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Right atrial endocarditis mimicking a catheter-related thrombus in an immunocompromised young patient: A multimodality imaging challenge

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Abstract

Background: Right atrial infective endocarditis is a rare clinical entity, typically secondary to endothelial injury from central venous catheters.

Case description: A 32-year-old male with T-cell Acute Lymphoblastic Leukemia (T-ALL) developed septic shock secondary to KPC-producing Escherichia coli bacteremia after multiple central venous catheters placements. Echocardiography revealed a poorly mobile right atrial mass. Given the challenging differential diagnosis between a catheter-related thrombus, cardiac tumor, or vegetation, multimodality imaging was performed. Due to the massive dimensions and imminent embolic risk, the patient underwent urgent open-heart surgical resection. Histopathological analysis and tissue cultures of the 5x5 cm mass isolated KPC/ESBL-producing *Escherichia. coli,* definitively establishing isolated right atrial infective endocarditis. Despite a complicated postoperative course involving severe hypofibrinogenemia, the patient recovered successfully with targeted dual antimicrobial therapy and supportive care.

Conclusion: Isolated right atrial infective endocarditis represents a formidable diagnostic and therapeutic challenge in immunocompromised hosts. Early multimodality imaging and a timely, individualized surgical approach are essential to prevent fatal embolic events and ensure the safe continuation of oncological care.

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Keywords: Right atrial endocarditis; T-cell acute lymphoblastic leukemia; Central venous catheter; Echocardiography.

Introduction

Right-sided infective endocarditis constitutes approximately 5% to 10% of all cases of infective endocarditis, characteristically localized to the tricuspid valve. Isolated right atrial infective endocarditis (RAIE) —occurring without valvular involvement— remains an exceptionally rare clinical entity in the absence of congenital structural defects [1,2]. The pathophysiology of RAIE is fundamentally linked to mechanical endothelial microtrauma caused by the presence, friction, or frequent manipulation of Central Cenous Catheter (CVC). This localized endocardial injury triggers fibrin deposition, creating a fertile nidus for bacterial colonization during transient bacteremia episodes [3]. In patients with hematological malignancies, this risk is compounded exponentially by intensive chemotherapy-induced neutropenia and profound immunosuppression. Furthermore, the emergence of Multi-Drug Resistant (MDR) Gram-negative bacilli, such as KPC-producing *Escherichia coli (E coli),* introduces

an aggressive endovascular pathogen that accelerates tissue destruction and complicates targeted antimicrobial eradication.

Case presentation

A 32-year-old male, a former smoker, was diagnosed with T-ALL. He was admitted to a specialized hematology center to undergo the intensive GATLA ALL chemotherapy protocol, which included L-asparaginase, mercaptopurine, methotrexate, vincristine, and intrathecal chemotherapy. During his oncological management, the patient's clinical course was highly turbulent, characterized by recurrent episodes of febrile neutropenia and intensive endovascular intervention. Initially, during his first admission to the specialized hematology center, he developed an episode of febrile neutropenia with blood cultures positive for *Enterobacter cloacae* and *E coli,* which was managed with piperacillin-tazobactam and daptomycin. Following clinical resolution and hematological recovery, the patient was discharged and continued his chemotherapy protocol on an outpatient basis. The patient subsequently required readmission to the same hematology center due to a new episode of febrile neutropenia secondary to an endovascular source, isolating *Enterobacter cloacae* complex and KPC-producing *E. coli,* prompting an antimicrobial rotation to meropenem and daptomycin. Within 24 hours, the patient developed septic shock of endovascular origin. 48 hours later, the clinical status was further complicated by acute heart failure. Due to these recurrent infectious complications, the patient required multiple CVC placements and frequent access site rotations. As part of the infectious workup during this readmission, a bedside Transthoracic Echocardiogram (TTE) was performed at the specialized hematology center. It revealed a mobile, heterogeneous echogenic mass adhered to the posterolateral wall of the right atrium without causing inflow obstruction. Given the high-risk nature of an intracardiac mass in an immunocompromised host, the patient was immediately transferred to our center for advanced cardiovascular imaging and specialized surgical evaluation. Upon admission to our institution, a comprehensive confirmatory TTE was performed. This study characterized the right atrial mass as a broad-based, poorly mobile, homogeneous echogenic lesion measuring 29 mm × 14 mm along the lateral wall (Figures 1-3). It was accompanied by a 9 mm inferolateral pericardial effusion, while the vena cava appeared free of thrombi. Due to its smooth, broad-based morphology and low initial diagnostic specificity on this study, the mass raised a challenging differential diagnosis among an organized catheter-related thrombus, a primary cardiac tumor, and an atypical vegetation. Clinical examination upon admission noted that the patient was lucid, afebrile, and hemodynamically stable with a right conjunctival hemorrhage and mild bilateral lower limb edema.

An admission pan-tomography performed the following day demonstrated the distal tip of the CVC within the superior vena cava, a global pericardial effusion maximizing at 16 mm anterior-inferiorly, a laminar left pleural effusion with passive atelectasis, and a pulmonary artery trunk diameter of 23 mm. Crucially, comprehensive screening with complementary diagnostic studies—including a brain CT, a carotid artery duplex, and a fundoscopic examination—revealed no evidence of systemic septic embolization or peripheral embolic impacts.

The only notable positive systemic finding was splenomegaly, which was confirmed by both abdominal ultrasound and the CT scan, the latter also demonstrating multiple small splenic hypodensities (3 to 5 mm). Correlating the prior recurrent multi-drug-resistant Gram-negative bacteremia with the right atrial mass, the clinical scenario was interpreted as a probable isolated RAIE. Consequently, the targeted antimicrobial therapy with ceftazidime-avibactam, which had been initiated at the referring institution, was strictly maintained upon admission to ensure uninterrupted endovascular coverage against the KPC-producing E. coli strain.

Given the mass's significant dimensions and the imminent risk of septic pulmonary embolism, the patient underwent urgent open-heart surgery. Through a median sternotomy and under cardiopulmonary bypass on a beating heart (without aortic cross-clamping), a massive 5 cm x 5 cm mass was successfully excised from the right atrial free wall (Figure 4). Histopathological evaluation of the resected specimen revealed acute inflammatory tissue, and microbiological tissue cultures isolated *Escherichia coli* positive for both KPC and ESBL resistance mechanisms, definitively establishing the diagnosis of isolated RAIE.

The early postoperative period was marked by hematological and volume management challenges. The patient developed recurrent bouts of symptomatic anemia requiring serial single-unit PRBC transfusions. A follow-up chest CT revealed a 15 mm anterior-inferior pericardial effusion and an increased bilateral pleural effusion with passive atelectasis. This volume overload subsequently triggered an episode of acute heart failure, requiring bolus intravenous furosemide.

From an infectious disease standpoint, the patient later experienced isolated evening fever spikes (38.5°C), prompting CVC line exchanges; notably, all subsequent catheter tip and blood cultures returned negative. A follow-up pan-tomography revealed an acute fluid-debris level in the left maxillary sinus, compatible with acute sinusitis, while showing a reduction in the pericardial effusion to 12 mm. A subsequent Transesophageal Echocardiogram (TEE) confirmed normal left-sided cavities free of thrombi, intact right-sided structures, and a correctly positioned new CVC. The patient evolved toward a stable condition, remaining in good general health and completely afebrile.

Discussion

Isolated RAIE—occurring without any concomitant valvular destruction or involvement—is an absolute clinical rarity [1-2]. When reported in the literature, it is almost exclusively associated with congenital structural anomalies, such as a prominent Chiari network or persistent eustachian valves, which alter right atrial hemodynamics and create a substrate for endothelial damage [4,5]. The patient presented a unique "perfect storm" of predisposing factors that facilitated the development of this massive infection. First, the underlying hematological malignancy (T-ALL) combined with the aggressive GATLA ALL chemotherapy protocol induced profound, prolonged neutropenia, severely dismantling the patient's primary defense mechanisms against circulating pathogens. Second, and perhaps most critically from a mechanical standpoint, was the history of multiple CVC placements and frequent line rotations. Indwelling catheters can cause direct, repetitive mechanical microtrauma against the right atrial free wall, leading to localized endothelial erosion. This disruption exposes subendothelial collagen, initiating a cascade of fibrin-platelet deposition that creates an ideal avascular nidus. When exposed to persistent bacteremia from highly virulent, MDR

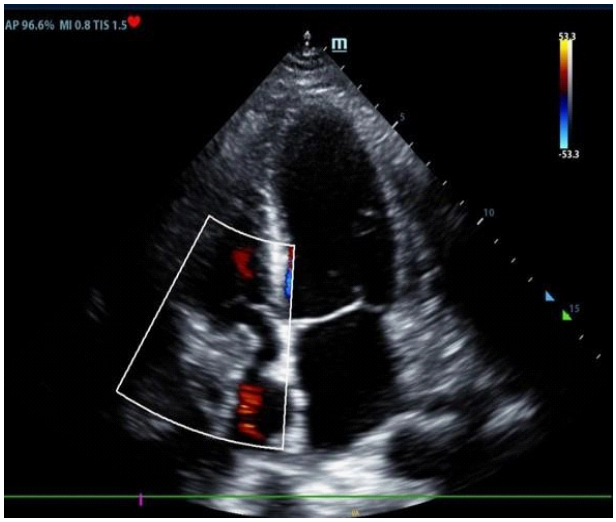

Figure 1: Transthoracic Doppler echocardiogram, apical window, four-chamber view, showing a vegetation on the right atrial free wall.

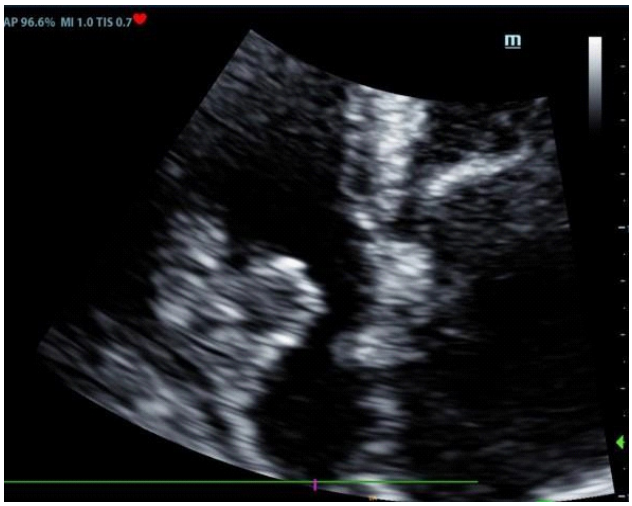

Figure 2: Transthoracic Doppler echocardiogram, apical window, four-chamber view, right atrium-focused view, showing a vegetation on the right atrial free wall.

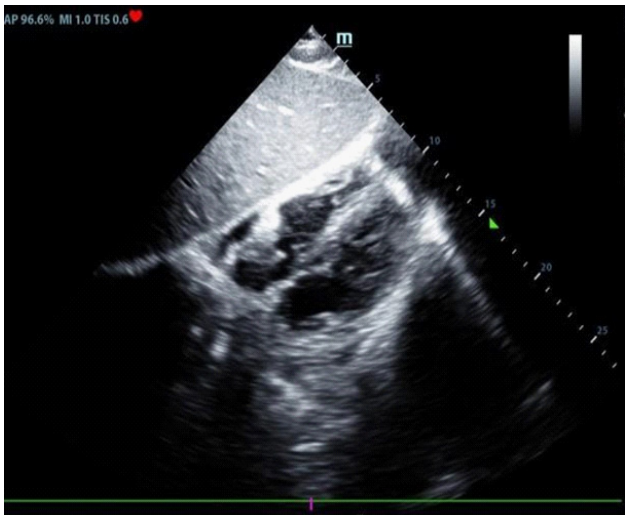

Figure 3: Transthoracic Doppler echocardiogram, subxiphoid window, demonstrating a vegetation on the right atrial free wall.

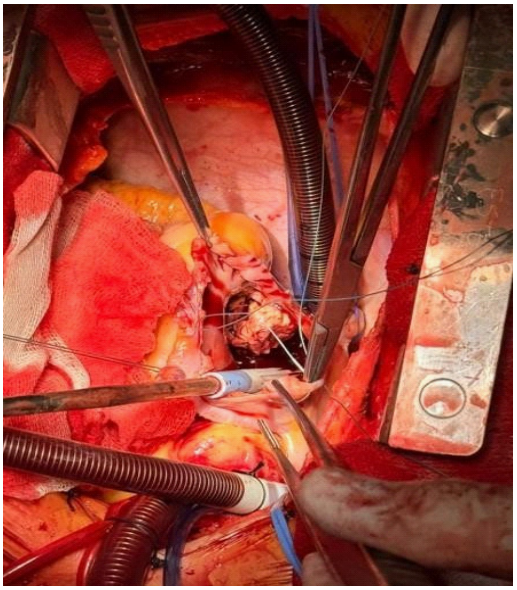

Figure 4: Intrasurgical image showing 5 × 5 cm vegetation attached to the right atrial free wall.

strains like KPC-producing E. coli, this substrate undergoes rapid microbial colonization and accelerated vegetation growth, culminating in the massive 5 x 5 cm mass observed in our patient. Differentiating a right atrial mass in a patient with a history of indwelling central lines represents a classic diagnostic dilemma. The primary differential diagnoses include catheter-associated thrombi, fibrin sheaths, primary cardiac tumors (such as myxomas), and active infectious vegetations. Although in our specific case, TTE was highly illustrative and clearly delineated a large, mobile right atrial mass, this is not always the rule [6]. In many similar patients, early echocardiographic findings can be highly ambiguous, demonstrating low diagnostic specificity—as initially occurred at the referring center where the mass was thought to be a thrombus or tumor.

Therefore, when acoustic windows are suboptimal or diagnostic uncertainty persists, advanced multimodality imaging techniques are indispensable. Cardiac Magnetic Resonance (CMR) imaging plays a paramount role by offering superior tissue characterization. Through specific sequences, such as T1/T2 weighting and Early/Late Gadolinium Enhancement, CMR can reliably differentiate avascular structures like thrombi and vegetations from vascularized cardiac tumors [7]. Furthermore, multi-detector Computed Tomography (CT) provides exceptional spatial resolution, which is highly valuable for assessing the exact relationship of the catheter tip with the atrial wall, detecting subtle intramural abscesses, and ruling out silent pulmonary septic emboli. Ultimately, utilizing a multimodality imaging approach ensures early, precise diagnosis, which is critical to establishing timely surgical or targeted antimicrobial strategies in critically ill hematological hosts.

According to current American and European guidelines, the management of right-sided infective endocarditis is predominantly conservative, relying on targeted intravenous antimicrobial therapy. Surgical intervention is typically reserved for specific, stringent indications, such as right-sided heart failure secondary to severe valvular regurgitation, infections caused by highly difficult-to-eradicate pathogens or persistent large vegetations (greater than 20 mm) only after the occurrence of recurrent septic pulmonary emboli in patients who are already receiving optimal antibiotic therapy [8,9].

Our patient presented a profound therapeutic dilemma. At the time of diagnosis, comprehensive multimodality imaging confirmed the absence of active systemic or pulmonary septic embolization. Strictly speaking, a rigid application of standard guidelines might have favored an initial trial of exclusive medical therapy. However, the multi-disciplinary heart team decided on an early, aggressive surgical strategy based on three critical factors: the massive dimensions of the vegetation, the patient's complex oncohematological framework, and a remarkably favorable surgical risk profile.

A vegetation of this magnitude carries a catastrophic embolic risk; in a profoundly immunocompromised host with T-ALL, a massive septic pulmonary embolism or secondary right ventricular failure could be fatal, severely disrupting or permanently halting his vital oncological treatment [10]. Crucially, the patient's calculated surgical risk was exceptionally low. The procedure was successfully executed via a median sternotomy under cardiopulmonary bypass on a beating heart—completely avoiding aortic cross-clamping—with a remarkably short pump time of only 27 minutes and minimal intraoperative vasopressor requirements. This case beautifully illustrates that while guidelines provide a robust framework, the management of rare endovascular infections like isolated RAIE must be carefully individualized. When faced with massive embolic substrates in critically ill hematological patients, early surgical debridement can be safely performed, offering a definitive cure that clears the path for the continuation of their primary oncological therapies.

Conclusion

Isolated RAIE is an uncommon and insidious complication of recurrent central venous access that requires a high index of clinical suspicion, particularly in neutropenic patients undergoing intensive chemotherapy. While current international guidelines generally advocate for a conservative medical approach in right-sided endocarditis, this case clearly demonstrates that therapeutic strategies must be carefully individualized. In the presence of a massive embolic substrate and highly virulent, MDR pathogens like KPC-producing E. coli, early surgical resection can be safely performed in patients with a favorable risk profile. This aggressive, multidisciplinary approach not only prevents catastrophic septic pulmonary emboli but also achieves a definitive endovascular cure, ultimately clearing the path for the safe resumption of life-saving oncological therapies.

Declarations

Ethics approval and consent to participate: Written informed consent was obtained from the patient for the publication of this case report and any accompanying images.

Conflicts of interest: The authors declare that they have no conflicts of interest.

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