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Research Article

The Impact of Initial Blood Pressure on Early Mortality of Patients Suffering an Acute Stroke

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Abstract

Background: High blood pressure (BP) in an acute stroke has been demonstrated to result in a poor prognosis in several studies; however, controversial results were obtained. This study was designed to investigate the correlation between an initial high BP on admission and early mortality.

Methods: This study is based on the medical records of 1725 patients, who were admitted to Haydarpasa Numune Training and Research Hospital, and diagnosed with stroke. A total of 1187 patients that met the inclusion criteria [849 (72%) with an ischemic stroke and 338 (28%) with a hemorrhagic stroke] were included in the study. BP levels were grouped as systolic BP (SBP) values and diastolic BP (DBP) values. In the determination of stroke severity on admission, the Scandinavian Stroke Scale was used. The stroke outcomes were defined as dead or discharged during a 10-day hospitalization stay.

Results: In hemorrhagic stroke, mean initial SBP and DBP values were found to be statistically higher among those who died, as compared to patients who were discharged ($p<0.01$). In ischemic stroke, no statistically significant difference was present between mean initial SBP and DBP levels in died and discharged patients ($p>0.05$).

Conclusion: The high initial SBP and DBP were found to be associated with deaths during the first 10 days after a stroke, but not with severity of stroke experienced by patients suffering hemorrhagic stroke. Further, they were not associated in ischemic patients with deaths during the first 10 days after a stroke or severity of stoke.

INTRODUCTION

The high rate of cerebrovascular diseases remains as one of the most important health issues due to the seriousness of this prognosis, in addition to the social and economic problems created by these ailments. Therefore, the treatment of these diseases is vitally important in reducing the resulting mortality and morbidity. One of the most important interventions for the treatment of strokes is to regulate blood pressure initially. In the early phases of a stroke, BP is most commonly defined as high [1-4], and the high rate spontaneously decreases in the first week [5]. Raised BP, after an acute stroke can be harmful because it increases the risk of cerebral edema, hemorrhagic transformation of the infarct, or expansion of the hematoma. Although high BP has been demonstrated to result in a poor prognosis in some studies [5-7], whether lowering a high BP can improve the prognosis or not still remains unclear. The effects of an increasing BP on the perfusion of ischemic brain areas are still in doubt. Likewise, there is controversial data as to the effect of therapeutic BP alteration, during the acute phase of a stroke, on the outcome. For this reason, this study has focused on the impact of SBP and DBP on early deaths among acute stroke patients, as well as comparing the findings of previous studies on the subject in order to shed some light on the unknowns described above.

MATERIALS AND METHOD

This study investigated the medical records of 1725 patients who were diagnosed with stroke admitted to Haydarpasa Numune Training and Research Hospital. For patients who were admitted to the emergency room during the first 24 hours of their stroke, with their initial BP recorded, the following were excluded: transient ischemic attack, sinus thrombosis, subarachnoid hemorrhage, subdural hemorrhage, and brain tumor; and the remaining 1187 stroke patients [849 (72%) with an ischemic stroke and 338 (28%) with a hemorrhagic stroke] were included in the study.

Initial BP values from hospital records were reviewed, and measured values at home, during transportation to hospital or in the emergency room before the administration of antihypertensive treatment were accepted as initial BP. BP levels were grouped as systolic BP (≤119 mm Hg, 120-139 mm Hg, 140-

159 mm Hg, 160-179 mm Hg and ≥180 mm Hg) and diastolic BP (≤79 mm Hg, 80-89 mm Hg, 90-99 mm Hg, 100-109 mm Hg and ≥110 mm Hg). SBP≥180 mm Hg and DBP≥110 mm Hg were defined as upper threshold violation [8]. Additionally, measured BP values during visits on the 3rd morning were also recorded.

Each stroke was classified as ischemic or hemorrhagic on the basis of a clinical and brain MRI or CT. Ischemic strokes were classified according to arterial blood flow areas by cranial imaging methods as infarct of an anterior cerebral artery (ACA), a middle cerebral artery (MCA), a posterior cerebral artery (PCA), a vertebral artery, a basilar artery, and a lacunar. Hemorrhagic strokes were classified as putaminal, lobar, thalamic, cerebellar, pontine, and others (caudate, thalamocapsular and interventricular) according to bleeding at the site [7].

In the determination of stroke severity on admission, the Scandinavian Stroke Scale (SSS) was used [9]. The SSS evaluated levels of consciousness; eye movement; motor power in the arms, hands and legs; orientation; speech; facial paresis; and gait using scores ranging from 0 to 58 (maximum). The cutoff point of 15 for a SSS score was chosen because, in literature, an initial stroke severity of < 15 points is generally reported to be related to a poor prognosis and to represent the most severe stroke [9].

Age, sex, hypertension, diabetes mellitus (DM), coronary heart disease (CHD), atrial fibrillation (AF), hyperlipidemia (HL), obesity, history of strokes or transient ischemic attacks, smoking, and alcohol consuption, were recorded. The stroke outcomes included the deceased and other patients discharged during or after their 10-day hospitalization.

STATISTICAL ANALYSIS

In this study, findings were evaluated and SPSS for Windows 15.0 was used for statistical analysis. Besides the descriptive statistical methods, (mean, median, and standard deviation) in the analysis of data, a one-way ANOVA test was used to compare the quantitative data. On the other hand, the chi-square test and Fisher's exact chi-square test were used. Results were in the confidence interval of 95 % at a significance level of P<0.005.

RESULTS

A total of 1187 patients [665 females (55.8%) and 522 males (44.2%)] were present in this study. It was found that the youngest patient was 20, and the oldest patient was 103 years old, the average age for female patients was 68.9 +/-13.63, and for male patients, the average age was 66.74 +/- 12.69 (Table 1).

When localization of the infarcts of 849 patients with ischemic stroke was defined, it was determined that 462 (59.0%) had infarcts of MCA, 25 (2.9%) of ACA, 65 (8.0%) of PCA, 86 (10.4%) of basilar artery, 15 (1.8%) of vertebral artery, 150 (18.3%) of lacunar, and 12 (1.4%) of border.

When localization of the 338 patients with intracerebral hematoma was defined, the results were determined to be: putaminal in 140 (42.1%), thalamic in 111 (32.4%), lobar in 36 (10.6%), pontine in 33 (9.7%), cerebellar in 13 (3.7%), and five others (1.4%) with caudate, thalamocapsular, and ventricular.

In 392 of the patients (43.6%) with ischemic stroke and in 244 of the patients (69.9%) with hemorrhagic stroke, initial SBP levels were^3 180 mm Hg. In 222 patients (24.7%) with ischemic stroke and in 179 patients (51.3%) with hemorrhagic stroke, initial DBP levels were ^{3} 110 mm Hg. Initial SBP and DBP levels were statistically and significantly higher in a hemorrhagic stroke, as compared with an ischemic stroke (p<0.01) (Table 1).

To explore the association between mortality and initial BPs, records of 1187 patients were analyzed. Of 849 patients with ischemic stroke, 624 (73.4%) had been discharged, and 225 (26.5%) had died. Of the deceased and discharged patients, the mean initial SBP and DBP values were 168.68±41.65 and 168.58±41.05 (p=0.976), and 94.68±23.58 and 95.07±19.86 (p= 0.831), respectively. In patients with ischemic stroke, no statistically significant difference was present between the mean initial SBP and DBP levels, and at mortality (p>0.05) (Table 2). Of 338 patients with hemorrhagic stroke, 194 (57.3%) were discharged, and 144 (42.6%) died. While the mean initial SBP value was 205.28±43.27 in the deceased, it was 194.43±42.08 in those who had been discharged (p=0.022). However, the initial DBP values were 112.53±24.82 in the dead and 107.04±21.50 in those discharged (p=0.034). In patients with hemorrhagic stroke, the mean SBP and DBP values were statistically higher among the dead, as compared to those discharged (p<0.01) (Table 2). The SSS scales of 1187 cases, on admission, were defined as follows: most severe: 1-14 in 497 (41.1%) ; severe: 15-29 in 257 (22.9%) ; moderate: 30-44 in 258 (22.0%) ; and mild: 45-58 in 171 (15.0%). According to the scores on admission, no statistically significant differences were found between the distribution rates of the SBP and DBP values (p>0.05).

The 3rd-day decrease in initial SBP values were significantly higher in the deceased (p<0.01), but no difference was found between both groups in terms of the 3rd-day decrease in initial DBP values (p>0.05).

DISCUSSION

Increased BP in the early phase of stroke is believed to be

Table 1: Baseline characteristics of patients with stroke.

Variables	Ischemic(n=849)	Hemorrhagic(n=338)	P value
Age, Mean (SD)	68.66 (13.39)	64.57 (12.36)	<0.001
Female, n (%)	495 (58.3)	169 (50.0)	0.009
Male, n (%)	354 (41.7)	169 (50.0)	0.009
HT, n (%)	526 (62.2)	242 (72.7)	0.001
DM, n (%)	173 (20.4)	53 (15.7)	0.063
AF, n (%)	189 (22.3)	12 (3.6)	<0.001
CHD, n (%)	176 (21.9)	72 (22.0)	0.923
Smoking, n (%)	87 (10.3)	24 (7.1)	0.096
HL, n (%)	71 (8.4)	18 (5.3)	0.071
Obesity, n (%)	48 (5.7)	17 (5.0)	0.678
TIA, n (%)	36 (4.2)	0 (0.0)	<0.001
Alcohol, n (%)	26 (3.1)	12 (3.6)	0.661
CVA, n (%)	203 (23.9)	58 (17.2)	0.011
SBP on Admission, Mean (SD)	168.72 (41.27)	199.05 (42.86)	<0.001
DBP on Admission, Mean (SD)	95.19 (20.90)	99.37 (23.09)	<0.001

Table 2: Blood pressure in patients with stroke- ıschemic versus hemorrhagic.

Variable	Ischemic(n=849)		Hemorrhagic(n=338)	
	Discharged(n=624)	Dead(n=225)	Discharged(n=194)	Dead(n=144)
Mean SBP	168.68±41.05 *P=0.976*	168.58±41.05 *P=0.976*	205.28±43.27 *P=0.022*	194.43±42.28 *P=0.022*
Mean DBP	94.68±23.58 *P=0.831*	95.07±19.86 *P=0.831*	112.5±24.82 *P=0.034*	107.4±21.50 *P=0.034*
	Discharged(n=624)	Dead(n=225)	Discharged(n=194)	Dead(n=144)
Mean SBP	168.68±41.05 *P=0.976*	168.58±41.05 *P=0.976*	205.28±43.27 *P=0.022*	194.43±42.28 *P=0.022*

special in cerebrovascular events. This situation, which emerges as a means of increasing perfusion in the the area of brain tissue with hypo-perfusion [10], is also recognized as a serious reflection of neuro-endocrinal stress. As shown in many other studies [11,12], our study has also found that, in nearly half of the patients with ischemic strokes, and in more than half of the patients with hemorrhagic strokes, both SBP and DBP values were higher during the initiation, regardless of the patient's history of hypertension. In patients with a history of hypertension, these values tended to be much higher. The fact that the level of BP was higher among patients with hemorrhagic stroke, in comparison to those with ischemic strokes, is seen as possibly resulting from the increase in systemic pressure through what is called "Cushing reflex", an increase in intracranial pressure under the mass impact of the hematoma.

In many previous studies, it was shown that a high BP is associated with a poor prognosis and/or death [1,4,10,12-15], and that only a high SBP is associated with a poor prognosis [5]. They also found that there was a "U" or "J" type relationship between the SBP and the prognosis [13] and that only a mean BP had an impact on a poor outcome while the SBP or DBP had a more limited effect [16-24].

In all of these studies, patients that had been hospitalized within the first 24 or 48 hours of the onset of acute strokes were included and, with the exception of prospective studies, in all cases, the BP values recorded at the moment of admission to the hospital were taken as the initial BP.

An assessment, in terms of outcomes was made, of patients who continued to live either under hospital care or from the point of being discharged. Their indolence or disability was monitored in the course of the following 1, 3, and 6 months, extending to a maximum of 5 years. Data were obtained mostly from hospital records and, in some cases, follow-up and sequential measurements of prospective studies were also included. The upper limits recorded for BP values recorded in various studies constituted the most important variable in the literature. For instance, in one study, SBP>140 and DBP >90 was considered the high BP value, while in another, the high BP value was given as SBP>220 and DBP>110. However, despite these substantial differences in the values taken as high BP, the studies reached similar conclusions.

It should be noted that, while in some studies the relationship between low blood pressure and the prognosis was assessed, in many others this factor was not taken into consideration at all.

The study with the highest number of subjects, though involving only ischemic patients, is the one by Leonardi et al., which examined 17,398 patients from the International Stroke Trial scheme. This study emphasized that both higher and lower BP values (SBP<120 mm Hg) were associated with poor prognosis.

According to this study, patients with SBP<150 mm Hg, had an increased risk of early death at a rate of 17.9 % with each 10 mm Hg decline in BP. The study stressed that the same level of decline also increased the risk of death within 6 months, as well as the risk of dependency. Patients with SBP >150, however, were observed to have a lower rate of increased death risk at 3.8 % with each 10 mmHg rise in their BP, with no impact on the risk of death within 6 months or on the ratio of dependency. The study explained this situation with edema triggered by high BP impacting the prognosis negatively and, thus, leading to death [15]. The study published by Okumura in 2005 based on hospital records of a total of 2,101 patients, all affected by either ischemic or hemorrhagic strokes, showed that high BP was associated with a poor prognosis within the first 30 days of the stroke [16].

A recent study was performed as multi-centered in China by Yonghong Zhang et al. Admitted to the hospital during the first 24 h, a total of 3938 individuals with 2178 ischemic and 1760 hemorrhagic strokes, including subarachnoid hemorrhage, were included in the study. BP values were measured on admission three times within 30 min, and the mean value of these three measurements was accepted as the initial BP. During their hospital stay, all patients were evaluated as to the association between the survival rate and disability, and mean BP. As a result, a significant difference was identified between the death rates and disability in patients with hemorrhagic stroke, although no such a difference was observed in those with ischemia. In the same study, the risk of disability was also found to be lower in patients with high SBP [25]. Consistent with these findings, mean BP values on admission of those later deceased were found to be higher in the hemorrhagic group, as compared to the discharged patients. However, no statistically significant difference was found between the mean BP of the discharged and the dead patients in the ischemic group.

However, the fact that no association was present between high BP and a poor prognosis [19] or high BP was suggested as being associated with a good outcome [26]. This is among controversial issues reported by several studies. In a study conducted in 1984, Allen concluded that high BP was associated with a good outcome, unless the high BP continued severely after 24 h [26]. The reason why high BP was associated with a good outcome was that no patients over 76 who died within

the first 24 h, were included in the study by Allen. In another study conducted with 265 ischemic patients by Ahmed N. and Wahlgren G. to identify the association between high BP and the functional outcome, no significant difference was found between the patients with high and normal BP, although some difference was suggested to stem from the smaller number of participants and that only moderate or severe ischemic patients with stroke were included into the study. Moreover, in the study, high BP was reported to be a marker for a 21-day poor prognosis [1].

In all of the studies, whether retrospective or prospective, while high BP on admission was found to be related to deaths in patients with hemorrhagic stroke, different results occurred in cases with ischemia. Although the causes still remain unknown, other BP factors are considered to affect perfusion in the ischemic cerebral areas.

Another finding in our study was that, while the SBP that decreased on day 3, had been high on admission, it was significantly higher in those who later died. No difference was detected between the discharged patients and those who died in terms of a lower DBP. This condition suggested that alterations in SBP values were more effective in early mortality, compared to those in DBP values. Both high BP at an early stage and the fact that it is agressively decreased in the early stage had the same influence on a poor prognosis. Olivera-Fhilho et al. also reported that a sharp decrease in BP after a stroke was related to a poor prognosis 3 months later [27].

The most significant limitations in our study and earlier studies concerned interventions involving patients with high BP, where the effect of such interventions on survival rates was not indicated as to whether results were positive or not, and no rates were given. Further study to address this limitation would be beneficial.

An increase in BP was also observed after administering tPA as treatment for acute stroke. We believe that studies investigating the course of BP in stroke and its effect on a prognosis may also shed light on the effect of BP on the complication of intracerebral haemorrhages or haemorrhagic transformation that develop in patients treated with tPA. The number of such studies remains limited [28,29], so further studies are needed.

CONCLUSION

The high initial SBP and DBP were found to be associated with deaths during the first 10 days after a stroke, but not with severity of stroke experienced by patients suffering hemorrhagic stroke. Further, they were not associated in ischemic patients with deaths during the first 10 days after a stroke or severity of stokeVarious studies have reported different findings in terms of ischemic stroke cases, so further studies are needed to clarify such discrepancies.

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