Association of Blood Pressure Indices and Stroke Mortality in Isolated Systolic Hypertension

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**Background and Purpose**—Isolated systolic hypertension (ISH), systolic blood pressure (BP) $\geq 160$ mm Hg and diastolic BP (DBP) $< 90$ mm Hg, is associated with stroke; however, the correlation between specific BP indices and stroke mortality in ISH is not defined.

**Methods**—In a pooled analysis of 9 epidemiological studies, we examined whether pulse pressure (PP) was more predictive of stroke mortality than systolic BP (SBP), DBP, or mean BP (MAP) in persons with ISH. Subjects ($n=682$; 29% male; 77% white; mean age 63.6 years) with ISH, free of cardiovascular disease, and not on antihypertensive drug therapy at baseline were followed a mean of 13.0±7.3 years, and 54 stroke deaths occurred. The relative importance of each BP index was compared by the decrease in the $-2$ log likelihood (a measure of model agreement with data) because of the addition of 1 or a combination of BP indices to a Cox regression model. Hazards ratios (HRs) for fatal stroke for a 1-SD increase in each BP index were determined.

**Results**—PP was the best predictor of stroke mortality based on the decrease in the $-2$ log likelihood (10.65; $P=0.001$; HR=1.52), followed by SBP (7.19; $P=0.007$; HR=1.40), DBP (2.76; $P=0.10$; HR=0.80), or MAP (0.39; $P=0.39$; HR=1.10). Any combination of BP indices did not exceed a decrease in the $-2$ log likelihood of 10.72.

**Conclusion**—These data suggest that in persons with ISH, PP is a better predictor of fatal stroke than SBP, DBP, or MAP.

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**Key Words:** blood pressure ■ hypertension ■ stroke
the −2 log likelihood statistic when any 2 BP indices (ie, SBP−DBP, SBP−PP, SBP−MAP, DBP−PP, DBP−MAP, or PP−MAP) were added to the multivariable Cox model was 10.72 (df=2; P=0.005; Figure 1). This is the maximum decrease in the −2 log likelihood statistic attributable to any additive combination of these 4 BP indices. PP alone accounted for 99% ([10.65(PP)/10.72(2BP)] of the total possible decrease of the −2 log likelihood statistic attributable to any additive combination of BP indices.

We further examined models containing 2 BP indices. MAP was excluded because of its weak association. Because the decrease in the −2 log likelihood statistic attributable to any 2 BP indices was 10.72 (df=2; P=0.06) when DBP was added to a model containing SBP (model 2, Figure 2A). Similarly, the decrease in the −2 log likelihood was again much larger (112×) when PP was added to a model containing DBP (7.96 [10.72(2BP)−7.19(DBP); P=0.06] was 50× larger than when SBP was added to a model containing PP (0.07 [10.72(2BP)−10.65(PP); P=0.79; model 2, Figure 2A). In contrast, the decrease in the −2 log likelihood when PP was added to a model containing SBP (3.53 [10.72(2BP)−7.19(SBP); P=0.06] was 50× larger than when SBP was added to a model containing PP (0.07 [10.72(2BP)−10.65(PP); P=0.79; model 2, Figure 2A). 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**Discussion**

Our main finding was that PP was more predictive of stroke mortality than SBP, DBP, or MAP in of individuals with ISH. In our study, SBP (positively) and DBP (negatively) were significantly associated with stroke mortality when considered separately.

With increased peripheral resistance, increased cardiac output, or both, which begins sometimes in young individuals and often in aging subjects, SBP and DBP rise progressively with age. In contrast, because large-artery stiffness increases in middle-aged and elderly individuals, SBP rises but DBP falls, resulting in an increased PP, often with preservation of MAP in a stable, normal level. An increase in SBP with fixed DBP and a decrease in DBP with fixed SBP occur solely with an increase in PP. These findings imply that in persons with ISH, stroke mortality is more related to increased large-artery stiffness than to increased peripheral vascular resistance. These analyses may be more relevant to ischemic rather than cerebral hemorrhagic stroke. A major limitation of this study was the lack of knowledge about treatment of systolic hypertension during follow-up. Our data suggest that stroke mortality is more related to the...
pulsatile component, a marker for large-artery stiffness, rather than the steady component, which reflects peripheral resistance, of BP.

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**References**

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