

Damage Control Surgery in Abdominal Trauma Associated with Pelvic Fracture

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Introduction: A haemodynamically unstable patient with abdominal injury associated with pelvic fractures is a serious challenge for trauma surgeons and anesthesiologists. The **purpose** of this study is to evaluate the efficiency of patients' treatment with combined abdominal-pelvic lesions using the TRISS and ASCOT predictive scores.

Patients and methods: The study included polytraumatized patients with haemodynamic instability or signs of acute abdomen which required emergency laparotomy. Between 2008 and 2010, 124 patients were operated for abdominal trauma, 12 cases (9.6%) being associated with pelvic fracture.

Results: The mean age was 50.1 years (range 25–80 years). The lesions associated with pelvic fractures were the following: rupture of spleen (2 cases), liver rupture (2 cases), lung rupture (2 cases), diaphragm rupture and detachment (3 cases), small intestine and colon lesions (3 cases), rupture of the urinary bladder (4 cases), urethra rupture (3 cases), and head trauma (3 cases). In the treatment of retroperitoneal bleeding in 6 cases it was necessary to perform packing control of the pelvic haemorrhage. Four patients died, giving an overall mortality rate of 33.3%. The mortality was not influenced by age ($p = 0.31$), ISS ($p = 0.42$) and pH ($p = 0.63$). The probability of survival calculated using TRISS was 62.3% and the probability of death calculated using ASCOT was 28.6%.

Conclusions: The control of haemostasis and peritoneal decontamination are priorities in the case of abdominal-pelvic lesions. The packing control of haemorrhage proved to be effective in the management of bleedings caused by rupture of a retroperitoneal hematoma in the peritoneal cavity.

Keywords: abdominal injuries, pelvic fracture, retroperitoneal hematoma, damage control surgery

Introduction

The traditional approach to control injury care is surgical exploration with definitive repair of all injuries. This approach is successful when there are a limited number of injuries. Prolonged operative times and persistent bleeding leads to the lethal triad of coagulopathy, acidosis and hypothermia, resulting a mortality of 90%. Damage control is defined as the rapid initial control of haemorrhage and contamination, temporary closure, resuscitation to normal physiology in the ICU, and subsequent re-exploration and definitive repair. Since the last two decades, damage control surgery has become established as the appropriate surgical strategy in case of severely injured patient needing surgical intervention. This change has increased the survival rate after major trauma to over 50% [1].

Trauma patients, who present pelvic fractures, have suffered a high energy injury that is commonly associated with disruption of arteries and veins resulting a major haemorrhage. These patients, who were presenting haemorrhagic shock had a mortality of 20%. When the pelvic lesions are combined with other injuries such as the abdominal trauma, with intraperitoneal solid organ damages, the mortality is close to 50%. However a systematic multidisciplinary approach of these injuries, directed initially only on haemorrhage control, can lead to significant improvements in survival.

The aim of this study is to evaluate the treatment effectiveness in case of patients with combined abdominal-pelvic lesions using the TRISS and ASCOT predictive scores.

We calculated the W score resulting from the number of survived patients minus the expected survival rate, di-

vided by the total number of patients and multiplied by 100. The comparison of the predicted development using the predictive models and those obtained in reality can be applied in determining the quality of patient care [2].

Patients and methods

The study included polytraumatized patients with haemodynamic instability or signs of acute abdomen who required emergency laparotomy. Between 2008 and 2010 124 patients were operated for abdominal trauma, of which 12 cases (9.6%) were associated with pelvic fracture. We collected data based on age and sex of patients, mechanism of injuries, blood pH at admission, the performed operation, total hospital stay, complications and mortality. The scores were calculated as follows: Injury Severity Score (ISS), Revised Trauma Score (RTS), TRISS (RTS and ISS combination) and A New Characterisation Of Trauma Severity (ASCOT). The data was loaded and processed using statistical functions in Microsoft Excel and Graphpad, calculating significant differences between sets, depending on the mortality and survival, using Student t-test.

Results

During this 3-year study, 124 patients underwent a laparotomy after a trauma. In 12 cases (9.6%) the abdominal lesions were associated with pelvic fracture. The average age of patients was 50.1 years (range 25–80 years). There were 10 men and 2 women. Trauma occurred in traffic accidents in 9 cases (six car, two motorcycle, one rail accident), by crushing in 2 cases and fall from heights in one

Table I. Organ injuries in 12 patients with associated pelvic fracture

Organ lesions	Frequency
Retro- and subperitoneal vessels	12
Urinary bladder and ureter	6
Cranio-cerebral damages	3
Diaphragma	3
Lung	2
Large intestine	2
Spleen	2
Liver	2
Small intestine	1
Pancreas	1
Kidney	1
Femoral artery and vein	1

case. In the 12 cases with fractured pelvis, 36 organ lesions were also recorded (Table I). Surgery was performed in immediate emergency in 11 cases and in one case on the second day following the trauma, due to peritonitis occurred after segmental small intestine necrosis following mesenteric desinsertion. Four patients died and the mortality rate was 33.3%. Deaths occurred within 24 hours, two cases of intraoperative deaths were recorded. Surgical interventions were based on achieving haemostasis and peritoneal decontamination (Table II). The average age of the survivors was 45.7 years, and 59 years for dead patients ($p = 0.31$). ISS median was 35.67. There was no statistically significant difference between the ISS of the survivors and dead patients (33.6 vs. 39.7, $p = 0.427$). The probability of survival (PS) based on TRISS methodology was 62.3% and the probability of death (PD) based on the ASCOT methodology was 28.6% (Table III).

According to the W Score, which is the projection of predictive scores calculated on 100 patients, a difference of ± 4 patients can be noticed (Table IV). The average hospital stay was 24.6 days (range 9–45 days), number of days in Intensive Care Unit (ICU) was 8.2 days (range 5–13 days). Haemostatic packing of the pelvis was performed in six cases. In these cases, after 48–72 hours, scheduled reinterventions were performed to remove the packing. In one case it was necessary the repack the pelvis due to bleeding. One death was reported in patients who underwent haemostatic packing. Postoperative complications were: wound infection (4 cases), pneumonia (3 cases), venous thrombosis (one case) and haemorrhage (one case).

Discussion

Damage control surgery is a well-known concept that defines procedures which are strictly necessary to stop mas-

Table III. Calculated variables according to survival or death

	Age	ISS	PS (TRISS)	PD (ASCOT)	pH
Survivals	59	33.6	85.1%	3.8%	7.2
Deaths	45.7	39.7	16.8%	78%	6.9
	$p = 0.31$	$p = 0.427$	$p = 0.03$	$p < 0.0001$	$p = 0.63$

Table II. The performed surgical interventions

Operation	No. of cases
Cystoraphy	6
Pelvi- subperitoneal packing	6
Phrenoraphy	3
Splenectomy	2
Hepatoraphy	2
Intestinal resection	2
Orthopedic stabilisation	2
Pulmonary suture	1
Femoral artery and vein reconstruction	1

sive bleeding and peritoneal contamination in order to gain crucial time for rebalancing and correcting deficits, definitive surgery being scheduled for a later stage. Rotondo's concept was defined in 1992, a notion that was taken from the U.S. Navy, meaning the minimal emergency measures necessary to bring a seriously damaged ship to port for repair. The objective in damage control surgery is the initial control of haemorrhage and peritoneal contamination, followed by resuscitation in order to optimize haemodynamic parameters, respiration, body temperature, the correction of anemia, acidosis and coagulopathy. The reoperation is the final stage, having a stable patient and includes the ablation of the peritoneal packing, definitive surgical treatment and abdominal wall closure [3,4].

In the case of polytrauma, pelvic fracture can be just one of many injuries including other parts and organs too. Certain types of pelvic fractures can cause severe pelvic-subperitoneal hematoma. Pelvic-subperitoneal haemorrhage, due to the severe blood loss, can be life-threatening for a trauma patient. The source of bleeding can be both the fractured bone and the injured soft parts, which may lead to a 2000–3000 ml blood loss, rarely less than 500 ml.

The attempt to obtain haemostasis by identifying the injured vessel or organ is often doomed to failure. Due to the spongy appearance of the retroperitoneal fat tissue, blood penetrates into this space, so the evacuation of hematoma can't be achieved.

The therapy for abdominal injuries associated with pelvic fractures is primarily influenced by intraperitoneal organ damage. In these cases exploratory laparotomy is mandatory, which aims the immediate treatment of existing intraperitoneal lesions. The decision to explore the pelvi-subperitoneal hematoma should be taken with great caution and only where there is a recognized source of bleeding or pelvic-subperitoneal organ damage (bladder, ureter, rectum) suspected. Another difficult problem for surgical treatment is the rupture of the hematoma into the peritoneal cavity. Indication for the exploration of the hematoma

Table IV. Calculation of W score

Number of patients	Expected mortality based on TRISS/ASCOT	Actual mortality	Actual survival	Expected survival	W Score
12	4.52/3.43	4	8	7.48/8.57	4.33/-4.75

depends on many factors, among which the most important is the inefficient resuscitation (hemodynamic instability). A retroperitoneal hematoma requiring immediate surgical treatment is rarely caused by bleeding derived from the fractured pelvic bone without associated vascular or organ lesion [5]. During the exploration of the peritoneal cavity the follow-up of the hematoma's size is very important. If the hematoma is not growing we'll refrain from exploring it. In case of a ruptured or extensive hematoma, the haemostatic peritoneal packing is an easy solution that can be quickly executed, thus obtaining time for patient stabilization and resuscitation. The packing's inefficiency is due to the distensibility of the retroperitoneal tissue, preventing the air to maintain a strong compression.

In our cases, 3–4 surgical meshes were used and after the packing the abdominal wall was closed in single plane. This probably contributed to efficient compression. Recurrent bleeding after the extraction of the packing occurred in one case and the repacking was performed using Dürzen type mesh with further positive outcome.

The packing, just like the drainage of the retroperitoneal hematoma, can facilitate subsequent suppuration. Intra-abdominal abscesses occurred after packing extraction can be attributed to associated hollow organ lesions, foreign body, immunodeficiency secondary to shock and massive transfusion [6]. In one case we found prolonged pyrexia, which responded favorably to antibiotic treatment.

Based on statistical calculations, mortality rate is not affected by the age of patients, ISS score and blood pH value at hospitalization. The prediction of survival of trauma patients calculated based on TRISS model (62.3%) and the probability of death based on the ASCOT model (28.6%) proved a remarkable precision, we obtained a survival rate of 66.7%. Associated trauma deaths occurred at patients with cranio-cerebral and thoracic injuries of which two patients were in cardiopulmonary arrest at the scene. In five of six cases, where we performed hemostatic pelvic packing, the outcome was favorable.

Damage control should be limited to those few patients who are critically unstable, with associated multi-organ injury and exsanguinations [7].

The damage control concept places surgery as an integral part of the resuscitative process, rather than an end in itself, and recognizes that outcomes after major trauma are determined by the physiological limits of the patient, rather than by efforts of anatomical restoration by the surgeon [7].

Conclusions

The exact scoring of the trauma patient in the adequate risk group is essential for proper determination in terms of preventing lesion progression, management of critical patients and comparing the obtained results with standard ones. Treatment efficiency follow-up is possible using predictive scores. Based on statistical calculations, the survival rate was not influenced by the ISS score. In case of polytraumatized patients the mortality rate increases in association with serious injuries (Abbreviated Injury Scale ≥ 3) on various anatomical segments. Bleeding control in patients with abdominal injury associated with pelvic fractures is a major challenge and damage control surgery can be used successfully.

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