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MODERN PRINCIPLES OF THE EFFECT OF HEMODIALYSIS THERAPY ON HEART RATE

Olimova Aziza Zokirovna
Bukhara State Medical Institute

Abstract: A significant proportion of deaths in patients with end-stage renal disease receiving hemodialysis treatment are attributed to those associated with coronary heart disease [Foley R.N. et al., 2020; Sarnak M.J. et al., 2013; Cheung A.K. et al., 2014]. The theoretical method of research was used. Many articles and dissertations by international scientists were analyzed, which were based on various books, dissertations, as well as electronic journals.

Keywords: hemodialysis, renal failure, coronary heart disease, arrhythmia.

Introduction

More than half of the deaths of patients on renal replacement therapy are due to cardiovascular pathology, the mortality from which in patients on hemodialysis is 30-35 times higher compared to the general population [Zavy A.S. et al., 1998; Herzog S.A., 2003; U.S. Renal Data System, 2009].

Over the past decades, in connection with the significant achievements of modern nephrology, the most characteristic features of the diagnosis, treatment, assessment of the severity of the course, prognosis and prevention of chronic kidney diseases have been studied. However, the analysis of public literature data shows that many aspects of the above problems remain poorly understood and controversial [1,2]. This is especially true for the study of the cardiovascular system, which undergoes significant changes in chronic kidney disease. A number of authors point out that in pathogenesis of the occurrence of cardiovascular changes, the leading role is played by arterial hypertension and anemia. In the stage of chronic renal insufficiency (CRF), the number of factors that adversely affect the activity of the myocardium increases [2,4,8].

Among these factors causing damage to the myocardium, along with the generally recognized ones - arterial hypertension and anemia, consider the direct effect of toxic substances of nitrogen metabolism - urea, creatinine, electrolyte imbalance, impaired water-salt metabolism, acid-base state, hypoproteinemia, as well as autoimmune factors. At the same time, it should be taken into account that the violation of cardiac activity in chronic renal failure does not occur with the isolated effect of one of the above factors, but with the combined effect of several factors at the same time. The occurrence of cardiac disorders to some extent significantly affects the clinical course of the underlying disease, determines the prognosis and outcome of the disease, and is often the cause of death in patients with CRF. Among cardiovascular complications, a prominent place is occupied by a violation of the rhythm and conduction of the heart muscle [1,3,9]. Therefore, determining the state of the heart rhythm is important in establishing a detailed clinical diagnosis, in assessing the severity of the course, prognosis and choice of tactics for treating patients with chronic renal failure. Despite the importance of this problem, in the literature available to us there are only a few works, especially in the study of the cardiovascular system, which undergoes significant changes in chronic kidney disease. A number of authors note that arterial hypertension and anemia play a leading role in the pathogenesis of cardiovascular changes. In the stage of chronic renal failure (CRF), the number of factors that negatively affect myocardial activity increases [2,4,8] The prognosis among hemodialysis patients with diabetes mellitus is even worse: 24% of patients are unable to overcome the annual barrier of hemodialysis therapy, and their five-year survival is 29% [U. S. Renal Data System, 2009].

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Patients with chronic kidney disease are prone to developing arrhythmias such as atrial fibrillation (AF)/atrial flutter, supraventricular tachycardia and sudden cardiac death (SCD). Although a variety of therapeutic options exist, including drug treatment, use of devices, and other interventions, their use in chronic kidney disease remains difficult and limited. Patients with chronic kidney disease, including end-stage renal disease, are generally not included in randomized trials of treatment strategies for arrhythmias, although this situation is currently changing. The Consensus of the Cardiovascular Society of Cardiology recently highlighted this gap in the management of patients with chronic kidney disease and cardiac arrhythmias. In order to establish the main aspects related to the best prevention, optimal management of such patients and the treatment of arrhythmias and their complications, the Kidney Disease: Improving Global Outcomes (KDIGO) group held an international multidisciplinary conference "chronic kidney diseases and arrhythmias" in Berlin, Germany, in October 2016

AF is the most common form of permanent arrhythmias [8]. Chronic kidney disease affects about 10% of the adult population worldwide [9], and these patients are more likely to develop AF. The prevalence of AF is high, with an established range of 16% to 21% in pre-dialysis chronic kidney disease [10-12] and 15% to 40% in dialysis patients [13-18]. Chronic kidney disease and AF have many common risk factors, which makes it difficult to assess the contribution of any factor to the development of the disease or its relationship with the prognosis. The presence of a pre-dialysis stage of chronic kidney disease is independently associated with the risk of AF [19-25], although this association is not so well studied in terms of the level of estimated glomerular filtration rate (eGFR) or proteinuria [13, 14, 6, 7]. In the United States, both the incidence and prevalence of AF are increasing among dialysis patients [27, 28], which may be associated with older patients, better diagnosis of AF, and improved survival after cardiovascular events.

Since for the first time in 1974 it was suggested that the acceleration of atherogenesis in uremia [Lindner A. et al, 1974], there is convincing evidence that chronic kidney disease is an independent risk factor for the development of coronary artery disease [Levey A.S. et al, 2003; Antman E.M. et al, 2004]. Signs of myocardial ischemia are detected in a significant proportion of patients starting hemodialysis treatment [U. S. Renal Data System, 2009], which in this population of patients has a number of features. In particular, not only traditional cardiovascular risk factors, but also a number of specific factors associated with uremic status have a significant impact on the development of atherosclerotic vascular changes [Foley R.N. et al., 1995a; Foley R.N. et al., 1996a; Foley R.N. et al., 1996b; Foley R.N. et al., 1996c; Parfrey P.S. et al., 1996a; Levey A.S. et al., 1999; Collins A.J. et al., 1999; Massy Z.A. et al., 2000; Johnston N. et al., 2008]. Among persons receiving dialysis replacement therapy, clinical signs of coronary artery disease are detected in 33-46% of cases [Foley R.N. et al., 1998a; United States Renal Data System, 2009]. At the same time, in a third of hemodialysis patients with coronary artery disease, atherosclerotic changes in the coronary arteries are slightly pronounced or absent according to coronary angiography [Rostand S.G. et al., 1984; Patrick S. et al.,' 2000; Eisner D. et al., 2001].

As can be seen from the presented data, in the initial stage of chronic renal failure, the values of glomerular filtration and tubular reabsorption are mainly moderately reduced with an increase in serum creatinine. Blood electrolytes and hemoglobin levels in most patients remained within normal values, with only a tendency to hyperkalemia with hypocalcemia and anemia. It is known that, before leading to CRF, chronic kidney disease can last from one to two decades and go through a number of stages, the conditional allocation of which is necessary for proper treatment planning, assessment of the severity of the course and prognosis. With this pathogenetic factor of cardiac arrhythmia in patients with the initial stage of chronic renal failure, the symptom complex of the underlying disease is mainly associated, primarily arterial hypertension and associated left ventricular hypertrophy. In the subsequent stages of CRF, the functional indicators of the kidneys sharply decrease, uremic symptoms, electrolyte imbalance, arterial hypertension,

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and anemia increase. Therefore, in severe and severe stages of chronic renal failure, cardiac arrhythmias are often observed, while the quantitative and qualitative composition of the arrhythmia increases to high gradations. Identified cardiovascular changes, especially cardiac arrhythmias, are important in planning the treatment of patients with chronic renal failure in the pre-dialysis period, since the hemodialysis procedure itself can drastically worsen the course of cardiac arrhythmias [4–7].

Thus, a violation of the heart rhythm and conduction is observed in all stages of CRF. According to the structure of cardiac arrhythmia, sinus tachycardia, atrial and ventricular extrasystoles, slowing of intraatrial and intraventricular conduction with impaired repolarization processes are most common, sinus bradycardia and group extrasystoles are less common. There is a relative correlation between the frequency and nature of cardiac arrhythmias with the degree of renal failure. As arterial hypertension, anemia, azotemia and electrolyte disturbances increase, the frequency and severity of conduction disturbances and cardiac arrhythmias increase. Establishment of clinical manifestations of cardiac arrhythmia in patients with chronic renal failure is important in terms of constructing conservative renal replacement therapy in the pre-dialysis period.

In elderly patients, these factors become more important [6]. The average age of people on HD therapy is constantly increasing [9]. According to the European Association for Dialysis and Transplantation, the proportion of patients over 65 years of age, which in 1977 was 9% of the total number of patients treated with HD in Europe, in 1982 reached 17%, in 1987 - 25%, and in 1992 - already 38% [11].

Many aspects of arrhythmias in patients with chronic renal failure remain insufficiently studied and controversial. In particular, the role of changes in lipid status and left ventricular hypertrophy (LVH) in the development of arrhythmias in patients with chronic renal failure, the role of various factors directly related to the HD procedure itself, is not clear. In the vast majority of cases, lethal cardiovascular complications are based on atherosclerosis, the development of which accelerates several times against the background of HD [10, 17, 18, 15]. In addition, there is strong evidence that dyslipidemia itself plays an important role in the progression of CKD [5, 6, 7]. At chronic renal failure is present simultaneously with the main risk factors associated with the development of atherosclerosis: long-term nephrogenic hypertension, dyslipoproteinemia, hyperinsulinemia and impaired glucose tolerance, the imposition of an arteriovenous fistula and the effect of the HD procedure, a violation of the blood coagulation system, as well as the frequent use of β-blockers for the correction of hypertension and hyperparathyroidism [3, 8, 6].

At the present stage of development of HD, the problem of psychosocial adaptation and improvement of the quality of life of patients with chronic renal failure receiving treatment for chronic HD is highlighted [9, 8, 12]. This problem has become especially urgent in connection with the technical improvement of hemodialysis therapy, which has led not only to an increase in the duration, but to the formation of a new, artificially created life [7, 8]. The presence of cardiac pathology, hypertension, electrolyte shifts, cardiac arrhythmias, along with the most thoroughly studied factors such as anemia, anxiety and depressive disorders, low blood albumin levels, the use of acetate dialysate during the HD procedure, are the most significant factors that reduce the quality of life of patients, receiving HD [2, 7, 8]. A higher level of quality of life was noted with the use of bicarbonate dialysis solution during the HD procedure compared with acetate [7, 4]. Acetate in the course of metabolic transformations restores the bicarbonate buffer system in the body. At the same time, it affects the synthesis of lipoproteins and fatty acids, contributes to the development of hyperlipidemia and an increase in the frequency of complications in the cardiovascular system [13, 3, 4, 11]. During acetate dialysis, tissue hypoxia and metabolic acidosis increase. Acetate contributes to the development of AH, destabilizes myocardial activity, which leads to tachycardia, arrhythmias, CH, and significant dilatation of the heart cavities [4, 6].

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