

Association Between Adrenal Hematoma and Mortality in Pediatric Multiple Blunt Traumas: An Autopsy Evaluation

Farrokh Taftachi¹, Leyla Abdolkarimi¹, Maryam Ameri², Azadeh Memarian²,
Alireza Behzadi³ & Hooman Bakhshandeh¹

¹ Rajaie Cardiovascular, Medical and Research Center, Iran University of Medical Sciences, Tehran, Iran

² Department of Legal Medicine, Iran University of Medical Sciences, Tehran, Iran

³ Forensic Specialist in Hamadan Province, Hamadan, Iran

Correspondence: Leyla Abdolkarimi, Rajaie Cardiovascular, Medical and Research Center, Iran University of Medical Sciences, Tehran, Iran. Tel: 98-21-2391-2005. E-mail: leyly.abdolkarimi@yahoo.com

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Abstract

Adrenal hematoma is a common hidden catastrophic complication in pediatric victims of multiple blunt traumas. Adrenal hematoma has no obvious symptoms and may not be detected by diagnostic methods such as magnetic resonance imaging, computed tomography scan, and sonography; consequently, this complication may be neglected in children with multiple blunt traumas and cause death through sudden adrenal crisis.

The current study was conducted on 55 dead children (<13 y) and 110 matured youths (13–17 y) who died in consequence of multiple blunt traumas, comprising car crashes, fall from heights, and falling debris. Our autopsy results showed that the overall prevalence of adrenal hematoma was 26% and this rate was higher in lower ages (1–6 y). There was no significant difference regarding the occurrence of adrenal hematoma between the genders. Adrenal hematoma was most common in abdominal and pelvic traumas. Peritoneal hemorrhage, liver damage, spleen rupture, omental injury, retroperitoneal hemorrhage, renal hematoma, and pelvic fracture were the most common complications associated with adrenal hematoma. In contrast to the previous studies, hematoma was mostly observed in the left adrenal. The incidence of damage to the pancreas, which similarly to the adrenal is a retroperitoneal organ, was very low (1.7%).

The high incidence of adrenal hematoma due to severe abdominopelvic trauma in children warrants further research. Future studies should shed sufficient light on the efficacy of prophylactic steroids in patients with suspicion of severe abdominopelvic trauma.

Keywords: abdominal trauma, autopsy, adrenal hematoma, adrenal hemorrhage, children blunt trauma, children emergency, multiple trauma, trauma pathology

1. Introduction

Adrenal hematoma occurs following trauma, shock and stress, major surgery, and use of anticoagulants (Roupakias et al., 2011). According to an autopsy evaluation, adrenal hematoma was observed in 25% of adults and 28% of matured youths who had died due to multiple blunt traumas (Roupakias et al., 2011). In children, similar to adults, trauma is the most common cause of adrenal hematoma (Roupakias et al., 2011). Therefore, adrenal hematoma commonly occurs in multiple blunt traumas.

The adrenal is a retroperitoneal organ and its hematoma exhibits no symptoms in the early stages. Even in children, who have a small body size, adrenal hematoma may not be diagnosed through radiological methods (Karam et al., 2009). The best methods to diagnose adrenal damage are magnetic resonance imaging, computed tomography (CT) scan, and sonography—respectively (Karam et al., 2009). Nevertheless, even these modalities may fail to diagnose adrenal hematoma (Karam et al., 2009). It has also been reported that adrenal hematoma may not be diagnosed in patients undergoing laparotomy owing to abdominal hemorrhage (Hamner et al., 2008).

Since adrenal hematoma may not be diagnosed—especially in children, medical care for conscious patients with suspicion of adrenal injury is important because adrenal crisis may lead to sudden death (Chen et al., 2007).

Given that adrenal hematoma is a life-threatening complication, not least in pediatric victims of multiple blunt

traumas, we conducted this autopsy study to determine the association between adrenal hematoma and mortality in pediatric multiple blunt traumas.

2. Method

All cases under 18 years old who had died following multiple blunt traumas (car accidents, fall from heights, and falling debris) within a 6-month period between April 2013 and October 2013 and were evaluated by autopsy in Tehran Legal Medicinal Center were enrolled in the present study. All cases that had undergone surgery were excluded from the study to eliminate the effect of surgery on the results. One hundred sixty-five cases, comprising 55 children (<13 y) 110 matured youths (13–17 y), were studied.

Adrenal hematoma is macroscopically obvious and causes adrenal enlargement, such that its size increases 3–5 cm and its capsule stretches. In cuts of the adrenal, a rather fresh dark red clot can be observed in the cross-section (Saukko & Knight, 2016). Adrenal hematoma was diagnosed through the macroscopic method in the current study.

3. Results

Out of 165 children and matured youths under 18 years old, who had died due to multiple blunt traumas and were evaluated under autopsy, 43 (26%) cases of adrenal hematoma were diagnosed macroscopically.

Table 1 depicts the incidence of adrenal hematoma among the population under study based on gender. As is demonstrated in Table 1, adrenal hematoma was observed in 25% of the males and 32% of the females, with the difference not constituting statistical significance ($P=0.647$). Therefore, gender had no significant effect on the formation of adrenal hematoma in this study.

Table 1. Incidence of adrenal hematoma among the study population based on gender

Gender	With Adrenal Hematoma No. (%)	Without Adrenal Hematoma No. (%)	Total No. (%)
Male	34 (25%)	103 (75%)	137 (100%)
Female	9 (32%)	19 (68%)	28 (100%)
Total	43 (26%)	122 (74%)	165 (100%)

Table 2 shows the incidence of adrenal hematoma among the population under study based on age. In the current study, adrenal hematoma was diagnosed in 72% of the cases in the age range of 1 to 6 years, while it was observed in only 28% of the cases in the age range of 7 to 12 years. There was a statistically significant difference between the age range of 1 to 6 years and the other age ranges ($P=0.001$). The results revealed that the prevalence of adrenal hematoma was more in the age range of 1 to 6 years than in the higher age ranges.

Table 2. Incidence of adrenal hematoma among the study population based on age range

Age Range	With Adrenal Hematoma No. (%)	Without Adrenal Hematoma No. (%)	Total No. (%)
1–6 y	13 (72%)	5 (28%)	18 (100%)
7–12 y	9 (28%)	23 (72%)	115 (100%)
13–17 y	21 (18%)	122 (74%)	165 (100%)
Total	43 (26%)	122 (74%)	165 (100%)

Table 3 presents the incidence of adrenal hematoma among the population under study based on the type of trauma (car crashes, fall from heights, and falling debris). Adrenal hematoma was observed in 45% of the cases who had died due to fall from heights, whereas it was diagnosed in 23% and 25% of the cases who had died due to car crashes and falling debris—respectively. In terms of the incidence of adrenal hematoma, there was no significant difference between the 3 types of traumas ($P=0.120$).

Table 3. Incidence of adrenal hematoma among the study population based on the type of trauma

Type of Trauma	With Adrenal Hematoma No. (%)	Without Adrenal Hematoma No. (%)	Total No. (%)
Car crash	33 (23%)	108 (77%)	141 (100%)
Fall from heights	9 (45%)	11 (55%)	20 (100%)
Falling debris	1 (25%)	3 (75%)	4 (100%)
Total	43 (26%)	122 (74%)	165 (100%)

Table 4 shows the incidence of adrenal hematoma based on the site of the traumatized organs (the head, face and neck, chest, abdomen, and pelvis) and fractures of the extremities. According to Table 4, there was a significant difference between the group with adrenal hematoma and the group without adrenal hematoma concerning abdominopelvic trauma insofar as abdominopelvic trauma was associated more frequently with adrenal hematoma in the current study ($P=0.05$).

Table 4. Incidence of adrenal hematoma based on the site of the traumatized organs

Site of Trauma	With Adrenal Hematoma No. (%) (43 persons)	Without Adrenal Hematoma No. (%) (122 persons)	Total No. (%) (165 persons)
Head, face, and neck	26 (61%)	72 (59%)	98 (60%)
Chest	15 (35%)	47 (39%)	62 (38%)
Abdomen or pelvis	42 (97%)	68 (55%)	110 (67%)
Fractures of the extremities	24 (56%)	83 (68%)	107 (65%)

Tables 5 and 6 demonstrate a comparison of abdominopelvic and non-abdominopelvic injuries among the study population based on the incidence of adrenal hematoma. According to the data in tables 5 and 6, the prevalence of abdominopelvic injuries (peritoneal hemorrhage, liver and omental injury, spleen rupture, retroperitoneal hemorrhage, kidney hematoma, and pelvic fracture) in the group with adrenal hematoma was higher than that of the group without adrenal hematoma; this difference between the groups was significant ($P=0.001$). Hence, in the current study, abdominopelvic injuries were mostly associated with the occurrence of adrenal hematoma. On the other hand, vis-à-vis the prevalence of non-abdominopelvic injuries, there was no significant difference between the groups with and without adrenal hematoma.

Table 5. Incidence of adrenal hematoma based on abdominopelvic injuries

Abdominopelvic Injuries	With Adrenal Hematoma No. (%) (43 persons)	Without Adrenal Hematoma No. (%) (122 persons)	Total No. (%) (165 persons)
Peritoneal hemorrhage	19 (44%)	32 (26%)	51 (31%)
Liver rupture/hematoma	18 (42%)	36 (30%)	54 (33%)
Spleen rupture	7 (17%)	15 (12%)	23 (13%)
Omental hematoma	11 (26%)	18 (15%)	29 (18%)
Retroperitoneal hemorrhage	8 (19%)	10 (8%)	18 (11%)
Renal hematoma	5 (12%)	5 (4%)	10 (6%)
Pelvic fracture	8 (19%)	8 (7%)	16 (10%)
Total	76	124	190

Table 6. Incidence of adrenal hematoma based on non-abdominopelvic injuries

Non-Abdominopelvic Injuries	With Adrenal Hematoma No. (%) (43 persons)	Without Adrenal Hematoma No. (%) (122 persons)	Total No. (%) (165 persons)
Head and neck injuries	26 (61%)	72 (59%)	98 (60%)
Lung contusion	11 (26%)	39 (32%)	50 (30%)
Homo/pneumothorax	7 (17%)	27 (23%)	34 (21%)
Heart/pericardium	4 (9%)	18 (15%)	22 (13%)
Fractures of the extremities	24 (56%)	67 (55%)	89 (54%)
Total	72	223	295

Table 7 presents the incidence of adrenal hematoma on the left side or right side of the body among the study population. According to Table 7, the prevalence of adrenal hematoma was more on the left side of the body than on the right side, which was probably because most of the victims were pedestrians hit by cars on their left side of the body while crossing the street.

Table 7. Incidence of adrenal hematoma on the left side or right side of the body

Adrenal Hematoma	Number	Percentage
Right side	16	37%
Left side	26	61%
Both sides	1	2%

4. Discussion

The prevalence of adrenal hematoma in multiple blunt traumas varies in the existing literature. For example, Porter et al. (1995) reported 21 (7.8%) cases with adrenal hematoma in the autopsy of 269 adult victims of car crashes. Rammelt et al. (2000) reported that the prevalence of adrenal hematoma secondary to multiple blunt traumas was up to 25%. In an autopsy evaluation conducted by Sivit et al. (1955) on adults who had expired due to severe abdominal trauma, the rate of adrenal hematoma was 28%. In their literature review, Porter et al. (1995) reported a rate of 7% for adrenal hematoma in adults with multiple blunt traumas.

Studies conducted on children have also reported different rates. For instance, Bradly et al. (2011) evaluated 1,245 children with multiple blunt traumas and reported adrenal hematoma in 42 (3.45%) cases. It is noteworthy that the authors performed their study clinically using CT scan on children who survived the trauma. The rates of adrenal hematoma are much higher in postmortem studies than in clinical studies. In our study on dead children and matured youths under 18 years of age, the incidence rate of adrenal hematoma was 26%, which is compatible with the results obtained by Sivit et al. Hence, adrenal hematoma is common in pediatric multiple blunt traumas, with the prevalence being higher in children than in matured youths owing to the vulnerability of the former to trauma. Chiming in with that observation, our results demonstrated that the prevalence of adrenal hematoma was more in the age range of 1 to 6 years than in higher age ranges.

In some previous studies, the prevalence of adrenal hematoma in males was more than that in females (Chen et al., 2008), but we detected no significant difference in this regard between the genders in our study.

Another issue evaluated in the previous studies is the association between adrenal hematoma and different visceral injuries. For example, Luchtman and Breit qand (2000) reported 3 cases with adrenal hematoma in tandem with liver trauma and suggested the formation of adrenal hematoma as an index for the relevant visceral injuries. Likewise, in the study by Gabal et al. (2000), adrenal hematoma was reported in association with liver injury. In the current study, by comparison with other organ trauma, abdominopelvic trauma was more allied to adrenal hematoma. Evaluation of visceral injuries has also shown that abdominopelvic injuries—encompassing peritoneal hemorrhage, liver damage, spleen rupture, omental injuries, retroperitoneal hemorrhage, kidney hematoma, and pelvic fractures—are highly correlated with adrenal hematoma. Accordingly, in children with severe multiple

blunt traumas—especially abdominopelvic trauma—the formation of adrenal hematoma should be taken into consideration.

In the previous studies, the rate of adrenal hematoma on the right side of the body was more than that on the left side (Luchtman & Breit qand, 2000; Gabal et al., 2000; Shwartz et al., 2000). In contrast in the current study, adrenal hematoma was more frequent on the left side of the body (61%) than on the right side (37%). This is perhaps because most of the victims were pedestrians hit by cars on the left side of their body while crossing the street.

The pancreas is also a retroperitoneal organ (similar to the adrenal). Adrenal hematoma has been compared with pancreas hematoma in some studies. For example, in an autopsy study by Sivit et al. (1992), out of 1,045 victims of multiple blunt traumas, pancreas hematoma was reported only in 18 (1.7%) cases. We employed the macroscopic method and detected pancreas hematoma in only 2 (1.7%) cases out of a total of 165 cases; both of these cases did not have adrenal hematoma. Indeed, in our sample of dead children with multiple blunt traumas, adrenal hematoma was much more frequent than pancreas hematoma. Therefore, it seems that the adrenal is not as protected against trauma as is the pancreas.

5. Conclusions

The adrenal is a retroperitoneal organ which is not afforded as much protection against blunt trauma as is the pancreas. Adrenal hematoma commonly occurs in pediatric multiple blunt traumas. Our findings revealed that adrenal hematoma attributable to severe multiple blunt traumas was more frequent in cases with lower ages.

Adrenal hematoma is usually in association with abdominopelvic trauma, which causes peritoneal hemorrhage, liver damage, spleen rupture, omental hematoma, retroperitoneal hemorrhage, kidney hematoma, and pelvic fractures.

Since adrenal hematoma has no obvious symptoms in children in the early stages, especially in conscious patients, adrenal crisis may lead to sudden death. Thus, early diagnosis using magnetic resonance imaging, CT scan, and at least sonography is of great importance in pediatric emergency care. Moreover, in patients with suspicion of severe abdominopelvic trauma associated with different visceral injuries, the administration of prophylactic steroids may help. Nonetheless, future clinical trials are required to provide more precise assessment in this regard.

Competing Interests Statement

The authors declare that there is no conflict of interests regarding the publication of this paper.

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