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Blood Pressure and Hematoma Expansion in Hemorrhagic Stroke

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ABSTRACT

Introduction

Hematoma expansion after hemorrhagic stroke can lead to devastating consequences. An important factor associated with this is high blood pressure. This study was carried out to find out what proportion of patients with hemorrhagic stroke develop hematoma expansion and whether blood pressure during presentation could be associated with it.

Methods

This prospective observational study was carried out over a period of one year in patients who were admitted with the diagnosis of hemorrhagic stroke. The collected data were entered into and analyzed by using the Statistical Package for the Social Sciences version 26 after obtaining approval from the Institutional Review Committee of the Institute of Medicine, Tribhuvan University.

Results

Out of 83 patients included in the study, history of hypertension was present in 72 (86.7%). Hematoma expansion occurred in 11 (13.3%). There was no statistically significant associations between mean systolic, diastolic, and mean blood pressures between patients with and without hematoma expansion [(168.9±35.6, 164.5±28.5, t(81)=0.47, p=0.64), (101.8±18.9, 101.2±19.6, t(81)=0.10, p=0.92) and (124.2±23.6, 122.3±21.5, t(81)=0.27, p=0.79) respectively (values in mmHg)]. Majority of patients with hematoma expansion had high absolute systolic blood pressure (27.3% vs 26.4%) and high absolute diastolic blood pressure (54.5% vs 38.9%); however, the associations were not statistically significant (p= 1.00 and 0.33 respectively).

Conclusions

High blood pressure is highly prevalent but hematoma expansion is not common in patients with hemorrhagic stroke. There was no statistically significant association between history of hypertension, gender, patient age, absolute and mean blood pressures, and hematoma expansion in our study.

Keywords: hematoma; hypertension; intracranial hemorrhages; Nepal.

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INTRODUCTION

Stroke is an acute focal neurological deficit with presumed vascular cause. Hemorrhage accounts for 10-15% of all types of strokes.[1] Mortality of hemorrhagic stroke is 30-40% while a majority still remains disabled.[2,3] A recent meta-analysis has shown that 26.8% of strokes are hemorrhagic in Nepal.[4] In a single-center study, the mortality rate of hemorrhagic stroke was 14.4%, two times that of ischemic stroke.[5] Hypertension, being the commonest cause of hemorrhagic stroke, also doubles its risk.[6,7] Hematoma expansion, defined as a 33% increase in hematoma size compared to baseline scan occurs in 27 to 44% of patients within 24 hours of hemorrhagic stroke.[8,9] Hematoma expansion could lead to early neurological deterioration, death, and morbidities.[9] High and uncontrolled blood pressure is the strongest predictor of hematoma expansion.[10] This study was carried out to find out the proportion of patients with hematoma expansion and its association with blood pressure at presentation in hemorrhagic stroke.

METHODS

This descriptive observational study was carried out in a prospectively collected data over a period of one year from 17th November 2021 till 16th November 2022. All patients who were 18 years or older and were admitted to the Department of Neurology of Tribhuvan University Teaching Hospital, Kathmandu, with the diagnosis of hemorrhagic stroke were included in the study. Patients were included only after they or their caregivers, incase patients couldn't communicate, provided written informed consent. Convenience sampling was used to include the patients in the study. The variables that were studied were age, sex, history of hypertension, blood pressure on admission, and status of hematoma expansion after 24 hours of onset of symptoms. The diagnosis of hemorrhagic stroke and hematoma expansion was made by a computed tomography (CT) scan of the head. Hematoma expansion was defined as an increase in size of the hematoma by more than 33% baseline scan.[8] In our center, all patients with hemorrhagic stroke undergo a repeat CT scan of the head after 24 hours of the onset of symptoms if the first scan was done within the first 24 hours as per standard guidelines.[11] The proposal to carry out the research and to study the variables was approved by the Institutional Review Committee of the Institute of Medicine, Tribhuvan University [IRC Ref. No. 179 (6-11) E2; 078/079]. Self-designed proforma was used to collect the data. The collected data were entered into and analyzed by using the Statistical Package for the Social Sciences (SPSS) version 20. The continuous variables were analyzed by using means, medians and t-test. The associations between categorical variables were analyzed by using Chi-Square and Fisher's Exact test. Other data were expressed as frequencies and percentages.

RESULTS

A total of 83 patients with hemorrhagic stroke were admitted in one year. The mean age of the patients was 59.6 years (range 21-93 years, ± 13.3 years). There were 50 (60.2%) males and 33 (39.8%) females. A history of hypertension was present in 72 (86.7%) of the patients (Figure 1).

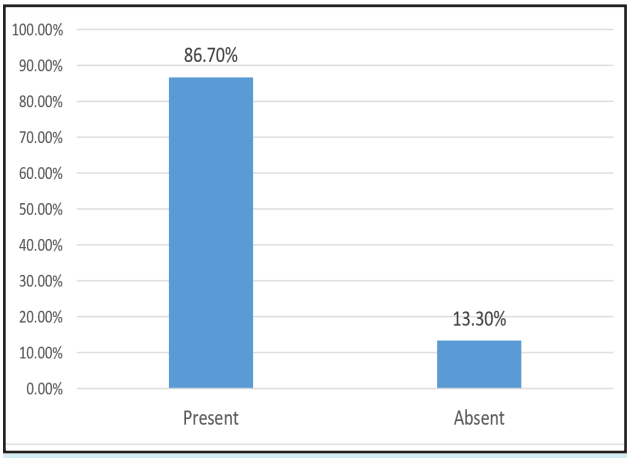

Figure 1. History of hypertension in the past.

The mean systolic blood pressure on admission was 165 mmHg (range 90-240; ± 29.3). The mean diastolic blood pressure was 101.3 mmHg (range 50-150; ± 19.4). The mean of mean blood pressure was 122.5 mmHg (range 63.3-173.3; ± 21.7). Hematoma expansion occurred in 11 (13.3%) of the patients (Figure 2).

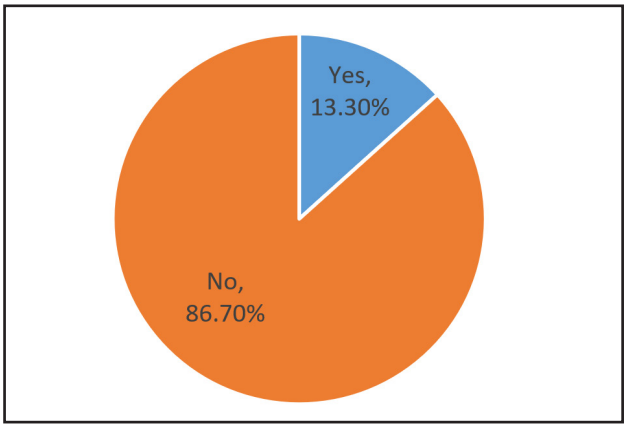

Figure 2. Hematoma expansion 24 hours after admission.

The association of continuous and categorical variables with hematoma expansion is shown in the following tables (Tables 1 and 2).

DISCUSSION

To our knowledge, this is the first study with this number of patients with hemorrhagic stroke studied within the timeframe of one year in a single center. In a study published from another tertiary care center in Nepal which collected patient data over the course of 3 years, the mean age of the patients with hemorrhagic stroke was 46.4 ± 23.2 years which is almost similar to our study.[12] The same study found that 54.9% of the patients were male and 45% were female. The sex ratio is also almost similar to our study. In a large-scale study from India which included 905 patients admitted over the course of 3 years, the mean age of the patients was also 58.10 ± 12.8 years.[13] There were 70.5% males and 29.5% females in the same study. Even though male to female ratio is not exactly similar, the mean age is almost similar to our study highlighting shared epidemiological risk factors between the neighboring countries. As eluded to previously, hypertension is the most common cause of hemorrhagic stroke and it is the most import-

Table 1. Association of hematoma expansion with continuous variables.

Variables	Hematoma Expansion		t-value	p-value
	Yes (n=11)	No (n=72)		
Mean ±SD Age (Years)	64.3±14.6	58.9±13.1	1.25	0.22
Mean ±SD SPP (mmHg)	168.9±35.6	164.5±28.5	0.47	0.64
Mean ±SD DBP(mmHg)	101.8±18.9	101.2±19.6	0.1	0.92

Table 2. Association of hematoma expansion with categorical variables.

Variables		Hematoma Expansion		p-value
		Yes (n=11)	No (n=72)	
Gender	Male	7 (63.6%)	43 (59.7%)	1
	Female	4 (36.4%)	29 (40.3%)	
Past Hypertension	Yes	9 (81.8%)	63 (87.5%)	0.64
	No	2 (18.2%)	9 (12.5%)	
Systolic Blood Pressure (mmHg)	≤ 180	8 (72.7%)	53 (73.6%)	1
	> 180	3 (27.3%)	19 (26.4%)	
Diastolic Blood Pressure (mmHg)	≤ 100	5 (45.5%)	44 (61.1%)	0.33
	> 100	6 (54.5%)	28 (38.9%)	

ant risk factor for both the first and recurrent hemorrhagic strokes.[6] In a small study from the capital city, the proportion of patients with hemorrhagic stroke who had hypertension was 78%.[14] In the study by Hegde et al from India, the proportion of patients with hemorrhagic stroke who had hypertension was only 57.8%.[13] This is in sharp contrast to our study as the proportion of patients with hypertension in our study is 86.7% which is very high. Hypertension is the most important and one of the most common risk factors for cardiovascular diseases in Nepal.[4,15] In a meta-analysis published in 2019, the prevalence of hypertension in Nepal ranged from 13.3% in adults less than 40 years to 36.8% in adults more than 40 years of age.[16] The same study states that the prevalence of prehypertension could be as high as 40.4% in the rural areas of Nepal. Making the situation even worse, multiple studies published in Nepal have found that almost half of the patients with hypertension are not aware that they have hypertension.[17] It is thus not difficult to visualize why hypertension could have been present as a risk factor in such a large proportion of patients in our study. Enlargement of the hemorrhage after hemorrhagic stroke is associated with neurological deterioration, excess mortality and morbidity.[9] Serial imaging of the brain in patients with hemorrhagic stroke have shown that the size of the clot usually enlarges in the first few hours after presentation in most patients.[18] In one prospective study of patients with hemorrhagic stroke, significant hematoma expansion occurred in 38% of the patients in the first 24 hours.[18] However, hematoma expansion can occur in 27 to 44% of patients within 24 hours of onset of symptoms.[9] In the large study by Hegde et al in India, the rate of hematoma expansion was around 5%.[13] Our rate of hematoma expansion of 13.3% is far less compared to the studies published in developed countries. The number of patients included in our study is small and this study was done over a period of only one year. This could be a reason behind the low number of hematoma expansion observed in our study. Another reason could be that this is a single-center study and findings couldn't be generalized. The hematoma expansion in our study is more compared to the study done by Hegde et al in India. We can attribute this to better care in India, however, it is still less compared to the developed countries. Factors other than patient care, like patient selection, might be responsible for this difference. One important factor that is associated with hematoma expansion and neurological deterioration after hemorrhagic stroke is high and uncontrolled blood pressure.[10,19] The mean systolic, diastolic, and mean blood pressures on admission in our study were 165 mmHg (range 90-240 ± 29.3), 101.3 mmHg (range 50-150; ± 19.4) and 122.5 mmHg (range 63.3-173.3 ± 21.7) respectively. As can be seen from Table 1, both the groups with and without hematoma expansion had very high and comparable different mean pressures. Remarkably, the differences were not significant. Similarly, as seen in Table 2, the proportion of patients with hematoma expansion had higher blood pressures compared to patients without hematoma expansion, however, the differences were also not statistically significant. Similarly, we couldn't find statistically significant association between the gender of the patients, past history of hypertension and hematoma expansion. Various factors other than blood pressure, gender and age are associated with hematoma expansion. In a large meta-analysis published in 2018, the factors that were found to be strongly associated with hematoma expansion were the time from symptom onset to baseline imaging, clot volume on baseline imaging, antiplatelet and anticoagulant use and spot sign in CT angiography of the brain.[20] Various other imaging markers of hematoma expansion and poor functional outcome have also been described.[21] These factors could have been responsible for hematoma expansion in our study too.

We had several limitations. This is a single center study done in a single department. The findings cannot be generalized. Some patients with hemorrhagic stroke with large bleeds who require surgical interventions from the outset get admitted under the care of the neurosurgery department in our center. These patients have not been entered into this study. The number of patients in our study is small. The earlier part of this study was affected by the third wave of the COVID-19 pandemic. This could have led to a smaller number of patients getting admitted to our center as our center was a government-designated care center for patients with COVID-19 infections. There are many other factors that could lead to hematoma expansion other than those that we have studied here, antiplatelet and anticoagulant use for example. We did not study these factors in this study. Also, the number of patients who developed hematoma expansion in our study is very small to allow the power of sufficient strength to draw meaningful conclusions to its association with various factors in this study. Still, this is the first study in the country that included 83 patients from a single center over a period of one year and can serve as a milestone to allow larger studies on hemorrhagic strokes to be carried out in the future.

CONCLUSIONS

High blood pressure is highly prevalent in patients with hemorrhagic stroke. Hematoma expansion is not common in our patients within 24 hours of onset of symptoms. Even though patients with hematoma expansion had high mean and absolute systolic, diastolic, and mean blood pressure compared with patients without hematoma expansion, there was no statistically significant association between these factors and hematoma expansion in our study.

Conflict of interest: None

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