Case Report

A case of thoracoscopy-guided lead extraction with an excimer laser sheath

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1. Introduction

Devices for cardiac arrhythmia, such as pacemakers, implantable cardioverter defibrillators (ICD), and cardiac resynchronization therapy (CRT), involve inserting leads into the cardiac chambers via veins. In patients in whom these devices have been implanted, the leads often adhere to the vascular wall, and their extraction (e.g., to treat infection) can be very difficult. If the lead is pulled excessively, fatal complications (e.g., vascular injury and perforation) may develop, eventually requiring open surgery and extraction of the lead by cardiopulmonary bypass [1]. Worldwide, many cases have extracted leads using an excimer laser sheath and have met with favorable results. However, the incidence of serious complications, such as cardiac tamponade and hemotherax, has not been low, indicating the necessity of care in using this technique [2,3]. The risk of vascular injury with this technique is particularly high when the pacemaker lead to be extracted adheres strongly to the superior vena cava (SVC), because there is a steep curve between the subclavian vein and the SVC. Immediate detection of SVC injury at its onset is difficult using intraoperative transesophageal echocardiography (TEE) alone. If a thoracoscope is used during this technique, it can detect complications soon after development, allowing for immediate action.

2. Case report

The patient was a 29-year-old male who had been diagnosed with transposition of the great arteries with an intact ventricular septum. At the age of 6 months, he underwent a Senning operation. At the age of 10 years, a dual-chamber (DDD) pacemaker was implanted via the right subclavian vein for the treatment of sick sinus syndrome. At the age of 25, the generator was removed due to a lead fracture, and a new pacemaker was implanted via the left subclavian vein, leaving the previous lead in the right subclavian vein. Later, the patient developed pain in the right precordium, cramping of the major pectoral muscle, and non-sustained ventricular tachycardia, suggesting physical stimulation of the left ventricle (functional right ventricle) by the residual leads. Therefore, lead extraction using an excimer laser sheath was planned. However, the leads adhered strongly to the vessels, and extraction was considered to involve a high risk of injury to the blood vessels, particularly the superior vena cava (SVC). We inserted a thoracoscope via the right precordial third intercostal space and observed the SVC via the thoracic cavity in order to immediately detect any complications. Using this approach, it was possible to extract the lead safely with an excimer laser sheath.
monitoring the area in the vicinity of the SVC. In order to immediately respond to any emergencies, such as vascular injury, a 4-Fr sheath had been inserted in advance via both the right femoral artery and vein for prompt establishment of extracorporeal circulation. An excimer laser generator (CVX-300®, Spectranetics Inc., Colorado Springs, CO, USA) and a laser sheath (SLSII, Spectranetics Inc., Colorado Springs, CO, USA) were used for the operation. A locking device (LLD) was inserted into the lead as a stylet. We were able to observe the excimer laser sheath as it was advanced inside the SVC through the thoracoscope. The atrial lead was easily extracted. The ventricular lead could mostly be extracted, but its tip of 2 cm in length remained in the junction between the right subclavian vein and the SVC. No injury of the SVC was observed thoracoscopically (Fig. 3). Intraoperative TEE revealed no pericardial fluid pooling. After the operation, we attempted to extract the remaining tip of the lead in the subclavian vein using a basket catheter inserted via the right femoral vein, but this approach failed. The residual lead seemed to be locked or adhered to the vein and was unlikely to be dislocated. Thus, the patient was followed with the residual lead left in place. The postoperative course was uneventful, and the subjective symptoms seen preoperatively subsided. The patient was discharged from the hospital on the fifth postoperative day.

3. Discussion

The excimer laser generator and the laser sheath allow for the extraction of leads while freeing them from the site of adhesion by making use of photoablation induced by the energy of ultraviolet rays. Since its approval in 1997 by the US Food and Drug Administration, the use of excimer laser sheaths for the extraction of implanted leads has rapidly increased throughout the world, yielding high success rates and excellent safety [4]. This technique was approved in 2008 in Japan. However, serious and potentially fatal complications, such as vascular injury, hemothorax, and pneumothorax, have been reported with this technique, although their incidences have been relatively low [3]. Thus, care is needed when applying this technique. In 1999, Wilkoff et al. compared lead extraction using the conventional mechanical sheaths with that using laser sheaths [5]. In 2009, the LExICon study reported the outcomes of lead extractions using excimer laser sheaths at 13 facilities in North America [6]. In that study, the success rate was as high as 97.7%, while the incidence of adverse events was 1.4%, and the death rate was 0.27%. The risk for complications tended to be higher at facilities where lead extraction had been used in fewer than 60 cases. The study did not identify any preoperative findings useful for predicting complications from this technique.

In the present case, the patient had previously undergone the Senning operation, and lead extraction by open surgery with the use of cardiopulmonary bypass was thought to be dangerous due to severe adhesion. Indications for lead extraction with excimer laser sheaths are determined based on the American
Heart Association and Heart Rhythm Society (AHA/HRS) joint guidelines [7,8]. The present case was classified as class IIa according to this guideline, since he complained of unendurable pain caused by the residual leads but had no fatal complications, such as sepsis. Because the preoperative CT scans revealed intense adhesion of the lead to the SVC, continuous intraoperative monitoring of the SVC during the procedure with a thoracoscope was considered extremely useful. Injuries to the lower SVC and the right atrium can result in cardiac tamponade, which can be diagnosed by TEE, whereas upper SVC injury is likely to be ruptured in the intrathoracic cavity. A thoracoscope is useful for monitoring complications in such cases. Thus, thoracoscopic assistance may be indicated particularly in the cases with where severe adhesion of a lead to the upper SVC is found during preoperative examination. In the present case, vascular injury did not occur during the operation, but we had planned to perform open surgery through a median sternotomy to achieve hemostasis immediately upon onset of vascular injury while maintaining percutaneous cardiopulmonary support (PCPS). In the present case, a one-port system was employed for insertion of the thoracoscope. If the thoracoscope is to be used for hemostasis upon onset of vascular injury, a two-port system is needed. The two-port system can control sudden bleeding in the upper SVC without opening the chest.

In conclusion, thoracoscopy-guided lead extraction with an excimer laser sheath is a useful technique especially in patients where strong adhesion is suspected. Thus, it is possible to extract the lead safely with an excimer laser sheath and to detect complications as soon as they occur.

Conflict of interest
No conflict of interest declared.

References