

Diagnostic and therapeutic challenges of isolated small bowel perforations after blunt abdominal injury in low income settings: Analysis of twenty three new cases

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ABSTRACT

Background: Isolated small bowel injury (ISBI) related to abdominal blunt trauma is rare. Timely diagnosis could be difficult, especially in the absence of modern imaging and laparoscopic facilities. The determinants of mortality under such circumstances are unclear.

Methods: This study presents twenty three cases of ISBI related to blunt abdominal injury identified between January 2005 and December 2009 in a level III Hospital in Limbe, Cameroon. Data were retrieved from an ongoing prospective study on injuries and augmented by analysis of individual patient's files. We analysed information regarding modalities of diagnosis, delay between injury and diagnosis, operative findings, treatment and outcome.

Results: The ages of our patients ranged from 7 to 38 years with a mean of 19 years. Thirteen patients were children below the age of 16. The most frequent mechanism of injury was a fall ($n = 11$). Associated lesions were identified in 7 patients. Delay between injury and diagnosis was above 12 h in 16 patients. Fifteen cases were admitted with obvious signs of peritonitis. Erect chest X-ray identified a pneumoperitoneum in 11 of the 17 patients for whom it was requested. Most perforations were located in the ileum. A total of 7 complications occurred in 5 patients. These included 4 cases of post-operative peritonitis. Two patients with at least one associated lesion died.

Conclusion: ISBI is seldom suspected. This causes delay in diagnosis and most cases present with a diffuse peritonitis. Early diagnosis and management in low income environment is likely to be improved by a greater awareness of clinicians about this injury, serial clinical assessment and repeated erect chest X-ray, rather than sophisticated tools such as CT scan or laparoscopy.

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Introduction

Small bowel lesions rarely occur following blunt abdominal injuries.^{1,2} When they occur, they are usually discovered during exploration for a solid organ injury.³ The recent introduction of non-operative methods for solid organ injury seems to have suppressed an opportunity to diagnose small bowel injury, thus increasing the rate of delayed diagnosis.^{4,5} Isolated small bowel injury (ISBI) defined as perforation of the small bowel in the absence of other associated intra-abdominal injuries, is even rarer

and often misdiagnosed.^{2,6} A significant number of cases occur in children.^{7,8}

Delay in diagnosis of ISBI has been significantly correlated to outcome.⁹ Timely diagnosis is difficult, especially in the absence of advanced imaging techniques and laparoscopic facilities.^{10,11} Most available studies report a limited number of cases over long periods of time.^{4,12} Consequently, surgeon's exposure and awareness of this potentially deadly condition is usually insufficient.^{8,13}

Different diagnostic approaches and algorithms have been proposed, most of them based on systematic computed tomography assessment, diagnostic peritoneal lavage and laparoscopic exploration.^{13,14} No strategy has been proposed to surgeons working under strenuous conditions with limited technical background.

In this study, we report twenty three cases of ISBI occurring within a short period of time (five years) in a context characterised by the absence of both laparoscopic facilities and advanced

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imaging techniques. These cases are analysed with regard to patient's epidemiological profile, diagnostic approach, therapeutic procedures and outcome. The underlying goal is to suggest an approach adapted to surgeons working under similar conditions.

Patients and methods

This prospective descriptive analysis was conducted in Regional Hospital, Limbe. This is a level III institution located in the south west region of Cameroon. Limbé is a rapidly growing city with a population approaching 100,000 people. Limbé Regional Hospital is a 200-bed hospital in a semi-urban setting with an Emergency Department that is functional 24 h per day. Patients who need sophisticated imaging investigations are referred to the major city of Douala, located 70 km from Limbé, with two large referral hospitals possessing more specialised services.

The data analysed in the study are retrieved from the database of an ongoing prospective study of blunt abdominal injuries started on January 1st 2005. These data were augmented by additional information gathered from the post-operative reports and patient's admission files. For a period of 5 years, from January 1st 2005 to December 31st 2009, all patients, irrespective of age and sex, diagnosed for an ISBI during the process of management for a blunt abdominal injury were identified and included in the study. Patients with a penetrating injury and those discovered to have an associated solid organ injury were excluded.

For each patient included, data regarding age, sex, mechanism of injury, extra-abdominal associated injuries, delay before diagnosis, clinical presentation, results of morphological studies performed, operative findings and outcome were recorded on a pre-established data collection sheet and analysed. Comparisons were performed using the Fisher's exact test. *P* value of less than 0.05 was considered significant. An ethical clearance was obtained from our local ethics committee and all procedures were in conformity with the Helsinki declaration. The "Strengthening the Reporting of Observational Studies in Epidemiology" (STROBE) guidelines were used in reporting the study.¹⁵

Results

Twenty four patients who met the inclusion criteria were identified from the database. One patient was excluded because the laparotomy discovered a duodenal peptic ulcer perforation. Twenty three cases could be analysed.

Their ages ranged from 7 to 38 years with a mean of 19.0 (SD 7.3) years. As shown in Fig. 1, the majority of patients were paediatric cases: 13 patients were less than 15 years old. A vast majority of patients were males with a sex-ratio of 10.5/1.

Half of the patients were victims of a fall. These were all children below the age of 15 years who had their accident either at the school playground (*n* = 7) or at home (*n* = 4). Of the 9 cases of road traffic injuries, 5 were motorcycle riders victims of handlebar injury. Patients above age 15 were at higher risk of sustaining their ISBI from a road traffic accident, while below 15 carried a higher risk of developing ISBI from a fall (Table 1) (*P* < 0.001).

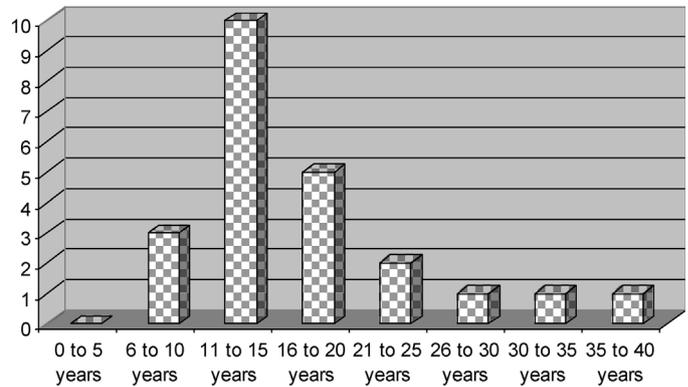


Fig. 1. Distribution of ISBI according to age groups in Limbe Regional Hospital.

Nine associated injuries were identified in seven patients. These included 3 cases of facial injury, 2 cases of head injury, 2 cases of lower limb injury with fractures and 2 cases of soft tissue injury. The two patients with head injury were admitted with a Glasgow Coma Scale of 11 and 12 respectively. Abdominal injury was not suspected. They had their abdominal involvement attended to only after 6–12 h after they gradually regained consciousness.

The Injury Severity Score (ISS) ranged from 9 to 24.

Delay between arrival and either diagnosis or decision to perform an explorative laparotomy ranged from 5 to 38 h. Fig. 2 indicates that the average delay was above 24 h in nearly half of the cases.

All patients presented with persistent abdominal pain after blunt abdominal injury. As shown in Table 2, the initial clinical presentation was that of an obvious peritonitis in more than half of cases. Two patients were identified with signs of shock leading to the suspicion of a solid organ injury.

An erect chest X-ray and a plain abdominal X-ray were performed in 17 patients. It was decisive in 11 patients who displayed a pneumoperitoneum. Eight of these patients already had obvious signs of peritonitis. Two patients displayed air fluid levels and the X-ray were normal in 4 patients. An ultrasound was performed in 7 patients. It identified some free peritoneal fluid in 5 cases (71%) and was normal in one case. This patient also had a normal erect chest X-ray and finally underwent explorative laparotomy after 38 h for persisting symptoms. The last case (with ultrasound) was diagnosed of splenic rupture by the radiologist and underwent a laparotomy within 5 h. Operative finding was a jejunal transection extending to the mesentery. This patient was a victim of motorcycle handlebar injury. Seven patients (30%) had a white cell count done and it displayed leucocytosis and shifting to the right of the formula in five cases.

Pre-operative diagnosis was achieved or suspected in 18 cases. These included all cases presenting with obvious features of peritonitis (*n* = 12), and 6 cases for which the combination of clinical and radiological findings was diagnostic. For the remaining cases, laparotomy was performed for a suspicion of an injury to a solid organ in 3 patients (one based on ultrasound results) and was explorative for the remaining 2 cases.

Table 1
distribution of ISBI according to mechanism of injury and age group.

Mechanism of injury	Age ≤ 15 years	Age > 15 years	Total	Percentage
Fall from height	11	0	11	48%
Interpersonal violence with blow to the abdomen	0	1	1	4%
Road traffic injuries	2	7	9	40%
Domestic violence	0	1	1	4%
Others (non specified)	0	1	1	4%

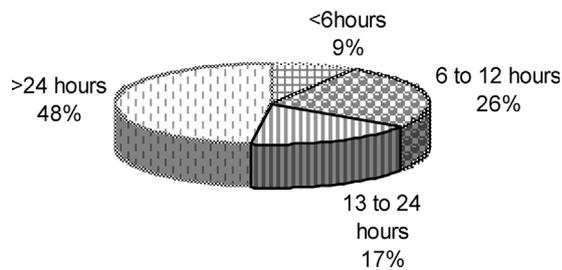


Fig. 2. Delay between injury and the beginning of the management process for ISBI in Limbe Regional Hospital.

During laparotomy, the lesion was found to be located in the jejunum or ileum in all cases. No gastric, duodenal or colic lesions were discovered. The lesion was a single simple perforation in 20 cases, multiple perforations as shown in Fig. 3 in two cases. The last patient had a trans-section of the jejunum extending to the mesentery. A simple suture of the bowel was performed in 17 cases and bowel resection with end-to-end anastomosis in 6 cases.

A total of seven complications occurred in five patients. These included 4 cases of post-operative peritonitis, 2 cases of wound dehiscence and one enteric fistula. All were successfully re-operated except from the case of enteric fistula which was successfully managed conservatively. Two patients died. They both had at least one associated injury and an ISS score of 24. They were both adult who sustained their ISBI as a result of motorcycle handlebar injury and were both admitted in the ward with a diagnosis of blunt abdominal injury. One case had peritonitis suspected from persistent pain and pneumoperitoneum on erect chest X-ray. He was diagnosed after 12 h. The second case developed obvious signs of peritonitis 24 h after admission. The final cause of death was not recorded in both cases.

All patients who developed a complication and the two patients who died were diagnosed after 24 h.

Discussion

ISBI is a rare entity. It seems to occur in less than 1% of all blunt abdominal injuries.^{1,2} In a multi-institutional trial, Watts et al. described only 0.3% of perforating small bowel injury.¹⁶ A significant number of cases seem to occur in paediatric populations and numerous studies have been devoted exclusively to paediatric cases.^{7,8,10}

Three factors give our study a unique character.

First, the number of cases (23) recorded over a period of five years in a small non specialised centre. The studies published so far usually report a limited number of cases over decades.^{4,5,12,17–19} Fakhry et al. identified only 98 cases over 9 years in 8 major trauma centres.¹⁷ Neugebauer et al. described only 70 cases over 25 years!¹²

Secondly, two types of mechanism seem to be abnormally frequent in our study: falls in school playground and motorcycle handlebar injuries. Though these mechanisms have been described



Fig. 3. An intra-operative view of the ileum showing multiple perforations.

in previous studies,^{10,11,20–23} the most frequent mechanism is usually road traffic injuries, especially lesions related to seat belt injury.^{5,7,9,20} Moss et al. describe a similar rate of injuries in children during recreational activities.²³ Few studies have attempted to correlate the mechanism of injury to the age group as we do. Hamill et al. with a similar sample size suggest fewer cases of road traffic injuries and a longer delay before presentation in children.⁷

Thirdly, the lesions described in our study are limited to the small bowel, exclusive of the duodenum. This pattern has been described previously,^{9,10,24} but the duodenum has frequently been pointed.^{9,10,24,25} It is worth noticing that during our search we found no injury to the stomach or colon. These locations have frequently been mentioned as well.^{9,10,25,26}

The age and sex distribution of patients frequently indicate that children and young adults are vulnerable groups.^{7,10,18,21,22,24} Associated injuries are frequently present, especially when the mechanism is related to a road traffic crash.^{10,18,21,24}

Long delay between the accident and the management of ISBI has been associated with increased morbidity and mortality,^{4,8,17} although this finding is becoming controversial.^{5,27,28} Fang et al. described a heavy impact on morbidity, but no impact on mortality.²⁹

Timely diagnosis of ISBI is still made difficult by the lack of a consensus on a diagnostic algorithm using the available imaging and laparoscopic facilities.^{4,13,20,30–32} All the current diagnostic approaches seem to lack sensitivity in identifying ISBI.⁴

Initial presentation with clinical evidence of peritonitis is a frequent finding^{5,9,10,18,21,33} and the decision to operate is often taken on the basis of clinical assessment alone.^{9,39} Repeated abdominal examination has proved to be useful as abdominal signs become more obvious within hours.^{8,23} Moss et al. credit physical examination with 100% sensitivity when performed on the conscious patient, though their sample included penetrating trauma.²³ Some authors however report that abdominal signs are often too subtle and could delay laparotomy if used as the sole decisive factor.^{34,35}

Computed tomography is described as accurate in determining the location of injury and its accuracy seem to increase over time.^{31,36} It has contributed significantly in reducing the rate of unnecessary laparotomies.³⁶ Harris et al. believe that the presence of free fluid on CT scan should be an indication for an aggressive approach.³⁵ However, numerous studies now question the value of computed tomography as a reliable tool for early diagnosing of ISBI as its sensitivity seems to be often too low,^{20,23,29,33} especially in children.³⁷ Erect chest X-ray is a useful diagnostic tool mostly in late cases.^{18,30} Saku et al. found it useful at the initial phase in only

Table 2
Mode of presentation of patients with ISBI in Limbe Regional Hospital.

Type of presentation	Number	Percentage
Obvious signs of generalised peritonitis	12	52%
Acute pain with no signs of peritoneal irritation	4	18%
Discharged home and rushed back with an acute pain	5	21%
Signs of solid organ injury	2	9%

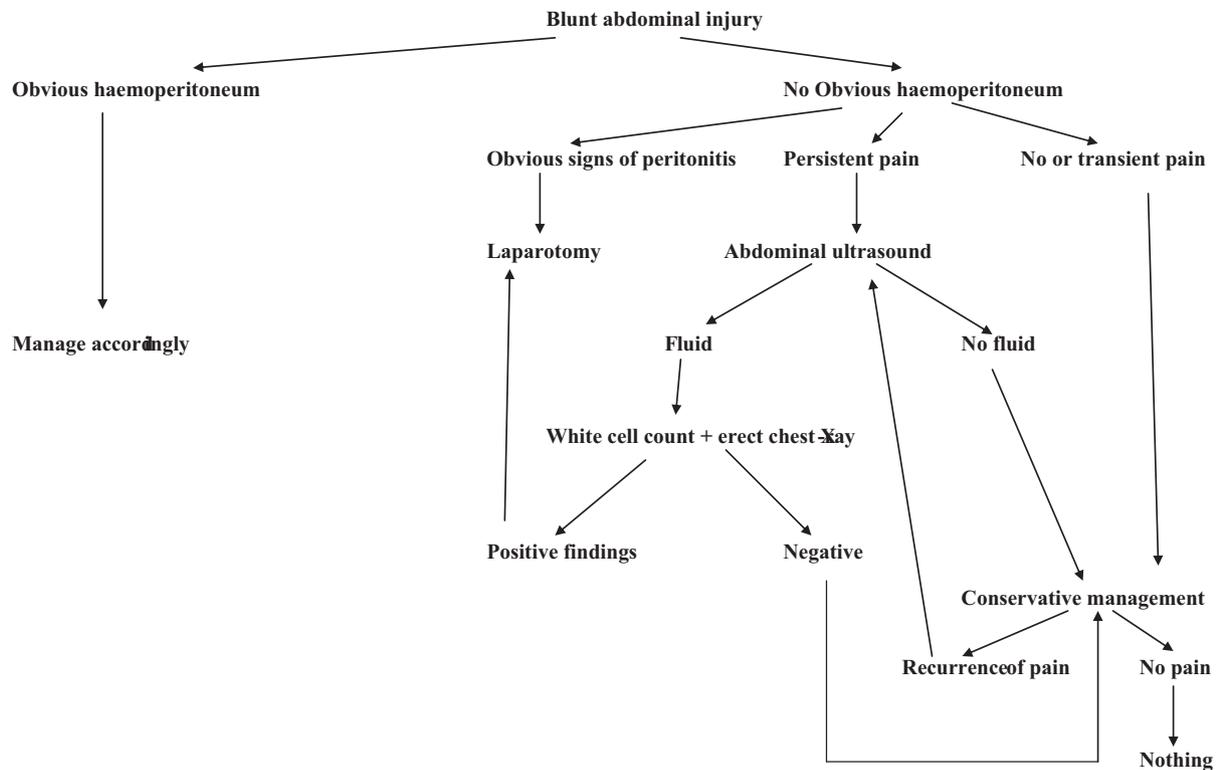


Fig. 4. Proposed algorithm for management of blunt abdominal injuries in the absence of CT scan and laparoscopy.

8% of cases. This rate however rose to 25% during follow-up.³⁰ In our study, erect chest X-ray was decisive in 3 patients who did not have obvious signs of peritonitis. Ultrasound has shown to be useful in some situations³⁸ but is generally not considered a reliable tool for diagnosing ISBI.

Modern diagnostic algorithms usually include peritoneal lavage.^{9,23,24,33} Moss et al. report that performed in 10 patients, it confirmed the diagnosis in five of them.²³ It is then considered a useful adjunct, but is likely to be associated with a higher risk on non therapeutic laparotomies.^{4,5,17,29}

Some studies assess the combination of these different tools in an attempt to build a universal diagnostic approach.^{3,4,6,9,13} Harris et al. propose to include leucocyte count³⁵ but this is likely to further delay management in low income settings where it is not always available as an emergency.

Laparoscopy is also a reliable diagnostic and therapeutic procedure proposed in an increasing number of selected cases.^{14,32,39} Mathonnet et al. credit it with 100% sensitivity and 100% specificity.³⁹

Treatment involves suturing of the bowel or resection with end-to-end anastomosis in a vast majority of cases.^{10,19,22,33}

The pattern and rate of morbidity described in our study is similar to what is usually described.^{5,21,22} Delay before management and high ISS score seem to increase morbidity rate.²²

The mortality rate described in our study is comparable to that of most studies in developed countries^{5,9,16,22} and also to those reported in similar settings.^{10,19,21} In all cases, death seems to be more related to associated injuries and time to operative intervention.^{16,17,21,40}

Conclusion

ISBI remains a rare entity and is still potentially deadly, especially in low income settings. Our study seems to point to children in school playgrounds and motorcycle riders as poten-

tially at greater risk of sustaining an ISBI. But this finding will need to be confirmed. ISBI is usually diagnosed at the stage of peritonitis, and this seems to indicate long delays between the accident and the beginning of the management process.

Timely diagnosis is likely to reduce morbidity and mortality but modern available diagnostic test usually lack sensitivity. There is still need to work towards building a diagnostic algorithm based on different combinations of computed tomography, peritoneal lavage and laparoscopy in selected cases, which could be applied to the majority of patients.

In low income settings where these sophisticated tools are usually not available, the challenge is to be able to identify these patients before they reach the stage of obvious peritonitis so as to improve on the outcome. This requires first of all a greater awareness of the condition. As shown in Fig. 4, a more timely diagnosis can in our opinion be reasonably be achieved by repeated clinical examination and a wise combination of the use of accessible and affordable tools such as serial ultrasound, erect chest X-ray and when possible white cell count for all suspect cases.

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Conflict of interest statement

All authors have no conflict of interest to declare.

References

- Baccoli A, Manconi AR, Caocci G, Pisu S. Isolated jejunal perforation after blunt trauma. Report of three cases. *G Chir* 2010;31(4):167–70.
- McStay C, Ringwelski A, Levy P, Legome E. Hollow viscus injury. *J Emerg Med* 2009;37(3):293–9.
- Frick Jr EJ, Pasquale MD, Cipolle MD. Small-bowel and mesentery injuries in blunt trauma. *J Trauma* 1999;46(5):920–6.

4. Fakhry SM, Watts DD, Luchette FA. EAST Multi-Institutional Hollow Viscus Injury Research Group, current diagnostic approaches lack sensitivity in the diagnosis of perforated blunt small bowel injury: analysis from 275,557 trauma admissions from the EAST multi-institutional HVI trial. *J Trauma* 2003;54(2): 295–306.
5. Fraga GP, Silva FH, Almeida NA, Curi JC, Mantovani M. Blunt abdominal trauma with small bowel injury: are isolated lesions riskier than associated lesions? *Acta Cir Bras* 2008;23(2):192–7.
6. Brownstein MR, Bunting T, Meyer AA, Fakhry SM. Diagnosis and management of blunt small bowel injury: a survey of the membership of the American Association for the Surgery of Trauma. *J Trauma* 2000;48(3):402–7.
7. Hamill J, Paice R, Civil I, Kolbe A. Blunt traumatic small bowel rupture: are children different? *A NZ J Surg* 2000;70(11):795–9.
8. Ameh EA, Nmadu PT. Gastrointestinal injuries from blunt abdominal trauma in children. *East Afr Med J* 2004;81(4):194–7.
9. Hughes TM, Elton C, Hitos K, Perez JV, McDougall PA. Intra-abdominal gastrointestinal tract injuries following blunt trauma: the experience of an Australian trauma centre. *Injury* 2002;33(7):617–26.
10. Chirdan LB, Uba AF, Yiltok SJ, Ramyil VM. Paediatric blunt abdominal trauma: challenges of management in a developing country. *Eur J Pediatr Surg* 2007;17(2):90–5.
11. Ameh EA, Mshelbwala PM. Challenges of managing paediatric abdominal trauma in a Nigerian setting. *Niger J Clin Pract* 2009;12(2):192–5.
12. Neugebauer H, Wallenboeck E, Hungerford M. Seventy cases of injuries of the small intestine caused by blunt abdominal trauma: a retrospective study from 1970 to 1994. *J Trauma* 1999;46(1):116–21.
13. Menegaux F, Trésallet C, Gosgnach M, Nguyen-Thanh Q, Langeron O, Riou B. Diagnosis of bowel and mesenteric injuries in blunt abdominal trauma: a prospective study. *Am J Emerg Med* 2006;24(1):19–24.
14. Mitsuhide K, Junichi S, Atsushi N, Masakazu D, Shinobu H, Tomohisa E, et al. Computed tomographic scanning and selective laparoscopy in the diagnosis of blunt bowel injury: a prospective study. *J Trauma* 2005;58(4):696–701.
15. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Lancet* 2007;370(9596):1453–7.
16. Watts DD, Fakhry SM. EAST Multi-Institutional Hollow Viscus Injury Research Group, Incidence of hollow viscus injury in blunt trauma: an analysis from 275,557 trauma admissions from the East multi-institutional trial. *J Trauma* 2003;54(2):289–94.
17. Fakhry SM, Brownstein M, Watts DD, Baker CC, Oller D. Relatively short diagnostic delays (<8 h) produce morbidity and mortality in blunt small bowel injury: an analysis of time to operative intervention in 198 patients from a multicenter experience. *J Trauma* 2000;48(3):414–5. 408–14 discussion.
18. Sule AZ, Kidmas AT, Awani K, Uba F, Misauno M. Gastrointestinal perforation following blunt abdominal trauma. *East Afr Med J* 2007;84(9):429–33.
19. Essomba A, Masso-Misse P, Bob'Oyono JM, Sosso MA, Malonga E. Traumatic jejuno-ileal ruptures: a propos of 18 cases at the Central Hospital of Yaounde. *Dakar Med* 1999;44(2):190–3.
20. Albanese CT, Meza MP, Gardner MJ, Smith SD, Rowe MI, Lynch JM. Is computed tomography a useful adjunct to the clinical examination for the diagnosis of pediatric gastrointestinal perforation from blunt abdominal trauma in children? *J Trauma* 1996;40(3):417–21.
21. Zafar A, Orakzai N, Ghafoor A, Ahmad S. Gastrointestinal perforation in children due to blunt abdominal trauma in Hazara, Northern Pakistan. *Trop Doct* 2003;33(3):168–70.
22. Öztürk H, Onen A, Otçu S, Dokucu AI, Yağmur Y, Kaya M, et al. Diagnostic delay increases morbidity in children with gastrointestinal perforation from blunt abdominal trauma. *Surg Today* 2003;33(3):178–82.
23. Moss RL, Musemeche CA. Clinical judgment is superior to diagnostic tests in the management of pediatric small bowel injury. *J Pediatr Surg* 1996;31(8):1178–81.
24. Ceelen W, Hesse U, De Hemptinne B. Small bowel perforation following blunt abdominal trauma. *Acta Chir Belg* 1995;95(4 Suppl):187–9.
25. Galifer RB, Forgues D, Mourregot A, Guibal MP, Allal H, Mekki M, et al. Blunt traumatic injuries of the gastrointestinal and biliary tract in childhood, Analysis of 16 cases. *Eur J Pediatr Surg* 2001;11(4):230–4.
26. Tejerina Alvarez EE, Holanda MS, López-Espadas F, Dominguez MJ, Ots E, Díaz-Regañón J. Gastric rupture from blunt abdominal trauma. *Injury* 2004;35(3): 228–31.
27. Letton Jr RW, Worrell V, Tuggle DW. American Pediatric Surgical Association Committee on Trauma Blunt Intestinal Injury Study Group, Delay in diagnosis and treatment of blunt intestinal perforation does not adversely affect prognosis in the pediatric trauma patient. *J Trauma* 2010;68(4):790–5.
28. Subramanian V, Raju RS, Vyas FL, Joseph P, Sitaram V. Delayed jejunal perforation following blunt abdominal trauma. *Ann R Coll Surg Engl* 2010;92(2):W23–4.
29. Fang JF, Chen RJ, Lin BC, Hsu YB, Kao JL, Kao YC, et al. Small bowel perforation: is urgent surgery necessary? *J Trauma* 1999;47(3):515–20.
30. Saku M, Yoshimitsu K, Murakami J, Nakamura Y, Oguri S, Noguchi T, et al. Small bowel perforation resulting from blunt abdominal trauma: interval change of radiological characteristics. *Radiat Med* 2006;24(5):358–64.
31. Kim HC, Shin HC, Park SJ, Park SI, Kim HH, Bae WK, et al. Traumatic bowel perforation: analysis of CT findings according to the perforation site and the elapsed time since accident. *Clin Imaging* 2004;28(5):334–9.
32. Germain MA, Soukhni N, Bouzard MD. Small bowel perforations after blunt abdominal trauma: evaluation with computed tomographic scan and laparoscopy. *Ann Chir* 2003;128(4):258–61.
33. Wisner DH, Chun Y, Blaisdell FW. Blunt intestinal injury. Keys to diagnosis and management. *Arch Surg* 1990;125(10):1319–22. [discussion 1322–3].
34. Yegiyants S, Abou-Lahoud G, Taylor E. The management of blunt abdominal trauma patients with computed tomography scan findings of free peritoneal fluid and no evidence of solid organ injury. *Am Surg* 2006;72(10):943–6.
35. Harris HW, Morabito DJ, Mackersie RC, Halvorsen RA, Schecter WP. Leukocytosis and free fluid are important indicators of isolated intestinal injury after blunt trauma. *J Trauma* 1999;46(4):656–9.
36. Kostantinidis C, Pitsinis V, Fragulidis G. Isolated jejunal perforation following blunt abdominal trauma. *Ulus Travma Acil Cerrahi Derg* 2010;16(1):87–9.
37. Peters E, LoSasso B, Foley J, Rodarte A, Duthie S, Senac Jr MO. Blunt bowel and mesenteric injuries in children: do nonspecific computed tomography findings reliably identify these injuries? *Pediatr Crit Care Med* 2006;7(6):551–6.
38. Chang YS, Wang HP, Huang GT, Chen SC, Wang SM. Sonographic detection of delayed small bowel perforations after blunt abdominal trauma. *J Clin Ultrasound* 2000;28(3):142–5.
39. Mathonnet M, Peyrou P, Gainant A, Bouvier S, Cubertafond P. Role of laparoscopy in blunt perforations of the small bowel. *Surg Endosc* 2003;17(4):641–5.
40. Kafie F, Tominaga GT, Yoong B, Waxman K. Factors related to outcome in blunt intestinal injuries requiring operation. *Am Surg* 1997;63(10):889–92.