Study on the Staging of Renal Insufficiency

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ABSTRACT

The kidney is the organ responsible for controlling the hydro-electrolyte and acid-base balance of our body. Acute renal failure may be caused by renal hypoflow, damage to the renal parenchyma itself, and obstruction of the uro-excretory system. Chronic renal failure is the state of persistent, irreversible renal dysfunction. Objective: to deepen the basic functions of the kidneys, the symptoms and phases of the
staging of the real insufficiency from its diagnosis to the stage of chronic renal failure, in order to learn to guide the prevention of the disease. Methodology: bibliographic research. Results: The new National Kidney Foundation chronic kidney disease staging system considers five stages, ranging from chronic renal failure to failure to chronic kidney failure. When it comes to the staging of renal failure, one should not forget to perform the early diagnosis of the disease, the immediate referral for nephrological treatment and the implementation of measures to preserve renal function. Conclusion: Patients over the age of 40 are advised to have an annual consultation with a nephrologist, blood creatinine test, and urinalysis.

Key words: Renal Insufficiency, Staging, Therapies for Treatment.

1. INTRODUCTION

The word Nephrology is originated in the Greek language (nephros), means "kidney", and represents a very important medical specialty. Nephrology is a medical specialty dedicated to the diagnosis and clinical treatment of diseases of the urinary system, mainly related to the kidney (BRAZILIAN SOCIETY OF NEPHROLOGY, 2013). The doctor who specializes in diseases of the urinary system is called a nephrologist. The time to form a nephrologist is 10 years of study as a whole. Nephrology in Brazil has made many achievements since the beginning of the 1960s when its focus was Renal Renal Therapy (TRS) - dialysis and renal transplantation. But what are the critical risk factors for loss of kidney function? What are the guidelines and strategies for treatment and care for the population?

According to the Ministry of Health, circulatory diseases account for a significant impact on mortality in the Brazilian population, corresponding to 32% of deaths in 2002, equivalent to 267,496 deaths (BRASIL, 2006). But what are the factors, major risk groups and staging of Chronic Kidney Disease (CRF)?

In Nephrology, the term staging is widely used and is understood as a way of assessing the extent of the disease in relation to the organ of origin and, therefore, assessing the degree of impairment of the organ in which the tumor began and assessing whether the spread beyond the place of origin. In this way, it is essential for the professional in Nephrology to consider the clinical history (complaints, symptoms, personal and family history) and the physical examination of the patient. Júnior (2004) points out that for clinical, epidemiological, didactic and conceptual effects, CRF is divided into six functional stages according to the degree of renal function of the patient, going from the normal renal phase without renal damage to the terminal.

Thus, the present study aimed to describe the basic functions of the kidneys, the symptoms and stages of the staging of the real deficiency from its diagnosis to the stage of chronic renal failure, in order to learn to guide the prevention of the disease.
2. THEORETICAL FOUNDATION

2.1 Anatomical description of the kidneys

Anatomically, the kidney is supplied by a single artery, called the main renal, with a relatively constant position and path until it forms the thread. The origin is found in the abdominal aorta between the L1 and L2 levels that constitute the lateral column of the thoracic and high lumbar spinal segments (OZKAN et al., 2006). There are differences in size between the right and left renal arteries in adults, while the right has a path of about 5 cm, the left one is 7 cm. The two are divided close to the thread in two, three or four terminal branches. One or more adrenal arteries of each renal artery, as well as a branch to the ureter and several branches to adjacent tissue and retroperitoneum (TESTUT and LATARJET, 1975 apud PALMIERI et al., 2011).

According to Satyapal et al. (2001), anatomical variations of these arteries do not interfere in the renal function and must be differentiated from anomalies or vascular malformations that cause functional renal and systemic disorders. As stated by Palmieri et al. (2011), there were times when variations in the arteries received terms such as accessory, aberrant, anomalous, supernumerary and supplementary. For Sampaio and Passos (1992), these arteries can be called multiple, because they do not have anastomoses between them constituting segmental vessels for the kidneys.

According to Moon et al. (1998), generally the arteries that go to the renal poles are less calibrosas than the hilar renal arteries, coming from the main renal arteries.

For Bordei et al. (2004), an evaluation of both the presence of multiple renal arteries, as well as the pattern of their prehilar divisions, should be performed because of the importance in relation to renal irrigation and to influence renal dissection and access plans.

For Motta (2011), the nephron is the basic organizational unit of the kidney and consists of a specialized capillary bed, the glomerulus, surrounded by the urinary epithelium (Bowman's capsule) and connected to a succession of specialized epithelial segments, the tubules. Each human kidney contains about 1.2 million nephrons. The nephron is responsible for two serial processes: glomerular ultrafiltration and tubular reabsorption / secretion.

2.2 Renal Functions

According to the Brazilian Society of Nephrology (2013), the kidneys, even small ones, with an approximate size of 10 cm, perform the important work of taking a healthy balance of the internal chemistry of the body. For healthy survival, these organs should function normally, performing four
functions: elimination of toxins from the blood by a filtration system, regulation of blood formation and production of red blood cells, regulation of blood pressure and control of the delicate chemical balance and body fluids.

2.2.1 The filter function: toxin excretion

The kidney has the function of eliminating most of the toxic substances derived from our metabolism from the body. The major toxins, formed daily, are derived from protein metabolism. These substances contain nitrogen in their molecules, because they originate from the breakdown of amino acids and are commonly called nitrogenous slags or azotemics. Urea, when at very high concentrations (> 380 mg / dL) also presents toxic effects such as nausea, vomiting, anorexia and bleeding (ENGEL et al., 2005).

The kidney performs its excretory function through glomerular filtration. The Glomerular Filtration Rate (GFR) is the parameter that quantifies this function. The normal value is between 80-140 mL / min, which is equivalent to approximately 120 liters of filtered plasma per day. Of these, about 118 liters return to the plasma through tubular reabsorption; the remaining 2 liters being eliminated as urine (which contains all the toxins that need to be eliminated from the body) (ENGEL et al., 2005).

Glomerular filtration is the best measure of renal function in normal individuals or patients with renal disease (KIDNEY DISEASE OUTCOME QUALITY INITIATIVE, K / DOQI, 2002). For Bastos et al. (2010), when the GFR reaches very low values, lower than 15 mL / min / 1.73m3, establishes what is denominated Functional Renal Failure (FFR), that is, the most advanced stage of the functional loss continuum progression in CKD.

Much like filter work, the kidneys work to keep the body free of toxins. Blood enters the kidneys through the renal artery. Once the blood reaches the kidneys, the toxins are filtered into the urine. Clean blood returns to the heart through a renal vein (BRAZILIAN SOCIETY OF NEPHROLOGY, 2013).

2.2.2 Production of red blood cells and bone formation

According to the Brazilian Society of Nephrology (2013), for the formation of bones and the production of red blood cells, it is necessary that the kidneys function normally. The kidneys regulate calcium and phosphorus concentrations in the blood as well as produce an active form of Vitamin D. They also release erythropoietin, which aids in the maturation of red blood cells and bone marrow. Ratifica Motta (2011) is role of the kidneys synthesize erythropoietin, renin, prostaglandins and 1,25-dihydroxycholecalciferol (active form of vitamin D).

2.2.3 Regulation of blood pressure
Another important function of the kidneys is regulating blood pressure. According to the Brazilian Society of Nephrology (2013), it is necessary to control sodium concentrations and the amount of fluid in the body. It is up to the kidneys to secrete a substance called renin. Renin stimulates the production of a hormone that raises blood pressure. When the kidneys do not work well if excess renin is produced and this can result in hypertension. Prolonged hypertension damages the blood vessels, thus causing kidney failure.

2.2.4 Control of chemical and body fluid balance

According to the Brazilian Society of Nephrology (2013), when the kidneys do not function properly, toxins accumulate in the blood. This results in a very serious condition known as uremia. Symptoms of uremia include: nausea, weakness, fatigue, disorientation, dyspnoea, and edema in the arms and legs. There are toxins that accumulate in the blood and can be used to assess the severity of the problem. The main substances commonly used for this purpose are called urea and creatinine. Kidney disease is often associated with elevated levels of urea and creatinine. For Motta (2011), the kidney regulates the electrolyte balance in the interstitial fluid, simultaneously controlling the movement and loss of water at the cellular level in collaboration with the skin and lungs.

2.3 Measurement of Renal Function

The only way to measure renal excretory function is by quantifying glomerular filtration. Acute uremic syndrome may occur with a TGF of less than 15-30 mL / min (less than 15-30% of renal function), which corresponds to a plasma concentration of urea and creatinine above 120 mg / dL and 4.0 mg / dL, respectively, in a 40-year-old adult weighing 70 kg (ENGEL et al., 2005).

According to Nunes (2007), the most commonly used methods for estimating GFR are serum creatinine concentration, endogenous creatinine clearance (ECD), or estimation of GFR or ECD by equations based on serum creatinine.

In medical practice, renal function can be quantified using excretory function parameters. They are: (1) plasma urea; (2) plasma creatinine; (3) creatinine clearance.

2.3.1 Plasma Urea

Urea is formed in the liver from ammonia (NH3) molecules, produced in large quantities by protein metabolism and bacteria in the intestinal flora. While ammonia is extremely toxic, being one of the causative substances of hepatic coma, the toxicity of urea is controversial. Only at very high concentrations (> 380 mg / dL) can produce adverse effects, usually related to gastrointestinal tract and
hemostasis. However, because urea is eliminated almost exclusively by the kidney and is easily plasma
dosed, a measure of its levels can be used to assess renal excretory function. In general, urea levels rise to
levels above the reference values when the GFR is less than 50 mL / min. The normal value of urea is
20-40 mg / dL (ENGEL et al., 2005).

However, urea is not the best 'thermometer' for measuring kidney function. A portion of the urea filtered
through the glomerulus is reabsorbed. Therefore, conditions that increase tubular reabsorption, such as
hypovolemia, may increase serum urea levels without a significant decrease in renal function. In addition,
the large production of ammonia after a digestive hemorrhage, when the intestinal flora intensely
catabolizes the released hemoglobin, leads to an increase in the urea's hepatic production, raising its
levels (ENGEL et al., 2005).

According to Motta (2011), urea constitutes 45% of the non-protein nitrogen in the blood. After hepatic
synthesis, urea is transported through the plasma to the kidneys, where it is filtered through the glomeruli.
Urea is excreted in the urine, although 40-70% is reabsorbed by passive diffusion through the tubules. A
quarter of the urea is metabolized in the intestine to form ammonia and CO₂, by the action of normal
bacterial flora. This ammonia is reabsorbed and taken to the liver where it is reconverted into urea.
Plasma urea level is affected by renal function, dietary protein content and protein catabolism content,
patient hydration status and presence of intestinal bleeding. Despite these limitations, however, the level
of urea still serves as a predictive index of symptomatic renal failure and in establishing a diagnosis in
distinguishing between various causes of renal failure.

2.3.2 Plasma Creatinine

It is a non-toxic substance produced by muscle tissue, derived from creatine, energy storage molecule. It
has great advantages to be used as a measure of renal excretory function: a) its daily production is
relatively constant; b) unlike what occurs with urea, it is not reabsorbed by the tubule (ENGEL et al,
2005).

For Stevens and Levey (2005), creatinine is an amino acid derivative with 113 daltons, derived from
muscle metabolism and meat intake. It is generated in muscle from a non-enzymatic reaction of creatine
and phosphocreatine. Its production and release by the muscle are practically constant.

Normal levels of plasma creatinine depend on the individual's muscle mass. In a muscular individual, a
plasma creatinine of 1.3 mg / dL may be normal, whereas in an undernourished patient, plasma creatinine
should be below 0.8 mg / dL. The normal creatinine value is: Men <1.4 mg / dL and Women <1.2 mg / 
dL (ENGEL et al, 2005).
2.3.3 Clearance of Creatinine

Another important concept is clearance, from English, means debugging. By definition, it is the volume of plasma that is free of the substance to be eliminated every minute. For example, the urea clearance is 50-70 mL / min. As a part of the urea is absorbed and returns to plasma, its clearance is less than the GFR. Creatinine is not reabsorbed, anything that is filtered in the glomerulus and excreted in the urine and therefore purified from plasma. It may be said that Creatinine Clearance (CICr) is a reasonable estimate of GFR even though it overestimates it (usually 15% larger than GFR). The normal value of CICr is 80-150 mL / min (ENGEL et al., 2005).

According to Godoy and Silva (2006) Creatinine Clearance (CLCR) remains one of the most used markers in the evaluation of renal function.

2.4 Acute Renal Failure

Ferraz and Deus (2009) conceptualize Acute Renal Failure (ARF) as the sudden loss of the kidney's capacity to maintain its endocrine and exocrine activity, as well as the glomerular filtration and elimination of the compounds discarded by this filtration, production and urinary concentration, maintenance of homeostasis and basic acid balance.

ARI can be caused by three basic mechanisms: (1) renal hypoflow (pre-renal azotemia); (2) injury to the renal parenchyma itself (intrinsic renal azotemia), and (3) obstruction of the uro-excretory system (post-renal azotemia).

ARI is frequently observed in hospitalized patients and its prevalence is increasing, especially in the elderly population, with multiple comorbidities and in patients with diseases considered serious, such as neoplasia, among others (NOLAN and Anderson, 2005).

2.4.1 Pre-Renal Azotemia

Pre-renal azotemia or pre-renal insufficiency is the elevation of nitrogenous slags caused directly by the reduction of renal blood flow. It is the most common type of ARI (55-60% of cases). It is clinically characterized by reversibility, once renal flow is restored. The main causes are: (a) hypovolemia; (b) shock states; (c) heart failure; (d) hepatic cirrhosis with ascites (ENGEL et al., 2005). Nitrogen slags such as arginine-derived guanidine compounds, aliphatic or aromatic amines (derived from tryptophan), phenols, indoles, among others, cause uremic syndromes (ETZEL, 2004).

Renal vessels have a protective mechanism against deleterious alterations of renal flow and GFR, which
is called self-regulation of renal flow and glomerular filtration. When the mean arterial pressure (MAP) falls, the afferent arterioles dilate, reducing the vascular resistance of the kidney, avoiding renal hypoflow. Under normal conditions, renal blood flow is preserved up to a PAM of 80 mmHg. If this pressure falls below these values, self-regulation is no longer able to avoid hypoflow, since the arterioles are already at their maximum vasodilation. At this point, the pre-renal azotemia is installed. It is important to note that individuals with impaired renal self-regulation may develop pre-renal azotemia even with MAP slightly above 80 mmHg. It is the case of some elderly, chronic hypertensive and long-standing diabetics (ENGEL et al., 2005).

For Nolan and Anderson (1998), pre-renal azotemia is the single most common cause of ARI, responsible for 30 to 60% of all cases. Pre-renal ARF occurs from the failure of glomerular perfusion due to an absolute reduction in extracellular fluid volume or a reduction in circulating volume even with maintenance of the normal volume of total extracellular fluid, which may occur under conditions such as left ventricular failure, advanced cirrhosis and sepsis. In pre-renal azotemia, the patient is oliguric and may present hypotension and dehydration.

2.5 Post-renal azotemia

Post-renal azotemia or renal failure is a renal dysfunction caused by acute obstruction of the uro-excretory system. It is responsible for only 5% of ARI cases, although in the elderly subgroup this percentage becomes larger due to a higher prevalence of prostatic disease (ENGEL et al., 2005).

According to Magro and Vattimo (2007), when evaluating renal function, creatinine and other biomarkers, they indicated that elevations in serum creatinine levels are currently the most indicative signs of impaired renal function. Although it is the main strategy to identify this syndrome, creatinine is considered a specific test, however, late, not sensitive and imprecise. It only changes when there is approximately 50% loss of renal function.

2.6 Chronic Renal Insufficiency

Chronic Renal Insufficiency (CRF) is the condition of persistent, irreversible renal dysfunction, usually due to a slowly progressive pathological process. At times, however, the chronic state of renal failure sets in rapidly after acute renal injury, which can irreversibly damage the kidneys, as in two classic examples - acute cortical necrosis and rapidly progressive glomerulonephritis (ENGEL et al. al., 2005).

CRI is a silent disease that does not have significant early signs and symptoms. These are manifested and are perceived when the pathology is installed in the organism. The symptomatology emerges unexpectedly, in later stages of the disease, subjecting the person to treatments that require changes in
habits of life (TOMÉ, 2011).

CRF is characterized by glomerular filtration of less than 90 mL / min / 1.73 m2 over a period of three months or more due to the inability of the kidneys to maintain metabolic and hydroelectrolyte balance, resulting in uremia. The treatment of CRF depends on the evolution of the disease, which may be conservative with the use of drugs, diets and water restriction, or with renal replacement therapies, hemodialysis, peritoneal dialysis and renal transplantation (GRICIO et al., 2009).

There are numerous examples of nephropathies that can lead to progressive loss of renal function. All of them after a variable period (3 to 20 years on average), progress to a state known as End Stage Renal Disease (DRFT), defined as the irreversible drop in renal function at residual levels (<15% of normal function). In this phase, renal histopathology loses the specific characteristics of the initial stages of nephropathy, presenting a universal alteration: glomerular and interstitial fibrosis associated with degeneration or atrophy of the nephrons (Fassini et al., 2011).

The patient then presents the various signs and symptoms that make up the so-called Severe Uremic Syndrome, all of which result from almost complete loss of renal function. At this time, renal replacement therapy, represented by dialysis or renal transplantation (FASSINI et al., 2011), becomes essential.

The number of patients with DRFT has increased steadily over the years in several countries. In Brazil, hemodialysis is the most used treatment for CRF, in a proportion of 90% of the dialyses. CRF can affect any age, gender or race (SESSO et al., 2007).

The main complication of CRF is the increase in blood urea (azotemia), which triggers a series of signs and symptoms known as uremia or uremic syndrome. The main causes may be: pre-renal (due to renal ischemia); renal (resulting from diseases such as glomerulopathies, hypertension, diabetes, etc.); (due to obstruction of urinary flow) (FERMI, 2008).

3. METHODOLOGY

A bibliographic search was performed using Scientific Electronic Library Online databases (SCiELO) and the Brazilian Society of Nephrology, involving periodicals from 2002 to 2015, regarding the literature on the types of renal failure and the staging of the acute disease to the chronic. The descriptors were: renal failure, staging and treatment therapies, the Portuguese language being defined as a research source, excluding articles that had no relation to the topic or published in the period prior to 2002.

4. RESULTS AND DISCUSSION
Articles researched in the database of SCiELO and the Brazilian Society of Nephrology were searched, involving topics related to the types of renal failure and its evolution from acute to chronic renal failure.

A new IRC staging system proposed by the National Kidney Foundation considers the following stages (KDOQI, 2002):

**Table 1: IRC Stages.**

| Stage 1 | GFR ? 90 mL / min / 1.73 m²  
| Stage 1 | Chronic renal failure in failure  
| Stage 2 | TFG = 60-89 mL / min / 1.73 m²  
| Stage 2 | Chronic renal failure LIGHT  
| Stage 3 | TFG = 30-59 mL / min / 1.73 m²  
| Stage 3 | Chronic renal failure MODERATE  
| Stage 4 | TFG = 15-29 mL / min / 1.73 m²  
| Stage 4 | Chronic renal failure SERIOUS  
| Stage 5 | TFG <15 mL / min / 1.73 m²  
| Stage 5 | Chronic renal failure (DRFT)  

Source: National Kidney Foundation (KDOQI, 2002).

According to Gomes et al. (2005), patients with CrCl <30 mL / min / 1.73 m² presented higher levels of intact parathyroid hormone (iPTH), despite normal values for calcium, phosphorus, alkaline phosphatase and tCO₂. Patients with iPTH values twice the upper normal value (144 pg / mL) had lower tCO₂ values. Bone alkaline phosphatase was evaluated in 37 patients with CrCl <30 mL / min / 1.73 m², showing correlation with alkaline phosphatase, but not with iPTH. Bone biopsy in nine patients with CrCl <30 mL / min / 1.73 m² and iPTH > 144 pg / mL showed fibrous osteitis (4), minimal lesion (4) and high remodeling (1).

For Silva (2011), the results show that, in order to increase the provision of arteriovenous vascular access before the start of hemodialysis in Brazil, efforts should be focused on pre-dialysis care.

CRF conditions the patient to perform renal replacement therapy in the form of peritoneal dialysis, hemodialysis or transplantation. Because it is a progressive and silent disease, its diagnosis, in most cases, is only done in the terminal phase, requiring immediate TRS. The disease itself and the treatment trigger a succession of conflicting situations, which compromises the daily life of the patient, as well as their family components, imposing adaptations and changes in lifestyle. Most of the time, the person in a chronic condition of some pathology needs to share this confrontation with his family or with other people nearby, seeking help and support, as this situation requires individual and family readaptation. It is important to emphasize, however, that family structures do not always alone account for being the basis
of these situations. They need the support of health professionals, as well as the support and collaboration of others in their community (SILVA et al., 2009).

The changes in the patients' lives are particularly troublesome, continuous for them, since they may feel different and excluded, because they are forbidden to eat certain foods, have a reduced and controlled water intake, need medication continuously and be submitted to treatment for the maintenance of their lives. In this perspective, it is necessary to carry out continuous therapy, including socio-educational activities with these patients so that they have more knowledge about CRF and its treatment, acquire safety and greater subsidies for self-care and thus have better adherence to treatment (MEIRELES, 2004).

Despite the establishment of routines for control, viral and bacterial infections continue to be the major cause of morbidity and mortality in patients with CRF, especially in those in SRT. Infections contribute 30 to 36% of the deaths of dialysis patients, however, many of these deaths could be prevented by vaccines (RANGEL, 2006).

According to Bastos and Kirsztajn (2011), early diagnosis, immediate referral and institution of measures to decrease / interrupt the progression of CRF are among the key strategies to improve outcomes.

In short, when it comes to the evolution of this disease, that is, staging, one can not forget the three pillars of CRF support, which are: 1) early diagnosis of the disease, 2) immediate referral for nephrological treatment, and 3) implementation of measures to preserve renal function (BASTOS; KIRSZTAJN, 2011).

**FINAL CONSIDERATIONS**

In the current evolutionary context of renal failure from stage to stage, it is the role of the specialist in nephrology to make the proper guidelines, carry out in their work environment with the local community, clients and family members the prevention of renal diseases. Other measures are very important as well, such as diagnosis and treatment of arterial hypertension, as well as diagnosis and treatment of urinary infections, among other tasks.

It is necessary to guide the prevention of the disease, before acute renal failure reaches stage five, that is, chronic renal failure. The focus is saving lives and decreasing expenses with hospitalization and treatment, which in the country has a high cost.

According to the Brazilian Society of Nephrology, it is advisable for patients over the age of 40 to make a medical appointment annually with a nephrologist, that is, perform blood creatinine dosing and urine tests. Also important are new research and new studies in this subject, in view of effective alternatives of
treatment of the disease.

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