Perforation of Bowel Associated with Blunt Abdominal Trauma in Children

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SUMMARY

Motor vehicle accidents remain the commonest cause of abdominal trauma in children, but there are many situations that expose the child more particularly to blunt abdominal trauma. In order to avoid unnecessary delay in diagnosis, a plan of management is proposed, based on our experience with 4 cases of abdominal trauma.

The need for early diagnosis is emphasised.

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Blunt abdominal trauma has been associated with small-bowel injuries in 1 - 10% of reported series.[1,8,10,13] The injuries are often multiple, and involve not only the extremities and head region, but frequently the intra-abdominal organs as well. Blunt trauma to the abdomen in children usually involves solid viscera, and rupture of the gastro-intestinal tract is infrequent. We describe 4 cases of traumatic bowel rupture to emphasise the difficulty in diagnosis and to outline a plan of management in these cases.

The relatively large volume of the liver in the abdomen makes this organ more prone to injury in the small child. Aerophagia, associated with crying in children, may distend the upper gastro-intestinal tract and make clinical evaluation difficult.

Maltreatment and child battering may be the cause of injury in the infant. The male preponderance among older injured children is not surprising, since a boy's inquisitive, adventurous nature makes him more liable to such injury.

The diagnosis of perforation of the bowel associated with blunt abdominal trauma in children may, therefore, be difficult; the need for exploratory laparotomy may be clear-cut. However, when the clinical picture is doubtful, delay in diagnosis may occur.

Delay in Diagnosis

The appalling mortality resulting from traumatic rupture of the gastro-intestinal tract, as reported in the early literature, has greatly improved according to recent reports,[5,11] mainly as a result of early diagnosis.

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Small-bowel perforations are often minute and may seal temporarily before free air is noted.[7] Associated spasm of the circular muscle above and below the level of the perforation, results in a localised ileus which further prevents leakage.[9] After 5 or 6 hours the spasm passes off and contamination of the peritoneal cavity occurs as the isolated segment takes part in the peristaltic activity again.[3] Klinger[12] described 50 patients of all ages, in only 10 of whom he noted free air; in one of them the perforation only became evident on delayed films.

Delay in diagnosis may occur as a result of late rupture of an intramural haematoma[12] or after serosal and tunica muscularis tears, or after interference with the blood supply, as occurs in avulsion injuries.[7]

Delayed diagnosis may also be the result of lack of careful examination in patients with multiple injuries.[2,15,16] Wilson *et al.*[17] pointed out that rigidity of the abdominal wall should not be ascribed to a head injury and, therefore, should be a warning of abdominal pathology.

Diagnosis

The investigations that we regard as important are listed in Table I.

TABLE I. IMPORTANT INVESTIGATIONS

Straight X-ray film	— abdomen	— supine
		— erect
	— pelvis	
	— chest	
Full blood count	— haemoglobin	
	— haematocrit	
	— white cell count	
Blood urea and electrolytes		
Serum amylase		
Intravenous pyelography		
Abdominal paracentesis*		
Peritoneal lavage*		
Contrast studies*		
Arteriography*		

* Optional investigations.

Thorough and repeated physical examination is of greater importance than any special investigation.[6] A rectal examination and careful inspection of the naso-gastric aspirate may help in making an early diagnosis.

The white cell count has a limited value as an aid to diagnosis of visceral injury, in the light of the leucocytosis which frequently occurs with other trauma.

Needle paracentesis is of value only when performed carefully and when considered together with the clinical picture. This procedure can be a useful means of making an early diagnosis of bowel perforation.[15] Repeated needle aspirations may cloud the clinical picture and interfere with the assessment of the clinical status of the abdomen. It should, therefore, be performed with reserve. However, microscopic examination of a single aspirate looking for leucocytes and organisms may be extremely valuable. Needle aspiration was not used in the present series.

Arteriography is most useful when dealing with injuries to solid organs and should be considered when injury to the liver, spleen, or kidney is suspected.

Pathogenesis

When considering the general features of abdominal trauma, it is important to remember that closed injuries are the consequence of shock waves or of direct compression of a viscus against a bony prominence.[6]

Three mechanisms of bowel perforation associated with blunt abdominal trauma have been reported:

Crushing of the intestine against the vertebral column produces injuries to the bowel lying in the narrow gap between the anterior abdominal wall and the lordotic lumbar spine.[7,13,14]

Tearing or shearing[7,14] injuries to the bowel and its mesentery at points of fixation is probably the most common explanation for the injuries seen. The tearing may occur in relation to normal fixed points,[6,7] viz. duodenojejunal flexure or the ileocaecal area, or in relation to pathological fixation such as occurs with adhesions or small intestine within a hernia.[6]

Bursting injuries[4] of a distended or kinked loop of intestine are unusual.

PATIENTS

In a 12-month period, the combined paediatric surgical service dealt with 4 cases of bowel perforation associated with blunt abdominal trauma (Table II). In one the diagnosis was made early; in the others the diagnosis was delayed.

Case 1

A male child, aged 4½ years, was admitted to hospital hours after a motor vehicle accident. He had multiple abrasions and lacerations on his head, face, elbow, fingers, and abdominal wall. The patient was managed on intravenous therapy, nasogastric suction, and clinical observation.

An elevation of the pulse rate over the next 24 hours, the presence of small-bowel dilatation, and persistent abdominal tenderness necessitated exploration. At laparotomy a small circular perforation on the antemesenteric border of the terminal ileum was noted, about 13 cm from the ileocaecal valve.

Case 2

A male child, aged 6 years, was admitted to hospital 1 hour after a motor vehicle accident. The child was conscious and complained of central abdominal pain. The abdomen showed abrasions and there was guarding and tenderness, particularly on the right. In view of the clinical status a laparotomy was performed and a perforation of the terminal ileum was found.

Case 3

A male child, aged 6 years, was admitted to hospital with a 4-day history of loss of appetite, abdominal pain and loose, bloody stools. He had fallen out of a tree some 5 days before admission, but this fact was only elicited later during his stay in hospital.

The patient was treated with nasogastric suction, intravenous fluids and antibiotics, and a presumptive diagnosis of gastro-enteritis was made. On the conservative regimen he continued to improve. Four days later he was seen by the surgical service because of persistent ileus. X-ray films showed a paucity of gas in the bowel and a small bowel loop was visible on the left side of the abdomen. The history of falling out of a tree was only now elicited. Review of earlier X-ray films showed air under the diaphragm. Laparotomy revealed the presence of a duodenal perforation 2,5 cm in diameter.

Case 4

A male child, aged 9 years, was admitted to hospital 2 hours after a motor vehicle accident. He had a fractured left femur but no abdominal symptoms. The abdomen was tense but soft. There was no peritonism, bowel sounds were present, and there was slight right-sided tenderness.

After 24 hours of conservative treatment blood was noticed in the nasogastric aspirate and peritonism developed. A laparotomy was performed and a perforation in the mid-jejunum identified.

TABLE II. DETAILS OF PATIENTS

Case No.	Age (yrs)	Sex	Site of injury	Associated injury	Delay in diagnosis
1	4½	Male	Ileum (13 cm from ileocaecal area)	Face, head, limbs	24 hours
2	6	Male	Terminal ileum	Nil	Nil
3	6	Male	Duodenum	Nil	4 days
4	9	Male	Mid-jejunum	Fractured femur	28 hours

DISCUSSION

Analysis of the cases revealed that the age of the patients varied from 4½ to 9 years and that they were all male, which is consistent with the findings in most series. The perforations were present in the mobile part of the bowel as well as at fixed points. The single patient who was operated on without delay was treated on the basis of clinical assessment, and special investigations were of no value in deciding this management.

Suggested Plan of Management

A review of the literature and assessment of our own clinical material has enabled us to formulate the following plan of management in blunt abdominal trauma:

1. There should be a careful initial clinical assessment.
2. A nasogastric tube is passed and left in place until intra-abdominal injury is excluded, and for at least 24 hours thereafter. Water-soluble contrast injected down the nasogastric tube can be of assistance in diagnosing a jejunal injury.
3. Intravenous electrolyte solution is given.
4. Rectal examination is important.
5. Urine examination is mandatory.
6. Close surveillance and careful radiological assessment of the presence of free fluid and air under the diaphragm is necessary. Intravenous pyelography or renal scan should always be carried out.
7. Paracentesis with microscopic examination of the aspirate should be done in selected cases.
8. Exploration of the abdomen should be undertaken with the following injuries to renal tract, liver and spleen that in themselves demand surgery; failure to improve on adequate treatment; marked local abdominal tenderness; air under the diaphragm; shock that cannot be explained; and the presence or development of ileus.

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