

### Hemodialysis treatment-related chronic complications in hypertensive people: integrative review

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## RESEARCH

HEMODIALYSIS TREATMENT-RELATED CHRONIC COMPLICATIONS IN HYPERTENSIVE PEOPLE: INTEGRATIVE REVIEW  
 COMPLICAÇÕES CRÔNICAS RELACIONADAS AO TRATAMENTO HEMODIALÍTICO EM HIPERTENSOS: REVISÃO INTEGRATIVA  
 COMPLICACIONES CRÓNICAS RELACIONADAS CON TRATAMIENTO DE HEMODIÁLISIS EN HIPERTENSOS: REVISIÓN  
 INTEGRADORA

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## ABSTRACT

**Objective:** To identify and analyze the main hemodialysis treatment-related chronic complications in hypertensive patients, as well as the prevention strategies. **Method:** This is an integrative literature review conducted in the VHL, BDNF, MEDLINE and SCIELO databases, by using the descriptors Kidney Failure, chronic, Hypertension, Hemodialysis, Cardiovascular diseases. **Results:** The main complications identified were: left ventricular hypertrophy (67.8%), heart failure (20.7%), heart arrhythmias (36.3%) and coronary artery disease (33.4%). Other factors also influence in these complications, namely: anemia, diabetes mellitus, dyslipidemias and the hydroelectrolytic changes. The appropriate monitoring of the blood pressure, the increased duration or frequency of the hemodialysis sessions, the use of antihypertensive and the early intervention in the modifiable risk factors are measures that control the evolution of these complications. **Conclusion:** The High Blood Pressure is the main risk factor of the cardiovascular complications and a chronic state of patients undergoing hemodialysis treatment. **Descriptors:** Chronic Kidney Failure, Hypertension, Kidney Dialysis, Complications, Cardiovascular Diseases.

## RESUMO

**Objetivo:** Identificar e analisar as principais complicações crônicas relacionadas ao tratamento hemodialítico em pacientes hipertensos, bem como as estratégias de prevenção. **Método:** Trata-se de uma revisão integrativa da literatura realizada nos bancos BVS, BDNF, MEDLINE e SCIELO, utilizando os descritores Insuficiência renal crônica, Hipertensão, Hemodiálise e Doenças cardiovasculares. **Resultados:** As principais complicações levantadas foram: hipertrofia ventricular esquerda (67,8%), insuficiência cardíaca (20,7%), arritmias cardíacas (36,3%) e doença arterial coronariana (33,4%). Outros fatores também influenciam nessas complicações, a saber: anemia, diabetes *mellitus*, dislipidemias e as alterações hidroeletrólíticas. O monitoramento adequado da pressão arterial, o aumento da duração ou frequência das sessões de hemodiálise, o uso de anti-hipertensivos e a intervenção precoce nos fatores de risco modificáveis são medidas que controlam a evolução dessas complicações. **Conclusão:** A hipertensão arterial é o principal fator de risco para as complicações cardiovasculares e um quadro crônico nos pacientes em hemodiálise. **Descritores:** Insuficiência Renal Crônica, Hipertensão, Diálise Renal, Complicações, Doenças Cardiovasculares.

## RESUMEN

**Objetivo:** Identificar y analizar las principales complicaciones relacionadas con tratamiento de hemodiálisis en hipertensos, y las estrategias de prevención. **Método:** Revisión integradora de la literatura realizada en las bases BVS, BDNF, MEDLINE y SCIELO utilizando los descriptors Insuficiencia Renal Crónica, Hipertensión, Diálisis Renal, Enfermedades Cardiovasculares. **Resultados.** Las principales complicaciones identificadas fueron: hipertrofia ventricular izquierda (67,8%), insuficiencia cardíaca (20,7%), arritmias cardíacas (36,3%) y enfermedad arterial coronaria (33,4%). También influyen en esas complicaciones anemia, Diabetes Mellitus, dislipidemias y las alteraciones hidroelectrolíticas. La monitorización adecuada de la presión arterial, el aumento de la duración o de la frecuencia de las sesiones de hemodiálisis, el uso de antihipertensivos y la intervención precoz en factores de riesgo modificables son medidas que controlan la evolución de esas complicaciones. **Conclusión:** La Hipertensión Arterial es el principal factor de riesgo de las complicaciones cardiovasculares y un cuadro crónico en los pacientes en hemodiálisis. **Descriptor:** Insuficiencia Insuficiencia Renal Crónica, Hipertensión, Diálisis renal, Complicaciones, Enfermedades cardiovasculares.

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## INTRODUCTION

In the last few decades, the deployment of specific sanitary measures, the advances in drug therapy, the scientific and technological development and increased life expectancy have been contributing to the population aging. The industrialization process, the disorderly growth of large cities, together with lifestyle changes, have made the population more susceptible to chronic and degenerative diseases.<sup>1-3</sup>

Chronic kidney failure (CKF), which is considered a chronic and degenerative disease, is a clinical syndrome caused by progressive and irreversible loss of kidney function. It results in local and systemic changes such as bone, mental, sleep rhythm, intraocular pressure and heart dysfunctions, besides anasarca and systemic arterial hypertension (SAH).<sup>1,2,4-6</sup>

Nowadays, hemodialysis is the most often kidney replacement therapy used as a treatment for CKF cases, which requires a stable heart function from the patient.<sup>7</sup> Such a therapy, over the years, has been providing greater longevity<sup>6</sup> to patients, being that it is considered safe and well tolerated by patients with Chronic Kidney Disease (CKD).<sup>8</sup> Nonetheless, the complications inherent in this process are still frequent, accounting for significant morbidity and mortality amounts.<sup>3,9</sup>

It is known that arterial hypotension, cramps, nausea, vomiting, headache, chest pain, back pain, itching, fever and chills are the main acute complications related to hemodialysis sessions.<sup>9</sup> However, there are important chronic complications related to the SAH establishment, since, at least, 80% of patients who start hemodialysis treatment are hypertensive.<sup>10-12</sup>

SAH associated with CKD arises from multifactorial<sup>11</sup> pathophysiological mechanisms, with an emphasis to the hydrosaline overload, as well as renin-angiotensin-aldosterone and

sympathetic nervous systems hyperactivation, endothelial dysfunction and chronic hyperparathyroidism.<sup>13</sup> Thus, SAH is considered a common complication in patients with CKF treated with hemodialysis and also a risk factor for development of chronic complications, especially the cardiovascular ones<sup>14-16</sup>, given the high mortality rate arising from these complications, even, surpassing voluntary dropouts to the hemodialysis treatment.<sup>19</sup>

In hemodialysis patients with chronic kidney disease, SAH causes structural changes in the cardiovascular system so much earlier in comparison with hypertensive patients without kidney disease. This is due to the CKF-related conditions such as overloaded volume, anemia, presence of uremic toxins and, even, the hemodialysis itself make the patient more likely to develop these complications.<sup>20</sup> Other factors that might interfere with their occurrence are the presence of diabetes mellitus (DM), increased creatinine levels, hyperparathyroidism, increased homocysteine levels, oxidative stress and elevated C-reactive<sup>21</sup> protein plasma concentration, besides smoking habit, obesity and dyslipidemia.<sup>22,23</sup>

Despite all this knowledge, the main clinical complications arising from these physiological changes caused by hemodialysis and SAH are not particularly summarized and discussed in literature, as well as the preventive measures to these complications. Based on the aforementioned considerations, the aim of this study was to identify and analyze the main chronic complications arising from the hemodialysis treatment related to SAH, by pointing out to prevention strategies for such complications.

This current study might be justified because the synthetic gathering of these knowledge sources is an important step to support the work of the nursing staff in an independent way or along with the multidisciplinary healthcare staff, by seeking improvements in the quality of

the provided services, complications prevention and adherence to the measures recommended by the professionals and patients themselves, besides encouraging further researches and teaching-learning shares.

## METHODOLOGY

This is an integrative literature review. This bibliographic review method allows a holistic understanding on the studied phenomenon, considering that it admits non-experimental and experimental studies about a particular study field. Furthermore, it enables the association between the theoretical and the empirical knowledge, as well as the inclusion of a wide range of purposes: defining the ideas, theories review and evidence, besides the analysis of problems in the set of rules of how to proceed in order to produce scientific knowledge about a particular theme.<sup>24</sup>

In this review, we have adopted the model proposed by the authors Souza, Carvalho and Silva<sup>25</sup>, which detail the production process of this study type in six stages: 1) defining the guiding question, 2) search of the literature, 3) data collection; 4) critical analysis of the included studies, 5) results discussion, and 6) integrative review presentation. Thus, as a starting point, the following question was formulated: *“What are the main chronic complications related to the hemodialysis treatment in hypertensive patients and their respective prevention strategies?”*

We have conducted a search in the electronic databases of the VHL, Brazilian Nursing Database (BDENF), Medical Literature Analysis and Retrieval System Online (MEDLINE) and Scientific Electronic Library Online (SciELO). Based on the health terminology MeSH, from the VHL, during the search, the controlled descriptors were used: *complicações, insuficiência renal crônica, hipertensão arterial, hemodiálise*, and their R. pesq.: cuid. fundam. online 2013. abr./jun. 5(2):3828-36

respective English versions.

Inclusion criteria established for the literature selection were: paper published between the period from 2001 to 2011, written in Portuguese, English or Spanish; showing resume for initial analysis and being available in its full version, by the databases themselves or by CAPES Periodicals Portal; besides discussing about the issue at stake. We have excluded theses, dissertations and educational stuff.

For extracting the data from the selected papers, we have used a previously validated tool in the literature.<sup>26</sup> Such a tool allows us to separately assess each item, by using a form that includes the following items: paper identification, methodological features of the study, assessment of the method accuracy, measured interventions and found outcomes.

Firstly, we carried out a pre-analysis of papers through critical reading of titles and detailed study of their respective *resumo*, abstract or *resumén*. After identification, possession and exhaustive exploration of the works, i.e., reading and rereading, we have selected those that actually mattered to the study. From the pre-analysis, we have selected 104 papers relevant to the issue. But, after applying the selection criteria, only 58 were selected and composed the sample.

## RESULTS AND DISCUSSION

We have found papers in three languages: Portuguese, English and Spanish, totaling 58 works published from 2001 to 2011. The most used descriptors by the authors of the papers were chronic kidney failure, end-stage kidney disease, hypertension, hemodialysis, epidemiology, left ventricular hypertrophy and cardiovascular diseases, being that some of these studies made use of kidney units and outpatient clinics as research fields.

Table 1 shows the average prevalence of the main chronic complications manifested in patients with SAH and CKF on hemodialysis treatment included in the reviewed studies and that mentioned the found values.

**Table 1:** Average prevalence of the main chronic complications arising from the association between hemodialysis treatment and SAH

Complications	Average prevalence (%)
Left Ventricular Hypertrophy	67,8
Heart Failure	20,7
Heart Arrhythmias	36,3
Coronary Artery Disease	33,4
Myocardial Ischemia	18,6
Peripheral Vascular Disease	12,9
Stroke	9,6
Myocardial Infarction	6,3

Regarding the preventive measures, the most reported in the reviewed studies were: increased time of duration or frequency of hemodialysis sessions; greater use of antihypertensive drug therapy; sodium and fluid intake restriction; heart function control; early referral and monitoring by nephrologists, as well as control and intervention in risk factors and constant monitoring of blood pressure.<sup>10,20,27-29</sup> Each one with specific action, however, all with one purpose: improving blood pressure and prevent or delay the progression of cardiovascular complications.

#### **Left Ventricular Hypertrophy**

Left ventricular hypertrophy (LVH) is the most prevalent heart abnormality in patients on regular hemodialysis.<sup>15,27</sup> The prevalence found in this study was lower in comparison to others. As an example, a bibliographic<sup>22</sup> review research has found that 94% of hemodialysis patients were at high risk for LVH. This complication is a consequence of both of SAH and the overloaded

volume<sup>18,28</sup>, which causes increased after-load and heart work.<sup>20</sup>

In addition to SAH, there are other risk factors for the development of LVH such as: advanced age, hemoglobin level and/or anemia<sup>22</sup> and parathyroid hormone level.<sup>29</sup> A study conducted with children with CKD records that anemia correction proved to be a factor able to significantly reduce the ventricular mass index in those hearts affected by LVH.

Furthermore, the lack of hemodialysis patient adherence to healthy lifestyles and limited consumption of sodium and water also contribute to the occurrence of dilated cardiomyopathies of this clientele.<sup>14</sup> Some authors<sup>17,29</sup> argues that a better volume control and of BP can revert LVH. Accordingly, some peridialytic measures are recommended, such as the thorough management of interdialytic<sup>19</sup> weight gain and extension of the hemodialysis sessions.<sup>10</sup>

#### **Heart Failure**

Heart failure (HF) is another cardiovascular complication arising from the hemodialysis chronic treatment. In this study, it has reached an average prevalence of 20.7%, although the reviewed studies present pretty diversified values. For example, a research conducted in a nephrology<sup>28</sup> service, in Spain, found a prevalence of 13.9%; another<sup>30</sup> methodologically very similar research, held in Japan, but in a cardiology service, found that 27% of hemodialysis patients showed HF. However, in several studies<sup>22,29</sup>, HF was the primary cause of death in patients treated with hemodialysis.

HF linked to SAH constitutes a strong risk factor, both for hemodialysis patients and for the population at large.<sup>28,31</sup> With the CKF progression and long-term hemodialysis treatment, the overloaded volume and pressure, the uremia clinical picture and hydroelectrolytic changes become more prevalent, by alarmingly increasing hypertension cases and inducing the onset of

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cardiovascular changes. Regardless of the established complication, all of them shall result in HF.<sup>20</sup>

Low hemoglobin levels (<10g/dl) also increase the susceptibility to HF.<sup>31</sup> This is due to the decreased delivery of oxygen to all tissues, especially to the myocardium discussed herein, which hinders the heart work, since the number of hemoglobin cells carrier of oxygen is sub-optimal (27%).<sup>21</sup> Another risk factor is the occurrence of DM, whereas diabetic and hypertensive patients have a high incidence of HF.<sup>28,31</sup>

### Heart Arrhythmias

Heart arrhythmia is another complication that can arise over the hemodialysis treatment. In this study, the average prevalence was of 36.3%, however, this value ranged from 21%<sup>8,18</sup> to 70%<sup>30</sup> among the analyzed studies. Arrhythmias are present in most investigations about the cardiovascular complications and are frequently observed in end-stage CKD patients, as well as being responsible for high rates of sudden death.<sup>16,29</sup>

Heart arrhythmias are resulting from acute changes in serum electrolyte levels in plasma<sup>20</sup> and stressed removal of fluid during the hemodialysis<sup>27</sup> accomplishment, being that these variations are common in advanced CKD patients. When the hemodialysis patient is hypertensive, the removal of fluids and electrolytes is justified by the hydrosaline retention, which makes the patient more susceptible to electrolytic changes, since this removal decreases the circulating blood volume, by contributing to the onset of arrhythmias.<sup>20,27</sup> Among these changes in serum electrolyte levels during these conditions, it should be mentioned those related to potassium ions (K<sup>+</sup>), calcium (Ca<sup>2+</sup>), magnesium (Mg<sup>2+</sup>), and phosphate (PO<sub>4</sub><sup>2-</sup>).<sup>27</sup>

The occurrence of arrhythmias can be promoted by other risk factors, including: male

gender, advanced age, presence of SAH and/or diabetes, hypoxemia occurrence, underlying cardiovascular condition<sup>20,27</sup>, as well as presence of anemia and LVH.<sup>29</sup> About 70% of hypertensive and 91% of diabetics patients, both on hemodialysis treatment, showed several degrees and types of arrhythmias and other heart problems, such as LVH and myocardial ischemia.<sup>27</sup> A Recent bibliographic review<sup>29</sup> involving 452 pediatric patients on hemodialysis treatment found that among heart events, arrhythmia was the most common in this clientele, by showing that hemodialysis children with CKD might also develop arrhythmias.

### Coronary Artery Disease

Coronary artery disease (CAD) is a relevant complication in the general population and is present in hemodialysis patients, mainly, due to the sustained increase of blood pressure.<sup>14,15</sup> The average prevalence of 33.4% was lower in relation the values found in other studies.<sup>22,32</sup> Nevertheless, some researches<sup>15,28</sup> have reported numbers lower than 20% for CAD cases, especially regarding this clientele.

Its development in hemodialysis patients who have SAH happens because of cardiovascular changes, which promote the onset of lesions. Changes such as hardening and thickening of the arterial walls, calcification of the coronary arteries, decreased arterial wall compliance and disorders of calcium and phosphorus metabolizing, not only increases blood pressure, but requires accelerated CAD progression.<sup>29</sup>

### Others

Complications such as heart ischemia, myocardial infarction, stroke and peripheral vascular disease might also be consequences of the association between hemodialysis and SAH. In this study, the values obtained for all these conditions were lower than 20%, being similar to those obtained in other surveys.<sup>8,15,32</sup> Nonetheless,

higher percentages are reported in the literature. A Brazilian research<sup>22</sup> conducted at the *Instituto do Coração (São Paulo)* with hemodialysis patients found that 28% of them had peripheral vascular disease. A study<sup>30</sup> conducted in Nagoya (Japan) monitored 100 patients subjected to hemodialysis treatment for at least five years, among the results, it is should be highlighted that 33% had ischemic heart.

Associated with SAH, risk factors such as DM, dyslipidemias, anemia and hyperparathyroidism, contribute to the development of cardiovascular lesions and to the low heart variability rate.<sup>32</sup> The presence of DM among hemodialysis patients increases the incidence, prevalence and severity of CAD.<sup>20,22</sup> A research developed in hemodialysis centers in Spain found that diabetic patients had higher rates of CAD (20.8%) in comparison with non-diabetic patients (16.7%).<sup>28</sup>

Lipid metabolism disorders early occur during the CKD course and are enhanced with a long-term hemodialysis treatment. Accordingly, patients who made use of long-term hemodialysis have low levels of HDL and high levels of oxidized LDL and triglycerides<sup>21,28</sup>, and it has a positive effect on the atherogenesis process.<sup>20</sup> Hence, pharmacological treatment with statins is often introduced, since, besides reducing the total cholesterol levels, have anti-inflammatory effects which, in turn, delay the CKD progression.<sup>28,33</sup>

It is noteworthy that changes as DM, hyperphosphatemia, disorders of calcium and phosphorus metabolism, besides dyslipidemias and anemia, foster the onset of stroke, peripheral vascular disease and heart ischemia.<sup>10,12,15,29</sup> DM, in particular, contributes to high incidence of arteriopathies<sup>28</sup>, while hyperphosphatemia increases the risk of calcification and hardening of the arteries, heart<sup>34</sup> ischemia and other adverse cardiovascular events.<sup>29</sup>

### Preventive measures

SAH is a relevant risk factor for the onset of cardiovascular diseases<sup>16</sup>, besides being very prevalent among patients subjected to the chronic hemodialysis treatment.<sup>10,11</sup> In this study, the majority of the raised cardiovascular complications have shown SAH as one of their main determinants.

Accordingly, the use of antihypertensive drugs has been widely implemented. More than 50% of hemodialysis patients make use of this pharmacological group, being that the main prescribed drugs are: angiotensin-converting enzyme inhibitors (ACEI), angiotensin receptors blockers, calcium channel blockers, alpha and beta-blockers, diuretics<sup>14,31</sup> and vasodilators.<sup>28</sup> Even with the majority of patients being treated with antihypertensive drugs, the number of hypertensive patients with blood pressure above 130/80 mmHg is considerable, which indicates the need to implement preventative measures.

In fact, longer hemodialysis sessions, increased the number of sessions and the sodium and fluid restriction in diet reduce hydric overload and hypernatremia; the use of antihypertensive drugs inhibits fluid retention and vasoconstriction; the thorough control over the heart function enables the early detection of myocardial and vascular changes; the early referral to the nephrologist might prevent the CKD evolution to the end-stage; and the intervention on the risk factors might be performed through the lipids level control, anemia treatment with recombinant erythropoietin and iron, statin usage, absenteeism from alcohol and tobacco, besides the hyperparathyroidism, hyperphosphatemia and metabolic disorders of calcium and phosphorus treatments.<sup>10,14,16,31</sup>

Importantly, the success of these measures is directly dependent on the implementation of health education strategies adopted by the multidisciplinary team which takes care of these

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patients. Health education, one of the main nursing actions in the health production process, besides facilitating patient understanding about the disease, its treatment forms and consequences, stimulates its participation in the applicability and choice of measures aimed at preventing and delaying the development of chronic complications arising from the relationship among CKF, hemodialysis treatment and SAH, thus promoting a better adherence to the treatment and lifestyle changes.

### CONCLUSION

From the literature review, we might conclude that SAH, chronic condition fairly common in hemodialysis patients, is a relevant determinant to the development of chronic complications. Cardiovascular diseases are highlighted as predominant, being that the main ones are: left ventricular hypertrophy, heart failure, heart arrhythmias and coronary artery disease. Nonetheless, SAH depends on the interrelation with a set of risk factors for that these impairments prevalently take place.

Among the preventive measures to these complications, it should be highlighted the effective blood pressure control, control and treatment of risk factors and appropriate use of antihypertensive drugs. But, for this purpose, the multidisciplinary team should devote special attention to health education, which serves as a mainspring for that the patient assumes, actually, the responsibility for its treatment and life.

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