



Clinical importance of ultrasonographic pelvic fluid in pediatric patients with blunt abdominal trauma

Künt karın travmalı pediatrik hastalarda ultrasonografiyle saptanan pelvik sıvının klinik önemi

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BACKGROUND

The aim of this study was to evaluate the significance of the ultrasonographic finding of pelvic fluid as a predictor of organ injury in pediatric patients with blunt abdominal trauma.

METHODS

We reviewed retrospectively the medical records of 85 consecutive pediatric patients who admitted to the Emergency Department of Dicle University from January 2008 to December 2008 with blunt abdominal trauma. Age, gender, mechanism of injury, isolated injuries, surgical interventions, hospitalization, and mortality were evaluated according to the location of fluid.

RESULTS

A total of 85 pediatric patients (63 male, 22 female; mean age: 7.88±3.403 years) with blunt abdominal trauma were included in the present study. Forty percent of the patients had intraperitoneal fluid, while 60% had pelvic fluid. The majority (35.3%) of patients applied due to falling from height. The difference between the mechanism of the injuries and location and presence of the fluid was not statistically significant ($p>0.05$). Twenty-nine patients had solid organ injuries. Splenic injuries showed the highest association with intraperitoneal fluid ($p<0.001$). Of the patients, 15.3% underwent exploratory laparotomy and 44.7% required blood transfusion. The presence of intraperitoneal fluid statistically increased the probability of the exploratory laparotomy and necessity of blood transfusion ($p<0.001$). Mortality rate was 4.8%.

CONCLUSION

In ultrasound examination, it was determined that the probability of solid organ injury was lower in the presence of pelvic fluid, while it was higher in the presence of intraperitoneal fluid outside the pelvis.

Key Words: Emergency department; fluid location; organ injury; pediatric trauma; ultrasonography.

AMAÇ

Bu çalışmada, pediatrik künt batın travmalı hastalarda organ hasarının bir göstergesi olarak ultrasonografiyle saptanan pelvik sıvı varlığının önemi değerlendirildi.

GEREÇ VE YÖNTEM

Ocak 2008 ve Aralık 2008 tarihleri arasında Dicle Üniversitesi Tıp Fakültesi Hastanesi Acil Servisine künt karın travması ile başvuran ardışık 85 pediatrik hastanın kayıtları geriye doğru değerlendirildi. Hasta yaşı, cinsiyeti, yaralanma mekanizması, izole yaralanmalar, cerrahi girişimler, hastaneye yatış ve mortalite mayi yerleşimine göre değerlendirildi.

BULGULAR

Künt karın travması olan toplam 85 pediatrik hasta (63 erkek, 22 kız; ortalama yaş 7,88±3,403 yıl) bu çalışmaya dahil edildi. Hastaların %40'ında intraperitoneal sıvı, %60'ında pelvik sıvı vardı. Hastaların çoğu (%35,3) yüksekten düşme nedeni ile başvurmuşlardı. Yaralanma mekanizması ile sıvı varlığı ve sıvı yerleşimi arasındaki fark istatistiksel olarak anlamlı değil idi ($p>0,05$). Yirmi dokuz hastada solid organ yaralanması vardı. İntraperitoneal sıvıyı en çok arttıran dalak yaralanması idi ($p<0,001$). Hastaların %15,3'üne laparotomi yapıldı (bunların tümünde intraperitoneal sıvı vardı) %44,7 hasta kan transfüzyonuna ihtiyaç duydu. İntraperitoneal sıvı varlığı laparotomi olasılığını ve kan transfüzyon ihtiyacını istatistiksel olarak artırmıştı ($p<0,001$). Mortalite oranı %4,8 idi.

SONUÇ

Ultrasonografi incelemesinde pelvik sıvı varlığında solid organ yaralanma olasılığı daha düşük iken, pelvis dışı intraperitoneal sıvı varlığında solid organ yaralanma olasılığı daha yüksektir.

Anahtar Sözcükler: Acil servis; sıvı yerleşimi; organ yaralanması; pediatrik travma; ultrasonografi.

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The Emergency Department (ED) evaluation of the acutely traumatized patient is difficult, in part because of poor sensitivity of the physical examination.^[1-3] The problem may be worse in the pediatric population, where communication and cooperation can be difficult. Neither triage trauma score nor physical findings have been useful in identifying injuries in pediatric trauma patients.^[1] Delays in diagnosis can be fatal. In different reviews of in-hospital fatalities after blunt trauma, two-thirds were considered to be the result of delays caused by imaging studies.^[1,4]

Emergency medicine physicians and surgeons use the presence of intraperitoneal fluid (IF) as an indicator of intra-abdominal injury and possible need for exploratory laparotomy.^[5] Because the majority of abdominal solid organ injuries hemorrhage into the peritoneal cavity, abdominal ultrasound (US) serves an important role in detecting patients with such injuries.^[5-7]

The primary role of abdominal US in the evaluation of patients with blunt trauma is to detect IF because the most clinically significant of intra-abdominal injuries are associated with hemoperitoneum.^[6,8]

The purpose of this study was to determine the importance of IF versus pelvic fluid (PF) in pediatric patients with blunt abdominal trauma.

MATERIALS AND METHODS

We retrospectively reviewed the medical records of 85 consecutive pediatric patients (<18 years of age) who admitted to the ED of Dicle University from January 2008 to December 2008 with blunt abdominal trauma. Ultrasonography was used for detecting intra-abdominal fluid. All data of patients were obtained from the ED records. The patients with penetrating abdominal trauma and those with insufficient surgical and radiographic records were excluded from the study. The records of all patients were reviewed in a defined sequence by using a single structured format. Demographic, historical data and final diagnoses were obtained from the ED Trauma records.

All ultrasonographic examinations were performed in the ED by radiologists. A portable scanner with 3.5 MHz and 5.0 MHz probes was used. The US protocol for abdominal trauma in the study included the following views: intraperitoneal (Morison's pouch, splenorenal fossa, paracolic gutters) and pelvis. All US examinations documented presence of fluid. The quantity of IF on an examination was not determined; however, the location of the fluid was recorded.

Any identifiable injuries to the liver, spleen, pancreas, gastrointestinal tract (from stomach to sigmoid colon), adrenal glands, gallbladder, or urinary tract were defined as intra-abdominal injuries. A patient was considered to have an intra-abdominal injury if

identified with exploratory laparotomy or visualized on abdominal computed tomography (CT).

Categorical data were analyzed using the Fisher's exact test. Continuous data were analyzed using Student t-test. Continuous data are described as the mean \pm 1 standard deviation (SD). Values of $p < 0.05$ were considered statistically significant. Data were analyzed with SPSS software version 10.0 (SPSS, Inc., Chicago, Illinois).

RESULTS

Eighty-five patients (mean age: 7.88 ± 3.403) with intra-abdominal fluids were identified by abdominal US after a blunt abdominal trauma. All patients underwent abdominal CT scan or exploratory laparotomy. Of the patients, 34 (40%) had IF, while 51 (60%) had PF. Sixty-three patients (74.1%) were male and 22 (25.9%) were female. Of males, 27 (31.7%) had IF and 36 (68.3%) had PF. The ratio of IF and PF in females was 31.9% ($n=7$) and 68.1% ($n=15$), respectively. Mean age of patients with IF and PF was 8.62 ± 3.162 and 7.39 ± 3.499 years, respectively. The differences between gender and age due to presence and location of the IF and PF were not statistically significant ($p > 0.05$) (Table 1).

Mechanism of Injury and Location of Fluid

The majority (35.3%) of patients applied due to falling from height, followed by motor vehicle accident (27.06%), motorcycle accidents (18.9%), abuse (12.9%), and automobile versus pedestrian (5.8%) (Table 1). The difference between the mechanism of the injuries and location and presence of the fluid was not statistically significant ($p > 0.05$) (Table 1).

Isolated Injuries and Location of Fluid

Twenty-nine (34.1%) patients had solid organ injuries. The commonest solid organ injury was splenic injury, followed by hepatic, gastrointestinal tract, renal, and pancreatic injury. The ratios of isolated organ injuries were higher in patients with IF (34.1%) than in patients with PF (2.3%). Presence of IF was significantly associated with (without pancreatic injuries, $p=0.061$) solid organ injuries ($p < 0.005$). Splenic injuries showed the highest association with IF ($p < 0.001$) (Table 2).

Laparotomy and Location of Fluid

Of the patients, 13 (15.3%) (all had IF) underwent exploratory laparotomy and 38 (44.7%) (28 had IF, 10 had PF) necessitated blood transfusion. The presence of IF statistically increased the probability of the exploratory laparotomy and necessity of blood transfusion ($p < 0.001$) (Table 2).

Hospitalization and Fluid Location

The patients with solid organs injury, IF, signs of

Table 1. Demographic data of patients

Characteristic	Intraperitoneal fluid (n=34)	Isolated pelvic fluid (n=51)	Total
Sex			
Male	27	36	63
Female	7	15	22
Age	8.62±3.16	7.39±3.50	7.88±3.403
Mechanisms of injury			
Motor vehicle accident	9	14	23
Automobile versus pedestrian	1	4	5
Falls	11	19	30
Abuse	7	4	11
Motorcycle accident	5	11	16
Results			
Recovered	31	50	81
Exitus	3	1	4

peritonitis (sensitivity, tightness, defense and rebound in abdomen), acidosis, electrolyte imbalance, hypotension (systolic blood pressure <85 mmHg), needing blood transfusion (hemoglobin <10 mg/dl), tachycardia (120 beat/min), tachypnea, fever (>38°C), and oliguria (<1 cc/kg/h)/anuria were observed in pediatric surgery clinics. Fifty-one (60%) were hospitalized in the pediatric surgery clinic, while 34 (40%) were observed in the ED. The patients with IF were mostly followed in pediatric surgery clinics, while the patients with PF were mostly followed in the ED. The presence of IF after blunt abdominal trauma in pediatric patients is a hospitalization indication to the pediatric surgery clinic ($p<0.001$) (Table 2).

Mortality and Fluid Location

Four patients (4.8%) (3 had IF, 1 had PF) died. Of the exitus patients, 2 had splenic, 1 had hepatic, and the other had gastrointestinal tract injury. The mortality rate in patients with IF (0.09%) was higher than in patients with PF (0.02%). The association between survey and location and presence of fluid was not statistically significant ($p=0.174$).

DISCUSSION

Abdominal US is useful in screening for injury in patients with blunt abdominal trauma, and its use represents a notable change in institutional practice.^[8-10] With the increasing use of abdominal US in the evaluation of injured patients, it is important to define accurately the clinical significance of intra-abdominal fluid. In addition, patients with intra-abdominal injuries and abdominal fluid are more likely to undergo exploratory laparotomy.^[5] Investigating the sensitivity of abdominal US was not the purpose of this study, but rather we sought to determine the location of IF in patients with intra-abdominal injuries. In this study, all patients with intra-abdominal injuries had intra-abdominal fluid.

The FAST examination traditionally includes images of Morison's pouch, the left upper quadrant, and the pelvis. The abdominal trauma US protocol in the current study included the following views: intraperitoneal (Morison's pouch, splenorenal fossa, paracolic gutters) and the pelvis.^[8]

Although extensively discussed in the adult popu-

Table 2. Injuries, clinical intervention and place of observation

Characteristic	Intraperitoneal fluid (n)	Isolated pelvic fluid (n)	Total
Isolated Injuries			
Hepatic	7	1	0.006
Splenic	13	0	0.001
Gastrointestinal tract	5	0	0.008
Renal	4	1	0.081
Pancreatic	3	0	0.061
Clinical Intervention			
Laparotomy	13	0	0.001
Blood transfusion	28	10	0.001
Place of Observation			
Pediatric surgery	32	19	0.001
ED	2	32	0.001

lation, little has been reported on outcomes and management of pediatric liver injury.^[11] Klapheke et al.^[11] found that a higher rate of liver-related mortality was seen in the pediatric population. In the present study, of 85 pediatric patients with intra-abdominal fluid, 8 (7 IF, 1 PF) had isolated hepatic injury and 13 (13 IF) had isolated splenic injury, and 5 (5 IF) had gastrointestinal tract injury. Presence of IF increased the risk of hepatic ($p=0.006$), splenic ($p=0.000$), and gastrointestinal tract injuries ($p=0.008$). IF was significantly associated with hepatic, splenic and gastrointestinal tract injuries.

A prior study on abdominal US showed the pelvis and Morison's pouch to have equal sensitivities for the detection of abdominal fluid in patients with isolated gastrointestinal injury.^[12] In our study, data showed significant association between IF and organ injuries. Presence of PF did not increase the risk of abdominal organ injuries. In contrast, it was reported in Rathaus et al.'s^[13] study that normal US examination or the presence of PF was associated with a low probability of an organ injury. It was also emphasized in that study that the presence of peritoneal fluid outside the pelvis was strongly related with an organ injury. This result supports ours.

Hulka's group reported a 9% (24/259 patients) incidence of isolated intra-abdominal fluid on CT scan in children with blunt trauma. They found that patients with a moderate amount of fluid were statistically significantly more likely to need a therapeutic laparotomy than those who had only a small amount of fluid.^[14,15] In our study, 13 (15.3%) patients, all of whom had IF, underwent exploratory laparotomy. None had isolated PF. Patients with IF were at an increased risk of undergoing exploratory laparotomy ($p<0.001$).

Robinson et al.^[16] had explained that blood transfusion was a strong independent predictor of mortality and hospital length of stay in patients with blunt liver and spleen injuries. In William et al.'s study and also in our study, IF was significantly associated with blood transfusion ($p<0.001$). In our study, of the patients requiring blood transfusion ($n=38$), 73.7% had IF.

Holmes and his colleagues observed 527 children with blunt abdominal trauma prospectively. They recommended that all patients with abdominal pain and isolated free fluid should be admitted to the hospital for repeat physical examinations.^[15,17] Current practice in many trauma centers related to pediatric patients recommends repeat observation despite normal abdominal CT scans.^[18,19] In this study, presence of IF was significantly associated with pediatric surgery hospitalization ($p=0.001$). Presence of PF was significantly associated with ED observation ($p=0.0011$). These results were confirmed by our study.

The limitations: The present study was made retrospectively. Radiologic and operative reports may have been incomplete, or full findings were not dictated in the final reports. The current study investigated patients who underwent exploratory laparotomy, not patients who necessarily required exploratory laparotomy. Indications for laparotomy are in a state of transition and vary among different facilities.

In conclusion, the presence of PF in US examination is associated with a low probability of an organ injury. Probability of an organ injury is very high in the presence of peritoneal fluid outside the pelvis. The major solid organ injury was splenic injury. Splenic injuries showed the highest association with IF.

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