

Evaluation of renal function in primary care

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ABSTRACT

Evaluation of renal function is one of the primary tools used in treatment and monitoring kidney injury such as acute kidney injury (AKI) or chronic kidney disease (CKD) in Primary Care patients. Accompanying chronic diseases also have

an impact on the assessment of renal function, treatment monitoring and adjustment of drug doses.

Keywords: chronic kidney disease, acute kidney injury, Primary Care

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INTRODUCTION

Kidney function is determined by serum concentration of creatinine, glomerular filtration rate (GFR) and structural and functional integrity of the basement membrane and the morphological integrity of the glomerular capillaries [1]. In General Practice terms serum creatinine level and GFR are used.

Creatinine is excreted in kidneys in urine as a metabolite of creatine. The level of creatinine in serum is dependent on gender, age and muscular mass and weight [2]. The level might be overestimated in well-muscled people and those who eat large amount of meat [1].

In clinical practice estimated GFR (eGFR) is used, based on simplified Modification of Diet in Renal Disease (MDRD) and CKD-EPI (Chronic Kidney Disease Epidemiology Collaboration) formulas. The Cockcroft and Gault test is used for estimation of creatinine clearance in ml/min, which is important in drug dosage in patients with renal impairment [1].

REVIEW

In the practice of a family doctor, many factors affecting the function of the kidneys are interwoven. First of all, these are coexisting diseases, which contribute to development of chronic kidney disease (CKD). A special place is occupied by type 2 diabetes mellitus (T2DM) and hypertension (HA).

Diabetic nephropathy is the leading cause of stage 5 CKD and occurs in 1 in 9 persons with newly diagnosed T2DM [3]. Screening of renal function should begin at the time of type 2 diabetes diagnosis to detect the presence of a decreased estimated glomerular filtration rate (GFR) and/or an elevated albumin excretion rate [3]. According to recent data regarding harms from overly intensive glycemic control, a target hemoglobin A1c (HbA1c) of approximately 7% has been recommended, with a higher target for those with a limited life expectancy or an elevated risk of hypoglycemia [4].

Both pharmacological and non-pharmacological treatment are crucial in hypertension and its impact on renal function. Recommended blood pressure for patients with chronic kidney disease is $\leq 140/90$ mm Hg [4]. Decreasing blood pressure under 130/80 mmHg is debatable. Sodium consumption is an important consideration for blood pressure control in chronic kidney disease, what shows how vital modification of lifestyle and appropriate diet is, next to pharmacotherapy [4].

Nephroprotective properties of angiotensin-converting-enzyme inhibitors (ACEI) and angiotensin II receptor blockers (ARB) is well-known. ACE inhibitors can prevent elevated intraglomerular pressure and the associated development of glomerulosclerosis by reduction of

systemic blood pressure [5]. However, the combination of drugs from these groups is not recommended due to increasing the risk of hyperkalemia, increasing the risk of development and worsening of renal failure and increasing the risk of sudden deaths [6].

In patients with heart failure (HF) there is a third group of drugs recommended - MRB, which might increase renal failure due to additive risk of hyperkalemia especially in combination with ACEI or ARB.

HF and CKD frequently coexist, share many risk factors (diabetes, hypertension, hyperlipidaemia) and interact to worsen prognosis. A further deterioration in renal function, termed worsening renal function (WRF), is used to indicate an increase in serum creatinine, usually by >26.5 $\mu\text{mol/L}$ (0.3 mg/dL) and/or a 25% increase or a 20% drop in GFR. The importance of these apparently small changes is that they are frequent, they promote the development and progression of CKD and can worsen the prognosis of HF. Increases in creatinine during an AHF hospitalization are not always clinically relevant, especially when they are accompanied by appropriate decongestion, diuresis and haemoconcentration [7].

Large increases in serum creatinine, termed acute kidney injury (AKI), are relatively rare in HF and are probably associated with the combination of diuretic therapy with other potentially nephrotoxic drugs such as some antibiotics (gentamicin and trimethoprim), contrast media, ACEIs, ARBs, NSAIDs, etc. Of relevance, some of these drugs may accumulate if they are renally excreted. In HF, WRF is relatively common, especially during initiation and up-titration of RAAS inhibitor therapy. Despite the fact that RAAS blockers can frequently cause a decrease in GFR in patients with HF, this reduction is usually small and should not lead to treatment discontinuation unless there is a marked decrease, as the treatment benefit in these patients is probably largely maintained. When large increases in serum creatinine occur, care should be taken and should include assessment of a possible renal artery stenosis, excessive hyper- or hypovolaemia, concomitant medication and hyperkalaemia, which frequently coincides with WRF [7].

Drugs like diuretics, especially thiazides, but also loop diuretics, may be less effective in patients with a very low GFR, and if used, should be dosed appropriately (higher doses to achieve similar effects). Renally excreted drugs (e.g. digoxin, insulin and low molecular weight heparin) may accumulate in patients with renal impairment and may need dose adjustment if renal function deteriorates. Patients with HF and coronary or peripheral vascular disease are at risk of acute renal dysfunction when they undergo contrast media enhanced angiography [contrast-induced acute kidney injury (CI-AKI) [7].

In older men we must remember the prostatic obstruction is common and can interfere with renal function. It should therefore be ruled out in men with HF with worsening renal function. Drugs like α -adrenoceptor blockers can cause hypotension and sodium and water retention, and may not be safe in HF. For these reasons, 5- α -reductase inhibitors are generally preferred in the medical treatment of prostatic obstruction in patients with HF [7].

Diabetic treatment also affects renal function. When metformin is not associated with fast progression of chronic kidney disease (CKD), sulfonyleurea is associated with progressive CKD in patients with type 2 diabetes mellitus [7].

Caregarol et al. study have shown underestimation of exponents of renal function in patients with cirrhosis, caused by excessive dosage of potentially nephrotoxic drugs, which might lead to failure in diagnosis of renal impairment induced by medical treatment [8].

Numerous reports on the impact of smoking accompany lung diseases, with lung cancer at the forefront, but it is important to remember about the adverse impact of smoking on renal function. It has been shown clearly that the risk for high-normal urinary albumin excretion and microalbuminuria is increased in smoking compared with nonsmoking subjects of the general population. Smoking is particularly "nephrotoxic" in older subjects, subjects with essential hypertension, and patients with preexisting renal disease [9]. Also chewing of a nicotine-containing gum leads to a decrease of GFR and effective renal plasma flow [9].

In routine practice GPs are faced with multimorbid patients receiving a multiplicity of drugs. The main problem is the drug prescription is limited by chronic kidney disease.

For daily practice it seems reasonable to use the Cockcroft-Gault (CG) equation as a more conservative approach to dose adjustment in renal impairment [10]. However, not only CG equation can be used for drug dosage. By using the literature sources different numbers of drugs are to be adjusted following renal impairment. Also the recommendations concerning critical values of GFR requiring drug dose adjustment differed considerably among the different sources [10].

The specific situation occurs, when GP's patient in a hospital care setting the GFR may fluctuate substantially, so the renal function group and therefore the recommended dose, can change within a few days. The magnitude and prevalence of the fluctuation of renal function in daily practice and its potential effects on appropriateness of drug prescriptions after discharge from the hospital is unknown [11]. The benefits for healthcare professionals comprise of the creation, adjustment or confirmation of recommendations for the monitoring of the renal function after discharge from hospital of elderly patients [11].

The need for a holistic approach to patients with multiplicity of diseases and drugs leads to the need for cooperation between GPs and other specialists. For example appropriate cooperation and treatment between GPs and nephrologists is associated with better renal function preservation in patients with diabetes mellitus. It is connected with better blood pressure control, more frequently used angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, and statins [12]. A multidisciplinary team approach to chronic kidney disease may help optimize care of CKD and comorbidities [13,14].

CONCLUSIONS

In Family Medicine, evaluation of renal function is one of the major tests, that has an impact on the prevention of kidney diseases, early diagnosis of kidney disease, such as acute renal failure (AKI) or chronic kidney disease (CKD), also has influence of accompanying chronic diseases to the renal function, treatment monitoring and drug dosage adjustment. The correct assessment of their function and many interactions, both drug and disease, is the basis of the skill in the practice of the family doctor. It is also worth noting the need to form a unanimous position and recommendation on the determination of renal parameters, especially in post-hospital treatment.

Conflicts of interest

None declared.

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