Preserving Bone Health in Kidney Patients: The Challenges of Disease and Aging

Pathways

TO BONE HEALTH

An educational series on optimizing bone health in kidney patients

aluminum-related osteomalacia has dropped now that aluminum is rarely found in dialysate water and is less commonly used as a phosphate binder. However, osteomalacia still appears in many dialysis patients, indicating that factors other than aluminum deposition are at fault (Hruska, 1998). This disease may also be idiopathic and related to osteoporosis of aging.

Other forms of renal bone disease

As noted above, kidney patients can experience other forms of bone disease not related to or only indirectly related to their kidney failure. *These diseases can cause problems beyond those directly related to the mineral imbalances that result from kidney failure.* The most common types are *osteoporosis* and *amyloid bone disease*.

- Osteoporosis is the thinning—and perhaps eventual collapse—of mainly trabecular bone (the interlaced struts that form the inner structural supports of larger bones). The most widely known symptom of osteoporosis is "dowager's hump." Osteoporosis is often associated with low estrogen levels (such as in post-menopausal women) or low androgen levels in men. In addition, most people suffer some osteoporosis as a result of the normal aging process. It can also be caused by prolonged exposure to medications such as corticosteroids (Lindberg and Moe, 1999).

- Amyloid bone disease is an especially painful form of bone disease caused by the deposition of insoluble proteins (fragments of immune cells) throughout the body, and especially in bones and joints. Amyloid forms when the immune system is repeatedly stimulated and appears in dialysis patients because of their repeated exposure to synthetic dialyzer membranes (Drüeke, 2000).

Factors contributing to renal bone disease

Many factors contribute to how and when kidney patients will develop bone disease, and what type of disease they are most likely to develop. There are a host of physiologic conditions that occur with a loss of kidney function—such as a loss of D hormone, the likelihood of increased acidosis, high phosphorus levels, and so on. In addition, patients have their own unique medical histories, including their age, length of time they have had the disease, types of medications they receive, and the condition that brought on renal failure—hypertension, diabetes, nephrolithiasis (kidney stones), etc. Many of these factors increase bone damage, or make the diagnosis of bone disease more difficult. Some of the most common factors are discussed below (*See also Table 2, page 20*).

Parathyroid Hormone (PTH)

PTH coordinates the action of several systemic and local factors to maintain serum calcium within a normal range and regulates the movement of calcium into and out of individual cells (Bro and Olgaard, 1997). PTH stimulates intestinal absorption of calcium through conversion of vitamin D (25-hydroxyvitamin D) to the active D hormone (1, 25-dihydroxyvitamin D). Active D hormone regulates the reabsorption of calcium and phosphorus in the kidney, and stimulates the exchange of calcium between serum and bone (Bilezikian et al., 1996; Jones et al., 1998).

With the loss of renal function and concomitant loss of active D hormone, serum calcium drops due to decreased

The Role of Phosphorus

Phosphorus could also be included in the list of factors that affect renal bone disease; phosphorus levels do, indeed, affect renal bone disease through at least several mechanisms (Slatopolsky et al., 2000): First, high phosphorus seems to inhibit the activation of vitamin D in the kidney. Second, even moderately high levels of phosphorus may cause a decrease in the release of calcium from the bone (though this may be another side effect of the loss of active vitamin D). Furthermore, high phosphorus levels contribute to the overproduction of PTH and parathyroid hyperplasia (Kurz et al., 1994), the factors that lead to SHPT and osteomalacia. Controlling levels of phosphorus is critical in patient care.