Association of Body Mass Index with Mortality and Functional Outcomes in Patients with Stroke

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ABSTRACT

Background: *The burden of obesity is on the rise and it is the one of the main risk factors for stroke. Many studies has highlighted the term obesity paradox which highlights good outcome in obese and overweight patients after an episode of acute ischemic stroke. The outcomes are scaled by use of various scoring system and modified Rankin Scale (mRS) is one of them. This study aims to find out the relation of body mass index (BMI) with the functional outcome in stroke with the use of modified Rankin Scale and Glasgow coma score (GCS).* ***Methodology:*** *This study was a prospective cross sectional study carried out from January 2018 to December 2018 in Department of Medicine in Bir Hospital, Kathmandu. A total of 55 patients were enrolled in the study. Statistical analysis was done by SPSS 20.* ***Results:*** *Out of 55 patients (mean age 64.58 ± 15.19 years) were enrolled in the study where 27.27% were overweight and 30.90% were obese. Overweight and obesity were associated with good functional outcome with improvement in mRS score that was statistically significant ($p<0.05$).* ***Conclusions:*** *The result of our study showed BMI as a predictor of functional outcome in patients of stroke. Overweight and obese patients were found to have better recovery after an acute ischemic stroke.*

Key words: *Body mass index (BMI), stroke, Glasgow coma scale (GCS), modified Rankin Scale (mRS)*

1. INTRODUCTION

The World Health Organization estimates that one new patient suffers stroke every 2 seconds worldwide and one new patient experiences either death or disability every 6 seconds due to stroke.[1] Male gender, older age, smoking, Hypertension, Diabetes, dyslipidemia, obesity are risk factors for carotid disease and stroke in general.[2] Obesity is a well-recognized risk factor for stroke and overall mortality.[3] A paradoxical phenomenon of lower mortality or risk of recurrent vascular disease in obese patients with established disease was coined as the obesity paradox.[4-6] The modified Rankin Scale (mRS) is the most commonly used to measure post-stroke disability. It is increasingly used as a primary outcome in stroke trials.[7] However data regarding stroke patients are scarce in our setup. Thus we aimed to find out the relation of BMI in acute stroke with the functional outcome with the use of mRS and GCS.

2. METHODOLOGY

The study was cross sectional prospective observational study conducted from January 2018 to December 2018 in Department of Medicine of National Academy of Medical Sciences (NAMS), Bir Hospital, Kathmandu, Nepal. Ethical clearance was taken from the Institutional Review Board of NAMS, Reg. no. . The sample size was calculated by formula, $n = z^2p\ (1\text{-}P) / d^2$. Where n = required sample size, p = prevalence of stroke, q = 100-p, d = maximum tolerable error, z = statistical value for a level of confidence (for 95% level of confidence, z=1.96), With the prevalence of acute stroke of approximately 16.6% annually[8] and error of 10%, sample size would be 53 cases however 55 cases were enrolled for convenience.

Patient with first episode acute stroke, presentation within 24 hours, and diagnosis confirmed by CT Scan/MRI scan were included in the study while patients of subarachnoid hemorrhage or not having CT or MRI done were excluded from study. Data were collected using a structured proforma covering the relevant details. A detailed clinical history including family history of cardiovascular disease, past history of Coronary Heart disease, Peripheral arterial disease, Hypertension, Diabetes, Dyslipidemia, smoking and alcohol intake was taken and clinical examination

findings as well as laboratory findings were recorded accordingly. An initial brain CT scan on admission. was done. BMI was calculated by formula (BMI = body weight [kg]/height [m^2]). All Data were collected and entered in IBM SPSS 20.0. For the purpose of this study a 95% confidence interval was accepted and a p value <0.05 was considered statistically significant. Mean GCS, Modified Rankin score were also calculated and correlated with BMI.

Table 1: modified Rankin Scale(mRS)

Grades	Description
0	No symptoms at all
1	No significant disability: despite symptoms, able to carry out all usual duties and activities
2	Slight disability: unable to perform all previous activities but able to look after own affairs without assistance
3	Moderate disability: requiring some help but able to walk without assistance
4	Moderately severe disability: unable to walk without assistance and unable to attend to own bodily needs without assistance
5	Severe disability: bedridden, incontinent and requiring constant nursing care and attention
6	Death

3. RESULTS

A total of 55 patients with ischemic stroke were enrolled in this study. Out of 55 stroke patients, 31(56.36)were male and 24(43.63)were female. The number of male patients was higher than the female. On presentation hemiplegia/hemiparesis was present in all 55(100%) cases. Facial deviation was present in 45 (81.8%) cases, followed by aphasia 12(21.8%), loss of consciousness/ altered sensorium 3 (5.45%), Headache 5 (9%). None of the patients had history of seizure or monoplegia/monoparesis. Among ischemic stroke patients majority of them had lacunar stroke 20(36.36%) , 17(30.90%) of them had total anterior cerebral circulation stroke while 18(32.72%) were found to have partial anterior cerebral stoke and remaining.

Table 2: Anthropometric variables

Parameters	**Minimum**	**Maximum**	**Mean**	**SD**
Age(years)	35	93	64.58	15.19
Height(cm)	149	166	157.49	4.40
Weight(kg)	40	85	58.27	10.47
BMI(kg/m^2)	16.02	31.18	23.41	3.53

Table 3: Age and sex distribution with BMI

Age group	**BMI (kg/m2)**				**Total (%)**
	<18.5	**18.5 – 22.9**	**23- 24.9**	**≥25**	

<45	0	1	0	6	7 (12.72)
45-50	0	0	0	5	5 (9.09)
50-55	0	0	2	3	5 (9.09)
55-60	0	0	0	1	1 (1.81)
60-65	1	0	1	0	2 (3.63)
>65	7	14	12	2	35 (63.63)
Sex Distribution					
Male	1	5	13	12	31 (56.36)
Female	7	10	2	5	24 (43.63)

Table 4: Risk factors of ischemic stroke with BMI

Risk factors	**BMI (kg/m2)**				
	Underweight <18.5	**Normal 18.5-22.9**	**Overweight 23-24.9**	**Obese ≥25**	**Total (%)**
Diabetes	0	3	4	3	10 (18.18)
Hypertension	5	10	12	11	38 (69)
Smoking	5	8	14	10	37 (67.27)
Atrial fibrillation	0	2	0	1	3 (5.5)

Coronary heart disease	0	0	0	0	0
Dyslipidemia	1	8	4	1	14 (25.5)
Alcohol consumption	3	7	7	8	25 (45.5)
Valvular heart disease	0	0	0	0	0
Family history of ASCVD	1	0	0	1	2 (3.6)

Table 5: BMI and mean GCS at presentation

BMI	**GCS (Mean)**	**Standard deviation**	**P value**
<18.5	13.25	1.38	0.003
18.5 – 22.9	14	0.84	
23- 24.9	14.13	0.91	
≥25	14.29	1.40	

Table 6: mRS score with BMI

BMI (kg/m2)	**mRS (mean)**		**P value**
	Day 1	**Day 7**	
<18.5	4.87	*4.25*	0.061
18.5-22.9	4.8	*3.73*	0.043
23-24.9	4.87	*3.87*	0.04
≥25	4.35	*2.35*	0.01

The table shows mRS score of patients among various BMI ranges on day 1 and day 7 of admission. The patients with underweight BMI <18.5 kg/m2 there was no significant change in mRS from day 1 of admission to day 7. Whereas in overweight and obese patients there was significant improvement in mRS score from day 1 to day 7.

Table 7: Correlation of BMI and mRS

		BMI	MRS on admission	MRS on discharge
BMI	Pearson Correlation	1	-.365**	-.687**
	Sig. (2-tailed)		.006	.000
	N	55	55	55
MRS on admission	Pearson Correlation	-.365**	1	.710**
	Sig. (2-tailed)	.006		.000
	N	55	55	55
MRS on discharge	Pearson Correlation	-.687**	.710**	1
	Sig. (2-tailed)	.000	.000	
	N	55	55	55

**. Correlation is significant at the 0.01 level (2-tailed).

Table shows the correlation between the modified Rankin score on day 1 and day 7 and the BMI in stroke patients. It shows negative correlation that is lower the BMI in patients with acute ischemic stroke the poorer is the functional status of the patients as indicated by the scores on day 1 and 7. The relation is statistically significant as p value is less than 0.05. for Day 7.

4. DISCUSSION

Obesity and its consequences is one of the biggest problems in developed countries and lately it is also growing as a silent epidemic in developing countries. Obesity can be influenced by multifactorial causes with significant impact on morbidity and mortality. In contrary obesity has been found to be protective after an insult of acute stoke with better outcomes in overweight and obese patients.

This study included a total of 55 patients with 31 male and 24 female with male to female (M:F) ratio of 1.29: 1. A study conducted in Bangladesh showed F:M ratio of 1.43:1.[9] Study conducted by Devkota et al in medical college in Kathmandu showed M:F ratio of 1.39:1 and mean age at presentation of 61.65 years which was comparable with our study.[10] A study conducted in India found that approximately 27% of the patients with stroke were below the age of 50 years,[11] whereas in our study the stroke below 50 years of age was 23.63%. Comparable figures from developing countries including India vary from 18.0% to 35.0%.[76] A stroke study from Qatar reported 18.0% of its study population to be younger than 45 yrs.[12]

At least one of the risk factors were present in 7(13%) cases. No identifiable risk factors were present in 13%. Of known risk factors multiple risk factors was present in 43(78%) cases. These risk factors included hypertension 38(69%) patients, smoking 37(67%), dyslipidemia or under statin 14(25.5%), diabetes mellitus 10(18%), atrial fibrillation 3(5.5%), family history of ASCVD 2(3.6%) and alcohol consumption in 25(45.5%) cases. These risk factors were comparable with study done in Sri Lanka in 2313 adults of age ≥18 years. Hypertension was the most common risk factor 62.5% followed by smoking 50%, excess alcohol 45.8%, diabetes 33.3%, TIA 29.2% and family history 20.8%.[13] Stroke study in Qatar showed hypertension in 63% of its population.[12]

Among the 55 patients, the mean BMI value was 23.41 kg/m^2. The mean BMI in female was 21.57 kg/m^2 and that of male was 24.83kg/m^2. This shows that male were slightly overweight as that of female. This wass in agreement with the study done by Amatya M. et al. among medical students that showed higher range of BMI among male participants.[14] In this study the patients with BMI less than 18.5kg/m^2 had mean GCS of 13.25(SD 1.38) which was lower than the patients with BMI more than 25 kg/m^2 who had mean GCS of 14.29 (1.40). These findings were statistically significant (p value 0.003). This indicated that there was poor GCS at presentation in cases with lower

BMI groups. This finding was supported by study of Weiping Sun where lower BMI group presented with much lower GCS of 3 – 12 compared to patients of higher BMI groups with GCS at the range of 13 – 15 at presentation.[15]

The severity of disability as assessed by mRS score in BMI <25 kg/m^2 and BMI above 25 kg/m^2 was 4.8 and 4.35 respectively. Among the total of 17 patients in obese category 6(35.3%) cases had severe disability i.e. mRS of 5 while remaining 11(64.7%) presented with mRS score of 4. This result was consistent to a study done by W S Choo where only 34% of patient in obese category presented with severe disability with mRS score of 5 and the patients in lower BMI had more number of severe disability.[16]

In the present study it was found that among the patients in BMI of <18.5 kg/m^2 had mean mRS of 4.87 on day 1 and mRS of 4.25 on day 7 which shows there was no significant improvemt in functional capacity among those patients. On the other hand the mean mRs on day 1 and day 7 of patients in BMI ranges of 18.5- 22.9, 23 – 24.9 and ≥25 kg.m^2 were (4.8, 4.87) and (4.35, 3.73), and (3.87, 2.35) respectively. Correlation using Pearsons was statistically significant in our study as p value <0.05 on day 7 compared to day 1. Our findings were similar to those in a study conducted by Vemmos et al which showed significant association of disability with low BMI group. The study also showed the early impact of mortality among low BMI patients.[4] Similar results were seen in the study where they followed patients for longer period of time. Overweight and obese patients with stroke or TIA have better survival and better combined outcomes of survival and non-fatal functional status than patients with the BMI ,25 kg/m2.[17]

5. CONCLUSIONS

BMI is a quick and easily calculated parameter, it can be a good predictor of clinical and functional outcome in patients of acute stroke. The study found significant association of BMI with functional outcome in patients with ischemic stroke using modified Rankin Scale scoring and Glasgow coma scale. Thus BMI can have a predictive role in management and prognosticating in ischemic stroke.

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7. Conflicts of interest: None

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