High mortality after emergency room laparotomy in haemodynamically unstable trauma patients

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ABSTRACT

INTRODUCTION: Hypovolaemic shock is a major course of death in trauma patients. The mortality in patients in profound shock at the time of arrival is extremely high and we wanted to investigate the outcome of patients undergoing laparotomy at the Trauma Care Unit (TCU).

MATERIAL AND METHODS: Forty-four emergency laparotomies performed at the TCU at Rigshospitalet between January 2003 and December 2009 were registered. The indication for surgical intervention was based on persisting, unstable haemodynamics and either positive findings at focused abdominal sonography in trauma (FAST) or penetrating injury. In some patients, laparotomy was performed despite a negative FAST because of ongoing instability. The patients were stratified according to their systolic blood pressure (BP).

RESULTS: After 24 hours, 46% (20 patients) of the patients were alive. The survival after 30 days was 41% (18 patients). Stratifying the patients into three categories according to the systolic BP at the time of arrival (BP > 80 mmHg (n = 14), 80 mmHg ≥ BP > 60 mmHg (n = 10) and BP ≤ 60 mmHg (n = 20) revealed a 64%, 50% and 34% survival rate within the first 24 hours (p = 0.04). In the group of patients with BP ≤ 60 mmHg, the survival decreased to 20% after 30 days. Stratification by penetrating or blunt trauma showed no significant difference in survival (40% versus 50% survival after 30 days) (p = 0.40). However, in those patients arriving with BP ≤ 60 mmHg (five penetrating and 15 blunt injuries), we found that the survival rate after laparotomy was 60% and 13%, respectively.

CONCLUSION: The present study shows that haemodynamically unstable patients with abdominal or suspected abdominal injuries undergoing emergency laparotomy have a high mortality, especially those with BP ≤ 60 mmHg. Patients with a penetrating trauma have a far better prognosis than those with a blunt trauma.

FUNDING: not relevant.

TRIAL REGISTRATION: not relevant.

Hypovolaemic shock is a major course of death in trauma patients. The decision to surgically intervene in the haemodynamically unstable patient with abdominal injuries is challenging and requires quick assessment. Blood pressure (BP) and pulse are easy and quickly measurable indicators of the circulatory state. The decision to perform surgical intervention has become easier with the introduction of focused abdominal sonography in trauma (FAST) as a routine diagnostic tool for detection of free fluid in the primary assessment of the abdominal cavity [1]. Haemodynamically unstable patients who do not respond to the initial standard bolus fluid resuscitation package and in whom free fluid is found by FAST require immediate exploratory laparotomy in order to control bleeding and stabilize the circulation.

In the present study, we investigated survival after emergency room laparotomy in general and in particular whether systolic BP measured at the time of arrival to the Trauma Care Unit (TCU) could predict outcome in haemodynamically unstable patients undergoing emergency laparotomy.

MATERIAL AND METHODS

All emergency laparotomies performed in the TCU at Rigshospitalet between January 2003 and December 2009 were registered. Pre-hospital and in-hospital resuscitation was conducted according to the advanced trauma life support (ATLS) concept [2]. A FAST was performed shortly after arrival to the TCU. BP was measured with a standard, non-invasive sphygmomanometer.

Data collection included: Age, sex, type of trauma (penetrating or blunt), transfer time from the scene of accident to the TCU, initial BP, result of FAST, number and type of blood products and time of death.

The indication for surgical intervention was based on unstable haemodynamics and either positive findings at FAST or penetrating injury to the abdomen. In individual cases with a persistently unstable patient despite initial standard bolus fluid resuscitation and with a history of trauma to the abdomen, decision to perform emergency laparotomy was made regardless of a negative FAST.

We chose to stratify the patients in three groups according to a systolic BP above 80 mmHg, between 80 and 60 mmHg and below 60 mmHg. At 60 mmHg, peripheral pulses are absent and only carotid pulses may still be present. Thus these patients may be considered to be in extremis [3].

ORIGINAL ARTICLE

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Dan Med Bul 2011;58(5):A4275

Trial registration: not relevant.

Statistics

Survival curves were estimated using the Kaplan-Meier method and log rank test was used to evaluate the statistical significance of the differences. Logistic regression analysis was employed to investigate whether systolic BP at the time of arrival was a predictor of death. The results of the regression analysis are given as odds ratio (OR) with 95% confidence intervals (CI). A two-sided p value < 0.05 was considered statistically significant. Because of the low number of patients in the present study, age, sex, type of trauma, result of FAST and transfer time were not included as variables of the regression model. The SPSS statistical package (version 11.0; SPSS inc., Chicago, IL) was used for all analysis.

RESULTS

Forty-four patients underwent immediate laparotomy after initial assessment in the TCU.

TABLE 1

Patient characteristics.

Sex (male/female), n (%)	38/6 (86/14)
Age, years, median (range)	33 (5-85)
Blood pressure, mmHg, mean ± standard deviation	67 ± 35
Trauma, n (%)	
Penetrating	12 (27)
Blunt	32 (73)
FAST, n (%)	
Positive	23 (52)
Negative	9 (21)
Lesions, n (%)	
Retroperitoneal haematoma	29 (66)
Pelvic fracture	17 (39)
Thoracic lesion	14 (32)
Organ lesion	31 (71)
Transfusions, n, median (range)	
Erythrocyte suspension (SAG-M)	19 (4-175)
Thrombocyte concentrate	6 (1-39)
Fresh frozen plasma	15 (0-157)

FAST = focused abdominal sonography in trauma.
SAG-M = saline-adenine-glucose-mannitol.

TABLE 2

Risk of death by blood pressure levels according to logistic regression.

Predictor	Odds ratio	95% confidence interval	p value
Blood pressure			
> 80 mmHg	1.0		
60 < BP ≤ 80 mmHg	2.7	0.5-14.4	0.24
≤ 60 mmHg	7.2	1.5-33.8	0.012

BP = blood pressure.

Patient characteristics are shown in **Table 1**. The majority of the patients were males who suffered from blunt trauma. FAST was performed in 73% of the cases. Simultaneous injuries in the thorax, the abdomen and pelvis were found in two (4.5%) patients. Eight (18%) patients had injuries to both the thorax and the abdomen.

Figure 1 shows the overall survival of the 44 patients who underwent acute laparotomy shortly after their arrival to the TCU. After the first 24 hours, only 46% (20 patients) of the patients were alive. The survival after 30 days was 41% (18 patients).

Figure 2 shows the survival after stratifying the patients into three groups according to their systolic BP at the time of their arrival (BP > 80 mmHg (n = 14), 80 mmHg ≥ BP > 60 mmHg (n = 10) and BP ≤ 60 mmHg (n = 20). The analysis revealed 64%, 50% and 34% survival rates within the first 24 hours, respectively (p = 0.04). In the group of patients with BP ≤ 60 mmHg, the survival had decreased to 20% after 30 days. No significant differences were seen in age, sex, type of trauma, result of FAST, presence of pelvic, abdominal or thoracic injuries between the three groups.

Stratification by penetrating or blunt trauma showed no significant difference in survival (40% versus 50% survival after 30 days) (p = 0.40). However, in those patients who arrived with BP ≤ 60 mmHg, 60% of the five patients with penetrating injuries survived after laparotomy and 30% of the 15 patients suffering from blunt trauma survived after laparotomy.

Stratification by transfer time (< 30 minutes (27 patients) versus > 30 minutes (17 patients)) showed a 40% survival in either group after 30 days (p = 0.77).

Logistic regression predicting probability of death (odds ratio) for each of the three blood pressures is shown in **Table 2**. Patients with BP ≤ 60 mmHg at the time of arrival had a 7.2 times higher risk of death compared with those with BP > 80 mmHg.

DISCUSSION

Patients in severe hypovolaemic shock due to blunt or penetrating trauma and suspected abdominal bleeding require immediate surgical attention. These patients have ongoing bleeding and have already suffered a massive loss of blood and consumption of coagulation factors caused by activation of the coagulation cascade starting at the time of the trauma.

At our institution, the overall survival in hypovolaemic trauma patients after emergency laparotomy was 46%. However, the chance of survival deteriorated substantially when systolic BP was below 60 mmHg (no peripheral pulses or only carotid pulse) at the time of arrival to the hospital [3]. The logistic regression analysis revealed a seven times higher risk of death in patients with BP below 60 mmHg. In a recent study

of 6,964 trauma patients during a five-year period, Lalezarzadeh et al demonstrated a nine fold increase in overall mortality in patients with prehospital systolic BP below 80 mmHg compared with patients who had systolic BP above 80 mmHg. They concluded that prehospital or emergency department BP was a strong predictor of in-hospital mortality [4].

In the present study, the mortality within the first 24 hours was 54%. These results matched reports from foreign trauma centres where mortality rates ranged from 45-50% for bedside laparotomies on patients in haemodynamic shock [5]. In recent years, fatal outcome due to severe haemorrhage in trauma patients has declined. In a review from 2009, Pfeifer et al found that the overall prevalence of early death caused by haemorrhage has decreased from 25% to 15% during the past 10 years [6]. This improvement is probably multifactorial and due to the more widespread implementation of the ATLS principles and the concept of damage surgery, better logistics of emergency rescue, haemostatic resuscitation and better diagnostic tools like FAST in trauma patients.

Different concepts have been developed regarding the initial treatment of the injured patient.

Today, the ATLS with damage control resuscitation and damage control surgery are the most widespread concepts which ensure systematic and unified treatment of trauma patients [7, 8].

The Damage Control Surgery principle was introduced by Rotondo et al in 1993 and is based on a staged approach in treating trauma patients. Surgery should be performed within a limited time frame and with simultaneous correction of the coagulopathy, hypothermia and acidosis before the next operation [9, 10].

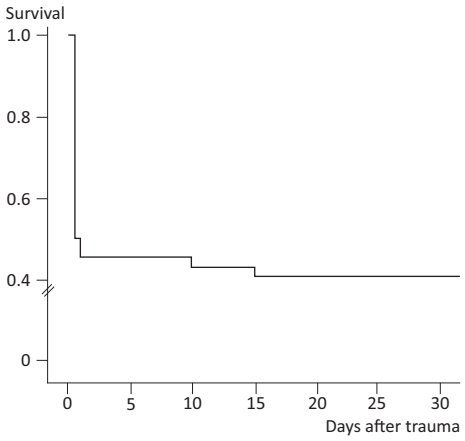
For the bleeding patient, time is crucial for survival. In these years rescue helicopters carrying anaesthetists and paramedics ready to stabilize the patient at the scene of trauma are being implemented throughout the country. In this way, transfer time is being diminished significantly. However, in our study, we found no significant difference in survival regarding transfer time to the hospital. Clarke et al found that the probability of death increases within the first 90 minutes with 1% for every three minutes spent in the TCU before laparotomy [11]. A quick assessment and decision to undertake explorative laparotomy is thus of great importance for these patients. Unfortunately, the time passing from trauma to laparotomy was not registered in our patients.

At our institution, FAST is performed within minutes after arrival at the TCU as a standard assessment in the screening of the patient according to the ATLS concept. Twenty-seven percent of our patients had a laparotomy performed despite a negative FAST. There may be several competing reasons for low BP in trauma patients like bone fractures and retroperitoneal bleeding. In some cases, surgery is therefore performed based on individual findings and not on strict criteria.

If further time delay is to be diminished, relocation

FIGURE 1

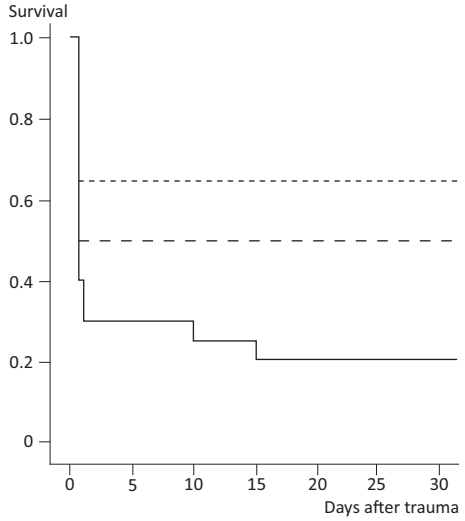
Overall survival of the 44 patients who underwent acute laparotomy shortly after arrival to the Trauma Unit.



Surviving patients	44	20	19	18	18	18	18

FIGURE 2

Survival after stratifying patients into three groups according to systolic blood pressure (BP) at the time of arrival (BP ≤ 60 mmHg (20 patients), 60 < BP ≤ 80 mmHg (ten patients) and BP > 80 mmHg (14 patients)), p = 0.04.



Surviving patients							
BP > 80 mmHg	44	9	9	9	9	9	9
60 < BP ≤ 80 mmHg	10	5	5	5	5	5	5
BP ≤ 60 mmHg	20	6	5	4	4	4	4

--- BP > 80 mmHg — — 60 < BP ≤ 80 mmHg —— BP ≤ 60 mmHg

Emergency laparotomy in the Trauma Centre, Rigshospitalet.

of the FAST examination to the scene of the trauma (preFAST) performed by medical or paramedical personnel may be a new, time-saving option. In this way, the surgeon and the hospital staff could be alerted early and make preparations for surgery even before the patient enters the TCU.

A study from 2006 showed that FAST performed during transportation to the hospital shortened the path to diagnosis by approximately 35 minutes. In 30% of the cases, the result of the FAST led to a change in the treatment of the patient or transport to a different hospital [12].

Several studies have shown that after a short training program in the use of ultrasonography, FAST may be performed on trauma patients with high accuracy by a non-radiologist [13, 14]. To our knowledge, no study has yet been made to show whether preFAST improves survival.

Unlike penetrating trauma were haemorrhage may be localized and take the form of a distinct vascular damage, patients severely injured due to blunt trauma may have diffuse abdominal bleeding caused by extensive organ injuries. Emergency laparotomy on patients arriving in pulse-less condition may thus be confined to those with penetrating injuries like stab wounds or gunshots.

In conclusion, the present study shows that haemodynamically unstable patients with abdominal or suspected abdominal injuries undergoing emergency laparotomy have a high mortality, especially those with BP ≤ 60 mmHg. Patients with penetrating trauma have a far better prognosis than those with blunt trauma.

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ACCEPTED: 16 March 2011

CONFLICTS OF INTEREST: none

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