Blunt abdominal trauma: evaluation of diagnostic options and surgical outcomes

Künt karın travması: Tanı yöntemlerinin değerlendirilmesi ve cerrahi sonuçlar

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BACKGROUND
In the present study, it is intended to outline the diagnostic tests and their influences on decisions of the surgeon about patients presented with blunt abdominal trauma.

METHODS
One hundred forty-four patients (98 males, 46 females; mean age 36; range 17 to 84 years) admitted to Gazi Universty School of Medicine due to blunt abdominal trauma (BAT) between May 2003-May 2005 were reviewed retrospectively. Age, gender, injury mechanism, Glasgow Coma Scale, revised trauma score, follow-up period, applied diagnostic procedures, and treatment methods were evaluated.

RESULTS
The underlying cause was traffic accident in 126 (87.5%) patients, fall from height in 14 (9.7%) patients, and blows in 4 (2.8%) patients. Isolated abdominal trauma was seen in 21 patients and multisystem trauma in 123 patients. The most frequent associated trauma was head injury (66.6%). Abdominal ultrasonography (USG) was applied in 139 (97%) of the patients, and abdominal computed tomography (CT) was performed in 73 (51%). Diagnostic peritoneal lavage (DPL) was applied in 41 (28%) patients, and 15 (37%) of them proved to be positive. While emergency laparotomy was applied in 19 (13.2%) of the patients, 21 hemodynamically stable patients were diagnosed to have free fluid through USG and CT and were followed-up. During the follow-up period, 2 patients were scheduled to be operated, and small intestine perforation was found in these patients. The overall mortality rate for all patients was 16%, and the postoperative mortality rate with respect to the operated patients was 14.3%.

CONCLUSION
If USG, CT, and DPL are applied in a complementary manner, a large number of patients with solid organ injuries secondary to blunt trauma can be managed nonoperatively. Thus, unnecessary laparotomies can be avoided and related morbidities and mortalities decreased.

Key Words: Abdominal injuries/therapy; blunt abdominal trauma; diagnostic tests; laparotomy;multiple trauma; unnecessary laparotomy.

AMAÇ
Künt karın travması ile başvuran hastalara uygulanan tanısal testlerin ortaya konulması ve bunların cerrahın kararları üzerine olan etkilerinin incelenmesi amaçlandı.

GEREÇ VE YÖNTEM
Gazi Üniversitesi Tıp Fakültesi'ne Mayıs 2003-Mayıs 2005 tarihleri arasında künt karın travması nedeniyle başvuran 144 hasta (98 erkek, 46 kadın; ort. yaş 36; dağılım 17-84 yaş) geriye dönük olarak incelendi. Hastalar yaş, cinsiyet, yaralanma mekanizması, Glasgow Koma Skalası, revize edilmiş travma skoru, izlem periyodu, uygulanan tanısal testler ve tedavi yöntemleri açısından değerlendirildi.

BULGULAR
Travma nedeni hastaların 126'sında (%87,5) trafik kazası, 14'ünde (%9,7) yüksekten düşme, 4'ünde (%2,8) ise darp olarak saptandı. Hastaların 21'inde izole karın travması, 123'ünde ise çoklu sistem yaralanması mevcuttu ve en sık karın travması ile birlikte görülen travma kafa travmasıydı. Hastaların 139'una (%97) karın ultrasonografisi (USG), 73'üne (%51) karın bilgisayarlı tomografisi (BT) uygulandı. Diyagnostik peritoneal lavaj (DPL) 41 hastaya (%28) yapıldı ve bunların 15'inde (%37) pozitif olarak değerlendirildi. On dokuz hastaya (%13,2) acil laparotomi yapılırken, karın USG ve BT'sinde serbest sıvı saptanan, hemodinamik olarak stabil olan 21 hasta takibe alındı. Bu hastalardan ikisine takip sırasında laparotomi kararı alındı ve ameliyatta intestinal perforasyon olduğu görüldü. Genel mortalite %16, cerrahi uygulanan olgularda ise mortalite %14,3 olarak bulundu.

SONUÇ
USG, karın BT'si ve DPL birbirinin alternatifi olan incelemeler olarak görülmemelidir. Bu incelemeler bir bütünün tamamlayıcıları olarak kullanıldığında, künt karın travmasına ikincil solid organ yaralanması olan birçok hasta ameliyat edilmeden izlenebilecektir. Böylelikle gereksiz laparotomiler ve bunların neden olacağı mortalite ve morbiditeler önlenmiş olacaktır.

Anahtar Sözcükler: Çoklu travma; gereksiz laparotomi; karın yaralanması/tedavi; künt karın travması; laparotomi; tanısal testler.

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Currently, trauma is the most common cause of death in the age group of 15-45 years.[1] Abdomen is the third most frequently injured region with injuries requiring surgery in civilian trauma victims. Abdominal trauma is present in 7-10% of all trauma victims and 85% of those abdominal traumas are of blunt character.[2-4] The presence of blunt abdominal trauma (BAT) along with other injuries poses a difficulty in diagnosis and accounts for higher mortality and morbidity.[5-8] The most common causes of BAT are road traffic accidents followed by pedestrian accidents, abdominal blows and fall from heights.[9]

In the present study, we present the diagnostic examinations of patients referred to the emergency room due to BAT, correlation of these examinations with clinical and laboratory results, and the treatment methods along with their results. We also outline challenging diagnostic approaches in terms of ultrasonography (USG), abdominal computed tomography (CT), and diagnostic peritoneal lavage (DPL).

MATERIALS AND METHODS

One hundred forty-four patients admitted to Gazi University School of Medicine due to BAT between May 2003-May 2005 were reviewed retrospectively. The patients were evaluated in terms of age, gender, injury mechanism, Glasgow Coma Scale, revised trauma score,[10] follow-up period, applied diagnostic and surgical procedures, and treatment methods.

On admission, all patients were resuscitated with intravenous (IV) fluids/blood transfusion and advised bedrest with hemodynamic monitoring at hourly intervals. Serial hematocrit, hemoglobin estimation, blood grouping and cross-matching, and other appropriate laboratory investigations were performed. Appropriate antibiotic therapy and tetanus prophylaxis were also instituted. All patients were subjected to straight X-ray of thorax, abdomen and pelvis, but abdominal USG, CT and DPL were not used routinely in all patients. Initially, FAST (Focused Abdominal Sonography for Trauma) was applied as an abdominal USG method and in required patients, a detailed sonographic evaluation was performed. Alert and hemodynamically stable patients (as indicated by normal vital signs, urine output of 30-50 ml/hr and minimal blood product requirement) in whom free fluid and/or solid organ injury was determined in abdominal USG and CT were scheduled for follow-up. FAST and/or DPL were chosen for initial management in hemodynamically unstable patients. A decision for laparotomy was undertaken based on one or more of the following criteria:

1. Obvious clinical deterioration with increasing abdominal pain, tenderness, rigidity and distention and progression of abdominal findings.

2. Unexplained, sustained hypotension, unexplained hematocrit and hemoglobin drop, and new findings on abdominal USG control or CT (Fig. 1).

During the assessment of the study data, we investigated the distribution of categorical measurements according to the frequency and percentages while we described our numerical parameters with mean and standard deviations.

RESULTS

During the review period, 144 patients [98 (68%) males; 46 (32%) females; mean age 36; range 17 to 84 years] admitted to Gazi University School of Medicine were evaluated. The commonest cause of the BAT was road traffic accidents in 126 (87.5%) patients, followed by fall from heights in 14 (9.7%) and abdominal blows in 4 (2.8%). The mean Glasgow Coma Score of the patients was 11 (range: 3-15) and the mean revised trauma score was 10 (range: 0-12). The most common clinical complaint was abdominal pain and was present in 115 (80%) patients. The abdominal signs of 29 (20%) patients could not be evaluated. Twenty-one (15%) of the patients were admitted due to isolated BAT and an associated injury was seen in 123 (85%) of 144 patients. Head injury was the most common coincidental injury with BAT and was present in 76 (53%) patients. Other injuries were pelvis-extremity fracture in 59 (41%) patients and rib fracture and/or hemo-pneumothorax in 53 (36%) patients (Table 1).

Overall, USG was applied in 97% of the patients, CT was used in 51%, and DPL was performed in 28%. USG was applied alone in 56 patients, USG + CT in 47 patients, USG + CT + DPL in 26 patients, and DPL alone in 5 patients (Table 2).

Immediate laparotomy was performed in 19 patients. The most frequently injured organs during

exploration were spleen and liver. Some patients had more than one injury. Splenectomy was the most frequently performed surgical procedure in operated patients (57%) followed by liver repair and hemorrhage control. Twenty-one hemodynamically stable patients in whom free fluid and/or solid organ injury (grade 1-2) was determined via abdominal USG and CT were scheduled for follow-up. In 10 patients spleen injury, in 14 patients liver injury, in 1 patient kidney injury was present, and moreover, 1 patient had a retroperitoneal hematoma (1 or more in 1 patient). The mean follow-up period of the patients was 36.3 hours. During the follow-up period, 2 of these patients were operated due to findings in USG, CT and DPL, and small intestine perforation was determined (Table 3).

A total of 22 out of 144 patients were exitus in the study and overall mortality rate was 15.2%. Nine of these patients died due to serious brain injury, 8 due to cardiac causes, 3 due to sepsis, 1 due to acute respiratory distress syndrome, and 1 due to pulmonary embolism. Three of the 21 operated patients due to BAT were exitus postoperatively and the postoperative mortality rate was determined to be 14.3%. Two of these three patients (1 with liver, jejunum and mesentery injury and 1 with liver, common bile duct, and spleen injury and retroperitoneal hematoma) died due to sepsis, and the third died due to associated serious brain injury (Table 3).

DISCUSSION

Evaluation of patients who have sustained BAT may pose a significant challenge even to the most experienced surgeon. Blunt trauma produces a spectrum of injuries from minor, single-system injury to devastating, multi-system trauma. Clinical abdominal examination is inaccurate for the assess-

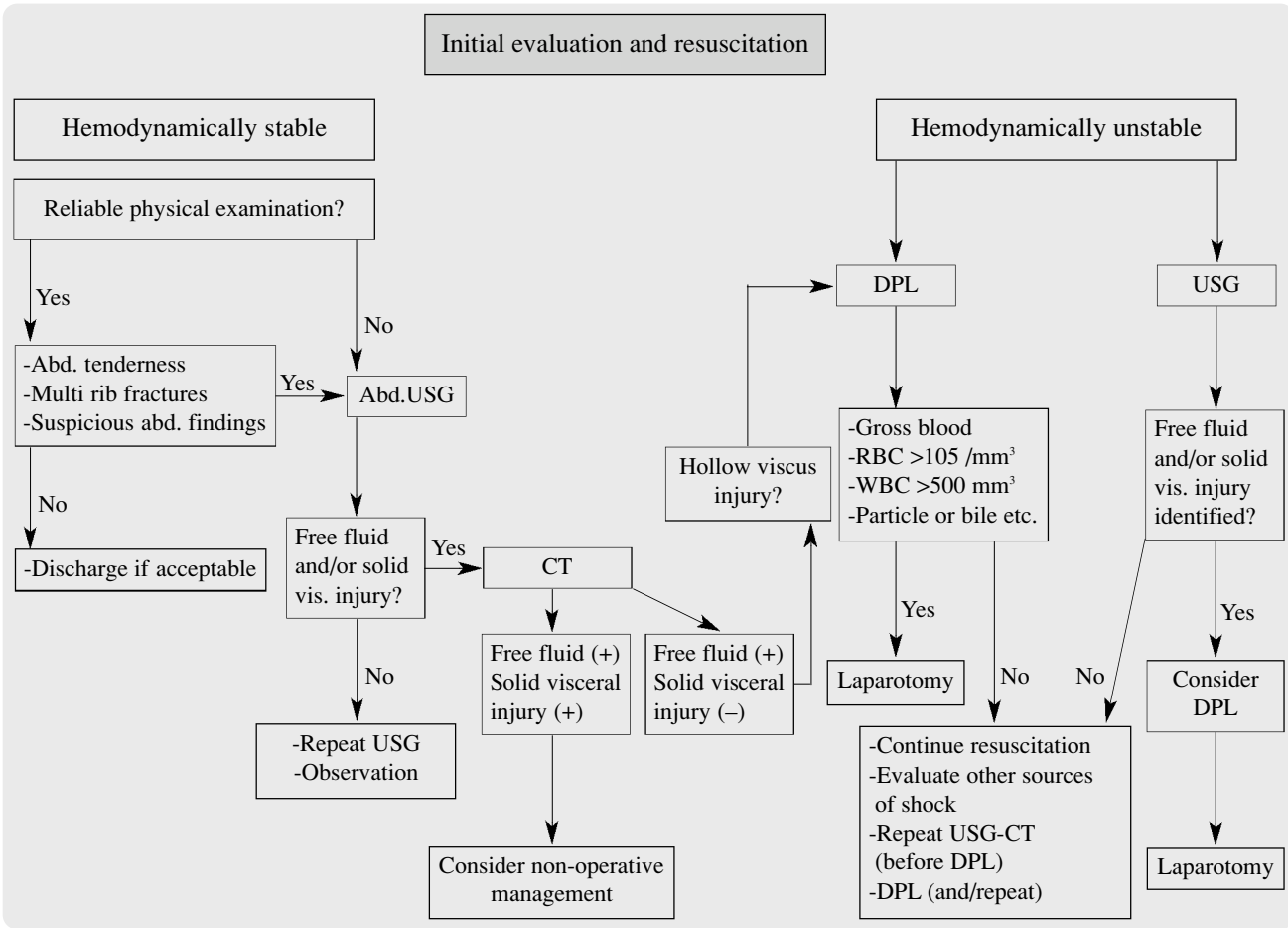

Fig. 1. Algorithm of diagnostic approaches in BAT.

ment of the BAT patients since there are often distracting injuries, altered levels of consciousness, nonspecific signs and symptoms, and large differences in individual patient reactions to intra-abdominal injury.[11] Forty percent of patients with hemoperitoneum do not have any peritoneal findings. This fact manifests itself more significantly in extraabdominal injuries, head trauma, and alcohol intoxications.[12] 23-36% of intraabdominal trauma patients do not reveal any significant signs. The timely and proper application of imaging methods in BAT patients along with physical examination have significantly decreased the number of non-therapeutic and unnecessary laparotomies as a result.[13-16]

The application of FAST in evaluation of BAT patients has resulted in a decrease of DPL, which is an invasive procedure. A few advantages of FAST

Table 1. Demographic characteristics of the patients

	n (%)
Total number of patients	144
Age (year)	
Mean	36
Range	17-84
Males / Females	98 (68%) / 46 (32%)
Blunt injury mechanism	
Motor vehicle accidents	126 (87.5%)
Fall from heights	14 (9.7%)
Abdominal blows	4 (2.8%)
Abdominal sign	
Abdominal pain	114 (80%)
Muscular rigidity	58 (40%)
Rebound tenderness	11 (8%)
Could not be evaluated	29 (20%)
Glasgow Coma Score	
Mean	11
Range	3-15
Revised Trauma Score	
Mean	10
Range	0-12
Concomitant injuries (One or more in one patient)	
Head injury	76 (53%)
Pelvic and/or extremity fracture	59 (41%)
Chest trauma	53 (36%)

Table 2. Applied diagnostic tests and the results

	n (%)
Applied diagnostic test(s) per patient	
USG	56 (39%)
USG + DPL	10 (7%)
USG + CT + DPL	26 (18%)
USG + CT	47 (33%)
DPL	5 (3%)
Subjective results of each test	
USG	139 (97%)
Free fluid	39 (28%)
Solid organ injury	13 (9%)
CT	73 (51%)
Free fluid	28 (38%)
Solid organ injury	27 (37%)
DPL	41 (28%)
Positive	15 (37%)
Negative	26 (63%)

Table 3. Operative findings, applied surgical procedures in laparotomy and mortality rates

	n (%)
Total laparotomy	21 (14.5%)
Operative findings (one or more in one patient)	
Spleen injury	12 (57%)
Liver injury	8 (38%)
Small bowel injury	2 (9.5%)
Colon injury	3 (14.2%)
Mesentery injury	3 (14.2%)
Diaphragmatic rupture	2 (9.5%)
Retroperitoneal hematoma	2 (9.5%)
Common bile duct injury	1 (5%)
Stomach injury	1 (5%)
Urinary bladder injury	1 (5%)
Applied surgical procedure (one or more in one patient)	
Splenectomy	12 (57%)
Liver repair and hemorrhage control	7 (33%)
Liver lobectomy	1 (5%)
Small bowel resection-anastomosis	4 (19%)
Colostomy	2 (9.5%)
Colon resection	1 (5%)
Primary bladder repair	1 (5%)
Diaphragm repair	2 (9.5%)
Mesentery repair	2 (9.5%)
Common bile duct repair	1 (5%)
Overall mortality	
Serious brain injury	22 (15.2%)
Cardiac causes	9 (6.2%)
Sepsis	8 (5.5%)
Acute respiratory distress syndrome	3 (2.1%)
Pulmonary embolism	1 (0.7%)

over other diagnostic tests are shortness of duration (approximately 3 minutes), low cost, availability, repeatability, exclusion of ionized radiation, and bedside applicability.[9] Actually, as seen in our study, FAST is a technique that can be immediately applied to all of the patients presented with BAT.[4,17,18] In our patients, USG was safely used in 97% of the patients for assessment. On the other hand, using the presence of free fluid or solid organ injury in USG as a threshold for laparotomy would have subjected 52 patients to a negative exploration.

DPL still has an important role in diagnosis of hollow viscus injury and may reduce the rate of non-therapeutic laparotomy in patients with free intraperitoneal fluid revealed by CT scan without evidence of solid organ injury, which could otherwise be treated non-operatively. It is also still useful in hemodynamically unstable patients when USG is not available.[15,19,20] Especially in hemodynamically unstable and unconscious patients and those patients requiring immediate operation for extraabdominal causes, DPL was chosen for the initial management in our group. The main disadvantages of DPL are painful and invasive characteristics of the procedure, relatively high false-positive results and misleading effect in the following USG and CT results, due to administered fluids and leakage of air. When used in combination with USG, it provides an accuracy of 90% in hemoperitoneum diagnosis.[7]

CT is a preferred diagnostic method in stable trauma patients. It can display and show the extent of specific organ injuries and lacerations of liver, spleen, and kidney, pelvic injuries, and retroperitoneal hematomas. CT should be performed in patients with central nervous system injuries and unexplained fluid loss, and in the physical examinations of small children that can not be evaluated properly.[17,18] In BAT patients, non-operative approaches are gradually becoming widespread especially in solid organ injuries. Thus, as a result of decline in the non-therapeutic laparotomy rate, morbidity, mortality, and hospitalization periods have decreased.[11,21,22] Combination of CT with USG and DPL has an important role in the decision of laparotomy (47 patients and 26 patients, respectively) and may reduce the rate of unnecessary laparotomy. Especially in solid organ injuries, CT has proven to be of significant assistance despite its disadvantages, such as long time requirement, high cost, need for experienced personnel, and inefficacy in viscus perforations.[23,24]

In the present study, the most frequently injured organs were spleen and liver. Twenty-one hemodynamically stable patients were followed up despite solid organ injury findings and thus, the rate of unnecessary laparotomy was decreased. Based on the above recommendations, a reasonable diagnostic approach to BAT is summarized in Fig. 1.

In conclusion, various diagnostic modalities have evolved to assist the trauma surgeon in the identification of abdominal injuries. The specific tests selected are based on the clinical stability of the patient, the ability to obtain a reliable physical examination and the provider's access to a particular modality. It is important to emphasize that DPL, USG, and CT should not be seen as competitive or alternative diagnostic methods. If these techniques are applied in a complementary rather than an exclusionary way, patients can be evaluated rapidly and safely and non-therapeutic laparotomies can be avoided.

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