a lack of bony protection. Trivial abdominal trauma can cause the rupture of a diseased spleen (13). Following the recognition of an increased incidence of systemic infection by encapsulated organisms in children who had a splenectomy, treatment of splenic injury has shifted from splenectomy to splenic preservation (14).

The male dominance reported in the present study is consistent with the reports of other authors (15-16). The reason for the male dominance may be because males tend to behave more impulsively and are exposed to more risk. The median age of our patients is similar to the reports of other studies but is at variance to the report of others (13, 17, 18). The average ages of children who sustain splenic injury vary from place to place and may depend on the mechanism of the splenic injury. Delayed presentation of the patients is evident in the 3-day lag period before presentation to the hospital. One study conducted in Benin, Nigeria attested to this late presentation of splenic injured children (14). This delayed presentation could be due to the poverty and ignorance that is prevalent in developing countries. The mean duration of hospital stay of our patients is not in agreement with the report of Cocanour et al (19). The duration of time a splenic injured patient stays in the hospital may depend on the modality (operative/non-operative) of treatment and if the splenic injury was an isolated injury. Operative management is associated with increased length of stay (20).

Road traffic accidents were the most common mechanism of splenic injury in the current study. This finding is comparable with other studies (21, 22). Penetrating abdominal injuries from bullets and stab wounds can be the predominant mechanism of splenic injury especially in areas of militancy, kidnapping, and other criminal activities (23). In rural areas where

children climb trees in search of fruit, falling from a height is a significant mechanism of splenic injury. Other authors also reported falling from a height as a common cause of splenic injury (18, 24). Splenic injury results from excessive traction on the splenic attachments that rips the splenic capsule.

Splenic injury may be associated with a fracture of a left rib. Left rib fractures have 3 times increased odds of splenic injury (25). Depending on the severity of the trauma impact, fractures of long bones can also occur in association with splenic injury. One of our patients presented with an extensive hemothorax that required a blood transfusion and a left tube thoracostomy.

A CT scan is the definitive investigation for the grading of splenic injury using the AAST grading system. CT has superior diagnostic ability in the evaluation of abdominal trauma. However, ultrasound has high sensitivity and high negative predictive value especially if performed by an expert trauma radiologist (26). The effectiveness of ultrasound in grading splenic injury lies with the experience and expertise of the sonographer: the CT scan is the gold standard for grading splenic injury. We used ultrasound for evaluation of the grade of splenic injury because of non-affordability of CT scans. The non-use of CT scans may have affected the exact grading of the splenic injury. Only a few patients could afford a CT scan. The majority of our patients had a grade III splenic injury. This finding tallies with the report of Yang et al (16). The grade of splenic injury is an important determinant of operative or non-operative management.

Treatment of splenic injury can be operative or non-operative. By far, the majority of our patients were treated non-operatively. Non-operative treatment of splenic injury has become the standard of care in children and is being extended to adults (27). Recognition of the immunologic functions of the spleen underlies the principle of non-operative management. Indications for operative treatment include failure of non-operative treatment which is evidenced by reducing hemoglobin values on serial estimations, a rising pulse rate and decreasing blood pressure despite maximal resuscitation with a blood transfusion. Associated intra-

abdominal injuries that require surgical exploration make operative treatment of splenic injury necessary.

The decision to do a splenectomy or splenorrhaphy depends on the degree of splenic injury and is taken intra-operatively. Risk of rebleeding is practically minimal when the spleen is fully mobilized and visualized during a splenorrhaphy. Splenectomy remains the last option when the spleen is unsalvageable.

Management outcome in the current series was good as over 90% of the patients recovered fully and were discharged home. Mortality of 3.3% is comparable to the reports of Alamri (28). Mortality following management of splenic injury varies widely and may depend on the predominant grade of injury, cohort of patients, number of blood transfusions, injury severity score and state of the patients at presentation (29).

#### **Limitations of the study**

A CT scan for grading of splenic injury was not performed in all the patients due to costs. This may have affected the exact grading of the splenic injury as a CT scan is the gold standard. The small number of patients: This study is limited by the small number of cases. A larger number of patients would have provided a better analysis.

#### **Conclusion**

Splenic injury can be associated with significant morbidity and mortality. Road traffic accidents are common cause of splenic injury and non-operative management is an effective modality of treatment. More than 90% of the patients recovered and were discharged. We recommend that a CT scan should be provided by the government or through public-private partnership at an affordable cost. This will assist in the care of injured patients.

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