HOSPITAL CHRONICLES 2010, 5(2): 103–106

CASE REPORT

Radiofrequency Ablation of Life-Threatening Supraventricular Tachycardia Due to a Posteroseptal Accessory Pathway in an Infant

John Papagiannis, MD,[1] Chrysanthos Alexopoulos, MD,[2] Dimosthenis Avramidis, MD,[1] Antonis S. Manolis, MD[3]

[1]Division of Pediatric Cardiology, [2]Division of Cardiothoracic Anesthesia, Mitera Children's Hospital, Athens, Greece, [3]First Department of Cardiology, Evagelismos General Hospital, Athens, Greece

KEY WORDS: *Accessory pathway, infancy, radiofrequency ablation, supraventricular tachycardia*

Abbreviations
AP = accessory pathway
AV = atrioventricular
LBBB = left bundle branch block
RF = radiofrequency
SVT = supraventricular tachycardia

Correspondence to:
John Papagiannis, MD
Division of Pediatric Cardiology
Mitera Children's Hospital
Erythrou Stavrou 6
15123 Maroussi
Tel: 210-6869788
e-mail: papagi@otenet.gr

Manuscript received February 22, 2010; Accepted after revision March 15, 2010

ABSTRACT

Supraventricular tachycardia (SVT) in infants may be resistant to multiple medications and cause life-threatening symptoms. Despite the known risks, catheter ablation may be necessary in rare cases. We present a 4-month-old 4.5 kg infant who presented with SVT that was resistant to all antiarrhythmic medications, including a combination of propafenone, amiodarone and propranolol at maximal doses. The infant underwent successful radiofrequency ablation of a posteroseptal accessory pathway. Despite later recurrence, medical therapy with propafenone and propranolol at standard doses resulted in complete control of the tachycardia until one year of age, when all medications were stopped without further recurrences.

INTRODUCTION

The most common cause of supraventricular tachycardia (SVT) in infants is an accessory pathway.[1] The vast majority of infants with SVT are managed with antiarrhythmic drugs, given the increased risk of interventional therapy and the favorable natural history of accessory pathways in infancy. However, there are infrequent cases where interventional therapy is absolutely indicated, either because of life-threatening tachycardia, or prior to a major cardiac operation which will make future treatment of the tachycardia very difficult, or will be complicated by the presence of the tachycardia. We present the first case in the Greek literature of an infant who was treated with catheter ablation because of life-threatening SVT.

CASE REPORT

A 4-month-old 4.5 kg male infant was referred to our hospital for management of SVT. He presented in utero with persistent SVT which was treated with maternal administration of digoxin with initial control of the tachycardia. In the neonatal period he required multiple antiarrhythmic medications because of recurrent SVT, with several hospital admissions. He received, successively or in combination, pro-

pranolol, digoxin, amiodarone and propafenone. Finally he was controlled with a combination of propranolol and propafenone. He presented to our hospital with recurrence of tachycardia, initially in stable condition. The tachycardia had a rate of 220 bpm and two different morphologies, one with narrow complex (Fig. 1a) and the other with left-bundle branch block (LBBB) (Fig. 1b). The tachycardia cycle length was slightly prolonged with the LBBB morphology, suggestive of a left-sided accessory pathway. There were retrograde P waves visible especially during the LBBB type of tachycardia. The infant had multiple recurrences which were interrupted only transiently with adenosine. He was loaded with esmolol (0.5 mg/kg), and a continuous infusion was started with titration up to 400 mcg/kg/min without success. An amiodarone bolus of 5 mg/kg with a drip of 0.4 mg/kg/hr was started. After initial control, he was switched to oral medications including propranolol 5 mg/kg/d, propafenone 15 mg/kg/d and amiodarone 15 mg/kg/d, with a plan to reduce the dose progressively to 5 mg/kg/d. However, 2 days later he developed sudden bradycardia with atrioventricular (AV) block, right bundle branch block (Fig. 2) and hypotension. He was treated successfully with cardiopulmonary resuscitation, intubation and intravenous administration of atropine and epinephrine. He developed again incessant SVT. Two-dimensional echocardiogram showed very poor left ventricular function and significant mitral regurgitation. Therefore, it was decided to proceed with catheter ablation.

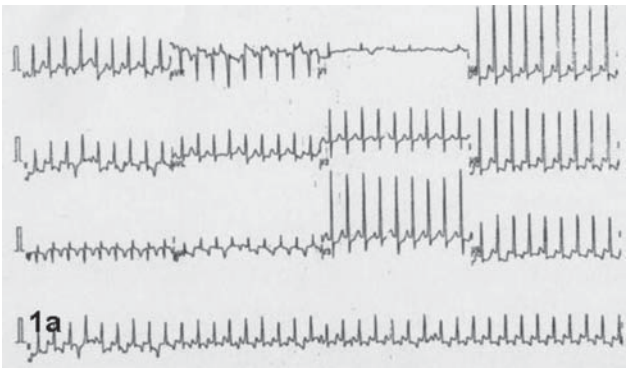

FIGURE 1A. 12-lead ECG of narrow complex tachycardia.

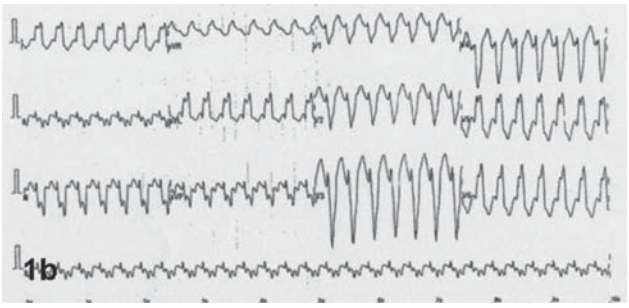

FIGURE 1B. 12-lead ECG of tachycardia with left-bundle branch block (LBBB).

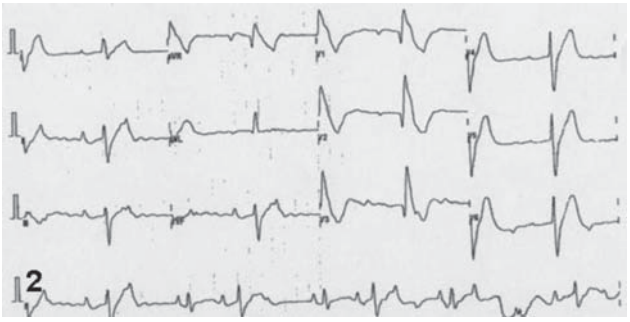

FIGURE 2. Bradycardia with AV block and right bundle branch block.

The procedure was performed during incessant SVT, using a 4 Fr diagnostic quadripolar catheter inserted through the left femoral vein and a 5 Fr mapping-ablation catheter inserted from the right femoral vein. After a very prolonged procedure (duration 8 hrs, fluoroscopy time 80 min), and 23 applications, the tachycardia was interrupted. There was transient interruption of the tachycardia both at the right and the left posteroseptal sites (the latter accessed via a transseptal approach), but with recurrence of the tachycardia (Fig. 3a and b). Finally, a loop was made in the right atrium and the catheter was wedged in the coronary sinus ostium, where the tachycardia was interrupted (Fig. 4a and b). The infant was transferred to the intensive care unit with the femoral sheaths left in place.

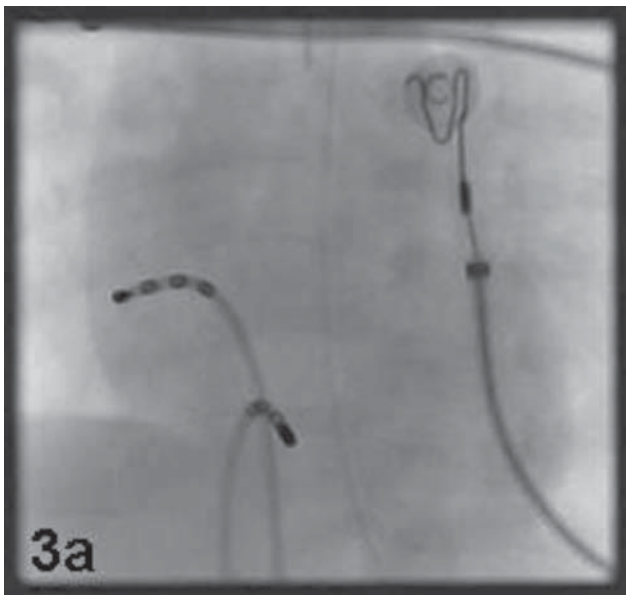

FIGURE 3A. Ablation catheter at right posteroseptal site.

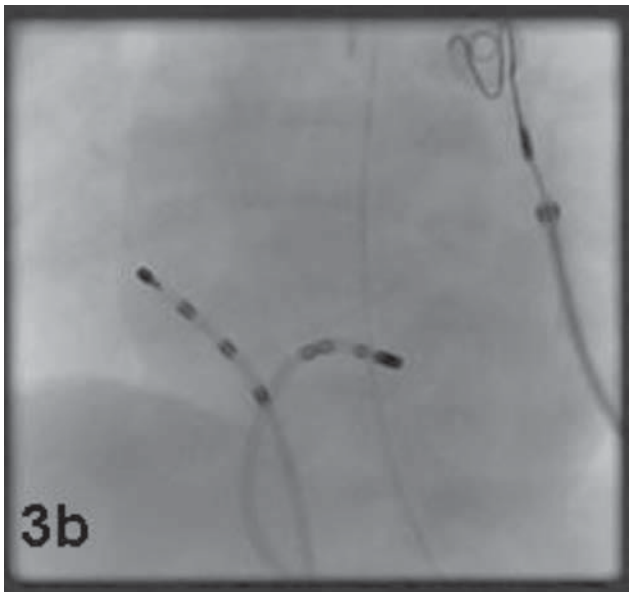

FIGURE 3B. Ablation at left posteroseptal site through a transseptal puncture.

Because of nonsustained tachycardia recorded on the bedside monitor, he was taken back to the electrophysiology laboratory the next day and the tachycardia was easily reinduced. After another prolonged procedure (6.5 hrs, 38 applications) the tachycardia was again interrupted in the coronary sinus os. During the successful lesion, the maximum temperature was 68° C, but the power was only 7 watts. After this procedure, he

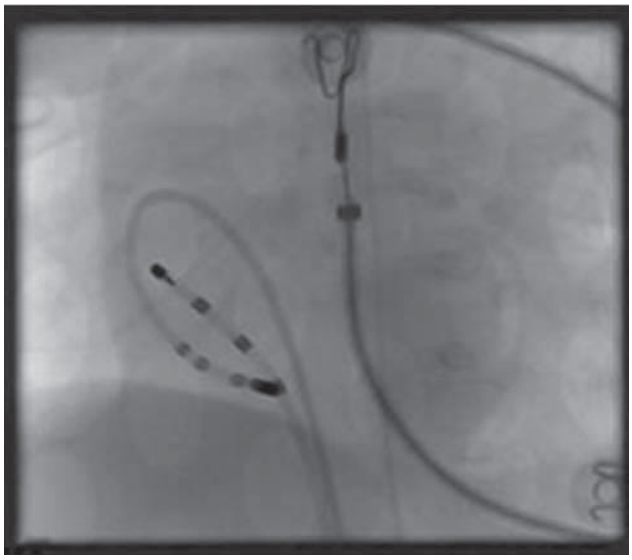

FIGURE 4A. Catheter positioned in the coronary sinus ostium during successful ablation.

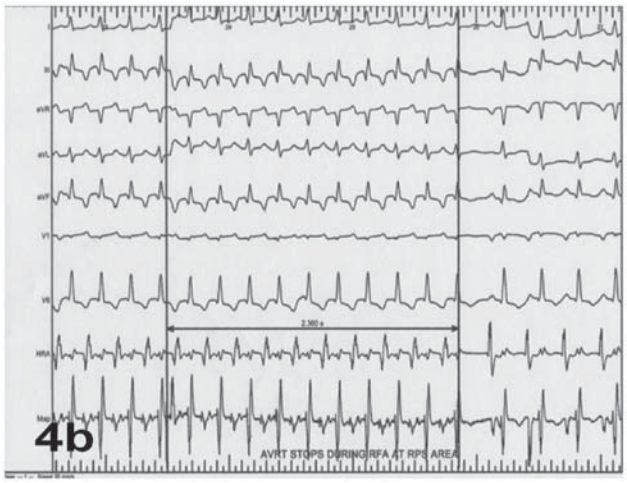

FIGURE 4B. Termination of the tachycardia during final RF application.

was stabilized with no more episodes of SVT and was switched to oral medications (propafenone 15 mg/kg/d and propranolol 2 mg/kg/d). He had a brief episode of tachycardia 10 days later. Because of this he was maintained on oral medications for a year with no further episodes. He has been off medications for a year with no further recurrences.

DISCUSSION

Supraventricular tachycardia (SVT) in infancy is often difficult to control, requiring multiple medications, sometimes in combination. Typically the most challenging tachycardias are automatic, such as ectopic atrial or junctional tachycardia. Occasionally reciprocating tachycardias due to accessory pathways may also be very resistant to medications and in these cases interventional therapy may be necessary. The reluctance to submit an infant to catheter ablation may arise from 3 areas: a) the natural history of SVT presenting in infancy, b) the highest risk of interventional therapy in infants and small children, and c) the technical problems related to small venous and cardiac structures and catheter sizes.

Perry et al studied the natural history of SVT due to accessory pathways (APs) in infants and children and have shown that a large number (>90%) will have loss of AP conduction in the first year of life, but a third of them will have reappearance of tachycardia after 8 years of age.[2] In the patients who present with tachycardia after 5 years of age, it persists in the majority of them during follow up. This pattern of clinical presentation forms the basis of the established practice of conservative management in the younger and more fragile patients and more aggressive therapy in the older ones. In addition, both experimental and clinical data suggest that radiofrequency

catheter ablation may cause significant myocardial damage in younger patients. Saul et al have shown that radiofrequency (RF) lesions increased in size when performed in infant lambs, especially when placed in the ventricular myocardium.[3] Although the lesions that were performed on the AV groove did not increase in size, it may be difficult to stabilize the catheter strictly on the AV annulus in small hearts. Another source of concern is the coronary arterial circulation. The coronary arteries may be only 2-3 mm away from the endocardium in small hearts. There have been studies in animals and children showing potential risk for coronary arterial damage after RF applications, especially in the posteroseptal area.[4] Despite all this information, several infants and young children have undergone RF ablation, usually for drug-refractory life-threatening tachycardia. Blaufox et al have summarized the patient characteristics of infants who underwent RF ablation compared to the total population of the pediatric RF ablation registry.[5] Infants comprised 2.2% of the patients (137 of 5960) in the registry. The majority of the patients had APs (67%) and the success rate was 87.8% compared to 90.9% in the older patients. The rest of the infants had ectopic atrial tachycardia (17%) and other diagnoses (AV node reentry, junctional, and ventricular tachycardia) in smaller numbers. The mortality rate in infants was 0.74% compared to 0.12% in older patients. Schafer et al studied factors related to mortality in the Pediatric RF Ablation Registry.[6] They concluded that mortality associated with pediatric RF catheter ablation is rare, but is more frequent when there is underlying heart disease, lower patient weight, greater number of RF energy applications, and left-sided procedures. Other single center series have documented the feasibility and safety of RF ablation in infants when necessary.[7,8] A higher number of complications has been reported in patients <15 kg (8.0 vs 2.3%), although this did not reach statistical significance in a certain study.[7] Successful ablation of a left lateral AP in a hydropic 2 kg premature infant has been reported.[9] The important message from the above studies as well as from our case is that RF ablation in infants should be avoided when possible, but can be performed successfully in cases with life-threatening tachycardias or serious complications of medical therapy. Technical problems can be solved in the majority of patients using smaller ablation catheters and limited diagnostic catheters (an esophageal catheter can be used for atrial pacing and recording). Problems with venous structures and catheter size may be extremely difficult to solve however. In our patient the location of the accessory pathway was probably-left sided, based on the prolongation of the tachycardia cycle length during LBBB morphology and the repeated (although transient) termination of tachycardia when applying RF energy at the left posteroseptal area via transseptal approach. The more sustained success achieved when wedging the catheter in the coronary sinus ostium suggests that the accessory pathway was related to the coronary venous system. However, the catheter size was larger than the coronary sinus and therefore it was not possible to advance it beyond the ostium. Apparently, there was significant damage to the AP, which allowed for better control with medications. Further changes in the structure and function of the AP with age may have led to long term cure. Conversely, the limitations of RF ablation reported in infants are not encountered in older children and adolescents, whereby the results are comparable to those observed in the adult population.[10]

REFERENCES

1. Ko JK, Deal BJ, Strasburger JF, Benson DW Jr. Supraventricular tachycardia mechanisms and their age distribution in pediatric patients. *Am J Cardiol* 1992;69:1028-1032.
2. Perry JC, Garson A Jr. Supraventricular tachycardia due to Wolff-Parkinson-White syndrome in children: early disappearance and late recurrence. *J Am Coll Cardiol* 1990;16:1215-1220.
3. Saul JP, Hulse JE, Papagiannis J, Van Praagh R, Walsh EP. Late enlargement of radiofrequency lesions in infant lambs. Implications for ablation procedures in small children. *Circulation* 1994;90:492-499.
4. Schneider HE, Kriebel T, Gravenhorst VD, Paul T. Incidence of coronary artery injury immediately after catheter ablation for supraventricular tachycardias in infants and children. *Heart Rhythm* 2009;6:461-467.
5. Blaufox AD, Felix GL, Saul JP, and Participating Members of the Pediatric Catheter Ablation Registry. Radiofrequency catheter ablation in infants ≤18 months old: when is it done and how do they fare?: short-term data from the pediatric ablation registry. *Circulation* 2001;104:2803-2808.
6. Schaffer MS, Gow RM, Moak JP, Saul JP. Mortality following radiofrequency catheter ablation (from the Pediatric Radiofrequency Ablation Registry). Participating members of the Pediatric Electrophysiology Society. *Am J Cardiol* 2000;86:639-643.
7. Aiyagari R, Saarel EV, Etheridge SP, Bradley DJ, Dick M 2nd, Fischbach PS. Radiofrequency ablation for supraventricular tachycardia in children ≤ 15 kg is safe and effective. *Pediatr Cardiol* 2005;26:622-626.
8. Chiu SN, Lu CW, Chang CW, Chang CC, Lin MT, Lin JL, Chen CA, Wang JK, Wu MH. Radiofrequency catheter ablation of supraventricular tachycardia in infants and toddlers. *Circ J* 2009;73:1717-1721.
9. Kolditz DP, Blom NA, Bφkenkamp R, Schalij MJ. Low-energy radiofrequency catheter ablation as therapy for supraventricular tachycardia in a premature neonate. *Eur J Pediatr* 2005;164:559-562.
10. Manolis AS, Vassilikos V, Maounis T, Chiladakis J, Cokkinos DV. Radiofrequency ablation in pediatric and adult patients: comparative results. *J Interv Card Electrophysiol* 2001, 5:443-453.