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Original Article

Diagnostic Accuracy of Apex-Pulse Deficit for Detecting Atrial Fibrillation

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ABSTRACT

Objective: To evaluate the diagnostic accuracy of Apex-Pulse deficit for detecting Atrial Fibrillation in adult patients
Study Design: Cross sectional study
Place and Duration of Study: Department of Medicine, Combined Military Hospital, Peshawar Pakistan, Nov 2022 to Oct 2023
Methodology: One hundred and thirty-nine patients, aged 18 years or more, newly diagnosed with atrial fibrillation (A-fib) or a history of palpitations were evaluated independently by three separate groups of two examiners each for the presence of Apex-Pulse deficit. A-fib was later confirmed with ECG and Holter monitoring. Sensitivity and specificity were calculated for both diagnostic methods. Pearson correlation was calculated for correlation of the severity of Apex-Pulse deficit with the New York Heart Association (NYHA) Class of heart failure.
Results: The mean age of patients was 44.32±13.22 years with 66.2%(n=92) females and 33.8%(n=47) males. Patients had symptoms of the atrial fibrillation for a mean duration of 2.99±2.03 days. Apex-Pulse deficit was noticed in 75.5%(n=105) of the studied cohort. There was a linear relation between the NYHA Class and Apex-Pulse deficit severity with Pearson Correlation coefficient of 0.764 (p<0.001). The Apex-Pulse deficit method was able to detect atrial fibrillation in 78.4%(n=109) of the patients with a sensitivity of 96.33% and a specificity of 0% whereas ECG was able to detect the atrial fibrillation with a sensitivity and specificity of 100%.
Conclusion: The assessment of the Apex-Pulse deficit as a diagnostic tool for detecting Atrial Fibrillation has high sensitivity of 96%.

Keywords: Apex-Pulse deficit, Ambulatory Electrocardiography, Atrial Fibrillation, Holter.

How to Cite This Article: *Abbas N, Rehman HY, Siddiqi FA, Sharif A, Rehman A, Ahmad F. Diagnostic Diagnostic Accuracy of Apex-Pulse Deficit for Detecting Atrial Fibrillation. Pak Armed Forces Med J 2024; 74(4): 1129-1132. DOI: https://doi.org/10.51253/pafmj.v74i4.11531*

INTRODUCTION

Atrial Fibrillation (AF), a common cardiac arrhythmia related with an augmented risk of stroke and other cardiovascular complications. It is often asymptomatic, but usually presents as the patient complaining of palpitations which he or she may describe as a sense of heart racing, beating irregularly, or skipping beats. It may also present as fatigue, lightheadedness, dizziness, or fainting, shortness of breath and at times, stroke.[1] Timely and accurate detection of AF is crucial for appropriate management and prevention of complications.[2] Traditional methods for AF detection include electrocardiography (ECG) and ambulatory monitoring. However, these methods may not always capture intermittent or paroxysmal episodes of AF, highlighting the need for alternative diagnostic approaches.[3]

Apex-Pulse deficit, defined as the difference between the radial pulse rate and the apical pulse rate, has been proposed as a potential diagnostic indicator for AF.[4] The measurement of Apex-Pulse deficit employs a two-person technique simultaneously assessing the radial pulse and the apical pulse. The radial pulse is commonly palpated at the wrist, while the apical pulse is typically measured at the apex of the heart using a stethoscope. The difference between the two rates constitutes the Apex-Pulse deficit.[5]

Various confounding factors, such as the presence of other cardiac arrhythmias or conditions, can influence the accuracy of Apex-Pulse deficit, potentially leading to false positives or negatives in AF detection using Apex-Pulse deficit.[6] The gold standard for diagnosing AF is electrocardiography (ECG). Comparing Apex-Pulse deficit with ECG findings in different studies reveals discrepancies and challenges in achieving a high level of agreement.[7]

The literature on the diagnostic accuracy of Apex-Pulse deficit for detecting Atrial Fibrillation presents a mix of promising results and conflicting findings. Further research is warranted to establish its role in clinical practice. Together with a dearth of similar

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Received: 26 Jan 2024; revision received: 22 Feb 2024; accepted: 01 Apr 2024

studies in our setup, this forms the rationale for our study.

METHODOLOGY

The cross-sectional study was conducted at Department of Medicine, Combined Military Hospital Peshawar, Pakistan, from November 2022 to October 2023. Approval was obtained from the Institutional Ethical Review Committee (ERB Certificate 00252/23). Sample size was calculated using the World Health Organization sample size calculator by keeping in view the prevalence of atrial fibrillation reported in Pakistan to be 6.5 % in acute cases.[8]

Inclusion Criteria: Adults of either gender, aged 18 years or more, visiting the Medical OPD with newly diagnosed atrial fibrillation or a history of palpitations suggestive of paroxysmal atrial fibrillation were included.

Exclusion Criteria: Any patient unwilling to participate or unable to provide informed consent or with any terminal illness was excluded.

Informed consent was obtained from the patients prior to examination. Data was collected using non-probability convenience sampling. Patients were evaluated independently by three separate groups of two examiners each. House officers of the hospital were designated as examiners. One of the groups recorded the electrocardiogram (ECG) of the patient. The rate and rhythm of the ECG was noted. The second group of examiners recorded the Apex Pulse deficit by examining the radial pulse and simultaneously listening to the apex beat of the patient using bell of the stethoscope for 1 minute. The Apex-Pulse deficit was calculated by the formula: (Apex Beat rate)—(Pulse Rate)=Apex-Pulse Deficit (Times/Minute)

A patient with a positive Apex-Pulse Deficit was considered having atrial fibrillation. Apex-Pulse deficit was graded into three grades as Mild (1-10), Moderate (11-20), severe (20-30) and very severe (>30). The rate, rhythm and character of the pulse and blood pressure was recorded by the third group of the examiners along with a brief history of the patient. Patients were Classified according to the New York Heart Association Classification in Classes 1 through 4.9 Patients were then admitted in the medical ward for a 48-hour Holter monitoring, results of which were followed through. Diagnosis of Atrial fibrillation made through either of the methods, was confirmed only by electrocardiographic recording whether ECG or Holter.

The results of the examination and the ECG were entered in the Statistical Package for Social Sciences (SPSS) version 23. The 2 x 2 table was made for either of the methods for detecting atrial fibrillation and sensitivities and specificities were calculated. The severity of Apex-Pulse deficit then correlated with the NYHA Class of heart failure using Pearson correlation coefficient. The *p*-value of 0.05 or less was taken as significant.

RESULTS

This study included One hundred and thirty-nine patients with a mean age of 44.32±13.22 years with a range of 52 years, including 66.2% (n=92) females and 33.8% (n=47) males. Patient had symptoms of the atrial fibrillation for a mean duration of 2.99 ± 2.03 days. The mean mode duration of the symptoms was 1 day (n=42), and the range was 8 days. Patients who did not have any shortness of breath were 81.3% (n=113) and were labelled as NYHA Class-1. Amongst the remaining patients 8.6% (n=12) were placed in the NYHA Class 2, 5.8% (n=8) were placed in NYHA Class-3 whereas only 4.3% (n=6) patients had dyspnea at rest and were placed in the NYHA Class-4.

When measuring the Apex-Pulse deficit, 24.5% (n=34) were found to have no Apex-pulse deficit. Mild Apex-pulse deficit was found in 46% (n=64) patients and moderate apex pulse deficit was found in 19.4% (n=27) cases. Out of the rest, 6.5% (n=9) had severe whereas 3.6% (n=5) had very severe Apex-Pulse deficit. The 139 patients included in the study had a mean systolic blood pressure of 124.6 mmHg. The median value of the systolic blood pressure was 125 mmHg.

When comparing the Apex-Pulse deficit with the NYHA Class of the patient, it was found that there was a linear relation between the NYHA Class and Apex-Pulse deficit severity (Figure-1). The Pearson Correlation coefficient was also calculated with r value = 0.764; p value < 0.001.

A similar relationship was observed when Systolic blood pressure was plotted against the Apex-Pulse deficit with a likelihood ratio of 143.20 and p < 0.001 (Figure-2).

The Apex-Pulse deficit method was able to detect atrial fibrillation in 78.4% (n=109) of the patients with a sensitivity of 77.8% and a specificity of 0.0% having diagnostic accuracy of 75.54% (Table-I).

When calculating the same for the ECG, it was found that ECG was able to detect the atrial fibrillation in 90.6% (n=126) patients with a sensitivity of 93.3% and specificity of 100% having diagnostic accuracy of 93.5%. (Table-II).

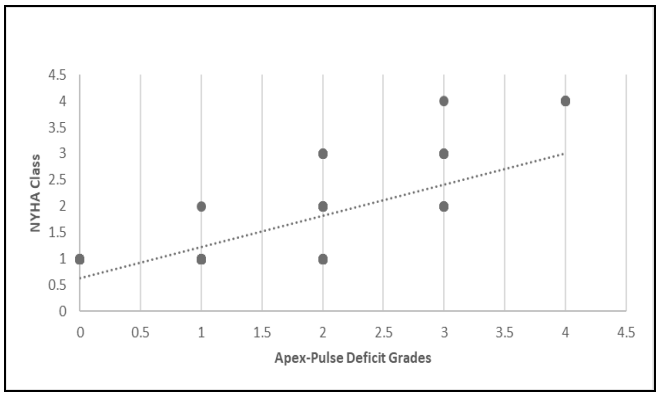

Figure-1: Linear Relationship of Apex-Pulse Deficit and NYHA Class (n=139)

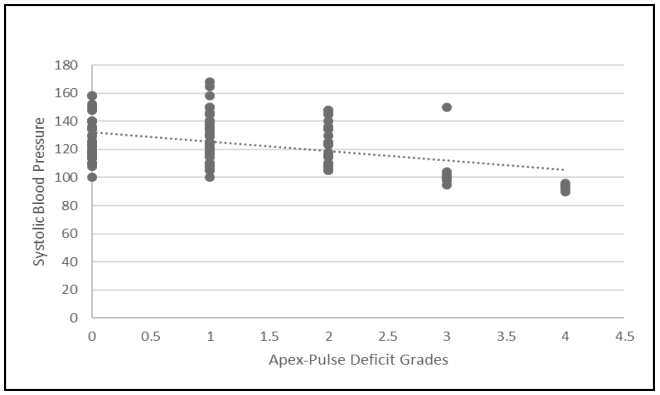

Figure-2: Relationship between Apex Pulse Deficit and Systolic BP (n=139)

Table-I: Diagnostic Accuracy Measure of Apex-Pulse Deficit to Diagnose Atrial fibrillation (n=139)

		Atrial Fibrillation		
		(Holter +)	(Holter -)	Total
Apex Pulse Deficit	Positive	105(77.8%)	4(100.0%)	109
	Negative	30(22.2%)	0(0.0%)	30
Total		135	4	139

Sensitivity = 77.8% Positive Predictive Value = 96.3%
Specificity = 0.0% Negative Predictive Value = 0.0%
Diagnostic Accuracy = 75.54%

Table-II: Diagnostic Accuracy Measure of ECG to Diagnose Atrial fibrillation (n=139)

		Atrial Fibrillation		
		(Holter +)	(Holter -)	Total
ECG	Positive	126(93.3%)	0(0.0%)	126
	Negative	9(6.7%)	4(100.0%)	13
Total		135	4	139

Sensitivity = 93.3 % Positive Predictive Value = 100.0%
Specificity = 100.0% Negative Predictive Value = 30.7%
Diagnostic Accuracy = 93.5%

DISCUSSION

In our study the mean age of the patients was 44.32 years. Median age was however 48 years. Comparatively, patient demographic as reported by a large multicenter study showed that over 1/3rd of the patients reporting to the hospital with atrial fibrillation were over 75 years of age.[10] The age difference can be attributed to the specific set of population to which our hospital provides its services and a lower average life expectancy in Pakistan as compared to the West.[11] Methods other than ECG for detecting atrial fibrillation are being studied, such as a wrist type pulse wave monitor has been studied and has been reported to have a sensitivity and specificity of 97% and 100%, respectively.[12] This is similar to our findings.

Another algorithm tested by one study utilized irregular pulse peal and irregular heart beat for detecting atrial fibrillation with a sensitivity and specificity of 97% and 99%, respectively.[13] Our study, however, looked into the more conventional and practical approach and found that Apex-Pulse Deficit has a sensitivity of 96.33% but is not specific at all. Studies have concluded that ECG is considered to be gold standard in detecting atrial fibrillation with estimated sensitivity of 80%, specificity 98% and positive predictive value (PPV) 88%.[13,14] A 12 lead ECG can detect atrial fibrillation with a sensitivity and specificity of 93% and 97% respectively.[15-17] In our study, we found that ECG was able to detect all the cases of atrial fibrillation accurately. Missing the ongoing atrial fibrillation on ECG is usually dependent upon the interpreting physician. Holter monitoring, however has been reported to be up to 96% sensitive and specific respectively.[18]

CONCLUSION

The assessment of the Apex-Pulse deficit as a diagnostic tool for detecting Atrial Fibrillation demonstrated a high sensitivity of 96%, indicating its effectiveness in identifying individuals with Atrial Fibrillation. However, the specificity of the Apex-Pulse deficit was found to be 0%, suggesting a limitation in its ability to accurately rule out the absence of Atrial Fibrillation. These results emphasize the importance of considering both sensitivity and specificity when evaluating the diagnostic performance of this method.

Conflict of Interest: None.

Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

NA & HYR: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

FAS & AS: Conception, data analysis, drafting the manuscript, approval of the final version to be published.

AR & FA: Data acquisition, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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