The lost superior vena cava: advancement in leadless pacemaker usability

Giovanni Morani[1], Marina Moretti[1], Bruna Bolzan[1], Gino Puntel[1], and Flavio Ribichini[1]

[1]Azienda Ospedaliera Universitaria Integrata Verona

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Abstract

A 70-year-old man affected by a metastatic lung adenocarcinoma developed an atrioventricular block. Due to an extensive thrombosis of the superior vena cava with invasion of the right atrium, a traditional transvenous pacemaker system (TTPS) implantation was not feasible. Despite the extensive development of the thrombosis in the right atrium, the patient successfully underwent Micra transcatheter pacing system (MTPS) implantation. This case report describes a quite rare condition in which a leadless pacemaker (LP) is the best option to treat an atrioventricular block and where the recent introduction of the groundbreaking AV MTPS would be the optimal therapy.

The lost superior vena cava: advancement in leadless pacemaker usability

Authors:

Morani, Giovanni, MD Azienda Ospedaliera Universitaria Integrata Verona, Cardiology

Moretti, Marina, MD (corresponding author): Azienda Ospedaliera Universitaria Integrata Verona, Cardiology, Verona, Veneto, 37126, IT 0039 045 8122320 m.moretti.d@gmail.com

Bolzan, Bruna, MD Azienda Ospedaliera Universitaria Integrata Verona, Cardiology

Puntel, Gino, MD Azienda Ospedaliera Universitaria Integrata Verona, Radiology

Ribichini, Flavio Luciano, AP Azienda Ospedaliera Universitaria Integrata Verona, Cardiology

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Introduction

The MTPS is an expanding technology that has been proved to be safe and effective both in investigational studies and real world setting. MTPS has been developed to address the limitations of standard transvenous leads-based pacing, by virtually eliminating lead - and pocket-related complications.

As a consequence, the population that should be expected to benefit the most from a leadless pacemaker (LP) is that with a higher risk of device infection. In addition, LP may offer a significant advantage over traditional leads based pacing in case of severe venous obstruction of subclavian veins/superior vena cava preventing pacing lead insertion[1,2]. Anyway, facing these pathological conditions may open an unexplored and challenging operative scenario. We report on a patient requiring pacemaker implantation, due to third degree atrioventricular block, and with a paraneoplastic chronic thrombosis of the superior vena cava infiltrating the right atrium and precluding the implantation of a traditional pacemaker.

Case report

A 70-year-old man affected by a metastatic lung adenocarcinoma developed a third degree atrioventricular block symptomatic for syncope.

The diagnosis of pulmonary neoplasia was previously made following the appearance of superior vena cava syndrome, causing oedema of the submandibular and supraclavicular regions of the neck and the upper limbs. The chest computed axial tomography revealed an extensive thrombosis of the upper central veins involving the superior vena cava, subclavian veins, jugular veins and the brachiocephalic vein, with multiple enlarged lymph nodes in the mediastinum and the axillary area bilaterally.

The patient started multiple courses of radiotherapy, chemotherapy and immunotherapy.

A year after the cancer diagnosis, the patient developed complete atrioventricular block symptomatic for syncope with class I indication to permanent pacing. At that time the lung cancer was even more locally advanced: there was an extensive mediastinal adenopathy with a chronic thrombosis of the superior vena cava invading the right atrium (figure 1 and 2) and precluding insertion of a traditional standard leads based pacemaker.

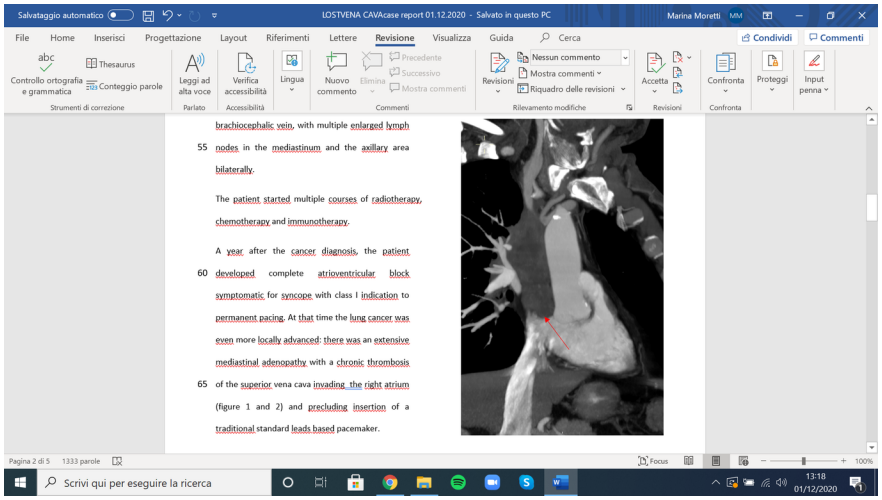

Figure 1 CT Multiplanar Reconstruction (MPR) of the heart, focusing on thrombosis of the superior vena cava invading the right atrium (red arrow)

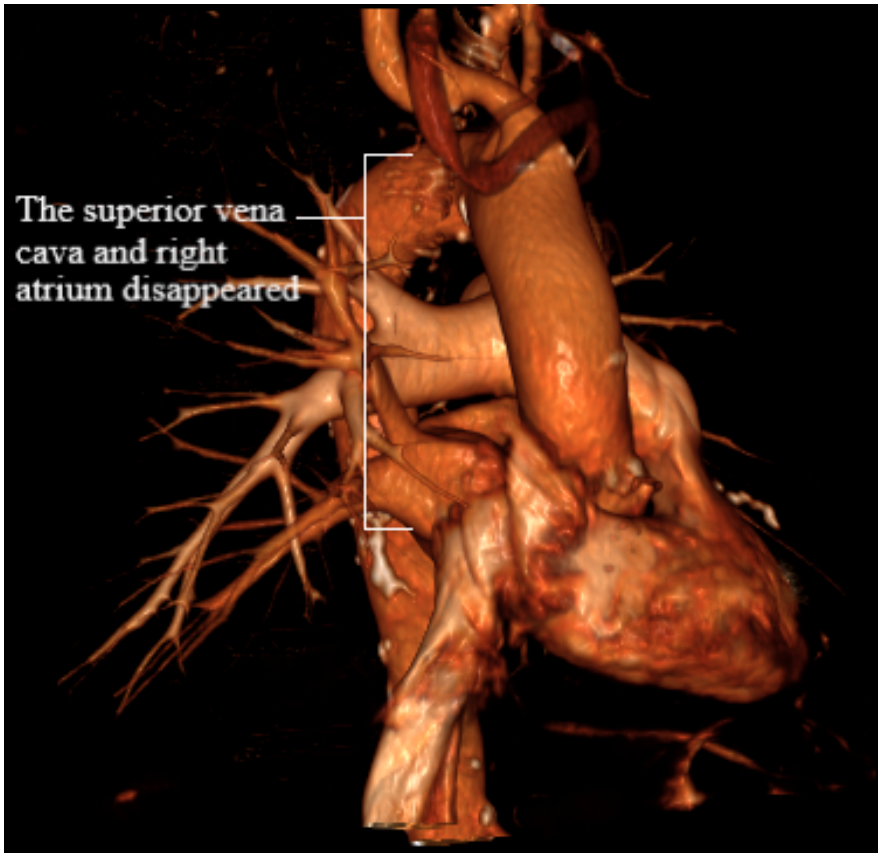

Figure 2 Three-dimensional (3D) Computed Tomography reconstruction of the "lost" superior vena cava and superior right atrium. In 3d reconstruction they are invisible due to thrombosis

The patient thus underwent a MTPS implantation. The implantation of the device was performed by the means of standard technique with some additional technical tricks. A first challenging operative condition resulted due to the impossibility of guidewire advancement up to superior vena cava, generally useful to provide a firm support for the safe advancement of the introducer and dilator over the wire up to the mid right atrium. To explore the in vivo anatomy of the right atrial chamber, the introducer was left in place inside the inferior vena cava and a pigtail catheter was advanced through the introducer up to the right atrium. Then, a small amount of contrast media was injected inside the right atrium to obtain a real time image of the anatomy and volume of the residual atrial chamber to assess the operating space (supplementary video). Subsequently, a gentle and careful manipulation of the large delivery system inside right atrium was performed in order to avoid crushing against the thrombotic invasion coming from the roof of atrium, therefore potentially causing a threatening mobilization of emboli. Finally, MTPS was successfully deployed in the mid septum, with optimal electrical parameters and without complications (figure 3).

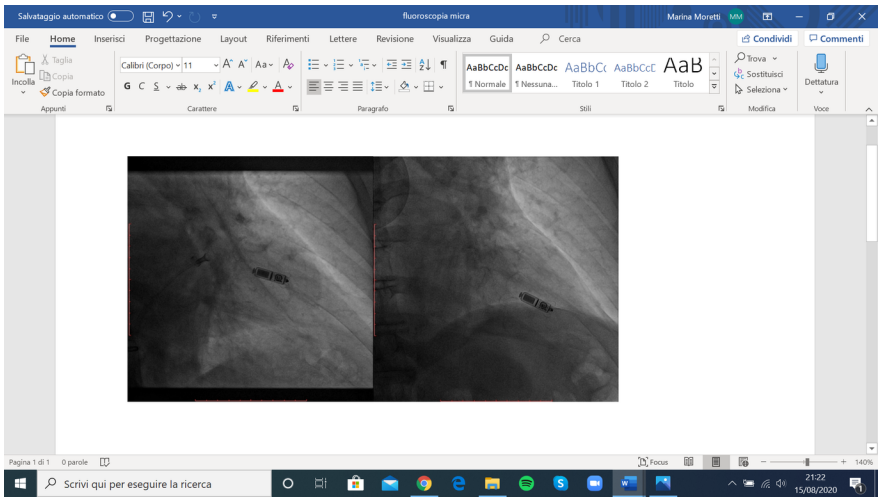

Figure 3 Fluoroscopic image of Micra. A) just after release B) Micra in place at the end of procedure

At the 6 months follow up, the patient remained in complete atrioventricular block with a continuous need for ventricular pacing from the device, without developing a pacemaker syndrome.

One year after the procedure, the patient is still alive and in fairly good health. He is undergoing immunotherapy, chemotherapy and stereotaxic radiotherapy for a brain lesion.

Discussion

The MTPS is an expanding technology with various advantages over TTPS. Conventional pacemaker therapy requires transvenous leads, commonly implanted via the upper central veins. In patients with occlusion of this transvenous axis epicardial permanent pacing has traditionally been the only viable alternative, even if encumbered by the risks of surgical approach, especially for frail patients, and increasing pacing thresholds over the time[1]. LP, since requiring only femoral vein access, represents a modern approach to permanent pacing in case of upper central venous obstruction involving the traditional venous access route for pacing leads[3,4].

However, clinical condition underlying complete obstruction of great venous vessels may be the most disparate and severe highlighting the possibility of unpredictable and challenging intraoperative conditions that are difficult to manage. An adequate preoperative imaging and a scrupulous study of the case may be very helpful to provide all the informations required for safe management of the procedure. In our case, multidetector computed tomographic and three-dimensional reconstruction provided a detailed image of the right atrium, allowing a precise evaluation of the extension of the cancer mass and the thrombotic expansion from the roof inside the right atrium. This information was essential to establish in advance the probability of a successful manoeuvrablity of the delivery catheter inside the atrial chamber without mobilizing thrombotic or neoplastic emboli.

In addition, we injected a small amount of contrast media through a pigtail catheter previously advanced over the wire up to the right atrium to obtain a real time imaging of the residual atrial chamber before advancing the large steerable MTPS delivery system.

This case describes a quite rare condition in which a LP is the only reasonable option to treat an atrioventricular block, although the patient was in sinus rhythm and the MTPS was a single chamber pacing system. LP therapy is a groundbreaking field in rapid development. With the recent introduction of AV Micra technology, with an accelerometer-based atrial sensing allowing a good atrioventricular synchrony, expanding indications are expected[5,6]. Appliability of LP technology is a field in continuous evolution and the operator

might face complex and unexplored procedural situation. Awareness of potentiality and operative limits of this technology is still growing.

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