Clinical Case

Contrasting Mechanisms and Management of Adrenal Hemorrhage: A Comparative Two-Case Series

Mecanismos Contrastantes e Gestão da Hemorragia Suprarrenal: Uma Série Comparativa de Dois Casos

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ABSTRACT

Adrenal hemorrhage (AH) is an uncommon condition with variable etiology, including trauma, coagulopathies, infections, and endocrine disorders. Clinical presentation is often nonspecific, ranging from flank or abdominal pain to hemodynamic instability. Prompt imaging with computed tomography and magnetic resonance imaging is essential for diagnosis and characterization. We report two cases of unilateral adrenal hemorrhage: a 75-year-old male with traumatic adrenal hemorrhage associated with multiple fractures and right renal infarction, and a 58-year-old male with spontaneous adrenal hemorrhage accompanied by adrenal vein thrombosis. Both patients were hemodynamically stable and managed conservatively, with favorable clinical and radiologic outcomes. This comparative analysis highlights differences in etiology, presentation, imaging features, and clinical course between traumatic and spontaneous adrenal hemorrhage, emphasizing the importance of early recognition, individualized management, and follow-up.

Keywords: Adrenal Gland Diseases/diagnostic imaging; Adrenal Gland Diseases/etiology; Adrenal Gland Diseases/therapy; Hemorrhage/diagnostic imaging; Hemorrhage/etiology; Hemorrhage/therapy

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RESUMO

A hemorragia suprarrenal é uma condição rara, de etiologia variável, incluindo trauma, coagulopatias, infeções e distúrbios endócrinos. A apresentação clínica é frequentemente inespecífica, variando de dor no flanco ou abdominal a instabilidade hemodinâmica. A realização rápida de exames de imagem, como tomografia computorizada e ressonância magnética, é essencial para o diagnóstico e caracterização. Relatamos dois casos de hemorragia suprarrenal unilateral: um homem de 75 anos com hemorragia suprarrenal traumática associada a múltiplas fraturas e enfarte renal direito, e um homem de 58 anos com hemorragia suprarrenal espontânea acompanhada de trombose da veia suprarrenal. Ambos se apresentaram hemodinamicamente estáveis e foram geridos de forma conservadora, com resultados clínicos e radiológicos favoráveis. Esta análise comparativa destaca as diferenças na etiologia, apresentação, características de imagem e evolução clínica entre a hemorragia suprarrenal traumática e espontânea, enfatizando a importância do reconhecimento precoce, tratamento individualizado e *follow-up*.

Palavras-chave: Doenças das Glândulas Suprarrenais/diagnóstico por imagem; Doenças das Glândulas Suprarrenais/etiologia; Doenças das Glândulas Suprarrenais/tratamento; Hemorragia/diagnóstico por imagem; Hemorragia/etiologia; Hemorragia/tratamento

INTRODUCTION

Adrenal hemorrhage (AH) is a rare but clinically significant entity, with reported incidence ranging from 0.14%–1.8% in autopsy series.[1,2] The adrenal gland's rich arterial supply and single central vein predispose it to venous congestion and rupture under conditions of trauma or stress.[1,3,4] Traumatic adrenal hemorrhage (TAH) usually follows blunt abdominal trauma or high-energy impact, often associated with multisystem injuries leading to a wide range of clinical presentations.[1,4] Spontaneous adrenal hemorrhage (SAH) occurs without trauma and may result from coagulopathies, antiphospholipid syndrome, infection, severe physiologic stress, or underlying tumors, including pheochromocytoma.[2,5-7] Despite these recognized associations, a substantial proportion of cases remain idiopathic, with no identifiable precipitating factor.

Diagnosis is challenging due to nonspecific symptoms such as flank pain, nausea, or hypotension. Computed tomography (CT) is the imaging modality of choice, allowing rapid detection of adrenal enlargement, hyperdensity, and periadrenal fat stranding, whereas magnetic resonance imaging (MRI) is particularly useful in characterizing hemorrhagic content and excluding neoplasms.[5,8] Hormonal assessment is essential to evaluate adrenal function, detect occult pheochromocytoma, and guide management.[1,9]

This report presents two cases of unilateral adrenal hemorrhage, one traumatic and one spontaneous, and provides a comparative discussion regarding clinical presentation, imaging findings, endocrine evaluation, and conservative management, with reference to current literature.[1–10]

CASE REPORTS

CASE 1 – TRAUMATIC ADRENAL HEMORRHAGE

A 75-year-old male with a history of hypertension, type 2 diabetes mellitus, and dyslipidemia presented to the emergency department after a fall from a ladder. He reported right thoracic and lumbar pain. Physical examination revealed stable vital signs without hemodynamic compromise.

Initial CT imaging showed a globular, hyperdense right adrenal gland (42 × 18 mm) consistent with acute hemorrhage, extending to the posterior pararenal space and right psoas muscle (Fig. 1A), without active contrast extravasation. Associated injuries included multiple rib fractures, right scapular, C7 transverse process and left trochanteric fractures, and a right renal infarction involving the mid-to-lower pole (Figs. 1B–C). Laboratory results demonstrated mild leukocytosis and elevated inflammatory markers, while adrenal function remained preserved.

During hospitalization, the patient developed fever with elevated inflammatory markers (CRP 301 mg/L, leukocytosis), raising concern for hematoma superinfection, as well as acute kidney injury (AKIN 3). Empirical broad-spectrum antibiotics (amoxicillin-clavulanate, later changed to piperacillin-tazobactam) were administered. Blood and urine cultures remained negative. Due to the risk of complications from the infected hematoma, the patient was transferred to an intermediate care unit for closer monitoring of hemodynamics, renal function, and early detection of sepsis. Conservative management with analgesia, supportive care, and imaging follow-up resulted in gradual clinical and radiologic improvement and resolution of inflammatory markers. No

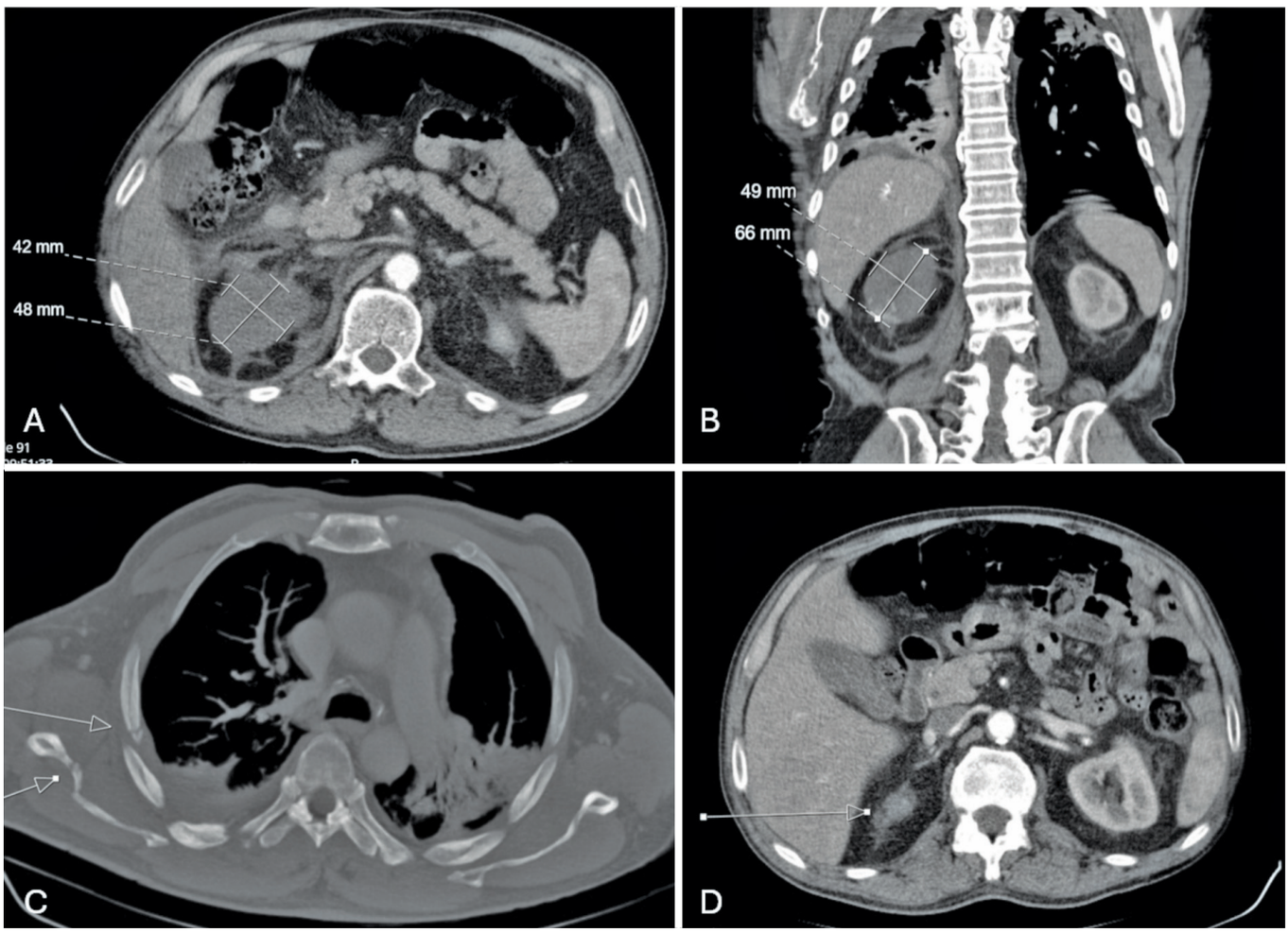

Figure 1: Case 1 – **A**. Axial CT showing globular hyperdense hematoma in the right adrenal gland; **B**. Coronal CT demonstrating extension of hemorrhage into the pararenal space and psoas; **C**. CT bone window highlighting associated right rib and scapular fractures; **D**. Axial follow-up CT showing resolution of the hematoma.

surgical or endovascular intervention was required and the patient was discharged after a total of 25 days.

CASE 2 – SPONTANEOUS ADRENAL HEMORRHAGE

A 58-year-old male, with dyslipidemia as his only known comorbidity, presented with progressive left-sided abdominal and lumbar pain of three days' duration, accompanied by nausea and vomiting as well as high blood pressure, of 170/100 mmHg at admission. He denied any recent trauma, and no physical findings suggested otherwise.

Initial CT imaging (Figs. 2A–D) demonstrated an ovoid, spontaneously hyperdense lesion measuring 42 × 32 × 40 mm centered on the left adrenal gland, surrounded by periadrenal fat stranding and areas of equivocal ecchymosis, findings most consistent with AH. No contrast extravasation or clear precipitating cause was identified. A follow-up CT performed shortly thereafter showed partial resorption of the hematoma and raised suspicion for distal left adrenal vein thrombosis extending from the left renal vein.

MRI confirmed the presence of subacute blood with T1 hyperintensity and T2 hypointensity, without post-contrast enhancement or features suggestive of active bleeding (Figs. 2E–F). Hormonal evaluation revealed normal cortisol and markedly elevated ACTH levels (265 pg/mL; normal 7–60), while plasma catecholamines and metanephrines were within normal limits, excluding pheochromocytoma. No other contributing factors for SAH were identified, such as coagulopathies, septicemia or other acute stressors.

The patient underwent conservative management, including blood pressure optimization, analgesia, and close biochemical and radiologic surveillance. He remained clinically stable, and serial imaging showed progressive regression of the

hematoma, with normalization of ACTH levels. He was discharged after 16 days and continued follow-up as an outpatient.

However, two months later, CT imaging showed a persistent irregular adrenal mass measuring 22 × 15 mm with contrast washout below 60%, raising concern for an underlying lesion. Consequently, a laparoscopic adrenalectomy was performed for definitive diagnosis. Histopathological analysis revealed only organizing hematoma, with no evidence of neoplasm. The patient recovered fully and experienced no postoperative complications.

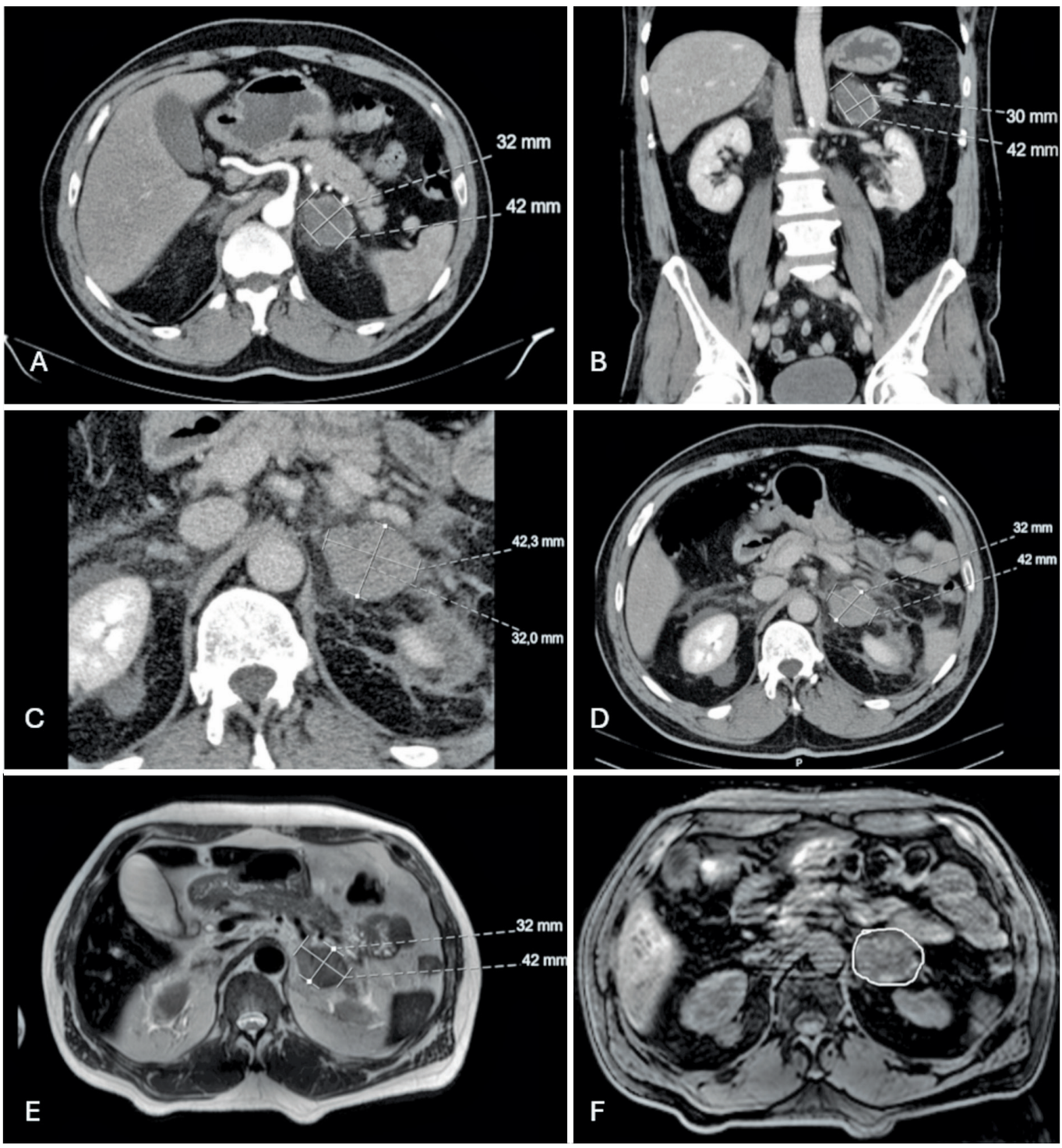

Figure 2: Case 2 – **A** and **B**. Admission axial and coronal CT of left adrenal hematoma; **C** and **D**. Follow-up axial CT (five days later) showing the hematoma with surrounding fat stranding; **E**. T1-weighted fat-saturated MRI demonstrating hyperintense hemorrhagic content; **F**. T2-weighted MRI showing hypointense areas consistent with subacute blood.

DISCUSSION

These cases illustrate the differing clinical and radiologic profiles of traumatic versus spontaneous adrenal hemorrhage, as summarized in Table 1. TAH (Case 1) resulted from vascular injury due to blunt trauma and was associated with multisystem injuries, including rib and scapular fractures and renal infarction. In contrast, SAH (Case 2) was isolated to the adrenal gland, likely related to adrenal vein thrombosis and possibly undiagnosed hypertension. Other contributing factors for SAH that can coexist include coagulopathies, anti-coagulant use, septicemia, stress and occult endocrine tumors, which were excluded.[1–3,6,7] In both cases, the hemorrhage was unilateral; SAH can frequently present as bilateral.

CT imaging in both cases demonstrated hyperdense adrenal lesions with periadrenal fat stranding, while MRI in the spontaneous case confirmed subacute hemorrhage and excluded neoplasm.[3,5,8] Figs. 1 and 2 illustrate these key differences, highlighting the role of imaging in diagnosing, differentiating hemorrhage from tumors or abscesses, and guiding follow-up monitoring.[4,5,8]

Endocrine evaluation revealed preserved function in Case 1, while Case 2 showed ACTH elevation, likely reflecting physiologic stress rather than primary adrenal failure, emphasizing the importance of hormonal workup in spontaneous hemorrhage.[1,8,9]

In addition, hematoma superinfection is a potential complication of TAH, particularly in patients with comorbidities or extensive soft tissue injury. In this patient, transient fever and elevated inflammatory markers prompted empirical antibiotic therapy and admission to intermediate care for close monitoring, highlighting the need for vigilance regarding infectious complications.[3,6]

Management strategies depend on hemodynamic stability and the presence of complications. Conservative therapy, including hemodynamic monitoring, pain control, and follow-up imaging, is effective in most cases, with surgical or interventional radiology reserved for expanding hematomas, bilateral involvement, or suspected neoplasm.[1,4,6,10] Our cases support this approach, as both patients were successfully managed non-surgically, with favorable outcomes and resolution of the hematomas on follow-up imaging. Thus, these cases highlight that, despite differing triggers, unilateral adrenal hemorrhage generally has a favorable prognosis when promptly recognized and managed conservatively.

Table 1: Comparative summary of key findings in traumatic versus spontaneous adrenal hemorrhage

Feature	Case 1 – TAH	Case 2 – SAH
Age / Sex	75 M	58 M
Comorbidities	Hypertension, DM2, Dyslipidemia	Dyslipidemia
Etiology	Blunt trauma	Spontaneous / adrenal vein thrombosis
Clinical presentation	Right thoracic and lumbar pain	Left abdominal and lumbar pain, nausea and vomiting, hypertension
Adrenal gland involvement	Right	Left
Imaging (CT)	Hyperdense, globular hematoma, extension to posterior pararenal space, periadrenal fat stranding	Hyperdense, ovoid hematoma, extension to both posterior and anterior pararenal space, periadrenal fat stranding, adrenal vein thrombosis
Imaging (MRI)	N/A	T1 hyperintense, T2 hypointense, no enhancement
Associated injuries	Rib, scapula, C7 and trochanteric fractures, renal infarction	None
Hormone function	Preserved	Raised ACTH, normal cortisol
Complications	Renal infarction, AKI, hematoma superinfection	None
Management	Conservative, empiric antibiotics	Conservative, hypertension control
Outcome	Resolution of hematoma	Resolution of hematoma

The combination of tabular summary (Table 1) and imaging comparisons (Figs. 1–2) reinforces how etiology, associated injuries, and endocrine assessment guide individualized management and follow-up strategies for optimal patient care.[1–10]

CONCLUSION

Adrenal hemorrhage, whether traumatic or spontaneous, is a rare but clinically important condition requiring high suspicion and prompt imaging, since its severity ranges from mild to life-threatening. TAH is commonly associated with multisystem injury and a higher risk of systemic complications, whereas SAH may be isolated, bilateral, associated with hemodynamic instability and its cause is often not identified.[1–7]

CT and MRI are indispensable for diagnosis, lesion characterization, and follow-up, as shown in Figs. 1 and 2. Hormonal assessment is crucial to rule out adrenal insufficiency or functional tumors.[1,9] Conservative management is effective for hemodynamically stable patients, with surgical or interventional approaches reserved for complications or diagnostic uncertainty. These cases underscore that individualized, multidisciplinary care enables excellent outcomes for both TAH and SAH.[1–10]

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AMF: Bibliographical search, study design, data collection, analysis and interpretation of results, drafting of the article.
HS: Data collection, drafting, analysis, interpretation of results, and critical review of the content of the article.
AQ, BG and EC: Analysis and interpretation of results, critical reviewing of the content of the article.
All authors approved the final version to be published.

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AMF: Pesquisa bibliográfica, desenho do estudo, recolha de dados, análise e interpretação dos resultados, redação do artigo.
HS: Recolha de dados, redação, análise, interpretação dos resultados e revisão crítica do conteúdo do artigo.
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