Permanent Epicardial Pacing Lead Implantation for Scheduled Multistage Operations in Fontan Candidate

Akio Ikai, MD, PhD, Junichi Koizumi, MD, PhD, Kazuyoshi Kanno, MD, Tomoyuki Iwase, MD, Tatsuya Furutake, MD, and Hitoshi Okabayashi, MD, PhD

Department of Cardiovascular Surgery, Iwate Medical University, Iwate, and Department of Cardiovascular Surgery, Mt. Fuji Shizuoka Children’s Hospital, Shizuoka, Japan

The use of an epicardial pacing lead may be essential in pediatric patients with rhythm disturbances. In patients with single-ventricle physiology who need scheduled multistage operations, the lead could be an obstacle because of the induction of tight adhesions and the need for dissection in the next operation. We propose a novel reproducible technique for the placement of an epicardial pacing lead followed by easy dissection of the entire length of the lead in the next operation in neonates or young infants who need multistage operations.

Some Fontan candidates with rhythm disturbances require the implantation of permanent pacing leads before the final surgery. However, artificial material induces the postoperative formation of severe adhesions, and the operation that follows the implantation of the permanent pacing lead can be time-consuming because of the need to dissect the pacing lead. Furthermore, it is critical that enough space be created between the heart and the diaphragm to enable the extracardiac conduit to be anastomosed to the inferior vena cava. We describe a useful technique to permanently implant epicardial pacing leads into Fontan candidates to facilitate easy dissection during subsequent operations.

Technique

The technique involves suturing the steroid-eluting bipolar epicardial pacing lead onto the atrium with 5-0 polypropylene sutures. A generator pocket is created in front of the posterior sheath of the rectus abdominis muscle within which the generator is placed. During chest closure, the heart is covered by a Gore-Tex surgical membrane (W. L. Gore & Associates, Inc, Newark, DE) in the usual way to prevent the formation of adhesions between the heart and the sternum. The surgical membrane was fixed to the pericardial edge with 5-0 polypropylene interrupted sutures. The pacing lead was then fashioned into a loop and placed on the surgical membrane. Another Gore-Tex surgical membrane the same size as the first membrane layer was placed on the lead, fixed to the pericardial edge, and slit several times to prevent the accumulation of fluid between the membranes (Fig 1). The two drainage tubes were placed in the pericardial cavity and on the second layer of the Gore-Tex surgical membrane. The sternum was closed in the usual way with surgical wire.

We used this implantation technique in 2 patients who had single ventricles with left atrial isomerism. Both patients had sinus node dysfunction–induced bradycardia. The patients were implanted with an AAI pacing system (Medtronic CapSure, Minneapolis, MN) before the second-stage bidirectional cavopulmonary anastomosis. An AAI pacing system consisted of bipolar steroid eluting epicardial lead and single chamber generator (Zephyr, St. Jude Medical, St. Paul, MN). One patient had the pacing system implanted as a concomitant procedure to hybrid ventricles.

Accepted for publication Nov 19, 2013.

Address correspondence to Dr Ikai, 19-1 Uchimaru, Morioka, Iwate 020-8505, Japan; e-mail: ikai@iwate-med.ac.jp.

© 2014 by The Society of Thoracic Surgeons

Published by Elsevier Inc

http://dx.doi.org/10.1016/j.athoracsur.2013.11.062

Fig 1. Surgical photograph. Double-layered Gore-Tex surgical membranes were sutured to the pericardial edge. The epicardial pacing lead was placed between the two membranes. The second layer of the surgical membrane was slit many times to prevent fluid accumulation.
stage 1 bilateral pulmonary artery banding and stenting of the ductus arteriosus at 11 days of age (Fig 2). The other patient had the pacing system implanted after a common atrioventricular valve plasty and the implantation of a modified Blalock-Taussig shunt at 34 days of age. We performed three resternotomies on each patient after the pacing system implantation. During the reoperations, we found no adhesion or only a small accumulation of fibrin between the two surgical membranes and dissected the pacing lead without difficulty. No adverse events such as increases in lead impedance and threshold were apparent in the pacing systems. The patients underwent extracardiac Fontan operations without any rhythm disturbance–associated problems.

Comment

Rhythm control is very important in patients with single-ventricle physiologies. Patients with left atrial isomerism have a high probability of developing bradyarrhythmia as a result of abnormal sinus node function [1]. Atrial pacing is essential for these patients to maintain good cardiac performance. If these patients have common atrioventricular valves, rhythm control becomes more important to prevent the progression of common atrioventricular valve regurgitation. However, implanting an epicardial pacing system in Fontan candidates is extremely stressful because of the multistage nature of the procedure. An enormous amount of dissection around the heart, especially between the heart and the inferior vena cava, is necessary to facilitate anastomosis of the extracardiac conduit. Moreover, if tight adhesions have formed on the epicardial pacing lead, it is very difficult to create enough space around the inferior vena cava. Therefore, the condition of the pacing lead can influence the difficulty encountered during the final extracardiac conduit Fontan operation.

Using the technique we described here enables the pacing system to be placed with any other main cardiovascular procedures concomitantly, using only the median sternotomy approach. Furthermore, we can thoroughly dissect the lead from the generator to the heart and acquire sufficient surgical space to perform any procedure.

Thoracotomy is an alternative approach to lead placement [2]. However, if pacing systems are placed by means of thoracotomy in cyanotic patients before a Fontan operation can be performed, the thoracotomy incisions can induce the formation of tight adhesions between the lungs and the chest walls inside the pleural cavities. Major adhesions could induce the formation of collateral arteries and increase pulmonary artery resistance.

In conclusion, the technique described here is a novel way to implant epicardial pacing leads that is reproducible in patients with single-ventricle physiologies who required treatment for rhythm disturbance as neonates or young infants. This technique should make scheduled multistage reoperations easier while maintaining good hemodynamics in these patients.

References