Imaging of unilateral adrenal hemorrhages in patients after blunt abdominal trauma: Report of two cases

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A B S T R A C T

Adrenal hemorrhage following blunt abdominal trauma is extremely rare. Most of the lesions are unilateral and right sided. Although often asymptomatic, life-threatening adrenal insufficiency may develop in the bilateral adrenal gland hemorrhage. Isolated adrenal injuries are very rare. They are often associated with other organ injuries. The mortality rates of patients range from 7% to 32%. In this report, we present the computed tomography and magnetic resonance imaging findings of unilateral adrenal hemorrhages in two patients with a history of fall from a height.

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Introduction

Adrenal injuries after blunt abdominal trauma are very rare, but have been reported in 0.15% of patients in the literature. In 75%–90% of cases, hemorrhages are unilateral and the most affected gland is the right adrenal. Isolated adrenal injuries are very rare (4%) and are often associated with other organ injuries.1 Associated trauma includes injuries of the liver (43%), spleen (23%), lung (19%), and kidney (18%), as well as pneumothoraces/hemothoraces. Also, skeletal injuries to the rib, clavicle, scapulae, pelvis, hip, and spine can be accompanied by adrenal gland trauma.1 The mortality rates of patients range from 7% to 32%.2 In particular, adrenal insufficiency due to bilateral adrenal gland hemorrhage, if untreated, can be fatal. Here, we present the cases of two patients with unilateral adrenal hemorrhage detected by using computed tomography (CT) and magnetic resonance imaging (MRI), together with the literature review.

Case report

Case 1

A 38-year-old male was admitted to the emergency department with a history of falling from a height of approximately 2–2.5 m. Upon admission, he was awake and complained of a severe pain in his right arm and pelvis. He was hemodynamically stable and laboratory findings were normal. The plain X-ray showed fractures in the right scaphoid bone and distal radius, as well as multiple fractures in the inferior pubic ramus. Also, contrast enhanced abdominopelvic CT was performed to evaluate the solid organ injuries. There was a slightly hyperdense (50 HU) 44 mm × 22 mm adrenal mass on the right with periadrenal fat stranding and minimal free fluid in Morison’s pouch in the non-contrast abdominopelvic CT (Fig. 1A). There was also slight peripheral enhancement after contrast administration in the lesion (Fig. 1B). There were no intra-abdominal solid organ injuries due to trauma. Primarily, the lesion was thought to be an adrenal hematoma.

Four days later, a dynamic abdominal MRI (Signa HDX 1.5 T; GE Medical Systems, Milwaukee, WI, USA) exam was performed after stabilization of the patient to rule out a hemorrhagic adrenal mass. Multiplanar (axial, coronal, and sagittal) T1 and T2 weighted (W) images with and without fat saturation, T1W images in-phase and out-phase spoiled gradient-recalled-echo, and dynamic T1W images
were performed. The MRI revealed a 44 mm × 22 mm hypointense lesion in T1 and T2W images. Within the gland, a 10 mm × 11 mm focal area of hyperintensity was seen. Dynamic MR images revealed peripheral contrast enhancement in the lesion (Fig. 2). In-phase, out-of-phase, and fat-suppressed sequences did not show suppression in the lesion. Dynamic MRI findings ruled out a hemorrhagic adrenal mass to the adrenal hematoma. According to MRI findings, the lesion was compatible with an acute-phase adrenal hemorrhage.

Thirty days later, MR imaging showed the reduction of lesion size (14 mm × 37 mm) and signal intensity changes. A hypointense lesion with a focal hypointense area is seen on T1W (Fig. 3A) and 2D fast imaging employing steady-state acquisition sequences (Fig. 3B). Dynamic MRIs revealed peripheral contrast enhancement. The lesion was thought to be compatible with a subacute hematoma. Also, signal loss in the hematoma could be associated with hemosiderin deposits. Again, there was no suppression in the lesion of in-phase and out-of-phase sequences. It was decided that the patient should be followed without treatment. The patient was discharged 2 weeks later with protective stable immobilization of the pelvis.

Case 2

A 35-year-old male was admitted to the emergency department with a history of a fall from a height of about 1.50 m. On admission, he was conscious and hemodynamically stable. Vital signs and laboratory findings were normal. Physical examination revealed pain and tenderness in the right chest wall. Plain X-rays showed multiple fractures of the right 9th, 10th, 11th, and 12th ribs. Immediate thorax and abdominopelvic CTs without contrast administration were performed on the patient. The patient refused the intravenous contrast administration because of a history of allergy. Multiple fractures of the right 9th, 10th, 11th, and 12th ribs, diffuse subcutaneous emphysema in the right anterior chest wall, and bilateral hemothorax and fracture of the right transverse process of the right L1-2 vertebrae were seen in the CT. A 24 mm × 25 mm left hyperdense adrenal mass (70 HU) and periadrenal fat stranding were seen in the CT (Fig. 4). Obvious solid organ injury and free fluid were not detected in the CT. The patient was treated conservatively because laboratory findings were normal.

Fig. 1. Case 1. A 38-year-old male with a history of fall from a height. Initial abdominal computed tomography (CT) scan was performed after blunt abdominal trauma. A: Axial noncontrast CT image shows right slightly hyperdense (50 HU) soft tissue mass without periadrenal fat stranding. B: Axial contrast-enhanced CT image shows slightly hyperdense right adrenal mass with thin peripheral rim enhancement.

Fig. 2. Follow-up abdominal magnetic resonance imaging (MRI) performed 4 days later. A: Axial T1-weighted image (TR/TE = 1.9/4.1) shows hypointense adrenal mass with small foci of high-signal intensity. B: Axial contrast-enhanced T1 sequences (TR/TE = 1.9/4.1) shows peripherally enhancing hypointense adrenal mass with small foci of high-signal intensity.

Fig. 3. Follow-up abdominal MRI performed 30 days later. A, B: Axial T2-weighted (TR/TE = 1.9/4.1) and axial 2D fast imaging employing steady-state acquisition sequences (TR/TE = 1.6/3.7) show hyperintense right adrenal mass with small foci of low-signal intensity.
The incidence of adrenal hemorrhage in trauma patients is not fully known because some adrenal injuries are asymptomatic and may remain undiagnosed. In CT-based earlier studies regarding the incidence of adrenal gland injuries, adrenal hemorrhages were found in less than 2% of scans. Adrenal hemorrhage from blunt trauma occurred unilaterally on the right side twice as often as on the left. Liver and ipsilateral kidney injuries most often accompany right adrenal gland trauma. Left adrenal gland trauma is less common than on the right and may be accompanied by injuries to the pancreas or spleen. Unilateral traumatic adrenal hemorrhages are often asymptomatic and, even if symptoms do exist, they are nonspecific. These symptoms include abdominal pain, nausea, vomiting, hypotension or hypertension, low fever, agitation, and a decrease in hematocrit. Bilateral adrenal hemorrhage is a rare and potentially life-threatening condition in adults. It occurs both in traumatic and nontraumatic conditions. Predisposing factors exist, including thromboembolic disease, pregnancy, burns and coagulopathy. Life-threatening adrenal insufficiency may be observed in patients with bilateral adrenal hemorrhage.

The exact mechanism of adrenal hemorrhage is not well known. Rupture of the vessels in the adrenal medulla and loosely textured juxtaglomerular cortex due to sudden compression and decompression can be a cause of the adrenal hemorrhage. The right adrenal gland is more susceptible to damage and can be associated with the different drainage course of the adrenal veins. The right adrenal vein directly enters the inferior vena cava, but the left adrenal vein drains into the left renal vein or inferior phrenic vein. Therefore, severe compression of the inferior vena cava might be responsible for intraglandular hemorrhage due to increased adrenal venous pressure. In the present case report, there was a history of falls from heights with multiple bone fractures and unilateral adrenal hemorrhage without intra-abdominal solid organ injury. Adrenal hemorrhage and bone fractures are on the right side in Case 1. However, in Case 2, adrenal hemorrhage was seen on the left side, despite right blunt trauma to the thorax.

Although ultrasonography is noninvasive, easily accessible, and relatively inexpensive, it is sometimes insufficient when evaluating the retroperitoneal organs. A CT scan is the best method for evaluating the retroperitoneum, especially under emergency conditions. Some CT findings are diagnostic for adrenal hematoma, although others are indistinguishable with adrenal neoplasms. A CT scan can show solid, round, or oval masses in the adrenal gland. High density on precontrast CT scans, as well as diminished size or resolution of the lesion over time, is indicative of a hematoma, especially in trauma patients. Infiltrative patterns are diagnostic for adrenal hemorrhage. Ill-defined soft tissue stranding around the adrenal gland is caused by infiltration of blood through the retroperitoneal fat. Retroperitoneal stranding is observed in approximately 90% of traumatic adrenal hemorrhage cases. Hematoma with active bleeding is a rare but important pattern. There is an indication for emergent embolization when diagnosed. Adrenal hemorrhages may also be seen in the form of adreniform enlargement and amorphous solid mass. Unilateral adrenal enlargement should be considered bilateral adrenal hemorrhage in the presence of a contralateral hematoma. Subacute hemorrhages into and around the adrenal gland can be seen as an amorphous solid mass with soft-tissue density. In both of our two cases, unenhanced CT scans demonstrated a \( \geq 50 \, \text{HU} \), hyperdense solid lesion and periaxial fat stranding, both of which are diagnostic of adrenal hemorrhages.

An MRI is an alternative imaging method for evaluating the adrenal hemorrhages. On MRI, hemorrhages can be seen in different signals in the acute, subacute, and chronic stages. In acute hemorrhage (less than 7 days), deoxyhemoglobin shows isointense or hypointense signal intensity in T1W images and hyperintense signal intensity in T2W images. In the subacute stage of hemorrhage (7 days–7 weeks), methemoglobin appears to be hyperintense on T1W images. Initially, intracellular methemoglobin appears to be hypointense on T2W imaging. Afterward, lysis of the red cells disperses the methemoglobin homogeneously throughout the liquid hematoma and hemorrhage appears to be bright on T2W imaging. Chronic hematomas (lasting more than 7 weeks) appear to be hypointense on both T1W and T2W images because of the presence of hemosiderin deposits. In here, there was a 44 mm \( \times \) 22 mm hypointense lesion in T1W and T2W images and a 10 mm \( \times \) 11 mm focal area of hyperintensity within the gland. Primarily, the lesion was considered as acute adrenal hemorrhage. Thirty days later, an MRI showed a hyperintense ovoid mass of 37 mm \( \times \) 14 mm in the adrenal region with a focal hypointense area of 7 mm \( \times \) 6 mm most likely a subacute hemorrhage with hemosiderin deposits.

Adrenal atrophy or a hemorrhagic adrenal pseudocyst can be seen at the later stage of hemorrhage. Adrenal atrophy appears on CT images as a shrunken, isodense adeniform structure. A hemorrhagic adrenal pseudocyst is a chronic organized collection of hemorrhage that can be seen on CT as a nonenhancing, low-attenuation fluid collection with a well-defined thin wall.

It is difficult to distinguish between a tumor-related adrenal hemorrhage and a nonmural adrenal hemorrhage, especially in the acute phase. In addition, pheochromocytoma, adenoma, carcinoma, metastases, and myelolipoma should be considered in the differential diagnosis. On CT or MRI, hemorrhagic adrenal masses of heterogeneous attenuation or signal intensity that demonstrate enhancement should be evaluated more carefully. In the differential diagnosis, detection of intralesional enhancement, calcifications, or hypermetabolic activity on positron emission tomography should be considered for tumor-related adrenal hemorrhage.

Unilateral adrenal hemorrhages are usually followed without treatment unless they cause adrenal insufficiency. However, bilateral adrenal hemorrhages are often acutely life-threatening. Patients must be treated with corticosteroids with mineralocorticoid replacement or misdiagnosis can be fatal for patients. According to the literature, 16%–50% of patients with bilateral adrenal hemorrhage have been reported to have life-threatening adrenal insufficiency. Bilateral adrenal hemorrhage with sepsis has a mortality rate of more than 90%.
Adrenal trauma should not be considered an incidental finding because it can lead to severe bleeding, which may require a blood transfusion. In addition, bilateral adrenal hemorrhage can cause potentially fatal hyponatremia, hyperkalemia, acidosis, hypotension, and lethargy associated with acute adrenal insufficiency. CT scan is the preferred imaging modality in emergency departments because of its easily accessible and rapid scan time. An abdominal CT is preferred to an ultrasound for assessment of the adrenals. A 50–90 HU hyperdense adrenal lesion and periadrenal fat stranding should be considered an adrenal hemorrhage in unenhanced CT images, especially if there is a history of trauma. Also, MRI is the most sensitive and specific method for diagnosing adrenal hemorrhage. Hyperintense adrenal masses of precontrast T1W images primarily indicate the acute hemorrhage in a patient with a history of trauma.

In conclusion, unilateral adrenal hemorrhage in adults is extremely rare and ranks a serious condition. Therefore, adrenal glands should always be carefully evaluated in patients with a history of trauma with imaging methods. MRI should be performed for differential diagnosis of high-density adrenal lesions detected on CT in patients presenting with trauma.

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