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Predictors of Recurrence of Accessory Pathway Conduction after Successful Ablation: Mansoura experience

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ABSTRACT

Background: An accessory pathway is an aberrant cardiac muscle bundle that often is capable of rapid conduction and that connects the atrium to the ventricle, usually at the atrioventricular (AV) annulus. Accessory pathways are a consequence of incomplete embryologic development of the AV annulus and sometimes may be genetic. The gold standard treatment of choice for individuals with recurrent and symptomatic AVRT, or even pre-excited AF, is catheter ablation. Successful ablation was defined as: 1) complete elimination of AP conduction after 30-min waiting period, 2) lack inducibility of any atrioventricular re-entrant tachycardia and 3) lack of recurrence of overt pre-excitation or tachycardia during a pre-charge period of 24-48 h.

Methods: This study was performed at cardiovascular medicine department at Specialized Medical Hospital, Mansoura University. A cross-sectional study with the primary aim to assess, evaluate and follow up our outcomes in accessory pathway ablation in cardiology department at Mansoura university. Also to evaluate characteristics of patients and accessory pathways as well as additional technical factors involved in the recurrence of accessory pathway conduction after successful ablation. We include 50 cases of individuals with accessory pathway and underwent RF ablation. Radiofrequency procedures were retrospectively analyzed, and patients were followed for recurrences of accessory pathway conduction. Electrocardiograms (before and after ablation and at follow-up) were analyzed for each patient.

Results: the study was directed on 50 patients, 11 of them (22%) reported reappearance of conduction through an accessory pathway that successfully ablated by radiofrequency current who represent recurrence group, while 39 patients (78%) reported no recurrence of accessory pathway conduction and those represent non recurrence group. There is statistically significant difference between the two groups regarding gender where (72.7%) of female have recurrence and (27.3%) only of males have recurrence. There is statistically significant difference between both groups regarding inducible AVRT with most of Non recurrent group (84.6%) were positive inducible AVRT while most of Recurrent group (72.7%) were negative inducible AVRT during pre- ablation study. There is statistically significant difference between both groups regarding median of number of ablation sessions with higher median in recurrence group (12(4-118)). There is statistically significant difference between both groups regarding median of fluoroscopy time with higher median in recurrence group (57(3.-120)).

Conclusion: The study revealed that the predictors of recurrence of accessory pathway conduction after successful ablation are: female gender, location of accessory pathway (incidence of recurrence increase in right sided accessory pathway), inducible AVRT (pre ablation) and inability to produce it after ablation are predictors for non-recurrence.

Keywords: *Accessory pathway, Catheter ablation, Recurrence, Atrioventricular re-entrant tachycardia, Predictors*

1. INTRODUCTION

An accessory pathway is an aberrant cardiac muscle bundle that often is capable of rapid conduction and that connects the atrium to the ventricle, usually at the atrioventricular (AV) annulus. Accessory pathways are a consequence of incomplete embryologic development of the AV annulus and sometimes may be genetic. [1]

The gold standard treatment of choice for individuals with recurrent and symptomatic AVRT, or even pre-excited AF, is catheter ablation. For other subjects with infrequent and asymptomatic episodes, treatment decisions should be weighed between the benefits and overall risks of the invasive procedure of ablation vs. long-term adherence to pharmacological therapy. [2]

AP treatment by ablation has a high acute success rate and less frequent complication rate according to site of AP pathway. Major complications may occur including pericardial effusion and tamponade (0.13-1.1%) and complete AV block (0.17-2.7%) especially in subjects with septal APs. [3]

Successful ablation was defined as: 1) complete elimination of AP conduction after 30-min waiting period, 2) lack inducibility of any atrioventricular re-entrant tachycardia and 3) lack of recurrence of overt pre-excitation or tachycardia during a pre-charge period of 24-48 h. [4]

2. SUBJECTS AND METHODS

A-Technical Strategy:

1-Setting:

This study was conducted at cardiovascular medicine department at Mansoura Specialized Medical Hospital.

2- Subjects:

The study was conducted on 50 cases of individuals with accessory pathway and underwent RF ablation

3-Study Design:

This study is a cross-sectional study

4-Sample size:

(50) cases of individuals with accessory pathway and underwent RF ablation.

B- Procedural Strategy:

1-Process:

Included patients were evaluated according to the following methods:

Detailed history taking:

Emphasis on:

Onset, course, termination, frequency of attacks.

Drug therapy during attack and maintenance drug therapy.

2-Full clinical assessment:

We obtained data for all patients with specific focus with specific focus on hemodynamic status (stable or not) as regard blood pressure, heart rate, UOP and cardiac auscultation.

3-Investigations involved:

Electrocardiogram:

With standard 12- lead ECG, will be done to all patients using a paper speed of 25 mm/s and standardization of 1mV/10 mm. Electrophysiological study

All antiarrhythmic Drugs (AADs) including beta-blockers were discontinued for At least 7Days before the ablation. The Surface electrocardiograms (ECGs) and bipolar intracardiac electrograms were continuously monitored and stored on a computer-based digital recording system [Lab System PRO(Bard Electrophysiology, Lowell, MA, USA)]. The Bipolar electro grams were filtered from 30To 500 Hz. A 6-Fr 10-pole Catheter was inserted through the right femoral vein and positioned in the coronary sinus for pacing and recording. A 6-Fr 4-pole Catheter was inserted through the left femoral vein and placed at the His Bundle region and in the right ventricle for pacing and recording. If Patients had left-sided Aps, Atrans aortic approach was performed in the early years while a trans septal approach was used more often in the more recent years according to the physician's preference. In addition, we did not use any heparin regardless of the AP Location until 2006, But after having experienced two transient ischemic attacks (TIAs) A 5000 IU Intravenous bolus of heparin was administered just after the femoral puncture.

Follow Up:

A12-lead ECG was obtained before hospital discharge. The Patients were followed up throughout 6 Months after the procedure. We judged the disappearance of the delta wave or tachycardia as a successful ablation. Recurrence was assessed

on the basis of the patient's symptoms in conjunction with serial 12-lead ECGs. Reappearance of delta waves or paroxysmal episodes of a regular narrow QRS Tachycardia after the ablation were considered as a recurrence.

2- limitations of study:

Underestimation of the recurrence rate because resumption of concealed pathway conduction without consequent tachycardia would not be recognized. the sample size was relatively small, so we need a larger study to confirm our result and increase its reproducibility. Time for follow up is only 6 months, we need to follow up for longer duration. We need Using of 3D mapping system to assess its effect on AP conduction recurrence post ablation as open window mapping and activation mapping. Age group didn't include children to assess reappearance of accessory pathway conduction post ablation in this age category. Poor compliance of patients follows up.

C-Organizational Design:

The study protocol was approved by the institutional research board (IRB) and the medical ethics committee in Mansoura University. All patients who were involved in the study gave their informed consent and gave permission for quality-control procedures including echocardiogram or further cardiac imaging and received a copy of these measurements along their medical reports on discharge. The patient also consented for publication of the clinical data while guaranteeing confidentiality of personal information.

Statistical Analysis:

We studied the medical records for collecting patients' data and statistical data analysis was performed.

Descriptive data:

Qualitative data: were presented by frequency tables (Number and percentages).

Quantitative variables: Data were first provided by central indices and dispersion, and the Shapiro-Wilk test was used to determine whether the data were normal:

Mean ± Standard deviation (SD)

Median and range (Minimum – Maximum).

Analytical statistics

Chi-square test is applied to test association between categorical variables. It is replaced by Fisher Exact Test if the expected cell count was less than 5 in four-cells tables, while it is replaced by Monte Carlo test if the expected cell count was less than 5 in more than four-cells tables.

Independent sample t-tests were employed to compare associations between normally distributed continuous variables in two independent groups, while paired sample t tests were utilized in pre- and post-testing.

Repeated measures to identify broad differences or changes in mean scores over three or more time points, ANOVA was performed.

Pearson correlation is employed to correlate normally distributed data.

Results for all the above-mentioned statistical tests were considered significant when the possibility of error is less than or equal 5% ($p \leq 0.05$).

3. RESULTS

Table-1: Sociodemographic data of patients with and without recurrence of Accessory Pathway Conduction (APC) after radiofrequency catheter ablation (N=50)

Items	Recurrence (n=11)	No recurrence (Succeed) (n=39)	Test of Significance
Age (years)			t= 1.9
Mean ± SD	28.8 ± 7.9	35.3 ± 10.5	p= 0.06
Gender			
Male	3 (27.3%)	26 (66.7%)	$\chi 2$= 5.47
Female	8 (72.7%)	13 (33.3%)	p= 0.02*

Data expressed as mean ± SD or number (%). χ^2: chi-square test.

t: independent samples -t- test. *: significant $p < 0.05$.

[Table 1] shows Sociodemographic data of patients with and without recurrence of Accessory Pathway Conduction (APC) after radiofrequency catheter ablation, there is no statistically significant difference between the two groups regarding age.

Table-2: Accessory pathway characteristics in patients with and without recurrence of Accessory Pathway Conduction (APC) after radiofrequency catheter ablation (N=50)

Items	Recurrence (n=11)	No recurrence (Succeed) (n=39)	Test of Significance
AP conduction			
Concealed (retrograde only)	2 (5.1%)	2 (5.1%)	MC= 3.9
Antegrade only	0	7 (18%)	p= 0.28
Ante+ Retro grade	9 (81.8%)	30 (76.9%)	
AP location			
Right- sided (on tricuspid annulus)	7 (63.6%)	22 (56.4%)	FET
Left- sided (on mitral annulus)	4 (36.4%)	17 (43.6%)	p= 0.67
AP site			
Septal	3 (27.2%)	19 (48.8%)	
Lateral	1 (9%)	16 (41%)	MC= 6.8
Anterior	4 (36.3%)	2 (5.1%)	p= 0.16
Posterior	3 (27.2%)	2 (5.1%)	

Data expressed as number (%). not significant: $p > 0.05$. FET: Fisher's Exact Test

MC: Monte Carlo test.

[Table 2] showed that, Accessory pathway characteristics in patients with and without recurrence of Accessory Pathway Conduction (APC) after radiofrequency catheter ablation, there is no statistically significant difference between both groups regarding AP conduction, AP location and AP site

Table-3: Comparison of patients with and without recurrence of Accessory Pathway Conduction (APC) after radiofrequency catheter ablation (N=50)

Items	Recurrence (n=11)	No recurrence (Succeed) (n=39)	Test of Significance
Inducible AVRT (pre ablation)			
Positive	3 (27.3%)	33 (84.6%)	FET
Negative	8 (72.7%)	6 (15.4%)	P= 0.001*
Catheter			
non irrigated	10 (90.9%)	34 (87.2%)	FET
Irrigated	1 (9.1%)	5 (12.8%)	P= 0.74

Data expressed as number (%). *: significant $p < 0.05$. FET: Fisher's Exact Test

[Table 3] showed that, Comparison of patients with and without recurrence of Accessory Pathway Conduction (APC) after radiofrequency catheter ablation regarding inducible AVRT pre- ablation and use of irrigated catheter or not during ablation:

There is statistically significant difference between both groups regarding inducible AVRT with most of Non recurrent group

(84.6%) were positive inducible AVRT while most of Recurrent group (72.7%) were negative inducible AVRT during pre-ablation study.

There is no statistically significant difference between both groups regarding using of irrigation or not during ablation.

Table-4: Comparison of patients with and without recurrence of Accessory Pathway Conduction (APC) after radiofrequency catheter ablation regarding number and time of RF ablation (N=50)

Items	Recurrence (n=11)	No recurrence (Succeed) (n=39)	Test of Significance
Ablation time (minutes)			Z= 3.64
Median (min – max)	7.5 (1.3 – 10)	2 (1 – 8.5)	p ≤ 0.001*
Number of ablation sessions			Z= 4.01
Median (min – max)	12 (4 – 18)	4 (2 – 18)	p ≤ 0.001*
Fluro time (minutes)			Z= 3.29
Median (min – max)	57 (30 – 120)	38 (12 – 90)	p= 0.001*

Data expressed as median (minimum – maximum). Z: of Mann Whitney test. *: significant p < 0.05.

[Table 4] showed comparison of patients with and without recurrence of Accessory Pathway Conduction (APC) after radiofrequency catheter ablation regarding number and time of ablation:

There is statistically significant difference between both groups regarding median of RF ablation time with higher median in recurrence group (7.5(1.3-10)).

There is statistically significant difference between both groups regarding median of number of ablation sessions with higher median in recurrence group (12(4-118)).

There is statistically significant difference between both groups regarding median of fluoroscopy time with higher median in recurrence group (57(3.-120)).

4. DISCUSSION

The purpose of this study was to evaluate characteristics of patients and accessory pathways, as well as additional technical factors on the recurrence of accessory pathway conduction after successful ablation. Our study was directed on 50 patients, 11 of them (22%) reported reappearance of conduction through an accessory pathway that successfully ablated by radiofrequency current who represent recurrence group, while 39 patients (78%) reported no recurrence of accessory pathway conduction and those represent non recurrence group. Regarding demographic data, our study revealed that no statistically significant difference between two groups as regard age which agreed with Chen et al, that directed on 257 patients with APs underwent radiofrequency ablation followed over 19±11 months and the recurrence rate was 24.6%. [5]

In contrary, Dionne et al that directed on 558 patients with APs underwent radiofrequency ablation followed over 4 months and the recurrence rate was 8% that reveal that Patients with recurrence were younger and they explain this as the younger age of patients with recurrence may reflect the difficulty with catheter manipulation sometimes encountered in patients with small heart. Alternatively, the biologic properties of accessory pathways may differ in young and older patients. [6] This discrepancy between our result and Dionne et al explained as the last focused on patients with a median of 13.6 (9.7–16.3) years of age at the time of ablation (younger age group) but in this study, patient age (21-45) years at time of ablation. As regard gender, our study reveals that recurrence is more in females (8 recurrence cases are female with percentage 72.7% and only 3 males with percentage 27%) and we explain that as the association between gender and electrophysiological characteristics is caused by hormonal differences, changes in the expression of the ionic channels, and by modifications in the autonomic tone. A higher incidence of concealed AP in adult females in comparison to adult males is also described and this is the rationale of increase incidence of recurrence in female. In contrary Chen et al and Wang et al that directed on 254 patients followed over 2-20 months with recurrence rate 6.3% and they said that no relation was found between the two groups as regard to gender. [7]

As regard accessory pathway location: our study reveals that the recurrence of AP conduction occurred more frequently in patients with right AP than those of left accessory pathway but the results is not statistically significance due to small sample size of patients and this agree with some studies like Twidale et al that discussed 204 patients followed up over 8.5± 5.4 months and reveal 17% recurrence and Timmermans et al that discussed 167 patients followed up over 2-27 months resumed

7.8 % recurrence in right AP. Both of these have shown that resumption of accessory pathway conduction occurred more frequently in right-sided accessory pathways. They proposed the higher rate of recurrence in right sided AP that contact of the ablation catheter with the tricuspid ring was less stable, resulting in less current flow into the tissue and, consequently, smaller lesions. [8,9] In our study, no relation was found between the two groups as regard to concealed or manifest accessory pathway which is against Chen et al and Twidale et al whose studies explain recurrence of accessory pathway conduction occurred more frequently in patients with concealed accessory pathways compared to manifest accessory pathways as that exact localization of the accessory pathway may be an important factor influencing the recurrence of accessory pathway conduction. [8] Localization of concealed accessory pathways was performed in most patients during orthodromic reentrant tachycardia by searching for an accessory pathway potential or the earliest atrial activation. However, retrograde accessory pathway potentials were often obscured by a large ventricular potential during tachycardia. This makes the localization of concealed accessory pathways more difficult than manifest accessory pathways. Furthermore, dislodgment of the ablation catheter after termination of reentrant tachycardia during application of radiofrequency current may also contribute to the high recurrence rate of concealed accessory pathway conduction. We explain this discrepancy as in our study, ablation during orthodromic tachycardia during VP at the same cycle length of tachycardia avoids catheter dislodgement if tachycardia terminates during ablation. On the other side, Timmermans et al showed a lower incidence of recurrence in concealed than in overt accessory pathways, although the difference did not reach statistically significance, possibly due to the limited number of patients. [9] In Timmermans et al study, unipolar electrograms have been used to measure the ventriculoatrial (VA) conduction time during circus movement tachycardia. [9] In concealed accessory pathways the target ablation site was selected according to the shortest ventriculoatrial conduction time, so the relatively low rate of recurrence of concealed accessory pathways could be due to the use of unipolar recordings, which permit a clear distinction between atrial and ventricular depolarization, and to the selection of the target site on the basis of the shortest ventriculoatrial conduction time during circus movement tachycardia.

As regard inducible AVRT preablation, our study reveals that induction of AVRT before ablation with no induction of AVRT post ablation considered as predictor of no recurrence of accessory pathway post ablation .

Regarding using irrigated catheter guided by power control system, our study reveals that the incidence of recurrence is more with non- irrigated catheter compared with irrigated ones but this is not statistically significance due to small number of cases used irrigated catheter and that agree with Siroky GP et al that comparing irrigated to non-irrigated catheters in the ablation of accessory pathways (AP) in 69 adult patients. [10] The principal finding of this study is that the acute success rate of RF ablation of APs in adults was higher when using irrigated catheters compared with non-irrigated catheters and was associated with decreased fluoroscopy time. The irrigated catheters have superior efficacy and are equivalent to safety as non-irrigated catheters. And also, Müssigbrodt et al that focus on the effect of irrigated tip catheter in radiofrequency ablation and find the same result and explain it as the irrigation of the catheter tip reduces excessive heating of the tissue and blood at the catheter tip and prevents the occurrence of thrombus and char formation [11].

As regard ablation time, in our study, there is statistically significant difference between two groups as the recurrence group has longer ablation time than no recurrence group. In contrary Twidale et al, Chen et al and Dionne et al also noted that duration of radiofrequency application was not related to recurrence of accessory pathway conduction. [5,6,8] As regard number of ablation our study reveal that there is statistically significant difference between two groups as increase number of ablations will increase risk of recurrences and Chen et al, Dionne et al and Langberg et al agreed with our study as they said that patients with recurrence AP after ablation were received a significantly higher number of radiofrequency applications during the procedure [5,6,12] which is against Wang et al who said that there were no significant differences between the groups in terms of number of applications of radiofrequency current. [7] In our study, there is statistically significant difference between two groups as regard fluoroscopy time as recurrence group has prolonged fluoroscopy time than no recurrence group which is against Wang et al and Dionne et al who said that there were no significant differences between the groups in terms of procedure time. [7,6]

The higher radiofrequency time and longer procedural duration are likely a reflection of the complexity of the ablation procedure and frequent number of ablations mostly associated with edema and tissue swelling prevent us from producing effective lesion and produce temporary inactivation of accessory pathway which present later as late recurrence.

5. CONCLUSION

The study revealed that the predictors of recurrence of accessory pathway conduction after successful ablation are: female gender, location of accessory pathway (incidence of recurrence increase in right sided accessory pathway), inducible AVRT (pre ablation) and inability to produce it after ablation are predictors for non-recurrence, using of irrigation system or not (incidence of recurrence decreases with irrigation) , a ERP or r ERP less than 250ms (increased risk of recurrence), longer fluoroscopy time or ablation time. (increased risk of recurrence) and ncreased number of ablation sessions. (increased risk of recurrence)

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