

Quality of Life in Patients on Dialysis: Benefits of Maintaining a Hemoglobin of 11 to 12 g/dL

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Quality of life (QOL) is of paramount importance to patients with chronic kidney disease (CKD) who are on dialysis. Numerous studies have shown that QOL is intricately associated with short- and long-term outcomes (Mapes et al., 2003; Moreno, Sanz-Guajardo, Lopez-Gomez, Jofre, & Valderrabano, 2000; National Kidney Foundation, 2001). However, patients are also acutely interested in how the ramifications of CKD can affect their daily activities, and what they can do to maximize the physical, cognitive, psychological, and social aspects of their lives (Valderrabano, Jofre, & Lopez-Gomez, 2001).

Anemia has a well-documented negative effect on QOL while partial correction of anemia to maintain Hb levels in the target range of 11 to 12 g/dL recommended by NKF-K/DOQI™ typically yields significant improvements in both physical and mental health-related QOL evaluations (see Table 1) (National Kidney Foundation, 2001). This article reviews data that illustrate the vital importance of maintaining targeted Hb levels on patient QOL, with a focus on the physical, cognitive, psychological, and social domains (see Table 2).

Anemia and Physical Functioning

When assessed in terms of available oxygen, it is not surprising that patients on dialysis often have difficulty performing activities of daily living. In general, activity levels that can

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Clinical data have consistently demonstrated that improvements in quality of life (QOL) are associated with hemoglobin (Hb) and hematocrit (Hct) levels maintained in the range recommended by the National Kidney Foundation's Kidney Disease Outcomes Quality Initiative (NKF-K/DOQI™). Hb levels between 11 and 12 g/dL and Hct levels between 33% to 36% yield significant improvements in a wide variety of parameters in the physical, cognitive, and psychological/social domains.

be sustained represent approximately 40% to 50% of the maximum amount of oxygen an individual can consume (VO_2 max). Patients on dialysis who have anemia have peak VO_2 max values that can be as low as 50% of the values seen in healthy, sedentary, age-matched individuals. This comparatively low level of available oxygen severely compromises the ability of most patients to work or to perform activities of daily living and may preclude the performance of even relatively simple tasks (Painter, 1994). For anemic patients on dialysis, an activity such as cooking may require 40% to 50% of maximal VO_2 and represent moderate work. Common daily activities such as walking may equate to heavy work for such individuals.

Patients on dialysis are acutely aware of how low Hb levels can negatively affect their QOL. In an assessment conducted by the Medical Education Institute, for example, patients consistently reported degradations in physical functioning that limited their ability to perform routine tasks when hemoglobin levels fell below 11 g/dL—even for a brief period of time (Schatell & Witten, 2004).

A number of studies have found that partial correction of anemia following initiation of Epoetin alfa therapy is associated with an increase in VO_2 max and exercise capacity. Robertson et al. (1990) reported a 17% increase in maximal oxygen uptake ($P < 0.0005$) after Hct levels were increased from 21.2% to 35%. The higher Hct level was also associated with improvements in both aerobic exercise capacity and isometric and isokinetic strength. Likewise, a study that evaluated the effect of

increasing Hb levels from 7.3 to 12.1 g/dL found that exercise intensity increased from 77 ± 27 W at baseline to 104 ± 51 W following 211 \pm 53 days of Epoetin therapy ($P = 0.05$). This improvement in performance was sustained in patients who were maintained at the higher Hb level for 6 months. Data also demonstrated an improvement in the aerobic (blood lactic acid) threshold, indicating an enhanced supply of oxygen to the muscles (Braumann, Nonnast-Daniel, Boning, Bocker, & Frei, 1991).

A study by Guthrie, Cardenas, Eschbach, Haley, and Evans (1993) reported significant improvement in isometric and isokinetic strength performance among 15 patients on hemodialysis whose Hct was increased from 21.2% to 35.4% ($P < 0.01$). Patients reported improvements in endurance and functional status that resulted in comparative decreases in weakness and shortness of breath and an increase in energy level.

These and similar data indicating that exercise and physical performance improve when Hb is maintained in the NKF-K/DOQI target range of 11 to 12 g/dL caused investigators to theorize that further improvements in physical functioning might be observed at physiologically normal Hb levels. Painter et al. (2002) assessed the effect of increasing Hct levels from 30%-33% to 40%-42%, with or without exercise training ($n = 48$). The authors found that while higher Hct levels led to significant improvements in general health, there was no difference in peak VO_2 uptake. The authors hypothesized that correcting anemia may unmask a

Table 1
QOL Benefits Associated With Hb Levels Maintained in the NKF-K/DOQI Range of 11 to 12 g/dL

<i>Higher Hb levels are associated with improvements in:</i>	
- Cognitive function	- Exercise capacity
- Energy/activity levels	- Functional ability
- Sleep and eating behavior	- Health status
- Satisfaction with health	- Sex life
- Well being	- Psychological effect
- Satisfaction with life	- Happiness

Table 2
Components of Health-Related QOL

Health-Related Quality of Life			
<i>Physical Domain</i>	<i>Cognitive Domain</i>	<i>Psychological Domain</i>	<i>Social Domain</i>
<ul style="list-style-type: none"> • Functional capacity • Work capacity 	<ul style="list-style-type: none"> • Concentration • Memory • Mental alertness 	<ul style="list-style-type: none"> • Satisfaction • Well-being • Self-esteem • Anxiety • Depression 	<ul style="list-style-type: none"> • Labor rehabilitation • Past times • Familial and social interactions • Sexual function

Note: Adapted from: Valderrabano (2000).

muscle limitation in which oxygen extraction at the skeletal muscle level becomes the limiting factor.

These data confirm that increasing the Hb level into the NKF-K/DOQI target range of 11 to 12 g/dL typically improves exercise tolerance. However, they also suggest that this effect may have a ceiling that is not overcome by either exercise training or a further increase in Hb to physiologically normal levels. Given that normal Hb levels failed to increase VO₂ to near-normal levels suggests that the reduction in exercise tolerance observed in patients on dialysis is a multifactorial disorder influenced by a variety of factors such as the degree of anemia; muscle blood flow, oxidative capacity, and dysfunction; level of cardiorespiratory fitness; nutritional status; and dialysis adequacy (Painter et al., 2002).

Anemia and Cognitive Function

Patients on dialysis frequently experience a degradation in cognitive function that manifests as confusion, impaired memory, inability to concentrate, and decreased mental alertness. Several studies have shown that improvement in cognitive function often results when Hb levels are maintained in the range recommended by NKF-K/DOQITM. In a representative study, Epoetin alfa was used to increase Hct levels from 23.7% to 36.5% over 3 months. Four neuropsychological tests—the Trail Making Test, part B (TMTB); the Symbol Digit Modalities Test (SDMT); the Controlled Oral Word Assimilation Test (COWAT); and the Rey Auditory-Verbal Learning Test (RAVLT)—were administered before therapy was initiated and repeated after 3 and 12 months. Results revealed significant

improvements in measure speeded perceptual-motor tasks, learning, and memory after partial correction of anemia. Similarly, an electrophysiological evaluation to assess the effect of partial correction of anemia on cognitive function found improvements in attention and the rapidity of processing information at the higher Hct level (Marsh et al., 1991).

More recent studies using various neurophysiological and neuropsychological tests have suggested the potential for graded improvements in cognitive function as Hb levels increase into the NKF-K/DOQITM range of 11 to 12 g/dL. In a study by Benz, Pressman, Hovick, and Peterson (1999) (n = 23), results using graded electroencephalogram analyses at different Hct levels showed a significant improvement in neurocognitive capacity and the ability to maintain focus on tasks when Hct levels were increased from 31.6% to 36.0%. The authors attributed this incremental improvement to an increase in the supply of oxygen to brain tissue.

Results from these studies highlight the fact that improvements in cognitive ability may be experienced when Hb (Hct) levels that are slightly below the NKF-K/DOQI-recommended level are increased into the 11 to 12 g/dL (33% to 36%) range. Studies are ongoing to determine the Hb (Hct) that is most appropriate for optimizing cognitive function (Stivelman, 2000).

Anemia and Psychological and Social Functions

Clinical trials have consistently found that anemia can affect the psychological and social health of patients on dialysis and, conversely, that increasing Hb concentrations can lead to improvements in these domains.

Comparing Hct Levels Less Than 30% to Hct of 35%

In a representative multicenter of more than 300 patients on dialysis, Evans, Rader, and Manninen (1990) followed more than 300 patients on hemodialysis who were new to Epoetin alfa therapy to determine the effect of increasing Hb levels from

<30% to about 35% on a wide variety of QOL parameters, including psychological and social functioning. The authors found that, once patients were maintained at the higher Hct level, there were significant improvements in well-being ($P = 0.004$), psychological affect ($P = 0.003$), and life satisfaction ($P = 0.017$). In addition, at the higher Hct, significantly fewer patients reported problems with social isolation ($P = 0.032$), home life ($P = 0.01$), sex life ($P = 0.004$), and their ability to participate in hobbies ($P = 0.001$).

In a similar analysis, Moreno, Aracil, Perez, and Valderrabano (1996) found that increasing Hb levels benefited QOL in elderly populations as much, if not more, than younger ones. In this study, Karnofsky scale scores increased from 73 to 85 in those younger than 60 and from 61 to 75 in older patients ($P < 0.0001$). More recently, the Spanish Cooperative Renal Patients Quality of Life Study Group examined QOL parameters in 156 patients whose mean Hb increased from 10.2 to 12.5 g/dL. Significant improvements in overall QOL were observed at the higher Hb level, including the psychosocial dimension (the mean decreased from 9.2 to 7.0: $p < 0.001$); global physical dimension (the mean decreased from 8.9 to 7.25: $p < 0.001$), and Karnofsky scale score (the mean increased from 75.6 to 78.4: $p < 0.01$) (Valderrabano, 2000).

Data also indicate that patients who experience problems with sexual function may benefit when Hb levels are increased and maintained in the NKF-K/DOQI™ target range. In a study of male and female patients on dialysis whose Hb was increased from 7.3 to 11.3 g/dL, for example, serum prolactin decreased from 66.9 to 9.6 ng/mL in females, and from 39.5 to 10.3 ng/mL in males. Sexual function improved in 4 of 7 males, and 5 of 9 females began to menstruate again (Schaefer, Kokot, Wernze, & Geiger, 1989). Similarly, Evans and colleagues found that when Hb was increased from less than 10 g/dL to about 11.3 g/dL, the percentage of patients reporting problems with their sex life decreased from 49.2% to 35.7% ($P <$

0.004) (Evans et al., 1990).

These data support the potential for significant improvements in the physical, cognitive, and psychological/social domains of QOL when Hb levels are maintained in the NKF-K/DOQI™ target Hb range of 11 to 12 g/dL. The potential benefits associated with higher Hb levels are illustrated in the following case study.

Case Study

A 59-year-old male patient with ESRD secondary to diabetes mellitus was recently initiated on hemodialysis. Baseline laboratory values were as follows: Hb = 9.3 g/dL; ferritin = 465 ng/mL; transferrin saturation = 30%; blood pressure = 128/83; weight = 70 kg. The patient exhibited shortness of breath and severe fatigue on exertion. The patient did not initially cite any additional complaints, however, probing by the nurse revealed that he had problems with muscle weakness, was not able to enjoy reading (one of his favorite pastimes) because of an inability to concentrate, and experiencing ongoing problems with sexual function.

Epoetin alfa therapy was initiated at a dose of 5,300 Units (75 Units/kg) three times a week to achieve a targeted Hb level of 11 to 12 g/dL. The Hb gradually increased to 11.8 g/dL and stabilized. The patient reported a significant reduction in fatigue and a reduction in shortness of breath. Muscle weakness persisted, and he was placed on a light weight lifting regimen. The patient reported an improved ability to concentrate and has started to enjoy reading again. He also reported that the problems with his sex life have resolved. He stated that he is happier than he has been for a long time.

Discussion

This case demonstrates the potential positive QOL impact of maintain-

ing Hb levels of 11 to 12 g/dL. This case also shows that, despite the negative effects of low Hb levels, some patients are reluctant to report low energy levels or difficulty in performing routine tasks, even when symptoms are severe, because they fear being considered weak or unmotivated. Further, the gradual development and worsening of physical impairment over time may cause patients to “adjust” to lower energy levels so that they no longer recognize the magnitude of their impairment (Medical Education Institute, 2004). These challenges with QOL can often be detected during a thorough nursing assessment, and many can resolve or improve following appropriate therapy.

Conclusions

QOL is of vital importance to patients on dialysis, and is often the gauge that they use to determine whether the treatments that we provide are successful. As nurses we need to be constantly aware of how factors such as anemia can negatively impact the physical, cognitive, psychological, and social components of QOL. It is vital that correctable abnormalities such as anemia be proactively diagnosed and aggressively managed to provide patients with the best opportunity for an improved QOL.

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