CASE REPORT

Multidetector row CT diagnosis of an infected right atrial thrombus following repeated dialysis catheter placement

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ABSTRACT. Right atrial thrombus formation is a known complication of dialysis catheter placements. We describe the case of a 61-year-old woman with end-stage renal failure who presented with gram-negative septicaemia. A gas-containing filling defect was noted incidentally in the right atrium during a CT scan of the abdomen and pelvis, indicative of a thrombus infected by a gas-forming organism. The finding correlated with a positive blood culture of *Klebsiella pneumoniae* and the two-dimensional echocardiography finding of an echogenic atrial thrombus.

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Patients with end-stage renal failure (ESRF) often undergo catheter placement for dialysis access, and right atrial thrombus (RAT) formation is a known complication. Infection is known to be associated with RAT, and death can ensue from pulmonary embolism [1, 2]. Timely diagnosis and prompt treatment (anticoagulation, thrombolysis or embolectomy) is crucial for survival, as the mortality rate reaches 100% in untreated patients [3].

Case report

A 61-year-old woman with ESRF presented with fever, chills and rigours during dialysis. She was on long-term catheter-dependent dialysis owing to poor vascular access. Over the past year, she underwent four left internal jugular dialysis catheter exchanges for blocked catheters. On two occasions, disruption of the fibrin sheath using angioplasty balloons was performed.

On admission, she had leukocytosis of 14.5×10^9 l^{-1} and her blood culture grew *Klebsiella pneumoniae*. In view of the positive blood culture, the indwelling dialysis catheter was removed. A multidetector row CT scan (MDCT) of the abdomen and pelvis was performed to look for the intra-abdominal source of infection (SOMATOM Sensation Cardiac 64-slice scanner; Siemens, Forchheim, Germany) (120 kV, 180 mA, 0.33 s per rotation, reconstruction slice thickness of 5 mm). Although MDCT did not reveal any intra-abdominal source of infection, a small 20 × 15 mm air-containing filling defect was found incidentally in the visualised sections of the right atrium (Figure 1). The findings raised suspicions of a RAT infected with a gas-forming organism, accounting for *Klebsiella pneumoniae* septicaemia. Transthoracic two-dimensional echocardiography (2DE) (1.8–3.6 MHz harmonic transducer, SONOS 4500 Ultrasound; Hewlett Packard, Andover, MA) confirmed the presence of a highly echogenic RAT, with the high echogenicity being attributable to internal gas collection (Figure 2). The patient was subsequently treated with anticoagulants and intravenous gentamicin.

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Discussion

Thrombus is the most frequently found intracardiac mass and has a myriad of aetiologies, including long-term central venous catheter placements. Unlike central venous catheters inserted for parenteral nutrition or chemotherapy, RAT formation in patients with dialysis venous catheters is reported to be uncommon, having an incidence of <6% [4]. Nevertheless, up to 29% of catheter-dependent dialysis patients are found to have mural thrombi on autopsy [5], alluding to a higher actual incidence than is reported. Death from a resultant pulmonary embolism is common, with an average mortality rate of 44.7% [1, 6].

Catheter-related thrombi can be found on the tip of the catheter, adjacent to the atrial wall or propagating from the superior vena cava [7]. Free-floating, sessile with a broad attachment, or pedunculated thrombus morphology has each been described [8]. Particular to the dialysis catheter is the common practice of catheter tip placement within the right atrium. This is thought to confer a lower rate of catheter thrombosis and increase dialysis adequacy, albeit at the increased risk of RAT [9, 10]. As a result of proximate atrial tip placement, direct atrial endocardium trauma promoting thrombogenesis can result from the ''to-and-fro'' movement of the catheter [11], with cardiac pulsations and ''jet'' injury from fast infusions. In our case, repeated passage of stiff guidewires into the right atrium for catheter exchange and fibrin sheath disruption are probably contributory.

There is a significant association between RAT and catheter-related septicaemia, although the exact relationship of the thrombus with septicaemia remains unclear [12]. Not surprisingly, urgent transoesophageal echocar-

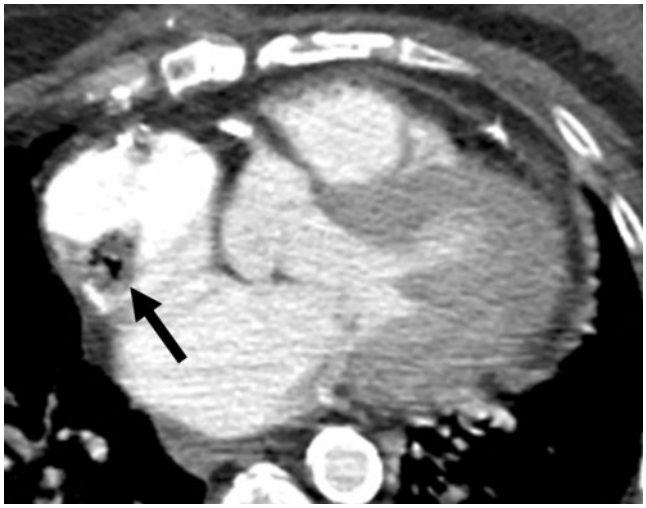

Figure 1. Axial CT image showing an air-containing filling defect attached to the free wall of the right atrium (arrow). The appearance is pathognomonic of a right atrial thrombus infected with a gas-forming organism.

diography (TEE) has been advocated to exclude an infected RAT in catheter-dependent dialysis patients presenting with sepsis [2]. The majority of the pathogens are either gram-negative rods (such as *Klebsiella pneumoniae*) or gram-positive cocci [13]. Although the presence of positive blood culture often leads to instinctive removal of the indwelling catheter, a catheter-related infective nidus can remain after catheter removal, in the form of an infected RAT, and has to be borne in mind.

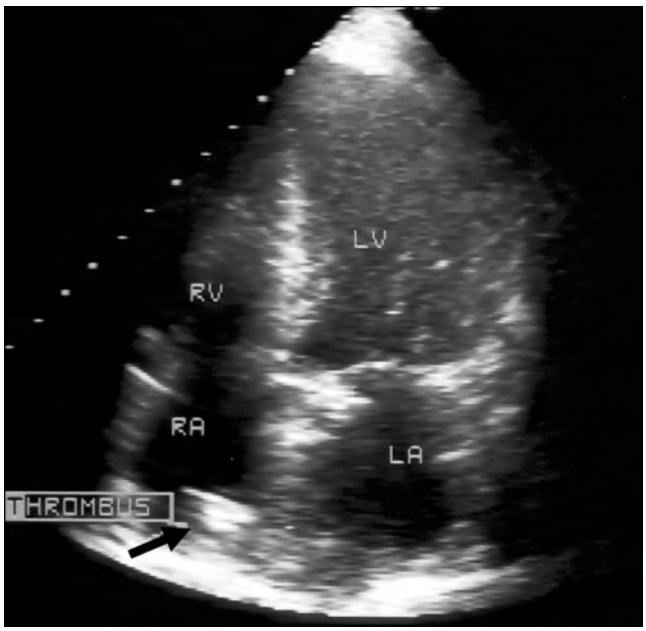

Figure 2. Apical four-chamber view from a two-dimensional transthoracic echocardiogram. A highly echogenic focus arising from the right atrial wall is present (arrow), separate from the tricuspid valve and interatrial septum. Definitive diagnosis of an air-filled thrombus is not possible without foreknowledge of the CT findings (see Figure 1), as a calcified mass can have similar sonographic appearances. RA, right atrium; LA, left atrium; RV, right ventricle; LV, left ventricle.

RAT is commonly diagnosed using 2DE, and a transoesophageal approach is superior to a transthoracic approach [14]. On 2DE, RAT is seen as a randomly mobile echogenic focus, separate from the tricuspid valves and present in multiple planes [7, 15]. The strength of 2DE lies in its low cost and real-time visualisation of thrombus. Although MRI can detect intracardiac thrombi with sensitivity close to that of TEE [16], its high cost is often prohibitive and expertise is often lacking. Detection of atrial lesions on CT has also been described [17–19]. However, on all imaging modalities, the differentiation of tumour from thrombus remains a diagnostic conundrum with therapeutic consequences.

Atrial tumours can be benign or malignant, with the majority being benign. Myxoma is the most common, with 25% residing in the right atrium [20]. Malignant atrial tumours include angiosarcoma and metastasis. Metastasis can occur via haematogenous spread from primaries, such as bronchogenic and breast carcinomas, or via direct venous extension from inferior vena cava invasion in cases of hepatocellular and renal cell carcinoma [17].

The differentiation of thrombus from tumour lies in the location of the lesion. Myxomas tend to arise from the atrial septum, whereas attachment to the lateral free wall of the atrium favours the diagnosis of a thrombus. Furthermore, thrombus caused by catheter friction against the endocardium may be found on the free wall facing the catheter position [8]. Visualisation of direct extension of tumour from the inferior vena cava into the right atrium, if present, is diagnostic for metastasis.

Although right atrial masses can be detected on contrast-enhanced MDCT, the ability to accurately characterise atrial masses on MDCT is limited for several reasons. The CT attenuation value of thrombus approximates that of tumour and is not helpful for distinction [18]. Furthermore, calcifications can be seen in both atrial myxomas and thrombi [19], and is therefore not a reliable distinguishing feature. Only homogeneity and a lack of enhancement have been shown to favour thrombus over tumour [17]. Additionally, normal right atrial anatomical structures, such as the crista terminalis and Eustachian valve, are known mimics and represent potential pitfalls [21].

Nevertheless, MDCT can potentially contribute to the diagnostic algorithm in cases of suspected RAT. As demonstrated in our case, MDCT is superior for the detection of air within the thrombus. This is in stark contrast to 2DE, with which gas within the thrombus cannot be diagnosed confidently, as both calcifications and air would appear as sonographically echogenic foci. The presence of air within a thrombus is a rare finding, with only one other reported case in which a RAT was similarly infected with a gas-forming organism (*Clostridium perfringens*) [22]. Air within a thrombus, in our opinion, is pathognomonic for superimposed infection by gas-forming organisms. As an added advantage, MDCT can detect concomitant pulmonary embolism, the most feared complication of RAT. It is therefore foreseeable that newer CT techniques such as cardiac gating can further refine the role of MDCT in RAT.

In conclusion, we report an infected RAT complicating multiple previous dialysis catheter placements in a patient with ESRF. MDCT is superior to 2DE for depicting air within the thrombus, a finding pathognomonic for an infected thrombus. MDCT can therefore potentially contribute in the face of equivocal sonographic findings.

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