Life-threatening Hypotension in a Multi-trauma-brain Injured Patient With Unilateral Adrenal Gland Damage; a Single Hydrocortisone Dose Unraveled Relative Corticosteroid Insufficiency.

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Case report

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Abstract

Background

The incidence of adrenal injury after trauma is very rare. Bilateral adrenal injury, which may lead to acute adrenal insufficiency and death, whereas unilateral adrenal trauma is often asymptomatic and masked by injuries to other organs. However, when unilateral adrenal trauma is associated with multiple injuries including brain trauma, critical illness-related corticosteroid insufficiency (CIRCI) may be present; despite the importance, criteria for the diagnosis are not well established.

Case presentation

We report a 16-year-old multi-trauma, brain-injured patient with unilateral adrenal gland injury. An intraparenchymal catheter for intracranial pressure (ICP) monitoring was inserted and craniectomy was performed. Postoperatively, the patient was admitted in the Intensive Care Unit (ICU) under sedation. He presented severe circulatory shock (noradrenaline dose of 1.86 μg/kg/min). which was not reversed despite red blood cell transfusions (noradrenaline increased to 2 μg/kg/min, lactate 1.8-2.1 mmol/L, although Hct was stabilized to 34 g/dl). Empiric hydrocortisone (150 mg intravenously) was administered for suspected adrenal insufficiency, after a blood sample for cortisol levels was drawn. An abrupt improvement in hemodynamics was noted [noradrenaline dose was reduced by half (1 μg/ kg/min) in less than 1 hour, and almost became insignificant during the next 8 hours, while lactate normalized (0.9 mmol/L)]. Hydrocortizone administration was continued for nine days. Fluid balance was restored after the first day. Baseline cortisol levels were 11.45 μg/dl. ICP was steadily less than 20 mmHg.

Adrenal hematoma dimensions had increased (4 x 2.7 cm), as seen in the abdominal CT scan performed 9 hours after admission. Twenty days later, a follow up CT scan revealed regression of the hematoma. His remaining ICU course was complicated by fever and sepsis and remained in the ICU for 41 days.

Conclusion

Although, data do not support the use of empiric steroids in trauma patients (with or without brain injury), this case demonstrates that adrenal insufficiency must be considered in the differential diagnosis when shock exists; adrenal gland injury, even unilateral, may play an additional factor. An urgent decision is needed, that can influence outcome.

Background

The incidence of adrenal injury after trauma is very rare.[1,2,3] Identification of adrenal injury can be of critical importance in patients with bilateral adrenal injury, which may lead to acute adrenal insufficiency and death, whereas unilateral adrenal trauma is often asymptomatic and masked by injuries to other organs.[1,3,4] However, when unilateral adrenal trauma is associated with multiple injuries including brain

trauma, as in our case, critical illness-related corticosteroid insufficiency (CIRCI) may be present; despite the importance, criteria for the diagnosis are not well established.

Case Presentation

A 16-year-old male presented in the Emergency Department after a motor vehicle accident with multi trauma, comatose (Glasgow Coma Scale (GCS) of 5), severely hypotensive and was immediately intubated. Brain computed tomography (CT) revealed extensive contusions, subdural hematoma and brain edema, while chest and abdominal CT scan revealed multiple lung contusions, pneumomediastinum and pneumothorax with subcutaneous emphysema needing a chest tube insertion, multiple fractures [involving the C2 (Type I), C5, C7, left clavicle, multiple right ribs], hemorrhagic collection in Morrison's pouch, extended to the right perinephric space. There was a hypodense lesion in the adrenal gland suggesting hematoma (2.48 x 1.61 cm), with periadrenal fat stranding (Fig. 1A). Multiple bleeding skin lacerations were also present.

Laboratory findings included: hematocrit (Hct) of 28%, White Blood Cells (WBC) 10,500 cells/μL platelets (PLT) 143,000/μL; coagulation and liver function tests were normal. Two Red Blood Cell (RBC), two Fresh Frozen Plasma (FFP) and two Platelet units were administered. The patient was transferred to the operating room, where an intraparenchymal catheter for intracranial pressure (ICP) monitoring was inserted and craniectomy was performed.

Postoperatively, the patient was admitted, just after midnight, in the Intensive Care Unit (ICU) under sedation. He presented severe circulatory shock (noradrenaline dose of 1,86 μg/kg/min); Three RBC units and fluids (4 liters in 9 hours) for resuscitation were administered; yet, shock was not reversed (noradrenaline increased to 2 μg/kg/min, lactate 1.8–2.1 mmol/L, although Hct was stabilized to 34 g/dl). APACHE II and SOFA scores upon admission, were 29 and 10 respectively.

Empiric hydrocortisone (150 mg intravenously) was administered for suspected adrenal insufficiency, after a blood sample for cortisol levels was drawn (ACTH stimulation test was not performed). An abrupt improvement in hemodynamics was noted [noradrenaline dose was reduced by half (1 μg/ kg/min) in less than 1 hour, and almost became insignificant during the next 8 hours, while lactate normalized (0.9 mmol/L)].

Hydrocortizone administration was continued at a dose of 300 mg (100 mg x 3), for 3 days, 150 mg for 2 days and tapered over the next 4 days. Fluid balance was restored after the first day. Baseline cortisol levels (results received after a three-day delay) were 11.45 μg/dl. ICP was steadily less than 20 mmHg.

Adrenal hematoma dimensions had increased (4 x 2.7 cm), as seen in the abdominal CT scan performed 9 hours after admission (Fig. 1B). Twenty days later, a follow up CT scan revealed regression of the hematoma. His remaining ICU course was complicated by fever and sepsis and remained in the ICU for 41 days. He was discharged to a rehabilitation center and his brain function was gradually restored (GCS 15), although extensive spasticity remained.

Informed written consent was obtained from the patient next of kin.

Discussion And Conclusion

In our multitrauma-brain injured patient with a unilateral adrenal gland injury, presenting with refractory shock, a bolus hydrocortisone dose uncovered CIRCI; corticosteroid replacement weaned vasopressors and fluids.

CIRCI may be common in severe trauma patients, and is associated with uncontrolled inflammation, vasopressor dependency and poor clinical outcomes,[5] independently of Adrenal Gland Trauma (AGT) presence; coexistence of AGT may deteriorate the clinical status.

Therefore, the present case raises the following questions:

a) Is there a real cut off level of plasma cortisol to define CIRCI in severe cases and especially in trauma? Is trauma severity a key factor? b) Does unilateral AGT participate in CIRCI? c) Are there any clinical indications, in trauma patients with shock, to administer a bolus corticosteroids dose, in order to diagnose CIRCI?

CIRCI occurs across a broad spectrum of critical illness. Most guidelines are extrapolated from studies in sepsis.[6] However, even in septic shock, the most studied pathology, there is no standard method to diagnose CIRCI. The task force of the Society of Critical Care Medicine (SCCM) and the European Society of Intensive Care Medicine (ESICM) were unable to reach an agreement on a single test that can reliably diagnose CIRCI, although they suggest that clinicians may use a random plasma cortisol of < 10 μg/dl for the diagnosis. [6]

Therefore, cortisol levels-if CIRCI guidelines could be extrapolated to trauma- of 11.45 μg/dL in our patient could initially be considered sufficient. However, stress degrees may be completely different depending on injury severity and the etiology of critical illness. Gannon et al, defined adrenal insufficiency in critically ill trauma patients as a serum cortisol less than 25 mcg/dL,[7] thus, diagnosing occult adrenal insufficiency in over 50% of their patients. Recently multi-trauma patients were categorized in three groups, namely severely low, relatively low and normal cortisol levels, when serum cortisol was ≤ 15 μg/dL, 15.01-25 μg/dL, or > 25 μg/dL respectively, revealing the confusion that prevails, concerning cortisol levels, to define relative adrenal insufficiency[8].

Adrenal gland trauma (AGT) is often a result of blunt trauma, reported most commonly in association with injuries to the ribs, thorax, spine, kidney, spleen and liver[1,2,3]. Therefore, AGT is associated with high injury severity and mortality rates up to 5 times higher than non-AGT trauma.[3] Usually, AGT is a coincidental finding on diagnostic imaging; therefore, the overall incidence in trauma patients has not been well characterized, although a rate ranging from 0.03 to 4,95% has been reported.[1,2,3] Life-threatening adrenal insufficiency may follow.[5]

The SCCM and ESICM suggest against the use of corticosteroids in major trauma, although with low quality of evidence.[6] Yet, no recommendation exists for major trauma associated with adrenal gland injury (bilateral or unilateral) and shock.[6] Moreover, low Hct and hemorrhage followed by shock may cover adrenal insufficiency.

Cortisol levels were clearly insufficient at this grade of severity in our multi-trauma with brain injury patient. Probably, isolated AGT participated in circulatory collapse, although according to the above, this is only a hypothesis.

We did not perform cosyntropin test. To date this diagnostic criterion has not been adopted in routine practice.[6] Even in sepsis patients, the latest Surviving Sepsis Campaign guidelines suggest against using the ACTH stimulation test to select patients that may be treated with hydrocortisone.[9] Yet, delta cortisol (change in baseline cortisol of < 9 μg/dl after cosyntropin administration), may have a clinical application when cortisol plasma levels are very low, as cortisol levels below 18 μg/dl after ACTH stimulation test may indicate adrenal insufficiency.[10] However, very low plasma cortisol levels are not observed in severe trauma patients.[7,8]

To date there are not sufficient data to support the use of hemodynamic response to a single hydrocortisone dose (50–300 mg) as a reliable test for the diagnosis of CIRCI.[6] However, in our patient there was an abrupt hemodynamic improvement, enabling the weaning from vasopressors in a few hours and normalizing lactate levels, clearly indicating CIRCI; the patient's Hct had been stabilized, and he was not responding to fluid resuscitation.

Although, hydrocortisone has been found to improve the vasopressor response to norepinephrine at least in septic patients, this effect is more marked in patients with CIRCI.[6] Therefore, we believe that a single dose of corticosteroids (followed by intravenous hydrocortisone for a few days after positive result) helped to reach a diagnosis of CIRCI in our multi-trauma AGT patient. Moreover, this test seems to be safe without disturbing immune response; even hydrocortisone therapy did not affect or even decreased infections (hospital-acquired pneumonia) in multiple trauma patients with or without head trauma, respectively. [11,12]

Life threatening CIRCI must be considered in a multi-trauma hypotensive patient, serum cortisol levels, indicating adrenal insufficiency, may vary depending on the degree of stress induced by the injury. Adrenal gland trauma may play an additional role to the occurrence of shock. As there are no reliable tests to diagnose CIRCI, a dose of hydrocortisone may reveal relative corticosteroid insufficiency in a hemodynamically unstable patient not responding to resuscitation.

Abbreviations

ACTH: Adrenocorticotropic Hormone; APACHE II: Acute Physiology And Chronic Health Evaluation; CIRCI: Critical Illness-Related Corticosteroid Insufficiency; CT: Computed Tomography; ESICM: European Society

of Intensive Care Medicine; FFP: Fresh Frozen Plasma; RBC: Red Blood Cells; GCS; Glasgow Coma Scale; Hct: Hematocrit; ICP: Intracranial Pressure; ICU: Intensive Care Unit; PLT: Platelets; RBC: Red Blood Cells; SCCM: Society of Critical Care Medicine; SOFA: Sequential Organ Failure Assessment; WBC: White Blood Cells;

Declarations

Declaration of conflicting interests

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Ethical approval

Not applicable

Informed Consent

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Consent for publication

All authors have read the final manuscript and consent for publication.

Guarantor

GEZ

Availability of data and materials

All data shall be shared upon reasonable request

Contributorship

GEZ wrote the first draft of the article. AT described the CT findings. All authors reviewed, adited the article and approved the final version. GEZ and VT edited clinical photographs and organized them for the article.

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Figures

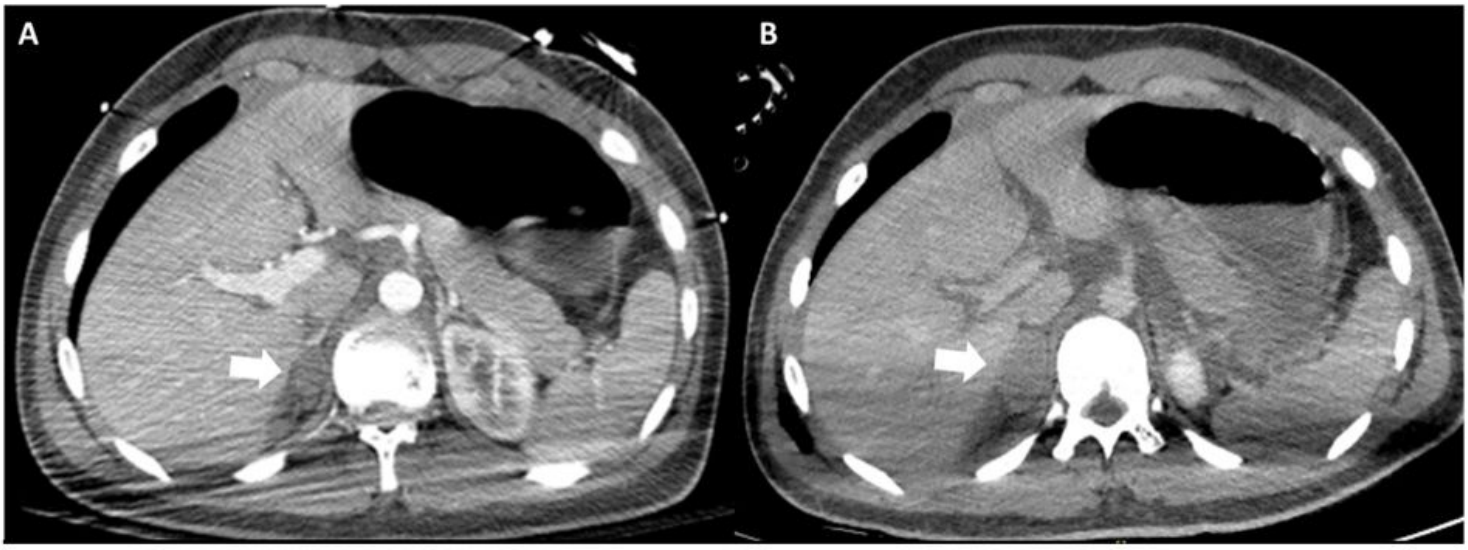

Figure 1

Abdominal CT findings A. Abdominal Computed tomography scan on admission: The arrow indicates a hypodense lesion located in the right adrenal gland, suggesting hematoma (2.48 x 1.61 cm). B. Right adrenal gland hematoma dimension has increased 9 hours after admission (4 x 2.7 cm). Diffuse perihepatic and peripancreatic hemorrhagic fluid collection is also seen.