Penetrating abdominal injuries in children: a study of 33 cases

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Background **Trauma is gradually becoming a major cause of disability and it can be of any form, physical or emotional. For the surgeon the physical form is of major interest, especially its causes and incidence, which can be influenced by environmental or social factors.**

Aim **The aim of this work was to study the incidence, etiology, principles of management and outcome of children with penetrating abdominal injuries.**

Materials and methods **This was a 2-year prospective study of 33 children aged 0–15 years with penetrating abdominal injuries at the University of Maiduguri Teaching Hospital in northeast Nigeria. Information obtained included the following: the patient's biodata, mechanism of injury, time of presentation to the Accident and Emergency Department after the injury, haemodynamic status at presentation, presence or absence of abdominal organ evisceration, presence or absence of associated injuries, the timing of surgery, intraoperative findings, the type of surgical procedure and outcome.**

Results **Thirty-three (31.4%) children [of whom 24 (i.e. 72.7%) were from the rural areas] of 105 children with trauma-related injuries had penetrating abdominal injuries. The male : female ratio was 3 : 1, and the mean age ± SD was 2.30 ± 0.81 years. There were 15 (45.4%) children with gunshot wounds, 11 (33.3%) with bomb blast wounds, three (9.1%) with impalement injuries and two (6.1%) with arrow injuries. Fourteen (42.4%) patients had abdominal organ evisceration; of them, nine were as a result of gunshot injuries. Routine exploratory laparotomy was carried out in all 33 patients. Seven (21.2%) were operated on with simultaneous resuscitation in the immediate laparotomy group, and 26 (78.8%) underwent delayed laparotomy. There was a negative laparotomy in four (12.1%) patients, two of whom had only omental evisceration with no other accompanying visceral injuries, and two without evisceration. Three (9.1%) patients died after developing enterocutaneous fistula, compartment syndrome and sepsis.**

Conclusion **There were more cases of penetrating abdominal injuries among boys and children from the rural areas than in those from urban areas.** ***Ann Pediatr Surg*** **14:8–12 © 2018 Annals of Pediatric Surgery.**

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Introduction

In children, unintentional injury due to either road traffic accidents, sports and occupational and recreational activities are a frequent cause of abdominal trauma, and often result in blunt abdominal injury [1,2]. Nevertheless, penetrating abdominal injury due to stab wound, firearms, or impalement injuries can still occur, but often as isolated cases [3,4]. Blunt abdominal trauma may be the common type of abdominal trauma in children [5–7], but in times of civil or communal conflicts and insurgency this pattern can change as firearms and other forms of missile injuries such as improvised explosive devices (IED) may be rampant, to the extent that penetrating abdominal injury become common [8]. This could account for the relative increase in the incidence of penetrating abdominal injuries recently seen in both developed and developing countries [9,10], because of the recent rise in communal conflicts and insurgent attacks. This has obviously translated into increased burden of firearm-related morbidity and mortality not only in developing countries alone but across the globe [11]. In 2009, firearms accounted for 89% of hospital admissions in the USA among children less than 15 years of age and this figure has not remained static [12]. Although in developing countries there is no unified data on the incidence of firearm-related injuries, it has been reported as one of the leading cause of morbidity and mortality after malnutrition and communicable diseases in sub-Saharan Africa [13]; thus, it has gradually joined the rank of conditions that threaten the well-being of the child. As such, trauma has become the disease of the 21st century and it is gradually taking its place as the leading threat to the health of children in Africa. There is, therefore, the need to consider this threat in health budgeting and planning among the ranks of others such as malnutrition and communicable diseases in Africa [14]. This study aimed at determining the incidence, etiology, principles of management and outcome of penetrating abdominal injuries in children.

Materials and methods

A prospective observational study was carried out on 33 children aged between 0 and 15 years with penetrating abdominal injuries at the University of Maiduguri Teaching Hospital in northeast Nigeria, from June 2013 to June 2015. Children with penetrating abdominal injuries, which had not breached the peritoneum, were excluded from the study. After obtaining ethical approval

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from the hospital ethics and research committee. Data collected from patients included either rural or urban dwellers, cause of the penetrating abdominal injury (gunshot, bomb blast/IED, arrow shot, stab wounds, impalement injuries), and the presence or absence of visceral evisceration. For those with evisceration the type of the eviscerated organ and the assault device were ascertained. The time that the patient's presented to the Accident and Emergency Department was noted as follows: less than 6 h; 6–12 h, and more than 12 h after injury. Those patients who presented less than 6 h are classified as the immediate presentation group, whereas those who presented between 6 and 12 h and those who presented more than 12 h of injury are the delayed and late presentation groups, respectively. In terms of their haemodynamic status at presentation, patients who had tachypnoea, pulse rate above 90 beats/min, pallor, dehydration and abdominal distension with peritonitis were considered haemodynamically unstable; patients without dehydration and pallor, with respiratory rate less than 20 cycles/min, pulse rate less than 90 beats/min, absent abdominal distension, and also without peritonitis were considered haemodynamically stable. Patients who were operated less than 6 h of presentation constituted those who had immediate reaction time (immediate laparotomy); those who were operated after stabilization of hemodynamic status in more than 6 h of presentation had delayed reaction time (delayed laparotomy). The intraoperative findings determined the type of surgery performed; however, the surgical procedure was categorized into one-stage, two-stage, or three-stage procedures based on intraoperative findings. If a definitive procedure was performed at the first laparotomy it is attributed as one-stage procedure. Two-stage procedures are attributed to damage control or any form of enterostomy only at the initial laparotomy (i.e. a second surgery will be required to return the , a patient that will have anastomosis/closure of a rectal perforation with a protective proximal diverting stoma at the initial laparotomy, and subsequent revision of the stoma later is qualified as three-stage procedure. The outcome of the procedures was recorded.

Results

There were 33 (31.4%) children with penetrating abdominal injuries of the 105 children with trauma-related injuries admitted during the study period. Boys were predominant, with a frequency of 75.8%. The male-to-female ratio was 3 : 1; the mean ± SD for age was 2.30 ± 0.81 and peak age group was 5–10 years. The age distribution is shown in Table 1.

Twenty-four (72.7%) children were from rural areas. Most injuries were caused by gunshot in 15 (45.4%) children, followed by IED in 11 (33.3%) children. Other causes of penetrating abdominal injuries are shown in Table 2. There were 14 (42.4%) children with evisceration of abdominal organs and 19 (57.6%) without evisceration.

The eviscerated organs were the omentum with jejunum in four, jejunum alone in two, ileum in two, stomach with the omentum in two, the omentum only in three and the stomach alone in one child. Gunshot injuries were a common cause of evisceration (64.3%), followed by IED (28.6%) (Table 2). As regards duration of presentation to the Accident and Emergency Department, most of the patients (19, 57.6%) presented less than 6 h of injury, eight (24.2%) and six (18.2%) children presented between 6 and 12 h and more than 12 h, respectively, after the injuries had occurred. A child with evisceration due to IED injuries presented after 6 days. Of those who presented less than 6 h of injury, nine (47.4%) had abdominal organ evisceration. Among the eight (24.2%) patients who presented between 6 and 12 h of injury, three (37.5%) were with eviscerations. Two children (33.3%) out of the six (18.2%) patients who were admitted more than 12 h and beyond had eviscerated abdominal organs.

Concerning haemodynamic status, 21 (63.6%) haemodynamically unstable patients were admitted; 12 (57.1%) of them were with evisceration. Plane abdominal radiography performed on 12 (36.4%) haemodynamically stable patients showed pneumoperitoneum in 10 of them; a radioopaque shadow, extending covering about one-third of the abdomen was observed in the other two on an oblique view.

Associated injuries in eight (24.2%) children included the following: grade IV scrotal injury, two severe head injuries, closed fracture of the mid-shaft of the left radial bone, mangled left upper limb, open fracture of the right radial and ulnar bones, closed segmental fracture of the right femur, and open fracture of the tarsus of the left foot. These associated injuries were all in children with missile injuries.

Patients were resuscitated according to the advanced trauma live support protocol. Seven (21.2%) patients underwent exploratory laparotomy in less than 6 h of presentation (immediate laparotomy); of them, three patients underwent two-stage surgeries and four underwent one-stage surgery. One patient in the immediate laparotomy group died. Twenty-six (78.8%) children underwent exploratory laparotomy when they presented after more than 6 h of sustaining their injuries (delayed laparotomy); of them, 22 underwent one-stage and four

Table 1 Frequency of age distribution of the study population

Age	*n* (%)
<12 months	2 (6.1)
1–4 years	5 (15.2)
5–10 years	15 (45.4)
11–15 years	11 (33.3)
Total	33
(100.0)	

Table 2 Causes of penetrating abdominal injury with frequency of abdominal organ evisceration

Cause of abdominal injury	Total number of patients [*n* (%)]	Number of patients with organ evisceration [*n* (%)]
Gunshot	15 (45.4)	9 (64.3)
Bomb blast	11 (33.3)	4 (28.6)
Impalement	3 (9.1)	0 (0.0)
Knife stab injury	2 (6.1)	1 (7.1)
Arrow shot (Fig. 1)	2 (6.1)	0 (0.0)
Total	33 (100.0)	14 (100.0)

patients underwent three-stage surgeries, among whom there were two deaths. Intraoperative findings with their surgical details are shown in Table 3.

In all laparotomies a supraumbilical transverse incision was made separate from the point of injury.

In four (12.1%) patients, of whom two had omental evisceration and two without evisceration, there were no intraoperative findings suggestive of visceral injury; hence, these were considered as negative laparotomies. In all patients with evisceration, the eviscerated viscera were copiously washed with warm normal saline before being returned to the peritoneal cavity. In patients who had avulsion of the anterior abdominal wall the peritoneum was repaired immediately, whereas the wound tracts were debrided and allowed to granulate for secondary closure.

Ten (30.3%) patients had complications; of them, six (60.0%) were with evisceration and four (40.0%) were without evisceration. The complications included the following: paralytic ileus, superficial surgical site infection, burst abdomen, anastomotic dehiscence, pelvic abscess and deep surgical site infections. Other complications are postoperative adhesive intestinal obstruction, incisional hernia, postoperative jejunojeunal intussusception and secondary hemorrhage.

Three (9.1%) patients died. The deaths were among those patients who presented more than 12 h and beyond after the injury. Death was due to high output enterocutaneous fistula, compartment syndrome, and sepsis, respectively (Fig. 1).

Discussion

In our environment and other developing countries, penetrating abdominal injury, unlike in developed countries, commonly follows a gore by a bull, impalement, and rarely a stab with sharp objects [15–17]. However, nowadays there is an obvious noticeable increase in the incidence of penetrating abdominal injuries from firearms because of increased civil conflicts and rising insurgent attacks [18]. This could account for why gunshot injury alone was responsible for penetrating abdominal injury in about 45.4% of our patients, who were predominantly boys aged 5–10 years and in children from the rural areas. A similar relationship was observed by Grossman *et al*. [19] and others, citing that children from the rural areas are likely to present with penetrating abdominal injury [20,21]. Most probably, children, especially boys are more adventurous and likely to explore the environment compared with their female counterpart and are thus exposed to the risk for injury more.

Generally, with missile injury there is tissue damage, which occurs because of unabated energy transfer to adjacent tissues, and the magnitude of damage is directly proportional to the kinetic energy of the missile and the tissue density [22–24]. Cytokines are also released from

Table 3 Intraoperative findings, operations performed, and outcomes

Reaction time (number of patients)	Intraoperative findings	Operation performed	Number of stages	Outcome
Patients operated <6 h of presentation				
2	Transverse colonic injury with significant fecal contamination	Transverse colostomy	Two stages	Survived
1	Grade III liver injury (right lobe), rent on greater curvature of the stomach, multiple transverse colon perforations	Liver debridement, repair of stomach rent, transverse colostomy	Two stages	Survived
1	Grade IV liver injury, multiple jejunal perforations, hemoperitoneum	Liver debridement + hemostasis, jejunojejunal resection and anastomosis	One stages	Died
1	Grade IV splenic injury, perforation in the left diaphragm and on the jejunum, hemoperitoneum, grade IV scrotal injury	Splenectomy, repair of diaphragmatic and jejunal perforations, debridement of the scrotal injury	One stages	Survived
1	Ileocecal perforations with hemofeculent peritoneal contamination	Limited right hemicolectomy	One stages	Survived
1	Wide rent on greater curvature of the stomach, hemoperitoneum mixed with gastric content	Repair of gastric rent	One stages	Survived
Patients operated >6 h of presentation				
8	Multiple ileal perforations with minimal fecal contamination	Ileoileal resection and anastomosis in 5, closure of the perforations in 3	One stages	Survived
4	Jejunal perforations, multiple in 1 with moderate hemoperitoneum	Closure of the perforations in 3, resection, and anastomosis in 1	One stages	Survived
3	Stomach injuries, peritoneum contaminated with gastric content	Repair	One stages	Survived
2	Grade IV rectal injuries with hemofeculent contamination	Repair of rectal injuries + sigmoid colostomy	Three stages	Survived
2	Omental evisceration only with mild hemoperitoneum	Return of the omentum after irrigation with warm saline fluid	One stages	Survived
2	Ileocecal perforations	Limited right hemicolectomy	One stages	Survived
2	Breach in the peritoneum only with minimal hemoperitoneum	Closure of the peritoneal opening	One stages	Survived
1	Rectal injury, avulsed left ureter, intraperitoneal bladder rupture	Repair of the rectum with a proximal protective sigmoid colostomy, left ureterostomy, closure of the ruptured bladder	Three stages	Died
1	Shattered third part of the duodenum with contused pancreas	Duodenojejunstomy	One stages	Survived
1	Multiple jejunal perforations, grade IV anorectal injury, significant hemoeritoneum	Resection and anastomosis of the jejunum, repair of anorectal injury with a proximal diverting sigmoid colostomy	Three stages	Died

Fig. 1

One of the patients with penetrating abdominal injury due to arrow shot in whom laparotomy was negative intraoperatively.

the damaged tissues that can cause physiologic and metabolic changes resulting in hemodynamic disturbance in the whole body system [25,26]. Nevertheless, primary or secondary injuries are the resultant physical effect of such injury on the body. In some of our patients, the secondary injury was caused by the scrap metal objects, bolts nuts, screws, nails, and household tiles used in fabricating the IED.

In terms of visceral evisceration, we observed that the omentum was the organ that was eviscerated most often. Probably because the omentum is the abdominal gatekeeper and also a highly mobile viscerus it can easily eviscerate when there is a breach of the peritoneum. There were more patients with organ evisceration in missile injuries compared with those with nonmissile-related penetrating abdominal injuries as was seen in other studies [27].

Twenty-four percent of the patients had associated injuries. They were all in those with the missile injuries. Ogwang [28] observed that 87.5% of associated injuries occurred in their cohort of 100 patients who came in with missile injuries.

Rarely will penetrating abdominal trauma in the pediatric age occur without an underlying associated visceral injury. This is because organs such as the liver and spleen occupy a large part of the intra-abdominal surface area, and, coupled with the less protection given by the lower part of the rib cage and the relatively less developed anterior abdominal muscles, the risk for abdominal organ injury increases [29]. Therefore, knowledge of the mechanism of injury and the type of weapon used is important in ascertaining the magnitude of organ involvement.

Preoperative stabilization is important because irreversible hemodynamic imbalance can easily lead to extensive tissue damage if hypotension, hypothermia and metabolic acidosis are unresolved immediately [30]. The intravenous fluids should be at least warm to prevent hypothermia and dextrose be added to the intravenous fluids. Resuscitation should not completely overshadow the general concept of a through clinical assessment; perhaps there may be more than one organ injury, which may require a multidisciplinary approach after stabilization [31].

Usually, minimal diagnostic evaluation is required in a patient with penetrating abdominal injury, especially if the patient is unstable [32]. Plain abdominal radiography could be useful in those patients without abdominal organ evisceration to diagnose possible bowel perforation, which may reveal pneumoperitoneum. Furthermore, when available, computerized tomography (CT) should be used as it can delineate the tract of injury and the state of adjacent structures better [33]. Some studies have even used CT findings as the sole determinant for surgery in patients with penetrating abdominal injury [34]. However, CT may not be available in most institutions in sub-Saharan Africa. When it is available it may either be nonfunctional or be unaffordable, and, when functional, its use may be hampered by lack of power supply or trained operating personnel [35].

The definitive management of penetrating abdominal injury, unlike in blunt abdominal trauma, is usually straightforward; it should be routine emergency exploratory laparotomy except in situations in which there are other severe associated injuries [36]. To avoid untoward physiologic and metabolic changes with any delay in intervention, we opted for routine emergency exploratory laparotomy for all patients. With laparotomy there was liberty to directly control hemorrhage, peritoneal contamination, and can still continue resuscitation in the form of damage control in some of the patients. Arguably, patients with stable haemodynamic status could be selected for nonoperative management of penetrating abdominal trauma as advocated by Shaftan and colleagues [37–40]. Our challenge was lack of a dedicated trauma team and readily available additional diagnostic facilities (ultrasound scan, CT) with a committed radiologist, and also our sample was small. The success rate with routine exploratory laparotomy for penetrating abdominal injury was 87.9% in our series. Granson *et al.* [41] also had successful routine exploratory laparotomy rate of 69% in a study of 100 patients.

Concerning the choice of definitive surgery, degree of peritoneal contamination determined the choice. Patients with minimal peritoneal contaminations and mainly those with small bowel perforations underwent one-stage surgery (i.e. closure of a single perforation, resection and anastomosis in multiple perforations less than 5 cm apart). Staged surgery was used in those patients with significant peritoneal contamination, especially in patients with colonic and rectal injuries. Staging the surgical operation reduced morbidity and mortality in most of those patients with fecal peritoneal contamination.

The complication rate was 33.3%. Complications were often seen in those patients with evisceration and colonic injuries as compared with those without evisceration. This was also observed by Demetriades *et al.* [42]; they also noted that colonic injuries resulted in the development of postoperative complications. All patients who died had major injuries; in addition to having major trauma there was also delay in presentation after injury, which gave time for systemic exhaustion and sepsis to develop. The delay in presentation could be attributed to the fact that most of the injuries were sustained while

fleeing the conflict area. Locating the patients and transporting took some time. One of the patients was found on sixth day with gunshot injury.

In conclusion, there is no denying the fact that the incidence of firearm-related injuries is gradually rising among children in developing countries. Thus, there is the urgent need to develop a systematic approach aim at indentifying the vulnerable, predisposing factors, and the immediate intervention in areas of conflict. Finally, the rights of children need to be recognized and protected by warring parties.

Conflicts of interest

There are no conflicts of interest.

References

1 Abantanga FA, Mock CN. Childhood injuries in an urban area of Ghana: a hospital-based study of 677 cases. *Pediatr Surg Int* 1998; **13**:515–518.
2 Ameh EA, Chirdan LB, Otabor IA, Nwomeh BC. Abdominal trauma. In: Ameh EA, Bickler SW, Lakhoo K, Nwomeh BC, Poenaru D, editors. *Paediatric surgery: a comprehensive text for Africa*, 1st ed. Seattle, WA: Global HELP Organisation; 2011. pp. 184–189.
3 Stylianos S. The impact of firearm violence on children: support for prevention strategies. A position report from the APSA trauma committee. American Pediatric Surgical Association. *J Pediatr Surg* 1999; **34**:1445–1446.
4 Nance ML, Sing RF, Branas CC, Schwab CW. Shotgun wounds in children. Not just accidents. *Arch Surg* 1997; **132**:58–61.
5 Wegner S, Colletti JE, Van Wie D. Pediatric blunt abdominal trauma. *Pediatr Clin North Am* 2006; **53**:243–256.
6 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**:505–509.
7 Schmidt B, Schimpl G, Hollwarth ME. Blunt liver trauma in children. *Pediatr Surg Int* 2004; **20**:846–850.
8 Gosselin RA. War injuries, trauma, and disaster relief. *Tech Orthop* 2005; **20**:97–108.
9 Sayi EN, Mlay SM. Abdominal injuries in children at Muhimbili Medical Centre Dares Salaam. *East Afr Med J* 1993; **70**:120–122.
10 Bahebeck J, Atangana R, Mboudou E, Nonga BN, Sosso M, Malonga E. Incidence, case fatality rate and clinical pattern of firearm injuries in two cities where arm owning is forbidden. *Injury* 2005; **36**:714–717.
11 Christofell KK, Naureckas SM. Firearm injuries in children and adolescents: epidemiology and practice approaches. *Curr Opin Pediatr* 1994; **6**:519–524.
12 Leventhal JM, Gaither JR, Sege R. Hospitalization due to firearm injuries in children and adolescents. *Pediatrics* 2014; **133**:219–225.
13 Nordberg E. Injuries in Africa: a review. *East Afr Med J* 1994; **71**:339–345.
14 Ebrahim GJ. Editorial. Child health beyond 2000. *J Trop Pediatr* 1994; **40**:318–319.
15 Ameh EA, Nmadu PT. Penetrating abdominal injuries in children in Nigeria. *Ann Trop Paediatr* 1999; **19**:293–296.
16 Nayci A, Stavlo PL, Zarroug AE, Zietlow SP, Moir CR, Rodeberg DA. Snowmobile injuries in children and adolescents. *Mayo Clin Proc* 2006; **81**:39–44.
17 Chatterjee H, Jagdish S. Intestinal injuries in childhood: analysis of 32 cases. *J Pediatr Surg* 1992; **27**:583–585.
18 Zavoski RW, Lapidus GD, Lerer TJ, Banco LI. A population-based study of severe firearm injury among children and youth. *Pediatrics* 1995; **96**:278–282.
19 Grossman DC. The history of injury control and the epidemiology of child and adolescent injuries. In: Behrman RE, editor. *The future of children Vol 10*. Los Altos, CA: The David & Lucille Packard Foundation; 2000. pp. 23–52.
20 Fitzmaurice LS, Gaddis GM, Knapp JF. Firearm injuries in children: an increase in violent intent, frequency, and severity. *Mo Med* 1993; **35**:233–237.
21 Tataria M, Nance ML, Holmes JH, Miller CC, Mattix KD, Brown RL, *et al*. Pediatric blunt abdominal injury: age is irrelevant and delayed operation is not detrimental. *J Trauma* 2007; **63**:608–614.
22 Rich NM. Missile injuries. *Am J Surg* 1980; **139**:414–420.
23 Feuchtwanger MM. High velocity missile injuries: a review. *J R Soc Med* 1982; **75**:966–969.
24 Lowe RJ, Boyd DR, Folk FA. The negative laparotomy for abdominal trauma. *J Trauma* 1972; **12**:853–861.
25 Jensen AR, Hughes WB, Grewal H. Secondary abdominal compartment syndrome in children with burns and trauma: a potentially lethal complication. *J Burn Care Res* 2006; **27**:242–246.
26 Powers DB, Delo RI. Characteristics of ballistic and blast injuries. *Atlas Oral Maxillofac Surg Clin North Am* 2013; **21**:15–24.
27 Silva M, Navsaria PH, Edu S, Nicol AJ. Evisceration following abdominal stab wounds: analysis of 66 cases. *World J Surg* 2009; **33**:215–219.
28 Ogwang DM. High velocity missile injuries of the liver. *East Afr Med J* 1999; **4**:13–16.
29 Stylianos S. Evidence-based guidelines for resource utilization in children with isolated spleen or liver injury. The APSA Trauma Committee. *J Pediatr Surg* 2000; **35**:164–169.
30 Rothrock SG, Green SM, Morgan R. Abdominal trauma in infants and children: prompt identification and early management of serious and life-threatening injuries. Part I: injury patterns and initial assessment. *Pediatr Emerg Care* 2000; **16**:106–115.
31 Stafford PW, Blinman TA, Nance ML. Practical points in evaluation and resuscitation of the injured child. *Surg Clin North Am* 2002; **82**:273–301.
32 Grosfeld JL, Rescorla FJ, West KW, Vane DW. Gastrointestinal injuries in childhood: analysis of 53 patients. *J Pediatr Surg* 1989; **24**:580–583.
33 Strouse PJ, Close BJ, Marshall KW, Cywes R. CT of bowel and mesenteric trauma in children. *Radiographics* 1999; **19**:1237–1250.
34 Ertekin C, Yanar H, Taviloglu K, Guloglu R, Alimoglu O. Unnecessary laparotomy by using physical examination and different diagnostic modalities for penetrating abdominal stab wounds. *Emerg Med J* 2005; **22**:790–794.
35 Sippel S, Muruganandan K, Levine A, Shah S. Review article: ultrasound scan in the developing world. *Int J Emerg Med* 2011; **4**:72.
36 Mcfarlane M. Management of penetrating abdominal injuries. *West Indian Med J* 1999; **44**:140–142.
37 Lowe RJ, Saletta JD, Read DR, Radhakrishnan J, Moss GS. Should laparotomy be mandatory or selective in gunshot wounds of the abdomen? *J Trauma* 1977; **17**:903–907.
38 Shaftan GW. Indications for operation in abdominal trauma. *Am J Surg* 1960; **99**:657–664.
39 Mcfarlane ME. Non-operative management of stab wounds to the abdomen with omental evisceration. *J R Coll Surg Edinb* 1996; **41**:239–240.
40 Ciqdem MK, Onen A, Siga M, Otcu S. Selective nonoperative management of penetrating abdominal injuries in children. *J Trauma* 2009; **67**:284–286.
41 Granson MA, Donovan AJ. Abdominal stab wound with omental evisceration. *Arch Surg* 1983; **118**:57–59.
42 Demetriades D, Lakhoo M, Pezikis A, Charalambides D, Pantanowitz D, Sofianos C. Short course of antibiotic prophylaxis in penetrating abdominal injuries: ceftriaxone versus cefoxitin. *Injury* 1991; **22**:20–24.