Original Article

Radiofrequency Catheter Ablation for Supraventricular Tachycardias: A Six-Year Single Centre Experience at NICVD

Md. Mustafizur Rahman[1], Md. Mohsin Hossain[2], Asif Zaman Tushar[3], Al-Mamun[4], Md. Nazmul Haq[3], Kanak Jyoti Mondol[5]

Abstract:

Pharmacological therapy is mostly employed in the management of supraventricular tachyarrhythmias in different part of the world including Bangladesh. However, Radiofrequency catheter ablation has been found to be highly effective and safe in the treatment of such tachyarrhythmias. Objective: The current study is aimed at sharing our experiences of 842 patients who presented with Supraventricular tachycardias and were diagnosed by EPS and treated with Radiofrequency catheter ablation. Methods: This descriptive study has been carried out in the cardiac electro physiology Department of NICVD, Dhaka, Bangladesh from 2nd January 2015 to 31st December, 2020. Electrophysiology study(EPS) was carried out to identity and diagnose the mechanism of different SVTs in 842 consecutive patients. RF catheter ablation was used to interrupt the tachycardia circuit. Results: Out of a total 842 patients who underwent Electrophysiology study, 435 were found to have atrioventricular nodal re-entry tachycardia (AVNRT) as underlying mechanism and 391 were having accessory pathway responsible for the reentry mechanism; of these accessory mediated tachycardia, 250 patients were manifested accessory pathway (WPWS); 141 were concealed accessory pathway (out of them 365 were presented with orthodromic and 26 as antidromic reciprocating tachycardia); moreover among the accessory pathway 231 patients were found having left sided accessory pathway whereas 155 having right sided pathway; 12 patients were having focal atrial tachycardia and 4 were found atrial flutter as the underlying cause for SVT. Radiofrequency catheter ablation was used with an overall success rate of 95%, recurrence rate of 2% without any significant complication. Complication: One patient developed pulmonary thrombo-embolism, 6 patients developed DVT of right lower limb, 4 patients developed complete heart block. Conclusion: RF catheter ablation is safe and highly effective mode of treatment of different types of supraventricular tachyarrhythmias which is emerging and becoming popular in our country.

Keywords: Radiofrequency Catheter ablation (RFA), Supraventricular tachycardia (SVT), Atrioventricular nodal re-entry tachycardia (AVNRT), Wolf Parkinson White (WPW) Syndrome

(Bangladesh Heart Journal 2021; 36(2): 68-73)

1. Assistant Professor, Department of Cardiac Electrophysiology, National Institute of Cardiovascular Diseases & Hospital, Sher-e-Bangla Nagar, Dhaka, Bangladesh.
2. Professor, Department of Cardiac Electrophysiology, National Institute of Cardiovascular Diseases & Hospital, Sher-e-Bangla Nagar, Dhaka, Bangladesh.
3. Medical Officer, Department of Cardiac Electrophysiology, National Institute of Cardiovascular Diseases & Hospital, Sher-e-Bangla Nagar, Dhaka, Bangladesh.
4. Junior consultant. Department of Cardiac Electrophysiology, National Institute of Cardiovascular Diseases & Hospital, Sher-e-Bangla Nagar, Dhaka, Bangladesh.
5. Resident, Department of Cardiac Electrophysiology, National Institute of Cardiovascular Diseases & Hospital, Sher-e-Bangla Nagar, Dhaka, Bangladesh.

Address of Correspondence: Dr. Md. Mustafizur Rahman Palash, Assistant professor, Department of Cardiac Electrophysiology, National Institute of Cardiovascular Diseases & Hospital, Sher-e-Bangla Nagar, Dhaka, Bangladesh. Email: drmmrpalash@gmail.com,contact no: +8801816641767.

DOI: https://doi.org/10.3329/bhj.v36i2.56031

Introduction:

Over the last 4 decades, cardiac electrophysiological studies have gained widespread acceptance for the diagnosis and treatment of cardiac arrhythmias. The spectrum of tachyarrhythmias that can be cured by catheter ablation has increased dramatically and includes most types of supraventricular and ventricular arrhythmias. In cardiology, our ability to cure is rare. When cardiac disease is diagnosed, most of our treatments are palliative. Complaints may be diminished and life prolonged, but the disease process will not be stopped. Cure, however, is possible in the patient suffering from a tachycardia in an otherwise normal heart. [1–4]

Supraventricular type of tachyarrhythmias (SVT) are a frequent cause of admissions to emergency room and mostly drug therapy is offered due to limited availability of electrophysiological (EP) services. In the past, occasionally surgery and even catheter-based DC shocks have been used for drug refractory SVT.[1–4] By carrying out an EP study, we can locate the site of abnormal impulse formation or a critical part of the tachycardia pathway by cardiac activation mapping during the arrhythmia. By means of a catheter, radiofrequency (RF) energy can be applied to that area, resulting in destruction of a few mm of critical tissue and cure of the patient. This technique of EP/RFA has been found to be the first line of therapy for poorly tolerated SVT with hemodynamic intolerance or recurrent symptomatic SVT.[3,5–7] The charm of this treatment modality is that most of the patients, once treated with EP/RFA, can have complete cure of their arrhythmia, and do not require any further drug therapy or follow-up.

The estimated prevalence of SVT is 3.5%.[8] There are different forms of SVT; atrioventricular nodal re-entry (AVNRT) is the most common form accounting for approximately 60% of the cases, while 30% are atrioventricular tachycardia (AVRT), atrial tachycardia and atrial flutter constitute 10% of SVT. [9]

The first interventional catheter fulguration of an accessory pathway was performed by Weber and Schmiz in 1983.[10] Since then, there has been lot of development to make ablation safer and now cryo-ablation has been proposed to be the safest for ablation targets close to sensitive structures like compact AV node.[11] The success rate of RFA depends upon the type of arrhythmia, however, it is more than 96% in atrioventricular nodal re-entry.[12] Although several energy sources have been used for ablation, this article will deal only with ablation of different types of supraventricular tachyarrhythmias using RF energy.

The current study is aimed at sharing our experiences of 842 patients who presented with SVTs and were diagnosed by EPS and treated with RF catheter ablation.

Material and Methods:

After obtaining informed consent, 842 consecutive patients with symptomatic drug resistant SVT were admitted in the Cardiac Electrophysiology Department of NICVD, Dhaka, Bangladesh from 2nd January 2015 to 31st December,2020. All antiarrhythmic drugs were discontinued at least three half-lives of the respective drugs before the study except amiodarone, which was withdrawn two months before study. Those with atrial fibrillation, age below 12 years of age, SVT with structurally abnormal heart, were excluded from the study. The study protocol was approved by the hospital ethical committee and patients were transferred to the lab in a fasting state having been sedated with tab. diazepam or midazolam, while pethidine was given as analgesic. An intravenous bolus dose of Regular Heparin 2500 IU for left sided procedures was routinely administered.

Four diagnostic EP catheters were introduced, through the right femoral veins and placed at the following sites; right atrial appendage (quadripolar 6-Fr catheter), right ventricular apex (quadripolar 6-Fr), His bundle region (Octopolar 6-Fr catheter) and Coronary sinus (CS) (decapolar 6-Fr catheter). A 7-Fr 4 mm ablation catheter was introduced through the right femoral vein. Left sided pathways were approached transeptally (via interatrial septal puncture) by using multipurpose 7-Fr sheath. An indifferent patch was applied on back at left scapular area. EP recording system Lab System Pro (Boston Scientific), stimulator Micropace III and Maestro 4000 (Boston scientific) EP ablator were used to deliver radiofrequency current. Before inducing tachycardia, baseline intervals (PR, QRS, QT, AH, HV) were measured. The following parameters were looked for in all the tachycardias:

- Onset of tachycardia - with or without jump
- VA activation – concentric/eccentric
- VA interval – < or > 70 ms
- Parahisian Pacing response–Nodal or extra nodal
- Ventricular entrainment – post pacing interval < or > 115 ms
- VAV or VAAV response. The SVTs were grouped into four on the basis of initiating mechanism:
  1. Atrioventricular nodal re-entry
  2. Atrioventricular reciprocating tachycardia (Right or Left sided)
  3. Atrial tachycardia (Right or Left sided)
  4. Atrial flutter (Right or Left sided)

The right and left accessory pathways were further grouped into lateral, septal, anterior and posterior, parahisian and middle cardiac vein on the basis of their location. For ablation in atrioventricular nodal reentry, the RF energy was applied at anterior lip of CS os to modify the slow pathway. Mostly a power of 30 watts and a temperature of 60 ºC energy was delivered for 60 Sec. The accessory pathways were modified by RF energy delivery at AV ring during sinus rhythm in manifest pathways or during tachycardia or ventricular pacing in orthodromic tachycardias. The focal atrial tachycardias were targeted when atrial intracardiac electrogram on ablation catheter was 20–30 ms earlier than surface P wave. Isthmus dependent atrial flutters were managed by ablation line across isthmus from tricuspid valve to inferior vena cava. Ablation was declared successful if no tachycardia could be induced after RFA even with isoproterenol.

Results:

The mean age of our patients was 38±19 years, with male to female ratio of 1:2.37. Table-I summarizes the frequency of various types of SVTs among the patients who underwent RF ablation at our Centre and their outcomes. Majority of the patients had the clinical history of AVNRT. Among the Accessory pathways, more patients were presented with manifested ECG and the most of the patients had left sided pathways. Failure rate was more among the patients of focal atrial tachycardia.

Figure-2 shows the frequency and location of different accessory pathways. Left lateral pathways were more among our study sample.

Figure-3 shows how the pre-excitation pattern is lost on the surface ECG as soon as the accessory pathway is ablated. It is simultaneously visible in the intracardiac signals detected by the various catheters placed inside the heart at selective sites; there is fusion of AV signals which is lost after the pathway is ablated, and the AV signals become clearly separated from each other.

Table-I

Catheter ablation of different SVTs in our experience of 842 patients and outcome

Supraventricular tachycardias	Number	Percentage %	Outcome	
			Success	Failure
AVNRT	435	51.66%	428(98%)	07
AVRT	391	46.43%	366(93%)	25
Concealed	141	16.74%	127	14
Menifested	250	29.69%	239	11
Right sided pathways	153	18.17%	140	13
Left sided pathways	231	27.43%	221	10
Middle cardiac vein	4	0.47%	03	01
Mahaim pathway	3	0.35%	02	01
Orthdromic	365	43.34%	346	19
Antidromic	26	3.08%	20	06
Focal atrial tachycardia	12	1.42%	02	10
Atrial flutter	4	0.47%	03	01
Total	842		799(95%)	43(5%)

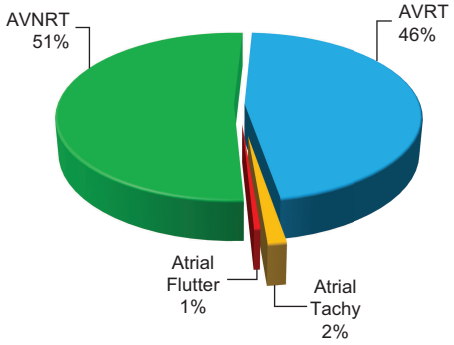

Fig.-1: *Frequency of the various SVTs that have undergone EPS & RFA at our Centre.*

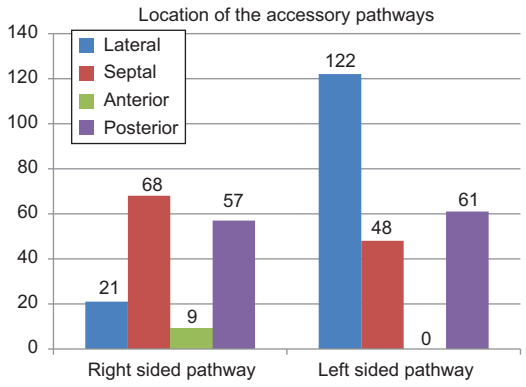

Fig.-2: *Frequency & location of different Accessory pathways that have undergone EPS/RFA at our Centre.*

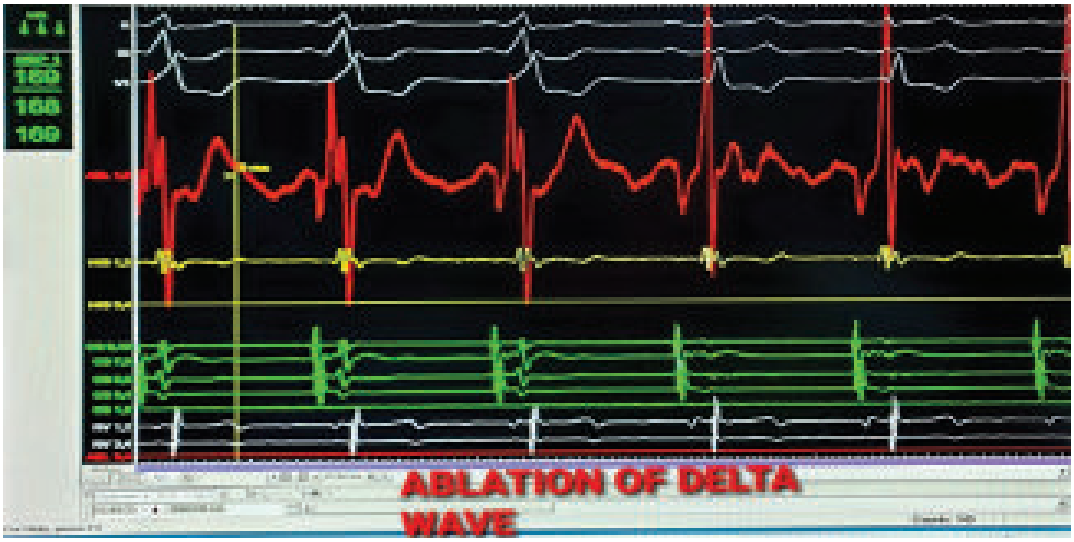

Fig.-3: *Top 3 tracings of surface ECG (leads II,III,V1) show pre-excitation in the first three beats which is lost in the 4th beat after RF ablation. Tracings CS of intracardiac signals show fusion of AV signals in first three beats, while separation of AV signals in the last two beats after ablation.*

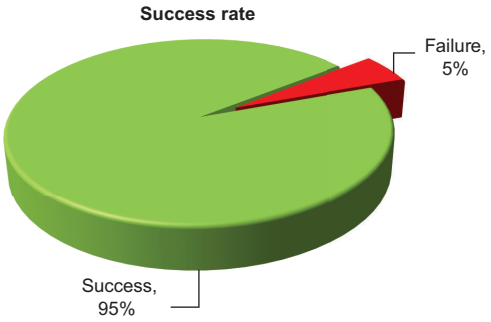

Fig.-4: *Success rate of EPS & RFA of different SVTs at our Centre*

Table-II

Common complications & its frequency during our procedure

Complications	Frequency
1. Pulmonary thrombo-embolism	1(0.1%)
2. DVT of right lower limb	6 (0.6%)
3. Complete heart block	4(0.4%)
Total	11(1.15%)

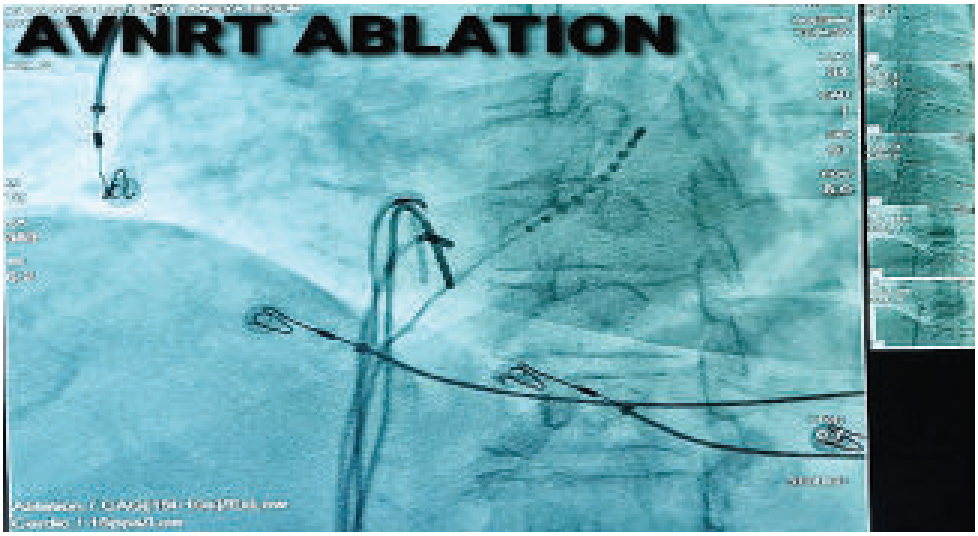

Fig.-5: *shows fluoroscopic view of AVNRT ablation in LAO 30^0.*

Discussion:

Atrioventricular nodal re-entry is the most common cause of regular narrow complex SVT. In our study, 52% of the tachycardias are due to atrioventricular nodal re-entry. If AVNRT are less frequent and responsive to therapy with beta blocker or Calcium channel blocker, then RFA can be deferred. However, in patients with frequent episodes or hemodynamic intolerance or those who refuse prolonged medication, RFA is a safe and cost-effective treatment modality. The success rate is more than 96% and the risk of damaging the compact AV node is less than 1% especially with cryo-ablation and the recurrence rate is also less than 3%.[13,14] All of the patients we ablated for SVT were symptomatic despite drug therapy. Our success rate in case of AVNRT is 98% and recurrence rate has been very low because it had been part of our protocol to look for slow junctional rhythm during RFA and to reassure with Isoproterenol that tachycardia could no longer be reinduced once RFA had been done. The presence of a junctional rhythm during slow-pathway ablation has been indisputably considered to be the most sensitive but non-specific marker of successful ablation.[15] Children under age of 10 years were not considered for the reason that radiofrequency ablation is not very safe in this age and cryo-ablation is a preferable option for AVNRT.[16–18] The SVTs due to AVNRT, ORT and ART on the right and left side were mapped usually by ablation catheter in LAO 30º view (Fig. 5). Those with evidence of ventricular pre-excitation on resting ECG were ablated in sinus rhythm targeting the closest AV site or the site having shortest delta-V wave and/or pathway potentials. [19–24] The RF energy was stopped if a pathway was not visualized in a 20 sec break. Also, after successful ablation, a confirmatory burn for 60 sec at 50 watts was given in all cases to reduce the risk of recurrence. Amongst our 51 patients with left sided accessory pathways, 48 were approached transeptally in LAO 60º view while in only 3 patients, ablation was done retrogradely via left ventricle; transeptal route was preferred because of the shorter procedure (average 20 min) and lesser radiation exposure. The all patients were given Aspirin 75mg and clopidogrel 75mg for 30 days after procedure to avoid any thromboembolic event. The higher failure rate in atrial tachycardia was due to limitations of conventional EP catheters to provide adequate information about the electrical activity at the roof of right atrium. [25,26] 3-dimensional or non-contact mapping system is now the preferred approach for atrial tachycardia to have better results. In our study, overall success rate was 95%(Fig:4), recurrence rate of 2% without any significant complication (only 1.15%) (Table II). One patient developed pulmonary thrombo-embolism, 6 patients developed DVT of right lower limb, 4 patients developed complete heart block.

Conclusion:

SVTs are mostly due to atrioventricular nodal re-entry or accessory pathways. RFA is a very safe and highly effective mode of treatment for SVT and should be considered as first line of therapy if EP services are available. Trans-septal approach for left side accessory pathways is also very safe and less time consuming and avoids prolonged exposure to radiation associated with retrograde approach. For atrial tachycardia, the preferred approach is non-contact mapping. However, conventional approach of RF catheter ablation is safe and highly effective mode of treatment of different types of supraventricular tachyarrhythmias which is emerging and becoming popular in our country.

References:

1. Ward DE, Camm AJ. Treatment of tachycardia associated with the Wolff-Parkinson-White Syndrome by transvenous electrical ablation of accessory pathways. Br Heart J 1985;53:64-8.
2. Bardy GH, Ivey T, Coltorti F. Development, complications and limitation of catheter-mediated electrical ablation of posterior accessory atrioventricular pathways. Am J Cardiol 1988;61:309–16.
3. Blomström-Lundqvist C, Scheinman MM, Aliot EM, Alpert JS, Calkins H, Camm AJ, *et al*. ACC/AHA/ESC guidelines for the management of patients with supraventricular arrhythmias executive summary. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the European Society of Cardiology Committee for Practice Guidelines (writing committee to develop guidelines for the management of patients with supraventricular arrhythmias). Developed in collaboration with NASPE-Heart Rhythm Society. J Am Coll Cardiol 2003;42:1493–531.
4. Kriebel T, Broistedt C, Kroll M, Sigler M, Paul T. Efficacy and safety of cryoenergy in the ablation of atrioventricular reentrant tachycardia substrates in children and adolescents. J Cardiovasc Electrophysiol 2005;16:960–6.
5. Gallager JJ, Pristchett FLC, Sealy WC. The prexcitation syndromes. Prog Cardovasc Dis 1978;20:285–355.

6. Scheinman MM, Morady F, Hess DS. Catheter induced ablation of atrioventricular junction to control refractory arrhythmia. JAMA 1982;248:851–5.

7. Morady F, Scheiman MM. Transvenous catheter ablation of a posteroseptal accessory pathway in a patient with the Wolff-Parkinson-White syndrome. N Engl J Med 1984;310:705–7.

8. Orejarema LA, Vidaillet H, Destafano F. Paxoxysmal SVT in general population. JACC 1998;31:150–7.

9. Wellens HJ. Twenty-five years of insights into the mechanisms of supraventricular arrhythmias. J Cardiovasc Electrophysiol 2003;14:1020–5.

10. Weber H, Schmiz L. Catheter technique for closed chest ablation of an accessory pathway. N Engl J Med 1983;308:654.

11. Skanes AC, Dubuc M, Klein GJ, Thibault B, Krahn AD, Yee R, *et al*. Cryothermal ablation of the slow pathway for the elimination of atrioventricular nodal reentrant tachycardia. Circulation 2000;102:2856–60.

12. Lockwood D, Otomo K, Wing Z. Electrophysiologic characteristics of atrioventricular nodal reentry tachycardia: Implications for the reentrant circuits. In Zipes DP, Jaliffe J (eds): Cardiac electrophysiology from cell to bedside 4th ed. Philadelphia: Sunders, 2004;537–7.

13. Jentzer JH, Goyal R, Williamson BD. Analysis of junctional ectopy during radiofrequency ablation of the slow pathway inpatients with atrioventricular nodal reentrant tachycardia. Circulation 1994;90:2820–6.

14. Kimman GP, Theuns DA, Szili-Torok T, Scholten MF, Res JC, Jordaens LJ. CRAVT: a prospective, randomized study comparing transvenous cryothermal and radiofrequency ablation in atrioventricular nodal reentrant tachycardia. Eur Heart J 2004;25:2232–7.

15. Hsieh MH, Chen SA, Tai CT, Yu WC, Chen YJ, Chang MS. Absence of Junctional Rhythm During Successful Slow-Pathway Ablation in Patients with Atrioventricular Nodal Reenterant Tachycardia. Circulation 1998;98(21): 2296–300.

16. Zrenner B, Dong J, Schreieck J. Transvenous cryoablation versus radiofrequency ablation of the slow pathway for the treatment of atrioventricular nodal re-entrant tachycardia: a prospective randomized pilot study. Eur Heart J 2004;25: 2226 –31.

17. Skanes AC, Dubuc M, Klein GJ. Cryothermal ablation of the slow pathway for the elimination of atrioventricular nodal reentrant tachycardia. Circulation 2000;102:2856–60.

18. Skanes AC, Klein G, Krahn A, Yee R. Cryoablation: potentials and pitfalls. J Cardiovasc Electrophysiol 2004;15(Suppl):S28–S34.

19. Warin JF, Haissaguerre M, Le Metayer Ph. Catheter ablation of accessory pathways with a direct approach. Circulation 1988;78:800–15.

20. Morady F, Scheinman MM, Kow WH. Long term results of catheter ablation of a posteroseptal accessory atrioventricular connection in 48 patients. Circulation 1989;79:1160–70.

21. Haissaguerre M, Warin JF. Closed-chest ablation of left lateral atrio-ventricular accessory pathways. Eur Heart J 1989;10:602–10.

22. Morady F. Catheter ablation of supraventricular arrhythmias: state-of-the-art. J Cardiovasc Electrophysiol 2004;15:124–39.

23. Haissaguerre M, Gaita F, Marcus FI. Radiofrequency catheter ablation of accessory pathways: A contemporary review. J cardiovasc Electrophysiology 1994;5:532–52.

24. Morday F, Strick Berger SA, ManKc. Reasons for prolonged or failed attempt at RFA of accessory pathways. J Am Cardiol 1996;27:683–9.

25. Anguera, Ignasi, Brugada, Jospe, Roba. Outcomes after radiofrequency catheter ablation of atrial tachycardia. Am J Cardiol 2001;87:886–90.

26. Hillock RJ, Melton IC, Crozier IG. Radiofrequency ablation for common atrial flutter using an 8-mm tip catheter and up to 150W. EP Europace 2005;7:409–12.