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THE HAEMODYNAMIC GENESIS OF HYPERTENSION

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the Cold War ended and was aimed at increasing collaborative science in the basic life sciences. Now supported by 14 countries and the EU, HFSP research grants fund basic, interdisciplinary team-based research; research whose aim is to break through the known frontiers of science and foster collaboration across continents. Our postdoctoral Fellowships scheme offer top postdoctoral biologists and non-biologists the opportunity to change fields and research new ideas in a new laboratory in a new country. Thirty years on, 27 researchers funded by HFSP have gone on to win a Nobel Prize.

Servier organised in collaboration with servier ARTERIAL STIFFNESS AS A RISK FACTOR FOR CEREBRAL VASCULAR LESIONS

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Increased arterial stiffness, a biomarker of vascular aging, is a recognized subclinical organ damage, and may thus serve as predictor of cardiovascular disease. The predictive value of arterial stiffness is higher in patients with higher baseline cardiovascular risk, such as in patients with hypertension. According to European Society of Hypertension, increased arterial stiffness should be recommended as a negative prognostic factor in the management of patients with hypertension.

Arterial stiffness, an important determinant of transition of pulse wave energy from the heart into the periphery, could improve our understanding of the consequences of the hemodynamic-related vascular stress, especially in low-impedance organs, including the brain.

Epidemiological studies have demonstrated arterial stiffness as a risk factor for silent cerebral lesions, stroke, and cognitive impairment. Arterial stiffness was found to be independently associated with all components of cerebral small vessel disease including silent lacunar infarcts, white matter hyperintensities, and microbleeds, although there are some methodological differences between the various surrogate markers. Arterial stiffness may be important also in recovery after ischemic stroke. Aortic stiffness was found to be an independent predictor of both short-term clinical improvement and long-term functional outcome after ischemic stroke. Furthermore, increased aortic stiffness has been shown to be linked to acute hypertensive response after ischemic stroke.

However, the vascular, physiological, and metabolic roles of arterial stiffness in cerebrovascular diseases remain unclear. Better understanding of the hemodynamic consequences of arterial stiffness on brain damage is necessary, not only to select the most appropriate therapeutic management but also to optimize prevention, which should be started early in individuals at high risk of developing cerebral vascular lesions.

Focus update CHILDHOOD DETERMINANTS OF ARTERIAL DYSFUNCTION CENTRAL AND PERIPHERAL BLOOD PRESSURE

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Arterial Hypertension is one of the leading causes of death and disability worldwide. Measurement of peripheral brachial blood pressure using cuff sphygmomanometry belongs to the clinical routine assessment from childhood on. Based on age and length related reference values, it is widely accepted as surrogate marker of later cardiovascular events. Peripheral arterial pressure, however, does not necessarily reflect central aortic pressure, which seems to predict cardiovascular (CV) risk even better: many vital organs like brain and kidneys are perfused with aortic pressure, and keeping the systolic pressure amplification within the arterial tree in mind, the difference between peripheral and central blood pressure shows a wide variety.

Nowadays, oscillometric devices are able to measure central aortic as easy as peripheral blood pressure, but the clinical acceptance of the method is still low. Reference values for central arterial pressure in youth are existing and could help in CV risk stratification: we defined central systolic pressure ranges from 90 ± 5.8 mm Hg to 110.5 ± 9.6 mm Hg in boys and from 91.2 ± 7.5 mm Hg to 109.1 ± 8.6 mmHg in a cohort of 1445 children and young adults. Other central blood pressure measures, however, may show different results, and factors influencing the pressure amplification and end organ damage in childhood have to be defined in large series.

Debate ARE CENTRAL HEMODYNAMIC PARAMETERS BETTER PROGNOSTIC MARKERS THAN PERIPHERAL BLOOD PRESSURE IN STROKE?

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The complex pathophysiological mechanisms involved in stroke confound the associative and causal role of blood pressure. This is particularly relevant in monitoring changes in blood pressure with respect to treatment efficacy and stroke outcome, which is highly dependent on the both patient and stroke characteristics. However, whereas blood pressure may have a variable prognostic role in both the underlying causes of stroke as well as stroke outcome due to modifications of intracranial pressure and autoregulation of cerebral blood flow, particularly in the elderly, measures of pulsatile phenomena, such as arterial stiffness affecting wave propagation have been shown to be strong independent predictors of overall cardiovascular events. Aortic stiffness has been shown to be related to cognitive decline, cerebral small vessel disease and acute hypertensive response and outcome following ischemic stroke.

In this debate, a case will be made that measures associated with arterial stiffness (pulse wave velocity, magnitude of forward and backward waves, intensity of wave reflection), pulsatility of arterial pressure and flow and central aortic pressure are better prognostic markers than conventional brachial blood pressure for assessment of stroke outcome. Specifically, this will involve measurement of arterial stiffness gradient to assess the amount of pulsatile energy generated by central hemodynamics and that is transmitted to the peripheral cerebral tissue leading to potential microvascular damage. These measures can provide additional information beyond brachial blood pressure to enable better alignment of patient and stroke characteristics and so improve management of stroke and mitigate cerebrovascular risk.

The effects of aortic pulsatility impact on the heart, brain, kidneys and other vascular beds, particularly in the elderly with elevated blood pressure, in who pulsatility is enhanced due to large vessel stiffness and is transmitted further distally along blood vessels into smaller arteries, affecting target organs to a greater degree. The brain, like the heart and the kidney, "sees" central blood pressure more directly than peripheral, brachial, blood pressure. Thus, central blood pressure could be a more accurate and direct reflection of the pathophysiological effects of elevated blood pressure on the brain than peripheral blood pressure. Indeed, central blood pressure appears to have a closer correlation with risk of stroke or other target organ damage than peripheral blood pressure. However, peripheral blood pressure has been the subject of millions person-years studies, many of them with hard end-points such as stroke, myocardial infarction, renal failure, death, compared to a few thousand patient studies for central pressure and some measure of target organ damage. Brachial pressure is measured around the world, and definitions, thresholds and goals have been established on the basis of huge numbers of data. Beyond controversies on the accuracy and reliability of central pressure measurements, there are nowhere equivalent numbers available for central pressure or the data needed to provide evidence-based directives for treatment of elevated blood pressure based on central pressure. Thus, a small advantage in risk prediction does not justify the adoption of measurement of central pressure over a proven method that is cheaper and generalized across the world, including in low- and middle-income countries with financially constrained health care systems.

McDonald lecture THE HAEMODYNAMIC GENESIS OF HYPERTENSION

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Hypertension has classically been attributed to an increase in peripheral vascular resistance. Such an increase in peripheral vascular resistance would increase mean and diastolic blood pressure but have little influence on pulse pressure. However, hypertension in our ageing society occurs mainly as a

result of an increase in pulse pressure and hence in systolic blood pressure. Haemodynamic mechanisms leading to increased pulse pressure are complex and are best understood using a combination of detailed haemodynamic profiling in epidemiological studies, theoretical analyses, and experimental interventions. These underscore the importance of arterial stiffness, pressure dependence of arterial stiffness as a link between diastolic and systolic pressure and ventricular ejection characteristics as determinants of pulse pressure and pulse wave morphology. From the perspective of therapeutic interventions to prevent a rise in pulse pressure, it is key to understand the degree to which conventional anti-hypertensive agents may prevent or reverse arterial stiffening or whether this will be largely

dependent on the development of agents that have specific anti-stiffening effects. Ventricular ejection characteristics may depend on loading conditions, both pre-load and after-load, on central cardiac drive and on the intrinsic properties of the myocardium. As with arterial stiffness the relative importance of these factors and the degree to which they may be manipulated by conventional anti-hypertensive agents will determine future approaches to prevent or reverse systolic hypertension and its complication such heart failure. Tailoring the therapeutic approach to target individual haemodynamic determinants of hypertension may provide the best use of current and future treatments.