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Do Vascular Risk Factors Affect Hand Recovery in Patients with Ischemic Stroke?

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Abstract:

Introduction: Hand dysfunction is a common long-lasting disability after ischemic stroke, impairing the quality of a patient's life.

Aim of the study: To determine how various vascular risk factors impact hand motor recovery in ischemic stroke patients.

Subjects and Methods: One hundred individuals suffering from acute to subacute ischemic stroke were enrolled. Patients were separated into two categories: group 1, which contained individuals without risk factors, and group 2, which included patients with risk factors. A hand grip dynamometer was used to evaluate hand function. A check-up was conducted three months afterward.

Results: Patients without vascular risk factors showed a significantly better improvement in hand grip power recovery than those with risk factors ($p < 0.05$).

Conclusions: Patients with vascular risk factors have poorer functional outcomes than those without risk factors.

Keywords: Ischemic Stroke; Hand Recovery; Vascular Risk Factors.

1. Introduction

Stroke is a significant reason for enduring disability on a worldwide scale [1]. The most common type of dysfunction caused by strokes is weakness in the upper limbs, leading to long-lasting and limiting effects on stroke patients' quality of life and productivity [2]. After a stroke, it is common to have a decreased ability to control finger movements, which can make it difficult to pick up and handle objects, impacting daily tasks and overall quality of life. It is important to assess precision grip

accurately for predicting outcomes, as it involves grasping objects with the thumb and fingertips [3].

2. Subjects and Methods

2.1. Subjects

We enrolled 100 patients who had been diagnosed with acute to subacute ischemic stroke.

Inclusion criteria

First-ever ischemic stroke onset within three months, Age >18 years, Mild to severe hand weakness, i.e. (MRC scale 0 to 4).

Exclusion criteria

Patients with disturbed consciousness level, ischemic stroke with no hand weakness, unstable hemodynamics, and recurrent stroke.

2.2. Methods

All cases underwent the following:

Gathering historical information and conducting a neurological assessment:

According to the neurology sheet of the Neurology Department, Fayoum University, with particular emphasis on diabetes, hypertension, smoking, cardiac disease and dyslipidemia. Cardiac comorbidity was determined according to ECG and Echocardiography. Diabetes mellitus was determined with FBS >126 mg/dl or 2 hr. plasma glucose >200 mg/dl or HbA1c> 6.5 as per American Diabetes Association guidelines [4]. Hypertension was identified as office systolic blood pressure (SBP) values exceeding 140 mmHg and/or diastolic blood pressure (DBP) values exceeding 90 mmHg as per the diagnosis [5]. Dyslipidemia was identified by high levels of serum cholesterol over 200 mg /dl, and triglycerides over 150 mg /dl as per diagnosis [6].

Assessment of hand function by hand grip dynamometer (hand grip strength test)

The Model AL 169 hand grip dynamometer from China was utilized to evaluate the maximum voluntary isometric grip strength. To assess grip strength, the elbow was positioned at a 90-degree angle with the forearm in the middle position. Participants exerted maximum force on the devices for a total of five seconds. Three tests were conducted with a break of two minutes between each one. The average of the three attempts was documented [7].

Follow up

Assessment was done after three months. Hand function was assessed by a hand grip dynamometer

2.3. Statistical methods

Information gathered and organized for easier handling, entered twice into Microsoft Access, and analyzed using SPSS software version 22 on windows 7 (SPSS Inc., Chicago, IL, USA). Basic numeric and percentage-based analysis of qualitative data, alongside mean values for central tendency and standard deviations for measuring dispersion in quantitative parametric data. The study began by analyzing quantitative data for normality using the One-Sample Kolmogorov-Smirnov test in each group before choosing inferential statistical tests.

3. Results

3.1. *Demographic data and risk factors*

In this study, the mean age was (55.7 ±9.7) years, ranging between 30 and 70 years. 76% were male,27% had hypertension,44% had diabetes, 25% were smokers,29% had cardiac disease, and 59% had dyslipidemia, as shown in **Table 1.**

Table 1: Demographic characteristics of the study population.

Variables		**Study group (N=100)**	
		Mean ±SD	**Range**
	Age (years)	55.7 ±9.7	30-70
		No.	**(%)**
Sex	Male	76	76%
	Female	24	24%
Hypertension	No	73	73%
	Yes	27	27%
Diabetes mellitus	No	56	56%
	Yes	44	44%
Smoking	No	75	75%
	Yes	25	25%
Cardiac	No	71	71%

disease	Yes	29	29%
Dyslipidemia	No	41	41%
	Yes	59	59%

3.2. Comparative data

There was no notable variance in hand grip scores among patients with and without risk factors. Hand grip score was statistically significantly higher after 3 months in non-hypertensive, non-diabetic, and non-smokers, and non-cardiac patients versus those with hypertensive and diabetes and smokers and cardiac patients and those without dyslipidemia versus those with dyslipidemia, as shown in **Table 2**.

Table 2: Comparison of hand grip scores.

Variables		**At baseline**	***P*-value**	**After 3-months**	***P*-value**
Hypertension	No	3.7 ±2.44	0.1	5.9 ±2.97	0.006*
	Yes	2.22 ±2.04		2.3 ±1.88	
Diabetes mellitus	No	3.16 ±2.1	0.3	6.4 ±2.9	0.04*
	Yes	2.1 ±2.44		2.38 ±2.45	
Smoking	No	4.14 ±2.1	0.4	7.6 ±2.7	0.004*
	Yes	4.4 ±2.29		4.6 ±2.44	
Heart disease	No	4.41 ±2.1	0.2	7.94 ±2.8	0.01*
	Yes	2.1 ±2.16		2.5 ±2.17	
Dyslipidemia	No	5.05 ±2.1	0.4	8.1 ±2.8	0.01*
	Yes	2.3 ±2.13		2.3 ±2.15	

3.3. Correlative data

There was a statistically significant negative correlation between hand grip scores after three months of follow-up with the patient's age (**Figure 1**).

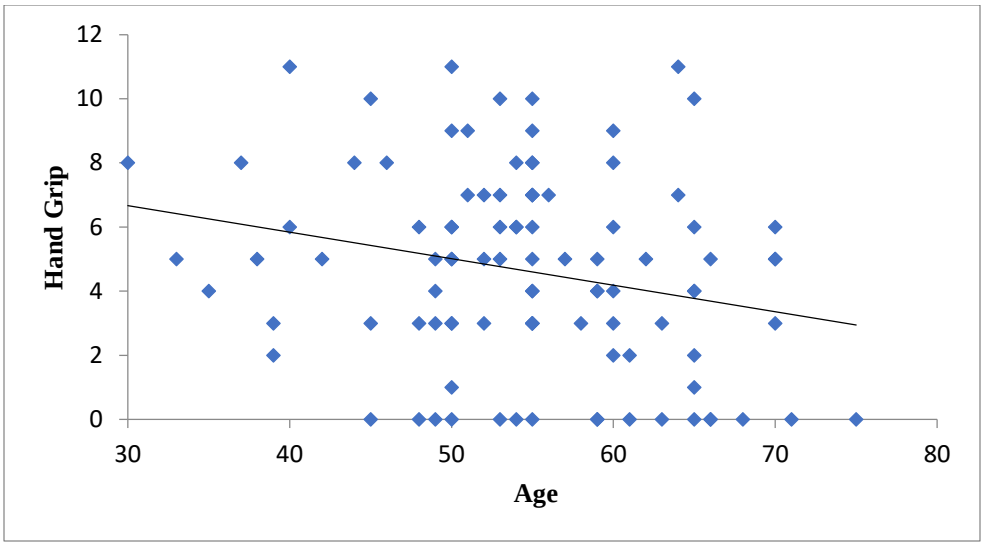

Figure 1: correlation between age and hand grip scores.

4. Discussion

In this research, a significant negative correlation was found between age and improvement in hand grip. This result was consistent with [8, 9], who postulated that younger subjects have greater potential to undergo plastic changes for motor recovery. As NSCs and their progenitors age, their proliferation and neuron production decrease, potentially leading to age-related cognitive decline and decreased plasticity crucial for certain forms of brain healing [10].

The patient's motor recovery was significantly influenced by the presence of diabetes when the Corticospinal tract was disrupted [11].

In this study, there was a statistically Significant difference regarding hand grip improvement in non-diabetics. This result was consistent with previous research that postulated that poor functional outcome was significantly higher in diabetic patients compared with non-diabetic patients [12]. Diabetes impairs the capacity for neuroplasticity such that patients experience a slower and poorer recovery after stroke [13]. That is because reductions in GABA-mediated intracortical inhibition seen in individuals with diabetes could impact the severity of damage following an acute ischemic stroke and hinder the cortical reorganization needed for later functional recovery [14]. This finding contradicted the

claim made by (15) that diabetes has no impact on motor outcomes, highlighting the importance of factors such as Corticospinal tract state, lesion location, age, lesion volume, and treatment method [11].

Hypertension is linked to unfavorable functional results following a stroke (16,17). In this research, there was a notable difference in hand grip improvement between non-hypertensive and hypertensive patients, with non-hypertensive patients showing greater improvement. This result was consistent with previous studies that found that hypertension has a negative correlation with functional outcome [18]. This is because high blood pressure affects the direction of microglial cells and leads to a state of inflammation linked to larger areas of tissue damage and poorer recovery. High blood pressure also hinders the growth of new neurons [19].

Smoking could lead to poorer functional results, higher chances of decline in functional status, and limitations in daily activities [20]. In this study, there was a statistically significant difference regarding hand grip improvement with more improvement in nonsmoker patients relative to smokers. As smoking causes vascular dysfunction, it impairs angiogenesis and the recovery of blood flow in ischemic areas [21].

Cardiac complications significantly impact the success of rehabilitation [16, 22]. In this study, there was a statistically significant difference regarding hand grip improvement, with more improvement in non-cardiac patients relative to cardiac patients. That is because cardiac comorbidities are linked to higher levels of CRP, interleukin, and other inflammatory markers that may lead to increased oxidative stress and damage to the endothelium [23].

In this research, a significant difference was found in hand grip improvement between patients with normal lipid profiles and those with dyslipidemia. Dyslipidemia has been shown to worsen ischemic damage by causing endothelial cell injury, oxidative stress, inflammation, and neuronal loss [24].

5. Conclusion

Patients with vascular risk factors have poorer functional outcomes of hand grip power concerning patients without risk factors.

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