Prostatic Calculi: A Review of the Literature

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Abstract

Background:
Prostatic calculi are common in men who are evaluated for benign prostatic hyperplasia (BPH) or prostate cancer, but the significance of prostatic calculi with respect to urological diseases and symptoms is obscure. In most cases, when symptoms are present, they are usually nonspecific. The majority of calculi are discovered incidentally, usually by means of a radiological investigation for other medical conditions. The incidental finding of prostatic calculi often produces a diagnostic and therapeutic dilemma.

Objective:
To review the literature on prostatic calculi

Results:
Prostatic calculi are presumed to be formed by the precipitation of prostatic secretions and calcification of the corpora amylacea under inflammatory conditions. The number of calculi found in the prostate gland may vary from single to several hundreds. There are no specific symptoms that are pathognomonic for the presence of prostatic calculi. A number of men with prostatic calculi may have no symptoms. The symptoms when they occur may be related to prostatic hypertrophy, chronic prostatitis or perhaps urethral stricture. Diagnosis of prostatic calculi may be made following digital rectal examination, plain radiographs or ultrasound scan. Asymptomatic patients with prostatic calculi do not require any treatment but those patients who have symptoms may require treatment to remove the calculi. Recurrences of prostatic calculi may be observed after treatment of prostatic calculi for a number of reasons which may be summarized as follows:
1. After prostatotomy if related diverticula are not excised or obliterated recurrence of prostatic calculi may occur.
2. De novo calculi may subsequently form in the remaining cavities of the prostate gland.
3. False recurrences which represent calculi that were overlooked at the time of the original operation may be subsequently identified. In view of this plain radiographs or ultrasound scans should be performed post-operatively to ensure there are no residual stones before the patients are discharged.
4. Following trans-urethral resection true or new calculi may subsequently form.

Conclusions:
Prostatic calculi quite often are asymptomatic. Prostatic calculi may also co-exist with prostatitis or benign prostatic hyperplasia (BPH) in elderly men. These patients suffer LUTS for underlying prostatic disease, such as prostatitis or BPH. It is unclear whether prostatic calculi independently produce LUTS. Recurrences of prostatic calculi may be observed after treatment of prostatic calculi for a number of reasons. Plain radiographs or ultrasound scans should be performed post-operatively to ensure there are no residual stones before the patients are discharged.

Introduction

Prostatic calculi are presumed to form by the precipitation of prostatic secretions and calcification of the corpora amylacea under inflammatory conditions [1], [2]. The precise mechanisms by which calculi form and the association of calculi with benign and malignant conditions of the prostate gland are unknown. Some authors agree that prostatic calculi simply accompany the presence of prostatic hyperplasia and carcinoma [3]. It has been stated that benign prostatic hyperplasia (BPH) produces lower urinary tract symptoms (LUTS) by mechanical obstruction of the prostatic urethra, in which the smooth muscle of the prostate and bladder neck contracts and when an enlarged adenoma is present [4], [5]. Some authors reported that prostatic calculi only produce non-specific lower urinary tract symptoms (LUTS) [6]. It has also been stated that there is a clear correlation between age and incidence of prostatic calculi, although the presence of prostatic calculi in younger men is often associated with symptoms of inflammation and prostatitis [7]. Konig and associates [8] reported that prostatic calculi induce prostatitis, which produces and aggravates LUTS. Prostatitis produces LUTS by contraction of the smooth muscle of the prostate and bladder neck. Inflammation of the prostatic parenchyma is suggestive of an important role for LUTS in men who have prostatic calculi. Prostatic calculi usually coexist with prostatitis or BPH in elderly men. These patients suffer LUTS for underlying prostatic disease, such as prostatitis or BPH. It is unclear whether prostatic
calculi independently produce LUTS. This paper reviews the literature on prostatic calculi.

**Literature Review**

**Classification:**
True prostatic calculi are those calculi that develop in the tissues or acini of the prostate gland and should not be confused with so-called false calculi which may be urinary calculi that had lodged in dilated prostatic urethra or in a pouch of the urethra. By the same token, a calculus which is present in an abscess cavity or diverticulum which communicates with the urethra must not be considered a true prostatic calculus. This latter type of calculus represents a urinary calculus that has formed within the anatomic area of the prostate gland.

**Aetiology:**
True prostatic calculi are believed to be formed by the deposition of calcareous material on corpora amylacea. Corpora amylacea are small ovoid or round bodies that are present within the alveoli of the prostate gland. Prostatic calculi are common in men but rare in boys. Corpora amylacea, which is composed of lecithin and nitrogenous substance of an albuminous nature, has a laminated structure and is believed to be formed around desquamated epithelial cells. Corpora amylacea are impregnated with inorganic salts (calcium phosphate and calcium carbonate), which convert them into calculi. Sutor and Wooley [9] stipulated that “false prostatic calculi” perhaps arise from the precipitation of salts found in normal prostatic fluid, that is, calcium and magnesium phosphates. Some workers feel that the corpora amylacea may serve only as nuclei, and infection also contributes to the formation of some prostatic calculi.

**Physical Characteristics:**
The number of calculi found in the prostate gland may vary from single to several hundreds. But in general, they are multiple and their sizes vary from 1mm to 4 mm in diameter. They are brownish gray in appearance and ovoid or round. Prostatic calculi are usually firm in consistency but they can be easily crushed.

**Composition:**
Huggins and Bear in 1944 [10] found that the organic components, which compose about 20 percent of the prostatic calculus, include proteins (8%), cholesterol (from 3.7 % to 10.6%), and citrate (0.17% to 2.9%). Sutor and Wooley [9] stated that true prostatic calculi comprise solely of calcium phosphate trihydrate (whitlockite) and carbonate. Huggins and Bear [10] stated that although corpora amylacea may occur in the anterior segment of the prostate, they tend to occur mostly in the posterior segment.

**Pathologic changes:**
The pathological changes that occur in the prostate gland which contains minute calculi may be chronic inflammation with areas of round cell infiltration. The acini may be filled with debris and desquamated epithelial cells, and the acini may or may not be dilated. In the case of large prostatic calculi the acini and ducts may be dilated, and the surrounding cavities may vary in shape and size. Their epithelial lining may be absent and round cell infiltration and fibrosis may be observed between the acini. Rarely, when a large calculus is present, little normal prostate tissue is identifiable.

**Symptoms:**
There are no specific symptoms that are pathognomonic for the presence of prostatic calculi. A number of men with prostatic calculi may have no symptoms. The symptoms when they occur may be related to prostatic hypertrophy, chronic prostatitis or perhaps urethral stricture. Erkyn and associates in 1974 [11] stated that prostatic calculi contain and harbour bacteria, just as infected renal calculi do. The asymptomatic patient may bring to the urologist a small calculus he had passed per urethram. The patient with a prostatic calculus may complain of dull aching pain in the lower back, perineum, or penis. If there is an associated prostatic enlargement or urethral stricture the patient may present with lower urinary tract symptoms. At times the patient may have a urethral discharge because of chronic prostatitis. Usually there is no haematuria in association with prostatic calculi, however, terminal urinary bleeding may be observed. Prostatic abscess formation due to prostatic calculi is very rare. However, a patient with prostatic abscess associated with prostatic calculi would have severe deep pain in the perineum and rectum and this pain would be aggravated by defecation. In addition such a patient may have an elevated temperature as well as constitutional symptoms. The prostate gland would then be exquisitely tender to palpation. In the event of cystitis, dysuria, nocturia, and frequency of micturition may occur.

**Treatment:**
There is no indication to treat patients with silent asymptomatic prostatic calculi. When surgical
treatment is required in the case of prostatic calculi three main options of treatment are available and these include [12]:

1. Trans-urethral removal of the prostatic calculi: This modality of treatment may produce temporary relief, but may not necessarily guarantee removal of all the prostatic calculi therefore, recurrent prostatic calculi formation may be encountered subsequently.
2. Combining ultrasonic observation of stone removal by trans-urethral surgery: This modality of treatment improves the surgeon’s ability to excise or remove all visible calculi. This form of treatment may be used in young patients to avoid impairment of sexual activity and to relieve pain or in the older patient who is a poor surgical risk.
3. Supra-pubic removal: This method of treatment may be used in the presence of a large stone or stones associated with significant prostatic enlargement.

Other available methods of treatment include:
1. Perineal prostatotomy: This method of treatment may occasionally be required for the removal of deep stones.
2. Total prostatectomy: Total perineal prostatectomy and bilateral seminal vesiculectomy may rarely be used in the presence of multiple symptomatic calculi to ensure curative treatment.

Recurrence:
Recurrences of prostatic calculi may be observed after treatment of prostatic calculi for a number of reasons which may be summarized as follows [12]:

1. After prostatotomy if related diverticula are not excised or obliterated recurrence of prostatic calculi may occur.
2. De novo calculi may subsequently form in the remaining cavities of the prostate gland.
3. False recurrences which represent calculi that were overlooked at the time of the original operation may be subsequently identified. In view of this plain radiographs or ultrasound scans should be performed post-operatively to ensure there are no residual stones before the patients are discharged.
4. Following trans-urethral resection true or new calculi may subsequently form.

Discussion

Most prostatic calculi are usually found in middle-aged and older men. Prostatic calculi are usually round ovoid bodies, with laminar surfaces, of variable sizes and shapes, and they are usually found in alveoli of prostatic glands. Prostatic calculi are formed as a result of deposition of calcareous calcium salts on corpora amylacea. Corpora amylacea are numerous, small, tannish-gray, laminated organic structures that are predominant in the central zone of the prostate. Corpora amylacea are composed of lecithin, and nitrogenous and albuminous materials. Corpora amylacea are conglomerated with desquamated epithelial cells within the prostatic alveoli. Urinary salts of calcium phosphate and calcium carbonate impregnate the corpora amylacea thereafter forming a fibrinous deposit within the prostatic acini. Sufficient and frequent ingestion of urine into the prostatic duct and acini over a period of time allows the crystallization, aggregation, and growth of prostatic calculi [13].

Prostatic calculi appear as scattered calcifications overlying the symphysis pubis and superior pubic rami on routine radiographs [14].

Prostatic calculi contribute to prostatic inflammation by obstructing central prostatic ducts, preventing urinary drainage, and providing a nidus in which bacteria can survive a host’s defences and antibiotics [15].

Prostatic calculi are usually found incidentally during digital rectal examinations, when viewing plain radiographs of the male pelvis in patients who are more than fifty years old, during trans-rectal ultra-sound scan, and during trans-urethral resection of the prostate. Prostatic calculi are commonly located at the apical margin of the prostatic adenoma within the cleavage line between nodular hyperplasia and the surgical capsule [16]. Prostatic calculi may be associated with prostatic hyperplasia, chronic bacterial prostatitis, or prostate carcinoma [17].

The reported incidence of prostatic calculi has varied from 7% in pathologic specimens, 20% in autopsies, and 30% in radiological studies, to even higher percentages in ultra-sound scan examinations [18].

Based on their composition, prostatic calculi have been classified as primary or endogenous calculi and secondary or exogenous calculi. Primary or endogenous calculi are said to be formed in acini from prostatic fluid. Endogenous or primary prostatic calculi are composed of apatite and whitlockie. Pure primary prostatic calculi are composed exclusively of apatite and whitlockie. However, impure primary prostatic calculi contain contaminants of oxalates and uric acid with apatite and whitlockie in the periphery. They have a compact nucleus with concentric layers of carboapatite and intercalated layers of whitlockie in the periphery [19].

Secondary or exogenous calculi are formed in the prostatic duct. They are composed initially of crystalline oxalic or uric nuclei however, at a later stage they are surrounded or covered by layers of
apatite and whitlockie. Pure secondary prostatic calculi exclusively contain crystalline components of urine. Impure secondary prostatic calculi contain apatite and whitlockie in the periphery [19].

In the study of Lin and associates [14], predominant-calcium phosphate stones with calcium oxide components or predominant calcium oxalate stones with calcium phosphate components were regarded as mixed prostatic calculi. Sutor and Wooley [9] estimated that about 50% of prostatic calculi in British patients are intrinsic or endogenously derived from prostatic substances and secretions. The remaining extrinsic or exogenous prostatic calculi are derived from the natural progression of the corpora amylacea and urine [9]. A crystallographic analysis of prostatic calculi showed their mineral constituents to be similar to urinary tract calculi [11]. Since most patients with prostatic calculi are asymptomatic, they have no clinical significance for treatment. However, pathogenic bacteria in refluxing urine may initiate and perpetuate a vicious cycle in some asymptomatic patients of chronic prostatitis, prostatic calculi formations and/or recurrent urinary tract infections by bacteria hidden within the crevices of the prostatic calculi [11]. These bacterial colonizations within prostatic calculi lead to recalcitrant chronic prostatitis and recurrent urinary tract infections despite adequate antibiotic therapy. Ludwig employed transrectal ultrasonography on men with chronic prostatitis and discovered that men with chronic prostatitis had a significant higher frequency of prostatic calculi compared with men without prostate inflammation [20].

Lin and associates [14] analyzed the composition of prostatic calculi from Taiwanese men with benign prostatic hyperplasia after transurethral resection of the prostate and assessed their relationship with the resected weight of the prostate, serum PSA level, urine white blood cell count, and previous urinary tract calculus formation. Based on data from Taipei Veterans General Hospital, Lin and associates [14] found that extrinsic or exogenous prostatic calculi comprised 16.1%, intrinsic or endogenous prostatic calculi comprised 32.2%, while Mixed-prostatic calculi constituted 51.6% of the patients in their analysis. Increasing the weight of the resected prostate was associated with more than 1 composition of prostatic calculi (p = 0.004). The association of previous urinary tract calculi with present prostatic calculi ranged from 9.6% in the kidney to 19.3% in the urinary bladder. Lin and associates [14] stated that all these results may be explained by the theory of intraprostatic urinary reflux and obstruction of prostatic ducts by hyperplastic nodules that lead to urinary and prostatic calculus formation, recurrent urinary tract infections, and prostatitis [21].

Lin and associates [14] reported that:
1. 1/2 of all prostatic calculi (51.6%) were mixed-type stones
2. Increasing the weight of the resected prostatic stones
3. Neither serum PSA level, nor urine WBC count was associated with prostatic calculus formation or prostatic calculus-induced prostatitis.
4. A proportion of patients with prostatic calculi (9.6%-19.3%) had previous urinary tract calculus formation.

Song-Woo Park and associates [22] determined the correlation between prostatic calculi and lower urinary tract symptoms (LUTS), as well as the predisposing factors of prostatic calculi. Of the 1 527 patients who presented at their clinic for LUTS, 802 underwent complete evaluations, including trans-rectal ultrasound scans, voided bladder-3 specimen and international prostatic symptoms score (IPSS). A total of 335 patients with prostatic calculi and 467 patients without prostatic calculi were divided into calcui and no calcui groups, respectively. Predictive factors of severe LUTS and prostatic calculi were determined using univariate / multivariate analyses. The overall IPSS score was 15.7 ± 9.2 and 14.1 ± 9.2 in the calciui and no calcui group, respectively (P = 0.013). The maximum flow rate was 12.1 ± 6.9 and 14.2 ± 8.2 mL s\(^{-1}\) in the calciui and no calcui group, respectively (P = 0.003). On univariate analysis for predicting factors of severe LUTS, differences on age (P = 0.042), prostatic calculi (P = 0.048) and prostatitis (P = 0.018) were statistically significant. However, on multivariate analysis, no factor was significant. On multivariate analysis for predisposing factors of prostatic calculi, differences on age (P < 0.001) and prostate volume (P = 0.001) were significant. To our knowledge, patients who have prostatic calculi complain of more severe LUTS. However, prostatic calculi were not an independent predictive factor of severe LUTS. They concluded that, men with prostatic calculi have more severe LUTS not only because of prostatic calculi but also because of age and other factors. In addition, old age and large prostate volume are independent predisposing factors for prostatic calculi.

Sung-Woo Park and associates [22] stated that: prostatic calculi are commonly diagnosed by trans-rectal ultrasound scan. However, it is unknown whether prostatic calculi are clinically insignificant or whether they have the potential to cause symptoms,
especially LUTS. They sought to determine whether prostatic calculi are an independent predictive factor for LUTS and predisposing factors for prostatic calculi.

There may be different incidences of prostatic calculi with diverse definition and community. Kovi and associates [23] in one autopsy study reported that the incidence was 70.1% and 29.1% in Black men from Washington, DC, and from Ibadan, Nigeria and Accra, Ghana, respectively. Kovi and associates [23] suggested that dietary pattern and age were important factors for the determination of the incidence of prostatic calculi.

Sung-Woo Park and associates [22] showed prostatic calculi in 41.8% of men who complained of lower urinary tract symptoms. Sung-Woo Park and associates [22] suggested that these differences may emerge because of selection bias and may obscure the definition of prostatic calculi. Sung-Woo Park and associates [22] also stated that the definition and classification of prostatic calculi were not unified. In the study of Sung-Woo Park and associates [22], prostatic calculi were diagnosed by the finding of hyper-echoic areas with shadowing and larger than 3 mm in size. Moore [24] stipulated that prostatic calculi could be divided into larger and smaller calculi on the basis of formation theories and histopathological characteristics. Geramoutsous [3] stated that the symptoms associated with prostatic calculi are strongly correlated with the larger-sized calculi.

Anderson and associates [25] stated that the first clinical reports of prostatic calculi associated with symptoms of urinary tract obstruction were published in the late eighteen hundreds (1800s). Pursuant to these reports, most of the studies have suggested that prostatic calculi are related to non-specific lower urinary tract symptoms [3], [6]. The effects of prostatic calculi on LUTS are unclear however, several explanations may be postulated. Some of these postulates include [22]:

1. Prostatic calculi probably influence a relaxation of the prostatic urethra and thus interfere with the urinary stream. There is a likelihood of a more significant effect on relaxation of the prostatic urethra in peri-urethral calculi than in scattered stromal calculi.
2. Another mechanism underlying LUTS is spasm of pelvic floor muscles [6]. Men with prostatic calculi had more severe irritative symptoms and voiding symptoms in our study (these results were not described). This observation suggests that prostatic calculi induce not only mechanical obstruction but also smooth muscle contraction.

The other problematic consideration to address in relation to prostatic calculi is when to treat prostatic calculi. Some authors [6], [26], recommend that if there are no complications due to prostatic calculi, periodic follow-up is sufficient [19]. Patients who have intractable infection or prostatic calculi protruding to prostatic urethra causing urinary retention may be treated by transurethral removal, which offers relief, but does not guarantee the removal of all calculi or eliminate the possibility of new calculus formation. If removal of calculi is deemed necessary, a transurethral removal is the procedure of choice in younger patients in order to preserve sexual function. In older patients, open prostatolithotomy may be performed for a single large stone or large cluster of stones [26].

The predisposing factor of prostatic calculi is not clear. Klimas and associates [6] as well as Søndergaard and associates [27] suggested that (The general acceptance is that) prostatic calculi are a consequence of aging in older men [19]. The study of Sung-Woo Park [22] also supported that age is a significant predictive factor for prostatic calculi. On univariate and multivariate analyses performed for possible risk factors of prostatic calculi, age and prostate volume were significant. Therefore, age and prostate volume should be considered as independent predisposing factors for prostatic calculi.

However, Sung-Woo Park and associates [22] did not show that prostatitis causes prostatic calculi. The role of prostatic calculi in the aetiology and symptoms of chronic prostatitis and chronic pelvic pain syndrome (CPPS) has been more actively studied. Recently, studies by Shoskes and associates [28], [29] have suggested that prostatic calculi are common in patients with CPPS and are associated with greater inflammation and symptoms [3]. Their studies showed a significant difference in the duration of pelvic pain between prostatic calculi and non-calculi groups, but did not show a significant difference in the WBC count in the prostatic fluid. Ludwig and associates [20] concluded from their study of patients with chronic prostatitis who had undergone trans-rectal ultrasound scan of prostate that prostatic calculi are typical signs of inflammation, but these sonographic abnormalities do not prove the presence of chronic prostatitis. The study of Sung-Woo Park and associates [22] did not show a difference in the WBC count in VB3 between the prostatic calculi and no calculi groups. They defined prostatitis as > 10 WBC and/or positive culture...
in VB3. Sung-Woo Park and associates [22] did not examine the symptoms of prostatitis by means of a questionnaire. They defined only chronic bacterial prostatitis and chronic nonbacterial prostatitis, except CPPS, as prostatitis. However, one cannot exclude inflammation in the gland simply on the basis of the absence of leukocytes in prostatic secretions. These definitions of prostatitis are inevitable limitations in these kinds of studies.

In the study of Sung-Woo Park and associates [22], men with a normal PSA and DRE did not undergo a biopsy. Although there was the potential for a missed diagnosis of prostate cancer, justifying a biopsy in the setting of a normal PSA and DRE is difficult. Thus, additional histological studies are needed to confirm such suspicions. Other studies had failed to find a relationship between prostate cancer and prostatic calculi, concluding that prostatic stromal calculi are a dystrophic, inflammation-mediated, benign process [30], [31].

Toyoshima and associates [32] reported a 37-year-old man who had sustained a lumbar vertebral fracture and who presented with the main complaint of high fever and leakage of urine from his perineal region. Computed tomography scan and urethroscopy showed a huge prostatic urethral calculus. He had a urethra-cutaneous fistula in the perineal region. Trans-vesical prostate-urethrolithotomy, debridement of the perineal abscess and cystostomy were performed. After the operation he developed total incontinence when the cystostomy was clamped. Four months later, ileal conduit and simple cystectomy were performed to improve urinary management.

Dessombz and associates [33] revisited the chemical diversity of the crystalline phases of prostatic calculi by means of SEM and FT-IR analysis by studying a set of 32 prostatic calculi. FT-IR analysis had determined the chemical composition of each prostatic calculus. The SEM observation had described the morphology of the calculus surfaces and layers. Infra-red analysis revealed that 90.7% of the stones were mainly composed of calcium phosphates. But several mineral phases not previously reported, in prostatic calculi were observed, as brushite or octocalcium phosphate pentahydrate. They concluded that: prostatic calculi exhibited a diversity of crystalline composition and morphology; as previously reported for urinary calculi, relationships between composition and morphology of prostatic stones and etiopathogenic conditions could be of interest in clinical practice.

Chen and associates [34] explored the relationship chronic prostatitis (CP) and prostatic calculus (PC). They used trans-perineal ultrasonography (TPUS) to detect prostatic calculus (PC) in 500 normal volunteers and 491 chronic prostatitis (CP) patients and divided them into a CP and CP + PC group according to the ultrasonic results. They then analyzed the NIH-CPSI scores, duration of symptoms, and white blood cell count in the expressed prostate secretion (ESP). They obtained the following results:

PC was found in 19.8% of the normal controls, 5% (5/100), 12% (12/100), 19% (19/100), 27% (27/100), and 36% (36/100) in the 20-30 year, 31-40 year, 41-50 year, 51-60 year, and > 60 year groups respectively. In comparison, PC was detected in 42.2% of the CP patients, 15.8% (12/76), 30.1% (61/215), 55.7% (59/109), 66.2% (43/65), 82.8% (24/29), in the aforementioned five age-groups respectively, with statistically significant differences between the control and CP groups (P < 0.01). The CP and CP + PC groups showed significant differences in the duration of symptoms and white blood cell count in ESP (P < 0.01) but not in CPSI scores (P < 0.05).

They concluded that the incidence of PC is higher in CP patients than in healthy men and is associated with inflammation, aging, symptom duration, but not with CPSI scores. Song and associates [35] tested the composition tested the composition, morphology and structure of enlarged prostatic utricle (EPU) stones, which as a kind of biolite in abnormal anatomical structures of the genitor-urinary, had not been reported. They reported that 31 EPU stones coming from 8 patients, who had been treated in their institution from 1985 to 2009, were taken out by trans-urethral fenestration of EPU and were analyzed by scanning electron microscopy, X-ray Diffraction (XRD) analysis, and Fourier transformation infra-red spectral (FTIS) analysis. Under scanning electron microscopy, all the EPU calculi were seen to be constituted of many intensive mini-crystals and amorphous matrix. By means of XRD and FTIS, Song and associates [35] determined that the 31 EPU stones were hydroxyapatite crystal. They considered that EPU calculi should belong to the category of prostatic pseudo-calculi and that the formation of EPU calculi is not caused by abnormal change of urine composition, but should be ascribed to continuously concentrated EPU liquid by absorption of capsule walls and calculous matrix mainly from deciduous epithelial cells of EPUDs. They concluded that the role of the amorphous matrix is to link micro-crystals, which promotes the growth of EPU stones.
Hsu and associates [36] stated that awareness of the chemical composition of prostatic calculi is of great importance for the pathogenesis of prostatic lithiasis. Hsu and associates [36] evaluated the feasibility of FTIR micro-spectroscopic mapping system used for rapidly screening and detecting of the real composited components of prostatic calculi in a short time. They retrieved prostatic calculi during trans-urethral resection of prostate in nine patients diagnosed as having benign prostatic hyperplasia and lower urinary tract symptoms. The level of serum PSA in these patients was between 0 and 12.63 nanograms per millilitre. The calculi samples were examined and compared using FTIR micro-spectroscopic mapping system, or the traditional FTIR and Raman micro-spectroscopies. The FTIR traditional microspectroscopic results indicated nine calculi samples mainly consisted of carbonated HA (hydroxyapatite), but calcium oxalate (undifferentiated) might also be detected in some samples. Nevertheless, Raman spectral results could detect three components, HA, COM (calcium oxalate monohydrate), or COD (calcium oxalate dihydrate) separated in nine samples. Different compositions in the prostatic calculi were obtained by both spectroscopic detections with manual single-point random analysis implying that both manually traditional methods failed to provide the real chemical composition of the prostatic calculi in a short time. The FTIR microscopic mapping system via point-by-point analysis evidenced that it could rapidly detect all the complicated components distributed the prostatic calculi rather than uncertain components detected by traditional FTIR or Raman microscopy. They concluded that this preliminary result would suggest that the FTIR mapping better characterizes the stone composition over single-point FTIR and Raman microscopic analysis in prostatic calculi. They recommended that more studies should be carried out in the future.

Hasegawa and associates [37] stated that prostatic calculi are classified into two types, endogenous and exogenous calculi. They also stated that endogenous prostatic calculi are observed in elderly men nevertheless, exogenous prostatic calculi are extremely rare. Hasegawa and associates [37] reported the case of a 51-year-old man who suffered incontinence and pollakiuria with a large exogenous prostatic calculus almost completely replacing the prostatic tissue. X-rays and computed tomography scans demonstrated a large calculus of 65 mm x 58 mm in the small pelvic cavity. The patient underwent trans-urethral lithotripsy with holmium-YAG laser and a total of 85 grams of disintegrated stone was retrieved and chemical stone analysis revealed the presence of magnesium ammonium phosphate. The incontinence improved and the voiding volume increased dramatically. In addition there was no evidence of any recurrent prostatic calculus over a period of 2-years follow-up. They stipulated that the aetiology this stone formation seemed to be based on some exogenous pathways combined with urinary stasis and chronic urinary infection due to compression fracture of the lumbar vertebra.

Conclusions

Prostatic calculi quite often are asymptomatic. Prostatic calculi may also co-exist with prostatitis or benign prostatic hyperplasia (BPH) in elderly men. These patients suffer LUTS for underlying prostatic disease, such as prostatitis or BPH. It is unclear whether prostatic calculi independently produce LUTS. Recurrences of prostatic calculi may be observed after treatment of prostatic calculi for a number of reasons. Plain radiographs or ultrasound scans should be performed post-operatively to ensure there are no residual stones before the patients are discharged.

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