



## Traumatic Adrenal Injury in Children

Michael Schwarz MD<sup>1</sup>, Gadi Horev MD<sup>1</sup>, Enrique Freud MD<sup>2</sup>, Nizza Ziv MD<sup>1</sup>, Amir Blumenfeld MD<sup>2</sup>, Ran Steinberg MD<sup>2</sup> and Liora Kornreich MD<sup>1</sup>

Departments of <sup>1</sup>Pediatric Imaging and <sup>2</sup>Pediatric Surgery, Schneider Children's Medical Center of Israel, Petah Tiqva, and Sackler Faculty of Medicine, Tel Aviv University, Israel

Key words: adrenal, adrenal hemorrhage, adrenal injury, adrenal insufficiency, abdominal CT

### Abstract

**Background:** Multiple organ injury in children is an increasingly frequent phenomenon in the modern emergency room. Adrenal hemorrhage associated with this type of trauma has received little attention in the past.

**Objectives:** Using computed tomography, we sought to determine the rate and nature of adrenal gland injury in children following blunt abdominal trauma due to motor vehicular accident.

**Methods:** A total of 121 children with blunt abdominal trauma were examined and total body CT was performed in cases of multi-organ trauma or severe neurological injury.

**Results:** Of all the children who presented with blunt abdominal trauma over a 51 month period, 6 (4.95%) had adrenal hemorrhage. In all cases only the right adrenal gland was affected. Coincidental injury to the chest and other abdominal organs was noted in 66.7% and 50% of patients, respectively.

**Conclusions:** Traumatic adrenal injury in the pediatric population may be more common than previously suspected. Widespread application of the more sophisticated imaging modalities available today will improve the detection of damage to the smaller organs in major collision injuries and will help in directing attention to the mechanism of trauma.

*IMAJ 2000;2:132-134*

Motor vehicle accidents are the most common cause of abdominal trauma in children. In most cases the visceral parenchymal organs are injured, but there may also be accompanying chest trauma. Relatively little attention has been focused, however, on the presence of adrenal hemorrhage in this subgroup of patients.

Adrenal hemorrhage due to abdominal trauma was first described in 1863 [1]. Sevitt [2], in a 1955 postmortem study of a series of young victims of fatal car accidents, reported a 28% rate of adrenal hemorrhage following severe abdominal trauma. Yet, as of 1992, only eight such

cases had been documented in the literature among hospitalized pediatric patients [3]. The low reported incidence may be explained by the fact that unilateral and even bilateral adrenal hemorrhage do not necessarily lead to signs of adrenal insufficiency [4], and that in the past, injury of these tiny retroperitoneal organs (measuring only 2x1.5 cm in infants) was difficult to detect by imaging techniques during the acute phase. Until recently, it was routine practice to perform immediate abdominal ultrasonography at the bedside of car accident victims, followed by CT for complete evaluation of the abdominopelvic region, as needed. Late follow-up of surgical candidates consisted of ultrasonography only. With the recent introduction of more sensitive imaging modalities, such as high resolution CT and more recently the high speed spiral CT scanners, improved visualization is now available. In 1992, Taylor [5] delineated the high risk signs of abdominal injury and listed the clinical indications for emergency abdominal CT.

In our prospective study, state-of-the-art CT methods were used to examine children with blunt abdominal trauma, all of them following vehicular accidents, and the rate and nature of coincidental adrenal injury were determined.

### Material and Methods

A total of 121 children admitted to Schneider Children's Medical Center from April 1993 to July 1997 (51 months) following blunt trauma were examined by emergency CT for suspected abdominopelvic visceral injury. A Twin spiral CT scanner or an Excel 1800 model (Elscint, Israel) was used. Contrast medium (Omnipaque 300, Winthrop, NY, USA) was administered by manual intravenous bolus injection at a dose of 2 ml/kg body weight, up to 120 ml. The abdomen was scanned from the lung bases through the symphysis pubis. Total body CT examinations were conducted in cases of multitrauma or severe neurological injury. Repeated CT studies in patients considered candidates for surgery, and follow-up ultrasonography in those whose clinical condition had stabilized or improved, were performed.

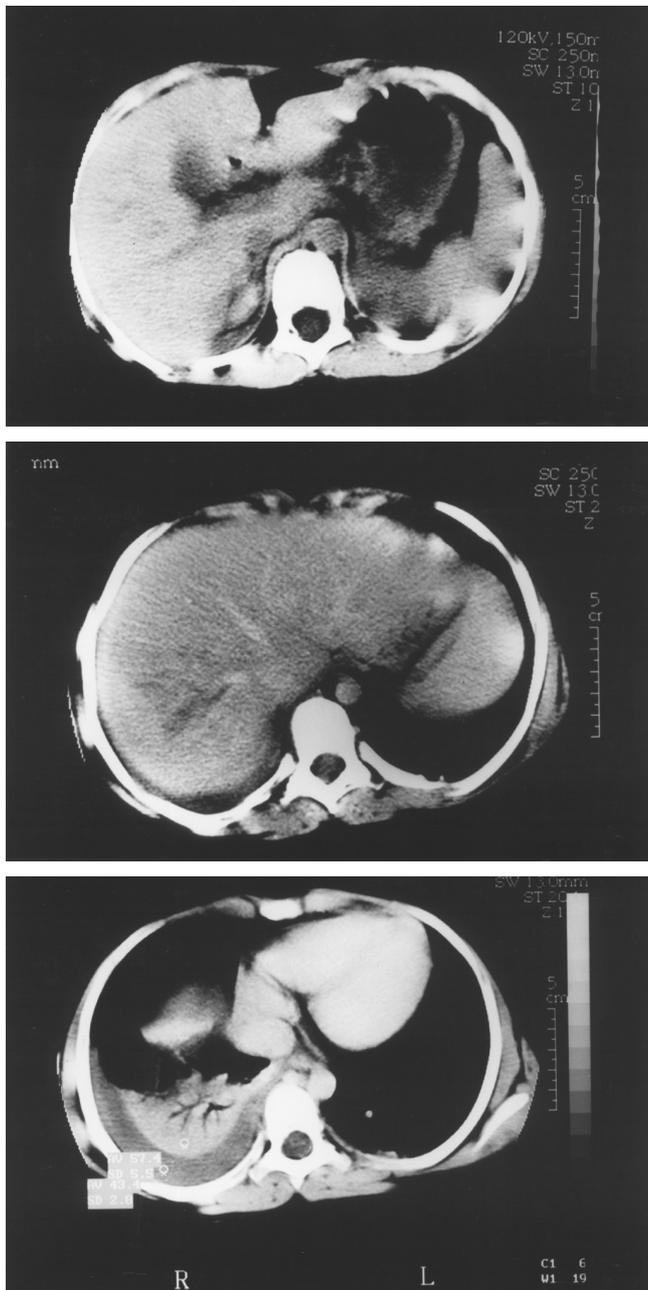


Figure 1. CT scans of a 9-year-old girl injured in a motor vehicle accident. [A] Non-enhanced CT scan reveals an ovoid hematoma in right adrenal. [B] Contrast-enhanced CT scan shows laceration of right lobe of liver. [C] CT scan through lower chest reveals right pleural effusion and contusion of the right lower lobe.

## Results

Of the 121 patients with blunt abdominal trauma, 6 (4.95%) showed adrenal hemorrhage on CT examination [Figure 1A]. The demographic characteristics and medical findings of this subgroup are shown in Table 1. All adrenal injuries were on the right side. None of the children had laboratory or clinical signs of adrenal insufficiency, but one (16.67%) had adrenal gland calcification on follow-up ultrasonography. In four children (66.7%) an ipsilateral abdominal organ (liver and/or right kidney) was also injured

Table 1. Demographic characteristics and radiology findings in patients with traumatic adrenal injury

Patient no.	Sex/Age (yr)	Abdominal injury	Chest injury	Adrenal injury
1	M/5	None	None	Rt
2	M/5	Retroperitoneal bleeding	Rt. lower lobe contusion	Rt
3	M/3	Rt kidney, liver: Rt lobe	None	Rt
4	F/9.5	Liver: Rt lobe	Rt. lower lobe contusion, Rt. pleural effusion	Rt
5	M/4.5	Liver: Rt lobe	None	Rt
6	F/2.5	Liver: Rt & Lt lobes; Rt kidney	Rt. & Lt lower lobes contusion	Rt

[Figure 1B]. Four children had chest injuries — ipsilateral (contusion of the right lower lobe and pleural effusion) in three (50%) and contralateral (contusion of the left lower lobe) in one (16.67%) [Figure 1C]. Additional retroperitoneal hemorrhage was found in one patient (16.67%).

## Discussion

The results of our study show that adrenal injury accompanies blunt abdominal trauma in almost 5% of pediatric cases. This figure is even higher than the 2% in adults [3] and 3% in children [4] reported previously. In most of the children the adrenal injury was accompanied by trauma to other abdominal organs, and in 50% by ipsilateral chest trauma. The literature reports injury rates of 61% [4] and 95% [3] to ipsilateral abdominal viscera. Research performed by automobile manufacturers has shown that individuals involved in car accidents are subjected to multiple vector forces, so that many organs may be injured simultaneously or successively. This factor is compounded in children by the higher energy transfer per body size coefficient.

All the adrenal injuries in our series were of the right gland, which concurs with earlier reports [3,4,6]. Several possible mechanisms of injury may explain this high right adrenal vulnerability. First, the proximity of the right adrenal gland to the inferior vena cava [7] may cause its mechanical compression during impact. Some authors have suggested a hydrodynamic theory involving the increased pressure in the right adrenal vein that drains directly into the inferior vena cava [6]. Furthermore, the venous lattice of the adrenal medulla may be susceptible to damage owing to its loose spongiform structure [2]. We suggest that at the moment of acceleration-deceleration, the liver, which is the heaviest abdominal parenchymal organ, moves to dorsal and/or caudal directions, pushing the right adrenal gland against the spine, such that the adrenal is clamped between these two structures, much like a nut in a nutcracker.

According to the current knowledge, unilateral adrenal injury is by itself of no clinical significance. The rare instances of bilateral adrenal injury may lead to some adrenocortical insufficiency, which compounds the burden of body trauma, stress and shock.

We conclude that injury to the adrenal gland in children following blunt abdominal trauma is probably more common than previously suspected. The newer spiral CT scanners provide improved visualization of the smaller retroperitoneal organs, enabling identification of the more severely injured adrenal glands. The accurate diagnosis of adrenal hemorrhage may serve as an important index for identifying other coincidental injuries of the ipsilateral abdominal and chest organs.

---

### References

1. Scully RE, Mark EJ, McNeely BU. Case 38. Case records of the Massachusetts General Hospital: weekly clinicopathological exercises. *N Engl J Med* 1984;311:783-90.
2. Sevitt S. Posttraumatic adrenal apoplexy. *J Clin Pathol* 1955;8:185-94.

3. Burks DW, Mirvis SE, Shanmuganathan K. Acute adrenal injury after blunt abdominal trauma: CT findings. *Am J Radiol* 1992;158:503-7.
4. Sivit CJ, Ingram JD, Taylor GA, Bulas DI, Kushner DC, Eichelberger MR. Posttraumatic adrenal hemorrhage in children: CT findings in 34 patients. *Am J Radiol* 1992;158:1299-302.
5. Taylor GA. Pediatric trauma: current concepts in abdominal imaging. Symposium of ARRS and SPR Stat and urgent imaging in pediatrics. The Marriott's Orlando World Center, Orlando, Florida, May 15, 1992.
6. Nimkin K, Teeger S, Wallach MT, Du Vally JC, Spevak MR, Kleinman PK. Adrenal hemorrhage in abused children: imaging and postmortem findings. *Am J Radiol* 1994;162:661-3.
7. Westra SJ, Zaninovic AC, Hall TR, Kangarloo H, Boechat MI. Imaging of the adrenal gland in children. *Radiographics* 1994;14:1323-40.

---

**Correspondence:** Dr. M. Schwarz, Dept. of Pediatric Imaging, Schneider Children's Medical Center of Israel, Petah Tiqva 49202, Israel. Tel: (972-3) 925 3671; Fax: (972-3) 925 3816; email: mikischw2@isdn.net.il.