

Clinical Analysis and Treatment Results of Eighty Children Who Sustained Blunt Abdominal Trauma*

Naci Gürses, M.D.** / Akgün Hiçsönmez, M.D.***

Progress in the diagnosis and management of blunt abdominal trauma has reduced the mortality rate which has been very high in preceeding decades. Despite progress, mortality from blunt abdominal trauma in children ranks third after head trauma and burns.¹ Yet there are a few publications on the subject which present a sizable series.

In this paper we would like to analyze and give the treatment results of the blunt abdominal trauma cases that underwent surgery at Hacettepe University Medical School's Children's Hospital from 1967 to 1974.

Materials and Methods

At Hacettepe University Medical School's Children's Hospital the charts of children under fifteen years of age who underwent surgery because of blunt abdominal trauma were reviewed for the period of 1967 to 1974. Those patients who were admitted due to blunt abdominal trauma, but in which subsequent studies and observation findings did not suggest the need for surgery were omitted from this study, as were patients sustaining blunt trauma of the urinary systems requiring conservative treatment.

During the period mentioned, eighty children required surgery due to blunt abdominal trauma. The records of these patients were evaluated and analyzed according to the following criteria:

* From the Department of Pediatric Surgery. Hacettepe University, Children's Medical Center, Ankara, Turkey.

** Associate Professor of Pediatric Surgery.

*** Professor and Chairman of the Dept. of Pediatric Surgery.

1. Distribution of the cases for the years
2. Cause of trauma
3. Sex distribution
4. Age distribution
5. Elapsed time from moment of trauma to arrival at the hospital and its effect on mortality
6. Signs and symptoms
7. Physical examination findings
8. Paracentesis findings
9. Operative findings
10. Mortality

Findings

Of the eighty children that were operated on for blunt abdominal trauma, seventeen (21.25 %) were seen during the first four years (1967-1970), and sixty three cases (78.75 %) were seen during the second four year period, (1971-1974). See Table I.

TABLE I
DISTRIBUTION OF CASES FOR YEARS

Year	Number of Patients	
1967	2	21.25 %
1968	—	
1969	5	
1970	10	
1971	9	78.75 %
1972	8	
1973	10	
1974	36	
Total	80	

Distribution of cases for the years:

Cause of Trauma: In our series, the most frequent cause of trauma is traffic accident, with 53 cases (66.25 %). The second most frequent cause of blunt abdominal trauma with 22 cases (27.50 %) is a fall from a height such as from a balcony or a tree. (Table II).

TABLE II
CAUSES OF BLUNT ABDOMINAL TRAUMA

Cause of trauma	Number of patients	
Traffic accident	53	(66.25 %)
Fall from a height	22	(27.50 %)
Hit by a fist or kick	3	
Horse kick	2	
Total	80	

Sex Distribution: Fifty-nine of eighty children (73.75 %) operated on for blunt abdominal trauma were boys. The remaining twenty-one (26.25 %) were girls (Figure 1).

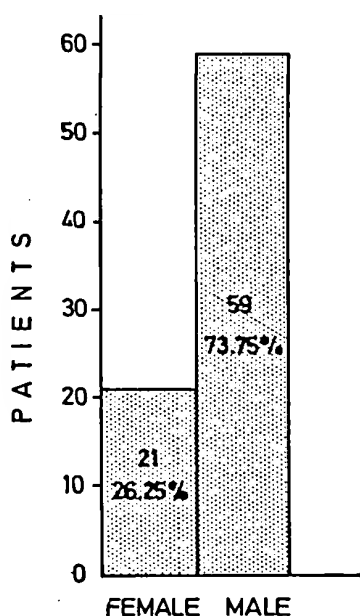


Figure 1

Sex distribution of 80 children operated for blunt trauma of the abdomen.

Age Distribution: Age distribution in this series, can be seen in figure 2. The youngest patient was eighteen months old, and the oldest fifteen years of age. Median age was 6.5 years. It was found that the three to six year old group was most liable to sustain blunt abdominal trauma.



Figure 2

Age distribution of 80 children operated for blunt trauma of the abdomen.

Elapsed Time From Moment of Trauma to Arrival at the Hospital and its Effect on Mortality.

Following trauma, twenty-three patients arrived within the first hour, sixteen within one to three hours, twelve within three to six hours, and eleven within six to twelve hours. Of the remaining eighteen patients, sixteen came to the hospital more than twelve hours following trauma. No record of lapse of time was found for two patients. Two patients from the 1-3 hour arrival group, and one patient from each of the 3-6, 6-12, and 24-48 hour arrival groups expired (Table III).

TABLE III

ELAPSED TIME FROM MOMENT OF TRAUMA TO ARRIVAL AT HOSPITAL AND ITS EFFECT ON MORTALITY

Elapsed time from trauma to arrival at hospital (hours)	No. of patients	Mortality
0 - 1	23	-
1 - 3	16	2
3 - 6	12	1
6 - 12	11	1
12 - 24	7	-
24 - 48	3	1
More than 48 hrs.	6	-
Not recorded	2	-
Total	80	5

Signs and Symptoms: Abdominal pain is the most frequent symptom for patients who sustained blunt abdominal trauma. Vomiting and hematuria are the associated findings (Table IV).

TABLE IV
SIGNS AND SYMPTOMS OF 80 CHILDREN WHO SUSTAINED BLUNT ABDOMINAL TRAUMA

SINGS AND SYMPTOMS	Number of patients
Abdominal pain	25
Abdominal pain, Vomiting	13
Abdominal pain, Hematuria	10
Abdominal pain, distension	2
Abdominal pain, left shoulder pain	2
Abdominal pain, vomiting, distension	1
Abdominal pain, fever	1
Abdominal pain, difficulty in breathing	1
Swelling of abdominal wall and pain	2
Difficulty in breathing	1
Unconsciousness or stupor	6
Not recorded	16

Physical Examination Findings: All six patients who were unconscious, also had head trauma. Eight of the sixty-nine patient's blood pressure was found to be below 80 mm/Hg systolic, the others were above this level. All of these eight patients had intra-abdominal bleeding, and five were in hypovolemic shock and had more than one intra-abdominal organ laceration.

In forty-three patients the pulse was above 120/minute, in eighteen below 120/minute, and in nineteen patients the pulse rate was not recorded.

It was found that in thirty-six patients there was abdominal tenderness and in twenty-seven, tenderness and muscle guarding. In two cases there was a tender mass, and in ten cases no record was found regarding the abdomen.

In seven patients bowel sounds were normal, in seven-increased, in fifteen-decreased, and in three absent. In one case, bowel sounds were audible in the left hemithorax. In forty-seven cases bowel sounds were not recorded (Table V).

TABLE V
PHYSICAL EXAMINATION FINDINGS

Physical Examination Findings	No. of patients
Unconsciousness or stupor	6
Blood pressure	
systolic more than 80 mm/Hg	61
systolic less than 80 mm/Hg	8
not recorded	11
Pulse	
above 120/minute	43
below 120/minute	18
not recorded	19
Abdominal tenderness	36
Abdominal tenderness, muscle guarding	27
Palpable tender mass	2
Normal abdominal examination	5
Abdominal examination, findings not recorded	10
Bowel sounds:	
Normal	7
Increased	7
Decreased	15
Not present	3
Heard in the chest	1
Not recorded	47

Thirty of the eighty patients who sustained blunt abdominal trauma also showed one or more sites of extra abdominal injuries. Extremities and head injuries, rib and pelvic fractures, pneumo and hemothorax were the most common site of extra abdominal injuries.

Paracentesis Findings: Paracentesis was performed in fifty-nine out of eighty patients. In one case it was false positive (1.69 %), in four cases false negative (6.77 %), and in fifty-four cases (91.52 %) the correct results were given.

Operative Findings: Operative findings of patients are shown in Table 6.

Splenic laceration:

It was found that in blunt abdominal trauma the most often injured organ in forty-eight cases (60 %) is the spleen. In all these cases splenectomy was performed (Table VI). Associated injuries to the ruptured spleen were in three cases liver lacerations, and in five cases, left renal lacerations. In one case, associated injuries included a ruptured spleen, transection of the pancreas and gastric perforation. (Table VII).

TABLE VI
ORGAN INJURIES ACCORDING TO FREQUENCY OF OCCURENCE

Operative findings	Number of patients
Ruptured spleen	48
Retroperitoneal hematoma	21
Gastrointestinal tract injuries	12 (9 perforations, 1 laceration, 1 intramural hematoma)
Urinary system injuries	10 (8 ruptured kidneys, 1 contusion of kidney, 1 rupture of urinary bladder)
Liver laceration	8
Right lobe 5	
Left lobe 3	
Pancreas injuries	1 (1 laceration, 1 transection)
Abscess of abdominal wall hematoma	2
Ventral hernia	2
Mesenteric bleeding	1
Ruptured left hepatic duct	1
Traumatic diaphragmatic hernia	1
Perforation of hydatid cyst of liver	1
Negative exploration	1

TABLE VII
ASSOCIATED ORGAN INJURIES TO THE RUPTURED SPLEEN

Operative findings	Number of patients
Spleen - liver laceration	3
Spleen - left kidney laceration	5
Spleen laceration, pancreas transection and gastric perforation	1
Total	9

There was no hypovolemic shock in thirty-nine patients with ruptured spleen only. On the contrary, five out of nine splenic rupture cases associated with other intra-abdominal organ lacerations showed hypovolemic shock.

Retroperitoneal Hematoma: In twenty-one cases (26.25 %), retroperitoneal hematoma was found. In nineteen of these cases the retroperitoneal space was explored. In the other two cases, the extent of the hematoma did not warrant exploration. (Table VIII).

Gastrointestinal Injuries: In twelve cases (15 %) gastrointestinal injuries were found (Table IX).

TABLE VIII
THE CAUSE OF RETROPERITONEAL BLEEDING

Cause of retroperitoneal bleeding	Number of patients
Laceration of kidney	9
Pelvis fracture	3
Ruptured urinary bladder	1
Left 9th and 10th rib fracture	1
Exploration not required	2
Despite exploration the obvious cause of bleeding was not found	5

TABLE IX
DISTRIBUTION OF GASTROINTESTINAL INJURIES IN TWELVE CASES

Injured Organ	Perforation	Laceration	Intramural Hematoma	No. of Patients
Stomach	2	1	—	3
Ileum	3	—	—	3
Jejunum	3	1	1	5
Colon	—	—	—	—
Appendix	1	—	—	1
Total				12

All gastrointestinal perforations were repaired with simple closure except in one case of jejunal perforation, resection, and end to end anastomosis was performed. Intramural hematoma of the jejunum did not require surgical intervention.

During exploration of one patient who had blunt abdominal trauma five days prior to coming to the hospital, ruptured appendicitis was found and appendectomy was performed.

Urinary System Injuries: In nine patients kidney injuries were found. The extent of the injury was such that five cases on the left and two cases on the right required nephrectomy. In one case of left kidney rupture, a partial nephrectomy was performed and in another case contusion of the right kidney was treated conservatively.

Liver Injuries: Liver lacerations were seen in eight cases, five of these in the right lobe and the other three in the left lobe of the liver. All of these lacerations were repaired with sutures.

Other injuries: Two cases of pancreas laceration were found. The first case involved a laceration of corpus of the pancreas and the other, transection of the pancreas at the level of corpus; in the latter, distal pancreatectomy and splenectomy were performed.

Two cases of abdominal wall abscess, secondary to traumatic hematoma, were incised and drained.

In two cases of intra-abdominal bleeding with associated epigastric hernia, exploratory laparotomy was performed and hernias were repaired. In one case an actively bleeding lymph node in the mesentery of the jejunum near the Treitz ligament was found and the lymph node was removed.

In one case, bile stained drainage was found at paracentesis. During exploration a laceration of left hepatic bile channel was found, primary repair and T-tube drainage of the common bile duct was performed.

One patient involved in a traffic accident six months prior to coming to our hospital developed difficulty in breathing two months following accident. Traumatic diaphragmatic hernia was found and repaired.

In one patient who had been kicked in the abdomen, hydatid cyst perforation of the liver was found and marsupialization was performed.

Negative Abdominal Exploration: In one patient who had had blunt abdominal trauma, the paracentesis was valued as positive and was taken to surgery. However, exploration of the abdomen was found to be negative.

Mortality

In our series the mortality, with five cases, is 6.25 %. Two cases of ruptured spleen died from intracranial hemorrhage. One patient who had a ruptured spleen, laceration of the liver and gastric perforation, died during the early post-operative period from hypovolemia. Reason for death was not explained in one case who died during early post-operative period following surgery for gastric perforation. One patient who had transection of the pancreas died on the 41st post-operative day because of acute hemorrhagic pancreatitis and sepsis.

Discussion

Abdominal trauma ranks third as cause of death of children.^{1,2} And the increased number of admissions of these cases to our hospital, (Table I) makes the subject worth while to discuss.

According to the reports, not only in our country, but all over the world, incidence of blunt abdominal trauma gradually increases.^{2,3,4}

In our series, included are blunt abdominal trauma cases that were operated on during an eight year period. Compared with the first four years, there is a 57.5 % increase of cases during the second four year period (Table I). The reason for this very fast rise in number of cases, in addition to the usual increase of traffic accidents, could be explained by the fact that the Hacettepe University Medical School and Hospital has become a large medical center with a much great increase in admissions through the years.

In children, the most frequent cause of blunt trauma to the abdomen was found to be traffic accidents (66.25 %), this followed with falls from a height (27.5 %), (Table II). These findings correspond with other series.^{1, 3, 5}

In our series, boys sustained more often blunt abdominal trauma than girls, as in the Welch², Westland et al⁶, Richardson et al¹ series. The probable reason for this is boys are prone to play outdoors more often than girls.

In our community the four to six year age group sustained blunt abdominal trauma more often than any other age group (figure 2), however, according to Welch² six to eight years, and Hood and Smyth³ the seven to nine year age group was involved more often. These three age groups are more apt to participate in unsupervised play.

Levy and Linder⁵ reported that the cases which were brought to the hospital early, were more critical and showed higher mortality. Four out of five of the mortality cases in this series arrived at the hospital in less than twelve hours following the accident. This statement also confirms the conclusion of these authors (Table III).

In this series, the most frequently observed symptom of blunt abdominal trauma is abdominal pain (Table IV), vomiting follows it. However, on physical examination, tenderness and muscle guarding are the main findings (Table V). In those patients who had intestinal perforation, tenderness and muscle guarding are the physical findings secondary to peritonitis, however, the same findings are also evident in intraperitoneal bleeding because of the irritant effect of blood on the peritoneal membrane.

More than 50 % of those patients in whom bowel sounds had been recorded, it was found that bowel sounds were absent or diminished as reported in other series.^{1, 2} In spite of this finding, if one thinks about the fact that examinations were performed by different physicians, the ways may differ in evaluating bowel sounds. To reach the conclusion that in blunt trauma of the abdomen, if bowel sounds disappear or are diminis-

hed, and use this assumption as a definite criteria for the diagnosis, this is in our opinion not good judgement. However, if bowel sounds are heard in the chest instead of breath sounds, this is a very valuable sign indicating traumatic hernia of the diaphragm, as in one of our cases (Table V).

In those patients who had a single solid organ laceration, such as spleen, liver and kidney, we did not see shock during the preoperative period. It was observed at surgery that in the majority of the patients bleeding had stopped. Hypotension, formation of a clot, adherence of the omentum and tamponade of the clots around the laceration of the organ, may have played a role in stopping bleeding. In addition to this there is an anatomical peculiarity of the splenic artery and its branches that it contracts and does not permit much bleeding² from the splenic laceration. Also, in children, the cardiovascular system adapts very well to slow blood loss.⁷ These facts may explain our clinical and operative findings. In five of nine patients where there was more than one organ laceration, hypovolemic shock was observed. This may indicate that risk increases as the number of organs involved increases.

For the diagnosis and indication for surgery of blunt trauma of the abdomen, paracentesis is a rather good method alongside with laboratory findings and X-ray. In our community paracentesis gave a correct diagnostic clue in 91.5 % of the cases; McCoy and Wolma⁸ also reported 91.4 % correct results from it. Because of the high percentage of correct results from paracentesis, it is mandatory to take the patients with a positive paracentesis to surgery. However, a negative paracentesis finding does not deny the possibility of intraperitoneal pathology from trauma.

In our cases the spleen is the most often ruptured organ as in the majority of the published reports^{1, 2, 9, 10} of blunt trauma of the abdomen. In order of frequency of their occurrence, retroperitoneal hematoma, gastrointestinal tract injuries, kidney, and liver lacerations follow splenic trauma. Liver-hydatid cyst perforation and perforated appendicitis following blunt trauma of the abdomen are rather interesting cases. It is difficult to say whether perforated appendicitis developed because of blunt trauma or not; however, this is an unusual coincidence which we include in our series.

In our series, the mortality percentage with five cases is 6.25 %. Two of these cases died from intracranial hemorrhage and another two had more than one organ lacerated. In the last case, gastric perforation caused death. Hood and Smyth³ reported 14.6 % mortality in 130 cases,

Engstrom³ 5 % in 40 cases, and Richardson et al¹⁰ % in 40 cases. Our mortality figure corresponds to the literature figures.

Summary

In this study, the eighty cases of blunt abdominal trauma that underwent surgery at Hacettepe University Medical School's Children's Hospital, from 1967 to 1974 have been analyzed and clinical outcome has been discussed.

There has been an increase in the incidence of blunt trauma of the abdomen during the last four years of this study, and the most frequent cause of trauma is traffic accidents. The majority of the patients being boys and the most often involved age group is four to six years. It was demonstrated that in blunt trauma of the abdomen the main symptoms are abdominal pain and vomiting; on physical examination abdominal tenderness and muscle guarding are the most often seen findings. Paracentesis is a rather good diagnostic test since cases in whom the test was performed, in 91.5 % correct result was obtained.

In our series of blunt trauma of the abdomen cases, the spleen was injured most often, then in order of frequency, retroperitoneal hematoma and gastrointestinal tract injury. Two of the five patients died from extra-abdominal causes.

REFERENCES

1. Richardson, J. A., Belin, P. R., Griffan, W. O.: Blunt abdominal Trauma in Children. *Ann. Surg.*, 176: 213, 1972.
2. Mustard, W. T., Ravitch, M. M., Snyer, W. H., Welch, K. L., Benson C. D.: *Pediatric Surgery. Year Book Medical Publishers. INC., Chicago, 1968, p. 709.*
3. Hood, J. M., Smyth, B. T.: Nonpenetrating intra-abdominal injuries in children. *J. Pediatr. Surg.*, 9: 69, 1974.
4. Zollinger, R. W., Creldon, P. J., Sanguily, J.: Trauma in children in a general hospital. *Amer. J. Surg.*, 104: 855, 1962.
5. Levy, J. L., Linder, L. H.: Major Abdominal Trauma in Children. *Amer. J. Surg.*, 120: 55, 1970.
6. Westland, J. C., Greaney, E. M., Snyder, W. H.: Experience with abdominal trauma in children. *Surg. Gynec. Obstet.*, 63: 609, 1955.
7. Toulonkian, R. J.: Abdominal trauma in childhood. *Surg. Gynec. Obstet.*, 127: 561, 1968.
8. Mc Coy, J., Wolma, F. J.: Abdominal Tap. *Amer. J. Surg.*, 122: 693, 1971.
9. Mathewson, C.: Early Management of Trauma Patient. *Surg. clin. North. Am.*, 52: 531, 1972.
10. Rosoff, L., Cohen, J. L., Telfer, N., Helgern, M.: Injuries of the spleen. *Surg Clin. N. Amer.*, 52: 667, 1972.