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EVALUATION OF TEMPORAL TAP ON CAROTID ARTERIES DOPPLER WAVEFORM IN NORMAL HEALTHY ADULTS

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Abstract

BACKGROUND: *Temporal tapping is a validated non-invasive method used during Doppler sonography to differentiate the external carotid artery (ECA) from surrounding branches, the internal carotid artery (ICA) and common carotid artery (CCA). Even though its clinical application is there, not much is known about differential effects of tapping at particular anatomical positions along the superficial temporal artery.*

OBJECTIVE: *To assess the diagnostic utility of temporal tapping at different anatomical points in distinguishing carotid artery waveforms using Doppler ultrasound.*

METHODOLOGY: *This research was of a cross-sectional type. The data was collected from the radiology department of Ali Hospital, Kot Radha Kishen. The study was conducted from December 2024 till March 2025. A total of 196 healthy individuals with normal BMI and no prior history of head & neck surgery were included. Baseline waveforms and rhythmic temporal tapping-induced changes at the proximal and distal sites of the superficial temporal artery were recorded using Doppler ultrasound. Doppler indices of PSV, EDV, RI, and PI of the ECA, ICA, and CCA were recorded. Paired sample t-test was applied for statistical comparison. Data were analyzed using SPSS version 25.*

RESULTS: *The study included 196 healthy adults with 56.6% males (111) and 43.4% females (85). Proximal temporal tapping caused a significant increase in ECA peak systolic velocity (103.6 to 110.15 cm/s) and end-diastolic velocity (29.87 to 30.15 cm/s) ($p < 0.001$), with minor, non-significant changes in PI and RI. Distal tapping produced smaller, non-significant changes in ECA parameters. No significant changes were observed in CCA and ICA Doppler measurements with either proximal or distal tapping ($p > 0.05$). These results demonstrate that temporal tapping primarily affects the ECA, confirming its specificity for external carotid artery assessment.*

CONCLUSION: *The study concluded that Proximal temporal tapping induces notable and statistically significant hemodynamic effects on the external carotid artery, thereby highlighting its position as a reliable diagnostic tool for differentiating the ECA from CCA and ICA . The research highlights the importance of site-specific tapping protocols in enhancing the precision and reliability of Doppler-based vascular ultrasound.*

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INTRODUCTION

A fundamental aspect of vascular diagnostics is the correct differentiation of the external carotid artery from the internal carotid and common carotid arteries. Doppler ultrasound, in this regard, has pivotal functions in sonographic diagnostics because it allows for a real-time view and hemodynamic evaluation of the carotid arteries. Of these methods, temporal tapping has been useful as an ancillary in identifying the ECA using its characteristic waveform response, especially in the differentiation of the latter from the ICA and CCA.[1] Temporal tapping is performed by tapping smartly along the temporal sphenoidal diagnostic line beginning in front of the ear and continuing forward, up, and around the whole line.[2] Temporal tapping or gentle rhythmic percussion of the superficial temporal artery has been known to produce diagnostic waveform fluctuations in the ECA but elicits a minimal or no response at all in the ICA or CCA. The maneuver, therefore, would be most useful in those situations where anatomical overlap or diseases such as atherosclerosis make differentiation between the arteries obscure.[3] This method is reported to be of value as the response was found positive in 81% of the ECAs, 54% of the CCAs, and only 33% of the ICAs. Thus, this further supported the specificity of the technique. Also, studies showed that temporal tapping produced characteristic alterations in the spectral Doppler waveforms in 92.5% of the ECA systems studied.[4] Temporal tapping in Doppler ultrasound is very important in enhancing the diagnostic accuracy and can provide a non-invasive technique for clinicians trying to differentiate between ECA, ICA, & CCA. It is highly applicable in resource-poor settings where expensive imaging equipment cannot be accessed.[4] In addition, the reliability of the technique makes it an excellent adjunct to conventional vascular studies, which can reduce the need for operator-dependent expertise without sacrificing diagnostic integrity.[5] Although the utility of a technique is known, the understanding of the effect due to tapping at different anatomical locations on the temporal artery and waveforms generated is not sufficient.[6] Previous studies have mainly focused on a single application site. Thus, questions arise here as to which application site is the best for high diagnostic yield. This will be essential to ensure that clinical applicability of temporal tapping improves and allows the same results with different groups of patients.[7] The need to bridge this gap will be addressed by this study, which systematically evaluates the effect of temporal tapping at three different sites on the temporal artery. The hypothesis is that there will be some changes in waveform, thereby enhancing the understanding of the diagnostic value of the technique. More than this, the study advances the methodology through setting a correlation of specific tapping sites and distinct hemodynamic responses with practical recommendations concerning its implementation in clinical environments.[8] Apart from its capacity to impact upon diagnosis, it may have broader effects on vascular ultrasonography as a discipline. By providing standardization to the technique along with the degree of its efficacy, the study could help in formulating temporal tapping as an inherent part of assessment procedures for the carotid arteries. Predicted results can help increase the reliability of Doppler ultrasound in distinction between carotid arteries by enhancing patient care and the strength of evidence-based practice in clinical contexts.[9]

Material and Method:

This cross-sectional observational study was conducted at the Radiology Department of Ali Hospital, Kot Radha Kishen, Kasur, from December 2024 to March 2025. A total of 196 healthy adults (aged 18–30 years, BMI 18.5–25 kg/m²) were selected through convenient sampling. Sample size was calculated using a standard formula based on an expected positive temporal tap response in the ECA (81%–92.5%), with a 95% confidence level and 5% margin of error. Doppler ultrasound was performed using a Toshiba Nemio 20 with a 7–14 MHz linear probe. Participants were scanned in a supine position with neck extension and head rotation. Temporal tapping was applied for 10–15 seconds at two anatomical points on the superficial temporal artery (proximal and distal), and Doppler waveforms of the CCA, ICA, and ECA were recorded before and during tapping. Hemodynamic parameters (PSV, EDV, RI, PI) were analyzed using SPSS 25, with paired sample t-tests.

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Results:

This study assessed the impact of proximal and distal temporal tapping on Doppler ultrasound parameters of the external (ECA), internal (ICA), and common carotid arteries (CCA) in healthy adults. Key hemodynamic variables included peak systolic velocity (PSV), end-diastolic velocity (EDV), resistive index (RI), and pulsatility index (PI). In the ECA, proximal tapping produced a statistically significant increase in PSV (103.6 ± 7.9 cm/s to 110.15 ± 8.5 cm/s) and a slight but significant rise in EDV (29.87 ± 5.2 cm/s to 30.15 ± 5.1 cm/s) with $p < 0.001$ for both. PI and RI also showed mild increases (PI: 1.109 to 1.145; RI: 0.711 to 0.727), though these changes were not statistically significant. Distal tapping caused only minimal changes in ECA parameters, with values remaining close to baseline. In contrast, the CCA and ICA demonstrated no significant hemodynamic changes with either proximal or distal tapping. Doppler values for PSV, EDV, PI, and RI remained stable across all conditions, reflecting the low-resistance and less reactive nature of these arteries. These results emphasize the specific responsiveness of the ECA to proximal temporal tapping, supporting its utility as a diagnostic maneuver to differentiate the ECA from other carotid branches during vascular ultrasound assessment.

Artery	Parameter	Before Tapping	Proximal Tapping	Distal Tapping	Significant Change
ECA	PSV (cm/s)	103.6 ± 7.9	110.15 ± 8.5	104.94 ± 7.7	Yes (Proximal, p<0.001)
	EDV (cm/s)	29.87 ± 5.2	30.15 ± 5.1	30.19 ± 4.7	Yes (Proximal, p<0.001)
	PI	1.109 ± 0.108	1.145 ± 0.096	1.110 ± 0.089	Mild Change
	RI	0.711 ± 0.043	0.727 ± 0.038	0.713 ± 0.037	Mild Change
CCA	PSV (cm/s)	95.37 ± 7.6	95.35 ± 7.5	95.34 ± 7.6	p ≥ 0.05
	EDV (cm/s)	32.98 ± 5.2	33.06 ± 5.0	33.06 ± 5.0	p ≥ 0.05
	PI	0.979 ± 0.089	0.977 ± 0.086	0.977 ± 0.086	p ≥ 0.05
	RI	0.655 ± 0.038	0.655 ± 0.037	0.655 ± 0.037	p ≥ 0.05
ICA	PSV (cm/s)	95.58 ± 7.6	95.59 ± 7.5	95.57 ± 7.6	p ≥ 0.05
	EDV (cm/s)	33.76 ± 4.3	33.75 ± 4.3	33.76 ± 4.3	p ≥ 0.05
	PI	0.956 ± 0.105	0.955 ± 0.104	0.955 ± 0.104	p ≥ 0.05
	RI	0.644 ± 0.051	0.643 ± 0.050	0.643 ± 0.050	p ≥ 0.05

Table: The statistical analysis of the dataset showed that Proximal temporal tapping caused a significant increase in ECA Doppler parameters, with PSV rising from 103.6 ± 7.9 to 110.15 ± 8.5 cm/s and EDV from 29.87 ± 5.2 to 30.15 ± 5.1 cm/s ($p < 0.001$). Mild, non-significant changes were noted in PI and RI. Distal tapping produced only slight, non-significant effects. The CCA and ICA showed no significant changes in any Doppler indices with either tapping method, indicating their stable flow characteristics. These findings highlight the diagnostic value of proximal tapping for identifying the ECA during carotid ultrasound.

Discussion:

This cross-sectional study aimed to assess the effect of the temporal tap on CCA ECA and ICA with a sample size of 196 healthy individuals aged 18-30 years out of which 111(56.6%) were males and 88 (43.4%) were females. The goal of the study was to determine the effect of proximal and distal temporal tap on doppler parameters such as PSV, EDV, PI and RI of carotid vessels. The PSV values of CCA before tap were recorded to be minimum 76cm/s, maximum 118cm/s with mean value of 95.377cm/s which aligns with the previous study performed by EG grant et al (2003) which suggested that the maximum value for normal healthy individuals should be < 120 cm/s.[10] When temporal tap was performed proximally the PSV values recorded were minimum 76cm/s, maximum 118cm/s with mean value of 95.35cm/s and Distal tapping values recorded were minimum 76cm/s, maximum 118cm/s with mean value of 95.3469cm/s exhibiting

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a non-significant correlation supporting the previous literature by Pellerito JS, Polak JF. et al (2020) that temporal tapping caused non-significant changes in CCA wave form.[11] Although no specific anatomical point was mentioned in the study. The EDV values of CCA before tap were recorded to be minimum 18cm/s, maximum 42cm/s with mean value of 32.98cm/s which aligns with the previous literature by EG grant et al (2003) which suggested that the maximum value for normal healthy individuals should be <40cm/s.[10] The PI values of CCA before tap were recorded to be minimum 0.83, maximum 1.27 with mean value of 0.8913 supporting previous study performed by Avrahami I, et al (2016) that the PI is equal to the difference in PSV and EDV by their Mean Velocity.[12] When temporal tap was performed proximally the PI values were minimum 0.83, maximum 1.27 with mean value of 0.9775 and Distal tapping values recorded were minimum 0.83, maximum 1.27 with mean value of 0.8608 stating a non-significant correlation. The RI values of CCA before tap were recorded to be minimum 0.59, maximum 0.78 with mean value of 0.6558 which aligns with the previous literature by Staub D at el (2003) stating that the mean RI value of CCA should be between 0.66 to 0.79 ±0.07 which closely aligns with our study.[13] When temporal tap was performed proximally the RI values were minimum 0.59, maximum 0.78 with mean value of 0.6550 and when tapping was performed Distally values measured minimum 0.59, maximum 0.76 with mean value of 0.655 exhibiting a non-significant correlation with before tapping values. Our study summarized that the temporal tapping had negligible effects on CCA. In our study in ECA there was a significant correlation found among variables. The before tapping values of PSV were recorded minimum 83cm/s, maximum 120cm/s with mean value of 103.62cm/s which supports the previous literature by Beach KW, at al (2010) that the ECA is a high resistive vessel due to which PSV slightly increase[14] and similar statement was given by Ginat DT, et al (2011) that due to high resistance of ECA the PSV value slightly raise.[10] For EDV there was a significant correlation found among variables. The before tapping values of EDV were recorded minimum 18cm/s, maximum 35cm/s with mean value of 29.87cm/s which supports the previous literature provided by Beach KW et al (2010) that the ECA is a high resistive vessel and EDV slightly dropped.[14] Although no specific anatomical point was mentioned. In the case of PI variables were statistically non-significant. The before tapping values of PI were measured to minimum 0.97, maximum 1.35 with mean value of 1.1091 supporting previous study performed by Avrahami I, et al (2016) that the PI is equal to the difference in PSV and EDV by their Mean Velocity.[12] Our study concluded that Temporal tap caused significant fluctuations in PSV and EDV of ECA proximally as compared to distal tapping and summarized that the temporal tapping had negligible effects on ICA.

Conclusion:

This study evaluated the hemodynamic effects of proximal and distal temporal tapping on Doppler parameters (PSV, EDV, PI, RI) in the CCA, ECA, and ICA of 196 healthy volunteers aged 18–30. Proximal tapping led to statistically significant changes in ECA parameters, particularly PSV and EDV, confirming its high-resistance flow and responsiveness to external stimuli. Distal tapping produced minimal, non-significant effects. The CCA and ICA showed stable Doppler indices regardless of tapping, reflecting their low-resistance flow. These findings underscore the diagnostic value of proximal temporal tapping in accurately identifying the ECA and support its role in standardizing vascular ultrasound techniques.

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