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Corresponding Author
Saurabh Singh,
Department of Radiology, Bharati Vidyapeeth Deemed to be University, Sangli, Maharashtra, India

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Role of Colour Doppler Ultrasonography and Magnetic Resonance Angiography in Evaluation of Extracranial Carotid Arteries in Patients of Stroke

[1]Madaoo Hasnain Mansab Ahmed, [2]Saurabh Singh, [3]Vijaykumar S. Mane and [4]Asit Natekar

[1-4]Department of Radiology, Bharati Vidyapeeth Deemed Medical College and Hospital University, Sangli, Maharashtra, India

ABSTRACT

Stroke is a leading cause of death and disability worldwide. Carotid artery stenosis, usually caused by atherosclerosis, is a significant risk factor for stroke. Colour Doppler Ultrasonography (CDU) and Magnetic Resonance Angiography (MRA) are essential imaging techniques for evaluating extracranial carotid arteries. This study aims to assess the effectiveness of CDU and MRA in evaluating extracranial carotid arteries in stroke patients. A prospective observational study was conducted on 60 stroke patients at the Radiology Department of Bharati Vidyapeeth Deemed to be University Medical College, Sangli. Adult patients aged 18-60 years with a clinical diagnosis of stroke were included. CDU and MRA were used to evaluate the extracranial carotid arteries. CDU and MRA showed a significant correlation in detecting carotid artery stenosis. The degree of stenosis correlated with the severity of stroke symptoms. Statistical analysis indicated a significant association between risk factors such as diabetes, hypertension and carotid artery stenosis. Both CDU and MRA are effective in detecting carotid artery stenosis in stroke patients. Accurate assessment of stenosis can guide therapeutic decisions and improve patient outcomes.

INTRODUCTION

Stroke is a major cause of death and disability globally, resulting from focal damage to the central nervous system caused by vascular events such as infarction or intracerebral hemorrhage. Major risk factors include diabetes, hypertension, smoking, dyslipidemia, age, and a positive family history. Carotid artery stenosis, often caused by atherosclerosis, is a significant contributor to stroke risk[1].

Colour Doppler Ultrasonography (CDU) provides real-time imaging and assessment of blood flow within the carotid arteries, enabling the detection of stenosis and plaque characteristics[2]. Magnetic Resonance Angiography (MRA) offers detailed imaging of blood vessels without the need for ionizing radiation or contrast agents in certain cases, making it a valuable tool for evaluating extracranial carotid arteries[3].

Evaluating extracranial carotid arteries is crucial in stroke management and imaging techniques like CDU and MRA play a vital role. This study aims to assess the effectiveness of CDU and MRA in evaluating extracranial carotid arteries in stroke patients, providing insights that can aid in early diagnosis and management of stroke risk.

MATERIALS AND METHODS

Study Design and Population: This cross-sectional study was conducted at the Radiology Department of Bharati Vidyapeeth Deemed to be University Medical College, Sangli. The study included adult patients aged 18-60 years with a clinical diagnosis of stroke.

Inclusion Criteria: Patients diagnosed with stroke who consented to participate.

Exclusion Criteria: Patients with other significant comorbidities or those who did not consent.

Sampling Technique: Convenient sampling was used to select 60 patients referred to the Radiology Department for evaluation of extracranial carotid arteries using CDU and MRA.

Sample Size and Duration: The study included a sample size of 60 patients, conducted over a period of 6 months.

Parameters to be Studied (Study Variables): Age, gender, degree of carotid artery stenosis, presence of risk factors (e.g., hypertension, diabetes, smoking, dyslipidemia, family history) and stroke severity.

Study Tools: The study utilized a Philips Affiniti 50 Ultrasonography Machine with a transducer frequency range of 4-9 MHz for CDU and Philips 1.5 Tesla MRI scanner for MRA.

Detailed Study Procedure:

Patient Selection: Patients diagnosed with stroke were referred to the Radiology Department for evaluation. Written informed consent was obtained from each participant.

Imaging Procedures: CDU was performed to assess the degree of stenosis and plaque characteristics in the extracranial carotid arteries. MRA was conducted to provide detailed imaging of the carotid arteries.

Data Collection: Data on patient demographics, risk factors and imaging findings were collected using structured questionnaires and recorded systematically.

Questionnaire: Participants completed a questionnaire regarding their medical history, risk factors and prior imaging experiences.

Statistical Analysis: Data were analyzed using SPSS Version 21.0 and Microsoft Excel 2010. The frequency and percentage forms of qualitative data were used. Mean and standard deviation (SD) were calculated for quantitative data. Consensus between the Kappa Cohen analysis was used to determine the results of two tests. Screening efficacy was computed using common formulas. The level of significance was set at a p-value of 0.05.

Logistic Regression Analysis: Logistic regression analysis was performed to identify the association between the degree of carotid artery stenosis and various risk factors. The odds ratio (OR) and 95% confidence intervals (CI) were calculated to determine the strength of associations.

RESULTS AND DISCUSSION

A total of 60 stroke patients participated in the study. The mean age was 45 years, with a higher prevalence among males. CDU revealed varying degrees of stenosis in the carotid arteries, with MRA confirming these findings.

Key Findings:

- **Demographic Data:** The participants' age distribution was as follows: below 25 years (5 participants), 25-34 years (12 participants), 35-44 years (20 participants), and 45 years and above (23 participants).
- **Gender Distribution:** 40 males and 20 females participated in the study.
- **Risk Factors:** The major risk factors identified were hypertension (80%), diabetes (65%), smoking (50%), dyslipidemia (45%) and a positive family history (30%).

Table 1: Age and Gender Distribution

Age Group	Male	Female	Total
<25	3	2	5
25-34	8	4	12
35-44	14	6	20
45+	15	8	23
Total	40	20	60

Table 2: Distribution of Risk Factors

Risk Factor	Frequency	Percentage
Hypertension	48	80%
Diabetes	39	65%
Smoking	30	50%
Dyslipidemia	27	45%
Family History	18	30%

Table 3: Degree of Stenosis on Colour Doppler Ultrasonography (CDU)

Degree of Stenosis (%)	Frequency	Percentage
<50%	25	41.67%
50-69%	20	33.33%
70-99%	10	16.67%
100% (occlusion)	5	8.33%

Table 4: Degree of Stenosis on Magnetic Resonance Angiography (MRA)

Degree of Stenosis (%)	Frequency	Percentage
<50%	23	38.33%
50-69%	21	35.00%
70-99%	12	20.00%
100% (occlusion)	4	6.67%

The findings from this study indicate a significant correlation between CDU and MRA in detecting carotid artery stenosis[4]. The degree of stenosis observed in both imaging modalities was consistent, underscoring their reliability in clinical practice. The study also revealed a higher prevalence of stenosis among patients with risk factors such as hypertension and diabetes.

The correlation between the degree of stenosis and the severity of stroke symptoms highlights the importance of early and accurate assessment of carotid artery stenosis. This can guide therapeutic decisions, such as medical management, lifestyle modifications and surgical interventions, ultimately improving patient outcomes[5].

Statistical analysis showed a significant association between risk factors and the degree of stenosis. For instance, patients with hypertension and diabetes were more likely to have severe stenosis. This finding aligns with existing literature, emphasizing the role of these risk factors in the progression of carotid artery disease[6].

The study's limitations include the relatively small sample size and the single-center design, which may limit the generalizability of the findings. Future research with larger, multi-center cohorts is necessary to validate these results.

Logistic Regression Analysis:

- **Hypertension:** The odds ratio for severe stenosis in patients with hypertension was 4.2 (95% CI: 2.1-8.3, p-value <0.01).
- **Diabetes:** Diabetes was significantly associated with severe stenosis (OR = 3.5, 95% CI: 1.8-6.7, p-value <0.01).
- **Smoking:** Smokers had a higher likelihood of severe stenosis (OR = 2.9, 95% CI: 1.4-5.9, p-value <0.05).
- **Dyslipidemia:** Patients with dyslipidemia showed increased odds of severe stenosis (OR = 2.4, 95% CI: 1.2-4.8, p-value <0.05).
- **Family History:** A positive family history was associated with severe stenosis (OR = 1.8, 95% CI: 0.9-3.7, p-value >0.05).

CONCLUSION

This study highlights the critical role of Colour Doppler Ultrasonography and Magnetic Resonance Angiography in evaluating extracranial carotid arteries in stroke patients. Both imaging techniques are effective in detecting carotid artery stenosis, which is crucial for managing stroke risk factors and guiding treatment strategies. Early detection and accurate assessment of carotid artery stenosis can significantly impact patient management and outcomes.

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