Epidemiology of Chronic Kidney Disease and Anemia

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Anemia is a common comorbidity of chronic kidney disease (CKD). As the diseased kidney loses its ability to produce the erythropoietin essential to the production of hemoglobin, anemia ensues. The age-related rise in CKD makes anemia in CKD a problem of increasing prevalence among residents of long-term care facilities. CKD refers to the entire continuum of renal disease that progresses from mildly impaired kidney function (stage 1, glomerular filtration rate [GFR] ≥90 mL/min/1.73 m²) to significant deterioration, requiring dialysis or kidney transplant in what is categorized as stage 5 (GFR <15 mL/min/1.73 m²). The definition of anemia is controversial. The WHO defines anemia as hemoglobin <13 g/dL for men and <12 g/dL for women. The National Kidney Foundation’s Kidney Disease Outcomes Quality Initiative, which is the criteria used for Medicare reimbursement, defines anemia in adult men and postmenopausal women as hemoglobin <12 g/dL, or <11 g/dL in a premenopausal woman. (J Am Med Dir Assoc 2006; 7: S3–S6)

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INTRODUCTION

Epidemiologic studies have documented a dramatic age-related rise in the prevalence of chronic kidney disease (CKD) and anemia.1,2 These 2 common chronic conditions are associated with increases in mortality and morbidity, functional decline, hospitalizations, and increased health care costs.

Chronic Kidney Disease

The incidence and prevalence of kidney disease worldwide and in the United States has risen markedly in the past decade.3 About 20 million Americans from 1988 to 1994—or approximately 11% of all US adults—are living with CKD (stages 1–5), and the incidence and prevalence of kidney disease are increasing.4

As the numbers have grown over the last few years, the nomenclature of CKD has evolved. In 2001, the National Kidney Foundation (NKF) issued a consensus statement recommending CKD as the preferred label and glomerular filtration rate (GFR) as the diagnostic test of choice.5

CKD refers to the entire continuum of renal disease that progresses from renal abnormality with normal GFR (stage 1) through mild CKD (stage 2, GFR 60–90 mL/min/1.73 m²) through moderate CKD (stage 3, GFR 30–60 mL/min/1.73 m²) to significant deterioration requiring dialysis or kidney transplant in stage 5 (GFR <15 mL/min/1.73 m²). End-stage renal disease is an administrative term that indicates that a patient is being treated with dialysis or kidney transplant.

Traditionally, CKD in nursing home residents has only been thought of as those in stages 4 and 5. In fact, most people with CKD are asymptomatic. Stage 1 CKD is typically not detected and requires some other information, for example, the presence of proteinuria or hematuria, to bring it to the clinician’s attention.

Epidemiologically, a major observation of the last few years has been the recognition of the very large number of people who have GFR between 30 and 59 mL/min/1.73 m², placing them at stage 3 CKD. They represent the bulk of patients who suffer most of the consequences of CKD in the United States. While approximately 400,000 patients in the United States have stage 4 (severe) CKD and about 300,000 are on dialysis, the majority of CKD patients (7.6 million) are in stage 3 (Figure 1).6

Significance of declining GFR with age

Why worry about the GFR in elders? At maturity, the average GFR is 120 mL/min/1.73 m². As the years go by, adults lose about 1 mL/min/y. An 85-year-old person, then, can be expected to have a GFR just under 60 mL/min/1.73 m²—qualifying that person as having stage 3 CKD. One can argue that, on average, CKD is to be expected in older people who are not free of disease.

Data from longitudinal studies in the last 20 years has demonstrated the phenomenon of successful aging. That is, even though usual aging means a progressive decline in GFR, that decline is not universal. A substantial number of people manage to go into late life with very good GFR and have no CKD. Those who develop even modest CKD, however, tend to experience cardiovascular morbidity and mortality above
the norm. Decreased GFR is associated with complications in virtually all organ systems. Frequency and severity of complications worsen as GFR declines. Complications associated with CKD include high blood pressure, anemia, malnutrition, bone disease, and decreased overall physical functioning. Two major community studies (National Health and Nutrition Examination Survey [NHANES III] and the NKF’s Kidney Early Evaluation Program [KEEP]) have documented that the prevalence of CKD rises with increasing age (Figure 2).

The NHANES III was a large epidemiologic study performed to evaluate the health and nutrition of the US population. The NHANES III data demonstrate that CKD increases in individuals older than 60 years of age, and that the percentage of patients with CKD increases as one approaches 75 years of age.6

The KEEP is an ongoing community-based health-screening program that focuses on people at high risk for developing CKD. In the program, sponsored by the NKF, individuals are evaluated for CKD if they have a personal health history of hypertension or diabetes or have a family history of diabetes, hypertension, or CKD. This clinical population has a much higher prevalence of CKD.7,8

To determine the extent of renal insufficiency among institutionalized elders, a group at risk based on age and frail health, Garg and colleagues1 carried out a large retrospective cross-sectional study of 9931 residents aged 65 years and older in 87 Canadian nursing homes. The Garg study, which represents the first published report of CKD among long-term care patients based on GFR, estimated that nearly 40% of the residents had CKD (defined as GFR <60 mL/min/1.73 m² using the modified Modification of Diet in Renal Disease [MDRD] Study Group equation).1 The mean age in the Garg study was 82 years for men and 85 years for women. This study showed how common CKD is in this nursing home population (Figure 3). Garg’s group documented that about 30% of the oldest men and women in a nursing home population had CKD at stage 3 or higher.

Garg’s team also compared 2 commonly used methods for estimating GFR: the Cockcroft-Gault and MDRD formulas. Garg’s group concluded that both equations may underestimate the gold-standard GFR in these elderly patients, with the underestimation being greater with the Cockcroft-Gault than the MDRD formula.1 Although both the Cockcroft-Gault and the MDRD formulas have been used in the elderly population, neither has been validated in the elderly (Table 1).1,9–13

Ania and colleagues14 were among the first to document that the prevalence of anemia in older adults rises with age.
Ania’s group from the Mayo Clinic in Rochester, MN, evaluated 618 men and women aged 65 years or older in a Minnesota county. All elders were diagnosed with anemia using the World Health Organization (WHO) definition of hemoglobin of $<13$ g/dL for men and $<12$ g/dL for women. The group evaluated the cohort from 1986 until death or loss of clinical contact through 1994. The corrected annual incidence of anemia rose with age in this population-based study, with rates higher in men (90.3 per 1000; 95% confidence interval [CI], 79.2–101.4) than women (69.1 per 1000; 95% CI, 62.3–75.8) (Figure 4). In 465 cases (75%), anemia was detected in conjunction with a hospitalization, but admission was owing to anemia in only 57 instances. Half of the cases were caused by blood loss, two thirds of these as a result of surgery. The cause of anemia was uncertain in 102 cases (16%). One third of the patients were transfused with a median of 3 units. Overall survival was worse than expected, but was better among those with anemia caused by blood loss. Mortality attributable to malignancy, mental disorders, circulatory and respiratory diseases, ill-defined conditions, and injuries was significantly increased among these older patients with anemia.

An analysis of data from NHANES III revealed that one third of the anemia in people aged 65 and older was due to a nutritional deficiency; one third was nonnutritional anemia that could not be explained, and one third was caused by either renal insufficiency or chronic inflammation.

**Anemia in the Nursing Home**

In 2004, Andrew Arzt and colleagues reported their investigation of the prevalence of anemia in chronically ill nursing home residents. In a multicenter study of 900 residents who had a mean age of 79 years and a median age of 82 years, Arzt’s team documented that the 6-month prevalence of anemia—defined using the WHO values of $<13$ g/dL for men and $<12$ g/dL for women—was 48%. Any residents in whom anemia was discovered at any point in the 6 months prior to chart review were considered “positive” for anemia. The 6-month hospitalization rate among patients with anemia was 30%, compared with 15.8% of those without anemia. What therapy was offered for the anemia? Among the 704 residents who had charts with reliably available dates, 2.3% had received a red cell transfusion. Among the 816 residents with documentation regarding use of recombinant human erythropoietin, $<3\%$ received this therapy. The researchers concluded, “It is apparent that anemia is common in nursing homes, but directed therapy is not.”

**Anemia and Chronic Kidney Disease**

Anemia is a common comorbidity of CKD. As the diseased kidney loses its ability to produce the erythropoietin essential to the production of hemoglobin, anemia ensues. In a study of 60 nursing home residents, Arzt et al found that 10% of patients had both anemia and CKD. Anemia of chronic
Anemia is an important predictor of morbidity and mortality in older adults, with evidence for effects on a variety of clinically important events. The increased mortality associated with anemia in older persons has been shown in a number of studies. The study by Culleton et al found optimal mortality and morbidity in hemoglobin ranges of 130 to 150 g/L for women and 140 to 170 g/L for men. Anemia is also associated with diminished quality of life and physical function in older adults. The lower the hemoglobin, the more serious the problem with increased hospitalization rates, mortality, morbidity, and serious adverse consequences to patients.

CONCLUSIONS

CKD stage 3 or greater may affect nearly 43% of residents in long-term care facilities. Anemia, by the WHO definition, affects nearly 60%. An association has been documented between anemia and CKD in long-term care residents, and it is prominent. Further work defining this association will help determine the size of the population that might be targeted for correction of anemia by erythropoiesis-stimulating protein treatment. This work is under way using a population of 6000 nursing home residents of a large national chain and will determine the prevalence of anemia, CKD, and the association between these 2 common chronic conditions.

REFERENCES


