

Extensive retroperitoneal hematoma in blunt trauma

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ABSTRACT

الأهداف: استعراض تجربتنا في التعامل مع التجمع الدموي الشديد خلف الصفاق لدى المرضى الذين يعانون من الإصابات الرضحية الحادة، بالإضافة إلى تحديد العوامل المرتبطة التي تؤثر على نسبة الوفيات.

الطريقة: أجريت هذه الدراسة الاسترجاعية المراقبة في مجمع الملك سعود الطبي، الرياض، المملكة العربية السعودية وذلك خلال الفترة من يناير 2004م إلى ديسمبر 2009م، وشملت المرضى الذين يعانون من التجمع الدموي الشديد خلف الصفاق إثر إصابات رضحية حادة. لقد تمت مراجعة سجلات المرضى للبحث عن البيانات التالية: درجة حدة الإصابة، والإصابات المرافقة، ومكان التجمع الدموي، وكمية الدم المنقولة، واضطراب عوامل تخثر الدم، وحالات التدخل الجراحي، ومدة الإقامة في المستشفى، ونسبة الوفيات، وعلى أساس ذلك تم عمل مقارنة بين المرضى الباقين على قيد الحياة والمتوفين.

النتائج: وصل عدد الحالات المصابة بالتجمع الدموي الشديد خلف الصفاق إلى 46 مريضاً (15.8%) وذلك من أصل 290 حالة مصابة بالتجمع الدموي خلف الصفاق، فيما كانت نسبة الوفيات 32.6%. ولقد كثر ظهور التجمع الدموي خلف الصفاق في الحوض ورافق ذلك ظهوره في المناطق المركزية والوحشية (65.2%). كانت كسور الأطراف السفلى وكسور الحوض من أكثر الإصابات شيوعاً، أما الإصابات داخل الصفاق فقد ظهرت في 39.1% من المرضى، وتم إجراء عملية فتح البطن لما يعادل 58.7% من المرضى (العدد=27). ترتبط العوامل المستقلة التالية بنسبة الوفيات وهي كالتالي: ارتفاع درجات حدة الإصابة (55.9) [للمتوفين مقابل 35.5] لمن هم على قيد الحياة ($p < 0.0001$)، اضطراب عوامل تخثر الدم ($OR = 7.8$, 95% [CI] 1.974-30.932, $p = 0.005$)، بالإضافة إلى الإصابات الصدرية ($OR = 5.94$, 95% CI 1.528-23.19, $p = 0.014$).

خاتمة: أشارت الدراسة بأن كلاً من الإصابات العضلية الهيكلية، والإصابات الداخلية في البطن، واضطراب عوامل تخثر الدم من العوامل الرئيسية المرتبطة بظهور التجمع الدموي الشديد خلف الصفاق، كما يعد ارتفاع درجات حدة الإصابة، واضطراب عوامل تخثر الدم، والإصابات الصدرية من العوامل المستقلة التي تؤثر على نسبة الوفيات.

Objectives: To report our experience of managing extensive retroperitoneal hematoma (RH) in patients with blunt trauma and to determine any associated factors affecting causation and mortality.

Methods: In this retrospective observational study, patients diagnosed with extensive RH following blunt trauma admitted to King Saud Medical Complex, Riyadh, Kingdom of Saudi Arabia between January 2004 and December 2009 were included. Patient data were explored for injury severity score (ISS), associated injuries, location of hematoma, amount of blood transfusions, coagulation profile, operative management, hospital stay, and mortality. The outcomes in surviving and non-surviving patients were compared.

Results: Out of 290 patients presenting with RH, extensive RH was found in 46 patients (15.8%). The overall mortality was 32.6%. The pelvis was the most frequent location of RH in combination with lateral and central zones (65.2%). The lower extremity and pelvic fractures were the most common injury. Associated intra-peritoneal injuries were present in 39.1% patients. An exploratory laparotomy was performed in 58.7% patients ($n=27$). A high ISS (55.9 versus 35.5, $p < 0.0001$), abnormal coagulation profile (odds ratio [OR] 7.8, 95% confidence interval [CI] 1.974-30.932, $p = 0.005$), and associated chest injuries ($OR = 5.94$, 95% CI 1.528-23.19, $p = 0.014$) were independent factors associated with mortality.

Conclusion: Multiple musculoskeletal injuries in addition to intra-abdominal injuries and abnormal coagulation are major factors associated with the presence of extensive RH. High ISS, abnormal coagulation, and associated chest injuries are independent factors associated with mortality.

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Retroperitoneal hematomas (RHs) are caused by blunt or penetrating trauma, but those resulting from blunt injuries are far more frequent.^{1,2} Despite all advances in the fields of technology and surgical techniques, retroperitoneal hematoma (RH) resulting from blunt injuries still remains a challenge for the surgeons. The published literature has emphasized to classify RHs into individual zones and traditional surgical management is based on the location of RH and stability of the patient. Central zone (Zone I) RH is explored to rule out a major vascular, duodenal, or pancreatic injury. Lateral zone (Zone II) RH is selectively explored and pelvic (Zone III) RH is usually not explored.²⁻⁷ The retroperitoneum is a complex compartment between posterior parietal peritoneum in front and the transversalis fascia behind. Classically, a compartmental model consisting of 3 spaces; anterior pararenal, perirenal, and posterior pararenal space is accepted.⁸ Investigators have now proposed that rapidly accumulating fluid that originates within any of the 3 spaces can extend into one or more embryologically defined planes from which further extension inferiorly to the pelvis or superiorly to the diaphragm is possible.⁹ Recently, a new concept has been brought forward that traumatic RH is mostly based in interfascial planes rather than the 3 compartments and extends through these planes.¹⁰ Surgeons not so infrequently have to manage blunt trauma patients with extensive RH involving 2 or more retroperitoneal zones, but the data regarding the prevalence of extensive RH are still limited. The aim of this study is to report our experience of management of extensive RH following blunt abdominal trauma, and to compare surviving patients with non-surviving to identify any associated factors affecting mortality.

Methods. This is a retrospective observational study. Study approval was obtained from the institutional Research and Ethics Committee. Consecutive patients diagnosed with extensive RH following blunt abdominal trauma admitted between January 2004 and December 2009 to King Saud Medical Complex, Riyadh, KSA were included in study. The extensive RH was defined as hematoma causing definite expansion of retroperitoneal space involving 2 or more adjacent zones. The patients in whom the hematoma was small and confined to one zone were excluded from the study. The RH was diagnosed either by CT scan in stable patients or during abdominal exploration in unstable patients. The abdominal CT was carried out in patients who had multiple injuries and were hemodynamically stable. All hemodynamically unstable patients underwent diagnostic peritoneal lavage (DPL), and exploratory laparotomy was carried out if positive. Patients with negative DPL had CT abdomen when patient

stabilized. The surgical specialty teams of orthopedics, neurosurgery, and thoracic surgery also joined during emergency exploration to stabilize these patients when required. Most of these patients needed multi-specialty management in ICU and General Surgery or one of the specialties was the primary admitting team. Very few patients underwent emergency angiography and embolization, as the available expertise is limited at our institution.

The medical records of 46 patients included in study were reviewed. A detailed tabulation was developed to record information on patient characteristics, injury severity score (ISS), associated injuries, operative or conservative management for hematoma, amount of blood products transfused, coagulation profile, hospital stay, and mortality. A comparison was made between the surviving and non-surviving patients. All continuous values are expressed as the mean±standard deviation. The Student's t- test was used to compare continuous variables and Fisher's exact test to analyze the categorical data. Significant variables in univariate analysis were included in a multiple logistic regression model in order to identify independent significant predictors. Odds ratio (OR) and its 95% confidence interval (95% CI) was calculated to assess risk. $P<0.05$ was considered statistically significant. Statistical analyses were carried out using the Statistical Program for Social Sciences (SPSS 12.0.1 for Windows; SPSS Inc, Chicago, IL, USA) software.

Results. A total of 290 patients were diagnosed with RH as a result of blunt trauma. Forty-six of these patients (15.8%) had extensive RH. Among the 46 patients, most were men (93.4%). There were 31 surviving patients (67.4%) and 15 non-survivals (32.6%). Road traffic accidents were the most common cause of injury (87%) followed by falls. Twenty-seven patients (58.7%) were operated upon, and 19 (41.3%) were managed conservatively. The mean hospital stay was 31.6 days for surviving, and 19.9 days for non-surviving patients. One non-surviving patient stayed for 155 days, if this patient is excluded, the mean hospital stay for non-surviving patients is 4.8 days. The ISS ranged from 16-75 overall, with a greater score in non-surviving patients (mean 55.9). Twenty-nine (63%) of all patients received packed red blood cell transfusions (PRBC), while 21 (45.6%) received fresh frozen plasma transfusions (FFP), and 10 (21.7%) received platelet concentrate transfusions during their hospital stay. Abnormal coagulation profile was present in 14 patients (30.7%) on presentation. In the univariate analysis, surviving and non-surviving patients showed no significant differences as regards to age, gender, mode of injury, type of management, hospital stay, amount

Table 1 - Patient characteristics.

Variables	Survivals (n=31) n (%)	Non-survivals (n=15)	OR	P-value
Age, mean years \pm SD (range)	25.8 \pm 10.99 (3 - 51)	28 \pm 10.21 (8 - 44)		
Males	29 (93.5)	14 (93.3)		
Females	2 (6.5)	1 (6.7)		
Road traffic accidents	28 (90.3)	12 (80.0)		
Falls	3 (9.7)	3 (20.0)		
Hospital stay, mean days \pm SD (range)	31.6 \pm 25.01 (7 - 92)	19.9 \pm 47.68(<1 -155)		
Operated	17 (54.8)	12 (80.0)		
Conservative management	14 (45.2)	5 (33.3)		
Injury severity score, mean \pm SD (range)*	35.5 \pm 11 (16 - 66)	55.9 \pm 15.2 (38 - 75)		
Abnormal coagulation profile [†]	5 (16.1)	9 (60.0)	7.8 (1.974 - 30.932)	0.005*
Packed RBCs transfused	17 (54.8)	12 (80.0)	3.294 (0.815 - 12.964)	0.117
Amount transfused (mean units \pm SD)	4.3 \pm 2.65	6.0 \pm 3.0		
FFP transfused	12 (38.7)	9 (60.0)	2.375 (0.692 - 8.136)	0.216
Amount transfused (mean units \pm SD)	10.3 \pm 12.53	12.3 \pm 16.19		
Platelet concentrate transfused	4 (12.9)	6 (40.0)	4.5 (1.089 - 18.564)	0.057
Amount transfused (mean units \pm SD)	11.3 \pm 9.23	22 \pm 6.0		
Emergency laparotomy	17 (54.8)	10 (66.6)	1.647 (0.469 - 5.717)	0.533

Significant *p*-value (Student's test^{*}, Fisher's exact test[†]), RBC-red blood cells, FFP-fresh frozen plasma, SD-standard deviation, OR - odds ratio

of transfusions, and type of blood products transfused. However, there were significant differences between the 2 groups regarding ISS and the abnormal coagulation profile; defined as abnormal prothrombin time (PT), partial thromboplastin time (PTT) and international normalized ratio (INR) (Table 1). Lower extremity fracture was the most frequent injury (71.7%) followed by pelvic fractures (54.3%), and most of the patients had both pelvic and lower extremity fractures, 47.8% patients had head injury. Abdominal injuries were present in 39.1%. Splenic, hepatic, and mesenteric injuries were the most frequent associated intraperitoneal injuries. Associated chest injuries were found in 28.2% patients. The univariate analysis of the individual injuries between surviving and non-surviving patients showed no significant differences regarding head and neck, upper and lower extremity, pelvic, spinal, renal, associated intra-peritoneal, vascular, and soft tissue injuries. However, the chest injuries were significantly more prevalent in the non-surviving patients compared to the survivals ($p=0.0145$) (Table 2). The pelvis was the most frequent location of RH in combination with lateral and central zones (Figure 1). There was no significant difference regarding the location of RHs between the surviving and non-surviving patients (Table 3). Seventy percent of the non-surviving patients underwent abdominal surgery compared to 55% of surviving patients. Exploratory laparotomy and packing for the hematoma were the most frequent surgical procedure performed for surviving and non-surviving

patients (Table 4). High ISS score, abnormal coagulation profile, and chest trauma was found to have significant association for mortality following extensive RH.

Discussion. An RH resulting from blunt trauma has been reported to constitute 2.9% of all admissions for blunt trauma, and 13% of all admissions for blunt abdominal trauma.⁷ The classification of traumatic RH into 3 zones, and a location based treatment protocol was introduced by Kudsk and Sheldon.¹¹ Later, Feliciano¹² classified RH into subdivisions and proposed a management plan based on the location, which has remained standard to date. Goins et al⁷ and Muftuoglu et al¹³ reported that few of their blunt trauma patients had RH involving 2 or 3 zones. Recently, Ishikawa and colleagues,¹⁰ in a retrospective analysis of CT images found RH extending over 2 or 3 zones in 93 of their 169 trauma patients (55%). Our study presents a large amount of data regarding extensive RHs resulting from blunt trauma.

Motor vehicle accidents are the most common mode of blunt injury causing RH.^{2,7} A high ISS has been reported in patients with RH. Selivanov et al¹ reported a mean ISS 26.⁴ for the entire series, and even higher for the non-survivors. A mean ISS of 29.4 is reported in patients with extensive RH.¹⁰ The present study reveals a mean ISS of 42.3. The mean ISS in non-survivors is significantly higher (55.9) compared to the survivors (35.5) showing that high ISS is associated with extensive RH and increased mortality.

Table 2 - Associated injuries.

Injuries	Survivals	Non-survivals	OR	P-value
Head	12	10	3.167 (0.894 - 11.132)	0.116
Maxillo-facial	3	5	1.3 (0.294 - 5.887)	1.000
Chest	5	8*	5.943 (1.528 - 23.190)	0.014*
Upper extremity	8	3	0.719 (0.175 - 3.035)	1.000
Lower extremity	22	11	1.125 (0.294 - 4.220)	1.000
Pelvis	14	11	3.339 (0.902 - 12.165)	0.115
Spine	5	3	1.3 (0.294 - 5.887)	1.000
Renal	3	4	3.394 (0.717 - 16.003)	0.913
Intra-peritoneal	12	6	1.056 (0.310 - 2.318)	1.000
Vascular	2	2	2.231 (0.352 - 14.197)	0.587
Soft tissue	3	2	1.436 (0.256 - 8.251)	1.000

*Significant *p*-value (0.0145)

**Figure 1** - Large left retroperitoneal hematoma involving pelvic and lateral zones.**Table 3** - Location of retroperitoneal hematomas.

Location	Survivals (n=31)	Non-survivals (n=15)
Central & left lateral	11	3
Central & right lateral	2	0
Pelvic & left lateral	7	3
Pelvic & right lateral	3	1
Pelvic central & lateral	8	8

Table 4 - Abdominal surgical procedures.

Procedures	Survivals (n=17)	Non-survivals (n=10)
Splenectomy	2	2
Splenectomy & packing	3	2
Liver repair & packing	2	2
Exploratory lap & packing	8	6
Repair of mesentery	3	1
Repair of superior mesenteric artery	1	1
Sigmoid colostomy	1	1
Nephrectomy	1	

A CT abdomen is the investigation of choice to evaluate the abdomen in blunt polytrauma victims. Diagnostic peritoneal lavage and focused assessment with sonography for trauma (FAST) are diagnostic tools available for hemodynamically unstable patients. In our study, all unstable patients underwent DPL as the expertise for FAST was not available round the clock. Exploratory laparotomy was performed in all DPL positive patients and those with intraabdominal injuries on CT. An initial CT abdomen was possible in 45.6% patients in our study, which shows that a large group of patients in this series were hemodynamically unstable. In the 1980s, 86.6% of traumatic RHs were diagnosed at exploratory laparotomy¹⁴ compared with 17.6% in 2004 owing to availability of advanced radiological facilities, expertise and modern resuscitation techniques.¹³

The extensive RHs involved 2 or 3 zones in our patients. Zone III RH with extension to the lateral or central zones was the most common site of RH present in 65.2% patients. Ishikawa et al¹⁰ investigating the extensive RH, found that RH extended out of the pelvis in 66 patients (39.1%) and extension throughout 3 zones in 41 patients (24.3%) with the worst prognosis. All the previous studies also report a high prevalence of zone III (pelvic) hematomas ranging from 46-68.5%, which is mostly secondary to the presence of pelvic fractures.^{1,7,13} In this series, 54.3% of patients had pelvic fractures. The proportion of head and maxillo-facial injuries, upper and lower extremity fractures and spinal fractures were comparable as reported by previous researchers, however, there was no statistically significant difference between survivals and non-survivals.

The literature reveals a very variable incidence of associated intra-abdominal injuries in patients with RH. In this study associated intra-abdominal injuries were present in 39.1% patients, mostly involving the spleen, liver, and mesentery. There was no significant difference between survivals, and non-survivals. There was lower prevalence of renal (15.2%) and major vascular injuries (8.6%) compared to some studies reporting confined RH,^{6,7} and extensive RH,¹⁰ but others have also reported even lower prevalence of major vascular injuries.¹³ The liver and spleen are the most common intraperitoneal organs injured in other series,¹³ but a higher incidence of duodenal, pancreatic⁷ and intestinal injuries¹⁰ have also been reported.

This study shows the presence of associated thoracic trauma as significantly higher in non-surviving patients and is associated with increased mortality. A similar prevalence is found in other series with extensive RH.¹⁰ Stagnitti et al⁶ showed that thoracic trauma caused an increment of ISS score up to 26% and mortality up to 14.6%. A requirement for ventilator support longer than 48 hours and lower PaO₂/FIO₂ ratio at 48 hours has

been reported as independent risk factors for mortality in RH patients.¹

All 27 patients who underwent exploratory laparotomy had either an associated intraperitoneal injury or ruptured extensive RH. All RHs were explored in the central or lateral zones to exclude major vascular or retroperitoneal organ injury. In this study, none of the patients had a major vascular injury, and only 2 patients had severe renal and pancreatic injuries. Most of these RHs had bleeding from paraspinal or pelvic regions and packing was required; either alone or in addition to other intra-abdominal procedures. It must be emphasized that in 8 surviving patients, and 6 non-surviving patients, the exploratory laparotomy was non-therapeutic; there were no intraperitoneal injuries, just minimal rupture of extensive hematoma, which gave a positive DPL result. An initial CT may have saved these patients from laparotomy. Previously, central RH (zone I) were considered due to a major vascular injury, but recently such hematomas are found to arise also from disruption of psoas muscles caused by lumbar fracture or injured lumbar vessels and are sub classified as type IV RH.¹⁰ The high proportion of patients with spinal injuries could be the reason for such extensive RH in our patients, although none had an aortic or vena caval injury. The 27 patients received PRBCs on admission, 21 patients received FFP, and 10 patients received platelets. There was no significant difference between survivals and non-survivals as regards the transfusion of blood products. Eight percent of non-survivals received PRBCs compared to 54.8% survivals. Sixty percent of non-survivals received FFP, while 38.7% of survivals received FFP. Forty percent of non-survivals received platelets compared to 12.9% among survivals. The ratio of transfused PRBCs, plasma and platelets given to our patients were less than the currently recommended massive transfusion guideline ratio of 1:1:1. The transfusions in this ratio should be started early if massive transfusion is expected.^{15,16}

In this study 16.1% surviving patients and 60% of the non-surviving patients had an abnormal coagulation profile on admission, which was statistical significant between the 2 groups. The abnormal coagulation was present before blood transfusions were received. Although this has not been previously investigated in patients with RH, several groups have reported that 25-36% of severely injured patients have abnormal coagulation tests on presentation after trauma.^{15,17,18} This may be related to a recently evolved concept of acute traumatic coagulopathy (ATC).¹⁹ It is being highlighted that routine laboratory coagulation tests are not sensitive for ATC and thromboelastometry and thromboelastography are more reliable tools.²⁰ This study shows an association between abnormal

coagulation, presence of extensive RH, and increased mortality.

The present study shows a mortality of 32.6% compared to 12.9-26% reported by most of the studies investigating the RH.^{1,2,6,11} These studies included RH caused by penetrating and blunt trauma and most of the RH was confined to one zone. However, Goins et al⁷ have reported overall mortality of 39% among 233 patients with RH due to blunt trauma.

It may be argued that how presence of extensive RH changes the management pathway from a simple RH or RH confined to single zone? Although this study does not provide a breakthrough strategy plan, the findings are significant to generate further research, which may modify the management plan. This study is the first to provide clinical data that extensive RH exists in a significant proportion of blunt trauma patients. The study highlights the evidence that extensive RHs are mostly related to musculoskeletal and soft tissue injuries and not related to major vascular injuries; therefore, the presence of coagulopathy may be the contributory factor in extension of hematoma. The patients in whom a diagnostic CT was possible and managed by a multidisciplinary team in ICU without exploratory laparotomy had the best chance of survival. Although exploratory laparotomy is unavoidable in patients with associated intra-abdominal injuries, non-therapeutic laparotomy in such critical patients is more detrimental.

The study suggests that the way forward in these difficult and challenging patients is future prospective research to validate these results and implement into the management algorithm of RH. The study also suggests that the future availability of CT in the emergency room or CT fitted emergency room beds where CT is possible for every polytrauma patient will make a huge difference in the management of RHs.

The study has a number of limitations. The sample size is small. A retrospective study can only identify associations to any factors, which may affect the causation and mortality but cannot determine causation. The high ISS and coagulopathy can be argued to be generic findings and can apply to any injured patient. Therefore, further prospective research study is required to determine the risk factors related to causation and mortality due to extensive RH. There are very few recent research publications on RH in general, and extensive RH in particular; therefore, old references are included relevant to the subject.

In conclusion, the extensive RH following blunt trauma has a high mortality despite advances in multidisciplinary management. Extensive musculoskeletal injuries cause extensive RH even in the absence of major vascular injuries. High ISS, associated

chest trauma, and early coagulopathy are associated with increased mortality. Non-therapeutic laparotomy can be avoided with increased use of CT abdomen available in emergency departments. Although this study does not change the existing practice, it provides hypotheses for further research.

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