Effect of Blood Pressure Variability during the Acute Period of Aneurysmal Subarachnoid Hemorrhage in Functional Outcomes

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Introduction

The relationship between blood pressure variability (BPV) and clinical outcomes in patients with subarachnoid hemorrhage (SAH) has not been studied. This study sought to identify whether BPV influences outcomes at last follow-up in aneurysmal SAH (aSAH) patients.

Methods

We conducted a retrospective review of all aSAH patients treated between 2007 and 2016. Included patients were diagnosed with aSAH on admission CT. Excluded patients had non-aneurysmal, traumatic SAH or mycotic aneurysms; expired within the first 24 hours of admission, had more than 4 SBP values missing, SBP records within the first 24 hours were not available, and if the time of admission was not recorded.

The primary outcome was a composite of good or poor functional outcomes at last follow-up, based on modified Rankin scale scores. Good outcome = 0-2; Poor outcome = 3-6.

Systolic blood pressure (SBP) values recorded: Mean systolic BP (SBP) Standard deviation (SD) SBP, Maximum SBP, Minimum SBP, Peak SBP (Maximum minus mean), Through SBP (Mean minus Minimum), Coefficient of variation (CV; SD divided by mean), and Successive Variation (SV; the square root of the sum of squares of differences between the successive available values, divided by the number of values).

$$SV = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n-1}(BP_{i+1} - BP_i)^2}$$

Figure 1. Successive Variation

Results

204 patients were included. The mean age was 56.8 years, and 66.2% of patients were female. 145 (71.1%) had a favorable and 59 (28.9%) had a poor outcome at a median of 18 months of follow-up.

On univariate analysis, patients with poor outcomes were older (p<0.01) had higher grades of Hunt and Hess (p<0.01), WFNS (p<0.01), modified Fisher scores (p=0.03) and were medically managed (p<0.01).

Analysis of systolic blood pressure parameters showed that a lower mean SBP over the first 24 hours (p=0.04) (Figure 2), a lower minimum SBP (p<0.01), but a higher peak SBP (p=0.02), and a trough SBP (p=0.04) predicted poor outcomes at last clinical follow-up (Table 1).

Variables	mRS 0-2 145 (71.1%)	mRS 3-6 59 (28.9%)	p-Value
First day antihypertensives	82 (56.6)	36 (61.0)	0.55
SBP variability metrics, mmHg			
Mean (Mean, SD)	131.4 (12.4)	127.6 (12.0)	0.046
SD (Median, IQR)	49.4 [45.9 - 53.5]	48.0 [45.6 - 52.4]	0.22
Minimum (Mean, SD)	108.4 (13.3)	101.3 (13.9)	<0.01
Maximum (Mean, SD)	152.1 (18.9)	152.8 (20.1)	0.82
Peak (Median, IQR)	17.2 [11.2 -27.8]	22.0 [16.6 - 36.2]	0.026
Trough (Median, IQR)	22 [16 - 8.6]	25.4 [19.5 - 29.6]	0.043
CV (Median, IQR)	37.6 [36.0 - 39.3]	37.8 [36.0 - 40.2]	0.27
SV (Median, IQR)	20.1 [14.0 - 26.7]	22.4 [16.6 - 28.9]	0.14

Table 1. Univariate analysis of SBP parameters

A multivariate analysis model was built with minimum SBP and controlling for age, Hunt and Hess and management. Minimum SBP did not predict functional outcomes at last follow-up (OR:0.96; 95% CI 0.93-1.009; p=0.13). Only Hunt and Hess (OR 2.37; 95% CI 1.54–3.65; p<0.01) surgical (OR 0.01; 95% CI 0.002–0.01; p<0.01), and endovascular management (OR 0.01; 95% CI 0.005–0.06; p<0.01) were independent predictors of functional outcomes (Table 2).

Conclusions

Systolic blood pressure variability in the first 24 hours of aSAH onset did not independently predict functional outcomes at last follow-up after controlling for potential confounders.

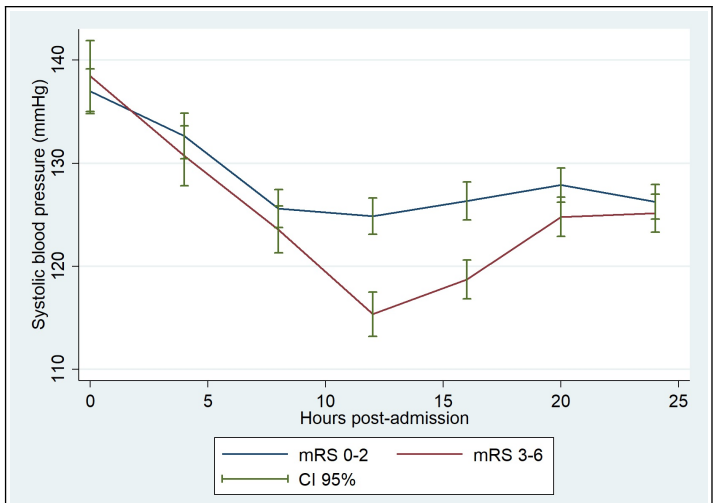

Figure 2. Mean SBP variability in the first 24 hours of aSAH onset

Variables	OR	95% CI	p-Value
Age	1.02	0.98 to 1.06	0.2
Hunt & Hess	2.37	1.54 to 3.65	<0.01
Management			
Surgical	0.018	0.002 to 0.125	<0.01
Endovascular	0.019	0.005 to 0.067	<0.01
Combined	0.194	0.009 to 2.64	0.19
Minimum SBP	0.96	0.93 to 1.009	0.13

Table 2. Multivariate model

References

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