

Surgical Audit

BLUNT ABDOMINAL TRAUMA IN CHILDREN WITH SOLID ORGANS INJURIES; EXPERIENCE IN 24 CASES

By

Khairi A MD, FRCS, El-Kholi N MD,* Tolba M FRCS

*Pediatric Surgery Unit, Alexandria Faculty of Medicine, Egypt, Dallah Hospital, Riyadh, KSA

Aim: Although operative-management was the standard for blunt abdominal trauma (BAT) in children, recently a non-surgical approach was recommended for pediatric solid-organs-injuries.

Methods: To determine the role of conservative approach in BAT children, we retrospectively analyze the data of children with (BAT) & solid-organs-injuries managed by the authors over 4 years.

Results: From December/2000 through December/2004, 24 children with (BAT) & solid- organs-injuries were managed. Injury mechanisms were road-traffic-accidents (RTA) in 19 (79%), sport-related in 4 (17%) and falling-from-height in 1(4%). The spleen was injured in 13 (54%); the liver in 12 (50%), the kidneys in 3 (13%), and the adrenal-glands in 2 (8%). Thirteen cases were managed conservatively (53%), and 11 operatively (47%). Operations for the spleen (6) included, splenectomy in 3 (50%), partial splenectomy in 2 (33%) and splenorraphy in 1(17%), for the liver (6), suturing tears in 4 (67%) and perihepatic packing in 2 (33%). Four children (17%) died from their injuries; (2) severe chest-injuries, (1) spinal-fracture, and (1) severe liver-injury.

Conclusions: Children with BAT & solid-organs injuries can be treated without surgery if the decision is based-on their hemodynamic-status& response to resuscitation. Management in pediatric-trauma-centers, with the involvement of pediatric surgeons gives the best outcome.

Keywords: Abdominal Injuries, Accidents, Traffic, Multiple Trauma, Spleen, Liver.

INTRODUCTION

Multiple trauma is the leading cause of mortality and morbidity in children.⁽¹⁾ Trauma is the leading cause of death in children in developed countries. In underdeveloped ones, it is beginning to assume importance as infections and malnutrition are controlled.⁽²⁾ Although operative management was the preferred method of treating blunt abdominal trauma (BAT) in the past, recent literature and practice recommend a nonsurgical approach for most pediatric solid organs injuries.^(3,4,5)

PATIENTS AND METHODS

To determine the role of conservative approach in BAT children, the study retrospectively analyzes the data of

children with (BAT) and proven solid organs injuries who had been managed by the authors over a period of 4 year.

RESULTS

From December 2000 through December 2004, 24 children with (BAT) and solid organs injuries were managed; 10 (42%) females and 14 (58%) males. The age ranged from 8 to 18 years (mean =12.9). The mechanism of injury was road traffic accidents (RTA) in 19 cases (79%), sport-related in 4 (17%) and falling from a height in 1(4%). The spleen was injured in 13 children (54%); the upper pole in 5 (38%), the lower pole in 3 (23%), the hilum in 2 (15%) and 3 had fragmented spleens (23%). The liver was injured in 12 children (50%); segment VII in 9 (75%), and segments V and VI in 3 (25%). Left lobe was injured in 3 cases (25%) in association with right lobe involvement. Transaminases

were significantly high in 8 cases with liver injuries, (mean AST= 637, ALT= 641), while in the remaining 4, they were not measured. The kidneys were injured in 3 (12.5%), all on the right side, and the adrenal glands in 2 (8%), both on the right side (with associated right hepatic injuries). Other systems involved were head injuries in 13 cases (54%), chest in 11 (46%), spinal in 4 (17%), extremities in 8 (33%) and pelvis in 2 (8%). Thirteen cases were treated conservatively (54%) (6, 7), and 11 cases operatively (46%). One case in the conservatively treated group had ultrasound-guided aspiration and drain insertion for unresolved pelvic collection. Operative procedures targeted the spleen alone in 5 cases (45.5%), the liver alone in 5 (45.5%), and both organs in 1 (9%). Operations were done within 24-hours of admission in 9 cases (82%), and after 24-hours in 2 (18%). For the spleen (total= 6), operative procedures were splenectomy in 3 (50%), partial splenectomy in 2 (33%), and splenorrhaphy in 1(17%). In one of the cases who underwent splenectomy, left-sided diaphragmatic tear was diagnosed intra-operatively and repaired during the same procedure. For the liver (total=6), operative procedures were suturing tears in 4 (67%) (one of them with splenectomy) and perihepatic packing in 2 (33%). The mean time of hospital stay was 6.5 days. Four children died because of their injuries (17%); 2 due to chest trauma (with tracheobronchial laceration in 1 and severe cardiac contusion in 1), 1 due to spinal fracture, , and 1 due to severe liver injury with massive hemoperitoneum upon admission.

DISCUSSION

In children, the abdominal solid organs are proportionately larger and more prone to direct injury than in adults. Additionally, these organs are not well protected by pads of fat. They are suspended in the abdominal cavity and can sustain shearing injury with acceleration/deceleration forces.⁽⁸⁾ BAT in this population results predominately from RTA.⁽⁹⁾

Computed tomography (CT) scan is the diagnostic modality of choice in stable patients.⁽⁸⁾ It allows for identification of many injuries as well as grading solid organs injuries.⁽¹⁰⁾ In unstable patients, ultrasonography is being utilized as a screening tool. It is fast, non-invasive and inexpensive.^(11,12) Diagnostic peritoneal lavage (DPL) can be performed in children; however, due to the small size of the abdominal cavity, the risk of complications is higher. With the advent of the imaging modalities, DPL use is declining. However, in situations where these imaging modalities are not available, DPL could be very helpful.⁽⁸⁾

The spleen is the most commonly injured solid organ in BAT in children.⁽⁹⁾ Non-operative management and splenic-preservation techniques (splenorrhaphy and partial

splenectomy) have become the standards of care for managing such cases. However, it is estimated that 15% of children with blunt splenic injury still undergo splenectomy⁽¹³⁾ However, it was noticed that children treated by pediatric surgeons are less likely to undergo splenectomy than those treated by general surgeons.⁽¹³⁾

In our study, 54% of children with splenic injuries were treated conservatively, with additional 23% treated with one form of splenic-preservation surgeries.

The incidence of post-splenectomy sepsis has decreased during the last decade. The liberal use of antibiotics and the pneumococcal vaccine has significantly controlled complications. Asplenic individuals are more at-risk for postoperative pneumonia, infection, abscess and coagulopathies rather than post-splenectomy sepsis.⁽⁹⁾ The three splenectomized children in the study had smooth postoperative course both on the short and long-terms follow-up (more than 3years).

Hepatic injuries are common in children due to the size and prominent location of the liver. Although splenic injuries are more common, hepatic injuries have the highest mortality.⁽¹⁴⁾ The only case in our study who died because of solid organ injury was having badly injured liver and massive hemoperitoneum upon admission. The American Association for the surgery of trauma (AAST) developed a grading system for liver injuries. This has been adopted by many for the management of pediatric hepatic injuries. However, the usefulness of this grading system in children remained undefined.⁽¹⁵⁾ We did not rely on any injury grading system in the management of our cases. Patient selection for the non-operative management was based primarily upon the hemodynamic stability of the patient, not on the injury grade.

Liver function tests are altered with hepatic trauma. Although the values obtained may not clarify the extent of injury, initial evaluation of liver transaminases levels was suggested by some authors as a useful means for determining the need for CT scan in stable cases.⁽¹⁶⁾ In our study, we noticed significantly increased levels of transaminases in all cases of liver injury in whom their levels were measured. However, the decision for proceeding with CT scanning was rather based on the clinical situation. We used the decreasing levels of liver enzymes during the follow-up period as one of the signs of improvement of the parenchymal liver injury.

Although the non-operative management has become the treatment of choice for mild to moderate liver injuries,^(6,7) there is no consensus as to the optimal treatment for the most severe hepatic injuries in children.⁽¹⁴⁾ These cases are associated with high mortality. Again, the need for

operative intervention should be guided by the child's physiologic response to resuscitation.⁽¹⁴⁾ In larger series, children with blunt hepatic injuries who were treated without surgery (50% in our study), had a lower mortality rate, require fewer transfusions, and have less risk of postoperative infection.⁽¹¹⁾

Renal lesions are frequently encountered in pediatric (BAT). A shift from operative to conservative treatment is notable. However, in severe cases, operative management is indicated.⁽¹⁷⁾ Controversy exists regarding whether children who present with BAT and hematuria should undergo renal imaging.⁽¹⁸⁾ Gross hematuria, shock or significant deceleration injury are considered as appropriate indicators for imaging. In this respect, CT scan superseded intravenous urography.^(18,19)

Pancreatic injuries are rare and difficult to diagnose. The pancreas is located in the retroperitoneal space, thus abdominal findings may not be present.⁽²⁰⁾ Elevated amylase and lipase levels are common following many types of abdominal injury. Although the extent of elevation is questionable, it is recommended that children with suspected mechanisms of pancreatic injury have amylase levels measured initially and repeated as needed.⁽²¹⁾

Adrenal hemorrhage (AH) was identified in 2 of our patients (8%), both with severe right lobe hepatic lacerations. However, the incidence of AH in larger series was 1%. (22) CT scan is considered as the best diagnostic tool. Associated visceral injury is common. AH should be considered as a strong indicator of associated visceral injuries.⁽²²⁾

The majority of children who died after sustaining abdominal trauma expire from an associated injuries.⁽¹⁰⁾ Three cases out of the four mortalities we had, were due to other systems injuries (chest trauma and spinal fracture).

The majority of children with blunt solid abdominal organs injuries can be treated successfully without surgery if the decision is based on careful initial evaluation, proper resuscitation as well as close observation of their hemodynamic stability.

Managing these cases in pediatric trauma centers with the involvement of pediatric surgeons gives the best outcome. However, in less optimum situations, adult surgeons could have good results as well, if they become aware that children are not just small adults.

REFERENCES

1. Schalmon J, Bismarck S, Schober P: Multiple trauma in pediatric patients. *Pediatr Surg Internat.* 2003;19:417-23.
2. Ameh EA, Chirdan LB, Nmadu PT: Blunt abdominal trauma in children: epidemiology, management, and management

problems in a developing country. *Pediatr Surg Int.* 2000;16:505-9.

3. R8 Jacobs IA, Kelly K, Valenziano C, Jones C: Nonoperative management of blunt splenic and hepatic trauma in the pediatric population: significant differences between adults and pediatric surgeons? *Am Surg.* 2001;67:149-54.
4. Cantor R, Leaming J: Evaluation and management of pediatric major trauma. *Emergency medicine of North America.* 1998;16:229-56.
5. Sanchez J, Paidas C: Childhood trauma: now and in the new millennium. *Surgical clinic of North America.* 1999;79:1503-35.
6. Shoham N, Swed Y: Abdominal trauma in childhood; the conservative approach in 95 cases Harefuah. 1999;136:672-7.
7. Mehall JR, Ennis JS, Saltzman DA, Chandler JC, Grewal H, Wagner CW, Jackson RJ, Smith SD: Prospective results of a standardized algorithm based on hemodynamic status for managing pediatric solid organ injury. *J Am Coll Surg.* 2001;193:347-53.
8. Rothenberg S, et al: Selective management of blunt trauma in children- the triage role of peritoneal lavage. *J Trauma.* 1987;27:1101.
9. Rothrock, S. et al. "Abdominal Trauma in Infants and Children: Prompt Identification and Early Management of Serious and Life-Threatening Injuries. Part I: Injury Patterns and Initial Assessment." *Pediatric Emergency Care.* 2000;16:106-15.
10. Centers for Disease Control and Prevention "Motor-vehicle occupant fatalities and restraint use among children 4 - 8 years- U.S. 1994-1998. *MMWR.* 2000;49:135-7.
11. Knudson M, Maull K. Nonoperative management of solid organ injuries. *Surgical Clinics of North America.* 1999;79:1357-71.
12. Rathaus V, Zissin R, Werner M, Erez I, Shapiro M, Grunebaum M, Konen O: Minimal pelvic fluid in blunt abdominal trauma in children: the significance of this sonographic finding. *J Pediatr Surg.* 2001;36:1387-9.
13. Potoka DA, Schall LC, Ford HR: Risk factors for splenectomy in children with blunt splenic trauma. *J Pediatr Surg.* 2002;37:294-9.
14. Pryor JP, Stafford PW, Nance ML: Severe blunt hepatic trauma in children. *J Pediatr Surg.* 2001;36:974-9.
15. Hackam DJ, Potoka D, Meza M, Pollock A, Gardner M, Abrams P, Upperman J, Schall L, Ford H: Utility of radiographic hepatic injury grade in predicting outcome for children after blunt abdominal trauma. *J Pediatr Surg.* 2002;37:386-9.

16. Puranik SR, Hayes JS, Long J, Mata M: Liver enzymes as predictors of liver damage due to blunt abdominal trauma in children. *South Med J.* 2002;95:203-6.
17. Wessel LM, Jester I, Scholz S, Arnold R, Lorenz C, Wirth H, Waag KL: Diagnostic and therapeutic consequences of kidney injuries in pediatric blunt abdominal trauma. *Urology A.* 2000;39:425-31.
18. Santucci RA, Langenburg SE, Zachareas MJ: Traumatic hematuria in children can be evaluated as in adults. *J Urol.* 2004;171:822-5.
19. Brown SL, Haas C, Dinchman KH, Elder JS, Spirnak JP: Radiologic evaluation of pediatric blunt renal trauma with microscopic hematuria. *World J Surg.* 2001;25:1557-60.
20. Rothrock S. Abdominal trauma in infants and children: Prompt identification and early management of serious and life-threatening injuries. PartII: specific injuries and ED management. *Pediatric emergency care.* 2000;16:189-95.
21. Morteza JA et al: Significance of serum amylase level in evaluating pancreatic trauma, *Am J Surg.* 1975;130:739.
22. Iuchtman M, Breitgand A: Traumatic adrenal hemorrhage in children: an indicator of visceral injury. *Pediatr Surg Int.* 2000;16:586-8.