

Arterial function and cardiovascular risk in dialysis

Forty years ago, Lowrie et al. (1) predicted that if a dialysis patient had survived long enough, the cause of his death would be cardiovascular disease (CV). In fact, several traditional and non-traditional factors cause an increase in CV mortality in dialysis patients (2). The patient on dialysis is often an old subject with hypertension, dyslipidemia, left ventricular hypertrophy, diabetes, and cardiovascular comorbidities. It is obvious to expect a high mortality in this type of patients. In addition, technological improvements and subsequent sophistication of dialysis techniques have not led to any reduction in mortality, resulting in a growing sense of frustration among nephrologists.

Recently, several studies have shown that elastic properties of arteries are an independent factor of CV mortality; therefore, we can introduce the concept of "Arterial system" (3): elastic pressure oscillation and elastic compliance allow an intermittent flow and provide a continuous perfusion of organs.

Central blood pressure is now used to describe pressure in the ascending aorta and it can be measured, highlighting the two separate components of blood pressure: a steady component (arterial pressure) and a pulsatile component (pulse pressure); both represent the continuous fluctuation of blood pressure around the mean pressure (4).

These physiological components of blood pressure may be altered by a number of significant traditional and non-traditional factors, as listed by Sarnak et al. (5). We must include early calcification of arteries in patients with chronic kidney disease or in those undergoing dialysis (6, 7).

In hemodialysis patients, cyclic inter-dialysis hydration and intra-dialysis dehydration can induce a worsening and an improvement of the alteration of the elastic properties of the arterial walls, respectively, as demonstrated by Yıldız et al. (8) in this issue entitled "Acute effects of ultrafiltration on aortic mechanical properties determined by measurement of pulse wave velocity and pulse propagation time in hemodialysis patients." published in *Anatol J Cardiol*. They showed that dialysis ultrafiltration improves worsened aortic mechanical properties in 26 hemodialysis patients; dialysis significantly reduces pulse wave velocity (PWV) (11.21 ± 3.11 versus 10.48 ± 2.58 m/sec; $p=0.02$) and improves pulse propagation time (PPT) (55.61 ± 11.8 versus 58.97 ± 12.36 s; $p=0.04$); and PWV and PPT play an important clinical role in CKD patients. The authors used two measures complementary to each other. Indeed, PWV had an inverse correlation with PPT depending on the age, heart rate, and blood pressure levels. In fact, they confirmed that the elas-

tic wall function can be altered by a higher heart rate (8). The study has some limitations such as a small sample size and the need for serial measurements to obtain convincing conclusions; however, it confirms data of previous papers and indicates the way for proper and modern care of CKD patients and CV complications.

It is no more acceptable not to take into account an instrumental evaluation of ascending, descending aorta and of large peripheral arteries for cardiovascular assessment, especially if it is safe and easy to use and not invasive for the patient. Large peripheral arteries.

Our group showed that PWV changes over time in relation to ultrafiltration obtained during dialysis treatment and to subsequent fluid intake during the interdialysis period (9). Torraca et al. (10) showed that the measurement of PWV in 167 anuric patients before and after dialysis may result in 3 groups of subjects: 1) patients with PWV in the normal range before and after dialysis (26.3%); 2) patients with high PWV before dialysis that is normalized after dialysis (31.8%); and 3) patients with high values of PWV both before and after dialysis. These three groups differ among themselves: there is a greater need of antihypertensive drugs in the third group and significantly higher values of vascular calcification (808 ± 1221 versus 351 ± 673 versus 288 ± 744 Agaston score, respectively, versus second and first group; $p < 0.0001$) (9). Finally, daily dialysis led to a decrease in PWV in comparison with the schedule of 3-weekly dialysis in subjects with high PWV before dialysis and normal PWV after dialysis (in the routine dialysis schedule) (11).

This transformation does not occur in individuals with a high value of Agaston score, confirming that PWV is a strong predictor of mortality in end-stage renal disease and that the large arteries, in relation to their elasticity, are a real "organ" (London defines the arteries as a system) that adjusts blood flow throughout the body in a regular laminar blood flow to peripheral tissues (3, 12-14).

In conclusion, the arterial system is heterogeneous and is influenced by the stiffness gradient from the ascending aorta and proximal large elastic arteries as well as peripheral arteries (3). At present, it is no longer possible to focus our attention only on the measure of peripheral blood pressure considering what happens at the central level (4).

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