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# RENAL ANAEMIA: THE ROLE OF HAEMOGLOBIN CONTROL IN PATIENTS WITH CHRONIC KIDNEY DISEASE

Viktorija Kuzema*,**, Aivars Pētersons*,**, Harijs Čerņevskis*,**, and Aivars Lejnieks*,***

* Rīga Stradiņš University, Dzirciema iela 16, Rīga, LV-1007, LATVIA; E-mail: viktorija.kuzema@gmail.com

** Pauls Stradiņš Clinical University Hospital, Rīga, Pilsoņu iela 13, LV-1002, LATVIA

* Rīga Eastern Hospital, Hospital "Linezers", Rīga, LV-1006, LATVIA

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*Chronic kidney disease (CKD) is a significant and prevalent health problem in the world. Anaemia is one of the most common manifestations in patients with CKD. The correction of anaemia with erythropoietin normalises haemoglobin level and improves quality of life. Many aspects of the impact of anaemia treatment with erythropoiesis-stimulating agents on the progression of CKD remain unresolved and disputable. The present study is a retrospective chart review of 1654 outpatients with CKD. The data were collected from the Centre of Nephrology between 1 January 2002 and 31 December 2006. The aims of the study were to assess the causes of CKD; the prevalence of anaemia based on the current guidelines for anaemia management in CKD (Kidney Disease Dialysis Outcomes Quality Initiative; K/DOQI); to evaluate haemoglobin (Hb), systolic and diastolic blood pressure (SBP and DBP), glomerular filtration rate (GFR) at the first referral to a nephrologist and at the start of renal replacement therapy (RRT). The most common causes of CKD were arterial hypertension (17.2%), chronic glomerulonephritis (17.2%), chronic intersticial nephritis (13.3%), and diabetes (12.8%). Twenty-three percent of end-stage renal disease (ESRD) patients had diabetes mellitus. At the first visit in the renal department, 16% of the patients had an advanced degree of CKD (GFR <30 ml/min). The proportion of patients under an observation in the kidney centre for a period of six months and more was only 34% (554 of 1654). Hypertension was recorded in 72% of study subjects. The blood pressure (BP) values in patients at the first visit (n = 1633) vs. at the start of RRT (n = 154) were: mean SBP 147.4 ± 24.8 mm Hg vs. 152.2 ± 23.0 mm Hg (P < 0.05); mean DBP 88.8 ± 13.6 mm Hg vs. 88.4 ± 12.0 mm Hg (P 0.05). Anaemia was recorded in 41% of study subjects, estimated using K/DOQI recommendations. The prevalence of anaemia was increased from 30.2% to 44.8% of study patients with a rise of BP (from normal BP to hypertension; P < 0.05). The mean Hb level at the start of RRT was 9.8 ± 2.1 g/dl. Only 18% of patients with renal anaemia had used erythropoiesis-stimulating agents before RRT (28 of 155). Anaemia is the prevalent condition at moderate degrees of CKD. The severity of anaemia in the CKD population is determined by evidence of diabetes, cardiovascular disease, and renal function. Anaemia may often be unrecognised or untreated.*

**Key words:** *chronic kidney disease, anaemia, erythropoietin.*

## INTRODUCTION

Chronic kidney disease (CKD) is a significant public health problem in the world and has a remarkable impact on cardiovascular morbidity and mortality in patients with end-stage renal disease (ESRD) (Foley *et al*., 1998). In Latvia, there were estimated 58.7 (Locatelli *et al*., 2004) and 69.1 (Cannata-Andia *et al*., 2007) incident patients per million population with ESRD in 2002 and 2005, respectively. In addition, the prevalence of patients with renal replacement therapy (RRT) significantly rose during five years and accounted for 368.6 patients per million population in 2006 (London, 2008). Diabetic kidney disease is the leading cause of end-stage renal disease (ESRD) in USA and Europe (Ritz, 1999). In Latvia, 23% of the ESRD patients have been reported to suffer from diabetes mellitus (Kuzema *et al*., 2008). An important aspect in the management of CKD is to evaluate risk factors and underlying causes of development of chronic kidney damage (McClellan *et al*., 2003), which may be diabetes, hypertension, proteinuria, metabolic disorders and anaemia (Levin, 2001). The role of anaemia in CKD has received much attention of nephrologists. In addition, with the beginning of the erythropoietin era, the treatment of renal anaemia is considered as a significant in the possible delaying of progression of CKD (Rossert *et al*., 2002).

The aims of the study were: to assess the causes of CKD; to analyse the prevalence of anaemia based on the current guidelines for anaemia management in CKD (Kidney Dis-

ease Dialysis Outcomes Quality Initiative; K/DOQI); to evaluate haemoglobin (Hb), systolic and diastolic blood pressure (SBP and DBP), glomerular filtration rate (GFR) in patients at their first referral to a nephrologist and at the start of renal replacement therapy (RRT).

## PATIENTS AND METHODS

The study is a retrospective analysis involving one centre and consists of data of 6520 consultations for CKD patients during five years (2002–2006). The data was collected from the archive of the Latvian Nephrology Centre. We studied the prevalence of causes of underlying renal disease, distribution of stages in CKD, clinical and laboratory findings on the first visit in the kidney centre and at the start of RRT, and the prevalence of anaemia and hypertension in patients with CKD.

A total of 1654 patients were examined in the study. We selected the following parameters: the data of patient visit, gender, age, primary renal disease, outcome, systolic blood pressure (SBP), diastolic blood pressure (DBP), weight, presence of diabetes, use of erythropoiesis stimulating agents (ESA), serum creatinine, haemoglobin (Hb) level, and ferritin concentration. The outcomes of analysis were: RRT, including hemodialysis (HD), peritoneal dialysis (PD) and kidney transplantation (Tx); death; and continuation of observation for each person on 31 December 2006. Excluded were patients who had pregnancy, acute infection, systemic disease with active immunosuppressive therapy, malignancy including haematological malignances, single kidney, patients with previous or current RRT. The final data set contained 4134 consultations of subjects with CKD.

For the purpose of this study, we use the definitions for CKD, hypertension, anaemia as follows.

**Classification and definition of chronic kidney disease.** According to the ERA-EDTA kidney disease coding system, CKD was divided into eight groups (Fig. 1): I. Glomerulonephritis; II. Pyelonephritis; III. Polycystic kidney disease; IV. Hypertension; V. Renovascular disease; VI. Diabetes mellitus; VII. Miscellaneous (chronic interstitial nephritis, gout, lead nephropathy, occupational diseases, systemic disorders etc.); VIII. Unknown diseases.

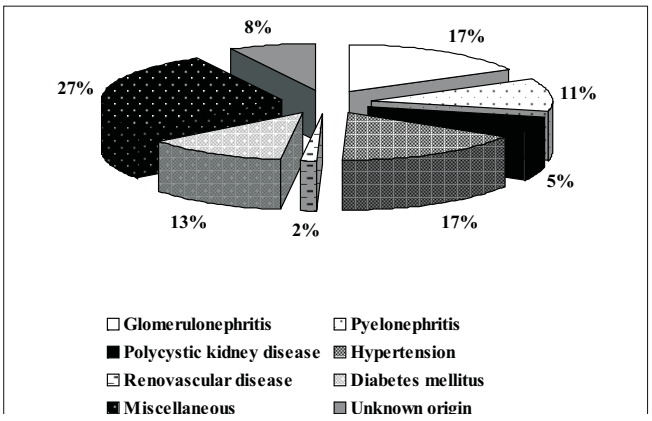


*Fig. 1.* The causes of chronic kidney disease (CKD) in the examined patients (n =1654).

**GFR and CKD classification according to stages.** Glomerular filtration rate (GFR) was calculated using the Cockcroft – Gault equation (Cockcroft and Gault, 1976):

GFR (ml/min) = [(140 – age, years) × (weight, kg)] / 72 × plasma creatinine, mg/dl. For women the result was multiplied by 0.85.

According to GFR, CKD was divided in five sequential stages: stage I – GFR >90 ml/min; stage II – GFR 60–89 ml/min; stage III – GFR 30–59 ml/min; stage IV – GFR 15–29 ml/min; stage V – GFR <15 ml/min or dialysis (Bolton *et al*., 2002).

**Hypertension.** The following definitions and classification were suggested by the seventh report of the Joint National Committee:

1. Normal blood pressure: systolic <120 mm Hg and diastolic <80 mm Hg.

2. Pre-hypertension: systolic 120–139 mm Hg or diastolic 80–89 mm Hg.

3. Hypertension: Stage 1: systolic 140–159 mm Hg or diastolic 90–99 mm Hg; Stage 2: systolic 160 mm Hg or diastolic 100 mm Hg (Chobanian *et al*., 2003).

**Anaemia.** According to USA K/DOQI guidelines concerning anaemia treatment in CKD patients, anaemia diagnosis is credible when the Hb level is <13.5 g/dl in men and <12.0 g/dl in women (Adamson *et al*., 2006).

Iron status also was calculated. Because our study had a retrospective design and there was available only serum ferritin concentration, we formulated the following criteria of iron storage: adequate iron status was considered as serum ferritin concentration of 100 ng/ml and iron deficiency was considered as serum ferritin less then 100 ng/ml. The data for transferrin saturation were not available and we did not have the possibility to check functional iron deficiency.

All examined patients were selected by gender and by age in following groups: 0–20; 21–44; 45–64; ≥65 years.

**Statistical analysis.** Statistical Package for the Social Sciences (SPSS) version 15.0 software was used for all analyses (SPSS Inc., Chicago, IL). Descriptive analyses are presented as mean with standard deviation or median with range, depending on the underlying distribution. We used *t*-tests, ANOVA for comparisons between parameters in independent groups. Pearson Chi-square or Mann-Whitney U tests were used to compare qualitative variables. The criterion for statistical significance was taken as a two-tailed $P$ value < 0.05.

## RESULTS

**Epidemiology.** The causes of CKD in the enrolled population were: hypertensive nephropathy (n = 284), chronic glomerulonephritis (n = 284), intersticial nephritis (n = 220), diabetes mellitus (n = 211), pyelonephritis (n = 184),

kidney disease of unknown origin (n = 127), polycystic kidney disease (n = 82), systemic lupus erythematosus and vasculites (n = 45), renal hypoplasia congenital — type unspecified (n = 27), gout nephropathy (n = 27), renal vascular disease due to renal artery stenosis/occlusion (n = 25), nephropathy due to analgesic drugs (n = 25), nephrocalcinosis (n = 23), hereditary nephropathy (n = 21), cystic kidney disease — other specified type (n = 21), amyloid (n = 19), tubular necrosis (n = 8), tuberculosis (n = 6), other identified renal disorders (n = 6), medullary cystic disease (n = 4), lead induced nephropathy (n = 2), haemolytic uremic syndrome (n = 1), sarcoidosis (n = 1), and trauma (n = 1). Diabetes was one of the most common causes for end-stage renal disease (23%) followed by glomerulonephritis (28%). Evidence of diabetes type 2 was observed in 44% (16 of 36) of ESRD patients. The mean age of patients was 55.9 ± 17.1 years (n = 1654). The proportion of women in the analysed population was significantly higher: 62.3% (total n = 1654). In addition, female patients were older than male: 57.5 ± 16.1 years in female and 54.1 ± 18.3 years in male ($P < 0.001$).

At the start of dialysis therapy mean age was 54.2 ± 16.0 (n = 155). Furthermore, 73.5% of them were part of the able-bodied population and 26.5% were above 65 years old. Forty-eight percent of patients were female (75 of 155). There was no significant difference in mean age between female and male patients with ESRD: 53.6 years versus 54.8 years ($P > 0.05$).

The majority of patients with different stages of CKD (840 of 1654) visited the Centre of Nephrology only once. The patients with repeated visits to a nephrologists had the following distributions of time under the observation: 8.1% (n = 67) for <1 month; 23.7% (n = 193) for 1 to 6 months; 17.2% (n = 140) for 6 to 12 months; 21.9% (n = 178) for 12 to 24 months; and 29% (n = 236) patients were under care of a nephrologist for over two years. The mean duration of the time under care of a nephrologist for patients who were observed repeatedly was 17.6 months, range from 1 to 59 months. Median period of time under care of a nephrologist for these patients was 13 months. At the visit to dialysis department, 14% (21 of 155) of the ESRD patients had visits for the first time. Thirteen patients were observed for one month; 22 patients for 1 to 6 months; 24 patients for 6 to 12 months; 38 patients for 12 to 24 months; 20 patients for 2–3 years; and 17 patients over three years. The mean observation period before start of dialysis therapy for patients with repeated consultation was 17.4 months, ranged from 1 to 53 months. Median length of the time under care of a nephrologist for patients who were observed repeatedly before initiation of RRT was 15 months. Peritoneal dialysis was started for 50 (32%) patients, haemodialysis for 103 (67%) patients, and 2 (1%) patients had preemptive kidney transplantations.

At the time of first referral, 54% (893 of 1653) of patients presented clinically impaired renal function (GFR <60 ml/min). The distribution of CKD for all patients at the first visit to a nephrologist was as follows (Table 1). By stage, an estimated 311 subjects (18.8%) had stage I; 441 (27.2%) stage II; 622 (37.6%) stage III; 227 (13.7%) stage IV; and 44 (2.7%) had end-stage renal disease. At the start of RRT (haemodialysis or peritoneal dialysis) GFR ranged from 3.5 ml/min to 29.8 ml/min. Mean GFR and standard deviation was 12.9 ± 5.1 ml/min. In addition, 33% (47 of 144) of these patients had glomerular filtration rate above 15 ml/min. Unfortunately, we lacked information on some clinical details for starting dialysis therapy because the study had a retrospective design.

Table 1

DISTRIBUTION OF CHRONIC KIDNEY DISEASE (CKD) FOR ALL EXAMINED PATIENTS AT THE FIRST VISIT

| Stage | GFR (ml/min) | Patients, n (%) |
|---|---|---|
| I | ≥90 | 311 (18.8) |
| II | 60–89 | 441 (27.2) |
| III | 30–59 | 622 (37.6) |
| IV | 15–29 | 227 (13.7) |
| V | <15 or dialysis | 44 (2.7) |

GFR, glomerular filtration rate.

**Hypertension.** Hypertension was the prevalent condition in patients with CKD (Fig. 2). At a patient first visit to a nephrologist normal blood pressure was estimated only in 5.8% (96 of 1654). Pre-hypertension and hypertension were recorded in 22.1% (365 of 1654) and 72.1% (1192 of 1654) of patients, respectively. In addition, subjects with hypertension stage 1 and stage 2 were recorded in 29.1% and 43.0%, of cases, respectively. At the start of dialysis therapy systolic blood pressure was significantly higher compared with patients without RRT: 152.2 ± 23.0 mm Hg *vs*. 147.4 ± 24.8 mm Hg ($P < 0.05$). No difference in the diastolic blood pressure record was found across CKD patients (with or without RRT) ($P > 0.05$).

**Anaemia.** At the first visit to Centre of Nephrology, haemoglobin level was determined in 72% of patients with CKD (1179 of 1633 patients). Haemoglobin level ranged from 6.3 g/dl to 18.1 g/dl, with a mean and standard deviation of 12.7 ± 2.0 g/dl (Fig. 3). Median haemoglobin level for these study patients was 13 g/dl. Baseline haemoglobin levels for 143 patients with RRT (92%; total n = 155 patients) are illustrated in Figure 4. There was missing data

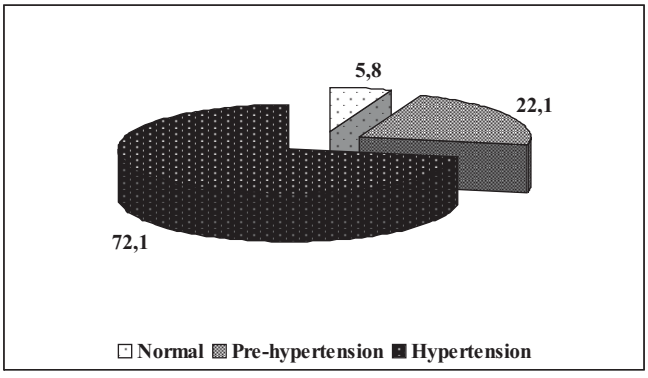


*Fig. 2.* Prevalence of hypertension in patients with chronic kidney disease (CKD), % (n =1654).

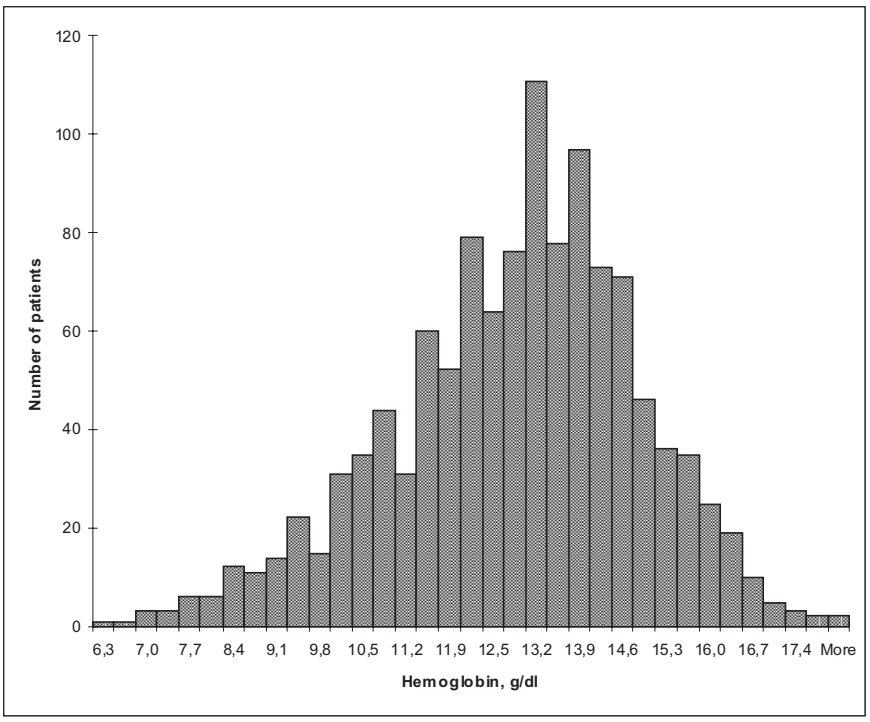


*Fig. 3.* Distribution of haemoglobin level in patients with chronic kidney disease (CKD) before renal replacement therapy (RRT) (n =1179).

for haemoglobin level in 12 patients with RRT. Haemoglobin level ranged from 5.1 g/dl to 14.6 g/dl, with a mean and standard deviation of 9.8 ± 2.1 g/dl. Median haemoglobin level for ESRD patients was 9.6 g/dl.

Evidence of anaemia was estimated at the first visit in kidney centre for all patients, including patients with RRT (total n = 1644). Patients with erythropoietin therapy were excluded. At the first visit to a nephrologist there was missing data for serum haemoglobin level in 455 patients (28%, total number = 1644). Forty one percent of patients (n = 487) had been diagnosed as anaemic using K/DOQI recommendations.

The study results demonstrated that with progression of CKD haemoglobin concentration considerably decreased.

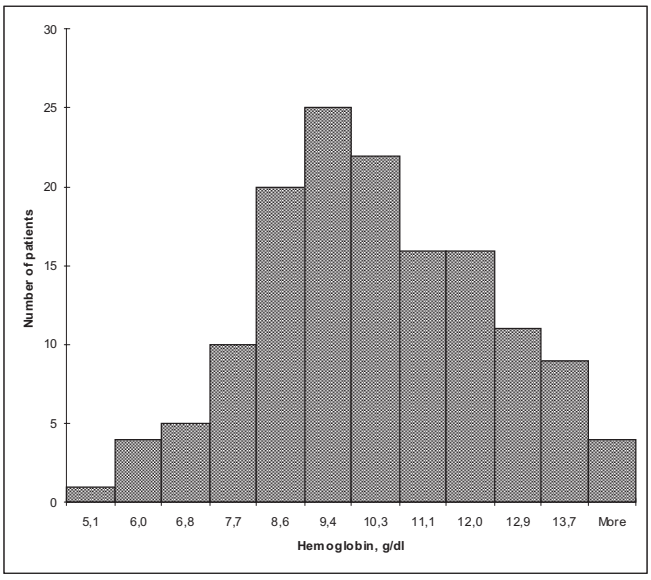


*Fig. 4.* Distribution of haemoglobin level in patients with renal replacement therapy (RRT) (n = 143).

Figure 5 shows decrease of haemoglobin level in diabetic and non-diabetic kidney diseases ($P < 0.001$). Mean haemoglobin levels for diabetic versus non-diabetic patients were 13.5 ± 1.6 g/dl *vs.* 14.1 ± 1.6 g/dl; 13.2 ± 1.5 g/dl *vs.* 13.5 ± 1.5 g/dl; 12.4 ± 1.8 g/dl *vs.* 13.0 ± 1.7 g/dl; 10.3 ± 1.5 g/dl *vs.* 11.2 ± 1.9 g/dl; 9.4 ± 1.5 g/dl *vs.* 9.4 ± 1.9 g/dl in stage I, II, III, IV, V CKD, respectively (Fig. 5).

The association between blood pressure and the prevalence of anaemia estimated by K/DOQI are presented on Figure 6. Haemoglobin concentration data was missing in 485 patients. The percentage anaemic patients with CKD was progressively higher with increased arterial blood pressure (Pearson Chi-square test; $P < 0.05$).

Serum ferritin level in subjects with GFR < ml/min was checked in only 13% of cases. Serum ferritin ranged from 1.1 ng/ml to 1196 ng/ml. Median serum ferritin level for these study patients was 121 ng/ml.

Only 18% of patients with renal anaemia had used erythropoiesis-stimulating agents before RRT (28 of 155).

## DISCUSSION

This is the first study in Latvia on CKD patients observed during a five-year period. We found that the most common causes of chronic kidney disease were arterial hypertension (17.2%), chronic glomerulonephritis (17.2%), chronic intersticial nephritis (13.3%), and diabetes (12.8%). Moreover, the proportion of patients with diabetes as the primary cause of ESRD in Latvia was 23%. Diabetes is the leading cause of CKD developing countries. High prevalence and incidence of diabetic kidney disease in the CKD population has been reported in previous publications (Zimmet *et al.*, 2001). The incidence rate of ESRD due to diabetes in the

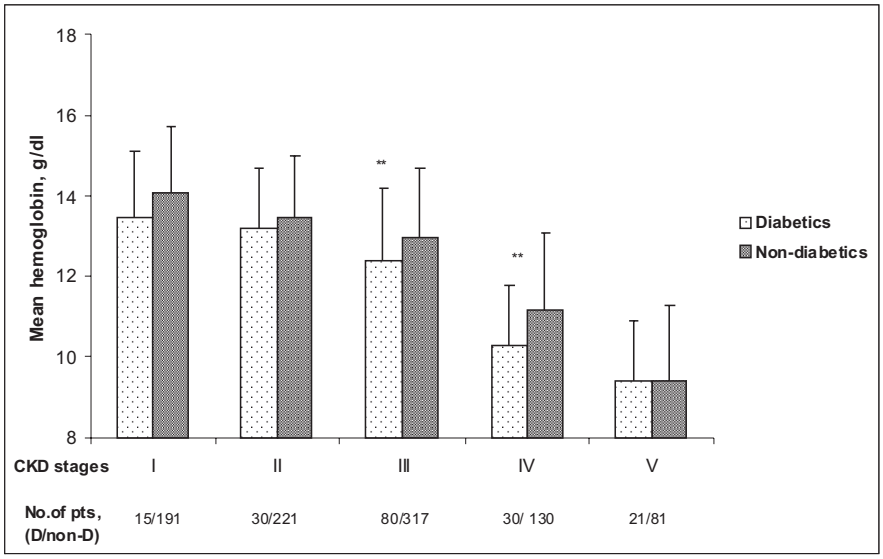


*Fig. 5.* Haemoglobin level in diabetic versus non-diabetic patients by chronic kidney disease (CKD) stage; pts, patients; D, diabetics; non-D, non-diabetics; $^{**}P < 0.05$.

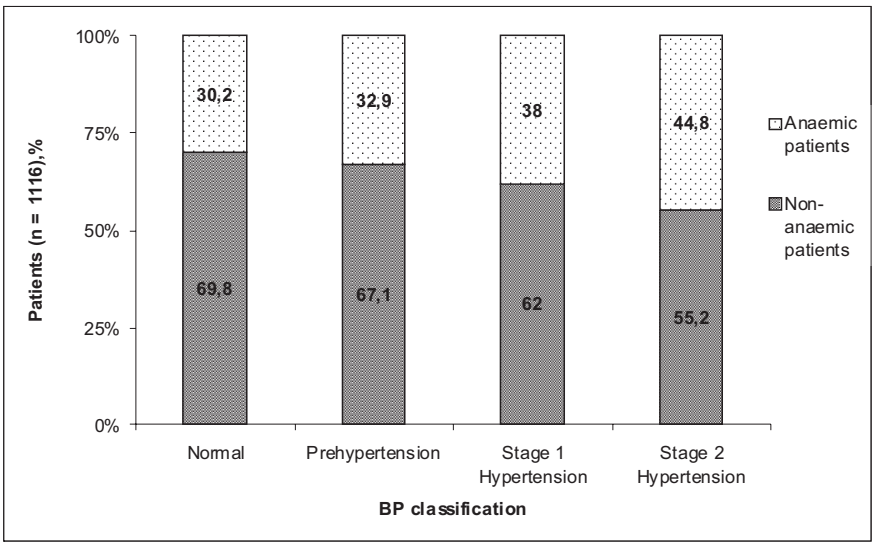


*Fig. 6.* Prevalence of anaemia depending on blood pressure (BP).

United States has recently stabilised, however, it had grown by nearly 60% and the rate per million population in 2005 remained at 152 (Collins *et al*., 2007).

The mean age of patients at the start of RRT in our study was 54.2 years. PRESAM results showed that the mean age of incident dialysis patients was 59.1 years (Valderrįbano *et al*., 2003). The USRDS data demonstrated an estimated mean age of 62.7 years in incident ESRD patients (Collins *et al*., 2007). The possible factors for this difference may be insufficient control and diagnostics of chronic kidney disease before dialysis treatment in Latvia. Secondly, the mean age of incident ESRD patients performed by USRDS was based on the general population, while our results reflect data from a single centre.

Most of the patients (16%) presented as a late referral to a renal centre (GFR <30 ml/min). Fifty four percent of all analysed patients at first visit to a nephrologist had GFR below 60 ml/min. About a half of all patients (50.8%) were in a kidney centre only once. The patients with duration of the time under care of a nephrologist at least six months and over were 33.5%: 8.5% for 6 to 12 months; 10.8% for 12 to 24 months; 6.8% for two to three years; and 7.4% for three and over years. In addition, at the first visit to dialysis department, 14% (21 of 155) of patients started RRT immediately. This finding shows that, at first, most of the patients present to the renal department with advanced degrees of CKD. Secondly, only one-third of the patients were under care of nephrologists for over six months. Similar data have been published elsewhere. Hörl *et al.* summarised data of a major retrospective study PRESAM (*PREdialysis Survey on Anaemia Management*) covering information on 4333 CKD patients from 23 countries, published in 2003, and made several practical conclusions. One of the most common problems was late nephrologist referral for patients with progressing renal failure, which once again made poor condition of renoprotective and cardioprotective treatment strategies an issue as patients enter nephrology centre late: average GFR at first visit was 18.2 ml/min (Hörl *et al*., 2003).

Hypertension was a prevalent condition in patients with CKD in our study patients. Hypertension was recorded in 72% of the patients. Hörl *et al.* (2003) presented 78% patients with CKD and hypertension. This report is distinctive since a different classification of blood pressure was used.

We used the classification of blood pressure suggested by the 7th report of the JNC and hypertension was defined as systolic blood pressure above 140 mm Hg or diastolic above 90 mm Hg, while PRESAM study researchers defined hypertension as the blood pressure above 145/95 mm Hg (Hörl *et al*., 2003). In our study, the prevalence of anaemia was significantly associated with a rise of arterial blood pressure. In a retrospective study by Phillipp *et al.* (2005), logistic regression was performed to evaluate the relative risk for several variables, including hypertension, on anaemia in 2941 patients with CKD. They found that arterial hypertension itself had no influence on anaemia, since diabetes was an independent risk factor on haemoglobin level and had an relative risk of 1.8 (95%CI; 1.28 – 2.54; $P < 0.05$) (Phillipp *et al*., 2005). However, the left ventricular hypertrophy and heart failure as the consequences of chronic arterial hypertension and its relationship with the anaemia in predialysis patients is clearly considered in numerous studies (Foley *et al*., 1998; Levin *et al*., 1999; Jurkovitz *et al*., 2003; Phillipp *et al*., 2005; Vlagopoulos *et al*., 2005; Drüeke *et al*., 2006).

Anaemia is one of the most common manifestations in CKD patients. The results of the retrospective analysis of this study suggest that anaemia among patients with stages I – V CKD is very common. According to USA guidelines on anaemia diagnostics, anaemia in CKD patients (Hb <13.5 g/dl in men and <12.0 g/dl in women) was diagnosed 41% of patients (n = 487). The mean haemoglobin level of patients at the start of RRT in our study was 9.8 g/dl, which is similar with that in the PRESAM report, estimated as below 10 g/dl (Hörl, 2003). The Levin *et al.* study results show than mean haemoglobin in patients with GFR <15 ml/min was 9.9 g/dl (Levin *et al.*, 2006). Only 18% of patients with renal anaemia had used erythropoietin prior to RRT. However, despite the high prevalence of anaemia in CKD patients, haemoglobin level was not determined in 28% of subjects. This obviously reveals indicates lack of information concerning CKD in the context of primary medical care. Clinical manifestations of anaemia emerge if the haemoglobin level falls to <11 g/dl, which is the reason why erythropoietin therapy and iron supplementation is recommended during this period according to main guidelines. However, as demonstrated in our study by a low proportion of patients undergoing anaemia treatment with erythropoietin, primary care physicians may not be aware of the critical importance of screening for anaemia in the CKD population and anaemia may often be unrecognised or untreated.

The association between impaired renal function, anaemia and diabetes is well recognised in several studies (Bosman *et al*., 2001; El-Achkar *et al*., 2005; Ravanan *et al*., 2007). Anaemia in diabetic nephropathy is more severe than seen in patients with non-diabetic kidney disease. Several studies have suggested that anaemia occurs at an earlier stage of the disease and is more severe in patients with diabetic nephropathy than in non-diabetic kidney disease patients. Ravanan *et al.* (2007) reported that mean haemoglobin levels in diabetic patients compared with those in non-diabetics were 129.5 *vs.* 136.9 g/l ($P < 0.01$), 120.5 *vs.* 126.9 g/l ($P < 0.01$) and 107.1 *vs.* 115.9 g/l ($P < 0.01$) at stages III, IV and V CKD, respectively (Ravanan *et al*., 2007). Bosman *et al.* (2001) compared 27 patients with diabetic nephropathy with 26 non-diabetic patients with glomerulonephritis and demonstrated that anaemia was presented in 13 of the 27 diabetics (mean Hb 10.6 ± 0.9 g/dl), in marked contrast to non-diabetics (mean Hb 13.7 ± 0.9 g/dl; $P < 0.05$) (Bosman *et al.*, 2001). The result of our study is similar. We show that the diabetic nephropathy in patients with stage III – V CKD is associated with more severe anaemia than non-diabetic patients ($P < 0.001$).

The main limitations of our study are the retrospective analysis design and missed factors to control. Therefore, the completed data for several variables, including erythropoietin therapy regimen, usage of iron, comorbidities (cardiovascular diseases, excluding hypertension) with its treatment possibilities, and other clinical significant manifestations in patients with CKD (secondary hyperparathyreoidism, malnutrition, dislipidemia) were not available, and maybe, can impact on our study derived results. However, despite this study weakness, we can conclude that anaemia is commonly observed among subjects with stage III –V CKD and more often in diabetics. Diabetic kidney disease is associated with lower haemoglobin levels in comparison with non-diabetic kidney disease. Despite the high prevalence of anaemia in the examined patients, erythropoietin therapy is underused. We hope that this finding may result in multidisciplinary healthcare team doctors to regularly monitor haemoglobin level and provide timely treatment with erythropoietin and iron supplementations.

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## RENĀLĀ ANĒMIJA: HEMOGLOBĪNA LĪMEŅA NOTEIKŠANAS NOZĪME SLIMNIEKIEM AR HRONISKU NIERU SLIMĪBU

Hroniska nieru slimība (HNS) ir nozīmīga sabiedrības veselības problēma pasaules mērogā. Anēmija ir viena no biežākām HNS izpausmēm. Anēmijas ārstēšana ar eritropoēzi veicinošiem medikamentiem labvēlīgi ietekmē HNS attīstību, slimnieka dzīves kvalitāti un sirds un asinsvadu sistēmu. Darbā ir retrospektīvi analizēti 1654 slimnieki ar HNS (P. Stradiņa Klīniskās universitātes slimnīcas Nefroloģijas centra arhīva materiāli no 2002. līdz 2006. gadam). Pētījuma mērķis bija izpētīt HNS pamatcēloņus, HNS slimnieku novērošanas ilgumu, arteriālās hipertensijas biežumu, anēmijas biežumu, smagumu un ārstēšanas iespējas slimniekiem ar HNS. Saskaņā ar ASV vadlīnijām par anēmijas ārstēšanu HNS slimniekiem (KDOQI 2006) anēmijas diagnoze bija ticama, ja hemoglobīna (Hb) līmenis bija <13,5 g/dl vīriešiem un <12,0 g/dl sievietēm. Pētījuma rezultāti liecina, ka visbiežākie HNS cēloņi bija hipertensīvā nefropātija (17,2%), hronisks glomerulonefrīts (17,2%), hronisks intersticiāls nefrīts (13,3%), cukura diabēts (12,8%). Bez tam cukura diabēts kā terminālas nieru mazspējas cēlonis bija 23% slimnieku ar nieru aizstājterapiju (NAT). Pirmā vizītē 16% slimniekiem tika konstatēta progresējoša nieru slimība (glomerulu filtrācijas ātrums <30 ml/min). Pētījuma rezultāti liecina, ka tikai 34% (554 no 1654) analizēto slimnieku bija regulāra ilglaika (>6 mēneši) ambulatoriskā novērošana pie nefrologa. Arteriālā hipertensija tika konstatēta 72% dalībnieku. Vidējais asinsspiediens pētījuma slimniekiem pirmajā vizītē (n = 1633) vs. NAT sākšanas brīdī (n = 154) bija šāds: vidējais sistoliskais asinsspiediens (SAS) – 147,4 ± 24,8 mm Hg vs. 152,2 ± 23,0 mm Hg (p <0,05); vidējais diastoliskais asinsspiediens (DAS) – 88,8 ± 13,6 mm Hg vs. 88,4 ± 12,0 mm Hg (p >0.05). Saskaņā ar ASV rekomendācijām par anēmijas diagnostiku un ārstēšanu, anēmija tika konstatēta 41% analizēto slimnieku. Anēmijas biežums korelē ar arteriālo hipertensiju: no 30,2% slimniekiem ar normālu arteriālo asinsspiedienu līdz 44,8% dalībniekiem ar hipertensijas 2. pakāpi ($P < 0,05$). Vidējais Hb līmenis, sākot NAT, bija 9,8 ± 2,1 g/dl. Vidējais Hb līmenis slimniekiem ar cukura diabētu bija ticami zemāks nekā slimniekiem ar citu HNS pamatpatoloģiju. Eritropoetīnterapijas lietošana pirmsdialīzes periodā tika konstatēta tikai 18% HNS slimnieku ar anēmiju. Anēmija ir viena no biežākām HNS klīniskām izpausmēm HNS slimniekiem. Anēmijas biežumu un smagumu nosaka blakus slimības (piem., cukura diabēts, sirds asinsvadu sistēmas slimības) un nieru funkcija (HNS stadija). Anēmija bieži vien netiek diagnosticēta un ārstēta.