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Management of blunt adrenal gland injury in a community-based hospital☆

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ABSTRACT

Introduction: Injury of the adrenal gland in blunt trauma is rare. The routine usage of the whole body computed tomography (CT) scan helps in early diagnosis. We aimed to study the incidence, mechanism of injury, management, and outcome of adrenal injury in blunt trauma patients treated in a community-based hospital.

Methods: CT scan of the abdomen of all blunt trauma patients who were admitted to our institution between October 2010 and March 2018 were retrospectively reviewed. The files of all the patients with CT scan-detected adrenal injuries were retrieved. Studied variables included demography, mechanism of injury, associated injuries, GCS, ISS, Intensive Care Unit admission, hospital stay, and outcome.

Results: 4991 blunt trauma patients were admitted to the hospital. CT scan of the abdomen was performed for 2359 (47%) patients. Blunt adrenal injuries were diagnosed in eleven male patients (0.22%). The main mechanism of injury was motor vehicle collisions in eight (72.7%) patients. Nine (81.8%) patients had right adrenal gland injury. The mean (range) ISS was 22 (6–50). All patients had intra-adrenal hematoma and periadrenal fat stranding. None of our patients had acute adrenal insufficiency. One patient died (overall mortality 9.1%).

Conclusions: The incidence of blunt adrenal injury, although rare, is similar in a community-based hospital to those reported from trauma I centers. It is associated with severe and multiple organ injuries. Blunt adrenal injuries are usually self-limiting.

Introduction

Blunt adrenal gland injury (BAI) has received little attention in the literature and is reported in only few small series. BAI is rare because of its retroperitoneal location and its protection by the lower thoracic cage and back musculature [1]. There are no specific symptoms or signs for BAI. It is usually a silent injury that can be missed during the initial assessment of blunt trauma patients [2].

Different mechanisms were proposed to explain the occurrence of BAI in blunt trauma patients. Intra-adrenal hematoma may occur due to rapid rise of intra-adrenal venous pressure secondary to compression of the inferior vena cava (IVC) (especially on the right adrenal gland which has short draining veins). Furthermore, the adrenal gland may be compressed between the spine and the surrounding organs [3].

Finally, the deceleration force in high speed road traffic collisions (RTCs) causes shearing of the small vessels that perforate the adrenal gland capsule [4].

BAI is usually occurring in severe thoraco-abdominal blunt trauma of multiply injured patients. It is usually associated with severe injuries [5]. The diagnosis of BAI improved following the era of whole body computed tomography (CT) scan [3].

We aimed to study the incidence, mechanism of injury, management, and outcome of BAI in blunt trauma patients in a community-based hospital.

Patients and methods

Al Rahba is a community-based hospital with a capacity of 190-beds. The hospital is located on the main highway connecting two main cities and has a busy Emergency Department. Around 6000 trauma patients are treated in the Emergency Department every year and 650 (10.8%) are admitted annually. CT scan of the abdomen of all blunt trauma patients who were admitted to our

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hospital over eight years (October 2010 - March 2018) were retrospectively reviewed. CT scans were performed using a General Electric 64 Slice Light Speed Volume (GE 64 slice Light speed VCT).

CT scan criteria for diagnosing BAI included; mass or hematoma involving the body or limbs of the adrenal gland with a density of 50–80 HU and/or altered morphology of the gland with diffuse enlargement. Ancillary findings included; soft tissue stranding of the adjacent fat, thickening of the diaphragmatic crus, psoas muscle hematoma and posterior pararenal hemorrhage [6,7]. In patients having kidney laceration, perirenal hematoma can be differentiated from adrenal hematoma by being confined to the area between the injured renal parenchyma and the Gerota's fascia [8]. Only unambiguous cases have been included in the study. Suspicious or doubtful cases were excluded.

The BAI grade was determined according to the American Association for the Surgery of Trauma (AAST) organ specific grading system. Grad I represents only a contusion, Grade II represents injury that only involves the cortex or 2 cm in depth, Grade III represents a laceration extending into the medulla, Grade IV represents a 50% parenchymal disruption, and Grade V represents total parenchymal destruction. Multiple injuries could advance the grade by one, up to Grade V [9].

The files of all the patients with CT scan detected adrenal injuries were retrieved. Studied variables included demography, mechanism of injury, associated injuries, GCS, ISS, Intensive Care Unit (ICU) admission, hospital stay, and outcome. Descriptive statistical analysis was performed. The Hospital Research Ethics Committee has approved this research project (ARH/REC-065).

Results

During the study period, 4991 patients were admitted to the hospital as a result of blunt trauma. CT scan of the abdomen was performed for 2359 (47.3%) patients.

BAI was incidentally discovered on performing trauma CT scan. Eleven male patients (0.22%) were found to have BAI (Table 1). The mean (range) of age was 31 (12–48) years. The main mechanism of injury was motor vehicle collisions (MVC) in eight (72.7%) patients followed by fall from height in three (27.3%) patients. On admission, the median (range) mean arterial pressure was 102 (0–168) mmHg and the median (range) pulse rate was 88 (0–144) bpm. Nine patients had right adrenal injury (81.8%) (Fig. 1), one on the left side (Fig. 2), and one had bilateral BAI (9.1%).

All patients who had BAI were multi trauma patients with abdominal injuries (Table 2). The most common associated abdominal injuries were kidney laceration, retroperitoneal hemorrhage and hemoperitoneum (Table 3).

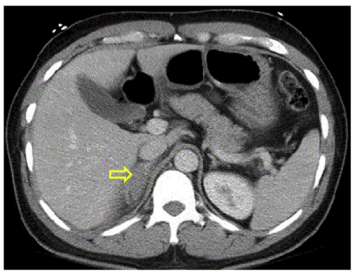

Fig. 1. Axial contrast enhanced CT scan of the abdomen showing an ovoid mass 2.1 × 2.4 cm replacing the right adrenal gland (arrow). The mass is hyperdense with a density of 60 HU consistent with a hematoma.

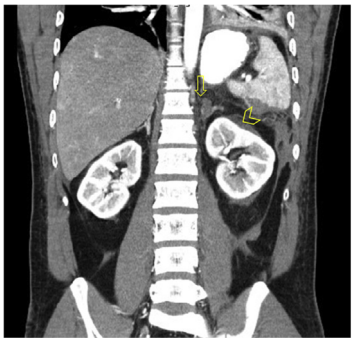

Fig. 2. Coronal contrast enhanced CT scan of the abdomen showing irregular 2 × 2.5 cm hematoma in the left adrenal gland (arrow). There is also subcapsular hematoma in the left kidney (arrow head) and retroperitoneal bleeding with thickening of the left Gerota's fascia.

Table 2
Injured anatomical body regions of eleven patients having blunt adrenal gland injury.

region	Number (%)
Head	7 (63.6)
Thorax	8 (72.7)
Abdomen	11 (100)
Pelvis	4 (36.6)
Spine	6 (54.6)
Upper limbs	2 (18.2)
Lower limbs	1 (9.1)

Table 1
Patients with blunt traumatic adrenal gland injury treated at the hospital between October 2010 and March 2018 (n = 11).

Patient	Age (years)	Gender	Mech	MAP (mmHg)	Pulse (bpm)	ISS	GCS	ICU stay (days)	Site and size (cm)	AAST/ AOIS	H S (days)	Management	Outcome
1	48	M	MVC	64	114	29	12	5	R 3.5 × 2.5	III	14	Conservative	Survived
2	34	M	MVC	109	132	34	15	1	R 2 × 2	II	5	Conservative	Survived
3	19	M	MVC	131	141	50	7	22	R 1.3 × 1 L 1 × 1	III	27	Laparotomy and Craniotomy (SDH)	Survived
4	42	M	MVC	141	96	12	15	–	R 3.8 × 3	III	3	Conservative	Survived
5	28	M	MVC	93	70	50	3	38	L 1.5 × 1.3	II	51	Craniotomy (SDH) & CSF	Survived
6	30	M	FFH	112	86	11	15	2	R 3.8 × 2	III	4	Conservative	Survived
7	34	M	FFH	102	86	6	15	–	R 2.2 × 1.8	I	2	Conservative	Survived
8	18	M	MVC	102	88	22	12	2	R 2.5 × 2.2	II	6	Conservative	Survived
9	42	M	MVC	109	92	17	13	–	R 1.8 × 1	III	9	Conservative	Survived
10	31	M	FFH	91	80	17	15	2	R 2.2 × 1.3	II	13	Embolization IPIA	Survived
11	12	M	MVC	0	0	27	3	6	R 2 × 2	IV	6	Adrenalectomy & nephrectomy	Died

M = male; MVC = motor vehicle collision; FFH = fall from height; R = right; L = left; MAP = mean arterial pressure; HS = Hospital Stay; AAST/AOIS = The American Association for the Surgery of Trauma Adrenal Organ Injury Scale; Mech = Mechanism; SDH = Subdural Hematoma; CSF = Cervical Spine Fixation; IPIA: inferior pole interlobar arteries.

Table 3
Associated abdominal injuries in eleven patients having blunt adrenal gland injuries.

Associated abdominal injury	Number (%)
Kidney laceration	5 (45.5)
Hemoperitoneum	4 (36.4)
Retroperitoneal hemorrhage	4 (36.4)
Liver laceration	3 (27.3)
Splenic laceration	2 (18.2)

CT findings of adrenal injuries has shown intra-adrenal hematoma and periadrenal fat stranding in all patients (Table 4). Two patients had active extravasation (blush) in the adrenal gland (Fig. 3). One of them had a history of fall from a height with associated lung contusion and minimal hemoperitoneum. He has stayed hemodynamically stable all the time and was treated conservatively. The second patient was a 12-year old child who was involved in a motor vehicle collision and was brought to the Emergency Department in cardiac arrest. He had severe head injury (subarachnoid hemorrhage and brain edema) and pelvic fracture. As we do not have the endovascular angioembolization facility in our hospital, following resuscitation the patient underwent an urgent laparotomy for severe kidney and adrenal gland (grade IV) lacerations. An en bloc adrenalectomy and nephrectomy were performed. The patient died on the 6th post-operative day because of severe head injury.

Serum cortisol level was measured only in one patient having bilateral adrenal gland injury and was normal. The median (range) GCS was 13 (3–15). The mean (range) ISS was 22 (6–50).

BAI was treated conservatively in ten patients (91%). Laparotomy was performed for only two patients, one of them had active extravasation (blush) in the adrenal gland and the other had bilateral BAI which was associated with severe head injury, hypovolemic shock, and mild intraperitoneal bleeding. He had a non-therapeutic laparotomy. One patient had an active bleeding from a right kidney laceration with blush on the CT scan. He was transferred to another hospital where he had a successful endovascular angioembolization for inferior kidney pole interlobar arterial bleeding. Neurosurgical operations were performed in three patients including craniotomy to evacuate subdural hematomas and cervical spine fixation for cervical spine fractures (Table 1).

Eight patients (72.7%) were admitted to the ICU. The median (range) of hospital stay was 6 (2–51) days. The median (range) of ICU stay was 3.5 (1–38) days. None of our patients had acute adrenal insufficiency. One patient died (overall mortality was 9.1%).

Table 4
CT findings of adrenal gland injuries in eleven patients.

CT scan features of adrenal injury	Number (%)
Intra-adrenal hematoma	11 (100)
Periadrenal fat stranding	11 (100)
Thickening of diaphragmatic crus	7 (63.6)
Thickening of the Gerota's fascia	6 (54.6)
Retroperitoneal hematoma	4 (36.4)
Psoas hematoma	3 (27.3)
Intra-adrenal blush	2 (18.2)

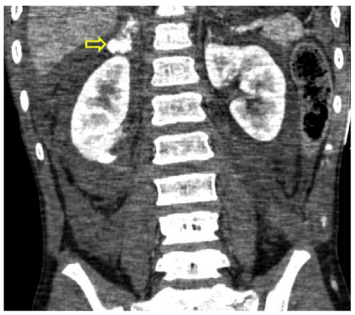

Fig. 3. Coronal contrast enhanced CT scan of the abdomen showing extravasation of contrast in the right adrenal gland consistent with active bleeding (blush, arrow). Retroperitoneal and intraperitoneal hemorrhage were also identified.

Discussion

CT scan is a useful accurate diagnostic tool for BAI. With the increased utilization of CT scan in trauma, the diagnosis of BAI became more frequent. In our series, 0.72% of patients who had CT scan for blunt abdominal trauma were diagnosed to have BAI which is similar to other studies [10,11]. Two autopsy studies on victims of blunt abdominal trauma that showed the incidence of BAI ranged from 7% to 26%. This does not reflect the real incidence of BAI but reflects the incidence in those who died from trauma [12,13]. Similar to others, our study has shown that most of the patients (72.5%) were involved in MVC [14].

As reported by other studies, all patients had multiple injuries and there was no isolated BAI in our series [4]. BAI is associated with high ISS which is considered as a marker of severe external force [15]. Eight (72.7%) of our patients had an ISS of more than 15. In another study, ISS was the only factor that predicted mortality in patients with BAI [2].

All patients in our study had associated abdominal injuries. kidney laceration was the most commonly associated injury in 45.5% of patients followed by retroperitoneal hemorrhage in 36.4% (Table 3). Chest (72.7%), head (63.6), and spine (54.6%) injuries were the most commonly associated non-abdominal injuries (Table 2). This injury pattern may help to suspect BAI in similar patients. Diagnosis of BAI often cannot be suspected on specific clinical findings which are usually related to associated injuries. All our patients were diagnosed to have BAI incidentally after CT scan examination.

CT scan findings of BAI in our study included the presence of adrenal hematoma (attenuated rounded or oval mass in the adrenal gland region) and periadrenal fat strands which was present in all patients similar to other studies [6,11]. The right adrenal gland was more injured (more than 80%), similar to others. This may be related to the compression of the gland between the liver and spine or because the right suprarenal veins are short and directly empty into the inferior vena cava [9].

Ultrasound examination can be useful in the diagnosis of BAI, but CT scan is more accurate [16]. Magnetic resonance imaging (MRI) was not used for the diagnosis in our study during the management of our severely injured patients mostly due to logistic difficulties [17].

Findings of adrenocortical insufficiency such as fever, hemodynamic instability, high serum potassium, and low serum sodium levels could be attributed to the effects severe trauma or electrolytes imbalance resulting from blood transfusion and intravenous fluid therapy [11,18]. Majority of patients who have bilateral BAI, will have a normal cortisol level and will not need glucocorticoids therapy as occurred in one of our patients [4,19]. Nevertheless, identification of adrenal crisis is crucial in bilateral BAI. This may also occur if one adrenal gland is removed and the other was injured. Patients who develop adrenal crisis need glucocorticoid therapy [20].

Ideally, the diagnosis of adrenal crisis is reached by measuring the basal cortisol and ACTH levels followed by giving a synthetic ACTH intravenously (cosyntropin) and repeating the measurement of the cortisol 30 and 60 min later [21]. Low cortisol and high ACTH

concentrations, along with the absence of cortisol response after ACTH stimulation is diagnostic of an adrenal crisis [22]. Nevertheless, this test may not be accurate in critically ill patients as both stimulated and non-stimulated cortisol levels can be much higher than normal [23].

Adrenal crisis following blunt abdominal trauma is a potentially fatal condition. Patients with adrenal insufficiency will not respond to fluids and vasopressors because of the impaired vascular adrenergic receptors. Although the patients are hypotensive, they are warm with a bounding pulse due to vasodilation contrary to massive bleeding. Adrenal crisis should be suspected in unexplained shock [21,23]. If other causes of shock are ruled out and the patient is deteriorating, dexamethasone can be initially administered instead of hydrocortisone. This will not affect the cortisol sample analysis later on [22,24].

BAI can be treated conservatively or surgically. The treatment of choice is based on the extent of the adrenal injury, the status of contralateral adrenal gland, the patient hemodynamic stability, and the associated injuries. There is an increased trend of conservative management of solid organ injuries including the BAI. In our series, BAI was treated non-operatively in 10 patients (90.9%) [10].

Angiography and embolization of bleeding vessels in the adrenal gland has recently become an alternative treatment option instead of surgery [2]. Contrast extravasation on CT scan is not only a sign of hemorrhage in the adrenal gland but is also an indicator of severe associated injuries. However, it is not always mandatory for angioembolization except if intractable hypotension is present [15,25]. Two patients in our series had adrenal gland contrast extravasation on CT scan, one of them was treated conservatively as he was hemodynamically stable while the second unstable patient had a laparotomy. Unfortunately, being a secondary hospital, we do not have angioembolization facility which could be of value for the second patient to avoid surgery.

The long hospital and ICU stay in our study is related to the severity of associated injuries rather than the BAI itself. The mortality of patients with BAI is usually not related to the adrenal gland injury but caused by other associated injuries [5].

Similar to other studies, the overall mortality in our study was 9.1%. Severe head injury was the main cause of mortality [2,4].

We have to note that our study is a retrospective study with a small number of patients. Some minor cases may have been missed because only 47% of our patients had CT scan. Nevertheless, the findings of our study, which stemmed from a community-based hospital, is similar to those from large trauma centers and National Trauma Data Bank with 1,766,606 recorded trauma cases [26]. This is important for the generalizability of the findings of this rare condition.

In conclusion, blunt adrenal injury is rare. The incidence of blunt adrenal injury is similar in a community-based hospital to those reported from trauma I centers. It is associated with severe multiple organ injuries. CT Scan is the diagnostic modality of choice. Most of blunt adrenal injuries are self-limited and do not require surgical intervention.

Conflict of interest statement

None of the authors have any conflicts of interest, including financial or personal relationships that could inappropriately influence or bias their work.

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