

Rhazes, a Genius Physician in Diagnosis and Treatment of Kidney Calculi in Medical History

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Keywords. Rhazes, medieval
history, Iran, urine, urinary
calculi

Abu Bakr Mohammad Ibn Zakariya Razi, known in the west as Rhazes (865 to 925 AD), was born in the ancient city of Rayy, near Tehran, Iran. He was a renowned physician in medical history and not only followed Hippocrates and Galen, but also greatly extended the analytical approach of his predecessors. Based on the existing documents, he was known as the most distinguished character in the world of medicine up to the 17th century. A great number of innovations and pioneering works in the medical science have been recorded in the name of Rhazes. His fundamental works in urology as part of his research in the realm of medicine have remained unknown. Pathophysiology of the urinary tract, venereal diseases, and kidney and bladder calculi are among his main interests in this field. He also purposed and developed methods for diagnosis and treatment of kidney calculi for the first time in medical history. He also presented a very exact and precise description of neuropathic bladder followed by vertebral fracture. He advanced urine analysis and studied function and diseases of the kidneys. Rhazes recommendations for the prevention of calculi are quite scientific and practical and in accordance with current recommendations to avoid hypercalciuria and increased saturation of urine. Rhazes was not only one of the most important Persian physician-philosophers of his era, but for centuries, his writings became fundamental teaching texts in European medical schools. Some important aspects of his contributions to medicine are reviewed.

IJKD 2010;4:106-10
www.ijkd.org

INTRODUCTION

Abu Bakr Muhammad Ibn Zakariya Razi was born in Rayy, a town on the southern slopes of Alborz mountains near the present-day Tehran, Iran, in 865 AD (251 Hegira). He was first interested in music but later studied chemistry and philosophy. Due to an eye irritation caused by chemicals he was experimenting with, he stopped his experiments in *alchemy* at the age of 30 years. By then, he was credited for the discovery of sulfuric acid and ethanol. There is a debate between historians as to where and from whom Rhazes gained his

medical knowledge, but both Jamal Al-din Al Ghefti and Ibn Abi Usaibia have mentioned that his teacher was Ali Ibn Rabban Tabari, which is almost certainly incorrect, as Tabari died at 861 AD (247 AH), while Rhazes was not born until 865 AD (251 AH). It is possible, however, that Rhazes had studied Tabari's medical texts (such as *Ferdows Al-Hakameh*), and thus, he had referred to him as his teacher of medicine.¹ Rhazes was quite generous and charitable with his patients, treating them humanely and free of charge. Unfortunately, because of cataract, he became blind in his latter

years and died in his hometown on October 27, 925 AD at the age of 60 years.

He wrote more than 224 books on various subjects, but his most renowned manuscript was the medical encyclopedia, *Al-Hawi fi al-Tibb*, known in Europe as *Liber Continens*. It was a compilation of Greek and Roman medicine, his own clinical observations and case studies, and his personal medical practice. Rhazes extensively exploited case histories, as an educational aid, for the documentation of different diseases he diagnosed and treated.²

RHAZES AND KIDNEY DISEASES

Rhazes insight into the concept of kidney diseases can be perceived from his writings. He described renal abscess or severe pyelonephritis as follows³:

Case I: *Abdullah ubn Sawada used to suffer from attacks of mixed fever which overtook him some times every 6 days, sometimes like a tertian, quartan, or quotidian. They were preceded by a slight rigor, and micturition was very frequent. I gave it as my opinion that either these accesses of fever would turn into quartan, or that there was an abscess [khuraj] of the kidneys. Only a short while elapsed before the patient passed pus in his urine; I informed him that these feverish attacks would not recur, and so it was. The only things that prevented me at first from giving it as my definite opinion that the patient was suffering from an abscess of the kidney was that he had previously suffered from tertian and other types of fevers, and in this the [my] opinion that this mixed fever might be due to inflammatory processes, which would tend to become quartan, was strongly supported. Moreover, the patient did not complain to me that he felt in his loins, when standing, as it were a weight hanging from him, and neglected to ask him about this. The frequency of micturition should have strengthened my suspicion about an abscess in the kidneys, except that I was unaware of the fact that his father suffered from weakness of the bladder and was subject to his complaint, and that he, himself, had suffered from it when he was healthy. It is, therefore, our duty to avoid lack of solicitude with the utmost care—if Allah will!*

That the abscess was small was indicated to me by the fact that he did not complain to me at first of a weight in his loins. After he had passed pus, however, I inquired of him weather he had experienced this symptom, and he replied in the affirmative. Had the abscess been extensive, he would of his own accord

*have complained of this symptom; and the rapid evacuation of the pus showed the small volume of the abscess. Other physicians, however, (whom he consulted beside me) did not understand his case at all, even after the patient had pus in his urine.*³

Rhazes advanced clinical judgment can be appreciated by his differential diagnosis for kidney calculi mentioned in *Al-Kinnash al-Fakhir (Glorious Compendium)*³:

*The kidneys can have stones and their pain resembles this pain of the colon and these two must be differentiated. Pain in the loin, sediment in the urine or the passage of stone, black urine passed with pain several months before denote stone pain. If there is nausea or the pain follows a meal or is located in the abdomen and more to the front than the back, then it is more likely to be colonic pain. The site of the pain is important: in abdominal colic, the pain is more generalized and tends to be anterior, while in kidney stones, the pain is more limited and tends to be in the back.*³

Relative to today's clinical practice, his recommendations for the prevention of kidney calculi were quite applicable, and there is not much difference from current suggestions, like avoidance of hypercalciuria and increased saturation of the urine: "[...] by avoiding heavy food which we have mentioned. Do not lie long on your back. Avoid cheese, milk derivatives, especially fresh cheese, hard-boiled eggs, unleavened bread. Use diuretics—cucumbers, melons, figs, grapes, crystal—clear water from natural sources."^{4'}

Surgical removal of the bladder calculi dates back to ancient times. In those days, it used to be performed through a perineal incision up to the bladder neck. Al-Zahrawi outstandingly improved this procedure and reduced the risks involved.^{5,6} His innovation reached Europe in Middle Ages and remained the procedure of choice until the commencement of the 18th century, when the present suprapubic method was introduced.^{7,8}

Rhazes, for the first time, introduced preoperative preparation of the patient by an enema.⁵ In *Al-Hawi*, he expresses: "Because stools in the rectum may render palpating for and locating of bladder stones difficult or impossible, it is essential that the patient should be given an enema beforehand. When the bowel empty out its content, feeling

the stone and also abdominal palpation becomes easier.⁹ As it can be observed, he was referring to suprapubic abdominal palpation. It is worthy to note that in those days, due to dietary factors and prevalent malnutrition, most of the patients were young children in whom because of the small pelvic cavity, the bladder could be palpated quite easily, and at the time of diagnosis, the calculi were usually very large in size.

Al-Zahrawi was the first one to utilize forceps to remove bladder calculi. Before him, the calculus would be extracted by an instrument like a small spoon called *almajarrah* (the dragger), and it would be scooped out. For operations, Rhazes also used *almajarrah*; however, when needed, he used *al-kalbatain* which was similar to the arrows extractor forceps. The extensive details he mentioned about ways to deal with multiple bladder calculi were not discussed in the works of ancient Greco-Roman scholars.⁵

Prior to Rhazes, it was believed that breaking the calculus inside the bladder to facilitate its removal could be dangerous; therefore, it was customary to extract these calculi through large incisions. Rhazes questioned this approach, and prior to Al-Zahrawi, he realized the hazards of resorting to large incisions. He invented a modified technique in which the sides of the calculus were pinched off through a small incision, and after they became small enough, they were removed with *al-kalbatain* forceps.⁹ This procedure was a significant advancement in the management of bladder calculus surgeries and was soon followed by breakthrough innovations of Al-Zahrawi that we mentioned earlier.

Rhazes was a dedicated observer, and while he described the signs and symptoms accurately, he differentiated diverse conditions that produced similar complaints in a methodical and advance way. For example, his approach to the symptom of "heaviness in the loins" to differentiate between kidney calculi and renal obstruction or pyelonephritis is: "[...] and the differentiation between them is that; with inflammation, [there are] mixed fevers, rigors, and polyuria with frequency; with obstruction, [there is] oliguria and the urine is clear and with stones, the urine is either clear or not and with sandy sedimentation."⁹

The discrimination between vesical and renal hematuria was first described by Rufus of Ephesus;

nevertheless, Rhazes stated the underlying physiopathology in a very scientific and up-to-date manner³:

*[...] Sudden hematuria is due to a ruptured renal vessel as this cannot be the case in the bladder because it cannot be for a vesical vessel to rupture due to plenty of blood coming to it as it happens in the kidney. And this is because blood is not filtered in the vessels of the bladder as it does in the vessels of the kidney. But the amount of blood that comes to the bladder is only enough for its nutrition, while in the kidney because blood is filtered in it and then, large blood vessels and plenty of blood comes to it, far more than its need for nutrition. Also the vessels in the bladder are not close to the interior and unsupported as the vessels which enter deep into the kidney.*³

His elucidation of renal hematuria observed in glomerulonephritis due to congestion and increased permeability was also precise.⁹

Celsus who lived at the start of the Christian era and Paul of Aegina (625 to 690 AD) had only referred to urinary retention, but Rhazes differentiated between retention and anuria:

The urine stops either because the kidney lacks it and the sign of this is the stoppage of urine and no heavy pains in the back and not in the loin, ureter, and bladder, any discomfort and not at the bladder neck, any cause of obstruction as we will show and together with this, the abdomen is lax and in the body, there is swelling and dropsy or profuse sweating. Or urine is within the kidney which is obstructed, and in it, the lesion which is swelling or stone or clots of blood or pus. Common to all of them is the pain in the lumbar region with emptiness of the bladder. But if it be a stone, the signs of the stone would appear before that. And if it be a hot swelling, with the pain, there is some throbbing. And if it be diseases in the kidney, then it is only heaviness. And if it be a solid swelling, the urine does not stop suddenly but gradually and with heaviness only. And if it be clots of blood or pus, then it would be preceded by ulcer.

*And if the urine is stopped because of the urinary passages from the kidney, the bladder will be empty and the pain in the ureter along its course with pricking and stitching as the ureteric pain is continuous and pricking, after this, use the previous criteria as in the kidney.*⁹

Similarly, he illustrated clinical presentation of retention.⁹ Both Al-Tabary and Rhazes differentiated between various kinds of anuria depending on the site of pathology (kidney malfunction, ureteral obstruction, or bladder neck obstruction); moreover, they emphasized the significance of the presence or absence of a suprapubic mass (dilated bladder). Rhazes also described other urological conditions such as azotemia, Fournier's gangrene of the scrotum, and hemoglobinuria.

In *Husain and Al-Okbey*,⁹ Rhazes differentiated between renal or vesical pain and pain due to colitis with meticulousness. He also described distinctions of dormant calculi and the moving ones and explained the exact location of them. Radbill asserted that Rhazes was the first who described spina bifida and its association with incontinence.¹⁰

Rhazes performed lithotomy similar to Paul of Aegina; however, he recommended enemas as a preparation for surgery for the first time. He also described crepitus on digital rectal examination as a diagnostic tool in cases with multiple vesical stones.⁹ Meatotomy for impacted urethral calculi was also first devised by Rhazes: "If a stone is impacted in the tip of the urethra be aware not to force it out by pushing as this causes laceration and subsequent severe pains and infections, but incise the end of the penis and remove the stone."⁹

SIGNS AND SYMPTOMS OF CALCULI

Rhazes very accurately described the symptoms of distal ureteral calculi: "[...] among these symptoms are: a simple abdominal irritation, tingling pain in the pelvic area, and pricking sensation in the urethra. Occasionally, the pain can extend to the inguines as the renal calculus passes through the ureters and moves towards the bladder." He clearly pictured kidney calculus signs: "[...] the darkness of urine, deposition of calculus materials in the urine, feelings of heaviness and discomfort in the abdomen, and stretching sensations in this area while lying as the symptoms which can indicate the formation of calculus."

In accordance to modern medical knowledge, both Ibn Sina and Rhazes believed that pain becomes worse when the calculi are passing through the ureters, otherwise patients just "feel heaviness in the flanks."

TREATMENT OF CALCULI

In ancient Iran, kidney calculi would be treated with baths, dietary restriction (particularly milk) and scormelon pips, Indian beans, and a pill made from burnt scorpions.¹¹

In *Alhesi Fe Alkuli Walmasanah*, which was translated into French by P Koning in Lion in 1896, Rhazes recommended immersion in *khazineh* (A big bathtub full of hot water) to augment urinary output, alleviating pain and facilitating kidney calculus passage: "During such times, the frequency of bathing and the number of times that one enters "Khazineh" should be increased, prescriptions should be followed and medications should be used. If such orders be followed consistently, the patients will not feel the pain and before its complete formation, calculus will be broken into small pieces and pain will not be intensified". He also underlines the importance of physical activity in ureteral calculi: "After getting out of bath or Khazineh, the patient should be ordered to move and jump around incessantly and for a long duration of time. Having done this, the patient should enter Khazineh again and stay there till the time he feels that the pain has been displaced and it is running down the inguines."¹²

Rhazes prescribed sedatives for renal colic attacks, and after the pain had subsided, a number of herbal remedies including wormwood, birthwort, and pepper to help calculi's expulsion. He also proposed juice of radish leaves, caper, prunus mahaleb, water of soaked chick peas, and bitter almonds were effective for breaking the calculi.¹³ As a preventive measure in calculus formation, Rhazes advised avoiding heavy foods and drinks and taking diuretics, eg, melon seeds, squirting cucumber, radish seeds, cumin, and bitter almonds. This recommendation of "diet, hydration, and diuresis" is what is currently advised for patients with urinary calculi. Rhazes devised various urological instruments, namely pliable lead urethral catheters, and replaced the traditional openings at the catheter tip with eyelets on the sides.¹¹

URINALYSIS

Since, in those days, new laboratory analyses for urine examination were not available, Muslim physicians had to observe physical characteristics of urine and draw their clinical decisions from its appearance. Rhazes believed that urine mirrored

the circulation in the urinary system. He used to scrutinize urine for color, consistency, deposits, taste, clarity, touch, etc, and classified each finding into various subdivisions and specified the underlying cause and significance of each. Hematuria, foul smelling urine, with debris in a patient with suprapubic pain, indicated cystitis. Urethral discharge and dysuria denoted urethritis.¹²

CONCLUSIONS

The kidney and bladder calculi disease has been discussed in great deal in the history of medicine by Rhazes. Explanations about formation, diagnosis, and treatment of these calculi do not basically differ from that of modern concepts. Differential diagnoses between colitis and renal colic and between kidney and bladder calculi were very clearly made.

CONFLICT OF INTEREST

None declared.

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Received September 2009

Revised November 2009

Accepted December 2009