

Improving Management of Mineral Bone Disease in Dialysis Patients with End Stage Renal
Disease

Melanie Johnson and Kara Roth

School of Nursing, Southern Illinois University, Edwardsville, IL

Improving Management of Mineral Bone Disease

Literature Review

Introduction

Chronic kidney disease (CKD) remains a prevalent issue in America. The National Kidney Foundation (2019) estimates that up to 37 million Americans are currently living with CKD. Of those 37 million, approximately 468,000 individuals are on dialysis (The National Institute of Diabetes and Digestive and Kidney Diseases Health Information Center, 2016). This costs the Medicare system an average of \$90,000 per patient annually in the United States, totaling \$28 billion (University of California San Francisco, 2019). Dialysis patients have a far greater mortality rate than the general population, due to the complexity of the disease and other comorbidities impeding the maintenance of good health (UCSF, 2019). Preventing hospitalizations and complication due to CKD is essential to reduce healthcare costs and optimize patient well-being.

One problem that affects CKD patients, particularly those on dialysis, is a condition known as mineral bone disease (MBD). Decrease in kidney function causes elevated levels of serum phosphate, hypercalcemia, and abnormal parathyroid hormone (PTH) leading to MBD (Kettele et al., 2018). These abnormal levels lead to numerous complications for patients that include increased cardiovascular disease, increased bone fragility, and an overall increase in patient mortality (Annals of Internal Medicine, 2018). Data from 2016 showed that approximately 60% of U.S. dialysis patients had hyperphosphatemia, one of the main factors contributing to MBD (Djukanovic, et al 2016). A major issue in the CKD and dialysis population is ensuring patients control their diet to keep these levels within normal limits as recommended by Kidney Disease Improving Global Outcomes (KDIGO) guidelines and the National Kidney Foundation (Burton, Goldsmith, Ruddock, Shroff, & Wan, 2018). It is recommended that serial

assessment of phosphorus, calcium, and PTH levels should be evaluated together to more thoroughly assess for risk of MBD (Kidney International Supplements, 2017). Making dietary changes as needed to bring phosphate and calcium levels close to normal limits will help decrease maleffects associated with patients with end stage renal disease (ESRD).

The goal of this project is to decrease the risk of MBD by educating CKD patients on basic understanding of this complication and ways to make better nutritional choices to improve their quality of life. Anderson and Nguyen (2018) have shown education can help them overcome many additional obstacles they may face in the course of their illness by making better dietary choices. Effectiveness will be evaluated by assessing patient understanding and compliance using voluntary post surveys, while also looking for improvements in patient reported dietary choices.

Aim

This literature review had multiple goals. The first and primary goal was to establish the risks of MBD and the need to address the problem. The second aim was to establish what interventions have been successful in the prevention and treatment for managing MBD in dialysis patients with ESRD. The third and final objective was to examine the literature and determine what hurdles currently undermine the effects of current treatment standards and how to best overcome those barriers.

Search Strategy

Several databases were searched in an effort to find relevant literature. Databases that were searched include CINAHL Plus, Cochrane Database of Systematic Reviews, Google Scholar, MEDLINE complete, and PubMed. Keywords searched included the terms “mineral

bone disease,” “MBD,” “end stage renal disease,” “ESRD,” “dialysis complications,” “burden of mineral bone disease,” “kidney failure,” “non-compliance,” and “chronic kidney disease.” “nutrition and ESRD”. Articles were limited to those published in English in an academic journal from the years of 2015 to present.

Results

Results of the original search for pertinent information yielded over 100 articles. Results were then narrowed down to only include those that presented level I and II research to review. Google Scholar, CINHALL, and PubMed produced the greatest amount of relevant literature. No difficulties were encountered in finding relevant research on non-compliance that were published between 2015- present. A total of 28 articles were reviewed and 17 were ultimately chosen to be used in the literature review. Several themes emerged including risk associated with mineral bone disease, goals of prevention and treatment, barriers of prevention and treatment.

Risks Associated with Mineral Bone Disease.

Djukanović et al (2016) studied over 1700 patients for a three-year period and found that phosphorus levels outside of 2.5-4.5 mg/dl and intact PTH levels outside of 10-65pg/ml were associated with higher morbidity and mortality for patients. Abnormalities in these lab values put patients at increased risk for fractures, calcification of arteries, valves, and myocardium, and calciphylaxis. 38.7% of patients who die with ESRD die of an arrhythmia or cardiac arrest (NIDDK, 2016). Another study in 2017 found that in patients over 70 years old more than 50% of fall injuries could be attributed to MBD and it was a causative factor in over two-thirds of fall related deaths (Sanchez-Riera, et al. 2017).

Interventions to Aid in the Prevention and Treatment of Mineral Bone Disease.

The basis of both prevention and treatment of MBD is to follow a prescribed dietary regimen and use medication or supplementation as necessary to keep calcium, phosphorus, and PTH levels as close to normal levels as possible. Effective dialysis can only remove between 250mg-1000mg per treatment (Davita, 2018). Patients frequently have high levels of phosphorus, as kidneys are responsible for most of excretion (Copland, Komenda, Weinhandl, McCullough, & Morfin, 2016). Adherence to dietary recommendations is difficult as many patients are low income so have greater difficulty accessing healthier food. Further, labeling that shows actual phosphorus levels in food and drinks is limited (Copland, Komenda, Weinhandl, McCullough, & Morfin, 2016). To help combat dietary intake of phosphorus, phosphate binders are recommended (Kidney International Supplements, 2017).

Calcium levels are indirectly controlled by kidney function and therefore frequent monitoring of these levels needs to be done to keep them within normal limits. Dietary adherence is important, but sometimes supplementation is necessary. Conservative supplementation is suggested as risks of hypercalcemia are greater for ESRD patients than those of hypocalcemia (Burton, Goldsmith, Ruddock, Shroff, & Wan, 2018). Bone mineral density studies are recommended by KDIGO to identify those at risk of fractures due to abnormal calcium levels. Lastly, secondary hyperparathyroidism can occur from loss of kidney function. This can be controlled by controlling phosphorus and Vit D intake, by removal of parathyroid gland or medication administration (Chen, et al, 2018).

Due to the demands of dietary guidelines and restrictions it can often be difficult for patients and their caregivers to manage food choices. Studies have shown the importance of a multi-disciplinary approach to managing MBD in patients with CKD (Chan, Cheah, & Padzil, 2019; Anderson and Nguyen, 2018; Milazi, Bonner, & Douglas, 2015). A key component all of

these studies denotes the value of dietary education for patients and their caregivers. The study by Chan, Cheah, and Padzil (2019) showed that the combination of dietary and medication education dropped phosphate levels from 1.86 mmol/L to 1.47 mmol/L in just 3 months after administration of education. In a separate systematic review, the importance of a multidisciplinary approach including dietary restriction, oral medication, therapy and hemodialysis was indicated. The review found dietary education can improve both compliance and electrolyte levels (Milazi, Bonner, Douglas, 2015). Additionally, Anderson and Nguyen (2018) clearly state that nutritional education is recommended for patients with ESRD and cardiovascular disease (CVD).

Barriers to Prevention and Treatment of Mineral Bone Disease.

Adherence to dietary constraints as well as medication regimen can be difficult. Patients may be prescribed phosphate binders to be taken at each meal and snack. This pill burden can cause noncompliance if a patient forgets to carry their medication along with them wherever they go (Copland, Komenda, Weinhandl, McCullough, & Morfin, 2016). One study suggests that patients skip up to 57% of their phosphate binder medication doses and found that the greater the number of pills the patient is required to take the greater likelihood of non-compliance (Fissell, et al. 2016). Also, as stated previously, many patients who suffer from ESRD are of low economic status, their ability to afford more nutrient dense foods is more limited, and proper labeling of phosphorus content in food/drinks are limited. To combat these problems, short daily hemodialysis and nocturnal hemodialysis are recommended to help decrease pill burden and decrease mortality (Fissell, et al, 2016). However, compliance with even the standard 3 times weekly in center hemodialysis is low (Copland, Komenda, Weinhandl, McCullough, & Morfin, 2016).

Discussion

High blood pressure and diabetes are the major contributing factors to developing CKD accounting for 75% of kidney failure cases between 2014-2016 (NKF, 2019). African American, Native Americans, Mexican Americans, and Asian Americans all have higher rates of CKD than Caucasians (NIDDK, 2016). Early education is important for prevention in developing CKD and ESRD. Twelve people die every day waiting for a transplant (NKF, 2019). Therefore, the goal to prevent further complications with patients with CKD and ESRD is paramount. MBD is a common complication for these patients due to kidney not being able to process phosphorus, calcium, and regulate PTH effectively. Providing simplistic education that suggests feasible changes to diet can have a long-lasting impact not just on the prevention and treatment of mineral bone disease but on other common comorbidities such as diabetes mellitus and congestive heart failure.

Conclusion

The reviewed literature pointed toward the clear dangers MBD poses to a dialysis patient's mortality and their quality of life. These dangers do not only affect the patient, but also their family and caregivers, creating an increased burden on the health care system. There is a clear need to prevent MBD and its associated complications. However, due to several barriers including non-compliance and low economic status, interventions must be simple and cost-effective. For example, small, easy, and affordable changes, such as healthier food choices, that require little effort on the patient's part are achievable and could eventually decrease the patient's pill burden and lead to greater compliance. Numerous studies have shown a clear correlation between nutritional education and decreased complications in CKD and MBD (Chan, Cheah, & Padzil, 2019; Anderson and Nguyen, 2018; Milazi, Bonner, & Douglas, 2015).

Education would ideally be given at the same time as the patient's dialysis treatment so there are no additional appointments that could further the burden on the patient and increase the risk of non-compliance. Easily referenced, simply presented guides should also be provided so the patient and their family can reference them when needed and do not need to memorize information. By providing continuing education at the time of dialysis, and increased accessibility to reference guides that suggest uncomplicated, cost-effective changes, those with the disease can take better control of their health and lower their risk of complications and prevent their chances of developing mineral bone disease.