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Review article

Echocardiography in patients with chronic kidney diseases^{☆,☆☆}

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ABSTRACT

Vast majority of chronic kidney disease patients die from cardiovascular complications. Echocardiography is a fundamental method, which reveals many of them. They include especially dilatation and systolic dysfunction of the left ventricle and atrium, left ventricular hypertrophy, diastolic dysfunction of the left ventricle, heart calcification, which could lead up to the development of stenotic valvular disease, right ventricular dysfunction and pulmonary hypertension. Patients with chronic kidney failure differ from the general population by cyclic changes of hydration and by the presence of a low resistant arteriovenous shunt (hemodialysis access). These factors significantly affect the actual echocardiographic finding.

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Introduction

Chronic kidney disease (CKD) is defined according to KDIGO (Kidney Disease Improving Global Outcomes) 2012 guidelines as a functional or structural kidney abnormality, lasting for at least 3 months. CKD could be classified according to etiology, glomerular filtration rate and/or albuminuria [1] – see Table 1.

According to epidemiological data, CKD G3-G5 affects approximately 10% of adult population. Therefore, it is a state with serious medical, social and economic consequences. The most frequent CKD causes include especially type 2 diabetes mellitus, vascular disease (hypertension and renal artery disease), primary and secondary glomerulopathy or polycystic kidney disease in the Western countries.

Mortality of CKD patients

CKD increases cardiovascular morbidity and mortality even in the milder stages. In end-stage renal disease (ESRD) patients, the mortality is approximately 10 times higher than in age-matched controls. [2]. Cardiovascular diseases account for almost 50% of deaths. The understanding of the cardiovascular disease etiopathogenesis is a mandatory step in the attempt to lower ESRD mortality. Echocardiography has a pivotal role – similarly to other cardiological diseases.

Hemodynamic fluctuations, adequate dry weight setting

Dramatic changes of hydration occur especially in anuric patients – continuous water retention is followed by the fast fluid loss by ultrafiltration during hemodialysis. ESRD patients suffer usually from arterial hypertension with the need of pressure-lowering medication – both blood pressure itself and the effect of antihypertensive medication changes according

to the hydration status. These factors lead to considerable variability of the parameters measured during echocardiography as we will show below. The diagnosis of heart failure is difficult to establish in ESRD patients, because the heart failure symptoms cannot be easily distinguished from the symptoms of pure hyperhydration. Echocardiography also plays a role in the adequate estimation of the dry weight – especially by the diameter and collapsibility of the inferior vena cava (Table 2). Other signs of elevated central venous pressure include the right atrial dilatation, leftward shift of the atrial septum, tricuspid valve E/e' ratio higher than 6 and predominance of the systolic flow in the superior vena cava and/or in the hepatic veins.

Lack of guidelines, recent attempt of unification

It is probably the high variability of echocardiographic findings, which is responsible for the fact that up to now there are no official guidelines of the European Society of Cardiology or of its American counterparts for the echocardiographic examination of patients with CKD. The cardiologists' knowledge of CKD patients specifics is usually inadequate and the cardiac complications are mostly managed by the nephrologists. This is probably why different cut-off values not respecting the current echocardiographic Guidelines were used.

Recently established “Acute Dialysis Quality Initiative XI workgroup” suggested therefore a new classification of heart failure in ESRD patients. It is based on the presence of 3 criteria: (1) echocardiographic evidence of structural heart disease; (2) shortness of breath, which cannot be explained by pulmonary disease; (3) improvement of congestion symptoms by ultrafiltration [3]. The same group chose the following 8 echocardiographic signs of the structural heart disease [4] – the latter is present in case of positive finding of at least one criterion – see Table 3. Despite it is a positive attempt to the standardization of the structural heart disease in ESRD patients, we have the following objections: (1) most importantly, pulmonary

Table 1 – Chronic kidney disease classification [1].

CKD level according to GFR		CKD level according to albuminuria		
Level	GFR (ml/min/1.73 m ²)	Level	Albuminuria (mg/24 h)	Albumin/creatinine ratio in urine (mg/mmol)
G1	≥90	A1	<30	<3
G2	60–89			
G3a	45–59	A2	30–300	3–30
G3b	30–44			
G4	15–29	A3	>300	>30
G5	<15			

GFR = glomerular filtration rate. G1 and G2 categories do not fulfill CKD criteria in the lack of renal damage evidence.

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