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Twenty-four-hour ambulatory blood pressure monitoring–from silent to whispering brain damage

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Context

A significant number of antihypertensive drugs have been developed to inhibit putative neurohormonal mechanisms involved in the pathogenesis of hypertension. However, the BP control rate and primary prevention of cerebrovascular events remain lower than desirable. The risk for cardiovascular and cerebrovascular events depends not only on the magnitude of BP elevation but also on BP variables including circadian rhythm, BP variability, and day-night-time BP ratio. These BP fluctuations are detrimental risk factors for the circulation of the brain leading to silent or whispering brain damage. Brain damage can be the only hypertension-mediated organ damage affecting at least 30% of hypertensive patients for several years before developing symptoms [1]. Current assessment of brain injury depends primarily on overt neurological deficits; therefore, it may be too late for initial screening and prevention. The recently proposed term "ambibaric" brain for the dual (high and low) BP systems appears to play a crucial role in optimal brain health [2].

"Difficult to treat" cerebral hemodynamics

The brain circulation is divided into two compartments including (1) a high-pressure compartment with rapid BP drop across the vessels (the evolutionary old basal ganglia, thalamus, and midbrain), supplied directly by the right angle branches of the arteries of the circle of Willis, and (2) low-pressure compartment with a gradual drop in pressure, comprising of the hemispherical arteries and arterioles, a highly anastomotic network, which runs through the parenchyma [2]. The deep subcortical white matter is also supplied by these long penetrating low-pressure arteries. Thus, the pressure in the cortex is around 33-42% lower than that in the basal ganglia and the evolutionary old structures of the brain. Hypertension affects cerebral arterioles resulting in impaired autoregulation and an inward remodelling process associated with the changes in vascular passive diameter, wall thickness, and elastic properties of the resistance arteries in hypertension. A flow with high pulsatile energy is transmitted through, for example, the lenticulostriate arteries in the particularly vulnerable evolutionary old structures and may lead to structural damage with the corresponding neuroimaging correlates. On the other hand, the impaired autoregulatory capacity of the low-pressure compartment may lead to excessive hypotension in the presence of persistently high BP variability and impaired circadian rhythm (i. e. non-dipping, extreme dipping, rising). However, these changes are partly reversible even when the mean BP returns to normal [3]. Increased BP variability is associated with increased odds of

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developing and progressing white matter hyperintensities (WMH). Even in treated hypertensive patients, the burden of periventricular white matter lesions is higher than in normotensives [4]. This highlights the importance of specific cerebral circulation for the correct assessment of brain damage [1]. When hypertension is treated without considering the low- and high-pressure cerebral compartments, and 24-hour BP pattern, the hypertension-modified cerebral vasculature may convey hypotensive damage to the low-pressure compartments and pulsatile hypertensive damage to the high-pressure compartment.

Silent–whispering brain damage

Silent (subclinical) cerebrovascular disease refers to [5] the presence of neuroimaging markers for cerebrovascular damage that exceed those expected in normal ageing but without neurological symptoms (Table 1).

Silent brain infarcts are 10 times more common than clinically manifest infarcts and they can aggravate neurodegenerative disorders [5]. There is a functional distinction and the impairment in certain cerebral tracts may have manifestations (cognitive disorders), quite different from the expected neurological deficit. Thus, the presumed silent brain damage can manifest as "whispering" due to symptoms of cognitive decline. Further studies should explore both clinical cases.

The importance of the problem for the timely (early) detection of whispering brain damage has several explanations:

- Conceptual–if cognitive endpoints were used for the assessment of correlation between the neuroimaging and hypertension, it would be concluded that the brain damage was not silent. There is a neuro-vascular continuum: normal ageing - silent brain damage (visualized only in neuroimaging) and symptomatic presentation (neuroimaging and neurological deficit), accelerated by hypertension. To assess the precise position in the neuro-vascular continuum, patients should be assessed with several assessment methods (neurological, neuroimaging, biochemical, cognitive).
- Risk profiling–if changes are evident on brain scans, the risk for neurologically manifested/symptomatic stroke is increased independently of other cardiovascular risk factors.

Table 1. Silent cerebrovascular disease.

(1) Silent brain infarcts
(2) Lacunes
(3) MRI vascular WMH (considered ischaemic white matter demyelination)
(4) Cerebral microbleeds
(5) Enlarged perivascular spaces

Practical significance of 24 ambulatory blood pressure monitoring (ABPM)

Twenty-four-hour ambulatory BP monitoring (ABPM) allows for detecting BP dynamic changes over the

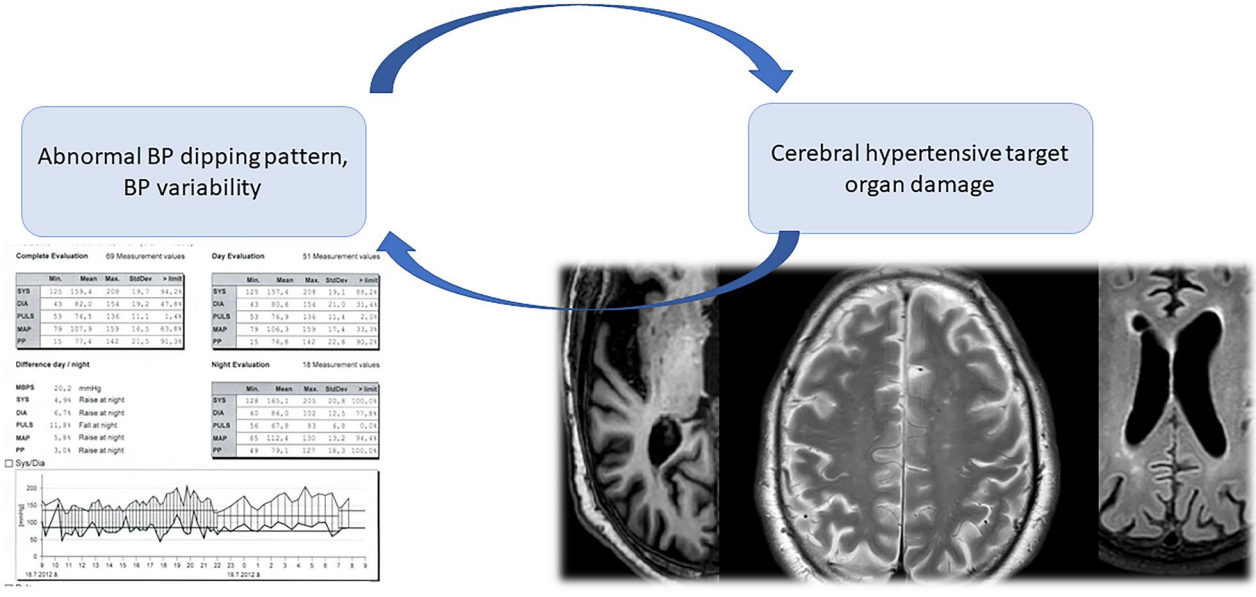

Figure 1. Relationship between abnormal 24-hour ABPM and whispering brain damage [9,10]–gliosis changes, lacunes microbleeds, silent brain infarcts, and accompanying brain atrophy on MRI.

Key point:

- Hypertension and hypotension affect cerebral hemodynamics, with changes in the deep white matter of the hemispheres in response to hypotension and the periventricular area to hypertension.
- Abnormal blood pressure (BP) circadian rhythm is relevant to silent brain damage, and stroke outcomes. Achieving target BP levels alone without considering BP variables (i. e. BP variability, alteration in dipping profile, too low-, too high BP, morning surge) may not be sufficient to ensure optimal brain protection, particularly in the case of partially reversible hypertensive vascular lesions.
- There are important reasons to identify cognitive impairment early ("whispering" hypertensive target organ damage) in the presence of altered BP variability. However, the treatment can be difficult due to different hemodynamic compartments in the brain and damage already developed.

24-hour of the systolic, mean, and diastolic levels, in response to heart rate changes and arrhythmia, BP variability, and alterations of the BP profile during night-time. Non-dipping and reverse dipping profiles were associated with both acute overt and silent cerebral infarction, leucoaraiosis [6], and cerebral microbleeds [7]. The presence of a non-dipping BP profile and increased BP variability have been linked to worse performance of cognitive function and incident dementia [8], as illustrated in Figure 1. Thus, long exposure to increased BP variability can serve as a marker of poor brain function. ABPM may be a powerful tool for the diagnosis of silent/whispering brain damage, providing better cerebrovascular prevention.

Conclusion

Hypertension and ageing contribute to the impaired structural and functional capacity of the cerebral microvasculature and large artery stiffening. Not all parts of the brain respond to BP changes in the same way. An abnormal 24-hour BP profile may pose an additional risk for cerebrovascular damage with the corresponding clinical manifestation of cognitive decline when considering the low- and high-pressure perfusion compartments of the brain. Neuroimaging can support the diagnosis and transition from silent to manifest cerebrovascular disease. Further studies are currently underway to further elucidate the triple correlation between 24-hour BP pattern, cognitive impairment, and neuroimaging markers. An abnormal ABPM profile in hypertensive patients should initiate screening for cognitive decline [1,8] and, if the deterioration is detected, diagnostic neuroimaging studies.

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References

[1] Scuteri A, Benetos A, Sierra C, et al. Routine assessment of cognitive function in older patients with hypertension seen by primary care physicians: why and how–a decision-making support from the working group on "hypertension and the brain" of the european society of hypertension and from the european geriatric medicine society. J Hypertens. 2021;39(1):1–4.

[2] Hachinski V, Østergaard L. The ambibaric brain: pathophysiological and clinical implications. Stroke. 2021;52(6):e259–e262.

[3] Sabharwal R, Chapleau M, Gerhold T, et al. Plasticity of cerebral microvascular structure and mechanics during hypertension and following recovery of arterial pressure. American Journal of Physiology. Heart and Circulatory Physiology. 2022;323(6):H1108–H1117.

[4] Vasan R, Song R, Xanthakis V, et al. Hypertension-Mediated organ damage: prevalence, correlates, and prognosis in the community. Hypertension. 2022;79(3):505–515.

[5] Wardlaw J, Smith E, Biessels G, Standards for Reporting Vascular changes on nEuroimaging (STRIVE v1), et al. Neuroimaging standards for research into small vessel disease and its contribution to aging and neurodegeneration. Lancet Neurol. 2013;12(8):822–838.

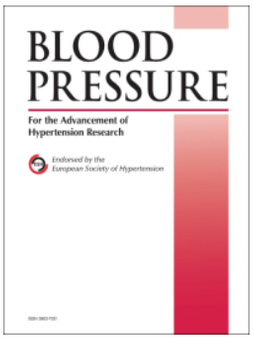
[6] Yang K, Zhu X, Feng Y, et al. Abnormal blood pressure circadian rhythms are relevant to cerebral infarction and leucoaraiosis in hypertensive patients. BMC Neurol. 2020;20(1):36.

[7] Klarenbeek P, van Oostenbrugge R, Rouhl R, et al. Higher ambulatory blood pressure relates to new cerebral microbleeds: 2-year follow-up study in lacunar stroke patients. Stroke. 2013;44(4):978–983.

[8] Rouch L, Cestac P, Sallerin B, et al. Visit-to-visit blood pressure variability is associated with cognitive decline and incident dementia. The S.AGES cohort. Hypertension. 2020;20276(4):1280–1288.

[9] Fodor DM, Marta MM, Perju-Dumbravă L. Implications of circadian rhythm in stroke occurrence: certainties and possibilities. Brain Sci. 2021; 11(7):865.

[10] Kumagai H, Oshima N, Matsuura T, et al. Importance of rostral ventrolateral medulla neurons in determining efferent sympathetic nerve activity and blood pressure. Hypertens Res. 2012;35(2):132–141.



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