

## Avicenna's *Canon of Medicine* and Modern Urology Part III: Other Bladder Diseases

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In the third part of this article on Avicenna's *Canon of Medicine*, diseases of the bladder other than bladder calculus are reviewed. Avicenna covers topic on bladder infection, pelvic abscess, urethritis, cystitis, prostatitis, bladder tumors, bladder dysfunction, urinary retention, and neurogenic bladder. The interesting point is that 10 centuries ago, Avicenna had described almost all diseases of the bladder. Avicenna's *Canon of Medicine* is a comprehensive book on semiology of bladder diseases. His approach to diagnoses complies with the modern methodology, and even in some interventions such as routes of drug administration and catheterization, his points are astonishing.

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### INTRODUCTION

Avicenna has had a great influence on the medical knowledge of the world by writing the *Canon of Medicine*. In the previous two parts of these articles, I reviewed chapters of Avicenna's book on bladder anatomy and diseases with modern urological findings.<sup>(1,2)</sup> In this part of these article series, review of book III, part 19 is completed by covering chapters 7 to 15 which are on bladder inflammation, infections, tumors, and neurogenic bladder.

### MATERIALS AND METHODS

This study is the comparison of modern urology with the urological chapters of Avicenna's *Canon of Medicine*. I used *the Canon* in its original language (Arabic),<sup>(3)</sup> along with its Persian translation.<sup>(4)</sup>

Part 19 of the 3rd book contains subjects related to a vast range of bladder diseases such as tumors, infection, and bladder dysfunction.

I compared the text to the current urological findings. Selected topics from *the Canon* are presented and a brief discussion follows each subject. A translation from the Arabic version and comparison with the Persian translation was done to present an accurate text.

The domain of traditional and herbal medicine in Avicenna's book was skipped here. These subjects were beyond the aim of this paper, and I was only engaged to the items that the current modern medicine obviously and clearly proceeds with them. It should be noted that this paper is a revised version of an article by the author in Persian which was published in the *Iranian Journal of Urology* in 1996.<sup>(5)</sup>

### DISCUSSION

#### Book III, Part 19, Treatise 1, Chapter 7

"Warm inflammation and Abscess

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in Bladder” is the title of this chapter, which is on bladder infection:

*Less frequently, there is warm inflammation in the bladder that is accompanied by the excretion of blood,... . This often affects children, but it can affect adults too. Bladder calculus can cause this condition. Calculus scratches the bladder and leads to pain and warm inflammation.*

*Its signs are fever, urinary retention or difficult voiding, and urinary dribbling. The patient cannot void in the flank position and only amount of urine is excreted in the standing position. Occasionally, the concentrated urine may be trapped in the bladder. There is inflammation in the flank and suprapubic area. There is pain in the flank area that is similar to needle insertion. It is sometimes throbbing accompanied by redness in the perirenal area. Another sign is that pain is alleviated if you bandage the area.*

*Symptoms of warm inflammation in bladder are: (1) severe thirst, (2) vomiting of bile, (3) dyspnea similar to that of asthma, (4) cold extremities, (5) delirium, (6) blackness of tongue, (7) worsening of disease by any astringent and diuretic food, and (8) relation of the disease and the patient's age. The worst signs of warm inflammation in the bladder are severe persistent fever, retention of urine, fecal impaction, severe constipation, and worsening pain.... If warm inflammation of the bladder converts to abscess, it is much more dangerous, but if urinary sediment of the patient is clear, there is hope of recovery. Otherwise, cloudy sediment is a sign of patient's death.*

*In bladder abscess, there are several types of rigor, various types of fevers, and signs similar to those described for kidney abscess. If the abscess bursts into the bladder, its sign is the pus that passes through urine. If the abscess ... does not burst, the patient dies in 1 week. Discharges of bladder in abscess often appear in bladder neck and occasionally may flood to other surrounding tissues. Bladder abscess can be opened and drip its content to the abdominal cavity or places other than the abdomen.<sup>(3,4)</sup>*

**Discussion 1.** Warm inflammation and abscess in the bladder to which Avicenna points is

indeed severe bacterial infection of the bladder, pyovesica, and prostatic abscess. Bladder infection itself is a frequent disease that is prevalent, especially in women. Pyovesica, however, is relatively rare and is often secondary to infravesical obstruction. It is especially associated with diabetes mellitus, chronic kidney failure, and immunocompromised conditions. This is now obvious that urethral instrumentation, chronic indwelling catheter, foreign bodies, and bladder calculi can aggravate bladder inflammation. In the ancient area with no antibiotics, it can be anticipated that the prevalence of bacterial infection of the low urogenital tract had been higher than that in the modern area.<sup>(6)</sup>

**Discussion 2.** The symptoms and signs that Avicenna lists in his book are fever, urinary retention, difficult voiding, dribbling, and concentrated urine. He describes signs of kidney abscess including inflammation in the flank and redness of that area due to renal or perirenal abscess, and signs of urinary retention, such as suprapubic bulging, that are a predisposing factor of pyovesica. Bulging of the suprapubic area as the sign of paravesical and prostatic abscess can lead to septicemia and septic shock. In the final stage, there is coldness of the extremities, confusion, cyanosis, vomiting, and acute respiratory distress syndrome with associated symptoms such as dyspnea.

Severe thirst can be a symptom of hypotension and early stages of septic shock. Also, diabetes mellitus that induces thirst is a predisposing factor for severe urinary tract infection and abscess. Neurogenic bladder due to diabetes mellitus can be another predisposing factor for urinary tract infection in these patients. Fever and rigor can be induced in the presence of perivesical abscess, pyovesica, and prostatic, renal, or perirenal abscess.<sup>(6)</sup>

**Discussion 3.** Bladder perforation can be induced by multiple causes. One of them which is the most frequent is trauma.<sup>(7)</sup> Occasionally, spontaneous perforation of the bladder is induced in some diseases such as bladder cancer or thinning of the bladder wall due to any causes.<sup>(7)</sup> Perforation of the bladder, as Avicenna states here, can be intraperitoneal or extraperitoneal,<sup>(7)</sup>

and if it is associated with purulent urine, it can induce infectious peritonitis or perivesical abscess.

### Book III, Part 19, Treatise 1, Chapter 8

In this chapter, named “Management of Bladder Inflammation,” Avicenna first describes some of the therapeutic methods which are outdated and I have to pass them aside. Then, he points to 4 of the important therapeutic methods that he uses for bladder inflammation in addition to oral drugs.

*In early stages of the disease, inject these drugs transurethraally into the bladder by a hollow cylindrical instrument, if the patient can tolerate [drugs list is omitted here]. If the pain of the inflamed bladder aggravates to a severe level that could induce [shock and] death, you must prescribe narcotics. You can prescribe it locally by rubbing onto the skin over the bladder or inject it into the bladder. You should know that asking the patient to sit in sitz bath is always useful even if the patient wants to void in the water. Let the patient do this because it is therapeutic and useful. There are some solutions that are compatible and useful for patients with bladder inflammation. There are solutions that are mixed with various drugs. And this method relieves the pain due to inflammation. You must dissolve these drugs in water and soak a handkerchief in it until the handkerchief absorbs the drug, and then, insert the handkerchief into the patient's anus until he pain is alleviated. The patient will immediately sleep. In this stage, if the patient tolerates, inject some of these narcotics through penile urethra with a hollow cylindrical instrument into the bladder. At this time, if you rub the narcotics on the patient's bladder topically you can boost the effects of these drugs.<sup>(3,4)</sup>*

**Discussion 1.** In this chapter, Avicenna points out to 4 important routes of drug administration in bladder disease: (1) transurethral injection of drugs by a hollow instrument, (2) rubbing the drug onto the skin over the bladder or topical administration of drugs, (3) sitting the patient in sitz bath, and (4) transrectal administration of analgesics.

It is notable how Avicenna was familiar with

intravesical drug injection. Today in modern urology, this method is prescribed in the local treatment superficial transitional cell carcinoma of the bladder.<sup>(8)</sup> Also, some drugs are prescribed by this method in the treatment of interstitial cystitis.<sup>(9)</sup> Avicenna also names local drug therapy that is the cornerstone of *iontophoresis* in drug prescription.<sup>(10)</sup> Iontophoresis is a noninvasive method of propelling high concentrations of a charged substance, medications, or bioactive agents transdermally by repulsive electromotive forces using a small electrical charge. Today it can be used in Peyronie's disease.<sup>(10)</sup> Another interesting point is Avicenna's indication of the use of sitz bath in some disease. In modern urology, hot sitz bath is used for the treatment of some disorders such as amicrobic cystitis and chronic prostatitis.<sup>(11)</sup> Finally, Avicenna points to rectal route of drug administration. This is astonishing that he was familiar to all of these methods of drug administration.

**Discussion 2.** Today, urologists prescribe anticholinergics, acetaminophen, nonsteroidal anti-inflammatory drugs, antidepressants, and selective bladder analgesics such as phenazopridine for bladder pain. In case of severe and intolerable pain, especially in inoperable high-grade and high-stage bladder tumors and even in chronic painful bladder syndrome, opiates are prescribed orally or parenterally.<sup>(9)</sup>

### Book III, Part 19, Treatise 1, Chapter 9

Avicenna describes a second type of bladder inflammation in this chapter entitled “Hard Inflammation in Bladder”:

*Causes of hard inflammation in the bladder are the same as causes of hard inflammation in the kidney, which are often induced by heat, trauma, and falling down to the ground on the suprapubic area. Occasionally, it is a complication of bladder surgery. Hard inflammation in the bladder has distinctive signs by which it can be diagnosed; (1) difficult voiding and difficult defecation is seen; (2) some signs and symptoms of hard inflammation of the kidney such as fecal retention, numbness of the lower leg, confusion, and debility are present (sometimes hard inflammation of bladder can lead to dropsy*

[estesga in Arabic]); (3) it has less severe symptoms in comparison with hard inflammation of the kidney; (4) the site of inflammation is compatible with the bladder location and not the kidneys (bladder inflammation is in the bladder in which the urine accumulates); and (5) the pain and other signs in hard inflammation of the bladder begins from a site more inferior than those of the kidneys.

Management of hard inflammation in the bladder is the same as that of the kidneys: (1) some ointments must be rubbed on suprapubic area; (2) drinking solutions that are combined with diuretic herbal seeds is recommended; (3) sitz bath is useful the same as in hard inflammation of the kidney; and (4) catheters [gasathir in Arabic] should be used. The latter are instruments by which drugs are injected from down to up. This treatment is specific for bladder inflammation, and in this method, the therapeutic drugs and solutions are injected into the bladder.<sup>(2,3)</sup>

**Discussion.** Apparently, hard inflammation of the bladder is chronic cystitis and chronic prostatitis, and Avicenna prescribes the above mentioned methods for treatment of these disorders.

### Book III, Part 19, Treatise 1, Chapter 10

This chapter is on bladder ulcers:

*Causes of bladder ulcer are probably the same as the causes of kidney ulcers. Bladder ulcer is often due to abrasion and desquamation induced by calculi. It is probable that there had already been inflammation in the bladder that has burst or there had been a boil that has become purulent and ultimately converted into ulcer. If a person has severely astringent urine for a long time, it can induce bladder ulcer. Management of bladder ulcer is more difficult than management of kidney ulcer because the bladder has been created from fibrous tissue. Curability of the ulcers originated from fibrous tissue is more difficult than of ulcers originated from fleshy material. In these patients, if the bladder is perforated or torn, death is the most probable event. During surgery, if some parts of the bladder tear, they will not heal except in states that the scalpel hits to fleshy part of bladder during operation in which state it*

*may be cured.*

*Bladder ulcer symptoms : Bladder ulcer can induce urinary retention or difficult urination and suprapubic and flank pain. In bladder ulcer, whitish scales are excreted in urine. If large, their origin is from bladder ulcer and if small, their origin is from ureteral ulcer. Bladder ulcer can be mutilating type and we discussed them in chapter on kidney ulcer. Symptoms of bladder ulcer are the same as symptoms of kidney ulcer and include blood in urine, pus in urine, frequency, and intermittency. Also signs of bladder and kidney ulcers are similar and include signs of inflammation or mass, mutilation [khoreh in Persian], and bladder cracking and perforation.<sup>(3,4)</sup>*

**Discussion 1.** Studying the Avicenna's descriptions in this chapter and the chapter of kidney ulcer reveals that bladder ulcer in the Canon means bladder cancer or malignancy. In the chapter of kidney ulcer, he specifies that kidney ulcer is malignant, but its malignancy is less severe than the malignancy of bladder and ureteral ulcers. He accurately discusses their signs.<sup>(3)</sup>

**Discussion 2.** Bladder and renal pelvis malignancies both have a same origin and a same etiology as Avicenna mentions. Bladder and renal pelvis urothelial chronic injury and irritation by calculi and chronic infection can be a predisposing factor of cancer in these organs, especially of squamous cell carcinoma of the bladder. Avicenna points to the role of bladder calculi in bladder carcinoma. Today, carcinogenic agents in urine, of course are the most important factors in the industrialized era (not at Avicenna's era) in the etiology of bladder cancer.<sup>(12)</sup>

**Discussion 3.** Avicenna, at the end of this chapter, describes 3 types of bladder cancer: inflammatory (mass and association with stone), mutilating (infiltrative), and ulcerative (perforative). Today there is no place for perforative bladder cancer in its classification, but bladder cancer can be a cause of spontaneous perforation of the bladder,<sup>(7)</sup> to which Avicenna points, too. In the Canon's classification of bladder cancer, Avicenna indicates the 2 major types of bladder cancer: papillary (exophytic) and infiltrative ulcerative or sessile types.<sup>(13)</sup>

**Discussion 4.** Avicenna discusses one important issue: postoperative urinary fistula. This complication, which rarely occurs today, is induced by unhealed bladder tissue and it can even cause tumoral tract and extension of tumor to the abdominal wall. Today in bladder cancer operations, the urologist must try as far as possible, not to insert cystostomy tube to prevent this complication.<sup>(14)</sup>

**Discussion 5.** Avicenna points to urinary retention and difficult urination as signs of bladder cancer. These signs are prevalent in tumors near the bladder neck. He also points to suprapubic and flank pain. Flank pain can be induced by ureteral obstruction and hydronephrosis due to bladder tumor.<sup>(12)</sup>

**Discussion 6.** Excretion of whitish scales in urine to which Avicenna points can in fact be necrotic papillary particles in cauliflower bladder tumors. Cancerous cells in urine was the basis of modern oncurological cytology and flowcytometric techniques.<sup>(12)</sup>

**Discussion 7.** Avicenna indicates astringent urine in ulcers. Painful bladder syndrome/interstitial cystitis—named at times as a pseudonym Hunner's ulcer—can be induced by urinary abnormalities. This theory, which is similar to astringent urine theory of Avicenna in bladder ulcer, is based on toxicity of interstitial cystitis urine.<sup>(11)</sup>

### Book III, Part 19, Treatise 1, Chapter 11

Chapter 11 of the *Canon of Medicine* is on bladder pustules or desquamation [*Jarab* in Arabic]:

*When a patient has dysuria, malodorous urine, severe suprapubic pain, itching around the bladder, and bran-like urinary sediment, the diagnosis is bladder pustules. The purulent material due to inflammation can induce bladder pustules. In this disorder, the patient urinates blood instead of urine occasionally.*<sup>(3,4)</sup>

**Discussion.** In this chapter, Avicenna does not give us additional information about pustules. By studying this disease in other organs such as the kidney in the *Canon*, we suppose that the bladder pustules is in fact urethritis.

### Book III, Part 19, Treatise 1, Chapter 12

Chapter 12 is on blood coagulation (clotting) [*jomoud dod dam* in Arabic] in the bladder:

*Occasionally, blood can be clotted in the bladder and remain there in coagulated form. Symptoms of blood clotting in the bladder are: (1) the patient is severely depressed; (2) sometimes, the patient faints; (3) on palpation, the extremities are cold; (4) the patient has short respirations; (5) the patient's pulse is weak and rapid; (6) the patient has cold perspiration; (7) the patient has nausea; (8) sometimes, hematuria and fever or rigor are seen; (9) sometimes, blood clots in the bladder after trauma due to direct hit to the bladder or falling down on the bladder.*<sup>(3,4)</sup>

**Discussion 1.** Please note that how accurate is Avicenna's description of intravesical hematoma and signs or symptoms of hemorrhagic and septic chock due to hematoma. His notes are comparable to the modern medicine. Avicenna describes shock and its signs such as restlessness, depression of body functions, tachypnea, hypoperfusion of the extremities and coldness, accelerated pulse, and cold perspiration.<sup>(15)</sup>

**Discussion 2.** Severe hematoma is one of the predisposing factors of urinary tract infection and septicemia, especially with urinary tract manipulation and catheterization. Today, this complication has been reduced by antibiotics and aseptic manipulation and surgical techniques.

**Discussion 3.** Avicenna points out to one of the causes of bladder hematoma, ie, bladder and urethral trauma and 2 mechanisms of injury: direct hit to the bladder and straddle injury.<sup>(16)</sup>

### Book III, Part 19, Treatise 1, Chapter 13

This chapter of the book is on neurogenic bladder using the terms "bladder luxation or displacement" and "laxity"[*esterkha* in Arabic]:

*Bladder displacement or descending is a state in which the bladder moves or descends from its natural anatomic place. Bladder laxity is a state in which urine rushes without patient's willing and control. One of the causes of descended bladder is trauma to back. Sometimes bladder displacement or bladder laxity causes difficult*

*voiding or dribbling, depending to the condition of the muscle that can be extended and dilated. If displacement of the bladder is due to back trauma, its treatment is difficult. Bladder displacement or laxity can be due to paralysis or convulsion.*<sup>(3,4)</sup>

**Discussion.** It is noteworthy that how Avicenna briefly points to neurogenic bladder and its two spastic and flaccid types. Spinal cord injury is a frequent cause of neurogenic bladder that, especially in modern era, is due to car accidents. Difficult voiding, frequency, dribbling, and urinary incontinence occur in this situation. Convulsion, especially due to space occupying lesions and also diseases that cause paralysis (eg, cerebrovascular accident), can induce neurogenic bladder and voiding symptoms, too. Avicenna knew these etiologies 10 centuries ago.<sup>(17)</sup> Neurogenic bladder is one of the main complicated urological diseases in modern urology that despite all advances, its therapeutic methods are controversial, yet.

### Book III, Part 19, Treatise 1, Chapter 14

Interestingly, Avicenna reviews all causes of pain in the bladder area [oojaol mathana in arabic] after all chapters on specific bladder diseases:

*Bladder pain can be due to one of the causes listed below: (1) abnormal temperament, (2) bladder calculus, (3) bladder ulcer, (4) bladder pustules, (5) inflammation, (6) wind or gas, and (7) other disorders that affect the bladder. Bladder pain often occurs in seasons with northern wind blowing.*

Then Avicenna discusses a case report about pain in the bladder area:

*It is said that if a patient has bladder pain and after several days, a mass grows in his left subaxillary area and he will die after 15 days, especially if after growing the subaxillary mass, he has lethargy. In this situation, death is indispensable.*<sup>(3,4)</sup>

**Discussion.** As you note in this chapter, Avicenna reviews some vesical causes of suprapubic pain. The most prevalent of them is cystitis (or bladder inflammation as Avicenna cites). Also, Avicenna indicates some other main

causes of pain including bladder calculi, bladder tumors (or bladder ulcer as Avicenna cites), and urethritis (or bladder pustules as Avicenna cites).

### Book III, Part 19, Treatise 1, Chapter 15

Chapter 15 is named “Bladder Weakness”:

*Bladder can become weak due to abnormal temperament, hard inflammation, bladder laxity, or bladder displacement. Cold weather is a cause too. Bladder weakness may be so severe that it cannot tolerate excessive urine, and thus, it expels it out. The bladder muscle can be so weak that it cannot expel the urine out. In these two conditions that both bladder and its muscles are weak, occasionally but not frequently and not regularly, there may be dribbling.*<sup>(3,4)</sup>

**Discussion.** As you notice, Avicenna points to bladder dysfunction and atony, the most important cause of which is neurogenic bladder. Two important progressive stage of this condition to which Avicenna points are overflow incontinence and urinary retention. In overflow incontinence, as Avicenna cites, the bladder weakness is severe, but it can expel the urine out. However, in the final stage, as he cites, the bladder muscle is so weak that it cannot expel the urine out. Especially in the first stage (overflow incontinence), there is urinary dribbling as he indicates.

## CONCLUSION

Ten centuries ago, Avicenna had described almost all diseases of the bladder. Although treatment methods and medications had not been developed enough, Avicenna's *Canon of Medicine* is a comprehensive book on semiology. His approach to diagnosis complies with the modern methodology, and even in some interventions such as routes of drug administration and catheterization, his points are astonishing.

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