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Master's Thesis

PECULIARITIES OF KIDNEY DISEASES' TREATMENTS: HOME HEMODIALYSIS AND PERITONEAL DIALYSIS

Master of Science in Nursing

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ABSTRACT

The kidneys play an exceptional role in maintaining the normal functioning of the body. The main function of the kidneys is excretory [3, 7, 19]. They remove by-products, excess water, salts, harmful substances, and some drugs from the body [1, 5]. The kidneys maintain the osmotic pressure of internal environment in the body at a relatively constant level. Along with other mechanisms, the kidneys ensure the constant nature of blood pH [6, 11]. They also perform a secretory function and take an active part in maintaining a constant internal environment in the body.

Two methods of dialysis therapy are used in renal failure: hemodialysis and peritoneal dialysis [2, 6, 8]. Their use is dictated by expediency, the available options and any standing medical tradition. The choice of the dialysis method is often a difficult dilemma for both the doctor and the patient [9, 14, 16]. Both methods have a number of advantages and disadvantages, however, regarding the former, peritoneal dialysis still leads [21, 24].

Due to the great importance of the kidneys for the body, the nurses should have a good knowledge of the main symptoms of kidney disease, to conduct nursing process in diseases of the kidneys, to be able to provide pre-medical aid in emergencies [13, 26] (including those in a setting of hemodialysis and peritoneal dialysis), to prepare the patient for laboratory and imaging tests, and to perform monitoring and routine patient care [2, 20].

The main aim of the study: to investigate the specific aspects of diagnosis and treatment of kidney disease, to explore the options for improving organization and increasing the quality of healthcare team’s work with nephrological patients and compare complication rates in patients who have had peritoneal dialysis and hemodialysis.

This study has explored the specific aspects and principles guiding the work in Nephrology, the main reasons why patients are admitted to the hospital Nephrology department, the specific aspects and principles of care in patients

with chronic kidney disease, their positive effects and potential complications; this research work has determined the specific aspects of nursing process when working with patients in a nephrological hospital unit and in the home; the authors have studied the specific aspects of peritoneal dialysis and hemodialysis, the principles guiding the selection of a dialysis method, indications and potential complications; the authors have conducted an analysis and comparison of the number of complications when conducting peritoneal dialysis and hemodialysis in patients with chronic kidney disease.

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INTRODUCTION

The relevance of the study. The kidneys play an exceptional role in maintaining the normal functioning of the body. The main function of the kidneys is excretory [3, 7, 19]. They remove by-products, excess water, salts, harmful substances, and some drugs from the body [1, 5]. The kidneys maintain the osmotic pressure of internal environment in the body at a relatively constant level.

Along with other mechanisms, the kidneys ensure the constant nature of blood pH [6, 11]. They also perform a secretory function and take an active part in maintaining a constant internal environment in the body.

The nurse should have an understanding of instrumental and laboratory methods used to diagnose and manage kidney disease [33, 37], especially chronic kidney disease, which often ends in renal failure. In the setting of such disease course, the use of hemodialysis or peritoneal dialysis is vitally important.

The duties of a nurse include preparing patients for various types of examinations and treatments for the kidneys and urinary tract [1, 2, 7]. The quality of the data obtained depends on adequate preparation for the test.

The nurse should be aware of the specific problems encountered by patients with kidney and urinary tract disease. In part, such patients may be depressed due to the loss of autonomy in their activities of daily living [12, 17]. Nursing intervention in such cases should be very considerate; the nurse will need to encourage the patient and teach them the self-care techniques that they are able to perform.

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Study objectives.

1. To investigate the specific aspects of hospital- and home-based nursing care in kidney disease.
2. To investigate the specific aspects of diagnosis, clinical presentation and treatment of various kidney diseases.
3. To determine the specific features of conducting peritoneal dialysis and its possible adverse effects in patients.
4. To determine the specific features of conducting hemodialysis and its possible adverse effects in patients.
5. To determine the nursing role when conducting peritoneal dialysis and hemodialysis in patients with renal disease.
6. To conduct evaluation and analysis of indications to the use of peritoneal dialysis and hemodialysis in patients with chronic kidney disease and comparative frequencies of complications when using these methods.

The object of research. Patients with chronic kidney disease who have had peritoneal dialysis and hemodialysis with subsequent comparison of the rates of potential complications when using these treatment methods.

The subject of research. The role of nursing process in Nephrology and the role of the nurse in conducting peritoneal dialysis and hemodialysis in patients with chronic kidney disease.

The methods of study included the following: general clinical assessment (general medical and general surgical methods, special methods used to diagnose nephrological diseases); collection of history of present disease and health history; observation of nephrological patients, physical examination, general health assessment; data comparison, laboratory, instrumental and imaging tests; analytical and statistical research methods.

The scientific and practical value of the study. Nursing care during peritoneal dialysis and hemodialysis is in great demand, since a large number of patients in nephrological practice have problems with the filtration capacity of their kidneys. This study has explored the specific aspects and principles guiding the work in Nephrology, the main reasons why patients are admitted to the hospital Nephrology department, the specific aspects and principles of care in patients with chronic kidney disease, their positive effects and potential complications; this research work has determined the specific aspects of nursing process when working with patients in a nephrological hospital unit and in the home; the authors have studied the specific aspects of peritoneal dialysis and hemodialysis, the principles guiding the selection of a dialysis method, indications and potential complications; the authors have conducted an analysis and comparison of the number of complications when conducting peritoneal dialysis and hemodialysis in patients with chronic kidney disease.

CHAPTER 1
NURSING PROCESS IN KIDNEY DISEASES AND ITS SPECIFIC ASPECTS IN HOSPITAL- AND HOME-BASED CARE (REVIEW OF LITERATURE)

In addition to urine formation, kidneys participate in the metabolism of proteins, carbohydrates and fats, and play a corresponding role in regulation of hemodynamics. The kidneys also carry out a secretory function, i.e. they produce biologically active substances, such as erythropoietin, renin and prostaglandins among many. However, the main function of the kidneys is the excretory function. They excrete salts dissolved in water and metabolic products, including nitrogenous substances, from the body [19, 21]. The outcome of treatment of patients with kidney disease largely depends on early diagnosis, which begins with detection of characteristic symptoms and their proper interpretation [5, 22].

The main symptoms in kidney disease. Edema. Renal edema is more often detected as facial swelling in the morning (puffiness of the face, "bags" under the eyes). With the progression of the disease and the associated edematous syndrome, cavitary edema and anasarca appear [15, 31]. Unlike cardiac edema, patients with renal edema do not need a raised position in the bed, since renal edema is not accompanied by shortness of breath and cyanosis. The skin in such patients is usually pale.

Changes in urine output. Edema is usually associated with reduced amount of excreted urine (oliguria, i.e. less than 500 ml per day). The amount of excreted urine less than 200 ml per day or the absence of urine output is referred to as anuria [30]. This may be the case in acute glomerulonephritis, acute renal failure, as well as in large fluid losses (uncontrollable vomiting, profuse diarrhea). If kidneys do not secrete urine, this situation is referred to as true anuria. However, if the kidneys do secrete urine and it accumulates in the urinary bladder because ureters or urethra is/are blocked by a tumor or a stone,

or compressed by an enlarged prostate in males, this situation is referred to as false anuria [13, 25]. An increase in daily urine output to more than 2000 ml per day or polyuria is seen in rapid evacuation of edemas. This can both be a favorable sign of renal functional recovery or a sign of progressive renal insufficiency [3, 28]. In the latter case, nocturia is typical (mainly nocturnal urine output).

Dysuric disorders manifest as painful frequent urination; they are mostly associated with urinary tract inflammation (i.e. cystitis, urethritis), prostatitis, and the passage of stone through the urinary tract. Dysuric disorders also occur in genitourinary tuberculosis [32].

Urine changes (urinary syndrome). In some diseases of the kidneys, the initial manifestations include changes in the color and composition of urine [34].

Urine color changes. The most common cause for discoloration of urine is the macroscopic amounts of blood in the urine (gross hematuria). Gross hematuria occurs after renal colic as a result of the passage of a stone through the urinary tract. The color of urine in this case is pink or bloody [21, 32]. If gross hematuria appears suddenly and is not associated with pain, a urinary tract tumor or tuberculosis should be suspected.

Nursing process in kidney disease has its characteristic stages.

Stage I. Nursing assessment includes the following

Interview. After establishing a friendly and trusting relationship with the patient, the nurse shall ask the patient about complaints and problems in detail [23, 27] and using active listening.

Possible complaints include pain in the lumbar region with irradiation to the inguinal region, dysuric disorders, edema, fever with chills, reduced or no urine output, blood in the urine, history of hypertension, etc. [7, 12].

During the inspection, the nurse pays attention to skin color (pallor), facial puffiness, bags under the eyes, dry skin and tongue, increased BP, positive costovertebral angle tenderness and blood in the urine [17, 26].

Stage II. Determination of patient’s problems (nursing diagnoses)

1. Patient is experiencing fear of death when seeing bloody urine, gross hematuria.

2. Patient is experiencing excruciating pain in the lumbar region irradiating to the inguinal area and accompanied by frequent and painful urination, renal colic [20, 32].

3. Impaired need for urination, edema due to anuria.

4. Impaired need for maintaining normal body temperature, fever with chills due to bacterial kidney disease (pyelonephritis) [11, 23].

Stage III. Planning of nursing interventions

Table 1.1. Drawing up a plan for nursing interventions, which meets the goals when providing medical care to patients with kidney disease

Goals of nursing interventions	Plan of nursing interventions
After the nursing intervention, the patient will not experience fear when seeing bloody urine	1. Explain the nature of their illness to the patient. 2. Inform the patient about any upcoming tests, and about preparation for urine tests, blood tests and imaging tests. 3. Prepare hemostatic agents: calcium chloride 10%, Vicasol 1%, Ethamsylate 12.5% and aminocaproic acid 5%. 4. Administer hemostatics as prescribed by the physician. 5. Talk to the family members about the rules of patient care
In 30 minutes, the patient shall be free from pain in the lumbar region	1. Provide the patient with a warm and dry bed. 2. Maintain air temperature in the room at 22-23°C. 3. Place the patient in a warm bath (if not possible, apply a heating pad to the lumbar region and on the abdomen).

	4. Administer intramuscular analgesics and antispasmodics (2-4 ml of 50% metamizole or 1 ml of 0.2% solution of platyphyllin, or a solution of drotaverine hydrochloride). 5. Call the physician. 6. If no pain control has been achieved, administer 1 ml of 2% promedol with 10 ml of 0.9% sodium chloride intravenously, as prescribed by the physician. 7. Monitor oral hydration
After the nursing intervention, the patient's edema should decrease	1. Put the patient on a diet with fluid restriction up to 1 liter a day and low sodium, up to 6-10 g per day. 2. Monitor temperature in the room to ensure normal elimination of moisture through the skin. 3. In urinary retention due to a stone, perform catheterization of the urinary bladder. 4. Fulfill all the physician's orders. 5. Talk with the relatives concerning the foods and drinks that the patient is allowed to have
After the nursing intervention, the patient shall not feel hot and have chills	1. Help the patient assume a comfortable position in the bed. 2. When the patient has chills, wrap them into warm blankets, put a hot water bottle/warmer to the lumbar region and extremities. 3. Plenty of oral fluids (including juices, compotes and tea) when the patient feels hot. 4. When the patient feels hot, hang an icepack above the patient's head. 5. Spicy and salty foods should be excluded from the patient's diet. 6. Fulfill doctor's orders concerning administration of

	antibacterial drugs in a timely manner
The patient shall not be at risk for exacerbation of symptoms after being discharged from the hospital	1. Teach the patient self-care skills and diet in edema, nausea. 2. Conduct a conversation with relatives/family members concerning maintaining room temperature at <20°C; keeping bed linen dry; rules for the preparation of diet-compliant meals; use of the necessary literature on prevention of kidney disease.

Stage IV. Implementation of the planned nursing interventions includes, according to the plan, observation of and care for patient, conversations with patients and relatives, timely completion of physician's orders, timely dispensing of medications [26, 35], performing nursing interventions, preparation of patients for the tests and collection of the required samples; performing interdependent interventions, preparing patients for consultations by specialist physicians.

Stage V. Evaluation of the efficacy of nursing interventions. When evaluation the outcomes of plan execution, the nurse shall make sure that all goals have been met completely, partially or not met at all [1, 36].

When evaluation the outcomes of plan execution, the nurse shall make sure that all goals have been achieved. The nurse is having conversations with the patient and their relatives regarding continued treatment after discharge [26, 28].

1. If stones have been detected in the kidneys, potential surgical treatment should be discussed with an urologist.
2. Inform the patient about the need for prolonged treatment of pyelonephritis as recommended by the internist.
3. Avoid hypothermia.

4. Advise the patient to adhere to fluid regimen, limit salty and spicy foods and to avoid alcohol.
5. From time to time, the patient may drink sour beverages and herbal teas for the kidneys.

The nurse should know the main complaints and symptoms in diseases of the kidneys and urinary tract, have an understanding of dysuric phenomena in kidney disease, and know the basic principles of treatment and prevention of kidney disease [12, 27]. The nurse should carefully listen to the patient and pay attention to any pain or discomfort in the lumbar region, changes in urine color and impaired urine output (polyuria, oliguria, etc.). Patients with kidney disease quite often experience headache, attacks of dyspnea, edema, dyspepsia and fever. It is important to find out whether the patient was exposed to low temperature, poisonous substances, and what are the special aspects of patient's work and living conditions [4, 30]. It is also important to pay attention to hereditary factors and to the presence of pernicious social habits. The nurse should know how the course of renal diseases in the elderly is different from that in younger individuals.

When examining the patient, the health professional should check skin color, turgor and moisture, as well as edema and areas of compromised skin integrity. In order to detect tenderness in the lumbar region, the health professional may use percussion in this area with the edge of their hand; the positive test is known as costovertebral angle tenderness [24, 27].

The nurse should have a fairly good understanding of instrumental and imaging tests, as well as laboratory assessments. The duties of the nurse include preparing patients for various types of examinations of the kidneys and urinary tract. The quality of the data obtained depends on adequate preparation for the test.

The nurse should be aware of the specific problems encountered by patients with kidney and urinary tract disease [29]. In part, such patients may be depressed due to the loss of autonomy in their activities of daily living. Nursing

intervention in such cases should be very considerate; the nurse will need to encourage the patient and teach them the self-care techniques that they are able to perform.

It is important to correctly perform the interventions aimed at prevention of urinary tract infections. The nurse should timely and properly perform perineal hygiene; train the patient in correct intimate hygiene; remind the patient to drink enough fluids; properly care for indwelling urinary catheter and empty the collection bag in a timely manner.

If the patient is sweating intensively, it is necessary to change linen in a timely manner and treat the skin with a low-concentration disinfectant solution [8, 13]. Since some of the urea is released through the skin, itching appears with potential for compromised skin integrity, so it is necessary to provide constant skin care. Uremic patients are more prone to pressure ulcers; in this case, the nurse should take preventive measures.

The nurse should teach the patient about the principles of diet therapy, prophylactic interventions, and explain what to avoid, for example, hypothermia [24, 27].

The nurse should clearly know the symptoms of renal colic in nephrolithiasis, and to be able to provide first aid.

Table 1.2. Symptomatic nursing interventions in patients with diseases of the kidneys

Problem	Nursing actions
Headache and dizziness, associated with increased BP	Ensure the administration of physician-prescribed drugs that increase the tone of the urinary bladder. When there is no effect, perform the catheterization of the urinary bladder (as ordered by the physician)
	Monitor patient compliance with the diet and salt and fluid restrictions. Monitoring patient compliance with the medication schedule. Conducting patient follow-up,

	especially that of BP, pulse rate, RR and skin color. Teach the patient and their family how to measure BP.
Reduction in urine output and emergence of edema	Monitor the diet and hydration of the patient. Measure daily urine output and count the fluid balance. Weigh the patient every other day. Monitoring patient compliance with diuretic drugs.
Dry skin, skin itching associated with impaired renal function; impaired skin integrity (scratching) due to itching; risk of skin infection due to scratching	Make sure that the patient takes proper care of their skin and takes a shower every day. Monitoring patient compliance with the medication schedule. Monitoring dietary compliance of the patient
Loss (absence) of appetite or aversion to food associated with impaired renal function	Discuss the causes of appetite changes with the patient. Monitoring dietary compliance of the patient. Explain the rationale behind the diet to the patient and the reason why salt is limited to 3-5 g per day. Create a favorable setting at mealtime.
Refusal to eat and drink due to nausea and vomiting	Consult the physician Discuss the importance of taking food and fluid with the patient.

Instrumental, imaging and laboratory methods in kidney disease.

Diuresis is the process of formation and excretion of urine. Daily diuresis or urine output is the total amount of urine excreted by the patient during the day [11, 19].

Daily urine output in adults ranges from 800 ml to 2000 ml and depends on age, ambient temperature and humidity, dietary conditions, physical activity and other factors. Daily urine output should constitute 75–80% of oral fluid intake; 20–25% of the fluid is excreted in sweat, breath and stool.

Daily fluid balance is a ratio between the amount of fluid that enters the body and the amount of excreted fluid during the day [7, 28, 35]. This takes into account the fluid in fruits, soups and vegetables, etc., as well as the volume of all parenteral fluids.

Methods that assess the cleansing capacity of the kidneys, i.e. clearance, are based on a comparative content of certain substances in the blood and in the urine; therefore, these are referred to as hemorenal tests.

The clearance of blood from individual metabolites during passage of blood through the kidneys is determined by glomerular filtration [21, 37]; therefore, the test determines the filtration function of the kidneys.

The test is based on an assumption that the amount of the substance excreted in the urine in a unit of time corresponds to the amount of the substance filtered in renal glomeruli during the same period of time.

Almost all substances are reabsorbed to a greater or lesser extent in renal tubules [8, 10, 17]. However, some substances are not reabsorbed at all, but are excreted in the urine in the same amount in which they passed through the glomeruli. A well-known example is endogenous creatinine.

Rehberg test is based on the determination of creatinine in serum and urine. No special preparation is required. Ultrasonography. This non-invasive method is based on a property of ultrasound waves to reflect from the interfaces of biological media with different densities [1, 9, 18]. The diagnostic use of ultrasound waves is free from adverse biological effects.

Ultrasound is indicated in the presence of focal abnormalities in the kidneys, as well as stones in the kidneys and elsewhere in the urinary tract. The examination is performed in a prone position, face down (the patient may sit if that is more comfortable).

Computed tomography (CT). This method allows a “slicing” scanning of an object with a thin beam of X-ray radiation, followed by image reconstruction of the layer using a computer. This method allows to differentiate pathological changes without the use of contrast agents. The diagnostic value of the method increases when CT is combined with intravenous administration of a contrast agent [25, 27]. No special preparation is required.

Magnetic resonance imaging (MRI) can provide additional information about kidney masses, which cannot be obtained by other methods. Unlike CT, MRI allows obtaining a layer-by-layer image of the area of interest in the transverse, frontal and sagittal planes. The morphological picture is reconstructed using a computer as a three-dimensional tissue reconstruction [15, 19]. No special preparation is required.

Radioisotope renography. The method is based on the ability of renal tubular epithelium to selectively extract hippuran from the bloodstream, followed by its excretion in the urine. The accumulation and excretion of hippuran is recorded using scintillation sensors installed above the kidney area, and presented (summed up) in the form of two curves, i.e. renograms of the right and left kidneys. The test is non-traumatic; it does not require any special preparation, lasts no more than 30 minutes and does not expose the patient to significant radiation. Radioisotope renography can be used to detect impaired renal function in the early stages, to assess the changes in renal process with time, and to monitor the condition of the kidneys in seriously ill patients [6, 14].

Angiography is obtaining a radio-contrast image of renal vasculature by injecting a contrast agent into the abdominal aorta via a catheter guided through the femoral artery. The main indication is verification of a suspected major vessel damage in patients with vasorenal hypertension [23].

Nurses provide care for adults at various stages of chronic kidney disease (CKD) in a variety of inpatient and outpatient settings. Regardless of the stage of CKD, the three main goals of nursing care are as follows:

- to prevent or slow down the progression of the disease
- to promote physical and psychological well-being
- to monitor the course of the disease and the complications of treatment.

The nurse may assess the patients' capacity for self-control before and after patient education classes [4, 7].

The nurse may ask questions such as:

"How is your physical and/or emotional health?"

"What worries you or what worries you the most?"

"What is important for you to achieve?"

"What are your priorities?"

"What can improve your quality of life and well-being?"

"How are you and your loved ones coping with illness?"

Based on patients' responses, the nurse can provide education and resources to help patients improve their disease management skills [2, 12, 30].

CKD can lead to a number of complications such as fluid overload, electrolyte imbalances, and anemia that require treatment. In collaboration with patients and health care providers, nurses help guide care by evaluating, planning, implementing, and evaluating care plans [17, 23]. For example, if a patient is experiencing fluid overload, it may be necessary to follow the physician's orders, including fluid restriction and/or the administration of diuretics. An electrolyte imbalance may require changes in diet and/or medication.

One should use the patient care process when performing these procedures and communicate frequently and in a timely manner with patients and providers to help improve outcomes [11, 26]. Accurate and detailed nurse assessment data

will help in reviewing treatment plans to ensure patients are meeting their goals. This data should include vital signs.

In patients with advanced CKD on hemodialysis or peritoneal dialysis, the nurse should evaluate access sites for any problems (e.g., signs and symptoms of occlusion and/or infection), keep access sites clean and dry to prevent infection [28, 33], and immediately report any problems to the physician. An identification tape should be securely attached to the hemodialysis/peritoneal dialysis access site so that other healthcare professionals know that they cannot use it for any other procedures.

The nurse should promptly update healthcare providers on any signs and symptoms (blood pressure changes, nausea, vomiting, chest pain, back pain, convulsions, and fever with or without chills), and infection [16, 37]. The signs and symptoms of local access site infection include local redness and hyperthermia, tenderness, purulent discharge, ulcers, and swelling.

The signs and symptoms of systemic infection include fever, chills, changes in blood pressure, nausea and vomiting. If the patient has a hemodialysis arteriovenous shunt or a fistula, the nurse should assess its patency and the signs of potential access site failure by palpating for thrill (vibration)/auscultation for bruit (characteristic noise) [9, 21]; and assess capillary refill time, pulse and any changes in sensation, color, temperature and shape (anomalies such as bulging and swelling).

In transplant patients, the nurse should report any signs of acute graft rejection (e.g., flu-like symptoms, pain at the transplant site, sudden weight gain or swelling, general malaise) [1, 34]. The nurse should know how to work with the transplant team in order to meet the patients' needs for care and education.

Patients always have the right to refuse treatment or opt for palliative care. The nurse should help patients make their best choice and respect their wishes [3, 36].

Nurses encounter adults with CKD in all settings and at all stages of the disease. When a nurse is able to identify risk factors of CKD, he/she will have a

better understanding of how to prevent/slow down the progression of the disease; the nurse will properly educate patients and monitor the course and treatment of the disease, and his/her confidence with care for such patients will increase [12, 15, 25]. With this confidence and knowledge, the nurse can promote the patient's physical and psychological well-being to ensure better quality of life.

CHAPTER 2
THE OBJECT OF RESEARCH AND METHODS OF STUDY

Nephrological patients who had peritoneal dialysis and hemodialysis were the object of research in this study. At the same time, we studied the special aspects of organization of nursing care in patients with chronic kidney disease and compared the number of complications after peritoneal dialysis and hemodialysis.

When studying the nursing process in peritoneal dialysis and hemodialysis in patients with chronic kidney disease, we have used general clinical assessments and special methods for examining nephrological patients, collected history of present disease and health history, including anamnesis vitae and anamnesis morbi, observation, objective examination, general health assessment, collection of information concerning the main complaints of the patient, and also used the methods of comparison, as well as analytical, statistical, and laboratory, instrumental and imaging tests as part of patient assessment.

Our study included 2 parts. In the first part of the study, we have performed an analysis of number of patients who had peritoneal dialysis and hemodialysis, determined the number of complications and the most frequent complications experienced by the patients after the procedure of peritoneal dialysis (64 patients) or hemodialysis (79 patients). A total of 143 patients were involved in the first part of the study. In the second part of the study, we have compared the number of complications when conducting peritoneal dialysis and hemodialysis in the same patients.

Subsequently, we have performed data consolidation and inferencing.

CHAPTER 3
THE PECULIARITIES OF CLINICAL PRESENTATION, DIAGNOSIS AND TREATMENT OF VARIOUS KIDNEY DISEASES

The diseases of the kidneys are characterized by various clinical manifestations, which should be readily identifiable and timely noticed by a nephrological/dialysis nurse.

In glomerulonephritis, that is, inflammation of the glomerular apparatus of the kidneys, microhematuria is a frequent characteristic feature, when red blood cells are found in a urine test. However, other patients may have gross hematuria, in which case the urine takes on the appearance and color of "meat slops". It should be kept in mind that the color of urine may be changed by the drugs used by the patient: pink when taking aspirin, black in phenol poisoning, blue-green in intravenous administration of methylene blue, dark yellow in severe burns, red-brown when large amounts of urates (salts of uric acid) are present in the urine.

Changes in urine composition. The composition of urine is established in laboratory tests. In diseases of the kidneys, proteinuria may occur in addition to hematuria. The normally excreted amounts of protein should be undetectable by either qualitative or quantitative reactions. Therefore, even the smallest amount of protein detected in the urine should alert for proteinuria and calls for a repeated urinalysis. It is important to ask the patient whether they had an intense physical stress or overindulged in protein-rich foods before obtaining the urine sample. Cylindruria is urinary excretion of epithelial proteins or leukocytic casts of distal renal tubules. Leukocyturia is detection of urinary white blood cells more than 5 per power field and more than 2-2.5 $\times 10^6$/l, but not more than 4.0 $\times 10^6$/day. This finding is more typical for pyelonephritis and cystitis, i.e for inflammatory conditions of the urinary tract.

Hypertension is a persistent increase in blood pressure, often due to kidney disease. Diastolic pressure tends to be more increased in hypertension of renal

origin. In diseases of the kidneys, their blood supply is often compromised. An anemic kidney secretes renin, which, by converting into angiotensin, increases blood pressure.

Pain in the lumbar region occurs as a result of stretching of the renal capsule or obstruction of the ureter(s). Stretching of the renal capsule may occur in inflammation of renal parenchyma (glomerulonephritis or pyelonephritis).

Renal colic is a paroxysmal, intense pain in the lumbar region with irradiation to the groin area. This manifestation is common in thrombosis of the renal arteries, paranephritis and nephrolithiasis. Pain in the suprapubic region combined with dysuria is evidence of inflammation in the urinary bladder.

Fever is a symptom of inflammatory kidney disease. It is common in patients with acute or chronic pyelonephritis, and less frequent in renal tuberculosis or kidney tumors.

Renal failure syndrome includes such symptoms as skin itching, nausea, vomiting, weakness, skin hemorrhages, smell of urea from the mouth and signs of encephalopathy.

These symptoms are explained by the fact that when kidney function is impaired, nitrogenous waste accumulates in the blood, causing a toxic effect on the entire body.

Acute glomerulonephritis (AGN) is an acute bilateral immunoinflammatory disease of the kidneys with a predominant damage to the glomerular apparatus and involvement of renal tubules, interstitial tissue and blood vessels; the condition is clinically manifested by renal and extrarenal symptoms.

Etiology. Etiological factors include streptococcal infections (strains of B-hemolytic Streptococcus group A), which cause tonsillitis, purulent otitis media, erysipelas, furunculosis, etc. Pneumococci, causative agents of brucellosis and other microorganisms also play a certain role in the development of AGN. Important exogenous factors include hypothermia and alcohol consumption. The inflammation may be triggered by administration of vaccines, sera and certain medications.

The pathogenesis of the disease is largely autoimmune-mediated.

Two possible mechanisms for the development of nephritis are suggested:

1) the formation of circulating antigen-antibody complexes in the blood, which are fixed in the glomeruli and damage their basement membranes;

2) production of autoantibodies to kidney cells in response to damage to the kidneys by the complexes of exogenous antibodies.

Morphological changes are as follows: the kidneys are somewhat enlarged and plethoric; small dotted formations of red color are visible on the surface (damaged glomeruli). On microscopic examination, the glomeruli are enlarged, and fibrin thrombi are visible in them.

In some cases, morphological changes become irreversible; the inflammatory process progresses, and acute glomerulonephritis becomes subacute, and then chronic.

Clinical presentation. Symptoms appear shortly after a recent streptococcal infection (in 2-3 weeks). They can be divided into two main groups: renal and extrarenal. The disease may begin violently with the development of the classic triad of symptoms: hypertension, edema and urinary syndrome. However, monosymptomatic course is possible, which makes diagnosis challenging.

Patients complain of bilateral pain in the lumbar region, fever, oliguria or even anuria (less than 50 ml of urine per day). Urine is of reddish or "meat slops" appearance; blood pressure increases; tachycardia and accent of II tone appears over the aorta. Edema is localized on the face and around the eyes ("pale edema"), in contrast to cardiac edema, it is dense. Other manifestations include headaches, reduced vision, nausea, restlessness and insomnia.

The course of glomerulonephritis has variants with predominant edema (nephrotic form) or with predominant hypertension (hypertensive form).

In a setting of rapid development and severe course of the disease, the edema is no longer limited to the face, but becomes widespread. If hypertension persists for several weeks, this may lead to left ventricular hypertrophy, dyspnea, rapid heartbeat and ocular fundus changes.

Diagnosis of glomerulonephritis. The urinary syndrome is characterized by proteinuria, cylindruria, as well as macro- and microhematuria (with altered red blood cells). A high protein content in the urine persists only during the first 7-10 days.

- Hematological findings include leukocytosis and ESR elevation
- Zimnitsky's test: oliguria; the concentration function of the kidneys is intact.
- Nicheporenko urinalysis: the predominance of red blood cells over white blood cells in the urine sediment (in case of the nephrotic form).
- Serum biochemistry: moderate azotemia, dysproteinemia, and increased cholesterol levels.
- The ocular fundus: narrowing of the arteries, dilated veins, retinal edema, hemorrhages.
- Renal ultrasound.

In difficult diagnostic cases, a puncture biopsy of the kidney with a histological examination of the biopsy is performed under ultrasound guidance.

Complications:

- acute renal failure (ARF);
- acute renal encephalopathy is more common in patients with edema (cerebral edema); manifestations include increased blood pressure, convulsions and loss of consciousness;
- acute heart failure (left ventricular).

Treatment of acute glomerulonephritis. Patients must be hospitalized. Strict bed confinement is used in these patients. With timely treatment, a full recovery occurs in a few weeks.

In the presence of foci of infection, antibiotic therapy is indicated. In manifest nephrotic syndrome, steroid hormones and diuretics are used. The treatment usually includes prednisolone 30 to 60 mg per day for 4 weeks. In

hypertensive syndrome, antihypertensive drugs are used. The physician may prescribe antihistamines and large doses of vitamin C.

In severe course and lack of treatment efficacy, cytostatics, anticoagulants (heparin) are used; persistent hematuria is managed with aminocaproic acid.

The following management approaches are used in complications:

1) acute renal failure (ARF): strict control of fluid balance, protein-free diet, intravenous sodium bicarbonate (for acidosis), forced diuresis. Effective modalities include hemosorption and peritoneal dialysis;

2) renal encephalopathy: complete rest, forced diuresis, aminophylline, intravenous glucose; if seizures occur, then anticonvulsants as prescribed by the physician;

3) acute left ventricular failure: complete rest in a sitting position, nitroglycerin, forced diuresis, intravenous opiates, intravenous cardiac glycosides.

Possible patient problems: pain in the lumbar region, swelling, fever, headaches, oliguria/anuria, knowledge deficit related to the disease.

When organizing nursing care, the nurse selects a drug therapy model, procedures and examinations. The nurse is discussing interventions with the patient. Such nursing assistance complements the patient's self-care potential.

Prevention of glomerulonephritis. Primordial prevention includes elimination of chronic inflammation foci in the body (i.e. chronic tonsillitis, sinusitis, pelvic inflammatory disease and dental cavities).

Secondary prevention provides for the optimal employment of the patient, compliance with the work and rest routine, therapeutic diet, as well as the prevention and treatment of intercurrent diseases.

Chronic glomerulonephritis (CGN) is an immunoinflammatory bilateral kidney disease that leads to progressive glomerular death, hypertension, and renal failure.

Etiology and pathogenesis. Chronic glomerulonephritis may be primary chronic, without a previous acute attack. Acute glomerulonephritis may become

chronic as a result of untimely recognition and treatment, unjustified discontinuation of treatment and lack of compliance with the physician's recommendations.

If a patient with acute glomerulonephritis has a focus of any other chronic inflammation, the danger of chronization exists even with correct treatment.

Etiological factors include: infections (bacterial, parasitic and viral) and non-infectious factors (alcohol, organic solvents, drug-induced injury: lithium- and gold-containing drugs, vaccines and sera).

The leading role in the pathogenesis belongs to circulating and fixed immune complexes causing damage to the basal membrane of renal glomerular capillaries (as in AGN).

Pathological changes in the renal glomeruli are not limited to inflammatory changes; there is also proliferation of connective tissue. This process also affects the area where the tubules are located. In the final stage of the disease, the kidneys are significantly reduced in size, have a granular surface, and a thinned cortical layer. Shrinkage of the kidney develops, i.e. arteriolosclerotic kidney.

Clinical presentation. Symptoms of chronic glomerulonephritis are in many ways similar to those of acute glomerulonephritis, and include edema, arterial hypertension and hematuria. However, chronic glomerulonephritis has some specific features. In urine tests, a decrease in its relative density, granular and waxy cylinders and proteinuria are noted.

The hypertensive type of chronic glomerulonephritis is characterized by a persisting elevation of blood pressure, heart failure (rapid heartbeat, shortness of breath on exertion/later at rest and disseminating edema).

In chronic glomerulonephritis with predominance of nephrotic (edematous) type, blood pressure is normal, but there is pronounced edema.

A mixed variant is possible, where edema and hypertension are combined.

The latent variant is mainly manifest as changes in the urine; patients often seek medical attention for complications.

A rare variant of CGN is the hematuric variant, which is manifest by ongoing hematuria. A rapidly progressive (malignant) variant of CGN is a special form of CGN. It is characterized by an acute onset and a dramatic escalation of renal insufficiency (within 3-4 months), when azotemia is associated with anemia already in the early stages of the disease.

Complications of CGN:

1. chronic renal failure (CRF), uremia.

In a progressive course of the disease, chronic renal failure may occur due to poisoning of the body with nitrogenous waste. They are not timely eliminated due to impaired kidney function. General health of the patient deteriorated. The tongue is dry; there is a specific odor from the mouth, since, as a compensation, urea is excreted through the mucous membranes of the digestive tract. Visual acuity is decreased in uremia. Uremia is an abnormal condition where multiple organs and systems in the body are involved; in part, there are CNS disorders (somnolence, seizures); pericarditis develops in some cases. Serum tests are notable for increased levels of creatinine and urea (azotemia), acidosis and hyperkalemia.

To clarify the diagnosis, a radioisotope assessment of the kidneys and renal biopsy are used.

2. chronic heart failure (myocardial dystrophy with increasing azotemia, anemia, acidosis and hypertension) – cyanosis, shortness of breath, tachycardia, arrhythmias and asthma attacks followed by liver enlargement and edema (sometimes even up to anasarca);
3. uremic pericarditis (dry or effusive) is manifest as cardiac pain, pericardial friction rub or muffled heart sounds; the condition may be complicated by cardiac tamponade;
4. accession of intercurrent diseases, such as pneumonia and pyelonephritis;
5. malignant hypertension may cause retinal detachment, loss of vision and hemorrhagic stroke.

Treatment. A patient with an exacerbation of CGN should be hospitalized to a nephrological or general medicine department. The patient is placed on complete bed confinement until their general health, BP and urinalysis parameters improve.

The diet is based on dietary salt restriction to 3 g per day. Nutrition should be complete, varied and rich in vitamins, and include fruit and vegetable juices. It should be noted that a long-term protein-free low-sodium diet does not prevent the progression of nephritis and has a negative effect on the general condition of the patient (much protein is excreted in the urine).

The basis of pathogenetic therapy is the use of corticosteroids. The initial dose is 40-60 mg prednisolone; the dose may be increased as necessary. When corticosteroids are contraindicated, non-hormonal immunosuppressants are used, such as azathioprine and 6-mercaptopurine. At late stages, i.e. in CRF, immunosuppressants and steroids are contraindicated.

In recent years, anticoagulants (heparin 20,000 IU per day intramuscularly or intravenously) have become widely used in the treatment of chronic glomerulonephritis. Plasmopheresis (plasma exchange) is widely used. Health resort and spa treatment is recommended during the remission period.

Symptom management includes hypotensive drugs (ACE inhibitors, calcium channel antagonists), diuretics in edema syndrome, cardiac glycosides in heart failure, sedatives and anticonvulsants in seizures, etc.

Exacerbation-free patients may benefit from health resort treatment. Prevention. Patients should be under the constant supervision of their local polyclinic physician.

People with CGN may benefit from relocating to areas with warm climate, but without sharp changes in humidity. They should avoid moist cold air at all times.

Secondary prevention is aimed at prevention of exacerbations and complications of CGN. Patients should be constantly on outpatient health

screening and monitoring programs. The principles and the measures of health screening are identical to those used in AGN.

Potential problems in the patient are the same as in AGN. In addition to that, patients may have concerns about the issues of disability, loss of their favorite job and being unable to eat some of their habitual foods.

The selection of nursing care models is guided by the same principles as in AGN.

Pyelonephritis is a non-specific inflammatory process with damage to the pyelocaliceal system, interstitial tissue and renal tubules, followed by damage to the glomeruli and blood vessels.

Predisposing factors are diabetes mellitus, gout, insufficient potassium content, abuse of analgesics, extrarenal foci of inflammation (in the urogenital area), allergies.

The nurse should also be knowledgeable about other kidney conditions that can lead to kidney failure. One of these diseases is pyelonephritis, which can be acute or chronic.

The causes include infection (E. coli, Staphylococcus, Proteus, Enterococcus, Streptococcus).

Sources of infection include chronic tonsillitis, furunculosis, mastitis, pelvic inflammatory disease, etc., as well as compromised aseptic precautions in urological procedures.

Acute pyelonephritis may develop quite rapidly under the influence of excessive physical exertion and exposure to cold. The penetration of infection into the renal tissue is possible by hematogenous, lymphogenous and urogenous routes.

In terms of morphology, acute pyelonephritis can be serous and purulent. In serous pyelonephritis the kidney is enlarged and dark-red. Histological findings in the interstitial tissue include numerous perivascular infiltrations.

Acute purulent pyelonephritis manifests itself in the form of pustular nephritis, abscess and carbuncle of the kidney. In the cortex and medulla of the

kidney, multiple small pustules are found, ranging in size from a pinhead to a pea.

Clinical presentation. Chills followed by high-grade fever; the patient has complaints of general malaise and weakness. Low back pain is the main presenting symptom; positive costovertebral angle tenderness and frequent painful micturitions are observed.

The course of acute pyelonephritis has certain peculiarities depending on the age of the patient. In the elderly, the presentation is often obliterated and atypical, without febrile reaction and chills. The disease has an especially severe course in patients weakened by previous illness.

Despite the overall severe course of the disease, such patients may have moderate to no leukocytosis; in some cases, even leukopenia may be seen.

Acute pyelonephritis can be complicated by paranephritis, subdiaphragmatic abscess, necrosis of the papillae of the kidneys with the development of acute renal failure, bacteremic shock and peritonitis.

Diagnosis. Complete blood count: pronounced leukocytosis (up to 30 $\times$ 10^9/l); left shift, elevated ESR.

Urinalysis: proteinuria, from traces of protein to 1.04 g/l; leukocyturia (pyuria); frequent findings include hematuria, cylindruria and bacteriuria.

Serum biochemistry: dysproteinemia; sometimes increased creatinine and urea.

Ultrasound, excretion pyelography (urography): increased kidney size.

Chromocystoscopy: slowed down excretion of indigo carmine on the affected side.

Treatment. Mandatory hospitalization to nephrological (urological in purulent pyelonephritis) department. The patients are on bed rest and plenty of oral fluids. Antispasmodics are used in intense pain. Antispasmodics reduce spasm and improve the outflow of urine.

Before administration of antibiotics, the health team should have a bacteriological urine test, identify bacterial pathogens and assess their sensitivity

to different antibiotics. The main principles guiding antibacterial therapy include the use of optimal (sometimes maximal) doses, early onset and sufficient duration.

If obtaining culture and sensitivity is impossible, broad spectrum antibiotics are used. The physician should avoid prescribing nephrotoxic antibiotics (e.g. aminoglycosides, polymyxin). If the bacterial flora is insensitive to antibiotics, sulfanilamide drugs are used. They may be combined with nitrofurans. If no improvement is seen, surgical treatment is indicated (in renal abscess or carbuncle of the kidney).

The inpatient treatment is followed by another 6 months of outpatient treatment aiming to prevent conversion of acute pyelonephritis into a chronic form.

Prevention. It is necessary to carry out prevention of inflammatory diseases of the urethra, bladder, avoid hypothermia, practice thorough hygiene of oral cavity and the nasopharynx and comply with the regimen prescribed by the doctor for tonsillitis, otitis media, etc.

Chronic pyelonephritis is an immune-mediated non-specific inflammation of predominantly interstitial tissue in combination with involvement of urinary tract and subsequent involvement of renal glomeruli and vessels. It is a consequence of untreated or undiagnosed acute pyelonephritis.

Etiology. Chronic pyelonephritis is caused by bacteria and bacterial associations. The concomitant factors are identical to those in acute pyelonephritis.

Pathogenesis. The development of pyelonephritis is underlain by autoimmune reactions, urodynamic disorders (reduced outflow) and urinary tract infection.

Ultimately, the kidney shrinks in size (nephrosclerosis) and uremia develops (the actual cause of death).

Clinical presentation.

There are several principal clinical forms of chronic pyelonephritis:

1) latent form with scarce clinical manifestations (fatigue, decreased appetite, weight loss; sometimes low-grade fever). Some patients experience heaviness in the lower back and have a weak positive symptom of costovertebral angle tenderness. Urinalysis is unremarkable except for mild proteinuria and leukocyturia;

2) hypertensive form: symptoms of hypertension (sometimes malignant); changes in the ocular fundus and changes in the urine;

3) recurrent form is more frequent that others. It is characterized by alternating exacerbations and remissions. Exacerbations are accompanied by pain in the lumbar region, dysuria, fever and signs of intoxication. The course of the disease is 10-15 years or longer; patients are eventually developing chronic renal failure;

4) anemic form: symptoms of hypochromic anemia. Urinary syndrome is less pronounced and intermittent;

5) hematuric form: constant micro- or gross hematuria. The clinical manifestations are scarce. The diagnosis is challenging.

Diagnosis. Complete blood count: leukocytosis with a left shift (during exacerbation), anemia and increased ESR.

Urinalysis: leukocyturia, microhematuria (in some cases), decrease in the relative density of urine, proteinuria and cylindruria.

KUB radiography: reduced size of the kidney.

Excretory pyelography: deformation of the calyces and pelvicalyceal structures.

Renal ultrasound: asymmetric changes in the kidneys.

Radioisotope scan: diffuse nature of the changes, a decrease in the size of the kidneys.

Biopsy is performed when the health team experiences difficulties with diagnosis.

Treatment. During exacerbations, patients with chronic pyelonephritis are hospitalized. When in hospital, they remain on bed rest.

Unless contraindicated, it is recommended to take 2-3 liters of oral.

Etiotropic therapy includes elimination of the causes for disruption of urodynamics and renal circulation, as well as antibacterial therapy (uroantiseptics, antibiotics, nitrofurans, fluoroquinolones, quinolines).

The choice of the drug is made taking into account the type of the pathogen and its antibiotic sensitivity.

Aminoglycosides (gentamicin, kanamycin, brulamycin) are nephrotoxic antibiotics, which should be avoided.

Symptomatic treatment includes antihypertensive drugs, diuretics, iron supplements and hemostatics.

Non-pharmacological treatment methods include plasmapheresis and health resort treatment.

Prevention includes a timely and adequate treatment of acute pyelonephritis, acute cystitis and concomitant disease (especially diabetes and gout).

Potential problems in patients with pyelonephritis include the following: knowledge deficit, dysuric events, fever, chills, pain in the lumbar region, etc. Special models are used in the organization of nursing care to meet the needs of the patient with acute pyelonephritis. In a setting of chronic pyelonephritis and its complications (improvement patient self-care) and at the health screening stage, the “health through development” model is used.

Nephrolithiasis is a chronic disease that is characterized by the formation of urinary stones (calculi) in the kidneys, often as a result of metabolic disorders and changes in the urinary tract.

Etiology. Renal calculi appear as a result of metabolic problems, vitamin deficiencies (in particular vitamin A deficiency and hypervitaminosis D), and congestion of urine in the renal pelvis, when salts may crystallize triggering the formation of stones. Impaired function of endocrine glands is another cause of stone formation.

Kidney stones may have different composition, and, respectively, different color and density. In terms of chemical composition, the stones can be homogeneous (oxalate, urate, phosphate, carbonate, xanthine, cholesterol) and mixed.

Clinical presentation. Kidney stones may not make themselves known for many years. The main symptom of the disease is an attack of renal colic (severe pain in the lower back on the right and left, radiating to the inguinal region, which may be accompanied by vomiting and even loss of consciousness). Visible blood often appears in the urine. The pain in renal colic is accompanied by frequent and painful urination. Urine output may be compromised.

Positive symptom of costovertebral angle tenderness is almost ubiquitous on physical examination of patients with renal colic.

After the attack, small amounts of protein, and “fresh” red blood cells and white blood cells appear in the urine.

A valuable diagnostic method is radiography of the urinary tract (the shadow(s) of one or more stones can be determined).

Complications. Acute or chronic pyelonephritis, ARF, calculous hydronephrosis, arterial hypertension, CGN.

Treatment. The treatment in renal colic includes injections of atropine sulfate (1 ml of a 0.1% solution) subcutaneously, and morphine hydrochloride (1 ml of a 1% solution) intravenously. Frequent attacks and a manifest inflammatory process with urinary disorders can prompt a surgical intervention.

To determine the diet indicated in the patient, the health team should find out the chemical composition of the stones. In phosphate stones/alkaline urine pH, carbonic mineral waters, fermented milk products and lemons are recommended; meat can be used in moderation. In uric acid stones, alkaline mineral waters and vegetable-based diet with restriction of meat are indicated. Health resort and spa treatment is recommended. In most cases, nephrolithiasis has a favorable prognosis.

Prevention. Primary and secondary prevention of nephrolithiasis is based on the treatment of metabolic disorders, timely and adequate treatment of chronic pyelonephritis, and increased diuresis due to oral hydration.

Chronic renal failure (CRF) is a syndrome of functional failure of the kidneys with reduction or complete cessation of their activity to maintain the homeostasis of the body's internal environment. This condition develops in various diseases of the kidneys as a result of progressive nephronal death.

More than 50 nosological entities are known to potentially end in chronic renal failure. Life expectancy largely depends on the nature of underlying disease.

Etiology and pathogenesis. The first place among the causes of chronic renal failure is occupied by chronic glomerulonephritis, and the second by chronic pyelonephritis, followed by diabetic glomerulosclerosis, hypertension, polycystic kidney disease, amyloidosis of the kidneys, etc.

Excretory, blood-cleansing and homeostatic functions of the kidneys are compromised; there is a retention of nitrogenous metabolic by-products in the blood.

Clinical presentation. The patients appear slow, apathetic and drowsy. The skin is dry and itchy, the face is puffy. Muscle weakness is apparent. Bone damage occurs, and changes in the skeleton (osteoporosis) are observed due to demineralization. Pericarditis and pleurisy may be seen in the terminal stage.

The patients experience anorexia, nausea, vomiting, dryness and unpleasant taste in the mouth, heaviness in the epigastric region after eating, and almost unquenchable thirst. Body temperature may drop.

In the blood, anemia is notable in combination with toxic leukocytosis; platelet count is reduced; the content of residual nitrogen, urea and creatinine in the blood serum increases. Chronic renal failure is often accompanied by hyperkalemia.

Diagnosis. Complete blood count: anemia.

Urinalysis: signs of underlying disease, low specific gravity of urine.

Serum biochemistry: high levels of creatinine, urea and potassium.

ECG: diffuse myocardial changes and arrhythmia.

The eye fundus: angioretinopathy and hemorrhages.

Treatment. The most important intervention is the treatment of underlying disease. The diet should be adequate, with sufficient calories, but with a protein restriction of up to 60-40-20 g per day, depending on the stage of the disease. Dietary restrictions involve salt, water, potassium and phosphates (i.e. restriction of fish and milk).

It is very important to correct fluid balance and electrolyte disorders (correction of potassium in the blood), and control the amount of oral fluids.

Drug therapy may include sorbents that adsorb ammonia and other toxic substances, and anabolic steroids to support metabolism. Correction of acid-base balance with intravenous fluids is often an important part of treatment.

Symptomatic therapy may include antihypertensive drugs, iron and vitamin supplements in anemia, and the treatment of infectious complications.

The most radical and effective method of CRF treatment is renal transplantation. Hemodialysis can be considered a successful treatment method, which may prolong the patient’s life by up to 10-20 years.

CHAPTER 4
THE SPECIFIC ASPECTS OF HEMODIALYSIS AND PERITONEAL DIALYSIS IN KIDNEY DISEASE

Dialysis is a method for cleansing the blood when the kidneys are no longer capable of performing this function. This method removes metabolic waste, as well as excessive salt and water from the body, and also helps control blood pressure.

There are two types of dialysis. In hemodialysis, blood is pumped from the body to an “artificial kidney” machine and returned to the body through the tubing that connect the patient's blood vessels to the machine.

In peritoneal dialysis, the inner lining of the abdomen acts as a natural filter. The waste is removed using a cleansing fluid called dialysate, which is cycled through and out of the abdomen.

There are two types of peritoneal dialysis:

- Continuous ambulatory peritoneal dialysis (CAPD)
- Automated peritoneal dialysis (APD)

The basic treatment is the same for everyone. However, the number of procedures and the way they are carried out distinguish each method.

Ambulatory peritoneal dialysis is "continuous", does not require machines, and is performed while the patient goes about their usual activities, such as work or school. The patient carries out their treatment by placing approximately two liters of cleansing fluid into the abdominal cavity and then draining it. This is done by attaching a plastic bag of cleansing fluid to a tube in the abdomen. Lifting the plastic bag up to shoulder height causes gravity to pull the liquid into the patient’s abdomen. The emptied plastic bag is removed and discarded.

When the exchange (fluid infusion and withdrawal) is complete, the fluid (which has now removed the waste substances from the patient’s blood) is expelled from the patient’s abdominal cavity and disposed of. This process is usually performed three, four or five times within 24 hours while the patient is

awake and during their normal activities. Each exchange takes from 30 to 40 minutes to complete. Some patients are more comfortable doing this procedure during the mealtime and at bedtime.

Automated peritoneal dialysis is different from continuous ambulatory peritoneal dialysis in that the machine (automated cycler) feeds and then drains the cleansing fluid. The treatment is usually performed at night, while the patient is sleeping.

Peritoneal dialysis (PD) is using an internal membrane in the abdomen (peritoneum) as a filter to cleanse blood. The surgeon inserts a soft plastic tube (catheter) through the wall of the abdomen or chest (presternal catheter). This tube is the size of a drinking straw. When the wound has healed, the nurse will teach the patient how to use the tube to fill their abdomen with sterile fluid.

Most people use a PD machine, i.e. a machine that fills the abdominal cavity with fluid and then drains it. Machine-assisted PD is most often performed at night while the patient is sleeping, so the patient's daytime is free. If the patient is able to perform the PD procedure and change the fluid bags independently, such patient does not need a PD partner.

After the nurse fills the abdominal cavity wit sterile PD fluid (dialysate), it will remain there for several hours. While the patient goes about their business, the liquid will collect waste and water. The nurse then drains the used fluid and refills with fresh fluid. A cycle of draining and filling is referred to as exchange.

Some people do four exchanges in a day manually. But the patient can do one exchange when they wake up, one exchange at lunchtime, one exchange during dinner and one exchange before going bed. Each exchange takes from 20 to 30 minutes to complete. This is referred to as continuous ambulatory peritoneal dialysis.

Peritoneal dialysis may be the best option for the patients who:

- Does not tolerate rapid changes in fluid balance associated with hemodialysis.
- Wants to minimize disruption of their activities of daily living

- Wants to work or travel easier
- Has some residual kidney function preserved.

Complications of peritoneal dialysis may include:

Infections. Infection of the abdominal mucosa (peritonitis) is a common complication of peritoneal dialysis.. An infection can also develop at the site where the catheter is inserted to bring cleansing fluid (dialysate) into and out of the abdomen. The risk of infection is higher if the person doing the dialysis has not been adequately trained.

Increased body weight. The dialysate contains sugar (dextrose). Absorbing some dialysate can result in the patient consuming hundreds of extra calories daily, which may result in weight gain. These additional calories may also cause an increase in blood sugar levels, especially if the patient has diabetes.

Hernia. Prolonged retention of fluid in the abdominal cavity can lead to muscle strain.

Inadequate dialysis. Peritoneal dialysis may become ineffective in several years' time. It is possible that the patient may need to switch to hemodialysis.

In our study, we have compared the incidence of complications after peritoneal dialysis in patients with chronic kidney disease. A total of 64 patients have taken part in this study series.

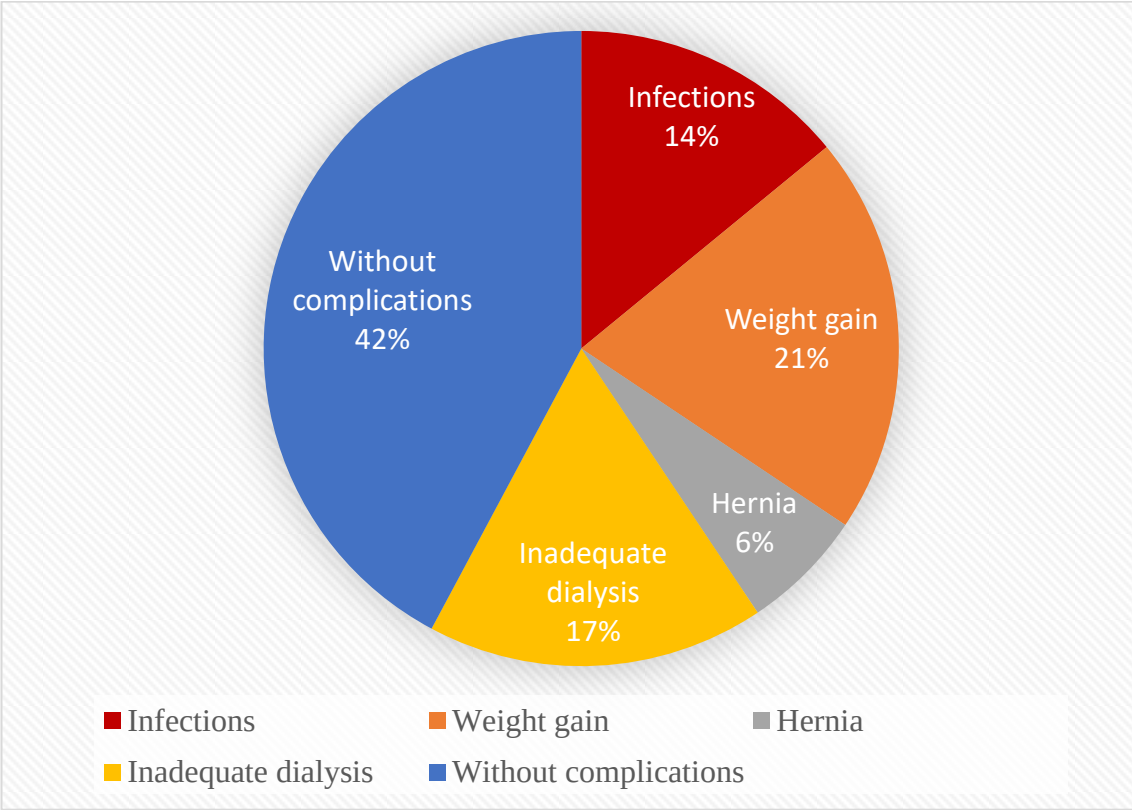

Diagram 4.1. Complications in patients with chronic kidney disease who had peritoneal dialysis.

Hemodialysis is the method for treatment of acute or chronic renal failure, based on extracorporeal treatment of blood in a special exchange device (dialyzer, hemofilter) with a dialysis solution for the purpose of correcting the main uremic syndromes (cleansing the blood of uremic toxins, removal of excess fluid, normalization of the electrolyte composition of the blood and acid-base state).

Throughout the entire history of clinical use of hemodialysis, the development of ways to increase the efficiency of eliminating uremic toxins and expanding the spectrum of excreted toxins have been the most important constituents of its improvement. Development proceeded along two related directions: increasing the permeability of the dialysis membrane and increasing the share of convection transport.

The transport of solutes across a membrane is possible by two physical processes: diffusion, when a solute permeates through a semipermeable

membrane as a result of a concentration gradient, and convection, when a solute moves through a semipermeable membrane together with a solvent along a hydraulic pressure gradient.

In hemodialysis, a constantly high diffusion across the dialysis membrane is maintained by the continuous reproduction of the solute concentration gradient: continuous delivery of crude blood with a high concentration of dialysable substances to the membrane, on the one hand, and a continuous flow of fresh dialysate, on the other hand.

These flows in the dialyzer are arranged in a countercurrent to maintain a concentration gradient along the entire length of the dialyzer: at the inlet to the dialyzer, blood with a high content of dialyzable substances contacts with the outflowing dialysate, which has absorbed a certain concentration of substances while flowing through the dialyzer, and at the exit from the dialyzer, partially cleansed blood contacts with fresh dialysate that does not yet contain the solutes to be removed. The efficacy of maintaining the concentration gradient and, consequently, diffusion, is determined by the following factors:

- blood flow rate,
- membrane permeability;
- dialysate flow rate.

The latter factor is the easiest to adjust. However, its value in real-world dialysis practice (i.e. 500 ml/min) is set at a magnitude where any further increases will not produce a noticeable increase in the transfer rate of solutes, since the limiting factor (in addition to membrane properties) is the rate of blood-borne delivery of solutes to the membrane. This factor is the most difficult to bring to high values, since it is determined by the possibilities of vascular access: for an arteriovenous fistula, the maximum blood flow (without recirculation) is usually limited to 300 ml/min; for central catheters it may be higher, but the effective and safe use of catheters is limited in time.

A measure of the effectiveness of blood cleansing by diffusion is the dialyzer clearance, i.e. the conditional fraction of blood that leaves the dialyzer

completely cleared of the dissolved substance: the dialyzer clearance of 260 ml/min in a blood flow of 300 ml/min actually means that the concentration of the substance at the outlet of the dialyzer will decrease by 87% (=260/300).

Renal replacement therapy (hemodialysis, peritoneal dialysis and renal transplantation) should be viewed as a single package of therapeutic methods. The best long-term results of treatment of patients with CRF are attained in consistent use of disease period-optimized treatment methods with allowances made for the objective health status of the patient, the availability of treatment methods and the informed preferences of the patient.

Worldwide, kidney allotransplantation is very rarely considered as an initial method of treatment. However, some patient populations (especially children) could benefit from kidney transplantation before the development of serious complications of renal insufficiency. In such cases, transplantation of organs harvested from family (i.e. from a living donor) is usually the case.

Therefore, in a real-world setting, the choice is between peritoneal dialysis (PD) and hemodialysis (HD). Numerous evidence obtained when starting dialysis with PD in the presence of relatively intact kidney function (~ 8 to 10 ml/min) in centers where both methods were equally available convince us that the formula expressed by Norbert Lamer: “start treatment with peritoneal dialysis where possible, switch to hemodialysis when necessary, and perform kidney transplantation as early as possible” is surprisingly fair.

This approach makes any efficacy comparisons between the two dialysis methods irrelevant. Each method has its own advantages and limitations.

Unfortunately, the majority of dialysis centers lack the option to perform peritoneal dialysis or access to peritoneal dialysis is limited.

If we consider HD as the only option of renal replacement therapy, then any consideration of the indications for dialysis is reduced to determining the proper timing to start hemodialysis and to an extremely limited list of reasons to refuse the start of dialysis.

All modern recommendations have established the range of reduction in residual kidney function, when measures to prepare for initiation of renal replacement therapy should undoubtedly be started. The patient should be provided with ample information on upcoming substitution therapy, and its options and tentative start dates at Stage IV of CKD (i.e. at GFR of 15-29 ml/min). After an informed decision is made in favor of HD as the initial method of renal replacement therapy at the GFR level of 15 ml/min (if there is a choice), the dialysis team should prepare and form a vascular access for hemodialysis; for the absolute majority of patients, an arteriovenous fistula will be used. Fistula maturation will take not less than a month. Using a fistula too early will adversely impact the duration of its effective functioning.

At a glomerular filtration rate of 6-8 ml/min, hemodialysis treatment should be initiated. In the last months before reaching this level, the progression of renal failure may accelerate sharply in the patient; any intercurrent infection, minor bleeding, imbalance of diabetes mellitus or worsening of the course of any chronic disease can become an additional impetus to deterioration.

It should be remembered that most patients with stage IV-V CKD die from complications of renal failure before dialysis is initiated, and the incidence of these complications (primarily of cardiovascular nature) increases rapidly as the need for dialysis approaches.

Therefore, waiting for a patient to reach a certain level of residual kidney function (e.g., 6 ml/min) can become dangerous. The decision to initiate dialysis should be based not only on GFR level (and, even more so, not on the level of creatinine), but also on clinical evidence of worsening renal failure, such as:

- poor control of hypertension;
- hyperhydration with threatening pulmonary edema;
- decreased nutritional status;
- escalating anemia despite adequate iron stores (ferritin at least 100 μg/l);
- hyperkalemia;

- uncontrolled phosphate levels despite dietary restrictions and the use of phosphate binders;
- aggravation of chronic infectious and non-infectious diseases.

Patients with diabetes mellitus may benefit from an earlier onset of dialysis.

At the GFR of 6 ml/min, all patients should be started on renal replacement therapy.

There is a very limited listing of conditions that may justify refusing renal replacement therapy:

- an extremely severe somatic condition associated with a comorbidity (not renal failure)
- a Stage IV cancer, which determines an unfavorable immediate prognosis
- a severe mental illness (NB: an acute psychosis may be due to uremia and is not a reason to refuse dialysis)
- informed refusal of the patient to receive renal replacement therapy

Renal replacement therapy must be initiated in an inpatient setting. During the first week (and longer in a severe condition of the patient), hemodialysis sessions should be performed daily, gradually increasing their duration from 2 hours, and using small dialyzers. This rule should be observed more strictly, the higher the initial level of urea, in order to prevent a pronounced disequilibrium syndrome associated with uneven removal of urea from various water sectors of the body; delayed excretion of urea from the brain tissue can lead to severe cerebral edema.

In the last decade, the reliability of dialysis machines, dialysis membranes, vascular access and water purification systems has risen to a fairly high level, but dialysis-associated complications are still likely. The increasing fractions of cardiovascular and diabetic patients, who are more sensitive to the effects of the dialysis machine on the fluid sectors of the body and their electrolyte composition, as well as to contact with foreign materials, contributes to the ongoing significant rates of intra-dialysis complications.

Although hemodialysis treatment may be effective in restoring partially lost kidney function, a patient may experience some of the conditions below, although not everyone has all of these problems.

Complications or adverse events associated with hemodialysis:

Low blood pressure (hypotension). A decrease in blood pressure is a frequent adverse effect of hemodialysis. Low blood pressure may be accompanied by shortness of breath, abdominal cramps, muscle twitching, nausea, or vomiting.

Muscle spasm. Although the cause is unknown, muscle spasm during hemodialysis are common. Adjusting fluid and sodium intake between hemodialysis sessions may also help prevent these symptoms during treatment.

Itching. Many people who have hemodialysis experience skin itching, which often gets worse during or immediately after the procedure.

Sleep disorders. People on hemodialysis often have sleep disorders, sometimes due to respiratory arrests during sleep (sleep apnea) or due to aching, uncomfortable or restless feet.

Anemia. Deficiency of red blood cells in the blood (anemia) is a frequent complication of renal insufficiency and hemodialysis. Renal failure reduces the production of the erythropoietin hormone, which stimulates the formation of red blood cells. Dietary restrictions, poor absorption of iron, frequent blood tests, or washout of iron and vitamins during hemodialysis can also contribute to anemia.

Bone disease. If the damaged kidneys can no longer process vitamin D, which helps the patient assimilate calcium, their bones may get weaker. In addition to that, excessive production of parathyroid hormone, a common complication of renal failure, can additionally release calcium from the bones. Hemodialysis may further aggravate these condition by removing too much or too little calcium.

High blood pressure (hypertension). If the patient consumes too much salt or drinks too much liquid, their already high blood pressure may worsen and lead to heart problems or strokes.

Fluid overload. Since fluid is removed from the body during hemodialysis, drinking more fluids than recommended between hemodialysis sessions may cause life-threatening complications, such as heart failure or fluid buildup in the lungs (pulmonary edema).

Inflammation of the membrane surrounding the heart (pericarditis). Inadequate hemodialysis may lead to inflammation of the membrane surrounding the patient's heart, which may affect the heart's capacity to pump blood to other parts in the body.

High potassium level (hyperkalemia) or low potassium level (hypokalemia). Hemodialysis removes excessive potassium, a mineral which is usually removed from the body by the kidneys. If too much or too little potassium is removed during dialysis, the heart may start beating irregularly or even stop.

Problems with access. Potentially dangerous complications, such as infection, narrowing or bulging of vascular wall (aneurysm), or occlusion may affect the quality of hemodialysis. The nurse and the patient should follow the instructions of the dialysis team on how to check for changes in the access site, which may suggest a problem.

Amyloidosis. Dialysis-associated amyloidosis develops when blood proteins are accumulated in joints and tendons, causing pain, stiffness and fluid accumulation in the joints. This condition is more frequently seen in people who have been on dialysis for several years.

Depression. Mood changes are typical for people with renal failure. If the patient experiences depression or anxiety after starting hemodialysis, they should discuss effective treatment options with their healthcare provider.

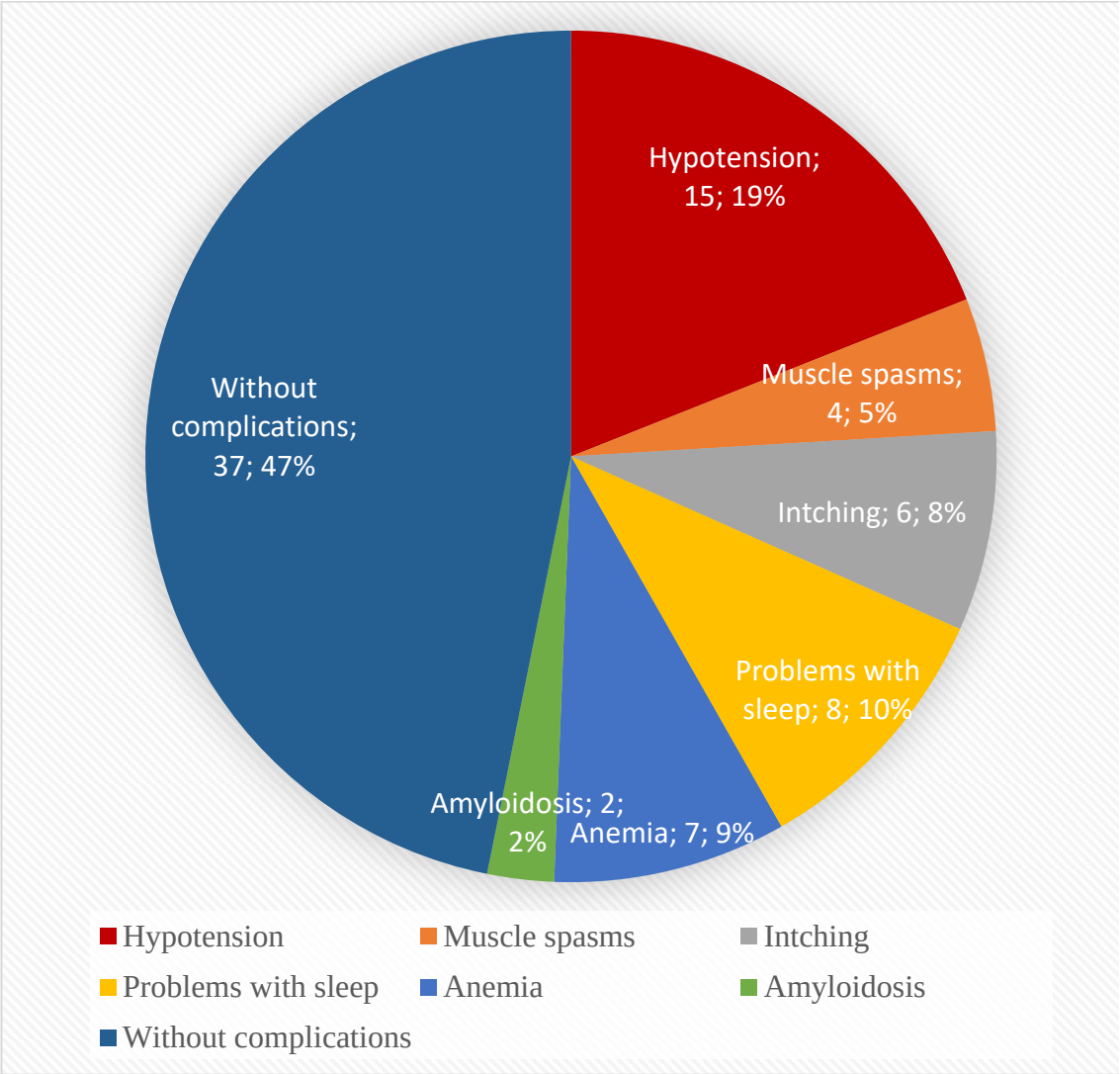

Diagram 4.2. Complications in patients with chronic kidney disease who had hemodialysis.

In this series of our study, we have compared the incidence of complications in patients with chronic kidney disease who had hemodialysis. This study series enrolled a total of 79 patients who had hemodialysis (Diagram 4.2).

Among the patients in this series who had hemodialysis, 37 subjects (47%) had no complications as of the period of our observation; at the same time the other 63% had complications when conducting hemodialysis, such as hypotension, muscle spasm, skin itching, sleep disorders, anemia and amyloidosis.

CHAPTER 5
EVALUATION AND ANALYSIS OF INDICATIONS TO THE USE OF PERITONEAL DIALYSIS AND HEMODIALYSIS IN PATIENTS WITH CHRONIC KIDNEY DISEASE AND COMPARATIVE FREQUENCIES OF COMPLICATIONS WHEN USING THESE METHODS

Two methods of dialysis therapy are used: hemodialysis and peritoneal dialysis (PD). Their use is dictated by expediency, the available options and any standing medical tradition. To date, PD occupies one of the leading places in nephrological practice among the treatments for patients with end-stage chronic kidney disease (CKD) accompanied by chronic renal failure (CRF).

The choice of the dialysis method is often a difficult dilemma for both the doctor and the patient. Both methods have a number of advantages and disadvantages, however, regarding the former, peritoneal dialysis still leads.

The primary reason why the majority of specialist physicians find it preferable is the less extensive range of contraindications and associated adverse effects compared to hemodialysis. This allows using PD in a far greater number of patients who need substitution therapy.

A second important advantage is the relative autonomy of the patient when treated with PD. The patient may carry out their procedures independently in the home, only occasionally visiting the specialized medical institution to monitor the main indicators and to correct the regimen of procedures.

In the case of hemodialysis, the patient is tied to a specific time and place, and must visit a dialysis center, the number of which is very limited in many countries.

In addition to that, in case the patient is using PD, they may, under the supervision of their healthcare provider, adjust the treatment schedule to their work schedule and other aspects of their daily living, even despite the fact that the procedures should be carried out every 4-6 hours.

Also, when automated peritoneal dialysis (APD) is used, the patient can completely free their day from the procedures. In case with APD, the procedures are performed at nighttime, when the patient is sleeping; multiple daily procedures are no longer needed.

On the whole, peritoneal dialysis has become widespread as required.

A huge proportion of patients with end-stage renal disease are people with cardiovascular comorbidities or systemic diseases. In this patient cohort, hemodialysis may be contraindicated, since it may aggravate chronic cardiovascular disease.

The cohort of individuals where hemodialysis is contraindicated, includes patients with any coagulation disorders, since constant use of anticoagulants is necessary during hemodialysis to avoid thrombosis.

Another advantage of peritoneal dialysis is that it is relatively adjusted to human physiology, since its dialysis membrane is the peritoneum, and not a synthetic filter membrane as in hemodialysis. Since the procedures are performed daily (several times a day or once a day in case of APD), they do not create sharp fluctuations in blood chemistry and hemodynamic loads.

In addition to good tolerability of this method, as one of the positive aspects of treatment, the patients note the autonomy that allows them to be relatively independent and unrestricted as they may move where they live, in their country or even abroad, since even the required products and dialysis solutions are usually delivered to their homes.

We identified complications in patients with renal failure, which were emerging after the dialysis.

In total, we have analyzed the results of using hemodialysis in 143 patients of 2 groups:

Group 1: patients with chronic kidney disease who had hemodialysis (79 patients);

Group 2: patients with chronic kidney disease who had peritoneal dialysis (64 patients).

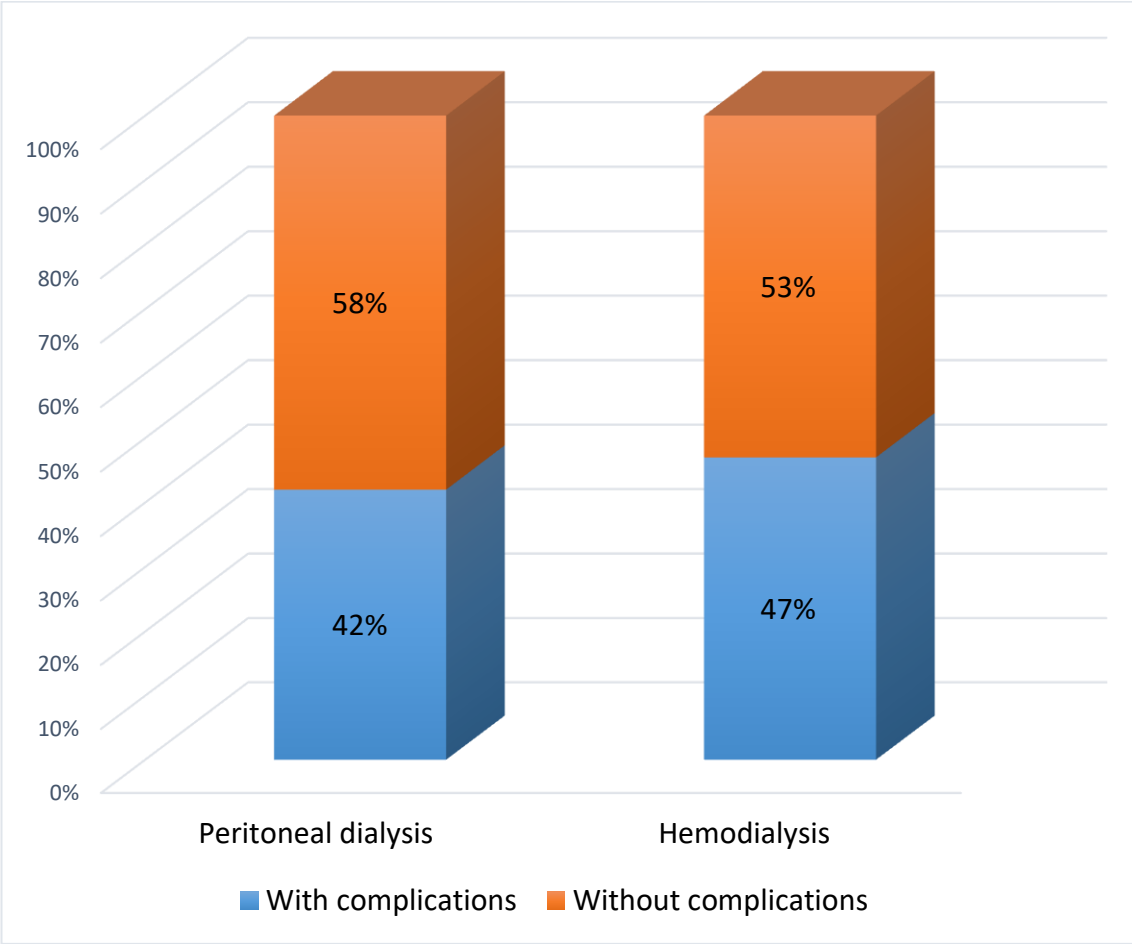

Diagram 5.1. Comparative complication rates in patients with chronic kidney disease who had hemodialysis and peritoneal dialysis.

The results of our study have shown that hemodialysis is characterized by a somewhat higher incidence of complications (47%) than peritoneal dialysis (42%).

Some specialist physicians believe that peritoneal dialysis has a number of advantages compared to hemodialysis. In continuous dialysis, it is easier for the patient to control excess in fluid, and this may reduce the load on the heart and blood vessels. The patient may eat more, take less medicines and have more time for their daily activities; overall, it becomes easier for the patient to work and live an active life.

CONCLUSIONS

1. The authors have investigated the specific aspects of hospital- and home-based nursing care in kidney disease.

2. The authors have studied the specific aspects of diagnosis, clinical presentation and treatment of various kidney diseases.

3. The specific features of conducting peritoneal dialysis and its possible adverse effects in patients have been determined.

4. The specific features of conducting hemodialysis and its possible adverse effects in patients have been determined.

5. The authors have determined the nursing role when conducting peritoneal dialysis and hemodialysis in patients with renal disease.

6. The authors have conducted evaluation and analysis of indications to the use of peritoneal dialysis and hemodialysis in patients with chronic kidney disease and comparative frequencies of complications when using these methods.

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