Blunt Abdominal Injury in Suspected Child Abuse Patients: A Three-Case Report

Ravit Ruangtrakool, M.D.

Department of Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.

ABSTRACT

Objective: To identify characteristics associated with suspected child abuse in the setting of blunt abdominal trauma.
Methods: Retrospective review.
Results: Three cases of blunt abdominal injury caused by suspected abusive force admitted in Siriraj Hospital between May 2001 and July 2006 are reviewed. The first case is a six-year old boy who had liver laceration grade III at segment II and III. The history of trauma was refused by his parents initially. At last, the patient confessed that he was hit by the mother's boy friend. The second case is a-10-month old girl who was operated for traumatic rupture in the 3rd part of the duodenum (90% circumference) as well as hematoma at the root of mesentery and ligament of Trietz following shopping with her family without history of traumatic event. Chest X-ray showed multiple old fractures at left posterior 6th, 7th, 8th ribs as well as a callus formation at the costochondral junction of the right 7th rib. Bone survey also demonstrated laminated periosteal reaction of the right tibia from previous fracture. The third case is a 3-year-old boy with intramural duodenal hematoma located between the 2nd part of the duodenum and the D-J junction. The patient told that he was stepped upon during lying down by his grandmother who has abused him many times before.
Conclusion: Child abuse is suspected in a case of conflict between physical examination findings and history of the accidental events, especially physically damage than the mechanism of injury. The patterns of inflicted injury are also discussed in this publication. Injury to the duodenum is unusual in the pediatric trauma patients but more commonly is the result of child abuse. Diagnosis and treatments of various types of duodenal injury including intramural duodenal hematoma are elucidated in this article.

Keywords: Child abuse, battered child, duodenal injury, intramural duodenal hematoma

Siriraj Med J 2010;62:73-78
E-journal:http:/www.sirirajmedj.com

Young children with inflicted abdominal injuries are more likely to have a tendency of severe injuries, multiple injuries, and a delay in seeking care than young children with accidental abdominal trauma. Diagnosis of abuse in children with internal abdominal injury is frequently delayed because of inaccurate or absent history, nonspecific or delayed physical findings or both. A high index of suspicion is essential to diagnose these inflicted abdominal injuries. Diagnostic delay results in significant morbidity and mortality. The objective of this study is to identify the characteristics associated with suspected child abuse in the setting of blunt abdominal trauma.

CASE REPORT

With an approval of the institutional review board at the Faculty of Medicine, Siriraj Hospital, Mahidol University, we retrospectively studied three cases of blunt abdominal injury caused by suspected abusive force admitted in Siriraj Hospital between May 2001 and July 2006. These three patients were operated by one surgeon of the Division of Pediatric Surgery, Department of Surgery, Faculty of Medicine, Siriraj Hospital, Mahidol University and further consulted with a multidisciplinary team composed of one pediatric psychiatrist, the Center for the Protection of Children's Rights Foundation, forensic medicine and social workers. The information of these three patients is reviewed.

Case 1.

A six-year old boy was admitted because of the history of severe abdominal pain and vomited for 6 hours. The history of trauma was refused by parents initially. The vital signs were BP = 100/50 mmHg, HR = 100/min, RR = 18/min and temperature = 37°C. Physical examinations found no evidence of trauma. Abdominal examinations revealed tenderness at both lower quadrants and guarding at the right lower quadrant. Complete blood counts revealed Hct = 37.3%, WBC = 29,800/

Correspondence to: Ravit Ruangtrakool
E-journal: sisuped@diamond.mahidol.ac.th

mm^3, PMN = 85.2%, L = 6.8%, Mono = 7.3%, Eo = 0.4%, Baso = 0.3% and platelets = 388,000/mm^3.The preoperative diagnosis was acute appendicitis. The Lanz incision was initially performed and the appendix was normal with some amount of frank blood in the peritoneum. Appendectomy was done initially and exploratory laparotomy was subsequently done. The operative finding revealed hemoperitoneum about 300 ml, a liver laceration grade III at segment II and segment III, retroperitoneal hematoma Zone II at both sides and scattered mesenteric hematoma. The liver injury wound was sutured and a drain was applied. The patient eventually recovered. He resumed liquid diet on the 6^{th} day and soft diet on the 7^{th} day postoperatively. The drain was shortened and removed on the 9^{th} day after the operation. Bone X-ray surveying other injuries as well as eye examination was normal. The mother explained that the patient might have fellen down to hit the water closet in the patient's uncle home one day prior to admission and the mother did not know the mechanism of injury. The patient was really frightened to an interviewer when we asked about the mechanism of injury. At first time, he still did not answer who has abused him but at last he confessed that he was hit by the mother's boy friend who denied this violation. The patient told that his stepfather often hung him and punched at his stomach seriously. After the social worker from the Center for the Protection of Children's Rights Foundation visited his home, all members of the team comprising of pediatric surgeon, pediatric psychiatrist, the Center for the Protection of Children's Rights Foundation, the Department of Children's Protection, and the Public Welfare Department, had a discussion with the mother, the mother's boy friend, the grand mother. At last the mother believed that her boy friend might be an abuser. However, the mother attempted to deny the accusation with the stepfather. As a result, the patient was not permitted to return home with his mother and the stepfather under the consideration of a safety matter. To solve this solution, the patient was further raised up by his grandmother with close follow up with the local Public Welfare. Twenty eight days after the operation, an officer of the Center for the Protection of Children's Rights Foundation took the patient along with his grandmother to a place of safety.

Case 2.

A-10-month old girl was admitted in the Department of Pediatrics due to failing consciousness for 2 hours. She was brought to the hospital by an aunt who had taken care of this baby since birth. She has no history of fever, convulsion or underlying disease. The history of using any drugs or toxic substances and history of trauma were absent. Four hours before admission, the patient was really fine. She had just returned to her house after she went shopping with her uncle and an eleven-year old boy who is a son of her aunt at the nearby department store. Initial vital signs were BP = 97/51 mmHg, HR = 180/min, RR = 51/min, temperatre = 38.8°C. Initial physical examination revealed drowsiness without localized neurological deficits. Complete blood count showed Hct = 32.8%, WBC = 14,170/mm^3, PMN = 71.3%, L = 21.7%, Mono = 4%, Eo = 2.8%, Baso = 0.2% and platelets = 277,000/mm^3. The provisional diagnosis was either meningitis or receiving toxic substances. Therefore, a lumbar puncture

Fig 1A. CXR, supine position, revealed multiple callus formation at left posterior 6^{th}, 7^{th}, 8^{th} ribs which represents old fractures (black arrows at left chest) as well as a callus formation at costochondral junction of right 7^{th} rib (black arrow at right chest)

Fig 1B. Right lateral chest X-ray demonstrated a callus formation at costochondral junction of right 7^{th} rib (black arrow)

was done which revealed normal as well as urine toxic substances screening was collected. Four hours after admission, she had bile vomiting as well as abdominal examination revealing general tenderness and guarding at her upper abdomen. Chest and abdominal x-ray revealed free air under the right dome of the diaphragm, therefore perforation of the intra-abdominal hollow visceral organ was diagnosed. Moreover, chest X-ray also showed multiple callus formation at the left posterior 6^{th}, 7^{th}, 8^{th} ribs which represented old fractures as well as a callus formation at the costochondral junction of the right 7^{th} rib (Fig 1A, 1B). Exploratory laparotomy revealed 200 ml of hemoperitoneum and traumatic rupture in the 3^{rd} part of the duodenum (90% circumference) as well as hematoma at the root of the mesentery and ligament of Trietz. Two cm in length of the ruptured part of the duodenum was resected and end-to-end anastomosis of the duodenum was done. Gastrotomy was performed in order to do pyloric exclusion following by gastrojejunosotomy and feeding jejunostomy (Fig 2). Two penrose drains were inserted at the subhepatic space and lessor sac. The patient was extubated from the respirator on the following day. Total parenteral nutrition was started on the 2^{nd} day postoperatively. Jejunostomy was fed on the 5^{th} day and the penrose drains were shortened on the 8^{th} day post operation. She resumed oral diet since the 9^{th} post-

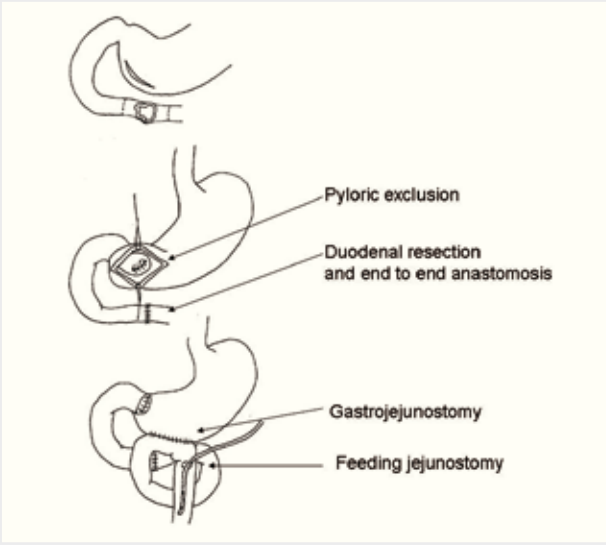

Fig 2. pyloric exclusion, gastrojejunosotomy and feeding jejunostomy

operative day and had an uneventful recovery. She was ready to be discharged on the 16th day. Bone survey did not only revealed old fractures of the ribs mentioned before but also demonstrated laminated periosteal reaction of the right tibia which represents the healing process from a previous fracture (Fig 3). Pediatric psychiatrist and the officer of the Center of the Children's Rights Protection were consulted. The aunt and mom

Fig 3. laminated periosteal reaction of right tibia which represents healing process from previous fracture

seemed to have a good cooperation to the doctor. They did not mention or express their feelings about the cause of child abuse, although there was evidence from an X-ray that the patient was seriously abused. The X-ray reported that the patient had many fractures which had been caused in different points of time. His aunt, her husband and her 11 years-old son did not try to provide any information about the accidents that might be a cause of the fractures. The social worker and an officer of the Center for the Protection of Children's Rights Foundation visited the patient's house. However, there were no unusual trails. The child development and the raising profile of the patient were found normal. Finally the patient was discharged after the 17 days of operation. The patient was well until 2 months later. She developed closed loop ileal obstruction from an adhesion band. The necroses ileal loop was resected and end-to-end anastomosis was performed. The patients had recovered well and were discharged on the 12th day post operation. In this admission, there was no associated evidence of further physically abuses.

Case 3

A 3-year-old boy was referred from a private hospital because of the history (told by his parents) of severe abdominal pain and vomiting for 1 week after falling from only a 10-cm-high step of stairs. The vital signs at the 7th day following the injury were BP = 104/60 mmHg, HR = 120/ min and temperature = 38°C. Initial physical examination revealed ill defined mass size 4 cm at the epigastium. There was minimal contusion at the left upper quadrant of his abdominal wall. Complete blood counts at the admission revealed Hct = 31.8%, WBC = 12,780/mm^3, PMN = 69.7%, L = 16.3%, Mono = 12.8%, E = 1%, Baso = 0.2% and platelets = 320,000 mm^3. Serum amylase at the 7th day post injury was 403 U/L (0-220) and urine amylase was 1333 U/L (0-1000). The nasogastric tube was aspirated with a content of 500-1,250 mL/day. Upper GI study on the 12th day following the injury revealed a large sausage shape intramural mass along the 3rd and 4th part of the duodenum to the D-J junction, causing moderately severe obstruction. Combined with the history of trauma, intramural duodenal hematoma was diagnosed (Fig 4). Following conservative treatment of the intramural duodenal hematoma for 16 days, there was no clinical improvement of the duodenum obstruction, therefore the operation to evacuate the intramural clot was performed. The operative finding revealed large intramural duodenal hematoma at the 2nd part extending to the 4th part of the duodenum as well as multiple hemorrhagic spots at the mesentery of the jejunum. The seromuscular walls of the 2nd and 4th part of the duodenum were incised and the intramural clot was evacuated without opening the mucosa of the duodenum. Following clot removal, the incised seromuscular walls were sutured. He resumed liquid diet on the 5th day and soft diet on the 6th day postoperatively. Bone survey X-ray examination was normal. Although intramural duodenal hematoma might be followed by the trivial event, the mechanism of injury in this case was questioned. All caregivers explained the mechanism of the injury in the different ways. Some said that he was stuck at his abdomen by a chair, whereas the others said that he fell onto a cement block. The patient told that he was abused by stepping upon 5 times during laying down in supine position by

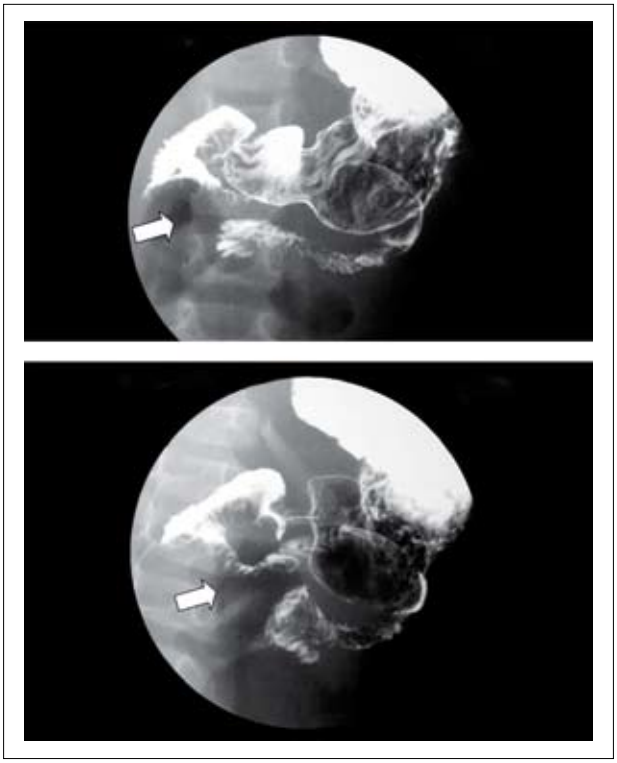

Fig 4. Intramural duodenal hematoma.
Upper GI study demonstrated luminal narrowing starting from the 2nd part of duodenum to duodenojejunal junction. The narrowing was caused by smooth large pressure effect with minimal tethering of the mucosa (white arrow)

his grandmother who has abused him many times before and his parents also knew this event. Pediatric psychiatrist, forensic medicine, and an officer of the Center for the Protection of Children's Rights Foundation were consulted. After visiting his home and examining the place of injury, we did not believe that the injury was caused by the accident. Following discussion with all multidisciplinary team, all agreed that he could return to his parent's home which was separated from the grandmother's home. Physically, he could be discharged from the hospital on the 8th day postoperatively, however pediatric psychiatric valuation was continued until the 32nd day and he could return home safely.

DISCUSSION

Diagnosis of child abuse is difficult. Child abuse is suspected in a case of a conflict between physical

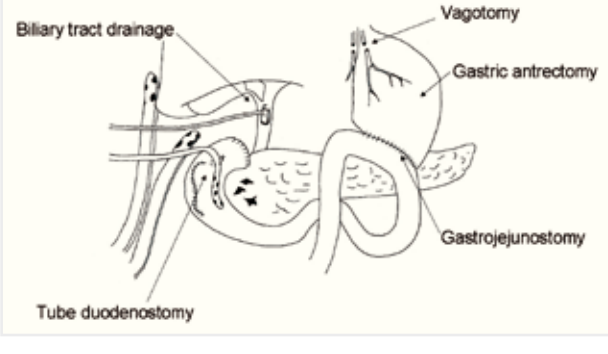

Fig 5. Duodenal Diverticulization

examination findings and history of the accidental events, especially physically damage than the mechanism of injury. In order to conceal the cause of injury, a care giver tends to give the history that the injury occured itself without any witnesses to the accident. Too frequent injury in various organs occurring in one child should give suspicion of a child abuse.

Young children with inflicted abdominal injuries were more likely to delay in seeking care than those with accidental abdominal trauma.[1] Fortunately, an intended delay medical seeking following the injury was not found in our series.

From the study of Trokel M[2], 927 cases of blunt abdominal injury to children ages 0 to 4 years were extracted from the National Pediatric Trauma Registry of the USA. The three most common mechanisms of abdominal injury were motor vehicles (61.27%), child abuse (15.75%), and falls (13.59%). Excluding motor vehicle injuries, the three most common mechanisms of injury were suspected child abuse (40.5%), fall (36.6%), and striking something (9.7%).[3] Hepatic injury (46.1%) was the most common intra-abdominal injury, followed by splenic (26%), hollow viscous (17.9%), and pancreatic (8.6%) injuries.[3]

The younger the patient is the higher the incidence of child abuse occurs.[4] Physical abuse is a significant problem in babies who are younger than 1 year old age. Very young babies (under 6 months old) have the highest risk of suffering damage or death as a result of physical abuse. Severe abuse, in particular subdural hematoma and fracture, is much more common in babies than in older children.[4]

Abused children are significantly more likely to have suffered from a hollow visceral organ injury comparing to either high-velocity accidental or low-velocity accidental abdominal trauma.[1,3,5,6] Moreover, abused children are also significantly more likely to have combined hollow viscus and solid organ injuries as well as suffered injuries with more severe trauma scores than the accidental group.[1] Therefore, young children with severe pancreatic or hollow viscous injuries or severe abdominal injuries in the context of either brain injury or undernourishment should be evaluated for the possibility that these injuries resulted from abuse.[3]

Diagnosis of hollow visceral organ perforation due to inflicted blunt abdominal injury is frequently delayed because of inaccurate or absent history, nonspecific or delayed physical findings or both, and routine laboratory tests with low sensitivity.[5] In these three cases of our series, vital signs as well as complete blood counts could not differentiate abusive abdominal injury from the other causes of peritonitis. Therefore, a high index of suspicion is essential to diagnose these inflicted abdominal injuries as significant morbidity and mortality results from diagnostic delay. In our series, the first case had normal vital signs with a leukocytosis blood picture without anemia, which was not different from an acute appendicitis. In the second case, pediatrician had a provisional diagnosis of either meningitis or receiving toxic substances until the chest X-ray demonstrating pneumoperitoneum which was not expected before.

Perforating duodenal injuries are seldom seen (0.3%) following blunt abdominal trauma in the pediatric patients.[7] In the young child, one must maintain a high index of suspicion regarding the etiology of the

injury, because a large percentage is potentially the result of child abuse.[7,8] A high energy force directed to the center of the upper abdomen may result in disruption of the duodenum. Early diagnosis is difficult due to minimal peritoneal irritation resulted retroperitoneal rupture. Some children indeed are diagnosed too late and in septic shock because of minimal symptoms.[9] Plain abdominal X-ray may reveal air loculation around right kidney and right psoas muscle. Upper GI study could reveal this injury but CT abdomen with oral contrast is a better mordality. Treatments of duodenal injury comprise of simple closure, end-to-end duodeoduodenostomy, closure of both ends of the duodenum and gastrojejunostomy, pyloric exclusion and gastrojejunostomy. How to choose each technique depends on the extension of injury, contamination and devascularization of the duodenum and pancreas. Combination between duodenal resection with end-to-end duodeoduodenostomy and pyloric exclusion with gastrojejunostomy and feeding jejunostomy (Fig 2) was applied with the second case of our series with an eventful recovery. Pancreaticoduodenectomy is reserved for a severe or devascularized combined duodenum and pancreatic injury. Duodenal diverticulization which comprises of gastric antrectomy, gastrojejunostomy, vagotomy, tube duodenostomy, biliary tract drainage is an option to manage some severe duodenal injuries (Fig 5). Although many methods of repair are mentioned, primary repair is still often used in children. Clendenon JN[10] reported that in his series of twenty-four patients who underwent operative management, primary repair, duodenal resection and gastrojejunostomy and pyloric exclusion were operated in 18, 4 and 2 cases respectively.

Intramural duodenal hematoma results from rupture of the intramural duodenal blood vessel. It generates partial or complete duodenal obstruction which develops slowly and progressively with a consequent delay in diagnosis. Associated traumatic pancreatitis is common.[11] Bicycle handlebar, road accidents and sports trauma are the main etiologic factors in children, but child abuse should be kept in mind. Although intramural duodenal hematoma can occur following by any trivial accidental force directly to an epigastial area, the mechanism of injury in the third case of our series (which was told by his parents that he fell down from a 10-cm height stair) is questioned. Huntimer CM[12] explored whether there was any evidence in the medical literature that a fall on stairs could be a plausible explanation for a small intestine perforation. He found that although falling from stairs have been reported to be the one of the most common causes of injury in childhood, no evidence was found to support the contention that a fall from stairs could be consistent with perforation of the small intestine. Intramural duodenal hematoma may appear as a sausage-shaped mass at the right upper quadrant of the abdomen. Upper GI study demonstrates "coiled-spring" appearance located at the second and third parts of the duodenum. In an acute phenomenon, a well-localized intramural hematoma will be shown as coiled-spring appearance. In the resolving phase, localized mural masses in the lateral aspect of the descending duodenum and fold thickening are signs of prior intramural hemorrhage. When these radiologic features are encountered in a child with nonspecific abdominal complaints, child abuse should be suspected.[13] Most intramural duodenal hematoma usually resolves within 2-3 weeks, therefore non surgical treatments by stomach decompression with a nasogastric tube and prolonged total parenteral nutrition are offered. If upper gut obstruction does not resolve itself in 2-3 weeks, the operation to incise the seromuscular wall of the duodenum and evacuate the blood clot is justified. In the series of Clendenon JN,[10] duodenal hematomas could be treated nonoperatively in 94% of cases. In the third case of our series, we waited for 16 days until the operation to evacuate the clot was performed.

In the second case of our series, chest X-ray also shows multiple callus formation at left posterior 6th, 7th, 8th ribs representing old fractures as well as a callus formation at costochondral junction of right 7th rib (Fig 1A and 1B). Rib fractures are a common skeletal manifestation of non-accidental injury in infants and young children and are generally considered to be highly specific for abuse. There are, however, relatively few descriptions of fractures involving the costochondral junctions in non-accidental injury. This fracture has appearances analogous to "bucket handle" metaphyseal fracture of long bone.[14] It is difficult to visualize and heals with minimal callus formation. The importance of recognition such a fracture is highlighted in this case.

Increasing the awareness of the possibility of child abuse associated with a set of injury characteristics may allow for more complete medical evaluation. There is evidence of failure of secondary prevention of child abuse by health professionals, with a greater need to act on concerns regarding abuse and neglect.[4] When a child abuse is suspected, a multimodality team including pediatric surgeon, pediatric psychiatrist, social work and forensic medicine are included. Too vigorous questioning how the patient was injured will render the parent bringing the patients back home by signing "against advice" type of discharge before complete family evaluation is done. These inflicted injuries usually occur in broken families.[15] Interagency child protection working in partnership with parents should focus more on protecting children from further abuse than on maintenance of the infant within an abusive home. Lack of concern about child welfare in the community is the greatest obstacle to protecting children at risk of abuse. The most effective means of preventing child abuse is to educate the community about how to recognize the signs of abuse and to inform the authorities.

REFERENCES

1. Wood J, Rubin DM, Nance ML, Christian CW. Distinguishing inflicted versus accidental abdominal injuries in young children. J Trauma. 2005 Nov;59(5):1203-8.
2. Trokel M, DiScala C, Terrin NC, Sege RD. Blunt abdominal injury in the young pediatric patient: child abuse and patient outcomes. Child Maltreat. 2004 Feb;9(1):111-7.
3. Trokel M, Discala C, Terrin NC, Sege RD. Patient and injury characteristics in abusive abdominal injuries. Pediatr Emerg Care. 2006 Oct; 22(10):700-4.
4. Sibert JR, Payne EH, Kemp AM, et al. The incidence of severe physical child abuse in Wales. Child Abuse Negl. 2002 Mar;26(3):267-76.
5. Beckmann KR, Nozicka CA. Small bowel perforation: an unusual presentation for child abuse. J Am Osteopath Assoc. 2000 Aug;100(8): 496-7.
6. Barnes PM, Norton CM, Dunstan FD, et al. Abdominal injury due to child abuse. Lancet. 2005 Jul 16-22;366(9481):2345. Comment in: Lancet. 2005 Jul 16-22;366(9481):187-8.
7. Gaines BA, Shultz BS, Morrison K, Ford HR. Duodenal injuries in children: beware of child abuse. J Pediatr Surg. 2004 Apr;39(4):600-2.

8. Tracy T Jr, O'Connor TP, Weber TR. Battered children with duodenal avulsion and transection. Am Surg. 1993 Jun;59(6):342-5.
9. Nijs S, Vanclooster P, de Gheldere C, Garmijn K. Duodenal transection in a battered child: a case report. Acta Chir Belg. 1997 Aug;97 (4):192-3.
10. Clendenon JN, Meyers RL, Nance ML, Scaife ER. Management of duodenal injuries in children. J Pediatr Surg. 2004 Jun;39(6):964-8.
11. Iuchtman M, Steiner T, Faierman T, Breitgand A, Bartal G. Post-traumatic intramural duodenal hematoma in children. Isr Med Assoc J. 2006 Feb;8(2):95-7.
12. Huntimer CM, Muret-Wagstaff S, Leland NL. Can falls on stairs result in small intestine perforations? Pediatrics. 2000 Aug;106(2 Pt 1):301-5.
13. Kleinman PK, Brill PW, Winchester P. Resolving duodenal-jejunal hematoma in abused children. Radiology. 1986 Sep;160(3):747-50.
14. Ng CS, Hall CM. Costochondral junction fractures and intra-abdominal trauma in non-accidental injury (child abuse). Pediatr Radiol. 1998 Sep; 28(9):671-6.
15. Cooper A, Floyd T, Barlow B, et al Major blunt abdominal trauma due to child abuse. J Trauma. 1988 Oct;28(10):1483-7.