

Non-operative Management of Pediatric Blunt Abdominal Solid Organ Injuries: Our experience at Queen Rania Al-Abdullah Hospital for Children

Ahmad Al-Raymoony MD, Waseem Al-Meflh MD*, Ahmad Abu Qurah MD*, Samer Karadsheh MD* & Mohammad Dajaa MD**

ABSTRACT

Objective: The aim of this study was to report our experience with conservative management of pediatric blunt abdominal solid organ injuries regarding indications, complications, outcome, and success and failure rate.

Method: A retrospective study was carried out at Queen Rania Al-Abdullah Hospital for Children between May 2012 and October 2015, it involved 54 cases who sustained blunt abdominal trauma, 39 were males (72.2%) and 15 were females (27.8%), male to female ratio was 2.5:1, age of patients ranged from three months up to 14 years with mean age of 6.4 years.

Results: Non-operative management of pediatric blunt abdominal solid organ injuries was applied for 54 patients, 22 cases with isolated splenic injury, 15 cases with isolated liver injury, six cases with isolated renal injury, two cases with isolated pancreatic injury and nine cases with multiple solid organ injuries. Fifty-one cases (94.4%) were successfully treated with non-operative management, three cases (5.6%) underwent laparotomy after failure of non-operative management. No complications were identified during non-operative management apart from one case of pseudo cyst after pancreatic injury.

Conclusion: Non-operative management of pediatric blunt abdominal solid organ injuries in hemodynamically stable patients is a safe, reliable, simple and effective method with high success rate. It avoids unnecessary laparotomies and post-operative complications.

Key words: Complications, Non-operative management, Solid organ injuries

JRMS December 2018; 25(3):22-28/ DOI: 10.12816/0052729

Introduction

Trauma is the most common cause of morbidity, mortality and disability in pediatrics; it is a serious pediatric health care problem.⁽¹⁻³⁾ Children have unique anatomic and physiologic characteristics that make them more susceptible to injuries than adults; they have small bodies with close proximity of relatively larger internal

From Department of: Pediatric surgery, Queen Rania Al-Abdulla Hospital for Children (QRAHC), King Hussein Medical Center, (KHMC), Amman-Jordan. Correspondence should be addressed to Dr. Dr. Ahmad Ibrahim AL Raymoony MD. E-mail: ahmadraymoony@yahoo.com
Manuscript received July 10, 2018. Accepted October 25, 2018

abdominal organs, less supporting abdominal wall musculature and incomplete calcified skeleton.^(1,4-6)

Blunt trauma is the most common mechanism of abdominal injury and mainly due to road traffic accidents followed by falls.^(2,3,7,8) The spleen is the commonest solid organ injured in pediatric blunt abdominal trauma with an incidence of 45%,^(1,9) followed by liver (35%),⁽¹⁰⁾ kidneys (10%),^(1,11) and to a lesser degree is the pancreas (1.5-3.5%).^(8,12) (See Figures 1-4).

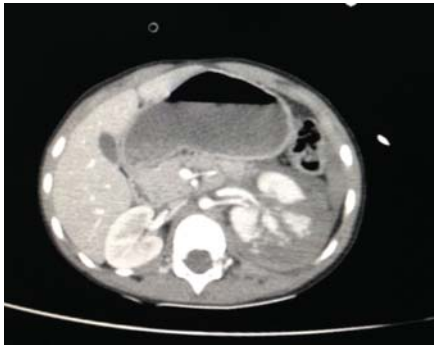


Fig 1: Left renal injury.



Fig 2: Splenic injury.



Fig 3: Liver injury



Fig 4: Pancreatic injury

Clinical examination of an injured child is challenging due to communication difficulties, fear and crying of child, which may lead to missed intra-abdominal injuries, therefore gaining trust and reassuring the child is an important aspect of the examination.^(1,2,13) The presentation of pediatric trauma patient is variable from no signs or symptoms, insignificant abdominal pain, apparent trauma with signs of abdominal trauma (tenderness, distention, bruises and ecchymosis) or hypovolemic shock.⁽⁶⁾ There is no single lab test that is sensitive and specific for the diagnosis of intra-abdominal injury, tests are taken as baseline and the most important test is cross match and blood group for preparing blood products.^(1,6) Abdominal CT scan with IV contrast is the radiological imaging of choice in blunt abdominal trauma, it is highly sensitive and specific for diagnosis and grading of solid organ injury (SOI), it is available, rapid and decreases the incidence of negative abdominal exploration.^(2,3,14,15) The drawbacks of CT scan are its low sensitivity for bowel and mesenteric injury for hemodynamically stable patients, its cost, it requires sedation of the young child and it is associated with increased risk of radiation.^(1,2,16) Focused Assessment Sonography for trauma is not used commonly in pediatric trauma centers because identification of free intraperitoneal blood does not change the management, it has low sensitivity and specificity, images are distracted by gaseous distention and it cannot identify SOI without hemoperitoneum which occur in

about a third of patients.^(1, 17, 18) Nowadays non-operative management of solid organ injuries in hemodynamically stable patients after blunt trauma is the treatment of choice.^(1,9,15) It is composed of strict observation of vital signs, serial abdominal examination and hematocrit measurements, intravenous antibiotics and analgesia, monitoring urine output and complete bed rest with simultaneously resuscitating of patient including blood product transfusion for hematocrit drop.^(7,17) Non-operative management has many advantages including a high success rate of more than 90-95% with low mortality rate,^(9,16,19) It avoids unnecessary operations and post-operative complications mainly overwhelming post splenectomy sepsis, improves salvageability of solid organs,⁽⁶⁾ has shorter hospital stay with lower blood transfusion requirements and it avoids the anatomical, immunological and physiological consequences of organ removal.^(1,4,10,20) Exploratory laparotomy is required in less than 5% of patients who are hemodynamically unstable, have failed non-operative management due to ongoing bleeding unresponsive to resuscitation, or have peritonitis due to associated bowel injury and for patients with pneumoperitoneum.^(2,9,17,19) (see Tables I, II, III, IV)

Table I: AAST classification of splenic injury

Grade	Injury type	Injury description
I	Haematoma	subcapsular, <10% surface area
	Laceration	capsular tear, <1cm parenchymal depth
II	Haematoma	subcapsular 10%-50% surface area, intraparenchymal < 5cm in diameter
	Laceration	capsular tear, 1-3cm parenchymal depth that does not involve a trabecular vessel
III	Haematoma	subcapsular, >50% surface area or expanding ruptured subcapsular or parenchymal hematoma, intraparenchymal hematoma >5cm or expanding
	Laceration	>3cm parenchymal depth or involving trabecular vessels
IV	Laceration	laceration involve segmental or hilar vessels producing major devascularization (>25% of spleen)
V	Laceration	completely shattered spleen
	Vascular	hilar vascular injury which devascularizes spleen

Table II: AAST classification of liver injury

Grade	Injury type	Injury description
I	Haematoma	subcapsular, <10% surface area
	Laceration	capsular tear, <1cm parenchymal depth
II	Haematoma	subcapsular 10%-50% surface area, intraparenchymal < 10cm in diameter
	Laceration	capsular tear, 1-3cm parenchymal depth, < 10 cm in length
III	Haematoma	subcapsular >50% surface area or ruptured subcapsular or parenchymal hematoma, intraparenchymal hematoma >10 cm or expanding
	Laceration	>3cm parenchymal depth
IV	Laceration	parenchymal disruption involving 25% to 75% hepatic lobe or 1-3 Couinaud's segment
V	Laceration	parenchymal disruption involving > 75% of hepatic lobe or >3 Couinaud's segment within a single lobe
	Vascular	juxtahepatic venous injuries i.e. retrohepatic vena cava/central major hepatic veins
VI	Vascular	hepatic avulsion

Table III: AAST classification of pancreatic injury

Grade	Injury type	Injury description
I	Haematoma	minor contusion without duct injury
	Laceration	superficial laceration without duct injury
II	Haematoma	major contusion without duct injury or tissue loss
	Laceration	major laceration without duct injury or tissue loss
III	Laceration	distal transection or parenchymal injury with duct injury
IV	Laceration	proximal transection (RT to superior mesenteric vein) or parenchymal injury involving ampulla
V	Laceration	massive disruption of pancreatic head

Method

A retrospective study was conducted at Queen Rania Al-Abdullah Hospital for Children from May 2012 to October 2015. It involved 54 patients who sustained blunt abdominal trauma, 39 patients were males (72.2%) and 15 were females (27.8%), male to female ratio was 2.5:1. Patient ages ranged from three months up to 14 years with mean age of 6.4 years. Patients who were laparatomized due to associated bowel or bladder injury, penetrating abdominal injury and patients referred from other hospitals after being admitted there for few days were excluded from this study. The non-operative management for hemodynamically stable patient with its complications, blood transfusion reactions and the possibility of laparotomy due to management failure were explained to the parents and a signed consent form was obtained. Pediatric intensive care unit (PICU) admission and length of stay was according to general patient medical condition, isolated versus multiple organ injuries and the grade of injuries. Success of non-operative management is documented by normalization of vital signs and stabilization of hematocrit without need for blood transfusion at admission and during the 72 hours from hospitalization. If non-operative management failed due to ongoing profuse bleeding or undiagnosed concurrent other abdominal organ injury with deterioration of patient condition, patient was sent for exploratory laparotomy. Patients were followed up as outpatients after two weeks from discharge, one month, six months and later once yearly for two to five years with abdominal sonography.

Results

Non-operative management of pediatric blunt abdominal SOI was applied for 54 patients. The incidence of isolated splenic injury was 40.7%, isolated liver injury was 27.8%, isolated renal injury was 11.1%, isolated pancreatic injury was 3.7% and multiple injuries were 16.7%. The mean grade of solid organ injuries was 3.5, the average stay length in PICU was three days while the overall length of hospital stay was 7.9 days. The average hematocrit was 30.4% and the rate of blood transfusion was 62.5% with the amount of 15ml/kg. Fifty-one cases (94.4%) were successfully treated nonoperatively, three cases (5.6%) underwent laparotomy after failure of non-operative treatment. All patients were followed for two to five years at the outpatients' clinic. Mean follow up duration was 3.5 years.

No complications were identified using non-operative management during hospitalization and after discharge apart from one case of pseudocyst after pancreatic injury. Operative management was needed in three cases due to continuous bleeding; two of them with multiple organs injury and the third one with distal pancreatic transection. No relation was found between the grades of injuries and the success rate of non-operative management. (see Table V)

Table V: Percentage of intra-abdominal solid organs injuries

Injured organ	Number of cases	Failed non-operative management	Incidence of injury
Spleen	22	0	40.7%
Liver	15	0	27.8%
Renal	6	0	11.1%
Pancreas	2	1	3.7%
Multiple organs	9	2	16.7%
Total number	54(39 males+15females)	3	

Discussion

In the past exploratory laparotomy (partial or complete splenectomy, nephrectomy and repair of hepatic injury or hepatic resection) was the standard modality for abdominal SOI management after blunt trauma.⁽⁹⁾ After realizing the important role of spleen in immunity with the risk of overwhelming sepsis in splenectomized patients,⁽⁹⁾ and

the fact that abdominal solid organs can heal spontaneously in pediatrics due to the presence of smaller blood vessels with intense vasoconstrictive capability in addition to the thick capsule of liver and spleen that contain blood inside,^(6,21) so a trend toward conservative management of SOI has been practiced which recently became the management of choice.^(1,9,20) CT- scan with IV contrast in hemodynamically stable patients is the gold standard modality for SOI diagnosis and grade classification according to American association for the surgery of trauma (AAST).⁽¹⁸⁾ The prerequisites of non-operative management are hemodynamic stability on admission or after resuscitation, absence of peritonitis due to bowel injury, monitoring stability without persistent blood transfusion.⁽¹⁷⁾ Routine follow up imaging during admission for patients with SOI either CT scan or abdominal ultrasound is no longer requested because it will not change the management even if non-operative management has failed as patient is sent for laparotomy without CT scan.⁽¹⁷⁾ (see Table I)

Redhu, Khalid, Khalid and colleagues⁽⁴⁾ reported in their study in India that the spleen was the commonest solid organ injured after blunt abdominal trauma with incidence of 37% followed by liver (22.5%), in our study we had also the same order of frequency with incidence of isolated splenic injury of 42.6% in addition to 18.5% combined splenic injury with other organs injury whereas the incidence of isolated liver injury was 27.8%. Arslan, Güzel, Turan and colleagues⁽¹⁰⁾ in Turkey reported a success rate of non-operative management of blunt abdominal injuries about 87% and Cerit, Ergelen, Abdullayev and colleagues⁽²²⁾ reported that non operative management failure rate is <10%, while in our study the success rate was 94.4%. The cause for our higher success rate may be explained by the management of pediatric trauma patients by a pediatric surgical specialist in a specialized hospital for children.

Fox, Boysen, Gharahbaghian et al.⁽³⁾ in their study reported that FAST was done by Emergency medicine resident in 62% of total cases, attending emergency physician in 21%, U/S fellow in 8% and by surgeon in 8% of the total cases. FAST is not available at our hospital because it has a low sensitivity and specificity in addition to the fact that finding of free peritoneal fluid will not affect the management in hemodynamically stable patients, at our ER instead of FAST we use abdominal U/S in hemodynamically stable patient which is performed by a senior radiological resident under the supervision of radiologist specialist.

In a study conducted in Kansas city Missouri⁽²⁰⁾ the rate of blood transfusion was 36.7% while it was 62.5% in our study, our high rate of blood transfusion is due to the higher mean grade of SOI which was 3.5 while it was 2.4 in their study, in addition to there were variable protocols in transfusing blood according to hemoglobin level where at our hospital we transfuse blood if hemoglobin level is lower than ten. In another study conducted in Columbus⁽⁶⁾ pediatric injury had no gender variability and peaked at teenage years except for falls while in our study pediatric abdominal trauma peaks around age of five years and it predominates in males with male to female ratio about 2.5:1, this is may be due to different social and cultural issues. Streck and Jewett⁽¹³⁾ reported in their study at the medical university of South Carolina that Road Traffic Accident was the commonest mechanism of blunt abdominal trauma with incidence of 76% followed by falls (16.8%) whereas in our study falls was the commonest mechanism of blunt abdominal trauma with incidence of 55.5% followed by Road Traffic Accidents (33.3%), this difference may be attributed to higher age groups in Streck and Jewett's study and different surrounding environments and culture.

Zabolotny, Hancock, Postuma and colleagues⁽¹⁵⁾ in their study of blunt splenic injuries in a Canadian pediatric population reported that the average length of PICU stay was 1.9 days and the overall hospital stay was 9.2 days while in our study the average length of PICU stay was three days which is higher possibly due to a higher mean grade of injuries in our study which was 3.5 and 2.8 comparatively. Additionally in our study there was a high incidence of associated injuries involving the liver, kidneys, head, and/or lung which was 40.7% while this study was on isolated splenic injuries alone, and despite of that the overall length of hospital stay of 7.9 days is similar in both our and their study. Redhu, Khalid, Khalid, et al.⁽⁴⁾ reported that spleen was the most common solid organ requiring operative intervention after failure of non-operative management which was the same in our study and this is because spleen is the most common injured organ due to blunt abdominal trauma. They report a mortality rate after non-operative treatment failure and post-operative complications about 2.5% while we had no mortalities related to failure of non-operative management or post-operative complications.

Conclusion

Non-operative management of pediatric blunt abdominal SOI in hemodynamically stable patients is the best choice. It is reliable, safe and simple method with a high success rate. It avoids unnecessary laparotomies and post-operative complications and improves salvageability of solid organs. Unrecognized or delayed diagnosis of abdominal SOI after blunt abdominal trauma is a preventable cause of death. Prevention through family education about proper supervision of their children during playing can decrease trauma morbidity and mortality.

References

1. **Schacherer N, Miller J, Petronis K.** Pediatric Blunt Abdominal Trauma In The Emergency Department: Evidence-Based Management Techniques. *EB Medicine*. October 2014; Volume 11, Number 10.
2. **Allen CJ, Tashiro J, Sola JE.** Role of FAST or Abdominal Ultrasound to Limit CT Imaging in Evaluation of the Pediatric Abdominal Trauma Patient. *Curr Surg Rep* (2014) 2:56.
3. **Fox JC, Boysen M, Gharahbaghian L, et al.** Test Characteristics of Focused Assessment of Sonography for Trauma for Clinically Significant Abdominal Free Fluid in Pediatric Blunt Abdominal Trauma. *Academic Emergency Medicine* 2011; 18:477–482.
4. **Redhu N, Khalid S, Khalid M, et al.** Diagnostic efficacies of computed tomography and ultrasonography in pediatric blunt abdominal trauma. *Archives of International Surgery / September-December 2013 / Vol 3 / Issue 3.*
5. **Jacobs MA, Hotaling JM, Mueller BA, et al.** Conservative Management vs Early Surgery for High Grade Pediatric Renal Trauma—Do Nephrectomy Rates Differ?. *JUrol* . 2012 May ; 187(5): 1817–1822.
6. **Boulger C, El-Shammaa E.** Pediatric Abdominal Trauma Making a Difficult Diagnosis. *Emergency Medicine* May 2012.
7. **Prasad NH, Devraj R, Chandriah GR, et al.** Predictors of nephrectomy in high grade blunt renal trauma patients treated primarily with conservative intent. 2014; volume: 30, issue: 2, page: 158-160.
8. **Anand Alladi and Venkatachalapathy.** Pancreatic Injury in Children: Role of Nonoperative Management . *Pancreat Disorders Ther* ISSN: 2165-7092 PDT an *open access journal* , Volume 2 • Issue 4 • 1000108.
9. **Oumar N, Dominique F, Nikola k, et al.** Results of non-operative management of splenic trauma and its complications in children. *Journal of Indian Association of Pediatric Surgeons / Jul-Sep 2014 / Vol 19 / Issue 3.*
10. **Arslan S, Güzel M, Turan C, et al.** Management and treatment of liver injury in children . *Ulus Travma Acil Cerr Derg*, January 2014, Vol. 20, No. 1.
11. **Freedland SJ, Eilber KS, Palapattu GS, et al.** Conservative Management of a Grade 4 Renal Laceration in a Child . *Reviews in Urology*. 2001;3(1):40-41.
12. **Haugaard MV, Penninga L, Gluud C, Wettergren A, et al.** Non-operative versus operative treatment for grade III to V blunt pancreatic trauma in children (Protocol). *The Cochrane Library* 2012, Issue 4.
13. **Streck CJ, Jewett BM.** Evaluation for intra-abdominal injury in children following blunt torso trauma. Can we reduce unnecessary abdominal CT by utilizing a clinical prediction model? *J Trauma Acute Care Surg*. 2012 August; 73(2).
14. **Thorp AW, Young TP, Brown L.** Test Characteristics of Urinalysis to Predict Urologic Injury in Children . *Western Journal of Emergency Medicine* . May 2011; Volume XII, no. 2 .
15. **Zabolotny B, Hancock BJ, Postuma R, et al.** Blunt splenic injuries in a Canadian pediatric population: the need for a management guideline . *J can chir*, October 2002; vol. 45, no 5.
16. **Gaines BA.** Pediatric trauma and the Pediatric Trauma Society: Our time has come. *J Trauma Acute Care Surg*. Nov 2014; Volume 78, Number 6.
17. **Loveland JA.** Conservative management of intra- abdominal injuries . *CME* March 2010 Vol.28 No.3.
18. **Stanislaw P. A. Stawicki.** Trends in nonoperative management of traumatic injuries – A synopsis. *Int J Crit Illn Inj Sci* 2017;7:38-57.
19. **Arnold M, Moore SW.** Paediatric blunt abdominal trauma – are we doing too many computed tomography scans? . *SAJS*. Feb 2013; VOL 51, NO. 1.
20. **Keckler SJ, Tsao K, Sharp SW, et al.** Blood Utilization in Children Managed Non-Operatively for Blunt Solid Organ Injury . *J Surg Res* . 2008 June 15; 147(2): 237–239.

21. **Raashid Hamid.** Is successful non-operative management of isolated pediatric splenictrauma in children possible in an Indian urban hospital.*CurrPediatr Res* 2017; 21 (2): 221-224
22. **Cerit KK, Ergelen R, AbdullayevT,et al.** The effectiveness of non-operative treatment in high-grade liver and spleen injury. *Ulus TravmaAcilCerrahiDerg* 2018.