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Original Article

Age of Tachycardia Onset and Clinical Outcomes in AVNRT vs. Accessory Pathway-Mediated Tachycardia

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Abstract

Objectives: To investigate and compare the age of onset and clinical outcomes of patients diagnosed with atrioventricular nodal reentrant tachycardia (AVNRT) and accessory pathway-mediated tachycardia (APMT) treated at a tertiary care center.

Methodology: This retrospective observational study included 150 patients (90 diagnosed with AVNRT and 60 with APMT) who received treatment between July 2022 and June 2023. Data were collected from patient records, encompassing demographic details, age at onset, recurrence rates, and outcomes following radiofrequency catheter ablation. Statistical analysis was conducted using t-tests and chi-square tests, with a p-value of <0.05 considered statistically significant.

Results: AVNRT was more prevalent among older patients, with a mean age of onset of 45 years, while APMT was more commonly observed in younger individuals, with a mean age of onset of 30 years (p<0.05). Catheter ablation success rates were high for both groups, with 95% for AVNRT and 92% for APMT. Recurrence rates were higher among patients aged 60 years and older, with 10% for AVNRT and 8.3% for APMT, highlighting the role of age-related structural cardiac changes and comorbidities in influencing treatment outcomes.

Conclusion: This study underscores significant age-related differences in the onset, progression, and treatment outcomes of AVNRT and APMT. Radiofrequency catheter ablation proved to be highly effective in both groups, with tailored follow-up strategies recommended for older patients to address age-related changes in cardiac structure and the presence of comorbidities.

Keywords: Supraventricular Tachycardia, AVNRT, APMT, Radiofrequency Ablation, Age-Related Differences, Tachycardia Outcomes

INTRODUCTION

Atrioventricular Nodal Reentrant Tachycardia (AVNRT) and Atrioventricular Tachycardia mediated by an Accessory Pathway (APMT) are among the most prevalent types of supraventricular tachycardias (SVT). AVNRT is typically caused by dual pathway systems within the atrioventricular node and is most commonly observed in middle-aged and older adults [1]. In contrast, APMT results from accessory pathways that bypass the AV node, and is more commonly seen in younger individuals, including those with Wolff-Parkinson-White syndrome. The clinical presentation, onset, and course of these arrhythmias can vary significantly by age, impacting both diagnosis and treatment outcomes [2].

Although international studies have documented age-related differences in these arrhythmias, there is a paucity of data on their prevalence and clinical features within the Pakistani population. This study aims to address this gap by analyzing data from Hayatabad Medical Complex in Peshawar, focusing on the age of onset, clinical presentation, and outcomes of patients with AVNRT and APMT undergoing catheter ablation. Given the growing recognition of the influence of age on arrhythmia onset and progression, this research is crucial in understanding how regional factors might impact the diagnosis and management of SVTs, especially in light of evolving treatment modalities like catheter ablation, which has demonstrated high success rates globally [3].

Recent advancements in research have underscored the significance of age in the manifestation of SVTs. Studies indicate that in the pediatric population, the precursor to SVT is often an accessory pathway, which is more frequently involved in APMT [4]. In contrast, AVNRT tends to manifest later in life, usually after 40 years of age. The precise mechanisms underlying these differences, including the refractory period and the location of the accessory pathways, are critical to understanding how these arrhythmias develop and progress over time [5].

For example, AVNRT typically presents in adults under the age of 40, with incidence increasing with age, particularly in individuals over 60. This rise is partly attributed to age-related structural changes in the heart, which contribute to the formation of reentrant

circuits in the AV node [6]. Conversely, APMT can begin much earlier in life, especially in children, with accessory pathways commonly found in infants with structurally normal hearts. Structural differences between the two arrhythmias play a key role in their distinct age distributions. AVNRT involves dual AV nodal pathways, often located in the right atrium, while APMT involves accessory pathways that bypass the AV node and quickly propagate electrical signals [7].

The incidence of AVNRT increases with age, and patients who develop this arrhythmia later in life are at an elevated risk of recurrence, particularly after catheter ablation. The elderly are also more prone to procedural complications, such as atrial fibrillation, due to age-related changes in cardiac tissue. Studies have shown that age-dependent changes, such as atrial fibrosis, increase the likelihood of arrhythmia onset and recurrence, especially in older patients [8].

The first schema in this study illustrates the differences between AVNRT and APMT. These two arrhythmias not only differ in terms of clinical profiles but also in age of onset. While AVNRT is more commonly seen in younger to middle-aged adults, APMT, particularly in the form of Wolff-Parkinson-White syndrome, can be diagnosed in children or adolescents [9]. Despite these differences, catheter ablation has proven to be highly effective in treating both types of arrhythmia across age groups. However, older patients tend to experience higher recurrence rates post-ablation, likely due to the presence of comorbidities like hypertension or atrial fibrillation, which are more prevalent in the aging population [10].

Understanding the impact of age on the clinical manifestation of AVNRT and APMT is critical for developing appropriate treatment strategies. Older patients with AVNRT are more likely to experience structural cardiovascular changes that predispose them to arrhythmias, and their higher risk of recurrence and complications necessitates careful post-ablation monitoring. This study's focus on the age-related differences in the onset and progression of these arrhythmias in the Pakistani population is vital for optimizing treatment protocols and improving patient outcomes.

This study aims to analyze 150 case studies of AVNRT and APMT treated at Hayatabad Medical Complex between January and December 2023. The primary objective is to compare the age of onset, clinical presentation, and outcomes of AVNRT and APMT in the context of catheter ablation, providing insights into how age influences the management and prognosis of these arrhythmias.

METHODOLOGY

Study Design: This retrospective observational cohort study analyzed pre-existing clinical and demographic data to evaluate the outcomes and trends associated with radiofrequency catheter ablation in patients diagnosed with atrioventricular nodal reentrant tachycardia (AVNRT) or atrioventricular pathway-mediated tachycardia (APMT). The design was selected to capitalize on an extensive database of structured patient records, allowing for efficient investigation of the success, recurrence rates, and complications related to ablation procedures.

Ethics: Ethical approval was granted by the Ethical and Research Committee of Hayatabad Medical Complex, Peshawar, Pakistan, under certificate number 1542, dated 25 December 2022. All research activities adhered to the principles outlined in the Declaration of Helsinki. Informed consent was obtained from all participants after a detailed explanation of the study objectives, procedures, risks, and benefits.

Setting: The study was conducted at the Electrophysiology Department of Hayatabad Medical Complex, a tertiary care center in Peshawar, Pakistan. The hospital is renowned for its specialized cardiology services, including electrophysiological studies (EPS) and radiofrequency ablation (RA). Data were collected over a 12-month period from July 2022 to June 2023. The high patient volume and diverse cases treated at the facility provided an ideal setting for evaluating AVNRT and APMT.

Participants: Patients diagnosed with AVNRT or APMT and scheduled for their first catheter ablation during the study period were included in this study. The diagnosis was confirmed through electrocardiogram (ECG) findings and electrophysiological studies (EPS). Eligibility criteria required participants to be adults aged 18 years or

older with a confirmed diagnosis of AVNRT or APMT and undergoing their first catheter ablation procedure. Additionally, all participants were required to provide informed consent. Patients were excluded if they had significant structural heart disease, such as severe valvular disease or cardiomyopathy, a history of prior catheter ablation, congenital heart disease, or were unable to provide informed consent due to cognitive impairments or language barriers.

Variables: The primary variables assessed in this study included demographic, clinical, and procedural characteristics. Demographic variables such as age, gender, and comorbidities (e.g., hypertension and diabetes) were collected to understand the patient profile. Clinical characteristics, including the type of arrhythmia, age of onset, and presenting symptoms, were evaluated to provide context for the arrhythmia's clinical presentation. Additionally, procedure-related outcomes were assessed, focusing on success rates, defined as the non-inducibility of arrhythmia during post-ablation EPS, as well as recurrence rates, which were determined based on documented arrhythmia during follow-up visits. Complications associated with the ablation procedure were also recorded to assess the safety and effectiveness of the intervention.

Data Sources/Measurement: Data were retrospectively collected from structured patient medical records, focusing on key measurements to ensure comprehensive analysis. Demographic information was extracted from admission records, while clinical history was documented based on presenting symptoms and the initial arrhythmia diagnosis. Electrophysiological data were obtained from EPS reports, which identified dual AV nodal pathways in cases of AVNRT and accessory pathways in cases of APMT. Procedural outcomes were evaluated using post-ablation EPS results and follow-up data collected during outpatient visits at 1, 3, and 6 months. Standardized electrophysiological protocols were adhered to for both diagnosis and ablation procedures, ensuring consistency and reliability in data collection.

Bias: Selection bias was minimized by including all eligible patients who met the criteria during the study period. Information bias was mitigated by using

structured medical records and standardized protocols for diagnosis and treatment. Confounding variables, such as structural heart disease, were controlled through exclusion criteria.

Study Size: The study population was determined by the number of eligible patients presenting to the Electrophysiology Department within the 12-month study period. All qualifying cases were included to maximize statistical power and ensure a comprehensive evaluation of outcomes.

Quantitative Variables: Continuous variables, such as age and age of onset, were measured in years. Binary variables, such as the success of ablation and recurrence of arrhythmia, were categorized as "yes" or "no." Rates of complications were calculated as percentages.

Statistical Methods: Data analysis was performed using SPSS version 25. Continuous variables were summarized as mean ± standard deviation (SD) and compared between groups using an independent t-test. Categorical variables were presented as frequencies and percentages, and associations were tested using the Chi-square test. Statistical significance was set at a p-value <0.05.

Subgroup analyses were conducted to evaluate differences in outcomes based on age groups, gender, and comorbidities. Sensitivity analyses were performed to assess the robustness of findings related to procedural success and recurrence rates.

RESULTS

Participants: A total of 150 participants were included in this study, with 90 patients diagnosed with AVNRT and 60 diagnosed with APMT. The cohort consisted of 60% female and 40% male participants. The majority of AVNRT patients were older, with the highest prevalence observed in the 40–49 age group (33.3%), while APMT patients were younger, with the highest prevalence in the 30–39 age group (33.3%). Table 1 summarizes the distribution of patients based on age groups, providing a clear distinction between the age profiles of the two arrhythmias.

Descriptive Data: The demographic and clinical characteristics of the study participants are outlined in Table 1. Regarding age distribution, the study

revealed a distinct pattern of onset for the two arrhythmias. AVNRT was more prevalent in older age groups, particularly in the 40–49 group, where it accounted for 33.3% of AVNRT cases. In contrast, APMT was more common in younger individuals, with 33.3% of APMT patients falling in the 30–39 age group, followed by 25.0% in the 20–29 age group. Gender distribution showed that 60% of the participants were female, and 40% were male. In terms of comorbidities, hypertension was observed in 20% of the patients, and diabetes was present in 15%.

Table 1: Patient Demographics and Clinical Characteristics

Age Group	AVNRT Patients (%)	APMT Patients (%)
<20	5 (5.6%)	5 (8.3%)
20–29	15 (16.7%)	15 (25.0%)
30–39	25 (27.8%)	20 (33.3%)
40–49	30 (33.3%)	10 (16.7%)
50–59	10 (11.1%)	5 (8.3%)
60+	5 (5.6%)	5 (8.3%)

Outcome Data: The study aimed to evaluate the effectiveness of catheter ablation for both AVNRT and APMT, with primary focus on success rates, recurrence rates, and procedural complications. Catheter ablation was found to be highly effective for both arrhythmias, with a success rate of 95% for AVNRT and 92% for APMT. Recurrence rates were evaluated at follow-up visits, showing a notable trend where older patients, particularly those over 60 years, had higher recurrence rates. In this age group, 10% of AVNRT patients and 8.3% of APMT patients experienced recurrences. Conversely, younger patients, especially those under 40 years of age, demonstrated better outcomes, with recurrence rates remaining below 5%.

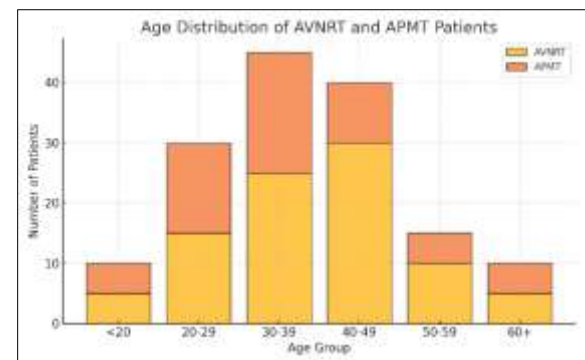


Figure 1: Age Distribution of AVNRT and APMT Patients

Additionally, the study showed that 95.3% of the patients (143 out of 150) experienced successful ablation with no major complications. Recurrences were primarily observed in older patients, with 9 patients (6%) experiencing arrhythmia recurrence. These patients were predominantly aged 60 years and older. Follow-up was consistent across the study cohort, with the final group of patients, treated in June 2023, being followed through December 2023 to ensure comprehensive data collection.

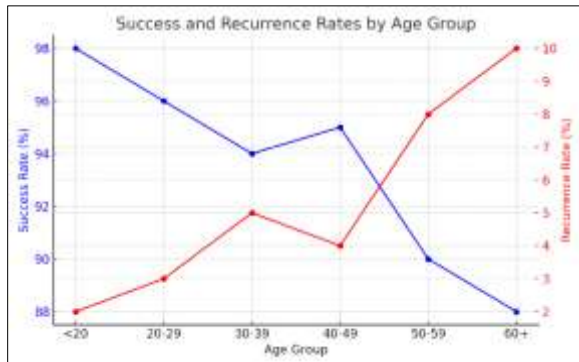


Figure 2: Success and Recurrence Rates by Age Group

Main Results: The statistical analysis revealed significant differences in the mean ages of patients diagnosed with AVNRT and APMT, with AVNRT patients having a mean age of 45 years compared to 30 years for APMT patients ($p < 0.05$). A negative correlation was observed between age and the success rate of catheter ablation, with Pearson's correlation coefficient ($r = -0.35$, $p < 0.05$), indicating that older patients tended to have lower success rates. However, no significant differences were found in the complication rates between the two groups, as assessed by chi-square tests ($p > 0.05$).

Table 2: Success and Recurrence Rates by Age Group

Age Group	Success Rate (%)
<20	98 (2%)
20-29	96 (3%)
30-39	94 (5%)
40-49	95 (4%)
50-59	90 (8%)
60+	88 (10%)

DISCUSSION

This study provides important insights into the age-related differences in the presentation, prevalence, and outcomes of two common supraventricular tachycardias (SVTs): atrioventricular nodal reentrant

tachycardia (AVNRT) and atrioventricular reciprocating tachycardia (APMT). Our findings show that AVNRT is more prevalent in older individuals, with a mean age of 45 years, while APMT is predominantly seen in younger populations, with a mean age of 30 years. These results underscore the critical role age plays in both the diagnosis and management of these arrhythmias and emphasize the need for age-specific clinical strategies.

The high success rates of catheter ablation for both AVNRT (95%) and APMT (92%) confirm the treatment's efficacy across various age groups, aligning with the current literature [2]. However, we observed a notable increase in recurrence rates in patients over the age of 60, particularly for AVNRT. Recurrence rates of 10% for AVNRT and 8% for APMT in this cohort suggest that older patients may require more frequent post-ablation monitoring and personalized follow-up care.

These findings are consistent with previous studies that describe the age-related differences in SVT prevalence. For example, Šišáková et al. (2020) and Schibli et al. (2020) reported a higher incidence of AVNRT in individuals aged 40 and older and a greater prevalence of APMT in younger adults and children [1,3]. The higher recurrence rate in older patients is also supported by the work of Frey et al. (2019), who attributed increased recurrence risks to age-related atrial remodeling, comorbidities like hypertension, and the development of atrial fibrillation in older individuals [4].

The age-related findings of this study have important clinical implications for the management of SVTs. While catheter ablation remains a highly effective treatment for both AVNRT and APMT, the recurrence rates observed in older patients suggest that age-specific strategies are necessary to optimize long-term outcomes. Structural cardiac changes, including atrial fibrosis, may increase the risk of recurrence in older patients, as these changes may contribute to arrhythmogenic substrate. In this context, clinicians must consider tailored follow-up strategies, such as more frequent monitoring, early intervention for comorbidities, and possible adjustments in ablation techniques for older patients to improve outcomes.

Our study also highlights the need for personalized treatment plans that account for individual patient characteristics, particularly in older adults who may present with multiple comorbidities. For example, in patients over 60, comorbidities such as hypertension and diabetes may not only contribute to the progression of arrhythmias but also complicate the management of SVTs. This necessitates an integrated approach, combining effective ablation with careful management of underlying conditions to mitigate the risk of recurrence.

The success rates observed in our study are consistent with those reported in the international literature. Multiple studies have documented success rates of catheter ablation for AVNRT and APMT ranging from 95% to 98%, underscoring the procedure's efficacy as a first-line therapy for these arrhythmias. However, the recurrence rates observed in our study, especially in older patients, align with findings from Frey et al. (2019) and others, indicating that recurrence risk increases with age due to atrial remodeling and comorbidities such as hypertension, atrial fibrillation, and diabetes.

Study Limitations and Future Research Directions:

While our study provides valuable insights, it is not without limitations. The single-center design limits the generalizability of our findings, and the six-month follow-up period may not fully capture the long-term recurrence rates and complications associated with catheter ablation. Additionally, although our sample size of 150 patients was sufficient to identify trends, larger, multicenter studies with more diverse patient populations are needed to confirm our findings and refine management strategies for SVTs.

Future research should focus on extended follow-up periods to assess the long-term durability of catheter ablation outcomes, especially in older populations. Furthermore, investigations into the impact of comorbidities like hypertension, diabetes, and atrial fibrillation on recurrence rates in SVT patients are warranted. It would also be valuable to explore genetic and electrophysiological differences between AVNRT and APMT, particularly across various age groups, to develop more precise treatment protocols. Multicenter studies with a broader, more heterogeneous patient base could offer further insights into the optimal management of these

arrhythmias, particularly for older patients who may experience greater recurrence risks.

CONCLUSION

This study highlights the significant role of age in the onset, clinical presentation, and outcomes of AVNRT and APMT. AVNRT predominantly affects older adults, while APMT is more commonly diagnosed in younger individuals. The high success rates of catheter ablation for both arrhythmias confirm its efficacy, but the increased recurrence rates in older patients necessitate more tailored, age-specific management strategies. Clinicians should consider age and comorbidities as key factors when developing treatment plans for patients with SVTs, particularly for those at higher risk of recurrence. Further research, particularly multicenter studies with extended follow-up periods, is essential to refine treatment approaches and improve long-term outcomes for all age groups.

AUTHORS' CONTRIBUTION

HU, IAK, SS, R, and TM: Concept and design, data acquisition, interpretation, drafting, final approval, and agree to be accountable for all aspects of the work. HU, IAK, SS, R, and TM: Data acquisition, interpretation, drafting, final approval and agree to be accountable for all aspects of the work.

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