ORIGINAL RESEARCH

Cardiac Electrophysiology And Radiofrequency Ablation In Advanced Apex Tertiary Care Centre: A Seven Year Retrospective Study

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ABSTRACT

Background: Radio frequency(RF) catheter ablation is a proven curative modality of treatment for several types of cardiac tachyarrhythmias. The aim of our study was to evaluate our experience of electrophysiology procedures over a 7-year-period and compare it with the published literature. **Method:** All patients undergoing cardiac electrophysiology and radiofrequency ablation procedures during the period from 01 January 2011 to 30 April 2018 were included in this study. Any patient with symptoms suggestive of tachyarrhythmia and documented, narrow QRS(<120ms) or Wide QRS(>/=120ms), complex tachycardia with heart rate more than or equal to 150 beats per minute and who was not responsive to optimal anti arrhythmic drug treatment were included. Any patient with renal dysfunction(Serum Creatinine>1.5mg %), who had associated history of bleeding diathesis, who had ongoing sepsis (Total Neutrophil Count>10,000 units cu. mm), who had past history of major vascular surgery of lower limbs making femoral vascular access unavailable. **Result:** The study analyzed 948 patients of which atrioventricular nodal reentranttachycardia (AVNRT) was 684(72.15%), accessory path ways 182(19.19%), atrialtachycardia 8(0.84%), atrial flutter 4(0.42%), atrial fibrillation 1(0.10%), ventricularrtachycardia 2(0.21%) and 67 diagnostic studies. Three-dimensional electroanatomicmapping was performed in 3 (0.31 %). The success rate was 99% with AVNRT, 96% with accessory pathway. The major and serious complications rate was 0.6%. **Conclusion:** The procedural success rate and the complication rate in this real-world study were comparable/superior to the reported literature.

Keywords: Cardiac arrhythmias, Cardiac electrophysiology, Radiofrequency ablation

HIGHLIGHTS

This retrospective analysis of cardiac tachyarrhythmia is about the diagnostic modality of investigation as Two Dimensional Electrophysiology Mapping followed by Ablation as treatment modality, when indicated with its pros & cons; when it is required as a part of Critical cardiac Care.

INTRODUCTION

The management of cardiac arrhythmias has undergone a significant change with the advent of invasive cardiac electrophysiology.

Cardiac arrhythmias most commonly result from the development of a re-entry circuit caused by a myocardial scar or a developmental anomaly. Wolff Parkinson White syndrome is a classic example where the reentry current is due to the presence of a congenital accessory pathway. Destruction of this and any other abnormal electrical circuits with radiofrequency (RF) current is termed radiofrequency ablation. RF ablation came into clinical practice at the end of the 1980s and revolutionized the way patients with arrhythmias could be cured and is in many cases the first-choice therapy.RF ablation has been shown to be effective and safe, with a success rate exceeding 90%-95% in patients with atrioventricular nodal reentrant tachycardia (AVNRT) or atrioventricular reentrant tachycardia (AVRT) due to accessory pathways (AP) and ranging from 80% to 100% in patients with atrial flutter[1-5].As techniques have been increasingly refined, more types of arrhythmias have become amenable to specific curative ablation

procedures. For instance, RF ablation has recently been proposed as an effective procedure for the treatment of atrial fibrillation, whose therapy was limited to antiarrhythmic drugs until a few years ago, and the favourable results reported in several studies have led to a considerable increase in the number of ablation procedures. Similarly, new techniques, such as electro-anatomic three-dimensional (3D) mapping, have made it possible to successfully ablate more complex rhythm disorders, such as atypical atrial flutter or atrial tachycardia, atrial fibrillation and ventricular tachycardia.Available data on RF catheter ablation in literature has mainly been provided by observational studies carried out in dedicated specialized centres performing large numbers of procedures and there is paucity of data on catheter ablation in everyday practice in the "real world". Complications associated with these ablative procedures occur at a low incidence of 2%-5%.[6,7]

OBJECTIVES

The current retrospective observational study analysed retrospectively the acute success and complication rates from an apex tertiary care center of patients undergoing electrophysiology and RF catheter ablation over a duration of seven years.

MATERIALS & METHODS

The acute outcomes and complications of all electrophysiology and RF catheter ablation procedures performed at an apex tertiary care center of Sheth Vadilal Sarabhai General Hospital, Ahmedabad during a 7 year period from January 1, 2011, to 30 April, 2018, were retrospectively assessed after the approval of Institutional Ethics Committee(IEC). Information was obtained from all patients enrolled in the study.

INCLUSION CRITERIA

The ablation procedures were classified according to the arrhythmias induced using standard electrophysiological techniques and definitions. The arrhythmia types included AVNRT (both typical and atypical); AV re-entrant tachycardia involving an AP, either concealed or manifest; atrial flutter, including clockwise or counter-clockwise right or left atrial flutter; atrial tachycardia, including focal or macro-re-entrant atrial tachycardia; atrial fibrillation with pulmonary vein isolation (PVI) and ventricular tachycardia (VT) ablation in patients with and without structural heart disease.

EXCLUSION CRITERIA

Any patient visiting the hospital with symptoms suggestive of tachyarrhythmia and documented Narrow QRS(<120ms) or Wide QRS(>/=120ms) Complex Tachycardia with heart rate more than or equal to 150 beats per minute, renal dysfunction(Serum Creatinine>1.5mg %), history of bleeding diathesis, sepsis(Total Neutrophil Count>10,000), history of major vascular sugery of lower limbs making femoral vascular access unavailable.

STUDY PROCEDURE

Ablation procedures were performed using standard mapping and ablative techniques. In greater than 99% of cases, radiofrequency was the energy source applied through a 4 mm tip ablation catheter. For atrial flutter, an 8 mm tip catheter was used for most procedures. For PVI, an irrigated catheter was used. Radiofrequency energy was typically delivered at a power required to achieve a set temperature of 50 degree Celsius to 65 degree Celsius. Radiofrequency energy was applied for 30 seconds to 2 min during continuous electrocardiography, intracardiac electrogram monitoring and intermittent fluoroscopic monitoring. In complex cases electro-anatomic three-dimensional (3D) mapping catheter navigation systems (CARTO, Biosense Webster Inc, USA and NavX, St Jude Medical, USA) was used (PVI, VT or atrial tachycardia).

Patients were brought to the electrophysiology laboratory in a fasting state. Coronary sinus access was routinely performed with a non-deflectable decapolar catheter from the left subclavian vein. His and right ventricular catheters were advanced from the femoral vein. Detailed electrophysiological evaluation was performed using standard stimulation and recording techniques to establish the correct diagnosis and identify the appropriate ablation site. The study was labeled as a diagnostic study when there was no inducible tachycardia and RF ablation was not performed. Slow pathway ablation was performed in patients with AVNRT, usually in the left anterior oblique view. The trans septal left atrial access approach via the femoral vein was routinely used for left-sided AP's (Fig.1).

Radio Frequency Ablation at Mitral Annulus after Trans septal Left atrial access was performed in patients with Left Free Wall Concealed Accessory Pathway with Orthodromic AVRT. (Fig 2) Right-sided APs were approached via the femoral veins using the antero-posterior or left anterior oblique view. For complex arrhythmias like atrial tachycardia and ventricular tachycardia 3D electro-anatomic mapping was used by CARTO systems(Fig. 3). Patients were routinely monitored for 24 hours after the procedure. A 12 lead electrocardiogram was obtained before discharge.

Acute ablation success was defined based on arrhythmia type as follows:

AVNRT: inability to initiate more than single AV node echo beat with and without isoproterenol challenge;

Atrial tachycardia: inability to reinitiate the tachycardia;

AV re-entry: absence of antegrade and/or retrograde AP conduction;

Atrial flutter: bidirectional isthmus block demonstrated following ablation with a multipolar electrode catheter;
Ventricular tachycardia: termination and non-inducibility on extra-stimulation in patients with structural heart disease and during isoproterenol infusion in patients without structural heart disease.

COMPLICATIONS AND FOLLOW-UP

The patients were followed for 4-24 weeks after ablation on outpatient visits and on telephone. **Complications were grouped into the following three categories according to the seriousness or permanence of the event:**

1. Major or life-threatening complications: death, myocardial infarction, embolic stroke involving transient or permanent neurological alteration, persistent unintentional heart block (second- or third-degree), valve disruption and pulmonary embolism;
2. Serious complications: deep venous thrombosis, pericardial effusion requiring drainage, pseudoaneurysm and transient heart block; and
3. Minor complications: hematoma, pericarditis and pericardial effusion without tamponade.

STATISTICAL ANALYSIS

Results are presented as the number of procedures performed and mean SD where calculated.

RESULTS

From January 1, 2011, to 30 April, 2018, 948 electrophysiology and RF ablations were performed at an apex tertiary care center of the ShethVadilal Sarabhai General Hospital. Patients' characteristics are presented in Table 1. The mean (SD) age of patients was 52±18 years (range 10-75 years), and 498 patients (52.53%) were males. The indications for ablation were AVNRT (n=684), accessory pathways (n=182), ventricular tachycardia (n =2), atrial tachycardia focal/macro-reentrant (n=8), isthmus dependent atrial flutter (n=4) and atrial fibrillation (n=1) as shown in Fig. 4. There were 67 diagnostic studies. Table 2 shows the short-term success rates and the procedural parameters according to ablation type. The management of complex arrhythmias with 3D electro-anatomic mapping was embarked upon 3 years ago and these were used in atrial tachycardias, atrial flutter, atrial fibrillation and ventricular tachycardias. The characteristics of patients who underwent 3D electro-anatomic mapping are given in Table 3. The overall success rates varied between 35% (atrial finbrillation) and 99% (AVNRT). There was no difference in the success rates between the younger and older patients. The incidence of complications as per the type of procedure done is given in Table 4. Fifteen patients (1.58%) had complications, including four major, four serious and seven minor complications. Among patients undergoing AVNRT ablation, three had a permanent pacemaker implanted for inadvertent persistent complete AV block during ablation and all patients had their pacemakers implanted immediately after ablation. One patient had a stroke during ablation of the left free wall pathway via the trans septal left atrial access that recovered completely over the next 2 days. Two patients had pseudoaneurysms of the femoral artery access site that were treated by ultrasound guided local compression. None of the patients with hematomas required a blood transfusion.

Table 1 - Characteristics of patients undergoing Electrophysiology Study and RF ablation (n = 948)

	Patients, n (%)	Men (%)	Age, Years[a]	Age, Range
AVNRT	684(72.15)	335(48.97)	50±17	12-75
ACCESSORY PATHWAY	182(19.19)	111(60.98)	36±18	11-69
ATRIAL TACHYCARDIA	8(0.84)	5(62.5)	44±11	12-63
ATRIAL FLUTTER	4(0.42)	2(50)	53±18	22-72
ATRIAL FIBRILLATION	1(0.10)	1(100)	43±14	26-55
DIAGNOSTIC	67(7.06)	43(64.17)	46±17	11-74
VENTRICULAR TACHYCARDIA	2(0.21)	1(50)	47±22	23-65

Table 2 - Short-term success rates and procedural parameters according to ablation type.

	AVNRT	Accessory Pathway(AP)	Atrial Tachycardia	Atrial Flutter	Atrial Fibrillation	Ventricular Tachycardia
Patients	684	182	8	4	1	2
RF lesions	6±3	11±10	19±14	19±10	36±13	22±12
Fluoroscopy time(In minutes)	11±10	25±19	32±16	28±13	45±20	40±15
Success rate(%)	99	96	80	90	35	63

Table 3 - Characteristic of 3D electro-anatomic mapping patients.

	CARTO Biosense Webster Inc. USA (n)	NavX, St Jude Medical USA (n)	Array Ballon, St Jude Medical, USA (n)
Atrial Tachycardia	7	1	0
Atrial Flutter	4	0	0
Atrial Fibrillation	1	0	
Ventricular Tachycardia-Structurally normal neart	2	0	0
Ventricular Tachycardia-Scar related	0	0	0

Table 4 - Complications as per the procedure done.

	Major (%)	Serious (%)	Minor (%)
AVNRT	3(0.31)	0	0
Accessory Pathway(AP)	1(0.10)	1(0.10)	4(0.42)
Atrial Tachycardia	0	0	1(0.10)
Atrial Flutter	0	1(0.10)	1(0.10)
Atrial Fibrillation	0	1(0.10)	0
Diagnostic	0	0	0
Ventricular Tachycardia	0	1(0.10)	1(0.10)
Total	4(0.42)	4(0.42)	7(0.73)

Fig 1. Trans septal Left atrial access was performed in patients with Left Free Wall Concealed Accessory Pathway with Orthodromic AVRT.

Fig 2. Radio Frequency Ablation at Mitral Annulus after Trans septal Left atrial access was performed in patients with Left Free Wall Concealed Accessory Pathway with Orthodromic AVRT

Fig 3. 3D electro-anatomic mapping by CARTO systems

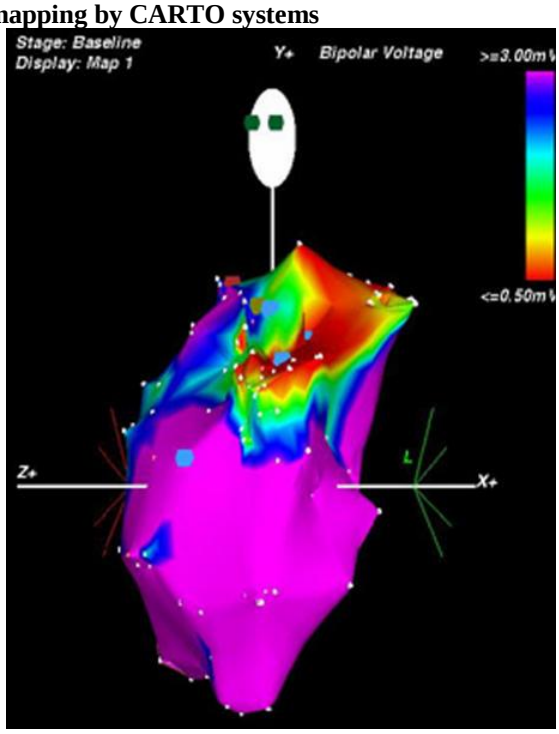
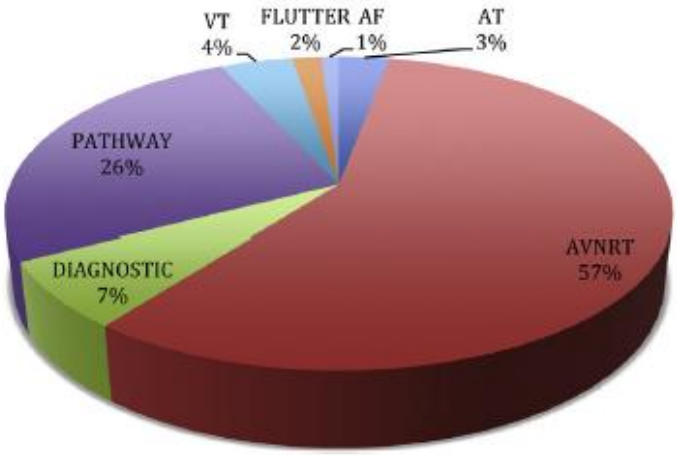


Fig. 4. Characteristics of procedures performed as per the arrhythmia.



DISCUSSION

During the past decade, several studies have reported results of RF ablation for cardiac arrhythmias. The present study confirms the safety and efficacy of radiofrequency catheter ablation (RFA) for cardiac arrhythmias. We found a high acute success rate (from 81% to 99%) using conventional electrophysiology techniques and a success rate of 34-64% using 3D electro-anatomic mapping. Our success rates with AVNRT were 99% vs 95% (p value 2.275), AP's were 94% vs 93% (p value 30.8), atrial flutter 91% vs 88% (p value 6.69) and for atrial tachycardia 81% vs 82% (p value 30.85) in published reports.[6,13] We had a relatively low complication rate (1.6%) vs 2.5% (p value 4.45) with no mortality related to the procedure. Our success rates with 3D anatomic mapping were not assessed on account of their recent introduction, low numbers & financial constraints. The major complications we had were in 4 (0.45%) patients that included the need for unexpected, permanent cardiac pacing in 3 (0.34%) patients and spontaneously recovering stroke in one patient (0.11%). The success rate and incidence of major complications reported in the present study are similar/superior to the results from published reports.[6-13].The present study is an observational, single-center study. The fluctuation in the number of procedures is related to the mobile population of the cardiac electrophysiologists at our institute and the arduous learning curve for these procedures. Interestingly, our results showed that notwithstanding the changing population of the cardiac electrophysiologists at our institute the learning curve rates were rapidly achieved.(within 2 years) with the overall success rates remaining stable over time. Of note, our electrophysiology procedures are performed in the real world where the cardiac catheterization laboratory time is shared amongst other invasive cardiology work. However, this factor

did not result in an increase in the complication rate or in ablation failure compared with other published studies emanating from dedicated electrophysiology centers in the world. Over the last few years, we have made forays into 3D electro-anatomic mapping for complex arrhythmias. However the stumbling block remains the steeper learning curve and long procedure time further clustering the cardiac catheterization laboratory time and staff. RFA improves health-related quality of life to a greater extent than medical treatments[14,15] and is less expensive than medical therapy over time among patients who have frequent symptomatic episodes of tachycardia. Every Cardiologist or the intensivist requires awareness of treating such tachyarrhythmias in challenging critical care situations. [16, 17]

STUDY LIMITATIONS

The present study was a database analysis. All procedures were prospectively included from 01 January 2011 to 30 April 2018. Complications were collected in the database during each hospitalization and also at the time of follow-up (4-24 weeks post ablation). Some complications may not have been reported for a minority of patients who were not seen for post ablation follow-up.

CONCLUSION

The results of this large single apex tertiary care center of the ShethVadilal Sarabhai General Hospital highlight the experience with cardiac electrophysiology over the last decade. The study is kind of a real-world assessment in an institution which performs a spectrum of cardiac interventions. Our experience showed results similar or superior to those of previous studies performed in dedicated institutions undertaking cardiac electrophysiology. Our results confirm that RFA is safe and effective, supporting ablation therapy as a first-line therapy for the majority of patients with recurrent symptomatic or disabling cardiac arrhythmias.

CONFLICTS OF INTEREST

All authors have none to declare.

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