Histopathology of an autopsy case of a leadless pacemaker system: a case report

Running title: leadless pacemaker system, autopsy, histopathological evaluation

Summary (Abstract)

Leadless pacemaker systems (LPSs) are therapeutic devices for patients with bradyarrhythmia who require right ventricular pacing (and atrial sensing if possible). Despite being less than one-tenth the size of a conventional pacemaker, the minimally invasive approach provides patients with advanced pacing technology. In the early days of the introduction of LPSs, problems with the reliability of the fixation method and the risk of cardiac perforation were pointed out, but these problems are now being resolved. However, removal of a LPS, especially after a long period of time after implantation, is currently a major unsolved problem. The autopsy in this case showed that the LPS device was stable in position and was a sufficiently safe distance from the epicardial site of the heart. However, the fibrosis covering the LPS device one month after implantation raised questions about the removability of the device after prolonged use.

Key words: leadless pacemaker system, autopsy, Elastica-Masson staining
All authors
Keigo Misonou, MD\textsuperscript{1}, Takahiro Doi, MD, PhD\textsuperscript{1}, Yusuke Shirai, MD\textsuperscript{2}, Daigo Nagahara, MD, PhD\textsuperscript{1}.

1. Department of Cardiology, Cardiovascular Center, Teine Keijinkai Hospital, Sapporo, Japan.
2. Department of Cancer Pathology, Faculty of Medicine, Hokkaido University, Sapporo, Japan.

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Consent: Since the patient passed away, we obtained the written consent of the family (his daughters) for an autopsy, and they also agreed in writing to allow us to publish a case report on the clinical course of the patient's death. In addition, the Ethics Committee of our hospital approved the case report. (The approval number is 3-023002-00.)
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Data availability statement: The data will be shared on reasonable request to the corresponding author.

Lead author biography
Keigo Misonou is a cardiologist. He has graduated from Sapporo Medical University School of Medicine in 2017. He is working at the Department of Cardiology, Teine Keininikai Hospital.
A 60-year-old man presented to a local hospital with chest pain. A computed tomography (CT) scan revealed subendocardial left ventricular contrast defects in the lateral wall region and pericardial effusion (Figure a). Transthoracic echocardiography performed after transport of our hospital revealed abnormal wall motion of the lateral region of the left ventricle and pericardial effusion at the posterior region of the left ventricle.

Coronary angiography showed 99% stenosis in the left circumflex artery (Figure b). Considering the small size of the myocardial infarction and concomitant cardiac oozing rupture, conservative management was chosen. However, administration of amiodarone and beta-blockers for treatment of refractory supraventricular and ventricular tachycardia resulted in sudden cardiac arrest due to sinus arrest on the 46th day. He became pacemaker-dependent, and a leadless pacemaker system (LPS) was implanted on the 53th day because a CT scan showed occlusion of an artificial vessel in the superior vena cava, which had been replaced 30 years earlier for treatment of a thymoma.1,2 (Figure c).

However, he died of pump failure from diastolic dysfunction of both ventricles due to marked epicardial fibrosis one month after implantation of the pacemaker.

Autopsy showed that the LPS was implanted in the right ventricular myocardium (Figure d). Elastica Masson staining (Figure e, f) revealed thrombus formation around the site of implantation. Endocardial fibrosis and inflammatory cell infiltration were also observed around the thrombus.

The removability of new LPSs after long-term implantation is a major problem that has yet to be resolved.3 At autopsy in this case, the LPS was covered with fibrotic
tissue on the surface of the implantation site even only four weeks after implantation, raising questions about removability of the device even after a short period. The indication for device retrieval should be carefully considered in cases with a long period after implantation.

References


Figure Legends

(a) Poor contrast image in the left ventricular lateral wall myocardium from the endocardium to the epicardium, leakage of contrast medium outside the heart, and pericardial effusion on contrast-enhanced CT at the previous hospital.

Inside of the red dotted line: site of myocardial infarction

Yellow arrow: pericardial effusion

(b) TIMI 2 (red arrow) in Seg12-2 of the left coronary artery circumflex branch on
emergency coronary angiography.

(c) Findings suggestive of occlusion of the superior vena cava and the replaced prosthesis on contrast-enhanced CT at the previous hospital

(d) The leadless pacemaker system implanted in the right ventricular myocardium on autopsy tissue.

Yellow arrow: the main body of the leadless pacemaker

(e) Surrounding tissue of the implanted leadless pacemaker system between the papillary muscles at autopsy (Elastica Masson stain).

Red dotted line area: the hole where the leadless pacemaker system was implanted.

Blue dotted line area: the site of the hole where the hook of the leadless pacemaker system was hooked into the myocardium.

(f) Higher magnification of the area indicated by the red arrow in Figure e

Thrombus formation with fibrous thickening of the endothelium and infiltrating inflammatory cells were observed around the hook of the leadless pacemaker system.

There is an increase in collagen fibers at the thrombus margin, but the thrombus is stained red and a small number of macrophages remain in the center, suggesting that it is a relatively new thrombus. (Elastica Masson stain)

Red dotted line area: the thrombus around the hook of the leadless pacemaker system

Blue dotted line area: the infiltrating inflammatory cells around the hook of the leadless pacemaker system
Figure 1

151x174 mm (DPI)