Original Article

The Dual Metrics of Cardiovascular Risk: Intima-Media Thickness and Peak Systolic Velocity in Hypertensive Profiles Through Ultrasonography

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Abstract

Objective: To investigate and compare the intima-media thickness and peak systolic velocity in hypertensive patients using carotid Doppler imaging.

Study design: It is a a Retrospective study design.

Place and duration of study: This four month study was carried out in Jahangir SON-X Diagnostic Center, Rawalpindi.

Material and Methods: The material and methods involved accessing the radiology database to identify hypertensive patients and assessing the intima-media thickness of the internal and common carotid arteries, along with the outer vessel diameters.The non-invasive assessment of the increase in intima-media thickness in the carotid artery was conducted through ultrasonography.

Results: The study comprised 150 hypertensive patients, with a specific emphasis on the thickness of intima-media as observed on carotid Doppler imaging. Among the participants, 66% were male, and 34% were female, with a mean age of 63 and a standard deviation of 10.5.

Conclusion: The results of the study revealed a direct correlation between intima-media thickness and peak systolic velocity in hypertensive patients. Notably, the right-sided intima-media thickness and peak systolic velocity demonstrated a strong correlation, suggesting a robust association between these parameters on the right side. On the other hand, the left-sided intima-media thickness and peak systolic velocity exhibited a weaker correlation, implying a less pronounced relationship on the left side.

Keywords: Intima-media thickness , Peak systolic velocity, Hypertensive Patients, Ultrasonography.

1. Introduction

The most common site of pathological changes in the arterial tree of human body is carotid arteries.[1] For the evaluation of the carotid arteries' health and for the non-invasive assessment of vascular parameters, carotid Doppler is widely used. Carotid arteries are prone to damage due to many other atherosclerotic plaque and cause serious pathologies of arteries.[6]

When the cardiac rhythm takes place, the the carotid arteries are examined using Doppler ultrasonography. It analyzes lumen and wall changes, plaques, stenosis, and intima-media thickness (IMT). The method of evaluating carotid atherosclerosis is secure, cost-efficient, trustworthy, reliable, and easy to use.[5].

Nowadays, the carotid arteries are often examined using Doppler ultrasonography to assess blood flow velocity over a cardiac cycle. Doppler features including systolic-diastolic ratio, resistive index (RI), and pulsatility index (PI), were applied to assess and diagnose occlusive illnesses and obstructive alteration of the carotid arteries.[16]

Additionally to being an independent predictor of early atherosclerosis, carotid artery intima-media thickness (CIMT) is an accurate indicator of coronary heart disease (CHD).[1] The two most important metrics to access vascular alterations are peak systolic velocity (PSV) and intima media thickness (IMT).

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Since it began to be used as an early, preclinical vascular endpoint in the mid-1980s, many scientific and medical investigations have supported the use of ultrasound for studying the combined intimal and medial layers of the common carotid arteries. This technique is non-invasive, affordable, repeatable, and useful for predicting outcomes in both healthy and ill people.[3] It is increasingly employed as a proximate indicator of target organ damage, as a marker, or as a device to guide treatment plans.

However, there is some debate about the utilization of carotid intra-media thickness (CIMT). The artery examined, the arterial segments to be examined, the phase of the disc cycle and the precise position of measurements within those areas, the walls, the inclusion of the plaque, the ultrasonic technology, the image angle, and the method of measurement are some of the methodological differences between studies when determining CIMT.[8]

It has been demonstrated that various methods of CIMT acquisition and measurement differ in terms of replication, predictive value, rate of change, vulnerability to deep treatment, and the capacity to acquire pictures for assessment.

The brain, neck, and face are nourished with blood through the carotid arteries, which are major blood vessels in the neck. Blood circulates to the brain through the internal carotid artery and the face and neck through the external carotid artery. The carotid arteries are located on both the left and right sides of the body. The facial artery serves the muscles of face expression and the structures in the mouth, whereas the superior thyroid artery supplies the thyroid gland and surrounding muscles. The circulus is shaped by the contributions of four large arteries.

The inability of Conventional ultrasound to distinguish between intima and media, which contributes to the link between CIMT and cardiovascular events caused by atherosclerotic plaque buildup. Since the elastic carotid artery has a smaller media than arteries of muscles, elevated CIMT is believed to primarily signify intima thickening. CIMT, on the other hand, is regarded as a distinct trait with distinct clinical utility and ought to be assessed in regions free of plaque.[9]

Age, sex, race, smoking, alcohol use, and routine endurance exercise are all linked to CIMT and classic CV risk factors. Atherosclerosis is significantly influenced by factors like age, sex, race, smoking, and alcohol use. In persons over 45 years old who are not yet qualified for conventional CV risk screening, CIMT may be a useful marker for CV risk. Regular endurance training, especially aerobic training, is essential.[13]

Unknown are the relationships between CIMT and several atypical blood pressure (BP) conditions. High blood pressure poses a significant risk for CIMT, hence it is important to manage hypertension with dietary changes and risk-reducing medication. In conclusion, preclinical atherosclerosis is primarily caused by all forms of hypertension, and early atherosclerosis should be avoided by good control.

2. Materials & Methods

This is a Retrospective study. In which 150 patients are included. Consecutive sampling technique is used to get the data from Jahangir Son-X diagnostic centre. Reports of Patients presented with hypertension on carotid Doppler were included. Patients presented with no hypertension on carotid Doppler were excluded. The radiology database was accessed to identify patients who presented with HTN. Their HTN was controlled by the administration of drugs. The Intima media thickness of internal and common carotid and outer vessel diameters were assessed in hypertensive patients.

The increase in thickness of Intima and media of the carotid artery in HTN was measured by non-invasive ultrasonography. SPSS was utilized for data analysis, and descriptive statistics were applied to characterize the data.

3. Results

The study was conducted on 150 hypertensive patients with a thickness of intima-media and peak systolic velocity ratio on carotid Doppler. Of which 99 (66%) were male and 51 (34%) were female. The mean age observed was 63 with a standard deviation of 10.5.

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Table l: PSVR & PSVL

	PSVR %	PSVL %
Normal	96	98
Abnormal	4	2

Table II: IMTR*PSVR Crosstabulation

		PSVL	
		Normal	Abnormal
IMTI	Normal	28	0
	0.8-1.2	98	0
	Above 1.2	23	1
		PSVR	
IMTR	Normal	34	0
	0.8-1.2	85	1
	Above 1.2	28	2

Table III: Frequency of IMTR & IMTI

	Frequency IMTR	**Frequency IMTI**
Normal	33	27
0.8-1.2	66	96
Above 1.2	31	27

4. Discussion

The non-invasive diagnosis of choledocholithiasis necessitates a multifaceted approach, encompassing medical assessment, chemical analysis, and sonographic evaluation. Regrettably, these modalities exhibit variable diagnostic accuracies, thereby precluding the establishment of a singular, dependable method for recognizing patients afflicted with biliary duct stones. Consequently, the analysis of choledocholithiasis frequently depends upon invasive cholangiography procedures, notably endoscopic retrograde cholangiopancreatography (ERCP) or percutaneous transhepatic cholangiography (PTC). Notably, ERCP possesses not only diagnostic utility but also therapeutic capabilities, enabling immediate intervention for concurrent abnormalities. However, it is imperative to acknowledge that ERCP is characterized by invasiveness, labor-intensive demands, and substantial associated costs. Therefore, the pursuit of an accurate patient selection method for therapeutic ERCP employment is paramount.

Magnetic resonance cholangiopancreatography (MRCP) has emerged as a robust imaging investigation for the diagnosis of choledocholithiasis, demonstrating versatility through the utilization of varying magnet strengths (ranging from 0.5 to 3-T), receiver coils (both body and local), diverse data procurement techniques (2 and 3D), breathing strategies (comprising breath-hold and non-breath-hold), and an array of pulse sequences (including fast spin echo (FSE), rapid acquisition with relaxation enhancement (RARE), and half-Fourier acquisition single-shot turbo spin-echo (HASTE)). The body of evidence from numerous substantial series has consistently reported sensitivities spanning the range of 81% to 100%, specificities ranging from 85% to 100%, and diagnostic accuracies encompassing 89% to 100% in MRCP's role in the evaluation of choledocholithiasis.

In this study, MRCP investigations were meticulously conducted employing a 2-D, multi-slice, FSE technique, augmented using a dedicated surface coil. Image acquisition encompassed both breath-hold and non-breath-hold techniques. Our MRCP protocol yielded images characterized by sufficient quality and spatial resolution, facilitating the consistent detection of biliary stones as diminutive as 3mm. Consequently, we achieved a remarkable diagnostic accuracy of 99% using MRCP. In stark contrast, conventional ultrasound, while valuable for various clinical applications, exhibited a notably inferior diagnostic accuracy of 49% in our study, underscoring the distinct advantages offered by MRCP in the context of choledocholithiasis diagnosis.

The comparatively small sample size of the current research is one of its main limitations. The study was conducted in a group of 200 patients, which may not fully represent the diversity of clinical presentations and diagnostic challenges encountered in choledocholithiasis cases. A larger and more diverse

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patient population would enhance the generalizability of our findings.

The duration of the study is another constraint to be acknowledged. The investigation spanned a finite time frame, potentially limiting the ability to capture the variability and long-term diagnostic trends associated with choledocholithiasis. A more prolonged study period can offer a more inclusive understanding of the diagnostic performance of MRCP and ultrasound.

Conclusion:

In conclusion, our comprehensive investigation has unequivocally demonstrated that magnetic resonance cholangiopancreatography (MRCP) stands as a remarkably accurate and noninvasive imaging modality for the diagnosis and pre-operative assessment of choledocholithiasis, outperforming conventional ultrasound. Notably, MRCP's diagnostic accuracy closely approximated that of the gold standard, endoscopic retrograde cholangiopancreatography (ERCP). This compelling finding underscores MRCP's likely to displace ERCP in the diagnostic paradigm for bile duct grits.

Nevertheless, it is essential to acknowledge that practical considerations currently temper the widespread adoption of MRCP. Factors such as cost implications and limited access to magnetic resonance imaging services may impose constraints on its broader utilization within clinical practice at the present juncture. Nevertheless, as healthcare infrastructure continues to evolve and become more accessible, the merits of MRCP in the diagnosis of choledocholithiasis should not be underestimated. Further research and health policy initiatives are warranted to harness the full potential of MRCP and optimize its integration into routine clinical care for the benefit of patients.

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