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Carotid Artery Evaluation and its Correlation with White Matter Hyperintensities: A Study Protocol

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ABSTRACT

Background: White matter hyperintensity is an independent and one of the important risk factors than can foresee future stroke and is a very common MRI brain finding. It is one of the most accessible markers to access the effect of vascular hemodynamics on the brain. Carotid Doppler indices have a strong correlation with WMH mainly due to atherosclerotic plaques. Thus these indices we can predict the white matter Hyperintensity burden

Objectives: Study cerebral white matter hyperintensities association with structural and hemodynamic parameters of the carotid artery. To calculate composite intima-media thickness. Evaluate white matter Hyperintensity into low and high burden plaques.

Methodology: 76 patients with white matter hyperintensities will be included in the study subsequent Carotid artery Doppler will be performed to determine various indices which will be later be correlated to MRI findings

Results: Statistical parameters like specificity, sensitivity, accuracy, negative predictive value and positive predictive value of each carotid Doppler value will be correlated to white matter score. ROC curve will be plotted to prove its diagnostic accuracy

Conclusion: Using carotid artery doppler, we can predict the burden of T2/FLAIR white matter ischemic changes in the brain and thus can be used as a predictor of stroke.

Key Words: Carotid Artery, White matter hyperintensities, Composite intima-media thickness

INTRODUCTION

The wide availability of MRI in recent times has led to increased detection of white matter hyperintensity[1] and have become a very common finding on MRI Brain. it is an independent and one of the important risk factor than can foresee future stroke.[2,3] It remains one of the most accessible markers to access the effect of vascular hemodynamic on brain.[4] Damage to deep sited blood vessels leads to small vessel ischemic changes and the most common cause are the atherosclerotic plaque.[5] There is a significant correlation between carotid artery indices and white matter ischemic changes

In this present study, Carotid Stenosis and composite intima-media thickness is large vessel atherosclerosis marker[6], and internal carotid artery Pulsatility Index (PI) which indicates cerebral microangiopathy is evaluated in association with white matter scores.[7] Association of white matter scores with the risk factors for cerebral microangiopathy like hypertension, diabetes and dyslipidaemia are also studied.[8]

OBJECTIVES

- Study cerebral white matter hyperintensities association with structural and hemodynamic parameters of the carotid artery.
- Score the white matter Hyperintensity into low and high burden plaques
- To determine carotid artery composite intima-media thickness and various other parameters.

MATERIALS AND METHODS

Study design: Cross-sectional study

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All patients referred to our Radio diagnosis department for MRI Brain showing white matter hyperintensities over 2 years. After written informed consent from the patients who come for MRI Brain which reveals white matter hyperintensities suggestive of small vessel ischemic changes are included

Exclusion criteria

1. Patients with a previous history of stroke and intracerebral bleed.
2. Patients with known causes of white matter Hyperintensity like acute demyelinating encephalomyelitis, multiple sclerosis, vasculitis, connective tissue diseases, migraine, major psychiatric disorder, normal pressure hydrocephalus.[9]
3. Post radiotherapy patients.
4. Patients who did not give consent for participating in the study
5. Uncooperative patients in whom MRI brain or carotid artery Doppler cannot be performed.

MRI Brain

Modified Scheltens scoring system is used to score White matter. Carotid artery composite intima-media thickness, Degree of stenosis and internal carotid artery Pulsatility index will is accessed. Modified Scheltens scoring system includes:

Deep white matter score

- Parietal
- Frontal
- Occipital
- Temporal

Each region has a minimum score of 0 and a maximum scoring of 6

Periventricular white matter score

- Frontal
- Occipital
- Lateral Vertical bands

Each region has a minimum score of 0 and a maximum scoring of 2.

So total Scoring can range from 0 to 30, which will further be divided into high and low burden scores.

Carotid artery variables:

1. Composite Intima media thickness
   - It is the average of the measurement of IMT of both left and right side's segment of the carotid artery. It includes Common and internal carotid, carotid bulb segment.[10]
2. Plaque
   - Any focal or diffuse thickening noted within the artery.
3. Carotid stenosis
   - Using an appropriate acoustic angle, It is calculated in terms of the degree of stenosis which percentage the lumen that is occluded due to IMT or Plaque. It is divided into hemodynamically significant and insignificant stenosis.[11]
4. Pulsatility index
   - PI of the internal carotid artery will be used. It is calculated automatically by the scanner.

Study size: total sample size is calculated to be 76 patients with white matter hyperintensities by using Chi-Square formula.

X^2=Chi square value is 3.84 at 5% level of significance

P=50%

Proportion=0.50

C: confidence interval of the one choice (95%CI) = 0.05

The prevalence rate for WMH: 94

$$N = \frac{3.84X94X0.5X0.5}{0.05^2X93+3.84X0.5X0.5}$$

$$= 76$$

Bias: Inter-observer variations will be minimized by taking an average of the 3 reading. The images will be zoomed in at required magnification to minimize error[12].

EXPECTED OUTCOMES/RESULTS

In this cross-sectional observational study, white matter score should be more in men and increases as the age advances. Composite IMT will have better indicator than Common carotid IMT and is expected to behave better sensitivity and specificity than other parameters. As the burden of white matter score increases, the Composite IMT increases. Hemodynamically significant stenosis when present, high burden score is expected. hypertension, diabetes, dyslipidemia are most commonly associated risk factors. Among them, Hypertension could be the commonest. We should be able to calculate the diagnostic cut-off value for periventricular, deep and total WMH by using receiver operating characteristic.

DISCUSSION

Cerebrovascular events are the commonest cause of mortality and morbidity in population especially the elder ones.[13] With the use of this study, we will determine the burden of white matter in brain which is itself a known risk factor for stroke.[14,15] In this, we will divide WMH into a low and high burden. Further, they are correlated and statistically analysed. Single centric study leading to bias, since verte-

bral artery is not evaluated[16] and only Carotid artery is being evaluated, the lesion and hemodynamically status of them will be skipped which causes many cerebrovascular events especially the posterior circulation.[17]

CONCLUSION

By use of carotid artery Doppler, we can predict the burden of T2/FLAIR white matter ischemic changes in the brain and thus can be used as a predictor of stroke.

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