

High Risk Parahisian Pathways – Mid Septal and Anteroseptal: Feasibility, Advantages, Safety and Outcomes of Alternate Site Approach– A Single Centre Study

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ABSTRACT

Background: Radiofrequency catheter ablation is the treatment of choice for symptomatic accessory pathways (APs). Parahisian pathways – mid septal and anteroseptal APs are rare, but associated with lower success rates and higher incidence of atrioventricular (AV) block. Various techniques and approaches were explored to make the procedure, more safe and successful. Trans aortic cuspal approach, ventricular end ablation, catheter inversion technique, cryo-energy, superior approach and many more have been tried to make it safer. **Methods:** We present a case series of 12 patients with parahisian pathways, where in jugular or superior approach was used, and these pathways were mapped electrophysiologically and ablated successfully by radiofrequency catheter ablation (RFA) without any complications through jugular approach. **Results:** In all 12 patients, radiofrequency catheter ablation (RFA) of accessory pathways was done from jugular approach. The mean number of therapies required were 3(2 to 7). Mean procedure time of 43(20 to 120) min, mean fluoroscopy time of 11.6 (8 to 25) min. Not even a single patient had transient or permanent AV block. During a mean follow-up period of 24 (8-45) months, all 12 patients are asymptomatic without any symptoms, pre-excitation on ECG or documented arrhythmias. **Conclusion:** It is easier, safer and faster to ablate these accessory pathways from superior or jugular approach.

Key words: His Bundle Region, Internal jugular venous approach, Orthodromic Atrioventricular re-entrant tachycardia, Para hisian pathway, Radiofrequency catheter ablation.

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INTRODUCTION

Radiofrequency catheter ablation is the treatment of choice for accessory pathways (APs).^{1,2} Parahisian APs are luckily uncommon. Approximately they constitute 2-4.5% of the accessory pathways.²⁻⁶ These pathways can be suspected based on the specific electrocardiogram (ECG) criteria⁷ and can be confirmed by electrophysiological studies (EPS).⁸⁻⁹ The major problems associated with these pathways are, its closeness to his bundle (HB) region.^{5,10-11} Since they are close to HB region, they are associated with high risk of high grade AV block.^{6,12} Catheter stability is of foremost importance in the ablation of this pathways. Minimal movement of the catheter can damage HB, which is very close to parahisian pathways. Recurrence rate with parahisian pathway ablation is very high, upto the tune of 20%.^{2,4,12} To counteract the complications rate and lower long term success rate, various techniques and approaches have been tried. Transaortic approach from non-coronary or right coronary cusp,¹³⁻¹⁴ cryoablation, ventricular end of the accessory pathway ablation, superior approach has been tried with varied success.¹⁵⁻¹⁶ The approach from a superior location has been discussed briefly in the literature as early as in 1991 by jackman *et al.*¹ They described 13 cases of anteroseptal accessory pathways ablated by radiofrequency catheter ablation from a subclavian approach, changing to the traditional femoral approach in unsuccessful cases.¹ Brugada *et al.* argued that superior approach could be used, with a reasonable success rate than standard femoral approach in anteroseptal pathways.¹⁶ We present and discuss the feasibility, safety and success rate of jugular venous approach¹⁷ in these high risk APs.

MATERIAL AND METHODS

Patients

Among 61 patients of accessory pathways who underwent radiofrequency catheter ablation at our centre from january 2014 to june 2017,

12 patients (19.7%) had parahisian accessory pathways, relatively higher incidence, possibly a sample bias. This 12 patients had APs close to the HB, namely anteroseptal and midseptal, and underwent radiofrequency catheter ablation (RFA) (Figure 1). The patient's clinical characteristics are presented in Table 1. All 12 patients were symptomatic with either palpitations, dyspnoea, giddiness or syncope, and had documented narrow complex tachycardia. 11 out of the 12 patients had manifest pre-excitation on surface electrocardiogram and on EPS. 1 patient had concealed AP on EPS (Figure 3C). In 2 of the 12 patients, pathways were mapped electrophysiologically to parahisian area in a different hospital, and advised medical management inspite of recurrent symptoms on medications, because of high risk of high grade atrioventricular (AV) block (Figure 2). Out of 12 patients, 8 patients had anteroseptal accessory pathways, and rest 4 patients had midseptal accessory pathways (Table 1, Figure 1).

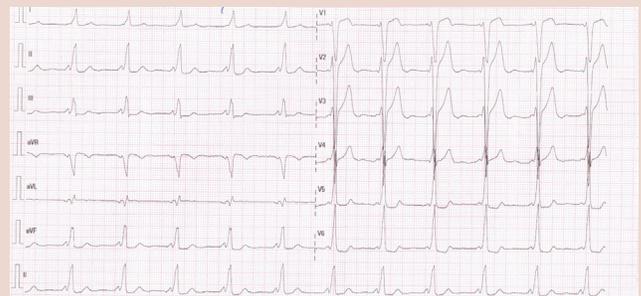


Figure 1: ECG of right anteroseptal accessory pathway.

Table 1: Procedure and Follow up.

	1	2	3	4	5	6	7	8	9	10	11	12
Age (years)	37	41	31	25	56	19	30	36	19	31	59	35
Gender	M	M	M	M	F	F	M	M	M	F	M	M
Procedure date	April 2014	May 2014	Mar 2015	Mar 2015	June 2015	June 2015	Aug 2015	Dec 2016	Jan 2017	April 2017	April 2017	May 2017
Diagnosis	WPW-AS	WPW-MS	WPW-AS	WPW-AS	WPW-AS	WPW-MS	WPW-MS	AVRT-AS	WPW-MS	WPW-AS	WPW-AS	WPW-AS
TCL	270	250	280	270	300	270	280	310	290	300	260	280
Fluoro time (min)	25	14	10	10	12	10	10	12	10	8	10	8
No of therapies	7	4	3	3	3	2	2	4	2	2	3	2
Procedure time (min)	120	60	30	45	30	30	45	45	30	30	20	30
Complications	None	None	None	None	None	None	None	None	None	None	None	None
Follow up (months)	45	43	34	34	31	27	27	13	12	9	9	8
Recurrence	None	None	None	None	None	None	None	None	None	None	None	None

AS-Anteroseptal pathway, AVRT-Atrioventricular re-entrant tachycardia, MS-Mid septal pathway, min-Time in min, months-Duration in months.

Electrophysiological study

After informed consent, explaining the risk of high grade AV block, patients were taken up for the procedure. Antiarrhythmic drugs including beta blockers or calcium channel blockers were discontinued for at least 4 drug half-lives. Both right femoral and right jugular venous approaches were taken. Catheters were positioned in posteroanterior, 30 degrees right anterior oblique (Figure 3B) and 45 degree left anterior oblique projections (Figure 3A).¹² Quadripolar catheter (6F Bard Viking) was placed in His bundle region from femoral approach. Decapolar coronary sinus (CS) (6F Response CSL™ St Judes Medical) catheter was placed into coronary sinus from jugular approach. Programmed atrial and ventricular stimulation was done according to standard protocol.² Orthodromic atrioventricular reentrant tachycardia (AVRT) was induced in all the cases (Figure 3C), standard EPS protocol was done to confirm the participation of the AP.² Tricuspid annulus was mapped in all the cases in both sinus rhythm and during tachyarrhythmia. In 3 cases, where tachyarrhythmia was transient, mapping was done during sinus

rhythm and ventricular pacing. In all 12 cases, APs were localized to parahisian region. It was divided into anteroseptal and midseptal pathways, based on location of the pathway in relation to His bundle. If the pathway is above or superior to HB, then named as anteroseptal.^{6,12,18} If the pathway is below or posterior to HB and anterior or superior to CS,



Figure 2: Demonstration of AV fusion in HB region during sinus rhythm on EP Study.

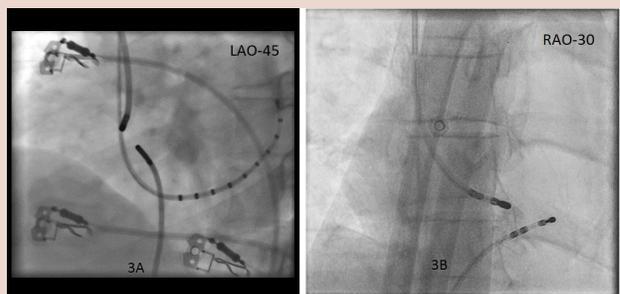
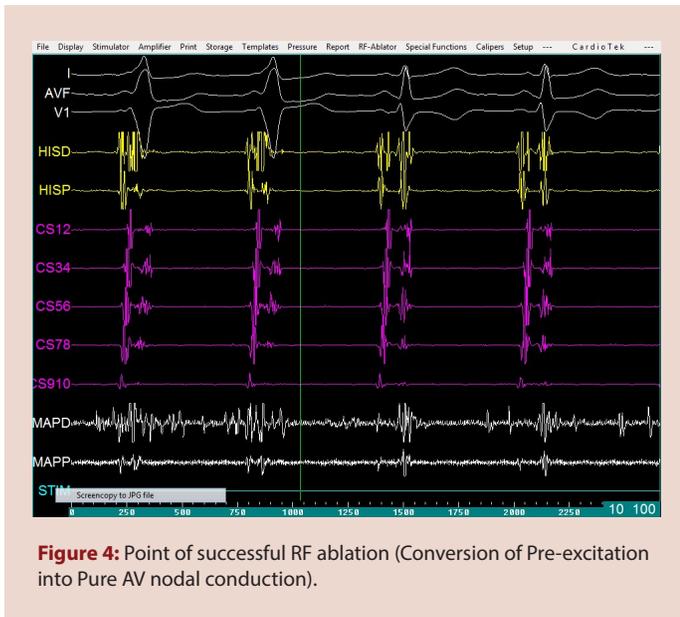


Figure 3A: RF ablation of anteroseptal accessory pathway from jugular approach in LAO view.

Figure 3B: RF ablation of anteroseptal accessory pathway from jugular approach in RAO view.

Figure 3C: Mapping of anteroseptal accessory pathway during AVRT.



then midseptal pathways.^{6,12,18} Details are given in Table 1. In all the 12 patients, HB catheter documented VA fusion during tachycardia (Figure 3C) and AV fusion in sinus rhythm (except 1 with concealed pathway). Accessory pathway was confirmed by standard criteria.^{1-3,12,19} 11 out of the 12 patients had antegrade pre-excitation (Figure 1,2). Antegrade pre-excitation was confirmed electrophysiologically by the presence of atrial and ventricular electrograms showing a rapid intrinsic deflection on the same recording, with either the presence of an electrogram (sharp deflection) compatible with an accessory-pathway potential located between the atrial and ventricular electrograms, or the recording of the intrinsic deflection of the ventricular electrogram before the onset of the delta wave on the surface electrogram atleast by 30milli sec with AV interval shorter than 40 milli sec.^{12,19} For all 12 patients, APs location was reconfirmed during ventricular pacing or reciprocating tachycardia by the presence of atrial and ventricular electrograms showing a rapid intrinsic deflection on the same recording, with earliest recorded atrial activation (Figure 3C).¹⁻³ After radiofrequency catheter ablation, the EPS was repeated after 30 min to confirm the absence of both antegrade and retrograde conduction.⁶ Disappearance of delta wave, prolongation of AV and VA intervals to normal physiological limits, non inducibility of tachyarrhythmia with programmed electrical stimulation, demonstration of bidirectional blockade by intravenous adenosine were considered as successful ablation (Figure 4).

Ablation technique

After ablation site was identified, in initial 2 patients, ablation was attempted from femoral side. However lots of difficulties were faced. Catheter position was not stable. Lot of catheter movements was noticed inspite of using SR sheath. Very first patient, had prolongation of AH interval, hence plan was to go with jugular approach first, if jugular approach was not successful then thought of going with aortic approach from aortic cusps. Mapping of the accessory pathways was done from jugular approach with smaller curve catheter (7F Celsius ablation catheter from Biosense Webster) (Figure 3A, 3B). Catheter looked very much stable in jugular approach. Location of the APs looked far from HB when mapping from jugular side than from femoral side. Distance on the fluoroscopy looked wider on jugular approach from HB, which gave more confidence to ablate (Figure 3A, 3B). Ablation from atrial side

targeted with AV ratio of 3 to 5. RF energy was delivered from jugular approach in a step wise manner. The temperature was limited to 40° C at the beginning in a temperature control mode,¹² (Cardiotek EP system made in Netherlands, Cordis-RF generator) followed by step wise increase by 10°C to maximum of 60°C. Power achieved during RFA was 35-50 watts. In case of successful ablation within 15 sec, the RF energy was applied for total of 60 sec monitoring AH interval, appearance of accelerated junctional rhythm. There was no prolongation of AH interval or accelerated junctional rhythm during procedure. Catheter position was very stable. In second case, initially tried with femoral approach. Similar difficulties were faced as in the first case. Hence went with jugular approach in a similar way as in first case. All subsequent parahisian pathways were approached from Jugular approach with no complications in a similar way. Fluoroscopy time, total procedure time was very short and presented in Table 1. After a successful ablation, patient was kept in EP lab for 30 min. Various Atrial and Ventricular programmed stimulation was done to check for the completeness of the procedure after 30 min of observation after ablation. Bidirectional AV blockade was demonstrated by intravenous adenosine in all the patients. All patients were discharged within 12h of the procedure with mean of 10 h. Long term follow included visits at 2 weeks, 3months and every 6 months thereafter.

RESULTS

Baseline electrophysiological study (EPS)

Orthodromic atrioventricular tachycardia (AVRT) (Figure 4) was induced in all 12 patients with mean cycle length of 280+/- 30ms. Antidromic tachycardia, atrial fibrillation (AF) or concomitant atrioventricular nodal re-entry tachycardia (AVNRT) was not induced in any of the 12 patients. The mean antegrade effective refractory period of the 11 manifest APs was 250+/- 40 msec. During baseline EPS, discrete his bundle (HB) potential was not documented because of AV fusion in 11 manifest APs (Figure 3C). His bundle potential could only be demonstrated by programmed electrical stimulation.

Procedure data

All 12 patients were ablated from jugular approach after localizing APs as per standard criteria (Figure 3A, 3B and 4).^{1-3,12,19} Catheter stability was good. There was no need for supporting sheath. The mean number of therapies required were 3 (2 to 7). Mean procedure time of 43(20 to 120) min +30 min for observation followed by EPS, mean fluoroscopy time of 11.6 (8 to 25) min. Not even a single patient had transient or permanent AV block. All patients had programmed atrial and ventricular stimulation as per standard protocol including demonstration of bidirectional blockade by intravenous adenosine after the procedure (30 min after RFA) to assess the completeness of ablation of APs.² There were no minor or major complications noted during periprocedure period.

Long- term follow up

During a mean follow-up period of 24 (8-45) months, all 12 patients are asymptomatic without any symptoms, pre-excitation on ECG or documented arrhythmias. No patients had transient or complete AV block. No local or systemic, minor or major complications were noted in the follow up period.

DISCUSSION

Radiofrequency catheter ablation is a well-established treatment modality for symptomatic accessory pathways.² Accessory pathways, located at anteroseptal or midseptal locations are quite rare.²⁻⁶ As these pathways are located anteriorly and medially, and close to HB, it is technically challenging to map this area and ablate. Anatomically these pathways are located from 12 o clock to 3 o clock position in left anterior oblique

fluoroscopy views. These pathways are very close to bundle of his.^{5,10-11} Major limitations during ablation of these pathways are its closeness to his bundle and catheter instability.²⁰ Unless we get good catheter stability, precise localization, less mechanical movement during RFA, chance of damaging bundle of His is high. From femoral approach, catheter may not be stable and co-axial. Contact force may not be good because of the catheter instability. Catheter course will be along the His bundle. We may need long sheaths, deflectable or steerable catheter. In spite of using long sheaths, steerable catheters, achieving catheter stability is difficult from femoral approach. Large case series reported by Kugler *et al.*²¹ showed lower peri-procedure success rate (79%) from femoral approach as against 94 to 96% by subclavian²² or jugular^{11,23} approach by different authors. However reported cases from jugular or subclavian approach are small in number. We used jugular approach in all our patients. Primary outcome of our study was success rate, which was seen in 100% of the procedures. Secondary outcome of our study was the recurrence rate and complication rates, major in the form of high grade AV block or minor in the form of vascular complications like hematoma, local or systemic bleed or thrombus formation, which was not seen in any of our patients. In our study, we could separate out site of accessory pathway from his bundle, in a better way than from jugular approach. We used non deflectable catheter which is financially more affordable. There was no requirement of long sheath. Fluoroscopy time was minimal. Contact force was good. No intraprocedural, post procedural, short term and long term complications noted in our series. Di Lorenzo MP *et al.*²³ findings also support our study findings suggesting jugular approach is feasible, safer and effective with less chance of complications in this subset of accessory pathways. The use of cryotherapy should decrease the risk of AV nodal injury and heart block, but the acute and long-term success rates are significantly lower than with the use of RFA. Tuzcu *et al.* reported acute success of 73%, with cryotherapy, with a recurrence rate of 24%.²⁴ The approach from the non-coronary cusp has also been described for anteroseptal pathways.²⁵ This approach, however, involves accessing the femoral artery, theoretical possibility of injuring coronary vessel.²⁵ In addition, the potential long-term effects of ablating in this area has not been studied. Overall decrease in fluoro time, better stability, co axialness of the catheter, better contact force, better separation of point of ablation from bundle of his region, fast ablation and procedure time and good long term success rate would prefer jugular over femoral approach as the modality of approach in accessory pathways associated with parahisian region-antero-septal or mid septal.

Limitations of the study

Number of patients in this study is small. It is an observational study. Direct comparison of jugular with femoral approach was not done. Irrigation catheter or deflectable catheters were not used because of financial reasons. Contact force of the catheter was not measured. Prospective, randomised study, comparing jugular and femoral approach is essential to better answer the merits and demerits of this approach.

CONCLUSION

Parahisian, right antero-septal or mid-septal accessory pathways can be safely ablated from superior or jugular venous approach, with higher success rate, lower complications rate and good long term outcome.

CONFLICT OF INTEREST

The authors have none to declare.

ABBREVIATIONS

AF: Atrial Fibrillation; **AH:** “A” to “H” interval; **APs:** Accessory Pathways; **AV:** Atrio-ventricular; **AVRT:** Atrioventricular re-entrant tachycardia;

AVNRT: Atrioventricular nodal re-entry tachycardia; **ECG:** Electrocardiogram; **EPS:** Electrophysiological studies; **HB:** His bundle; **IJV:** Internal jugular vein; **RFA:** Radiofrequency catheter ablation; **VA:** Ventriculo-atrial.

SUMMARY

Radio frequency catheter ablation of parahisian accessory pathways are associated with lower success rates and higher incidence of atrioventricular block. Various techniques and approaches were explored to make the procedure, more safe and successful. Trans aortic cuspal approach, ventricular end ablation, catheter inversion technique, cryo-energy, superior approach and many more have been tried to make it safer. We demonstrate in our study that, these accessory pathways can be safely ablated from superior or jugular venous approach, with higher success rate, lower complications rate and good long term outcome.

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