

## Abnormal Imaging Findings of the Kidneys in a Patient with Shock

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### Case Description

A 19-year-old woman arrived at the hospital after a gunshot wound to the chest. She was minimally responsive and hemodynamically unstable, with a systolic BP of 60 mm Hg and heart rate at 150 beats per minute. She underwent exploratory thoracotomy with pulmonary artery repair and wedge resection of the left lung. She received massive blood transfusion and fluid resuscitation and, subsequently, developed abdominal compartment syndrome requiring decompressive laparotomy. She was maintained on vasopressor support in the intensive care unit.

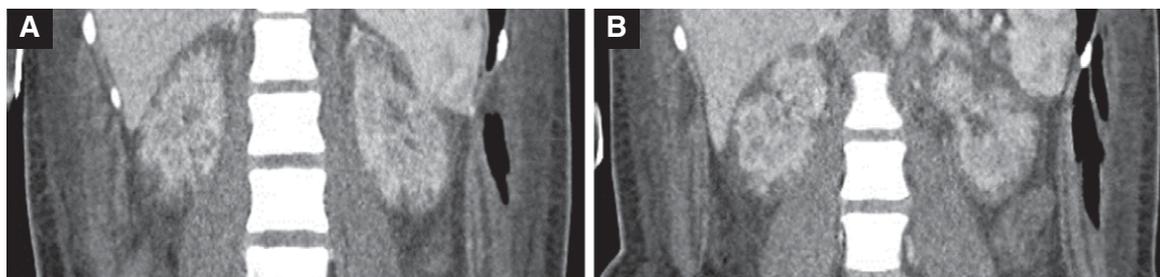
On presentation, serum creatinine was 0.7 mg/dl, but kidney function quickly deteriorated, leading to anuria and a rise in serum creatinine to 2.9 mg/dl on day 5. On day 10, due to persistent hypoxia, increasing vasopressor requirement, and leukocytosis, a contrast-enhanced computed tomography (CT) scan was performed. The scan showed a grossly distorted appearance of the kidneys, with hypodensity of the renal cortices with patchy medullary enhancement bilaterally, consistent with bilateral acute cortical necrosis (ACN) of the kidneys (Figure 1). She received continuous RRT for 15 days, and then transitioned to intermittent hemodialysis after vasopressors were discontinued. On day 26, urine output increased to 1250 ml/d and dialysis was discontinued. Kidney function continued to improve, reaching a serum creatinine of 1.2 mg/dl. A

repeat CT scan 60 days later revealed resolution of previous kidney abnormalities (Figure 2).

### Discussion

Bilateral ACN of the kidneys accounts for <2% of AKI cases. It occurs most frequently after complications of pregnancy, with abruptio placentae accounting for 50% of the cases. The most common nonobstetric cause of bilateral ACN of the kidneys in adults is ischemic AKI after hemorrhagic shock. Other causes include septic shock, burns, envenomation, neoplasm, hemolytic uremic syndrome, renal transplant rejection, acute pancreatitis, renal artery dissection, orthotopic liver transplantation, amphetamines, and cocaine abuse (1,2). The initiating event appears to be vasospasm of small vessels or liberation of toxins causing capillary endothelial damage (3). Prolonged vasospasm of both cortical and medullary vessels has been shown to induce ACN of the kidneys in experimental studies (4).

Early diagnosis of bilateral ACN of the kidneys can be difficult. Kidney biopsy is essential for definitive diagnosis. However, the procedure may be contraindicated in patients who are critically ill with shock or disseminated intravascular coagulation (1). Renal cortical calcification with an “eggshell” or “tram-track” pattern on abdominal x-ray is the hallmark of ACN of the kidneys, but it is uncommon and can take several



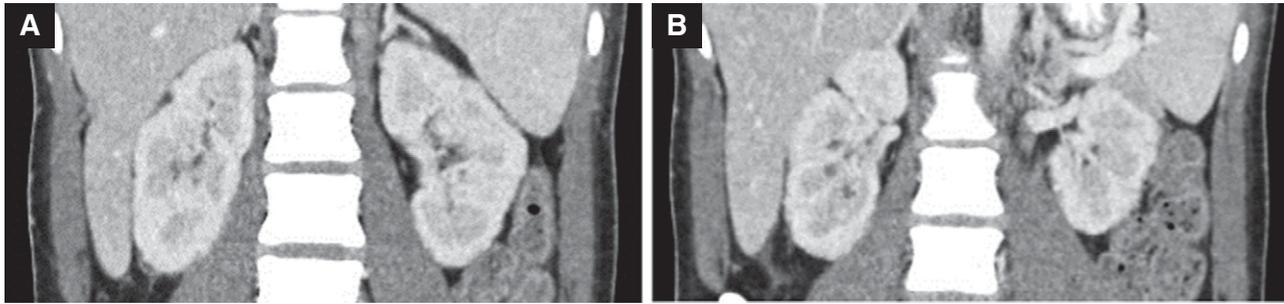
**Figure 1.** | **Imaging showing bilateral acute cortical necrosis of the kidneys.** (A and B) Contrast-enhanced computed tomography scanning coronal images disclose remarkable distortion of the anatomic appearance of both kidneys, including irregular margins, presence of hypodensity of the renal cortices, and patchy medullary enhancement.

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**Figure 2.** | Imaging showing resolution of bilateral cortical necrosis of the kidneys. (A and B) After 60 days, repeat computed tomography scanning (coronal view) shows complete resolution of previously observed kidney abnormalities.

months to develop. CT scans can be used for diagnosis, with key findings of lack of renal cortical enhancement, enhancement of a thin layer of subcapsular cortex, enhancement of the renal medulla, and lack of radiocontrast medium in the collecting system (2). The clinical course of ACN is ominous, commonly leading to anuria and permanent loss of kidney function. A study reported that only 18% of patients with ACN of the kidneys recover without long-term dialysis (5). Our case provided an example of a rather impressive radiologic and clinical resolution of bilateral ACN of the kidneys.

### Teaching Points

- Bilateral ACN of the kidneys is a rare cause of AKI; the main etiologies include abruptio placentae and hemorrhagic shock.
- Contrast-enhanced CT scans can be used for diagnosis of ACN, but judicious use of iodinated radiocontrast medium is advised.
- Bilateral ACN of the kidneys is a serious condition that can only be reversible in about 18% of patients.

### Disclosures

J.C.Q. Velez has participated in advisory board meetings for Mallinckrodt Pharmaceuticals and Retrophin, and in a speaker bureau for Otsuka Pharmaceuticals. None of the products related to those engagements are discussed in this manuscript. All remaining authors have nothing to disclose.

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### Author Contributions

A.G. Cielo wrote the original draft; A.G. Cielo and X. Luo were responsible for data curation; A.G. Cielo, X. Luo, and J.C.Q. Velez were responsible for investigation; X. Luo and J.C.Q. Velez reviewed and edited the manuscript; and J.C.Q. Velez conceptualized the study, was responsible for project administration, and provided supervision.

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