ORIGINAL ARTICLE

CROSS OVER: A RELIABLE MANEUVER IN THE CONFIRMATION OF ATRIOVENTRICULAR NODAL REENTRANT TACHYCARDIA ABLATION

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Background: Atrioventricular nodal re-entrant tachycardia (AVNRT) is still the most common presentation to our electrophysiology laboratory for ablation. The aim of this study is to document the confirmative value of cross over manoeuvre in successful AVNRT ablation. **Methods:** This study was conducted in Hayat Abad Medical complex Peshawar June 2006 to October 2015. In all patient with AVNRT, Dual-nodal pathway physiology confirmed by programmed atrial pacing of eight Tran with an extra beat by 10 millisecond (ms) decrement and at least Atrial HIS (A-H) interval prolongation of 50 ms. The dual pathway was further confirmed by cross over manoeuvre. Slow pathway potential identified and radiofrequency ablation (RFA) energy applied at 60 temperatures and 30 powers in Left Anterior Oblique (LAO) projection. Post ablation absence of cross over documented with and without isoproterenol and patient followed for any complication or recurrence. **Results:** Total 567 patients studied with mean age 36.56±12.16 and male to female ratio 1:1.4 with presentation of supra-ventricular tachycardia (SVT). Slow pathway was successfully modified and statistically no significant complication or recurrence documented. **Conclusion:** Failure to cross over reliably excludes any conduction over the slow pathway and so recurrence of AVNRT.

Keywords: Atrioventricular nodal re-entrant tachycardia; AVNRT; Supra-ventricular tachycardia; SVT; Radiofrequency ablation; Dual nodal pathway; Physiology

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INTRODUCTION

Supra-ventricular tachycardia (SVT) was the most common arrhythmic[1] presentation to electrophysiology laboratory for radiofrequency catheter ablation in the past two decades. About 50–90% of SVTs are AVNRT in our laboratory though the scenario is changed in the rest of the world particularly developed countries where Atial fibrillation is the commonest presentation to electrophysiologist.[2] AVNRT is a diagnosis of exclusion. There is no single confirmatory test or finding in the laboratory to confirm the diagnosis.[3,4] Dual Atrioventricular (AV) node physiology is found in most individuals but the incidence and prevalence of AVNRT cannot be predicted in all those with dual node physiology[5]. Patients who present to laboratory for the ablation of AVNRT, it is confirmed by excluding all other SVTs, i.e., atrial tachycardia, SVT due to concealed pathway, junctional tachycardia or sinus node re-entrant tachycardia by different electrophysiology manoeuvres. Once it is confirmed that the presenting tachycardia is AVNRT, the typical presentation in the laboratory is shown in figure-1, then the next step is to successfully modified the slow pathway so that no re-entry of current is possible in the antegrade or retrograde direction but at the same time taking care to avoid injury to fast pathway so to prevent complete heart block.[6] The ablation is done at location where slow pathway potential is found and no tachycardia could be induced after ablation.[7] Most of the time, due to acute injury and oedema during ablation, tachycardia is suppressed for a while but it recurs when the acute phase passes.[8] So at time the decision become difficult to call the procedure successful and stop the ablation. Post ablation different manoeuvres are applied to declare the procedure successful and still avoid any complication. We conducted this study to document the efficacy and reliability of the cross over manoeuvre for successful ablation of AVNRT and reduce the chance of recurrence.

MATERIAL AND METHODS

This cross-sectional study was conducted in Hayat Abad Medical Complex Peshawar electrophysiology department. All patient who presented to hospital for recurrent SVT were included in the study, patients who were not willing for procedure or they were in need of any anti arrhythmic drugs for any other reasons were excluded from the study. Base line characteristics tabulated in table-1. All candidates had base line investigation including full blood count, virology; random blood sugar renal profile and serum electrolytes. Premedication for procedure were alprazolam 0.5 mg at night of procedure and 0.25 mg on the morning of procedure. Most of the patients were not given any intravenous analgesia. Patients were kept nil by mouth in the morning and informed consent obtained. Under local anaesthesia with 2% lignocain catheter were introduced from both femoral veins. We usually introduce right atrial and right ventricular catheters from right femoral vein and HIS and coronary sinus (CS) catheter from the left femoral vein for electrophysiology study (EP). The ablation catheter is also introduced from the right femoral vein. The study was conducted on

Bard and St: Jude's workMate EP system. We start our study with ventricular pacing to rule out any left sided pathway and then documented dual node physiology by extra atrial stim. When there is ≥50 ms increase in atrial HIS interval with a decrement of 10 ms in the extra coupling interval, it is declared as dual node physiology. To reconfirm we performed the cross over manoeuvre for which we burst paced the right atria with continuously reducing the cycle length until the fast pathway was blocked and the conduction went through the slow pathway and conducted down to the ventricle. The signal from the atrial and ventricular catheter are put closed to each other's and when the signal block in fast pathway and pass through the slow pathway its ventricular signal will be lag behind the following atrial signal and will look like as if there are two atrial signals and the ventricular signal just crossing the second atrial signal figure-3. As opposite to the complete blocked signal figure-2, where the first beat will not be followed by a ventricular signal and the second beat will be followed by a ventricular beat which will be at a same interval as a conducted beat before block. After confirmation of dual node physiology, the AVNRT was confirmed by parahisian pacing, HIS refractory premature ventricular contraction (PVC), early PVC, HIS refractory premature atrial contraction (PAC), early PAC, Morady manoeuvre, post pacing interval and dissociation of circuit from atria and ventricle. Once the diagnosis was confirmed the slow pathway potential identified and the area ablated with 60 Celsius temperatures and 30–40 watts power. The ablation point was declared right one if there was induction of slow junctional rhythm during application of radiofrequency energy and subsequently no tachycardia could be induced. If for any reason we failed to document good slow junctional rhythm during ablation and beside failure to induce tachycardia with all inducing manoeuvres, we repeated the cross over manoeuvre and if there was no cross over we concluded that the ablation is successful for typical AVNRT. If the study was started with isoproterenol the same was used after the ablation but if the initial documentation was without isoproterenol the study was declare successful without isoproterenol in most of the time except in few cases where we had a difficult ablation or there was history of previous ablation for AVNRT then in that case isoproterenol was used to see for possible induction of AVNRT. Patients were mobilized after 4–6 hour of procedure and were discharge from the hospital next morning after having a bedside echocardiography examination.

RESULTS

There were total 567 cases during our study period. The basic characteristics are shown in the table. Mean Age of the study population was 36.56±12.16 and male were 40.6% and female 59.4%. The average rate of episode of tachycardia before ablation remains 3.26±1.14 per month in all patients who came for ablation. Dual node physiology was documented in all patients and cross over demonstrated. Tachycardia was induced with burst pacing or Atrial Extra Stim (AEST).

Table-1: Basic characteristics

Total cases	567
Male	230 (40.6)
Female	337 (59.4)
Age	36.56±12.16
Episodes of tachycardia per month	3.26±1.14
Dual node physiology	512
Cross over after ablation	84
No cross over after ablation	483
Total recurrence within first year	5
Recurrence in cases with cross over after ablation	3
Recurrence in cases with no cross over after ablation	2
***p*-value**	0.004
Ablation time	1–5±0.794 (mean 3.78)

Figure-1: Induction of AVNRT with atrial burst pacing

Figure-2: AV block after successful ablation

Figure-3: Cross over after partial ablation

During ablation, junctional rhythm was achieved in 98.4% patients. In the remaining 1.6% patients, the kocks triangle anatomy was difficult and the position of ablation catheter was not very much ideal. So, the ablation was done at a higher level and after each ablation tachycardia was induced and procedure repeated until no more tachycardia could be induced with and without isoproterenol. 60% patients received isoproterenol before and after the ablation, and 20% of the patients were given the drug only after ablation because their tachycardia was inducible without isoproterenol before ablation and the ablation site was not ideal but after ablation tachycardia was not inducible so they were given the drug to avoid any chance of recurrence. In two patients, there was a pouch on the inter-atrial septum so during mapping we got very good signal to deliver ablation energy but as the catheter used to fall in the pouch the impedance used to jump very high and the ablation generator stopped to deliver energy. And so, the position of the catheter was shifted to the mid-septal position for ablation and they were successfully ablated. Of 567 patients 85.2% revealed no cross over after ablation and 14.8% there was cross over but only 0.9% recurrence rate after one year and the *p*-value remain 0.004%. These cases were successfully ablated again and no further episode was documented. There was two documented case of complete atrio-ventricular (AV) block and they were implanted permanent pacemaker then. One case of 1st degree block was documented and the patient remained asymptomatic. One lady who was obese and whose procedure was prolonged had pulmonary embolism and she did not recover from that.

DISCUSSION

Atrioventricular nodal re-entrant tachycardia is the most frequent presentation of symptomatic tachycardia[1] to the general cardiologist in common and electro physiologist in particular. The acute episode of tachycardia can be terminated by physical manoeuvres like Valsalva, immersion of face in cold water or carotid sinus massage.[9] Pill in pocket approach of Verapamil or propranolol is another way for the termination of an episode or the patient can be kept on beta blockers or calcium channel blockers as a preventive therapy lifelong.[10,11] In very rare condition when the patient is getting unstable, he or she can be DC cardioverted.[12] All these measures subside an acute episode in most of the cases but it is not the cure because the next episode may be in the next few minutes or months to years cannot be predicted.

Radiofrequency ablation is the only permanent cure for patients with AVNRT.[13] But the big problem with this tachycardia is its diagnosis and differentiation from other form of supraventricular tachycardia. There is no single indicator to till us the diagnosis or differentiate the tachycardia from other SVTs.[14] Even after ablation, on resting ECG, there is no end point for stopping the ablation. In most laboratory ablation of the AV nodal slow pathway is performed with the goal of eliminating tachycardia, AH jump, and retrograde atrial echo beats and the endpoint is freedom of recurrent supraventricular tachycardia at follow-up.[1] But there is about 1.5–5.2% chance of recurrence in most of the studies.[16–18] Moreover the end point of the procedure, failure to induced the tachycardia at the time of study, by itself is not very reliable because if the delivery of ablation energy is suboptimal there is oedema at the site of ablation which transiently block the conduction through the conducting system of the heart and when oedema subsides after a while there is recurrence.[19] Sometime the lesion of ablation is suboptimal and again the system stop conducting but when there is sympathetic activation the partially modified slow pathway is competent again and the patients become symptomatic.[20] So still there is a room for research to find ways and means for declaring the completion of a successful procedure and minimize the chance of recurrence on one side and the possibility of avoiding complication on the other side. Besides documenting block and failure to induce tachycardia we used the cross over to call it a day.

By doing so, the chance of recurrence in our study was much lower than other studies. Also by keeping the ablation to the minimal possible limit the complication rate was much less than other studies. The reported rate of complete AV block is 1.2–1.35%.[21,22] We had two complete AV block during our study about 0.35% and the patient was implanted permanent pacemaker (PPM) then. They are in our follow up and fully dependent on PPM. One case of first degree block was documented in the study population. Patient was asymptomatic and no arrhythmia was reported then. One of our patients who were an obese lady had an abnormally prolonged procedure, she reported breathlessness after a week of the procedure and then she had sudden collapsed and expired after a week she reported dyspnoea and the cause of death was possibly pulmonary embolism, though no post-mortem was done. There were 3 cases of recurrence which were successfully ablated again without any complication, though high-risk consent was taken for AV blocks. No other major complication or bleeding was noted during the study period.

I think that still it is not the end of the story. Like the diagnosis of AVNRT which by itself is the diagnosis of exclusion so is the treatment and the declaration of cure, but we can add to maximize the

success and minimize the recurrence rate and complication by different manoeuvres and there should be no short cuts in the ablation of AVNRT.

CONCLUSION

Failure to cross over is a reproducible manoeuvre in the ablation of AVNRT. It helps to reduce the rate of recurrence and document the success of ablation for modification of slow pathway. At the same time by timely indicating successful ablation the complication can be avoided by not further Appling the ablation energy.

AUTHORS' CONTRIBUTION

BS: Conceived the topic of research and designed the study, Literature review and manuscript writing. SS: Proof reading. ZAA: Supervised the study, approved the final manuscript.

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