ORIGINAL ARTICLE

Successful non-operative management of blunt abdominal trauma in highly selective cases: A safe and effective choice

Georgios Theodoros Liagkos, M.D.,[1] Charalampos Spyropoulos, M.D.,[2] Gerasimos Tsourouflis, M.D.,[3] Aris Papadopoulos, M.D.,[1] Paulos Ioannides, M.D.,[1] Constantine Vagianos, M.D.[3]

[1]1st Department of Surgery, Nikaia General Hospital, Nikaia, Piraeus-*Greece*

[2]3rd Department of Surgery, Iaso General Hospital, Holargos, Athens-*Greece*

[3]2nd Propedeutic Department of Surgery, Laikon Hospital, National & Kapodestrian University of Athens, Athens-*Greece*

ABSTRACT

BACKGROUND: The non-operative management (NOM) of abdominal injuries has gained wide acceptance over the last few decades. The present study evaluated the efficacy of NOM in blunt abdominal trauma (BAT) at a regional Hellenic hospital.

METHODS: We analyzed the results of a pre-decided treatment protocol, which was applied to all patients hospitalized for BAT, from 2008 to 2015. The protocol proposed NOM in hemodynamically stable patients with no signs of peritonitis. The demographic characteristics, type of injury, injured organ(s), type of management (operative vs. non-operative), Injury Severity Score (ISS), morbidity, mortality rates, and health costs were evaluated.

RESULTS: One hundred and forty-six patients hospitalized for BAT at our department were included. Among them, 49 were operated and 97 were subjected to NOM. Although ISS was significantly higher in the surgical group, the severity of injuries in liver, spleen, and kidneys was not different between the two groups. Surprisingly, no case subjected to NOM required a conversion to operative management, which may probably be because of the strict inclusion criteria for NOM.

CONCLUSION: Patients with hemodynamic stability and normal physical examination may be non-operatively treated, independent of the grade of injury, in highly selective cases. ISS score is an independent risk factor for surgical treatment.

Keywords: Blunt abdominal trauma; hemodynamic stability; non-operative management.

INTRODUCTION

Most fatalities in individuals aged ≤35 years are due to trauma.[1] Blunt mechanisms account for 78.9%–95.6% of all injuries,[2] with the abdomen being affected in 6.0%–14.9% of all traumatic injuries.[2,3] In any case, patients with signs of peritonitis and/or hemodynamic instability and those with ultrasound findings of intra-abdominal fluid should undergo laparotomy.[4] However, the selection of these patients, particularly in the poly-trauma setting, is always a challenge. The definition of hemodynamic stability remains a significant problem, which often ignores that >30%–35% of circulating blood volume may be lost before the onset of hypotension.[5] The classification of patients, as proposed by the Advanced Trauma Life Support Committee on Trauma (ATLS), into hemodynamic categories, namely responders, transient responders, and non- responders, may help in avoiding the underestimation of bleeding.[6] However, in general, patients with minimum systolic arterial blood pressure of >90 mmHg without vasopressors and maximum heart rate (HR) of <110 beats/min may be considered hemodynamically stable.[7]

Over the last few decades, a shift has been noted from operative management (OM) to non-operative management (NOM) in hemodynamically stable blunt abdominal trauma (BAT) patients.[8,9] This approach may be safely applied in

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Address for correspondence: Georgios Theodoros Liagkos, M.D.
Kountourgiotou 43 12351 Athens-Greece
Tel: +30 693 6994 993 E-mail: gliagkos.surg@gmail.com

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trauma centers that are sufficiently equipped with recent imaging modalities, intensive care capabilities, blood bank, and 24-h operative services.[10] The close monitoring of patients along with modern imaging and laboratory examinations play a key role in attaining therapeutic decisions, thereby preventing unnecessary laparotomies. In general, liver injuries present a higher successful rate of NOM, which exceeds 90%.[11] Hemodynamically stable patients with liver and spleen injuries may be non-operatively managed, independent of the grade of the injury; NOM is also highly successful in patients with renal trauma.[12,13] The revision organ injury scale by the American Association for the Surgery of Trauma, which was established in 1994, is the most widely used grading system for abdominal trauma.[14]

In the present study, we used OM and NOM for abdominal injuries in a regional hospital. The aim of the study was to outline the major indications for NOM, feasibility of this approach in this setting, morbidity and mortality rates, and outcomes compared with cases of surgical approach and to exhibit the success of NOM in selective trauma cases.

MATERIALS AND METHODS

A prospective study, based on a pre-decided treatment protocol, was conducted between 2008 and 2015 at a regional hospital, which included all patients hospitalized for BAT. The type of injury, injured organ(s), and method of treatment (OM vs. NOM) were recorded. The failure of NOM as well as morbidity and mortality rates were also documented.

On admission, all patients were assessed and resuscitated, if necessary, in accordance to the ATLS protocol. Focused assessment with sonography for trauma (FAST) was conducted in most cases, depending on its availability. Hemodynamically unstable patients with positive FAST as well as those with signs of peritonitis were surgically explored. Unstable patients included non-responders and transient responders. Stable patients with positive FAST were selected for NOM and further evaluated by performing CT scan with IV contrast. CT scan was also performed in stable patients when FAST ultrasound was unavailable. Diagnostic peritoneal lavage (DPL) was performed only in poly-trauma patients with hemodynamic instability and when FAST was unavailable. Patients with an HR of <110/min and systolic BP of >90 mm Hg on admission or following initial resuscitation were considered stable.

Based on the hemodynamic status, clinical findings, and investigations, 97 (66.4%) patients were selected for NOM. According to the study protocol, the exclusion criteria for NOM included persistent hemodynamic instability with no response to initial resuscitation and positive FAST or signs of peritonitis. Because of the application of the rather strict criteria, "gray-zone" patients were surgically managed. Thus, all patients with splenic injury and active arterial extravasation and most poly-trauma patients with multiple injuries and borderline hemodynamic status underwent emergency explorative laparotomy. Indications for revision were the deterioration of hemodynamic stability, ongoing drop of hematocrit, and suspicion of missed hollow organ injuries. Angioembolization was performed in hemodynamically stable patients with expanding pelvic hematoma or active arterial extravasation due to pelvic and liver injuries.

Statistical Package for the Social Sciences (SPSS) 19.0 for Windows was used for data analysis. Descriptive statistics were presented as mean and standard deviation. Categorical data were analyzed using the chi-square test. Significance level was set at $p<0.05$.

RESULTS

One hundred and forty-six patients (102 males, 44 females) with various types of BAT were included in the study and statistically analyzed. The mean age of NOM and OM groups was 42.7±20.3 and 46.4±18.8 years, respectively. After the initial evaluation, 97 (66.4%) patients were selected for NOM and 49 (33.6%) were operated.

The decision for surgical exploration in the OM group was made on the basis of the presence of hemodynamic instability and/or peritonitis (28 patients), intraperitoneal rupture of the bladder (two patients), hemi-diaphragmatic injury (two patients), multiple injuries, and borderline hemodynamic status with mean Injury Severity Score (ISS) of 27.2 (nine patients) and splenic injuries with active arterial extravasation (eight patients). The patients of both groups had similar age, comorbidities, and mechanisms of injury. ISS was significantly higher in the group of patients who required surgical exploration ($p=0.001$). The mean ISS in this group was 22.1 vs. 10.6 in the NOM group. It is noteworthy that the grade of injury in the most commonly affected solid abdominal organs (liver, spleen, and kidney) was similar between the two groups. The characteristics of patients in both groups are presented in Table 1.

The grade of injury in patients subjected to surgery was established by both radiological modalities and operative findings. The grade of spleen injury was slightly higher in the OM group, but the difference was not statistically significant (Figs. 1–3).

FAST was unavailable in two patients with hemodynamic instability and severe co-existent head trauma, and DPL was performed to establish the indication for exploratory laparotomy. In both cases, intraperitoneal bleeding was revealed.
Eight trauma patients with splenic injury and blushing in the arterial phase of CT scan were surgically explored. Splenectomy was performed in all patients. In four patients with signs of peritoneal irritation, surgical exploration demonstrated hollow organ injury, and primary repair was performed. Two patients with the intraperitoneal rupture of the bladder were treated by primary suturing and long-term urinary catheterization, whereas in two patients with left expandable

Table 1. Characteristics of patients in both studied groups

	Non-operative management group (97 pts.)	Operative group (49 pts.)	p
Age (Mean±SD)	42.7±20.3	46.4±18.8	0.728
Injury Severity Score (Mean±SD)	10.6±8.4	22.1±12.1	0.001
Diagnostic modality on admission			
Focused assessment with sonography for trauma	8	19	
Computed tomography	2	3	
Focused assessment with sonography for trauma +			
Computed tomography	87	25	
Diagnostic peritoneal lavage	0	2	

SD: Standard deviation.

retroperitoneal hematoma and splenic injury, splenectomy and nephrectomy were performed in one and splenectomy and renal suturing were performed in the other. Hepatic hemorrhage was controlled by applying local hemostatic agents. Hepatic packing was utilized in four patients "in extremis," as part of the damage control surgery (DCS) protocol. These patients were reoperated within 48 h, and the packing was successfully removed without any sign of residual bleeding.

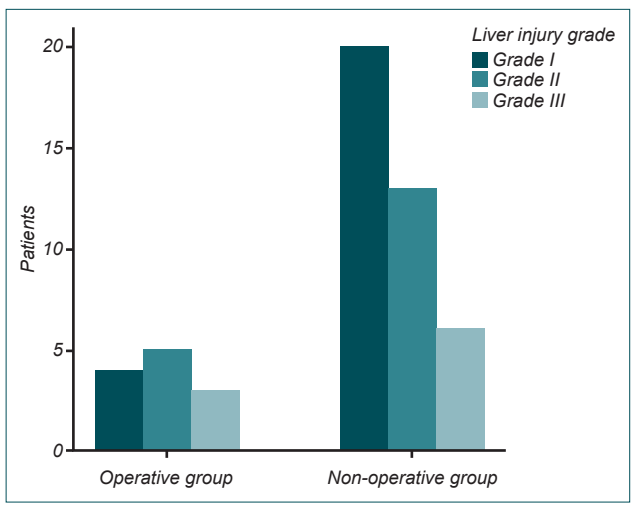

Figure 1. *Grade of liver injury in patients treated surgically and non-operatively (p=0.531).*

All patients subjected to surgery because of splenic injuries underwent splenectomy. No splenic preservation was attempted because of hemodynamic instability. A massive pancreatic injury with concomitant splenic trauma was treated by splenectomy and distal pancreatectomy (resection of the tail of the pancreas). Surgical re-exploration was necessary in five (10.2%) patients, including four patients for the scheduled liver unpacking after DCS and one for intra-abdominal bleeding (epiploic vessels). There were eight deaths recorded in the OM group (16.3%). Six of these patients had sustained severe head injury and two developed severe and irreversible respiratory complications.

CT scan was the diagnostic modality of choice in the NOM group, which was always performed after the initial evalua-

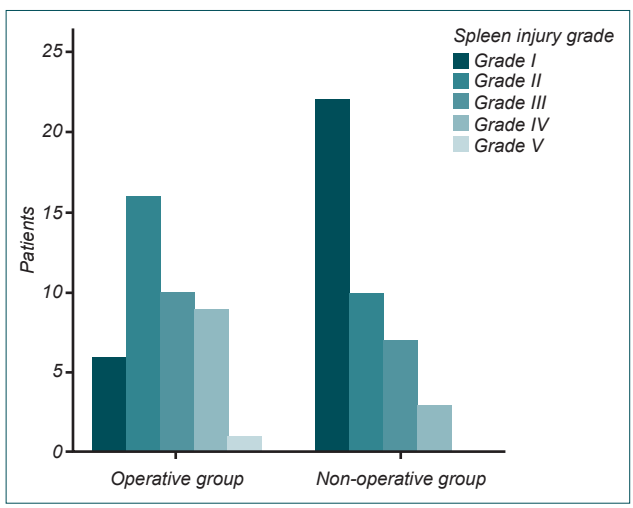

Figure 2. *Grade of spleen injury in patients treated surgically and non-operatively (p=0.06).*

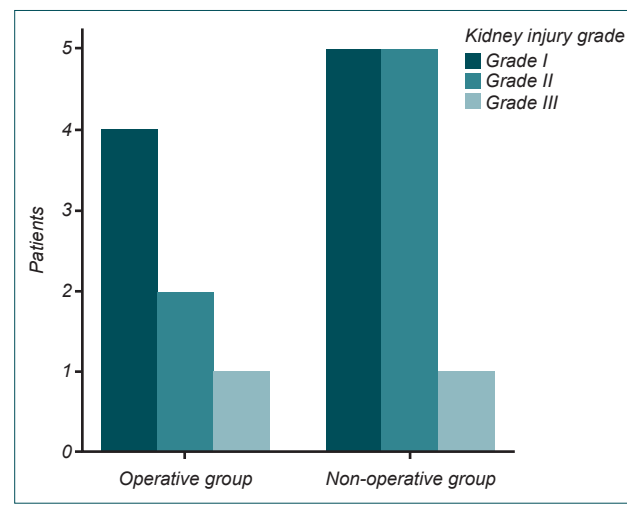

Figure 3. *Grade of kidney injury in patients treated surgically and non-operatively (p=0.777).*

Table 2. In-hospital parameters of patients depending on the strategy of treatment

	Non-operative management group (97 pts.)	Operative group (49 pts.)
Blood transfusion (units, mean±SD)	0.38±1.1	3.4±2.2
Intensive care unit/high dependency unit admission (%)	9.3	46.3
Morbidity (%)	12.4	55.3
Mortality (%)	2.1	16.3
Hospital stay (days, mean±SD)	6.7±4.5	13.9±10.4
Cost in € (median, range)	560 (100–18102)	3499 (10.4–75896)

SD: Standard deviation.

tion and resuscitation. FAST was the only diagnostic modality applied in eight patients because of the unavailability of CT scan. Eighty-seven patients with positive FAST were further evaluated by CT scan. In three patients, CT scan demonstrated pelvic arterial blushing, and successful embolization was performed in both internal iliac arteries using microcoils. Two other successful embolizations were performed for liver injury with active arterial contrast extravasation.

NOM was successful in all patients. Two deaths were documented in this group due to severe head trauma on the 17th and 20th day of hospitalization, respectively. Autopsy revealed no abdominal causes related to the fatal outcome. Only minor complications were seen in this group of patients, which were mostly related to the respiratory system.

As expected, the necessity for blood transfusion was higher in patients treated surgically. Overall, the OM group had an ICU/HDU admission rate of 46.3%, mean hospital stay of 13.9±10.4 d, morbidity rate of 55.3%, and mortality rate of 16.3%. The NOM group had an ICU/HDU admission rate of 9.3%, mean hospital stay of 6.7±4.5 d, morbidity rate of 12.4%, and mortality rate of 2.1%. The total cost for the patients' healthcare was also higher in the OM group. The results are summarized in Table 2.

DISCUSSION

Although Sir McCormack has advocated since 1900 that "A man wounded in war in the abdomen dies if he is operated upon and remains alive if he is left in peace,"[15] this aphorism faded and was gradually replaced by the dogma of mandatory laparotomy in all cases of hemoperitoneum after the Second World War. The operative approach was once again questioned and significantly modified after 1990 when the NOM of BAT in selected cases was introduced, leading to a significant reduction in the number of unnecessary laparotomies.[16]

Several reports in the literature have validated NOM as an established and accepted management protocol for solid organ injuries in hemodynamically stable patients.[17,18] However, NOM may be challenging in cases of severe associated injuries, particularly head injury and alcohol/drug abuse, which may fade or hide abdominal signs and symptoms. All hemodynamically stable patients with no signs of peritoneal irritation and solid organ injury should be considered for NOM. CT scan represents the gold standard in the evaluation of these patients; however, its usefulness in the diagnosis of bowel injuries remains controversial.[19] It has been proposed that the presence of free fluid without any evidence of solid organ injury is a significant marker of possible mesenteric or bowel injury.[20] However, in patients with BAT, even in these cases, the initial application of NOM is appropriate in most patients.[21]

Although the radiological grade of severity of injury is not a contraindication for NOM, the higher grade of injury is often accompanied by a higher rate of failure. IV contrast blushing by minor vessels in solid organs should be interpreted with extreme caution during NOM. If an ongoing hemorrhage is evident, then NOM should probably be abandoned, although arterial embolization could be helpful in selected cases.[22]

Recent studies have suggested that the injured organ is important and sometimes even critical in the success of NOM. Non-splenic blunt injury has been identified as an independent prognostic factor. Furthermore, splenic trauma is reported to be associated with the highest failure rates of up to 30%.[23,24] Moreover, splenic embolization has limited benefits and is associated with higher rates of re-embolization.[25] Based on these data, no splenic embolization was performed in our study.

In the present study, the success rate of NOM was 100%, which is higher than the mean reported rate of 80%.[26] This fact was obviously attributed to the "over-strict" management of trauma patients, which resulted in the exclusion of the so-called "gray-zone" patients who could be initially treated non-operatively, but with a higher possibility of failure and surgical conversion.[27] Personal judgment and experience of the trauma surgeon, hospital's infrastructure, and the homogeneity of the team are important factors.

In our study, ISS was higher in the group of patients treated surgically. ISS >15 is indicative of poly-trauma patients, and

ISS >25 is related to higher failure rates for NOM.[28] Interestingly, the grade of injury of the most usually injured organs (liver, spleen, and kidney) was similar in both groups and did not affect the outcomes of NOM.

NOM for BAT is highly successful and safe when applied in hemodynamically stable patients without any sign of peritonitis. NOM reduces blood transfusion requirement, morbidity, mortality, and the incidence of unnecessary laparotomies. Even cases with multiple abdominal injuries can be successfully managed by NOM, independent of the grade of injury, if they are closely monitored, preferably by the same clinical team. ISS is an independent risk factor for surgical treatment. NOM is associated with a low overall morbidity and mortality and does not increase the length of hospital stay and cost.

Conflict of interest: None declared.

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ORİJİNAL ÇALIŞMA - *ÖZET*

Yüksek derecede selektif olgularda künt abdominal travmanın başarılı cerrahidışı tedavisi: Güvenli ve etkili bir seçim

Dr. Georgios Theodoros Liagkos,[1] Dr. Charalampos Spyropoulos,[2] Dr. Gerasimos Tsourouflis,[3] Dr. Aris Papadopoulos,[1] Dr. Paulos Ioannides,[1] Dr. Constantine Vagianos[3]

[1]Nikaia Genel Hastanesi I. Cerrahi Bölümü, Nikaia, Pire-*Yunanistan*
[2]Iaso Genel Hastanesi 3. Cerrahi Bölümü, Holargos, Atina-*Yunanistan*
[3]Atina Ulusal ve Kapodestrian Laikon Üniversite Hastanesi, Propedik Cerrahi Bölümü, Atina-*Yunanistan*

AMAÇ: Abdominal yaralanmaların cerrahi dışı tedavisi (CDT) son 10 yıllarda geniş kabul görmüştür. Bu çalışmada, bölgesel Yunanistan hastanesinde künt abdominal travmada (KAT) CDT etkinliği değerlendirildi.

GEREÇ VE YÖNTEM: Künt abdominal travma için 2008–2015 arası hastaneye yatırılmış hastaların tümüne önceden kararlaştırılarak uygulanmış tedavi protokollerinin sonuçları incelendi. Protokol peritonit belirtileri olmayan hemodinamik açıdan stabil hastalarda CDT'yi önerdi. Demografik özellikler, yaralanmanın tipi, yaralanmış organ(lar), tedavi tipi (cerrahi'ye karşın cerrahi dışı) Yaralanma Şiddeti Skoru (YŞS), morbidite, mortalite oranları ve sağlık bakım maliyetleri değerlendirildi.

BULGULAR: Künt abdominal travma nedeniyle bölümümüze yatırılmış146 hasta çalışmaya alındı. Bunlar arasında 49'u ameliyat edilmiş, 97'sine CDT uygulanmıştı. Yaralanma Şiddeti Skoru cerrahi grubunda istatistiksel açıdan daha yüksek olmasına rağmen iki grup arasında karaciğer, dalak ve böbreklerdeki yaralanmanın şiddet derecesi açısından farklılık yoktu. Cerrahi dışı tedavi uygulanan hiçbir olgu için muhtemelen CDT'nin katı dahil edilme kriterleri nedeniyle cerrahi tedaviye geçiş gerekmemişti.

TARTIŞMA: Hemodinamik açıdan stabil, fizik muayenesi normal yüksek derecede selektif olgular yaralanmanın derecesine bakılmaksızın cerrahi dışı yöntemlerle tedavi edilebilir. Yaralanma Şiddeti Skoru cerrahi tedavi riskine ilişkin bağımsız bir risk faktörüdür.

Anahtar sözcükler: Cerrahi dışı tedavi; hemodinamik stabilite; künt karın travması.

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