Low incidence of complications after cephalic vein cutdown for pacemaker lead implantation in children weighing less than 10 kilograms: A single-center experience with long-term follow-up

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BACKGROUND Only a few studies on the cephalic vein cutdown technique for pacemaker lead implantation in children weighing ≤10 kg have been reported even though the procedure is widely accepted in adults.

OBJECTIVE The purpose of this study was to prove that cephalic vein cutdown for pacemaker lead implantation is a reliable technique with a low incidence of complications in children weighing ≤10 kg.

METHODS The study included 44 children weighing ≤10 kg with an endocardial pacemaker. Cephalic, subclavian, and axillary vein diameters were measured by ultrasound before implantation. The measured diameters were used to select either an endocardial or epicardial surgical technique. Regular 6-month follow-up visits included pacemaker interrogation and clinical and ultrasound examinations.

RESULTS Two dual-chamber and 42 single-chamber pacemakers were implanted. Mean weight at implantation was 6.24 kg (range 2.25–10.40 kg), and mean age was 11.4 months (range 1 day–47 months). In 40 children (90.1%), the ventricular leads were implanted using the cephalic vein cutdown technique, and implantation was accomplished via the prepared right external jugular vein in 4 of the children (9.9%). The atrial leads were implanted using axillary vein puncture and external jugular vein preparations. Mean follow-up was 8.9 years (range 0–20.9 years). Only 1 pacemaker-related complication was detected (a lead fracture near the connector that was successfully resolved using a lead repair kit).

CONCLUSION The cephalic vein cutdown technique is feasible and reliable in children weighing ≤10 kg, which justifies the application of additional surgical effort in the treatment of these small patients.

KEYWORDS Cephalic vein cutdown; Endocardial pacing; Complications; Long-term follow-up

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Introduction

For years, endocardial pacing has been the technique of choice for the adult population requiring a pacemaker. In the pediatric pacing population, particularly in small children, there are neither clear recommendations nor a consistent opinion regarding the preferred implantation technique.[1] Data from adult pacing studies cannot be extrapolated to children because permanent antibradycardia pacing in children is a different entity than that in adults. This seemingly tendentious assertion is supported by the essential differences in the etiology of bradycardia, pacing indications, implantation technique, and follow-up between children and adults.

The initial studies indicated that the epicardial approach is better for children.[2,3] This assertion was contested when studies of the endocardial approach with positive results were published.[3–6] Endocardial pacing has become the preference in the majority of centers. However, for children weighing ≤10 kg, attitudes both for and against endocardial pacing exist.[5,7,8] More intriguing is the lack of evidence-based opinions regarding endocardial lead implantation, that is, whether subclavian vein puncture or cephalic vein cutdown should be used in children weighing ≤10 kg. Therefore, the goal of this study was to prove that permanent endocardial pacing using cephalic vein cutdown for lead implantation is a reliable and safe method with a low incidence of complications over long-term follow-up for children weighing ≤10 kg.

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Methods

Study population

From May 1989 to December 2012, permanent antibradycardia pacemakers were implanted in 46 children weighing

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≤10 kg at 3 centers: (1) the University Children's Hospital, Belgrade; (2) the Institute for Mother and Child Health Care of Serbia, Belgrade; and (3) the Referral Pacemaker Center, Clinical Center of Serbia, Belgrade. This retrospective study included 44 children with endocardial pacemakers. In 2 children, the epicardial system was used because of the small diameter of the subclavian veins (<2.2 mm); hence, these children were not subjected to further follow-up.

The study protocol was approved by the Ethics Committee of the Clinical Center of Serbia and complied with the Declaration of Helsinki. Written consent was obtained from all patients (provided by their parents, in accordance with local law).

Implantation technique

All implantations were performed by a single surgeon (P. Stojanov from the Referral Pacemaker Center) under general endotracheal anesthesia in the operating room or catheterization laboratory. In the majority of cases, surgical loupe magnifying glasses with 3× magnification were used during the operations. Single- and dual-chamber pacemakers were implanted in both sides but were predominately implanted in the right side.

Since 2001, collection of preoperative ultrasonographic measurements of the cephalic, subclavian, and axillary vein diameters has been mandatory in our practice for children younger than 3 years (we later applied this regulation to children weighing ≤10 kg). These measurements allow for selection of the optimal approach vein (ie, cephalic, external jugular, or axillary vein), optimal pacing lead (based on the consideration that the lead diameter should not exceed 50% of the axillary or subclavian vein diameter), and, most importantly, the appropriate surgical technique (ie, epicardial or endocardial). The epicardial approach was used when the diameter of the axillary or subclavian vein was <2.2 mm.

Our surgical technique proceeded as follows. A 3- to 4-cm incision was made 1–2 cm infraclavicularly starting from deltopectoral groove and extending medially and in parallel to the clavicle. Next, a subcutaneous prepectoral pocket for the pulse generator was created via a sharp surgical preparation and placed beneath the major pectoral muscle fascia as medially as possible to reduce the risks of pocket decubitus and fracture of the extravascular portion of the lead due to generator movement during shoulder and arm motion. After identifying the cephalic vein in the deltopectoral groove, we assessed whether it was possible to introduce a unipolar lead. If the vein diameter was appropriate (≥2 mm), a venotomy was created transversely with sharp scissors or a blade. The venotomy did not exceed one third of the vein's diameter to avoid the risk of vein rupture during lead insertion. After successful venotomy, we dilated the vein with a fine surgical pean or tweezers to facilitate lead insertion. Venous lifters for endocardial leads that are provided by the manufacturers are not useful in this situation because they are too large for small veins (≤2 mm). Instead, we used fine microvascular tweezers for lead insertion.

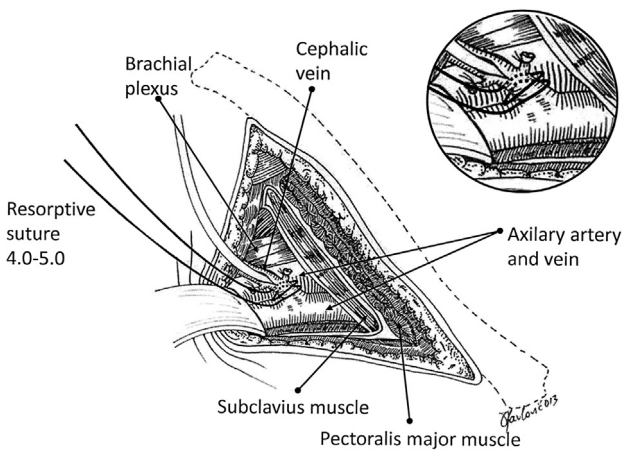

Figure 1 Cephalic vein diameter enlargement near the confluence of the axillary vein makes it suitable for lead insertion.

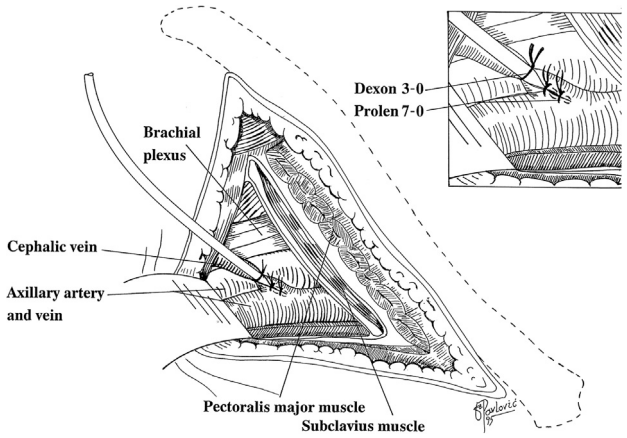

Figure 2 Directly fixing the lead with resorptive sutures (without the use of a sleeve).

Typically, it was necessary to prepare the cephalic vein up to its confluence with the axillary vein for children weighing ≤5 kg (and less often in other children) because its diameter in the deltopectoral groove was inappropriate for unipolar lead insertion. To enable this preparation, we were forced to partially detach the major pectoral muscle from the clavicle for approximately 1–1.5 cm (this procedure was performed in 18 children, and the detachments were reconstructed before wound closure). Negative consequences of this procedure on ipsilateral arm motion were not observed during follow-up. The cephalic vein most often receives tributaries close to the axillary vein confluence, which causes a 1- to 1.5-mm diameter enlargement before the confluence, which makes it suitable for lead insertion (Figure 1). In rare cases, the cephalic vein was too small for lead insertion even at this point; in such cases, the cephalic vein was cut off just before the confluence and the cut was spread toward the axillary vein (Figure 2). Bleeding control was achieved with double-loop sutures (5-0) that were applied proximally and distally on the axillary vein. The venotomy was closed with a nonabsorbable suture (6-0 or 7-0).

We directly fixed the lead with resorptive sutures (4-0 or 5-0) while exercising care not to apply inappropriate force