

Calcium Rim Sign in Plain Abdominal Radiograph: An Underrated Alert for Unstable Abdominal Aortic Aneurysm

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ABSTRACT

Abdominal pain is a common presentation in the emergency department, and constipation is one of the commonest causes in elderly patients. We report a patient with a ruptured abdominal aortic aneurysm (AAA) who presented with features mimicking acute bowel obstruction. The abdominal radiograph, which showed a calcium rim sign, raised the suspicion of AAA. It was confirmed with contrast-enhanced computed tomography, which showed a large ruptured AAA. The patient was transferred immediately to a vascular center for urgent endovascular repair of AAA and made a complete recovery. This case highlighted the usefulness of plain abdominal radiography in diagnosing abdominal pain, which should not be taken for granted as it can aid in raising concerns of AAA. This case sends an important message, particularly to junior doctors, that symptoms of abdominal pain, vomiting, and total constipation can mask the possibility of AAA. Immediate treatment of a ruptured aortic aneurysm requires a high index of clinical suspicion.

Keywords: Abdominal aortic aneurysm, Abdominal radiograph, Calcium rim sign,

INTRODUCTION

Abdominal aortic aneurysm (AAA), commonly defined as dilatation of the abdominal aorta with a diameter of 3 cm and above, is a potential surgical emergency that always causes a diagnostic dilemma due to its various presentations. It has a prevalence ranging from 1.3% to 12.5%. [1] Despite the huge number of patients undergoing AAA surgery in the United Kingdom (approximately 8000 patients annually) to prevent life-threatening complications, 4000 mortality cases of AAA rupture are still reported in the country. [2] The most dreadful complication, AAA rupture, has a mortality rate as high as 90%. [3] To reduce the mortality rate from AAA rupture, accurate and timely diagnosis is critical in ensuring that patients receive prompt treatment. Unfortunately, the classical presentation of palpable pulsatile abdominal mass in AAA is only appreciated in 40% of nonobese patients. [4] Thus, high clinical suspicion with correct judgment is of utmost importance. Endovascular aortic repair (EVAR) is the gold standard treatment, [5] but it can be performed only after a precise diagnosis. The common noninvasive diagnostic modalities for AAA are abdominal ultrasonography, computed tomography angiography (CTA), and magnetic resonance imaging. While ultrasonography, as a safe, readily available, and inexpensive imaging modality, is shown to have a sensitivity of 95% and specificity of 97% for detecting AAA, CTA is the gold standard for diagnosis of AAA, with nearly 100% sensitivity, and it can also delineate endoleaks of ruptured AAA. [6,7] Plain radiography is often performed in patients with abdominal complaints. However, it has a low diagnostic yield for AAA as aortic wall calcification is seen in less than half of the patients with AAA, resulting in a high false-negative rate. Here, we report a case of leaking AAA in an 83-year-old man who initially presented with intestinal obstruction symptoms, including constipation, vomiting, and abdominal pain. Our case highlights the significance of the calcium ring sign in plain radiography, which was found incidentally and raised the radiologist's suspicion of AAA. It was subsequently confirmed with CTA, and the patient was successfully treated with EVAR.

CASE PRESENTATION

An 83-year-old man presented to the emergency department complaining of vomiting and absolute constipation for three days and abdomen pain radiating to the right flank for two days. He normally passes motion every day. He had a similar pain a few years ago, which had not been investigated before. Moreover, he is an ex-smoker and does not drink any alcohol. He has a medical history of hypertension, hypercholesterolemia, type II diabetes mellitus, and chronic obstructive airway disease. His regular medication includes bendroflumethiazide, amlodipine, aspirin, prednisolone, Nicorette mouth spray, quinine sulfate, pravastatin, gabapentin, salbutamol, glycopyrronium, beclomethasone, and formoterol inhaler. He does not have any previous history of intra-abdominal surgery. Vital signs were as follows: temperature, 37°C; heart rate, 90 beats/min; blood pressure, 100/70 mmHg; oxygen saturation, 98%. The patient appeared to be in distress. On examination, there was generalized abdominal tenderness with guarding and distension. A digital rectal examination was unremarkable.

INVESTIGATIONS: Blood investigations were as follows: white cell count, 21×10^9 cells per litre; hemoglobin, 12.6 g/dl (normal range: 115–160 g/L); C-reactive protein, 14 mg/L (normal range: <10 mg/L); urea, 13.2 mmol/L (normal range: 2.5–6.7 mmol/L); creatinine, 76 micromol/L (normal range: 70–100 micromol/L); eGFR, 72 ml/min/1.73 m²(normal range: >90); amylase, 47 U/L (normal range: 40–140 U/L). Both chest and abdominal radiographs commonly showed a calcium rim sign (Figures 1 & 2, respectively). After admission, the radiologist on call informed us about the abnormal X-ray findings that were suggestive of AAA and proceeded with angiography. Contrast-enhanced computed tomography of the abdomen and pelvis confirmed a large leaking AAA (10.1 cm in anteroposterior diameter) with increased attenuation in the surrounding fluid, which extended into the right perirenal region (Figure 3).

TREATMENT: The patient was blue-lighted and transferred immediately to a vascular surgical team in the nearest tertiary hospital within 30 minutes of diagnosis. He was successfully treated with endovascular aortic repair (EVAR) surgery. A polytetrafluoroethylene endograft was implanted in the infrarenal portion of the abdominal aorta up to the origin of the common iliac artery via the femoral artery. The procedure was uneventful.

OUTCOME AND FOLLOW-UP: The patient was discharged seven days after the operation and recovered completely. The patient presented again with abdominal pain one month after the operation. Repeated contrast-enhanced computed tomography of abdomen and pelvis showed no evidence of graft-related complications such as infection, thrombosis, or endoleak.

DISCUSSION

Ruptured AAAs are devastating events with high mortality. Prognosis is inversely related to the time interval between clinical presentation, diagnosis, and treatment. AAA could present as a hypotensive shock with rupture; acute limb ischemia with thromboembolism; or mass effect and subsequent erosion into adjacent structures in which it literally could present as other systemic pathologies, such as neurological pathologies, like cauda equina syndrome, and gastroenterological pathologies, like gastrointestinal hemorrhage secondary to aortoenteric fistula and intestinal obstruction as demonstrated in this case. Therefore, a high index of clinical suspicion is critical for immediate definitive treatment of ruptured aortic aneurysms. Risk factors for AAA such as smoking, hypertension, hypercholesterolemia, and family history, as well as a history of ischemic events, namely, transient ischemic attack, ischemic stroke, and ischemic heart disease, should always be taken into consideration while assessing patients clinically so AAA would not be missed.

As a differential diagnosis, right flank pain with vomiting and increased white cell count should warrant consideration of ascending pyelonephritis. Urinary tract infection, especially at this age, when benign prostatic hyperplasia is common and urinary stasis would cause ascending infection. However, our patient did not have any fever or urinary tract infection signs and symptoms, albeit in the context of high white cell counts with slightly raised inflammatory markers. Renal colic is another possible differential diagnosis; however, it is more common in patients in the middle age group who are presented with loin to groin pain with or without haematuria. An elderly patient with constipation should raise suspicion of sigmoid volvulus. An abdominal X-ray would be good enough to rule out intestinal obstruction and check for any coffee bean signs. With advanced age, intestinal obstruction presentation should prompt the proper history taking with physical examination and investigations to rule out malignancy.

The National Institute of Health and Care Excellence (NICE) recommended ultrasonography as a screening modality for AAA in all men aged 65 and over with a detection rate of 1.18%, as reported by Benson et al., which has been reported to succeed in reducing the AAA-related mortality rate by 4 in 1000.[8] The Royal College of Emergency Medicine (RCEM) also recommended bedside AAA ultrasound scans be performed in patients above 65 years old who presented to the emergency department with acute abdominal pain syndrome for evaluation of AAA.[9] On the other hand, a plain abdominal radiograph plays a significant role in differentiating the causes of abdominal pain or acute abdomen and could be useful in discovering AAA, as shown in this case. It is widely available and not operator-dependent, making it an excellent tool to rule out other causes of intestinal obstruction. Our patient's abdominal radiograph showed peripheral calcifications of a central large mass, with loss of margin and one or both psoas shadows (calcium ring sign), raising the high suspicion of AAA rupture. Arterial calcification is a systemic pathological process that occurs in response to chronic inflammation and differently within different arterial beds. [10] Aortic calcification is found within the intimal and medial layers of the arterial wall, leading to vascular stiffness and subsequent hypertension.[11] Medial calcification is strongly associated with aging, diabetes, and end-stage disease. [12] Our patient has aggressive atherosclerotic risk factors for arterial calcification such as advanced age, gender, hypertension, hypercholesterolemia, diabetes, and history of smoking. As such, arterial calcification is undoubtedly an essential process in developing both thoracic and AAA diseases and is a significant marker of poor cardiovascular outcomes. Buijs et al., 2013, identified a trend of an increased degree of calcification in patients with symptomatic or even ruptured AAA, compared to that in patients with elective AAA.[13] Therefore, it can be concluded that arterial calcification increases the risk of AAA rupture.

In conclusion, ruptured AAA can present with a hemodynamically stable condition, and typical features of intestinal obstruction can masquerade AAA, especially in the elderly. Thus, high clinical suspicion is always required to obtain the correct and timely diagnosis, and the usage of basic investigations like plain abdominal radiography will aid the diagnostic process in the case of abdominal pain in the elderly. Our case reveals that a calcium rim sign in plain abdominal radiography can help clinicians in reaching an accurate diagnosis of a ruptured AAA. The degree of arterial calcification is a strong risk indicator of vascular abnormalities and instability.



Figure 1: Anteroposterior erect chest radiograph film shows calcified aortic knuckle (black arrow).

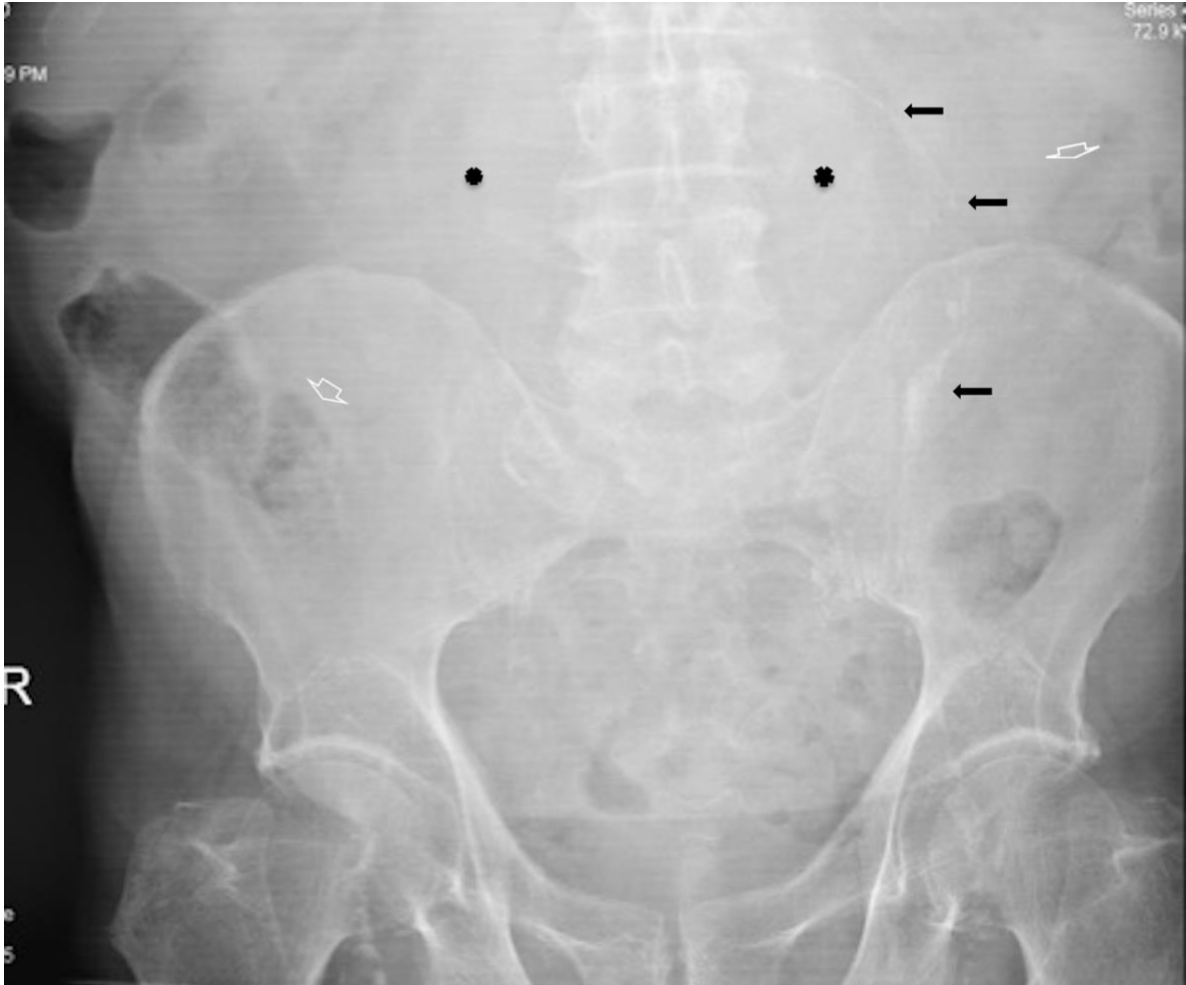


Figure 2: Plain abdominal radiograph reveals a large abdominal aortic aneurysm appearance. Left-sided prominent curvilinear vascular calcification (black solid arrows) on the lower abdomen represents an intimal calcified abdominal aortic aneurysm (left lateral wall) with loss of the right-side margin. The blurring of the psoas borders (asterisks) is noted on both sides. The central globular soft-tissue mass (mural thrombus) displaces and compresses both small and large bowels (white hollow arrows).



Figure 3: Coronal view of contrast-enhanced computed tomography of the abdomen shows a large abdominal aortic aneurysm with extensive peripheral calcifications (black arrows) and rupture point of the aneurysm over the right side (white arrow).

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