Ablation of a left-sided accessory pathway with near-zero fluoroscopy in a 9-year-old boy

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Abstract
Catheter ablation of cardiac arrhythmias in pediatric population is associated with the risk of ionizing radiation on the child. Due to a greater radiation sensitivity in children and a longer life expectancy newer techniques try to reduce the radiation exposure. A new technique for zero-fluoroscopy catheter ablation is described in a 9-year-old boy who had a left-sided concealed accessory pathway. The NAVX Ensite 3D mapping system permits catheter placement inside the venous system and movement inside the heart chambers without the use of X-rays. The success rate is similar to the techniques requiring X-rays.

INTRODUCTION
Fluoroscopy is still used to guide the majority of cardiovascular invasive interventions.

This requires the use of ionizing radiation which is associated with an increase risk of carcinogenesis in a linear way and there is no threshold for which radiation cannot produce malignancies [1, 2]. Children have a higher risk of malignancies due to their higher radiation sensitivity and longer life expectancy [3]. Newer electrophysiology techniques using non-fluoroscopic imaging were developed with the aim to reduce radiation exposure [4–8]. We describe a technique for zero-fluoroscopy catheter placement and ablation in a 9-year-old boy with concealed lateral accessory pathway.

CASE REPORT
A 9-year-old boy was hospitalized in our cardiology department for repeated episodes of paroxysmal tachycardia at 180 bpm (Fig. 1). Propranolol was ineffective to control arrhythmia. Because of frequent episodes of tachycardia the family accepted electrophysiological study and ablation.

The ECG during sinus rhythm showed no sign if pre-excitation. Echocardiography showed normal values for the age of 9 years (Fig. 2).

During the electrophysiological study we mechanically induced PSVT. The coronary sinus catheter confirmed an orthodromic reentrant tachycardia using a left lateral accessory pathway (Fig. 3). Our protocol is to perform electrophysiological study with zero or near-zero irradiation in children under 14. We used the NAVX Ensite Velocity system provided by Saint Jude medical (Fig. 4). The impedance-based system permits introduction of catheters through the femoral or jugular veins and inside the heart chambers without the use of fluoroscopy. The system delivers a small amplitude electrical signal between surface electrode patches. A catheter that is introduced in the electrical field has a clear position and can be visualized inside the heart chamber. The 3D geometry of the
Figure 1: ECG during tachycardia shows narrow QRS tachycardia with a heart rate of 175 bpm.

Figure 2: Echocardiography showing normal values for the heart chambers, no valvulopathy. (A) Parasternal short axis view at the level of the great arteries; (B) parasternal short axis view at the level of the mitral valve; (C) apical view with pulsed Doppler at the level of the mitral valve; and (D) suprasternal view.
cardiac structure can be thus created. Using the patch surface electrodes from the abdomen and thigh we first created the image of the right common femoral vein, than the right iliac vein, inferior and superior vena cava. Using the previously created contours we placed the catheters inside the right atrium, right ventricle and coronary sinus.

After catheter placement at the His level and right ventricular apex, we punctured the right femoral artery and introduced the ablation catheter retrogradely through the aortic valve at the level of the mitral ring. We reconstructed the descendant, ascendant aorta and the aortic arch and precisely localized the mitral annulus (Fig. 5). During tachycardia we mapped the mitral ring and we found a spot where the ventricular and atrial electrograms were fused (the blue dot, Fig. 6). Radiofrequency application at this spot stopped the tachycardia (Fig. 7) which became uninducible. During ventricular stimulation there was no retrograde conduction towards the atrium. At 12-month follow-up the boy had no arrhythmia recurrence. No medication was needed.

**DISCUSSION**

Ablation of supraventricular tachycardia is the most frequent procedure performed in children in electrophysiology.
Figure 5: 3D reconstruction of the aorta. With yellow—the coronary sinus catheter, with blue—the His bundle catheter, with green tip—the ablation catheter at the level of the mitral ring. The image shows 2 projections: RAO and LAO.

Figure 6: Different views of the ablation points at the level of the distal mitral ring. The only point that was effective is the blue one.
laboratories. The high efficacy and low risk of complications demonstrated in adults, enables its use in children. In patients with accessory pathways, catheter ablation has become a routine method of treatment.

A previous study on Hiroshima and Nagasaki survivors showed that children are more susceptible than adults for cancers [9]. Furthermore in the study of Mathews, children after CT scans have an increased incidence for all cancers [10].

Considering the cumulative malignancy risk of ionizing radiation, zero-fluoroscopy catheter ablation should be used for supraventricular tachycardia in children. Knowing this risk, numerous reports were published showing the benefits of non-fluoroscopic techniques in electrophysiology. We presented a simple and safe technique of catheter placement using non-fluoroscopy-guided catheter navigation. An important concern is to avoid inadvertent perforation of the veins or heart chambers, or injury the AV node. We used a low dose of X-rays to pass the aortic valve and place the ablation catheter on the mitral ring. Some authors have focused on the complete elimination of X-rays from the ablation procedure [11]. The question is whether the primary goal should be complete elimination or substantial reduction of radiation exposure.

CONFLICT OF INTEREST STATEMENT
The authors declare that there is no conflict of interest regarding the publication of this article.

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CONSENT
The patient provided consent for the work and personal images to be published.

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