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Case Report
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Adrenal injuries following blunt abdominal trauma in children: report of two cases

Çocuklarda künt karın travmasından sonra oluşan adrenal yaralanmalar: İki olgu sunumu

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Adrenal injuries following blunt abdominal trauma are uncommon. Adrenal hemorrhage in children associated with multiple organ injury, which has received little attention in the past, is an increasingly recognized phenomenon in modern trauma centers with the widespread use of abdominal computed tomography. Adrenal trauma occurs in the setting of multisystem organ injury. Isolated adrenal injury is exceedingly rare. We report two children with blunt adrenal trauma (one isolated and one with associated injuries), who were admitted during the last two years to our Pediatric Surgery Department after abdominal trauma. We determined the prevalence, management and general prognosis of blunt adrenal injury in the pediatric population. Traumatic adrenal hemorrhage appears to be an incidental and unsuspected finding that resolves on follow-up imaging.

Key Words: Adrenal; adrenal gland; blunt abdominal trauma; children; hematoma; hemorrhage; injury.

Künt karın travmasından sonra oluşan adrenal yaralanmalar nadirdir. Geçmişte az ilgi görmüş bulunan çocuklardaki çoklu organ yaralanması ile birlikte olan adrenal hemoraji, bilgisayarlı karın tomografisi yaygın kullanımı ile birlikte modern travma merkezlerinde giderek artan bir şekilde tanı koyulan bir fenomen haline gelmiştir. Adrenal travma, birden daha fazla sistemi tutan organ yaralanması ortamında oluşmaktadır. İzole adrenal travma son derece nadirdir. Son iki yılda karın travmasından sonra çocuk cerrahi bölümüne yatırılan künt adrenal travması bulunan (bir tanesi izole ve diğeri eşlik eden yaralanmalarla birlikte) iki çocuk sunuldu. Pediyatrik popülasyondaki künt adrenal travma ile ilgili prevalansı, tedaviyi ve genel prognozu belirledik. Travmatik adrenal hemoraji, takip görüntülemesinde çözülen rastlantısal olarak oluşan ve kuşkulanılmayan bir bulgu gibi görünmektedir.

Anahtar Sözcükler: Adrenal; adrenal gland; künt abdominal travma; çocuklar; hematom; hemoraji; yaralanma.

Abdominal trauma accounts for 8-10% of all trauma admissions to pediatric hospitals, and more than 80% of traumatic abdominal injuries in children result from blunt mechanisms.[1] The significance and true incidence of traumatic adrenal hemorrhage in children is not known.[2] In the past, injury of these tiny retroperitoneal organs was difficult to detect by imaging techniques during the acute phase.[3] Since the advent of modern imaging examinations, there has been an increase in the number of recognized cases.[2] Because of their small size and retroperitoneal location, the adrenal glands are protected by surrounding structures, and are infrequently injured following impact to the torso.[4] Although the right gland lies deep in the abdomen, medial to the right hepatic lobe and lateral to the spine, at a location protected from blunt trauma, it appears to be vulnerable.[5] However, in children, the adrenals are relatively large and may be more susceptible to injury following external compressive forces.[4] Adrenal gland injuries are most often associated with high injury severity[6] and are a strong indicator of a possible associated blunt visceral lesion.[2] Thus, isolated adrenal injury is exceeding rare,[7] with only a few cases (<10) having been documented in the literature among hospitalized pediatric patients. Depending on the extent of the injury and the patient's hemody-

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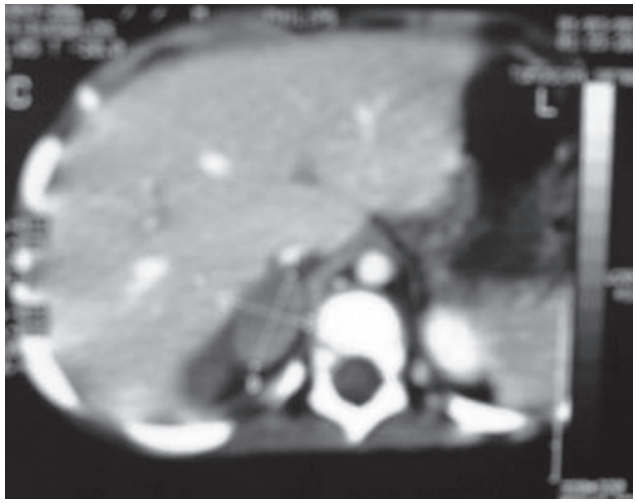

Fig. 1. Right adrenal hematoma in emergency abdominal CT.

namic stability, adrenal hemorrhage is addressed surgically or conservatively, and a few adult patients with isolated adrenal hemorrhages have been treated with embolization.[5] Given the infrequency of this sort of injury, we present our experience and speculation in the management of two children (one isolated and one with associated injuries), who were admitted to our Pediatric Surgery Department during the last two years after abdominal trauma.

CASE REPORTS

Children with adrenal injuries were identified by searching our trauma database and medical imaging database for the last two years. The Pediatric Surgery Department at Hippokration General Hospital of Thessaloniki is a level one pediatric trauma center and the largest in Central and North Greece, with approximately 100 major trauma admissions per year and 50 emergency computed tomography (CT) examinations performed for major blunt abdominal trauma.

Case 1- A 2.5-year-old boy was admitted after sustaining a fall from a height of about 150 cm; he was referred from a regional hospital with the diagnosis of central nervous system injury. At admission, he was awake and alert in his mother's arms. She maintained that her child seemed to have suffered injury to the abdomen, experiencing several emetic episodes. He was hemodynamically stable, with a respiratory rate of 25/min and a Glasgow Coma Scale (GCS) score of 15. No visible sign of an internal or external injury was present. On the physical examination, palpation of the abdomen revealed tenderness of the right hypochondrium. An immediate abdominal CT was performed, which showed a right adrenal gland hematoma (2.7 cm x 1.8 cm x 3.5 cm) with no other signs of intraabdominal injury (Fig. 1). Vomiting was not endocrine-related but caused by retroperitoneal irritation and should not be attributed in error to a possible central nervous system injury. There was no change in the child's vital signs or electrolyte disturbance during his hospitalization. His serum cortisole was measured with and without adrenocorticotropin hormone (ACTH) stimulation test and was normal. Ultrasound (US) examination 3 and 10 days after the accident revealed a phased decrease in the hematoma size (Fig. 2). The child was discharged on the 10th posttraumatic day. According to the one-month US follow-up, the hematoma was almost completely absorbed (Fig. 2).

Case 2- A six-year-old girl was referred to our emergency department about half an hour after a vehicle accident, as a rear seat passenger in a car with a visible seat belt sign. On admission, she was conscious and hemodynamically stable. Her blood pressure was 100/60 mmHg, heart rate 130 beats/min, and respiratory rate 24 breaths/min, with SpO_2: 95%. She complained of cervical spine pain and right upper quadrant abdominal pain. The physical examination revealed no acute peritoneal signs. Immediate CT examinations revealed liver laceration, right adrenal attenuation indicating local bleeding, and vertebral injury of the cervical spine. She was treated conservatively. Ten days later, follow-up CT showed good resolution, and the patient was discharged on the 15th posttraumatic day with protective stable immobilization of the cervical spine.

DISCUSSION

Adrenal gland hematomas, which are more common in children than adults, are associated with an-

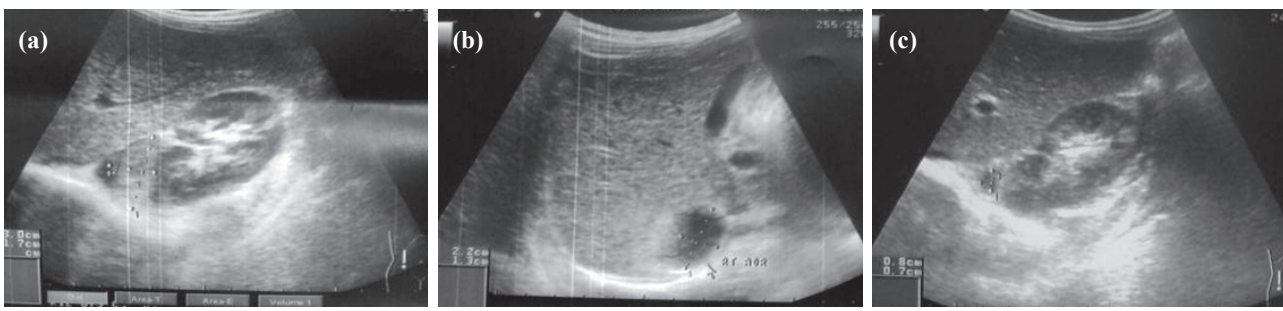

Fig. 2. US examination **(a)** 3 and **(b)** 10 days and **(c)** 1.5 months after the accident revealed a phased decrease in the hematoma size.

ticoagulant therapy, septicemia, shock, severe stress, tumors, pregnancy complications, or traumas.[8] Traumatic adrenal hemorrhage is an uncommon lesion in children, which is increasingly recognized because of routine use of CT for the evaluation of blunt abdominal trauma in stable patients.[9] The incidence of blunt adrenal trauma in children ranges from approximately 0.2%-1% of children admitted and evaluated for abdominal trauma and from 3%-5% of children followed with CT examination.[2,3,7,10]

Most reported cases are right-sided and associated with liver injury, but both left-sided and bilateral posttraumatic bleeding have been recorded.[2] Several possible mechanisms of injury may explain this high right adrenal vulnerability. Direct compression of the adrenal gland between the spine and the liver and an acute increase in intra-adrenal venous pressure due to compression of the inferior vena cava seem to produce adrenal injury.[3,5] Alternatively, hemorrhage may be secondary to deceleration forces that result in shearing of the small vessels that perforate the adrenal capsule,[5] and the venous lattice of the adrenal medulla may be susceptible to damage owing to its loose spongiform structure.[3] Ipsilateral solid-viscous lesions, mainly of the liver and kidney in right-sided and the pancreas or spleen in left-sided traumatic adrenal hemorrhage, as lower chest injuries, must be searched as well.[2] Thus, adrenal gland trauma is associated with high injury severity and mortality.[11]

Clinical manifestations of adrenal hemorrhage are rare. Bilateral adrenal hemorrhage may present with acute adrenal insufficiency,[12] including hyponatremia-hyperkalemia-acidosis-hypotension and lethargy,[13] and can be a potentially fatal condition.[12] On the other hand, unilateral adrenal injuries have limited clinical significance.[12] Isolated injuries have been reported with severe hemorrhage requiring blood transfusion.[9] Nevertheless, right-sided hematoma may cause compression of the inferior vena cava with thrombus formation; in addition, adrenal hematomas should be considered as a source of possible delayed infection causing posttraumatic sepsis like any other hematoma.[12] Child abuse is another possibility to be considered in isolated adrenal injuries.[4,14] Also, an isolated adrenal hematoma raised the possibility of bleeding into a tumor, and if this is suspected, further evaluation -biochemical markers, imaging- may need to be carried out.[9] Non-symptomatic adrenal gland hematomas are sporadic and usually follow sports activities.[8,15] We would not recommend the routine use of the ACTH stimulation test, even simple hormone measurements, or preventive cortisone administration in the setting of a diagnosed adrenal injury for isolated adrenal trauma or in the absence of the above-mentioned signs and symptoms.

CT is the best diagnostic tool, while US is very useful in follow-up examinations.[2] CT findings considered specific for adrenal injury include round or oval hematoma expanding the adrenal gland, irregular hemorrhage obliterating the gland, uniform adrenal gland swelling, active extravasation of contrast material from the adrenal vessels, and adrenal gland rupture.[12] Associated CT findings include stranding of the periadrenal fat, diffuse hemorrhage in the adjacent retroperitoneum and compression of the adrenal gland by adjacent traumatic lesions.[12] The differential diagnosis of adrenal neoplasms, retroperitoneal bleeding, and hepatic or renal lesions is difficult, but must be considered.[2]

In conclusion, in the pediatric population, blunt adrenal injuries are rare and typically present as part of a multiorgan trauma, but they are probably more common than previously suspected. Although unilateral adrenal lacerations are not fatal injuries and are of limited clinical significance, they are markers of severe external force. The right adrenal gland is more likely to be injured, with liver trauma as the most commonly associated injury, followed by ipsilateral renal injury. Adrenal trauma by itself is typically self-limited and does not require intensive care monitoring or operative intervention. However, adrenal trauma should not be considered an incidental finding because of the possibility of significant hemorrhage requiring transfusion. In the case of a child with an isolated adrenal hematoma, the possibility of bleeding into a tumor or child abuse must be suspected.

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