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The kidney in arterial hypertension

Luis M. Ruilope and Jose L. Rodicio

Hypertension Unit, Hospital 12 de Octubre, Madrid, Spain

Abstract
The kidney facilitates the development of arterial hypertension and suffers its consequences. Once renal damage is clinically manifested, a clear increase in cardiovascular risk appears. The coincidence of renal and cardiovascular damage strengthens the need for therapies attempting the simultaneous protection of both the kidney and the cardiovascular system.

Keywords: chronic renal failure; essential hypertension; microalbuminuria; proteinuria; renal function

Introduction

The existence of a close relationship between renal function and arterial hypertension has been widely documented. The kidney facilitates the initial elevation of blood pressure and in turn can suffer its consequences. An abnormality in renal function has been proposed to participate in the origin of arterial hypertension [1]. The existence of renal vasoconstriction from the very early stages of the disease seems to be the most plausible renal defect facilitating the increase in blood pressure [2,3]. Renal vasoconstriction can be accompanied by glomerular hyperfiltration [4] which may also contribute to, or trigger, the development of essential hypertension.

Established arterial hypertension is characterized by the presence of elevated renal vascular resistance, a normal renal blood flow and an increased filtration fraction [5]. Renal insufficiency can appear as a consequence of arterial hypertension through two different mechanisms [6]. The traditional view is that hypertension leads to renal failure as a consequence of glomerular ischaemia induced by damage to preglomerular arteries and arterioles with progressive luminal narrowing and a subsequent fall in glomerular blood flow. An alternative view is that hypertensive renal damage depends on the direct transmission of the elevated systemic pressure to glomeruli. This transmission would, in turn, facilitate glomerular hyperperfusion and hypertension leading to glomerular structural injury and progressive loss of renal function.

Detection of early renal damage

Table 1 lists the markers of early renal damage in human essential hypertension. Hyperuricaemia is present in up to 25% of untreated hypertensives [7]. Hyperuricaemia is the consequence of early renal involvement (nephrosclerosis) in essential hypertension [8] and is a component of the metabolic syndrome that frequently accompanies essential hypertension and increases cardiovascular risk [9].

The existence of microalbuminuria can be detected in a relevant percentage of both treated and untreated essential hypertensives. Microalbuminuria constitutes an excellent predictor of cardiovascular and renal risk in diabetes, and this also seems to be the case in essential hypertension [10]. In fact, microalbuminuria correlates with other cardiovascular risk factors commonly associated with hypertension and is an early marker of diffuse target organ damage in essential hypertension [11]. For all these reasons, microalbuminuria could be useful to identify patients at an elevated global cardiovascular risk for whom more aggressive preventive strategies or additional treatment measures are advisable.

Another indicator of early vascular renal damage in essential hypertension is the existence of a blunted renal haemodynamic response to protein loading or amino acid infusion [12,13] that correlates with the presence of vasoconstriction in the afferent arteriole. On the other hand, the presence of glomerular hyperfiltration has been shown to correlate with early target organ damage, in particular left ventricular hypertrophy when arterial hypertension is present [14]. Proteinuria can appear in a small percentage of the hypertensive population [15] and represents an independent risk factor for the development of cardiovascular events. Elevated blood pressure, in particular the systolic component, the presence of diabetes, black race, and elevated serum uric acid and triglycerides are

Correspondence and offprint requests to: Luis M. Ruilope, Unidad de Hipertension, Hospital 12 de Octubre, 28041 Madrid, Spain.

Table 1. Markers of early renal damage in essential hypertension

Hyperuricaemia
Increased urinary excretion of *N*-acetyl-β-glucosaminidase
Elevated urinary albumin excretion
Elevated urinary β_2-microglobulin excretion
Diminished renal haemodynamic response to protein loading or amino acid infusion
Glomerular hyperfiltration

all independent and early predictors for the development of nephrosclerosis and chronic renal failure in hypertension [16,17].

Chronic renal failure in essential hypertension

It is generally accepted that the treatment of arterial hypertension protects the kidney from the renal vascular injury induced by sustained elevation in blood pressure. The prevalence of renal insufficiency in mild and moderate forms of the disease seems to be $<5\%$ considering serum creatinine as the parameter that indicates the presence of chronic renal failure [17]. However, an adequate measurement of the glomerular filtration rate is needed in order to evaluate the prevalence of chronic renal failure in essential hypertension. In any case, the high prevalence of this disease in the general population enhances the relevance of this complication even considering that it is seen with a low frequency. Any increase in serum creatinine is also relevant because this parameter is a very strong independent predictor of cardiovascular risk [18]. The identification of the potential patients who would later develop renal failure is then of great interest. In this sense, the previously quoted predictors could be of value as well as the detection of potential genetic markers [19].

Last, but not least, a meticulous control of blood pressure to values $<130/85$ mmHg, or even lower if proteinuria >1 g/day is present [20], has to be attained when any degree of chronic renal failure is present. That blockade of the renin–angiotensin system could afford further protection for the kidney in essential hypertension [21], as it does in diabetics, remains as an interesting possibility.

Cardiovascular risk and renal involvement in arterial hypertension

A marked increase in global cardiovascular risk is seen from the early stages of renal damage caused by arterial hypertension [17]. In fact, the presence of microalbuminuria, proteinuria or mild renal insufficiency [17,22] is accompanied by an augmented prevalence of cardiovascular events and death. The predictive value, for an increased cardiovascular risk, of mild renal insufficiency in the general population has been stressed recently [23]. In agreement with what happens in arterial hypertension, clustering of associated risk factors seems to occur after the enhanced cardiovascular risk that accompanies the finding of mild renal insufficiency in the general population.

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