

# A Detailed Overview of Nephrolithiasis

## Introduction

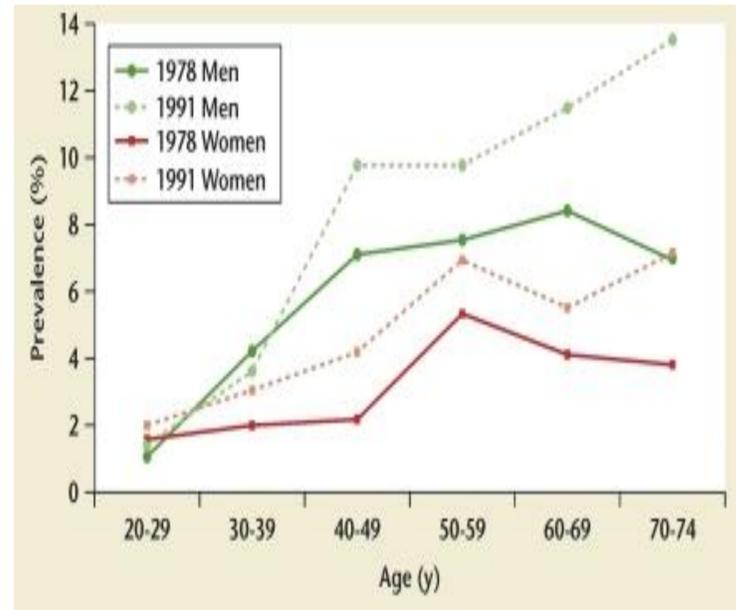
Nephrolithiasis or more commonly known as kidney stones is one of the most frequent medical conditions of the kidneys affecting both people of all ages and genders (**Figure 1**). Nephrolithiasis is estimated to affect 11% of men and 7% of women in the United States.<sup>2</sup> Nephrolithiasis is a condition in which kidney stones develop due to increase concentrations of solutes, calcium, phosphates, and uric acid develop in the renal calyces or pelvis along with anti-stone substances are low.<sup>3</sup> To put it in simple terms according to the Mayo Clinic nephrolithiasis or kidney stones are hard deposits made up of minerals and salts that form inside the kidneys. How these stones are formed can be due to a multitude of factors, how the aspect of dietary restrictions and processes of food production dominate the main reason of an increase in rates of the years. Along with diet; genetic effects, trauma to the spine, and inflammatory bowel disease can also be contributing factors to stone development.

## Types

The different types of stones are almost as vast as the causes for them. Uric acid stones may form in the presence of gouty diathesis or in secondary causes of purine overproduction. Cystine stones are due to a rare, congenital condition resulting in large amounts of cystine (an amino acid) in the urine. Pathologic stones are caused by infections in the body, an example of a pathological caused stone is a urinary tract infection, which affects the chemical balance of the urine, raising the pH. Eighty to eighty-five percent of calculi or stones diagnosed in the United States are idiopathic (spontaneous).<sup>4</sup> (**Figure 2**)

## Signs and symptoms

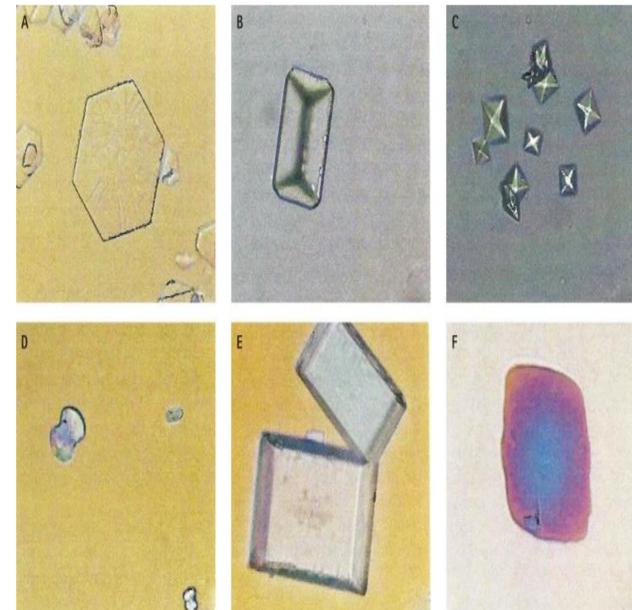
The signs and symptoms of nephrolithiasis are very noticeable and distinguishable from other illnesses someone may have experienced before. Patients often present with episodes of flank pain that radiates to the anterior abdomen or even to the genitalia. The pain is very severe and comes in waves. Often, there is microscopic or gross hematuria (blood in urine). Calcium oxalate crystals, if small enough, may be present in urine. In some cases, renal stones are completely asymptomatic or produce painless hematuria.<sup>6</sup> If there is pain with urination, cloudy or a “foul-smelling” urine, nausea and vomiting, more urination, or urinating in small amounts.<sup>7</sup>



**Figure 1.** A chart showing the increase in the prevalence of nephrolithiasis US males and females from 1978-1991.<sup>1</sup>



**Figure 3.** Coronal view of bilateral nephrolithiasis on a non-contrast Computed Tomography scan.<sup>9</sup>



**Figure 2.** Type of stones. Light microscopy of urine crystals. (A) Hexagonal cystine crystal; (B) coffin-lid shaped struvite crystals; (C) pyramid-shaped calcium oxalate dehydrate crystals; (D) dumbbell-shaped calcium oxalate monohydrate crystal; (E) rectangular uric acid crystals; and (F) rhomboidal uric acid crystals.<sup>5</sup>



**Figure 4.** How a percutaneous nephrolithotomy is performed.<sup>12</sup>

## Diagnosis

Before an image is taken there are multiple factors that must be considered to use the most effective imaging technique; the clinical setting, body habitus of the patient, cost, and tolerance of ionizing radiation all need to be addressed before an order is placed.<sup>8</sup> In most cases patients with suspected nephrolithiasis will have a Computed Tomography (CT) scan of their abdomen performed (**Figure 3**). The main goal of a CT image is to identify the size of the stone. Stone size, which traditionally has been quantified as the maximum in-plane diameter on a CT image, is consistently identified as a primary predictor of the likelihood of spontaneous stone passage.<sup>10</sup>

## Treatment

If the stone is small enough to completely pass through the ureters, bladder and eventually out of the urethra is the preferred method of nephrolithiasis. This process is arguably the most painful and causes the most discomfort, but after complete passage the patient can feel back to normal in a matter of hours. For stones that are too large an invasive or surgical process is needed to break up the stone into small enough fragments to pass the urinary tract.

One popular method for smaller stones is extracorporeal shock wave lithotripsy. ESWL is effective for small stones located in the upper urinary tract, especially at the junction of the upper ureter and renal pelvis.<sup>11</sup> ESWL sends shock waves at a frequency that can break up the stone without doing damage to the surrounding tissue and allows the patient to pass the new fragments. Another method that is needed for stones that have a mass greater than 2 cm is percutaneous nephrolithotomy (PCNL) (**Figure 4**). In PCNL an incision is made into the area of the kidney where the stone is located, waves are used to break up the stone, and the smaller fragments are suctioned out.

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