Epicardial Pacing Lead Implantation in Complete Heart Block as a Manifestation of Cardiac Mass: Case Report

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SOUHRN

Kontext: Abnormální atrioventrikulární (AV) převod se může projevovat širokým spektrem klinických nálezů od asymptomatických případů až po těžké symptomy spojené s bradykardií. Zatímco transvenózní implantace kardiostimulátoru je obecně ceněna pro svůj minimálně invazivní charakter a účinnost v klinické praxi, tento přístup může být kontraindikován u pacientů s anatomickými anomáliemi nebo s významnými komorbiditami. V této kazuistice přinášíme popis vzácného případu intrakardiálního útvaru tvořícího překážku převodní dráhy srdeční, přičemž klasický transvenózní přístup nebyl proveditelný. V takových složitých scénářích se jako nejvhodnější a nejúčinnější intervence jeví implantace epikardiálního kardiostimulátoru.
Popis případu: Do nemocnice byl přivezen 48letý muž s postupným úbytkem tělesné hmotnosti a dyspnoe po dobu šesti měsíců, přičemž v předchozím týdnu došlo k exacerbaci symptomů. Transtorakální echokardiografie odhalila intrakardiální útvar v pravé síni, mezisíňové přepážce a v levé síni. Následně provedené vyšetření výpočetní tomografií (computed tomography, CT) potvrdilo maligní zvětšující se solidní útvar v mezisíňové přepážce, který zasahoval do pravé i levé síně, pravé plicní žíly a dolní duté žíly a připomínal primární srdeční tumor. Okraje útvaru byly nepravidelné a samotný útvar měl rozměry přibližně 6,0 × 6,0 × 8,2 cm. Útvar přerušil převodní AV dráhu a způsobil kompletní srdeční blokádu s následnou hemodynamickou nestabilitou. Vzhledem k velikosti útvaru a jeho anatomickému uložení v pravé síni bylo transvenózní zavedení stimulační elektrody považováno za neproveditelné pro potenciální riziko jejího chybného umístění, perforace nádoru nebo embolizace; proto byla provedena chirurgická implantace epikardiálního kardiostimulátoru. Výkon byl úspěšný a bez komplikací; u pacienta bylo zaznamenáno významné zlepšení hemodynamiky. Pooperační zotavení proběhlo bez zvláštních příhod a pacient byl propuštěn pět dní po operaci s výrazným zlepšením klinického stavu.
Diskuse: Tento případ zdůrazňuje vzácný a komplexní projev velkého intrakardiálního útvaru vyvolávajícího systémové symptomy, jako je úbytek tělesné hmotnosti a dyspnoe postupně se zhoršující po dobu šesti měsíců. Případ byl z hlediska diagnostiky a léčby náročný obzvláště pro skutečnost, že útvar zasahoval do několika srdečních struktur včetně pravé síně, mezisíňové přepážky a levé síně. Vzhledem k tomu, že útvar již značně prorostl srdeční a žilní struktury, nebylo možné provést transvenózní implantaci kardiostimulátoru; takový výkon by byl navíc riskantní. V tomto kontextu představovalo bezpečnou a účinnou alternativu zavedení epikardiální elektrody, jež by umožnilo vyhnout se rizikům spojeným s transvenózním přístupem. Popsaný přístup vyzdvihuje zásadní úlohu implantace epikardiálního kardiostimulátoru při léčbě pacientů s obstruujícími útvary v srdci a zdůrazňuje účinnost a bezpečnost tohoto postupu v situacích, kdy klasické transvenózní přístupy nelze použít.
Závěr: Epikardiální zavedení elektrody je nutno zvážit v situacích, kdy nelze provést primární transvenózní umístění elektrody ve složitých situacích, jakou je právě popsaný případ, kdy srdeční hmota obstruovala dráhu AV převodu.

ABSTRACT

Background: Atrioventricular (AV) conduction abnormalities can manifest with a wide spectrum of clinical presentations, ranging from asymptomatic cases to severe bradycardia-associated symptoms. While transvenous pacemaker implantation is widely regarded for its minimal invasiveness and clinical efficacy, this approach may be contraindicated in patients with anatomical anomalies or significant comorbidities. This report presents a rare case of an intracardiac mass obstructing the AV conduction pathway, where the conventional

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transvenous approach was not feasible. In such complex scenarios, epicardial pacemaker implantation emerges as the most suitable and effective intervention.

Case description: A 48-year-old male presented with a six-month history of progressive weight loss and dyspnea, with symptom exacerbation over the preceding week. Transthoracic echocardiography revealed an intracardiac mass involving the right atrium, interatrial septum, and left atrium. Subsequent computed tomography (CT) imaging confirmed a malignant, enhancing solid mass occupying the interatrial septum, with extensions into the right atrium, left atrium, right pulmonary vein, and inferior vena cava, suggestive of a primary cardiac tumor. The mass exhibited irregular borders and measured approximately 6.0 × 6.0 × 8.2 cm. This mass disrupted the AV conduction pathway, leading to complete heart block and resulting in hemodynamic instability.

Given the mass's size and its anatomical position within the right atrium, transvenous pacemaker lead placement was deemed unfeasible due to the potential risk of lead misplacement, tumor perforation, or embolization. Thus, surgical epicardial pacemaker implantation was performed. The procedure was completed successfully without complications, resulting in significant improvement in the patient's hemodynamic status. Postoperative recovery was uneventful, and the patient was discharged five days after surgery with marked clinical improvement.

Discussion: This case underscores a rare and complex presentation of a large intracardiac mass causing systemic symptoms such as weight loss and dyspnea, progressively worsening over six months. The involvement of multiple cardiac structures, including the right atrium, interatrial septum, and left atrium, posed significant diagnostic and therapeutic challenges. The mass's extensive involvement of cardiac and venous structures rendered transvenous pacemaker implantation impractical and potentially hazardous. In this context, epicardial lead placement provided a safe and effective alternative, circumventing the risks associated with transvenous approaches. This case highlights the critical role of epicardial pacemaker implantation in managing patients with obstructive cardiac masses, emphasizing its efficacy and safety in scenarios where conventional transvenous methods are not viable.

Conclusion: Epicardial lead placement should be considered when primary transvenous lead placement cannot be performed in challenging cases, such as in the case where a cardiac mass obstructs the AV conducting pathway.

Keywords:
Cardiac mass obstruction
Complete atrioventricular block
Epicardial pacemaker
Intracardiac mass

Background

Patients with atrioventricular (AV) conduction abnormalities can present with a wide spectrum of clinical manifestations, ranging from asymptomatic cases to severe bradycardia-induced symptoms.[1] Numerous conditions, both congenital and acquired, can impair the AV conduction system, leading to varying degrees of AV block. In rare instances, structural abnormalities such as cardiac masses may disrupt the integrity of the AV conduction pathway, resulting in complete heart block and necessitating permanent pacing.[2] While transvenous pacemaker implantation remains the standard approach due to its minimally invasive nature and proven efficacy, it may be contraindicated in cases with anatomical alterations or significant comorbidities. This report describes a rare case of a cardiac mass obstructing the AV conduction pathway, rendering the conventional transvenous approach unfeasible. In such complex clinical scenarios, epicardial pacemaker implantation offers a safe and effective alternative, ensuring optimal patient outcomes when traditional methods are not viable.

Case description

A 48-year-old male presented with a six-month history of progressive weight loss and dyspnea, which had significantly worsened over the preceding week. Initial transthoracic echocardiography, as illustrated in **Figure 1**, revealed an intracardiac mass involving the right atrium, interatrial septum, and left atrium. Further evaluation with computed tomography (CT) imaging confirmed the presence of a malignant, enhancing solid primary cardiac mass measuring approximately 6.0 × 6.0 × 8.2 cm. The mass exhibited irregular borders, occupied the interatrial septum, and extended into the right atrium, left atrium, right pulmonary vein, and inferior vena cava. This extensive involvement disrupted the atrioventricular (AV) conduction pathway, resulting in complete heart block and subsequent hemodynamic instability, as demonstrated in **Figure 2**.

Due to the tumor's considerable size and critical location within the right atrium, safe transvenous pacemaker lead placement was deemed impractical. The mass's involvement of the right atrium and adjacent venous structures posed a significant risk of procedural complications, such as lead misplacement, tumor perforation, or embolization. As a result, surgical epicardial lead implantation was identified as the most appropriate and effective intervention for this patient.

Intraoperatively, the pericardium was carefully opened, revealing dense adhesions between the epicardial surface and the underlying cardiac wall, likely secondary to tumor infiltration or chronic inflammation. The pacemaker lead was meticulously affixed to the visceral epicardium using 4-0 polypropylene sutures to ensure stable lead positioning. Epicardial sensitivity testing was conducted at the anatomical right ventricle (RV) site using a unipolar pacemaker lead, as illustrated in **Figure 3**. The obtained ventricular lead parameters demonstrated optimal function, with a pacing threshold of 1.0 V, sensing amplitude of 4.8 mV, and impedance measuring 310 ohms, confirming the lead's appropriate placement and functionality.

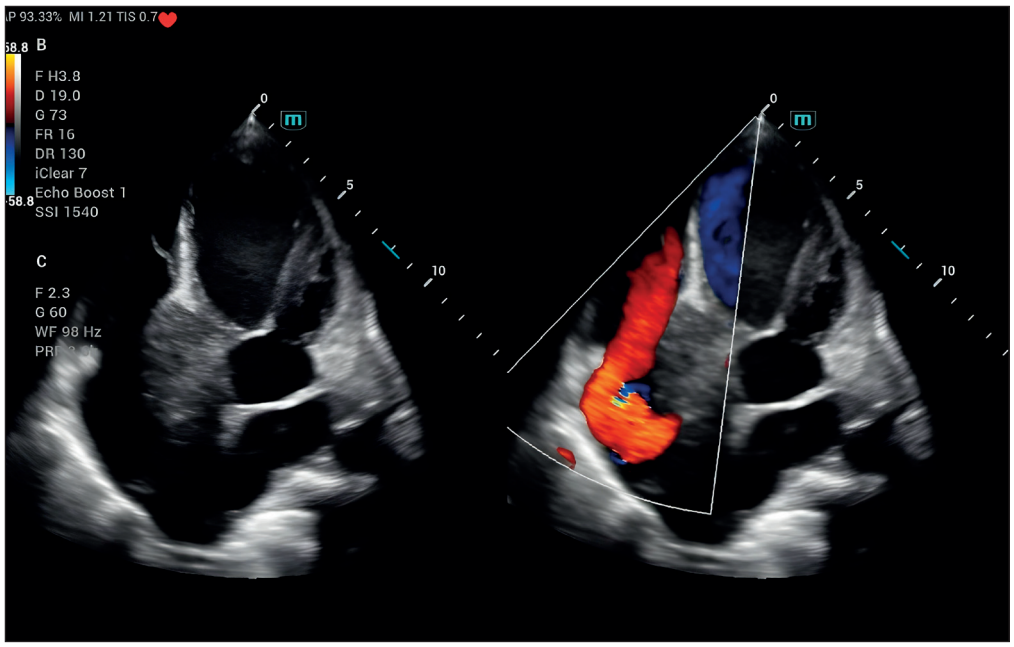

Fig. 1 – 2D transthoracic echocardiography showing mass in right atrium, interatrial septum, and left atrium.

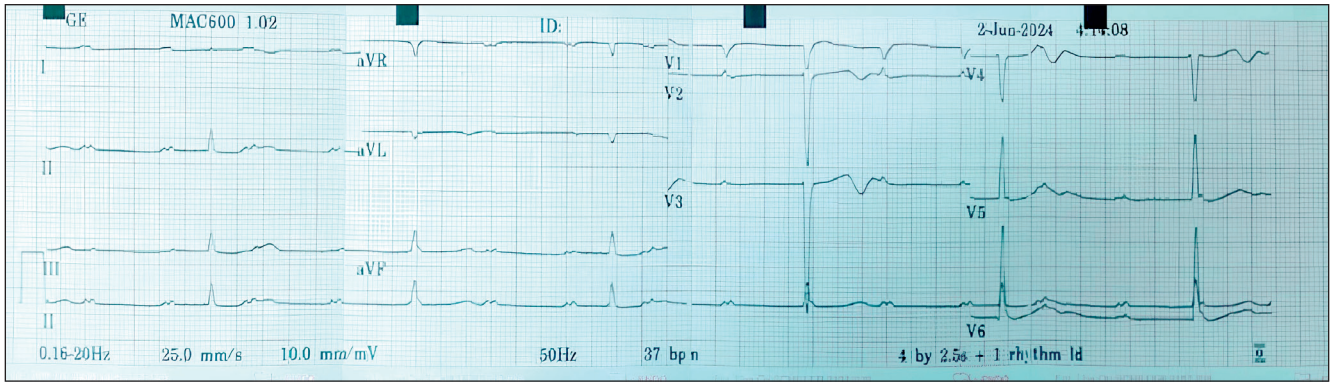

Fig. 2 – Pre-procedural ECG.

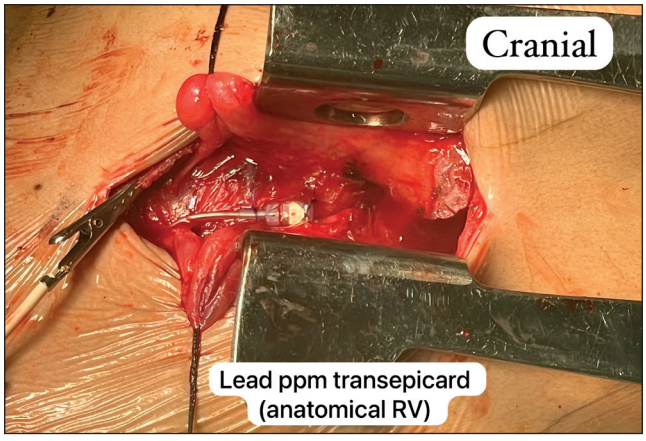

Fig. 3 – Epicardial lead implanted PPM through left anterolateral thoracotomy.

The procedure was completed without complications, leading to significant improvement in the patient's hemodynamic status. After confirming satisfactory pacing and sensing parameters, an incision was made in the upper left quadrant of the abdomen to create a generator pocket, as shown in **Figure 4**. The pacemaker lead was carefully tunneled from the abdominal pocket to the left hemithorax region to facilitate connection. The ventricular lead was then attached to the pulse generator, set in VVI mode, and securely positioned to ensure optimal device function. Additionally, a pericardial biopsy was performed to further assess the histopathological characteristics of the cardiac mass. Following the completion of device implantation, the left anterior thoracotomy incision was closed meticulously using layered suturing techniques to promote optimal wound healing and minimize postoperative complications. Due to the presence of a left pleural effusion, a 28 Fr chest tube was inserted into the left hemithorax for effective drainage.

The pacemaker implantation was successfully completed without any intraoperative complications, and the patient's hemodynamic parameters improved significantly. Post-procedural electrocardiogram (ECG) findings confirmed restored ventricular pacing, as demonstrated in **Figure 5**. The patient's postoperative course was stable, and he was discharged from the hospital five days after surgery, exhibiting marked clinical improvement.

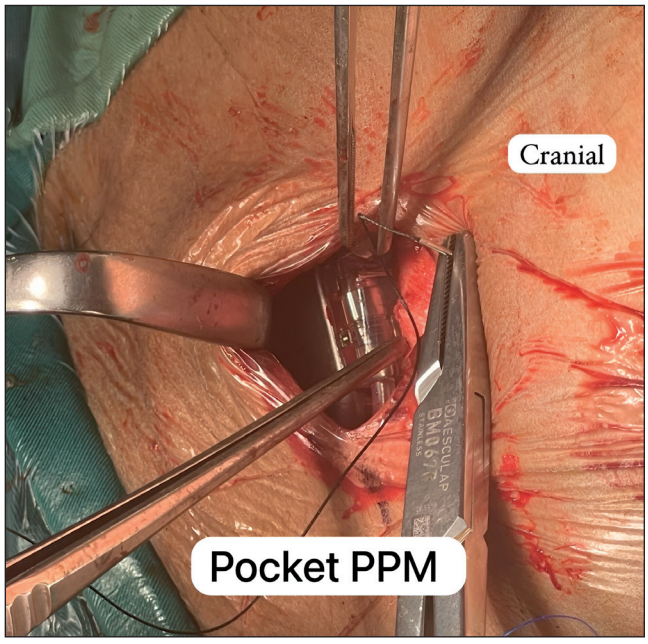

Fig. 4 – Generator pocket in the upper left quadrant of the abdomen.

Discussion

This case highlights a rare and complex presentation of a large intracardiac mass, manifesting with systemic symptoms such as progressive weight loss and dyspnea over six months. The extensive involvement of multiple cardiac structures, including the right atrium, interatrial septum, and left atrium, posed significant diagnostic and therapeutic challenges. Cardiac masses are broadly categorized as neoplastic or non-neoplastic, with neoplastic lesions further classified into primary benign, primary malignant, and metastatic tumors.[3,4] Primary cardiac tumors are exceedingly rare, with an autopsy-reported incidence ranging from 0.0017% to 0.33%. Among these, approximately 75% are benign, with cardiac myxomas being the most common, accounting for nearly half of all primary cardiac tumors.[3–6] The rarity and complexity of this case underscore the need for a multidisciplinary approach in the diagnosis and management of intracardiac masses, particularly when standard therapeutic strategies, such as transvenous pacemaker placement, are rendered unfeasible due to anatomical constraints. In the present case, computed tomography (CT) imaging revealed a solid mass with an attenuation of 30 Hounsfield Units (HU), characterized by spiculated margins, well-defined borders, and irregular edges. The mass measured approximately 6.0 × 6.0 × 8.2 cm and was located within the interatrial septum. Post-contrast imaging demonstrated enhancement of the mass, with attenuation increasing to 51 HU. The mass extended partially into the lumens of the right atrium, left atrium, right pulmonary vein, and inferior vena cava, with additional infiltration into the medial mediastinum. The central axis of the mass remained intracardiac. Furthermore, multiple pulmonary nodules were identified in both lungs, with the largest measuring approximately 1.0 × 1.1 × 0.9 cm in the lateral segment of the right middle lobe. A subpleural nodule, measuring 1.4 × 1.3 × 0.9 cm, was observed in the left hemithorax. These findings raised suspicion of a malignant, enhancing solid mass within the interatrial septum, suggestive of a primary cardiac tumor. The presence of multiple pulmonary nodules and a subpleural lesion indicated a potential metastatic process. A biopsy of the patient's tumor was obtained, and the initial histopathological result indicated a diagnosis of lipoma. However, due to the challenging nature of obtaining an adequate tissue sample through the available access, the quality of the specimen may not be optimal for definitive pathological evaluation. Therefore further biopsy and diagnostic assessment are required to confirm the diagnosis with greater accuracy.

Complete heart block necessitates pacemaker implantation due to the risk of serious complications, including hemodynamic instability and sudden cardiac events.[7] In this case, the tumor's considerable size and its critical location within the right atrium rendered transvenous lead placement impractical. The tumor's proximity to major venous structures significantly increased the risk of procedural complications, such as tumor perforation or embolization, during the advancement of transvenous leads. Given these anatomical and procedural challenges, surgical epicardial lead implantation was deemed the safest and most effective intervention.

Epicardial permanent pacemaker implantation is specifically indicated in cases where traditional transvenous pacing is unfeasible or contraindicated, such as in patients with complex congenital heart anomalies, lim-

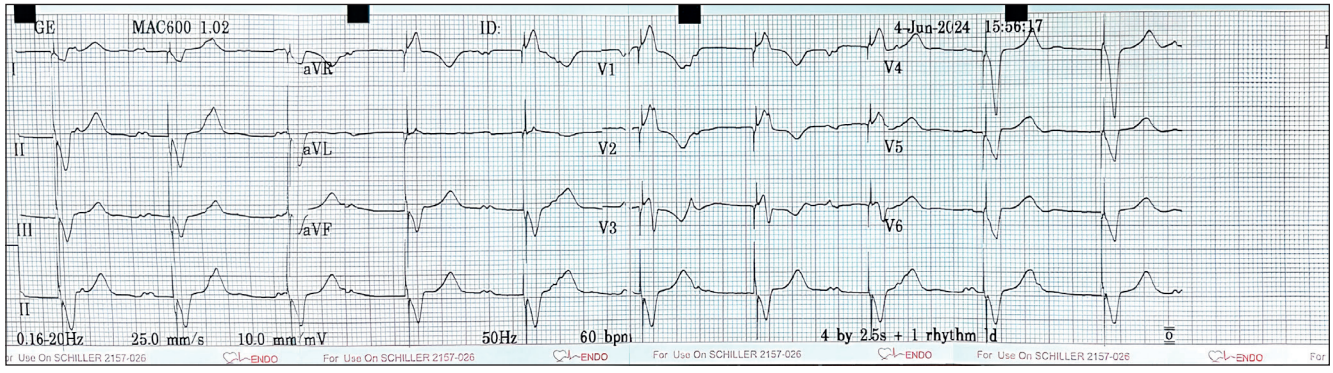

Fig. 5 – Post-procedural ECG.

ited venous access due to superior vena cava or subclavian vein occlusion, intracardiac mass in right atrial and right ventricle near the tricuspid, tricuspid atresia, or the presence of a mechanical tricuspid valve prosthesis. Additionally, it is preferred in patients at risk for recurrent infections, including those with a history of infective endocarditis involving the tricuspid valve.[7] Although epicardial pacemakers are more commonly utilized in pediatric populations and individuals with congenital cardiac abnormalities, their role extends to adult patients with structural heart disease where conventional transvenous approaches pose significant risks.[7,8] Unlike the standard transvenous technique, which involves threading leads through the venous system into the heart, epicardial pacing requires a more invasive surgical approach, with the leads being directly affixed to the epicardial surface of the myocardium.[8] This technique ensures reliable pacing in anatomically complex cases, reinforcing its value as an essential alternative when transvenous lead placement is not viable.

Various surgical approaches can be employed for epicardial pacemaker implantation, with the choice of technique depending on anatomical considerations, procedural complexity, and patient-specific factors. The most commonly utilized approaches include sternotomy, which provides optimal cardiac exposure through a standard midline incision, or a limited lower mini-sternotomy for a less invasive alternative.[9,10] Thoracotomy, performed via a left anterior or anterolateral approach, allows direct access to the epicardial surface and is frequently used in cases where sternotomy is not preferred.[11] A subcostal approach, involving a subxiphoid incision within the upper rectus sheath, serves as another viable option for pericardial access with minimal disruption to thoracic structures.[11] Additionally, video-assisted thoracic surgery (VATS) has emerged as a minimally invasive alternative, utilizing thoracoscopic guidance to facilitate lead placement while minimizing surgical trauma and postoperative recovery time.[12] In this case, a left anterolateral thoracotomy was chosen as the preferred approach, providing direct visualization and access to the myocardial surface for lead placement.

The epicardial pacemaker leads were secured using an active fixation mechanism, which incorporates a small screw (helix) at the lead tip to anchor it directly to the cardiac tissue.[1] Active fixation offers several advantages over passive fixation, including greater flexibility in lead placement, particularly in regions where passive fixation may not be feasible, such as the atrial wall or interventricular septum. Additionally, the screw mechanism provides enhanced lead stability, reducing the risk of dislodgement and ensuring long-term pacing reliability. However, this approach also carries potential drawbacks, such as an increased risk of myocardial trauma or perforation during lead placement. Moreover, lead extraction is inherently more complex, with a higher likelihood of cardiac tissue damage, making future revisions or removals more challenging.[13]

Patients with total atrioventricular block (TAVB) typically require permanent pacemaker (PPM) implantation, with the choice between dual-chamber (DDD) or ventricular (VVI) pacing modes depending on clinical and logistical factors. DDD pacing is considered more physiological, as it maintains atrioventricular synchrony and reduces the risk of pacemaker syndrome.[14] However, VVI pacing is often employed when dual-chamber pacing is not feasible due to anatomical restrictions, device availability, or financial constraints. In this case, due to the unavailability of a dual-chamber pacemaker and economic limitations, the VVI mode was selected as the most practical option.

Differentiating primary cardiac tumors from metastatic cardiac involvement is essential in guiding appropriate treatment strategies. Primary benign cardiac tumors are typically managed with surgical resection, whereas metastatic cardiac tumors often require systemic therapies such as chemotherapy, targeted therapy, or immunotherapy, depending on the primary malignancy. Accurate diagnosis is critical, as treatment decisions depend on tumor origin, histopathological characteristics, and the extent of cardiac involvement.[5,6]

In this case, the tumor's considerable size and extensive involvement of multiple cardiac structures, including the right atrium, interatrial septum, and left atrium, presented significant challenges in both diagnosis and management. The extensive infiltration of cardiac chambers raised concerns regarding the feasibility of surgical excision and the potential risk of hemodynamic compromise.[5] Given these complexities, a multidisciplinary approach involving cardiology, cardiothoracic surgery, and oncology is paramount in determining the optimal therapeutic strategy while ensuring patient safety and improving clinical outcomes.

Conclusion

Epicardial lead placement serves as a viable alternative when transvenous pacing is not feasible, particularly in complex cases where anatomical abnormalities, such as a cardiac mass obstructing the AV conduction pathway, prevent standard lead placement. For patients with severe AV conduction disorders, including advanced or complete heart block, pacemaker implantation is critical to preventing life-threatening complications such as syncope or sudden cardiac death. Although dual-chamber pacing (DDD) is generally preferred due to its ability to maintain atrioventricular synchrony and optimize hemodynamic function, VVI mode was selected in this case due to financial constraints and the limited availability of dual-chamber pacing hardware.

The tumor's considerable size and location within the right atrium posed significant risks, making transvenous lead implantation impractical. The close association of the tumor with major venous structures increased the likelihood of procedural complications, including tumor perforation or embolization. Given these challenges, surgical epicardial pacemaker implantation emerged as the safest and most effective alternative, allowing stable pacing without the risks associated with a transvenous approach.

Additionally, differentiating primary cardiac tumors from metastatic involvement is essential for guiding an appropriate multidisciplinary treatment strategy. While benign primary tumors are often managed surgically,

metastatic involvement typically necessitates systemic therapies such as chemotherapy or targeted treatments. In complex cases such as this, a multidisciplinary team approach, involving specialists in cardiology, cardiothoracic surgery, and oncology, is crucial for optimizing patient outcomes.

Conflict of interest
The authors declare no conflicts of interest.

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Informed consent
Written informed consent for publication, including accompanying images, has been obtained from the patient.

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