The Seventh International Workshop on Structure and Function of the Vascular System was held in Paris from March 12 through March 14, 2009. As with the preceding workshop (2007) the focus of the meeting shifted from large arteries toward a more integrative view on the structure and function of the vascular system, including the microcirculation. Recent insights have underlined the two-way traffic between the macro- and the microcirculation. On the one hand, pulse pressure generated in the macrocirculation penetrates deeper into the microcirculation than was previously believed. Increased pulse pressure at the level of the microcirculation causes functional and structural changes in the small vessels that contribute importantly to target organ damage. This is particularly the case in the renal pre- and postglomerular arterioles. On the other hand, the microcirculation is an important site of wave reflections in the arterial tree. Thereby, abnormalities in the microcirculation influence the contour of the pressure wave and the height of pulse pressure in the macrocirculation. A third potential interaction between the macro- and the microcirculation is the vaso-vasorum. Small arterioles have been found in the walls of larger arteries and may play a role in the structure and function of these arteries. Hypertensive disease is characterized by a “bad loop” between the macro- and microcirculation that maintains elevated blood pressure and causes target organ damage.

During the three-day symposium nine sessions were held. The first dealt with arterial stiffness and was opened with a lecture by Gary Mitchell. He reviewed how excessive pressure pulsatility leads to target organ damage on a microvascular level. Ian Wilkinson subsequently proposed that changes in endothelial nitric oxide production resulting from stiffness-induced alterations in local shear stress may underlie changes in endothelial nitric oxide production resulting from increased perfusion pressure at the level of the microcirculation, causing increased organ damage. This is particularly the case in the renal pre- and postglomerular arterioles. On the other hand, the microcirculation is an important site of wave reflections in the arterial tree. Thereby, abnormalities in the microcirculation influence the contour of the pressure wave and the height of pulse pressure in the macrocirculation. A third potential interaction between the macro- and the microcirculation is the vaso-vasorum. Small arterioles have been found in the walls of larger arteries and may play a role in the structure and function of these arteries. Hypertensive disease is characterized by a “bad loop” between the macro- and microcirculation that maintains elevated blood pressure and causes target organ damage.

The second session focused on the renal circulation. Pierre-Louis Tharaux stressed the role of endothelin in glomerulosclerosis. Anil Bidani presented evidence on the role of autoregulatory, myogenic responses of the glomerular vasculature to protect against hypertensive glomerular injury. The afferent arterioles sense and respond in particular to the oscillating systolic blood pressure signal. Gerard London reviewed his studies on carotid pulse wave analysis in end-stage renal disease patients. He concluded that in these patients characteristic impedance of the aorta is decreased. The clinical consequence is deeper transmission of pulsatile pressure to the renal microcirculation, causing increased organ damage.

The third session had a focus on molecular and hemodynamic determinants in vascular disease. Rhiouyz gave a state-of-the-art review on oxidative stress in vascular pathobiology. The central role of various forms of NADPH oxidases was stressed. Although most clinical trials on antioxidants have been negative, therapies against NADPH oxidase may be useful in minimizing vascular injury in hypertension and diabetes.3 Chantal Boulanger discussed the increasing evidence for a role of endothelial microparticles in cardiovascular disease. In the next presentation Bruno Panier reviewed methods to determine shear stress. It is now possible to directly evaluate the local shear rate by simultaneously recording of the changes in arterial diameter and changes in flow at the contact of the endothelium. In the next session clinical data on macro- and microcirculation were presented. Tine Hansen reviewed the determinants of ambulatory arterial stiffness index in 6 different populations. This index is derived from 24-hour ambulatory blood pressure recordings. Charalambos Vlachopoulos next discussed the influence of several environmental factors, including dietary factors and smoking on arterial stiffness and wave reflections. Jean-Jacques Mourad gave a review on how vascular endothelial growth factor (VEGF) affects the microcirculation and blood pressure. He concluded on the basis of a number of clinical studies that anti-VEGF therapy for cancer led to a significant rise in blood pressure. Sébastien Czernichow concluded this session with a presentation on a recent study on the macro- and microvascular changes in patients with the metabolic syndrome.

The fifth session was devoted to the ocular microcirculation. Inspection of the ocular microcirculation is one of the oldest methods to assess hypertension-induced organ damage in the clinic. Recent technological developments allow a refined measurement of the microvascular function and structure. Three speakers introduced such novel techniques and their application in hypertension research. Ronald Schneider showed that retinal arteriolar wall-to-lumen ratio is increased in untreated hypertensive patients and is associated with other parameters of target organ damage.4 Tien Wong reviewed the recent research of his team on retinal arteriolar narrowing in hypertensive patients. Their studies show that retinal arteriolar...
narrowing is detectable in young children with elevated blood pressure and with low birth weight. Simon Thom focused on the branching structure of the retinal vascular tree. Reduced branching angles associate with low birth weight, hypertension, and increasing age. Data from the Anglo-Scandinavian Cardiac Outcomes Trial (ASCOT) show a differential effect of various antihypertensives on the retinal microcirculation.

In the next session long-term follow-up studies on cardiovascular risk were presented. Stanley Franklin reported on recent analyses from the Framingham study concerning single versus combined blood pressure components and risk for cardiovascular disease. John Chalmers next presented new findings form the ADVANCE trial showing that both systolic blood pressure and pulse pressure are strong determinants of the risk of major cardiovascular, coronary and renal events, or cardiovascular death in patients with type 2 diabetes. Athanase Benetos concluded this session with a presentation on the role of metabolic syndrome and body composition on aortic stiffness in elderly men and women. He also presented data on novel techniques to assess pulse wave velocity.

Section 7 focused on new therapeutic strategies in vascular disease. Stéphane Laurent gave a lecture on recent morbimortality trials and their impact on management of hypertension and arterial disease. Damiano Rizzoni reviewed the studies performed by several groups in the past decade on microvascular remodeling. He focused in particular on the question how various therapeutic approaches affect microvascular structure. Jean-Sébastien Silvestre discussed the progress made in the past few years in the area of endothelial progenitor cells. The application of endothelial progenitor cell–based therapy for regenerative medicine constitutes a promising therapeutic avenue in the treatment of cardiovascular disease.

Section 8 had aging as its central topic. Jacques Blacher opened this session with a presentation on aortic stiffness, inflammation, denutrition, and prognosis in the oldest people (mean age: 85 years). He concluded that pulse wave velocity is a powerful determinant of prognosis in the elderly. Francesco Mattace Raso discussed the role of inflammation in isolated systolic hypertension in the elderly. Bryan Williams presented data on the impact of the HYVET trial on the management of the elderly (age: over 80 years) hypertensive patients. This study has confirmed that blood pressure lowering is one of the most effective therapeutic interventions in the very elderly.

In the final presentation in this session Samer Najjar showed that age-associated abnormalities in heart-arterial coupling during exercise stress are abolished by unloading the heart with sodium nitroprusside.

The final session was a roundtable discussion on systolic blood pressure and pulse pressure amplification and its control. The participants of this discussion were Alberto Avolio, Patrick Segers, Mary Roman, Carmel McEniery, and Luc Van Bortel. During the discussion precise definitions of pulse wave amplification were given. Subsequently the contribution of various segments of the arterial tree to pulse amplification were discussed; methods to measure central systolic blood pressure were reviewed; the relationship between central and brachial blood pressures to left ventricular hypertrophy and geometry was presented. Finally, therapeutic implications of altered wave reflections in hypertension were discussed.

As one overriding thought about this very stimulating workshop we were impressed about two important features. During the 1990s and the first years of the 21st century we saw a rapid rise in interest in the role of large arteries in health and disease. The June 2009 meeting of the European Society of Hypertension has four oral sessions devoted to large arteries, whereas only two to the kidney and one to the brain. We now see an increased focus on the interactions between the large arteries and the microcirculation. The workshop provided new insights in how these two segments of the vascular system influence each other. Future research should be aimed at answering remaining questions, such as the location of pulse wave reflection sites and the in vivo consequences of increased pulse pressure on the structure and function of the microcirculation. A second feature is the implication of research on arterial structure and function on the therapy of hypertension and related cardiovascular risk factors such as diabetes. Clinical trials have shown distinct advantages of drugs targeting the vasculature in the treatment of these risk factors. Future therapy of hypertension and diabetes should incorporate favorable effects on the vasculature, because a reduction of target organ damage is now regarded a major factor in reducing morbidity and mortality attributable to these risk factors. In this issue of Hypertension you can read a selection of papers that were presented during the workshop. Finally, we are most grateful to Servier for the unrestricted educational support for the workshop and the publication of its proceedings.

Disclosures

None.

References


Key Words: hypertension ■ peripheral vascular disease ■ remodeling ■ microcirculation ■ large arteries
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