4. NUTRITIONAL ASPECTS OF STONE DISEASE

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INTRODUCTION
Humans have been plagued for centuries with kidney stones of varying compositions, the most common of which is calcium oxalate, comprising 50%–80% of all stones [1,2]. In the United States, kidney stones are most prevalent in persons 20 to 40 years of age. The ratio of occurrence of calcium oxalate stones in the sexes is three men to every one woman. Women tend to form magnesium ammonium phosphate (struvite) stones twice as commonly as men. The incidence of uric acid stones tends to be similar for both men and women [3].

Robertson and Peacock explained urinary stone disease as “being due to periods of excessive crystalluria (which) may be so great or persistent that crystal aggregates form and become lodged at some narrow section of the urinary tract and there form the nucleus of the stone” [4]. The formation of abnormal crystals is partially dependent on the degree of supersaturation of the urine with the salts involved. The abnormalities which lead to increased supersaturation are known as risk factors. For calcium oxalate stones, these factors include high urinary calcium, oxalate, sodium, and uric acid, and low urinary citrate and volume.

It is well known that these risks may be caused or influenced by dietary excesses or deficiencies. Conversely, they may be ameliorated by certain dietary modifications [5]. Some patients with stones may be particularly susceptible or responsive to dietary aberration or corrections because of their...
underlying metabolic derangements. In others, nutrition may have a relatively smaller pathogenetic role, and dietary modifications may be relatively ineffective or contraindicated.

Many dietary elements have been cited as contributing factors in stone formation. Griffith and associates distinguished 24, including vitamins and several minerals [2]. This chapter will examine those dietary factors which are recognized to play a role in calcium oxalate stone formation: calcium, oxalate, purines, acid-ash content, sodium, and fluid [6,7]. In some patients, only one of these dietary components may be implicated, while in others several factors may be involved [8]. For each of the above dietary components, we shall discuss (1) pathogenetic role in stone formation, (2) amelioration of physiological disturbance and inhibition of stone formation by diet modification, and (3) conditions amenable to dietary treatment.

General overview of nutritional influences on calcium oxalate stone formation

A relationship between socioeconomic status and stone formation has long been appreciated. The frequency of stone formation can be correlated to per-capita income and expenditures on food. Animal protein has been shown to have the greatest influence on stone formation; it has been related primarily to the consumption of beef [9–13]. With an increase in protein consumption urinary excretion of calcium and urate is increased, and urinary pH and citrate excretion are decreased. These changes result in increased risk of stone formation. It has also been reported that an increased intake of refined carbohydrates is associated with calcium stone formation, due to a rise in calcium excretion secondary to a reduction in renal tubular reabsorption of calcium [14,15]. Some investigators have also suggested a pathogenetic role of fat intake and increased sodium consumption in stone formation, since both of these nutritional factors have been shown to be associated with a rise in calcium excretion [2,16]. Studies have also indicated that patients with calcium oxalate urolithiasis have significantly lower intake of dietary fiber, noncellulose polysaccharide, phytate, magnesium, phosphate, and thiamine when compared to controls [17,18]. It is generally assumed that a high calcium diet may predispose to calcium stone formation by provoking or exaggerating hypercalciuria. However, there are surprisingly limited data actually proving that a high calcium intake causes calcium stone formation. Most of the evidence is anecdotal.

Role of dietary modification in stone prevention

Once it is determined that the stone(s) being formed is composed of calcium oxalate, it must be determined in each individual case exactly what the abnormality is in order to provide proper therapy [5]. The object of therapy, of course, is to prevent subsequent stone formation.

Dietary modification should be applied to all patients with calcium stone...