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Contrast blush in pediatric blunt splenic trauma does not warrant the routine use of angiography and embolization

Samiksha Bansal, M.D.[a], Frederick M. Karrer, M.D.[b], Kristine Hansen, D.S.[b], David A. Partrick, M.D.[b,*]

[a]*Department of Pediatric Surgery, Cardinal Glennon Children's Medical Center, St Louis, MO 63104, USA;* [b]*Department of Pediatric Surgery, Children's Hospital Colorado, 13123 East 16th Avenue, Aurora, CO 80045, USA*

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Abstract

BACKGROUND: Splenic artery embolization (SAE) in the presence of contrast blush (CB) has been recommended to reduce the failure rate of nonoperative management. We hypothesized that the presence of CB on computed tomography has minimal impact on patient outcomes.

METHODS: A retrospective review was conducted of all children (<18 years) with blunt splenic trauma over a 10-year period at a level 1 pediatric trauma center. Data are presented as mean ± standard error of mean.

RESULTS: Seven hundred forty children sustained blunt abdominal trauma, of which 549 had an identified solid organ injury. Blunt splenic injury was diagnosed in 270 of the 740 patients. All patients were managed nonoperatively without SAE. CB was seen on computed tomography in 47 patients (17.4%). There were no significant differences in the need for blood transfusion (12.5% vs 11.1%) or length of stay (3.1 vs 3.3 days) or need for splenectomy when compared in children with or without CB.

CONCLUSION: Pediatric trauma patients with blunt splenic injuries can be safely managed without SAE and physiologic response and hemodynamic stability should be the primary determinants of appropriate management.

Trauma is the leading cause of childhood death (age < 18 years) with an annual mortality rate of greater than 20,000.[1] Blunt trauma accounts for 90% of childhood injuries, resulting most commonly in head and limb injury followed by abdominal trauma in up to 8% of the cases. The spleen is the most commonly injured intra-abdominal organ. The management of pediatric blunt splenic trauma has undergone a major paradigm shift in the last 4 decades. Nonoperative management (NOM) of pediatric splenic trauma was first described in 1968 by Upadhyaya and

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* Corresponding author. Tel.: +1-720-777-6571; fax: 1-720-777-7271.
E-mail address: david.partrick@childrenscolorado.org

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Simpson.[2] It is the current standard of care for hemodynamically stable children, because of high success rates without the morbidity and mortality associated with operative management, and avoiding long-term infectious sequelae from splenectomy. Guidelines for such conservative management of blunt splenic, hepatic, and renal trauma are well established.[3,4] Presence of contrast blush (CB) on computed tomography (CT) has been cited as a risk factor for the failure of NOM in the adult literature,[5] and splenic artery embolization (SAE) has been recommended and increasingly used in such cases.[6] Although few studies have addressed the significance of CB in pediatric splenic trauma in the past,[7] an increasing number of institutions continue to adopt a protocol using angiography and embolization in the presence of active extravasation of contrast on initial abdominal CT scan in children. We hypothesized that the presence of CB on abdominal CT has little impact on patient outcomes in the pediatric population. The purpose of our study was to review our management of splenic injuries in children sustaining blunt abdominal trauma and evaluate the frequency and need for SAE in the presence of CB.

Patients and Methods

Institutional Review Board approval was obtained before initiation of the study. Records of all children younger than 18 years of age who were admitted to the trauma service at Children's Hospital Colorado (CHCO), a level I pediatric trauma center, with documented blunt abdominal trauma over a 10-year period (2002 to 2011) were identified using the trauma registry. All patients with splenic injury documented by abdominal CT were included in the study. These patients included those with isolated splenic injury as well as splenic injury associated with multisystem trauma. Data were analyzed separately for isolated splenic injury patients. Patients were divided into 2 groups based on the absence or presence of CB. Only the patients with high-grade (grades 3 to 5) splenic injuries were included for this analysis as CB was only seen with high-grade injuries. Injury grade was determined according to the American Association for the Surgery of Trauma (AAST) solid injury scale.[8] CB was reported when a well-circumscribed area of contrast extravasation, hyperdense with respect to the surrounding parenchyma, was present on CT.[9] Demographics, admission, and management parameters were abstracted from the electronic medical record. Current diagnosis and procedural codes were used for the database search. Study data were collected and managed using REDCap electronic data capture tools hosted at CHCO.

Data collected included preadmission variables such as age, sex, mechanism of trauma, clinical and laboratory parameters at presentation, associated injuries, injury severity score, radiographic findings including the presence of CB on abdominal CT; management variables such as type of intervention, need for laparotomy, length of intensive care unit (ICU) stay, total hospital stay, need for blood transfusion, and complications including readmissions and mortality. Criteria for laparotomy were hemodynamic instability with evidence of massive bleeding on presentation or children who required transfusion of more than half of their blood volume within 24 hours of injury. The medical records of the pediatric trauma patients identified as requiring laparotomy were reviewed to confirm the details of the operation performed. The need for transfusion was decided by the surgical team members based on the fall in hematocrit and hemodynamic status of the patient. Hemodynamic stability was determined based on age-appropriate ranges for heart rate and blood pressure measurements.

At CHCO, injured children are initially evaluated by a team of emergency physicians, general surgery residents, and pediatric surgery fellows directly supervised by pediatric surgery attendings, who provide 24-hour in-hospital coverage. An abdomino-pelvic CT was obtained shortly after arrival for all hemodynamically stable patients with suspected blunt abdominal trauma. CTs were interpreted by board-certified pediatric radiologists. Patients were stratified according to their AAST injury grade based on the imaging findings and further management was decided based on an institutional solid organ injury protocol. Management decisions were overseen by the pediatric surgery attending throughout the hospital stay.

Statistical significance was determined using Fisher's exact test, Student t test, and continuous data were compared using analysis of variance. Data are reported as the mean $\pm$ standard error of mean, and P value less than .05 was considered statistically significant.

Results

During the study period from 2002 to 2011, there were 740 pediatric patients who sustained blunt abdominal trauma, of which 549 (74%) had an identified solid organ injury. Blunt splenic injury was diagnosed in 270 (49%) patients, of whom 143 had isolated splenic trauma and 127 sustained multiorgan injuries. Forty-three percent of our patients were transferred from outside hospitals. Time from injury to presentation to our hospital varied between 3 and 16 hours with an average of 5.6 hours. Mean age of the study patients was 9.5 $\pm$ .3 years; 193 (71%) were boys and the mean injury severity score of all patients was 17.8 $\pm$ .7. The mechanism of injury for the entire patient population is depicted in Fig. 1. Sports-related injury was the most common mechanism of injury (22%), followed closely by motor vehicle collision (21%), falls (15%), and pedestrian-related injuries (11%). Although sports-related mechanisms were responsible for most of the isolated splenic injuries (34%), motor vehicle collisions were the leading cause of splenic injury in multisystem trauma patients (38%). Associated extra-abdominal injuries included 42 patients with traumatic brain injury (41%), 32 with thoracic (31%), and 39 with