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Efficacy of Arruda Algorithm for Localization of Accessory Pathway in Patients with Wolff-Parkinson-White Syndrome from The Surface ECG

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ABSTRACT

Background: In Wolff-Parkinson-White (WPW) syndrome, Accessory pathway can be localized from surface Electrocardiogram (ECG) using different algorithm. Arruda algorithm is established and clinically tested localization method which uses initial 20 milliseconds of preexcitation in 5 leads (I, II, III, aVF and V1) of standard 12 lead ECG.

Methods: A hospital based observational study was conducted in 54 patients with WPW syndrome from April, 2023 to January, 2024 in Shahid Gangalal National Heart Centre. Data on demographics, clinical features, ECG localization using Arruda algorithm and Electrophysiological localizations of accessory pathway were collected through structured proforma and predictive accuracy of Arruda algorithm was determined. Statistical analysis was done using the SPSS version 16 software.

Results: The mean age of patients was 36.39±13.99 years, with maximum number of patients from 20-45 years of age group. 57.4% were male and the most common pathway being left lateral/ anterolateral. Arruda algorithm accurately localized accessory pathway in 90.7% (n=49) of patients. The overall sensitivity and specificity of the Arruda algorithm to exactly localize accessory pathway in WPW syndrome was 88.1% and 98.7% respectively.

Conclusion: Arruda algorithm is sensitive and specific to localize accessory pathway in patients with WPW syndrome undergoing electrophysiological study and radiofrequency ablation.

Keywords: accessory pathway; Arruda algorithm; electrocardiogram; radiofrequency ablation; Wolff- Parkinson-White syndrome.

INTRODUCTION

In WPW syndrome, manifest accessory pathway is present resulting in pre-excitation in resting ECG along with recurrent arrhythmias.[1] Catheter ablation is the main stay of therapy in symptomatic and recurrent atrioventricular reentrant tachycardia.[2,3] Different ECG algorithms based on delta wave vector are available for predicting likely anatomic location of the accessory pathway.[4] The Arruda algorithm is clinically tested localization method using 5 leads (I, II, III, aVF and V1) of standard 12 lead ECG and polarity of delta wave is measured within initial 20ms of the preexcitation and classified as positive (+), negative (-) or isoelectric (±).[5,6] Surface ECG localization of accessory pathway reduces the search time for pathway which in turn would reduce the procedure time and complications and also help for planning the procedure either to perform inter atrial septal puncture or the arterial puncture in left sided pathway. This study aims to find out the efficacy of Arruda algorithm among Nepalese population for the localization of accessory pathway undergoing electrophysiological study.

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METHODS

This is a hospital based observational study conducted in Shahid Gangalal National Heart Centre, Kathmandu from April, 2023 to January, 2024. Ethical approval was obtained from relevant Institutional Review Board at National Academy of Medical Sciences (Reference No. 956/2079/80) and Shahid Gangalal National Heart Centre before the start of data collection. The sample size was calculated by the formula, $n=z^2pq/d^2$, where, n=required sample size, p=accuracy rate of Wolff-Parkinson-White syndrome, d= 10% of maximum tolerable error, q=100-p, z=1.96 at 95% confidence interval. The sample size with 10% maximum tolerable error, taking accuracy rate of around 85% and 95% confidence interval, was 48. All patients with WPW syndrome undergoing Electrophysiological Study and Radio Frequency Ablation were included in the study. Patients with multiple accessory pathways and concealed pathway as diagnosed from electrophysiological studies, and patients with congenital heart disease, structural heart disease (ischemic heart disease, hypertrophic cardiomyopathy etc.) diagnosed in echocardiography were excluded from the study. Patients fulfilling the inclusion criteria were enrolled in the study after taking informed written consent. Demographic data, ECG localization of accessory pathway using Arruda algorithm and exact localization of accessory pathway using electrophysiological study were collected using structured proforma. All data were entered into an electronic spreadsheet (Microsoft Excel) and the statistical analysis were done using the SPSS version 16 software. Appropriate statistical test was carried out to analyze the data. All Categorical variables were expressed in frequency and percentage. All numerical data were presented in mean±SD. Sensitivity and specificity of Arruda algorithm to localize different accessory pathways were determined. Processing of all available information, statistical analysis of their significance were done.

RESULTS

Total of 54 patients with WPW syndrome were included with mean age of 36.39±13.99 years which range from 17 to 64 years. The demographics are summarized in Table 1.

Table 1. Demographic profile. (n=54)

Variables	Male n(%)	Female n(%)	Total n(%)
Age groups (years)			
< 20	4(12.90)	3(13.04)	7(13)
21-45	17(54.84)	16(69.57)	33(61)
46-60	9(29.03)	2(8.70)	11(20)
>60	1(3.23)	2(8.70)	3(6)
Total n(%)	31(57)	23(43)	54(100)

Most common accessory pathway was left lateral/ anterolateral using Arruda algorithm of surface ECG as demonstrated in Figure 1.

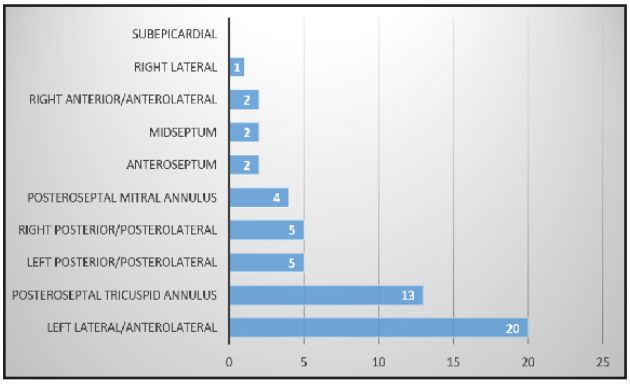

Figure 1. Localization of accessory pathway using Arruda algorithm of surface ECG. (n=54)

By electrophysiological study, the most common pathway was localized to left lateral/anterolateral as shown in Table 2.

Table 2. Localization of accessory pathway using electrophysiological studies. (n=54)

Localization by EPS	Frequency (%)
Left lateral/anterolateral	20(37)
Posterolateral tricuspid annulus	12(22)
Left posterior/posterolateral	6(11)
Posteroseptal mitral annulus	5(9)
Right posterior/posterolateral	5(9)
Right anterior/anterolateral	3(6)
Midseptum	2(4)
Right lateral	1(2)
Anteroseptum	0(0)
Subepicardial	0(0)

Total of 5 cases (9.3%) were misclassified using Arruda algorithm as shown in Table 3. So Arruda algorithm correctly identified the accessory pathway

location in 49 patients with WPW syndrome making the accuracy rate around 90.7%

Table 3. Inaccurate prediction of accessory pathway by Arruda algorithm. (n=5)

Pathway	Frequency (%)
Antero-septum	2(40.0)
Left lateral/Antero-lateral	1(20.0)
Postero-septal tricuspid annulus	1(20.0)
Right posterior/Postero-lateral	1(20.0)

The overall sensitivity and specificity of Arruda algorithm compared with electrophysiological studies was 88.1% and 98.7% respectively (Table 4).

Table 4. Sensitivity and specificity of pathways using Arruda algorithm compared with EPS.

Variables	Arruda algorithm	
	Sensitivity (%)	Specificity (%)
Electrophysiological study localization		
LL/LAL	95	97
PSTA	100	97.6
LP/LPL	83.3	100
PSMA	80	100
RP/RPL	80	97.9
RA/RAL	66.7	100
MS	100	100
RL	100	100
AS	NA	96.2
Subepicardial	NA	NA
Total	88.1	98.7

Note: AS: antero-septum; EPS: electrophysiological study; LL/LAL: left lateral/left antero-lateral; LP/LPL: left posterior/postero-lateral; MS: mid-septum; NA: not applicable; PSMA: postero-septal mitral annulus; PSTA: postero-septal tricuspid annulus; RA/RAL: right anterior/antero-lateral; RL: right lateral; RP/RPL: right posterior/postero-lateral.

DISCUSSION

Majority of patient with WPW syndrome presented for electrophysiological studies were male (57%) and mean age of 36.39±13.99 years which was similar to other studies done in Nepal and other countries.[7, 8, 9] The most common location of accessory pathway was left lateral/anterolateral in our study. Some studies found the most common location similar to our study.[7, 8, 9] Whereas few other studies like Teixeira CM et. al and Saidullah S. et. al found right postero-septal area being most common.[10, 11]

Our study accurately predicted accessory pathway locations in 49 patients out of 54 patients and the accuracy rate was 90.7% which was similar to Saidullah S. et. al however higher than Maden O. et al.[8, 11] The sensitivity and specificity of Arruda algorithm to localize individual accessory pathway locations ranged from 66.7 to 100% and 96.2 to 100% respectively which was similar to original Arruda MS. Et. al study. The overall sensitivity and specificity of Arruda algorithm in our study was quite similar to the original study done by Arruda MS. et. al with sensitivity being 88.1% and specificity of 98.7% calculated as weight averages (weighted by number of true positives).[6]

Limitations

There are few limitations to this study. This was a single Centre based study. Sample size was small. No patients below 17 years were enrolled in the study due to unavailability of such patients. There was no patient with pathway localized to antero-septum and subepicardial area by electrophysiological study. So, the result cannot be generalized to these areas and patient subsets.

CONCLUSIONS

The localization of accessory pathway in WPW syndrome before undergoing invasive procedure for ablation helps to plan for the procedure well and prepare for unwanted complications. Arruda algorithm has good sensitivity and specificity to locate accessory pathway in patients with WPW syndrome.

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