

ORIGINAL ARTICLE

Urinary Tract Infections in Ancient Greece and Roman

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Abstract

This study aims to assess the diagnostic and treatment methods used in ancient sources for urinary tract infections and to discuss some ancient practices that are reminiscent of the methods used by modern medicine with an analogy-based approach. As remains of ancient soft tissue diseases have not survived until the present day, our knowledge on this topic is limited primarily to knowledge conveyed by ancient authors being interested in community health, namely by Hippocrates (460-370 BC), Celsus (25 BC-50 AD), Pliny the Elder (23-65 AD), Dioscorides (MS 40-90), Rufus (1st-2nd century AD), Aretaeus (2nd century AD), and Galenos (129-216 AD). The study used the document analysis method, which involved analyzing original traditional medical texts, literary and historical works, and modern sources documenting the treatment of patients with urinary system disorders. It has been concluded that conservative treatments for urinary system diseases in antiquity resemble certain approaches found in the modern medical literature. The evaluations reveal that diagnosis and treatment information on urinary system disease have ancient Mesopotamia roots and findings pointing to a correlation between the kidneys and heart in ancient Egyptian civilization. Similarly, it was established that kidney disease and *Diabetes Mellitus* were considered interconnected in the Greek and Roman periods. Again, data regarding diagnosis and prognosis reminiscent of disorders defined as *alkaptonuria*, *proteinuria*, and *urinary retention* in modern medicine were encountered.

Key words: Antiquity, Urinary System, Illness, Diagnosis, Treatment, Kidney, Urinary Tract Infections

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Introduction

Urinary Tract Infections (UTIs) are among the most common infections in ancient societies. *UTIs* are among the most common bacterial infections in modern medicine, and they cause a significant financial burden to society. It is defined as a disorder that occurs when the pathogen, called *E. coli*, reaches 105 colonies/ml in the urine (Brumbaugh, and Mobley, 2012, p. 664; Smelov, Naber, and Johansen, 2016, p. 72; Karam, Habibi, and Bouzari, 2019, p. 56). It is an infection of the upper (kidneys) and lower systems (ureters, bladder, urethra) of the urinary tract. Complicated infection of these organs, which have an important function in maintaining the body's mineral balance, poses serious risks that may be fatal (Lichtenberger, and Hooton, 2008, pp. 499-500; Behzadi, Pawlak Adamska, and Agnieszka, 2019, p. 2). The majority of *UTIs* start with an infection of the bladder, which is clinically defined as cystitis. Cystitis occurs when pathological bacteria infect the perineum, urethra, and bladder. If cystitis is left untreated, it can lead to sepsis, which is a potentially fatal complication (Brumbaugh, and Mobley, 2012, p. 664). For this reason, *UTIs* are among the disorders that can increase morbidity and mortality (Karam, Habibi, and Bouzari, 2019, p. 56).

Information on symptomatic diagnosis and treatment of *UTIs* was first conceptualized in ancient Mesopotamia. Mesopotamian cuneiform tablets contain information on the diagnostic use of urine. In the Egyptian Civilization, leaving the heart and kidneys untouched during the mummification process was associated with the belief in the heart's and kidneys' holiness (Bongartz, Cramer, and Joles, 2012, p. 107). In this context, health services, as old as human history, and medical and pharmacological knowledge learned mostly through trial and error and observation have been divided into areas of expertise, transforming humanity into organized social units. In addition to the previous treatment methods applied with religious elements, there was a period in which treatments were made with the help of plants and an etiological treatment period in which the disease was tried to be eliminated. Then, the treatment process continued with a modern health approach (Altındağ, and Yıldız, 2020, pp. 157-160).

Evidence of kidney disorders and kidney stones was identified in Egyptian papyri (Forrester, 2013, p. 75). Medical Papyrus contains the prescriptions and spells for treating urinary disorders, such as haematuria, retention, infection, and urinary incontinence, demonstrating the high frequency with which these conditions were encountered in clinical practice (Salem, and Eknoyan, 1999, p. 140). The Book of *the Dead* (1600-1240 BC), discovered on the coffins of deceased individuals in Egypt and regarded as a primary reference source comprising texts believed to facilitate the transition of the deceased to the afterlife, contains numerous references to the heart (Budge, 1898, p. LXXXVIII; Salem, and Eknoyan, 1999, p. 141; Bongartz, Cramer, and Joles, 2012, p. 107). The book contains references that indicate a relationship between the heart and kidney (Hanafy, Saad, and Al-Ghorab, 1974, p. 114).

Since the remains of ancient soft tissue diseases have not survived to the present day, our knowledge on this subject mainly consists of information conveyed by ancient authors. Some scholars such as Aristotle (384-322 BC) and Hippocrates (460-370 BC), who were interested in Urinary Tract diseases, defined renal anatomy and concluded that the kidney separated excess fluid from the blood, and this fluid was excreted as urine. Celsus emphasized the necessity of a surgical treatment approach to obtain information about the color and texture of organs and whether they were diseased or damaged through



both dead and living dissections (Celsus, 1935, Vol. 7, p. 26). While describing herbal treatment methods in his *Naturalis Historia*, Pliny the Elder (23-65 AD) mentioned that some spring waters dissolved stones formed in the urinary tract. Dioscorides (40-90 AD) recommended more than 200 herbs for kidney diseases in his work *De Materia Medica*. Aretaeus (81-138 AD) revealed that kidney diseases and diabetes were related (Aretaeus, 1972, Vol. 2, p. 1). Rufus of Ephesus (1st-2nd century AD) was the person who wrote the first urology textbook called *De Vesicae Renumque Affectibus*. Rufus made a comprehensive definition of nephritis resembling renal obstruction due to renal infection and stones and distinguished hematuria of bladder and kidney origin. Thanks to dissections of dead or living animals, Galenos (129-216 AD) observed the flow of urine from the ureters to the bladder and revealed the separate functioning of sperm ducts and urinary tracts (Galenos, 1916, p. 13). This rational approach of the Greek and Roman Period for the diagnosis brought the treatment approach of Urinary Tract Infections to a different dimension. Galenos also identified three causes of urinary retention. He reported that the first of these was the obstruction of the urethra and bladder neck with stones, clots, and other substances, the second one was the compression of the urethra due to swelling in adjacent tissues, and the third one was the obstruction of the urethra and bladder due to a tumor or other reason (Nickel, 2005, p. 23). Galenos again recommended the use of catheterization in cases of urinary obstruction (Pasipoularides, 2014, p. 50). (4th century AD) Oribasius examined the tissue of the kidney and defined the renal vein and renal arteries through medical observations made with limited resources. Talking about acute and chronic nephritis, he recommended hydrated milk in the diet as a treatment approach. He also used phytotherapy, physiotherapy, and bath therapy in the treatment (Eftychiadis, 2002, pp. 137-138).

The Impact of Egyptian Medicine on the Science of Urology

Information about kidneys in papyri in the Egyptian Civilization is limited. The terms representing the urinary system were found in hieroglyphic inscriptions in the Ancient Egyptian Civilization. Once more, the kidneys are regarded as having a mystical role; thus, they are organs that are not removed from the body during mummification. Ebers Papyrus, one of the Egyptian medical texts, contains a wealth of detailed information about the symptoms, treatment approaches, and prescriptions related to kidney disorders. Another medical text, the Smith Papyrus, includes information on kidney disorders and treatment methods (Salem, and Eknoyan, 1999, pp. 140-144). In the Ebers Papyrus, the term *ib* is defined as the heart (Carpenter et al., 1998, pp. 4-6). In The Ebers Papyrus, the *metous* are located as two hollow tubes or ureters that lead to the bladder. The Berlin Papyrus states that there are two *metous* in the bladder, defined as the ones that produce urine. In general, the term *metous* encompasses excretory channels like the vascular system, tendons, nerves, urine, sputum, and other excretory products. It was widely accepted that this network of veins in the body is under the control of the heart. It was previously believed that the disease could spread throughout the body in the event of a pathological condition. Furthermore, expressions such as “may the *metous-ib* complex be intact” were observed in the incantations directed toward the departed (Salem, and Eknoyan, 1999, pp. 143-144). According to Bongartz et al. in the Book of *the Dead*, evidence was found in observing the blood vessels in the mummies in good condition and the frequency of cardiovascular diseases affecting the heart and kidneys. In the book, the statement of



Homage to thee, O my heart! Homage to you, O my kidney! is the first text mentioning the holiness of the heart and kidneys in parallel. It is understood from the text that a close connection between the kidney and the heart has been noticed. This situation has prompted debate regarding the existence of a condition defined as cardiorenal syndrome in modern medicine (Bongartz, Cramer, and Joles, 2012, pp. 107-109). Cardiorenal Syndrome has been defined in the way that acute or chronic kidney diseases can damage heart function while acute or chronic dysfunction of the heart can pose a risk to kidney functions. Empirical practices were used mainly in treating this condition, which was only clearly defined in recent years. It was suggested that physicians should have considered this clinical syndrome in diagnosis and provided treatments and interventions that would reduce mortality (death) and morbidity (disease) (Aksakal, Duman, and Keleş, 2011, pp. 197-199; Kara, 2014, pp. 335-336). Considering the increasing heart attack rates in recent years, Cardiorenal Syndrome emerges as an important research area in this context.

The Impact of Mesopotamia Medicine on the Science of Urology

Although not as much as contemporary medical texts in Egypt, the oldest and richest information on urinary system disorders that do not contain spells and magic dates back to the Babylonian medical texts from the 2nd millennium BC. The majority of Babylonian medical texts consist of descriptive information about symptoms. These prescriptions, which were probably recorded by “asus” who had the function of pharmacists, consisted of different herbal and mineral components (Geller, and Cohen, 1995, p. 1811).

As with many diseases, Mesopotamian texts contained remarkable prognoses for Urinary Tract disorders, as well as long prescriptions for treating diseases. The patient’s temperature, skin color, excretory state, or urine color were checked for diagnosis.

It was stated in one of these prescriptions that “...If a man suffers from urinary incontinence, cannot hold it in, or has a swollen bladder, dissolve puguttu in oil and apply it through a bronze tube...” (Geller, and Cohen, 1995, p. 1812). It is understood from the prescription that a person with a urinary tract disease was intended to be cured through using herbal treatment. Also mentioned in Akkadian medical texts, qunnubu, the cannabis plant, was used internally for the treatment of kidney stones and externally as an ointment (CAD 1982, p. 306; Şahin, 2014, p. 117).

Cuneiform tablets contain the following information about the prognosis (course of the disease) regarding the appearance of the urine for Urinary Tract infectious diseases;

“... If the patient’s urine is normal, the patient will recover... If the patient’s urine is like water, the disease will last for a long time, but the patient will recover... If the patient’s urine is like wine, the disease will be painful, but the patient will recover... If the patient’s urine is red, the patient will recover... If the patient’s urine is greenish-yellow, the disease will last a long time... If the patient’s urine is black, the patient dies... If the patient’s urine is white and thick in consistency, the patient has stones in the urinary tract... If the patient urinates blood on the first day of the illness, the disease is in the acute stage, and that patient will die...” (Eknoyan, 2016, p. 242).

Although the first records about the prognosis of black urine were found in Mesopotamia, prescriptions were given to patients by Asclepius, the God of healing, and priests authorized by the God in Knidos in the 500s BC in the Greek Civilization. In these prescriptions, the observation-based diagnostic method, which is still valid in modern medicine, states that the most lethal of all types of urine is black and smelly with a thick consistency



(Eknoyan, 2016, pp. 241-243). Among the early-stage treatment methods of this disorder, which is reminiscent of Alkaptonuria (, et al., 2015, pp. 105-106), also known as black urine disorder in medicine today, symptomatic treatment is foreseen in the treatment protocol of the disease. A black appearance may occur due to awaited bleeding in the urine.

Another prognosis is that "... If a person's penis becomes blocked, that person will die..." (Andersen, and Scurlock, 2005, p. 10). Accumulation of urine in the bladder due to an obstruction in the urethra can cause long-term pressure on the ureters and kidneys, impairing the functioning of the kidneys. It can lead to death if the obstruction is not resolved.

1- The Impact of Greek-Roman Medicine on the Science of Urology

A. The Diagnostic Impact of Greek-Roman Medicine on the Science of Urology

While discussing the medical practices of ancient physicians, the best approach would be to see the achievements they got in line with the limited resources of that period. For this reason, although laboratory and image examination methods are actively used today in the diagnosis of urinary system diseases in modern medicine, the role of the patient's physical findings, clinical examination, and visual evaluation cannot be denied. As a matter of fact, it is highly important to take the patient's anamnesis accurately and carefully and to evaluate the physical findings, such as the color of the urine (clear or light-colored, cloudy, bloody, colored (white urine, green urine, black urine, purple urine)), frequency of urination, amount of urine, daily fluid intake amount, in the clinical examination of many urinary system infections (Leadbetter, 1958, p. 271; Alpay, and Bıyıklı, 2003, pp. 124-125; Brosnahan, 2020, pp. 159-160).

One of the diseases from which ancient people suffered the most was the pain caused by stones in the urinary tract (Elder Plinius, 1855, Vol. 25, p. 7). Hippocrates assimilated such formations as stones and sand in the kidneys, and the resulting difficulty in urination, pain and hernia to small streams (which may be nephrons) flowing into large rivers, and the sediments brought by the currents forming deposits as they come from different directions with different intensity (Hippokrates, 1868). Hippocrates mentioned that while the sand components in the water the patient drank were excreted in the urine under normal conditions, these sands could turn into stone formation in pathological conditions in urinary tract stones (Nickel, 2005, p. 23). He mentioned that it became difficult for the concentrated urine to pass when fever and heat occurred in bladder inflammation. As the urine passed, the dense and cloudy sediment came together and caused first sand and then stone formation. Thus, Hippocrates reported that the stone blocked the urinary tract due to the pressure on the bladder neck while urine was passing and caused severe pain in that area. As an important finding, it was determined that people with stones in the urinary tract had a clear appearance because the cloudy part of the urine remained in the bladder, and they complained of not being able to urinate (Hippokrates, 1868). As a matter of fact, inflammation may occur in the bladder, especially in men, due to prostate enlargement and bladder stones may enlarge nowadays. This may cause obstruction and pain while urinating.

Celsus said that difficulty in urination and blood in the urine were symptoms of stones in the urinary tract. He mentioned that the rough structure of the stone caused bloody urine (Celsus, 1935, Vol. 7, p. 26). Again, an opinion was reached about the prognosis of the disease by looking at the condition of the urine. If precipitates were observed



in the urine of a patient with fever, it was predicted that the patient's illness would last a long time (Celsus, 1935, Vol. 7, p. 31). If bilious precipitates were observed in normal urine, it was considered as a sign of a sudden illness. Furthermore, the observation of urine separation was considered to signify a severe disorder (Celsus, 1935, Vol. 7, pp. 32-35), while the formation of bubbles and foam in the urine was seen as a sign of kidney disease. The observation of bead formations in the urine and the clear appearance of the urine were considered signs of dangerous kidney diseases. These symptoms, which may be a sign of protein leakage, defined today as Proteinuria (Kocabaş, and Başol, 2006, pp. 133-138), can be considered as findings indicating Urinary System anomaly. Hippocrates described the dark consistency of the urine and the appearance of small meat particles in it as another symptom, a sign of secretion (Hippokrates, 2020, Vol. 4, p. 76). In fact, small pieces of flesh may fall out of the kidney, and be seen in the urine in a group of kidney infections. He also stated that atypical bladder secretions in individuals, compared to healthy people, should be considered a sign of disease (Hippokrates, 2020, Vol. 7, p. 67). In his Aphorisms, Hippocrates also listed stranguria¹ as a symptom of inflammation in the kidneys (Hippokrates, 2020, Vol. 5, p. 58). He stated that blood or inflammation in the urine indicated wounds in the kidneys or bladder and that sudden blood observed in the urine could be a sign of bleeding in the renal vessels (Hippokrates, 2020, Vol. 4, pp. 75, 78).

Hippocrates also described four kidney disorders in his work. The first of these definitions refers to kidney stone disease with or without infection. In the first one, he mentioned that phlegm accumulated in the kidney caused stone formation. The second disease indicated Renal Vein Thrombosis. The pain is intense. Hippocrates recommended surgical treatment when the kidney filled with blood, contrary to his general principles. The third disease is a tumor characterized by severe pain in the waist, bladder, and perineum areas. The fourth disease is nephritis, which is characterized by pain in the waist and sides, dysuria, cloudy urine, and hematuria (Hanafy, Saad, and Al-Ghorab, 1974, p. 115; Nickel, 2005, p. 23). Hippocrates also described symptoms of bladder stone disease such as urinary incontinence, painful urination, and urinary retention (Hippokrates, 1868).

While describing kidney disorders, Galenos drew attention to the connection between excessive urination, which he defined as urinary diarrhea, and thirst. And he pointed out that it was a kidney problem. Galenos also described the structure of the kidneys and ureter channels and was the first physician to

1- Stranguria: painful discharge of urine drop by drop.



state that the kidney was an organ that separated urine. He also mentioned that the complaint of urinary retention caused pain in the lower back. He emphasized that the bladder acted as a sponge or wool in the body in this system (Galenos, 1916, p. 13). In his surgical procedure, Galenos observed where urine was collected by opening the peritoneum in front of the ureters, tying the urinary ducts, subsequently releasing the ligament. Since he performed this procedure on the animal, when the urine went down to the animal's penis, he tied the animal's penis and, at the same time, applied pressure to the bladder. Thus, he observed that the urine did not go back up, indicating a one-way urine flow through the system. He reported that he tried this process on living animals as well as on dead animals and got the same results (Galenos, 1916, p. 13). In these applications carried out by Galenos, the observation that the fluid flowing from the ureters to the bladder could not return led ancient physicians to perceive the human body as a very extraordinary mechanism and to wonder more about the Urinary System. Today, there is usually a mechanism that prevents urine leakage from the bladder to the ureters and kidneys. If this structure is congenitally defective or if the bladder outlet remains blocked for a long time, urine may leak from the bladder to the upper urinary system, and this disease is called Vesicoureteral Reflux.

Aretaeus, in his work *De Curatione Diuturnorum Morborum Libri Duo*, reported that conditions, such as urinary retention in kidney diseases, were quite dangerous, leading to life-threatening consequences or death (Aretaeus, 1972, Vol. 2, p. 2). Aretaeus revealed that kidney diseases and diabetes were related. He defined Diabetes Mellitus as a disease in which the body melts and flows out with urine (Aretaeus, 1972, Vol. 2, p. 1). As a matter of fact, in the modern medical literature, involuntary excessive weight loss is accepted as one of the symptoms of type-1/type-2 diabetes mellitus which prove this statement. The patient experiences a process that develops with excessive glucose excretion in the urine as a result of drinking too much water and frequent urination. Therefore, diabetes remains a significant consideration in the differential diagnosis of notable weight loss and frequent urination (Akyol, et al., 2013, pp. 60-61).

B. The Therapeutic Impact of Greek-Roman Medicine on the Science of Urology

Hippocrates mentioned that giving hot milk to children could cause some adverse effects, which could result in stone formation. He recommended drinking diluted wine rather than milk as a treatment approach (Hippocrates, 1868). As a matter of fact, the role of diet in patients with urinary stones and its role in the treatment is known today; fluid consumption is particularly emphasized; however, it was reported that foods, like milk and dairy products, containing more than 100 grams of calcium per 100 grams should not be given in cases of calcium stones. (Özkaya, Alpman, and Özkaya, 1992, pp. 98-102). Among the preventive treatment approaches in modern medicine, it is advocated to reduce the dietary intake of foods linked to stone formation, such as milk and grapefruit, to reduce the possibility of developing kidney stones or other stone diseases (Baştuğ, 2013, p. 147). In modern medicine, conservative treatments for stone patients include diet, fluid intake, and lifestyle recommendations. There is an inverse relationship between stone formation and fluid intake. That is to say, as fluid intake increases, the risk of stone formation decreases, and vice versa. Calcium restriction is applied only to patients with a strong tendency to stone formation upon consuming dietary calcium (Öner, 2016, pp. 366-367).

In fact, ancient nephrology used to administer milk to individuals with kidney disor-



ders, as witnessed in the works of Celsus. However, milk was preferred to be used in excretion treatments due to its complex structure (Celsus, 1935, Vol. 4, pp. 21, 22, 27; Vol. V, p. 21). Dioscorides also preferred milk for external use (Dioscorides, 2000, Vol. 2, pp. 70, 2, 10). Pliny the Elder recommended milk as a medicine for patients with nephritis and cystitis (Elder Plinius, 1855, Vol. 28, pp. 33, 125). However, today, there is no specific study in the literature on the use of milk in kidney patients, and plant-based proteins are recommended instead of animal-based proteins, such as milk in the diet of chronic kidney patients and urinary system patients (Çolakerol, and Yürük, 2020, p. 36; Kavala, and Enç, 2022, p. 31).

Hippocrates recommended diet, plant-derived diuretics, hot applications, and baths in the treatment of kidney-related diseases such as renal tuberculosis, renal colic, and kidney infection. In cases of Kidney stones, he recommended surgical procedures to remove stones (Hippokrates, 1868). It can be said that the emphasis on the importance of diet parallels the importance placed on dietary practices in contemporary medical treatment. Hippocrates' dietary recommendations for renal disorders encompass limiting the consumption of substances that negatively affect urinary function, such as excessive amounts of calcium. Furthermore, observing an adequate amount of fluid intake is advised (Leadbetter, 1958, pp. 276-280) in the treatment of urinary system diseases.

Hippocrates suggested cupping as a different approach in the treatment of urinary difficulty (Hippokrates, 2020, Vol. 6, p. 36; Celsus, 1935, Vol. 2, p. 10). Similar to Hippocrates' cupping method, Aretaeus recommended surgical method, cutting the vein on the side of the kidney from the ankle. He stated that this would help the stone expand at the narrowing site. Additionally, he suggested sea travel as a complementary therapeutic measure for patients suffering from urinary tract stones. (Aretaeus, 1972, Vol. 2, p. 2). notably, modern medicine does not practice cupping applications in treating urinary tract infections.

Celsus, who adopted a surgical treatment method in treating urinary tract stones, stated that pains occurred mainly in the internal parts of the body and that when pain occurred internally, the disease couldn't be cured without knowing the location and condition of each organ. Celsus also mentioned that diseases in external organs could only be managed by thoroughly understanding the body's internal structures and functions (Celsus, 1935, Vol. 1). Celsus recommended that the patient be starved the day before, as is the case today, to prepare the patient's body before surgical procedures (Celsus, 1935, Vol. 7, p. 26). In his work, Celsus explained the temperature of the room for the operation, the position to be given to the patient, the team that would assist in the operation, and the details of the procedure. He said that in the stone operation, when the tubes reached the bladder neck, the tubes were bent together with the penis and pushed into the bladder. After the urine was emptied, it was expelled again. A similar procedure was applied to female patients; the procedure would be more straightforward since the urethra was straighter and shorter. If the stone was near the mouth of the urethra, the stone could be removed by pulling it out with appropriate tools. If this could not be done, the foreskin was sometimes pulled forward as much as possible over the head of the penis and tied there with a thread. Then, a longitudinal incision was made on one side of the penis, and the stone was removed. If the stone was located in the posterior region, Celsus recommended that patients engage in walking to help facilitate the stone's moving down



toward the bladder neck² (Celsus, 1935, Vol. 7, p. 26). Celsus described in detail the following lithotomy knife, invented by Meges, an esteemed surgeon he admired (Milne, 1907, p. 42). When urine does not come out due to a stone or inflammation, urine must be removed by manual intervention. He recommended copper tubes (catheters) for this intervention (Milne, 1907, pp. 144-145). Celsus also mentioned that bronze tubes were used in case of obstruction in the urine flow. In this method, which the Egyptians previously used to relieve the bladder through bronze and tin tubes in the treatment of urinary retention, Celsus preferred tubes approximately fifteen fingers in width in men and shorter tubes in women due to the generally shorter urethral anatomy in women (Celsus, 1935, Vol. 7, p. 26; Nickel, 2005, p. 23).

In addition to the surgical operation, Celsus also touched upon manual downward pushing applications and emphasized the importance of carefully performing this procedure. He warned against the potential risks associated with inadequate technique. He highlighted that there were cases where bladder injuries during the stone removal procedure might lead to severe complications or even death. Explaining the meticulous procedures to be performed in cases where the outer surface of the stone was rough or not, Celsus explained in detail how the procedure would be carried out, including the required shape and dimensions of urethral incisions. He mentioned some different treatment procedures for women and men. When discussing the manipulation procedure (first inserting fingers through the rectum and respectively changing the position of the fingers to remove the stone gently), he mentioned that if there were several stones, they should have been removed one by one. Celsus emphasized that the manual application to the bladder should have been done as gently as possible. He warned that bladder injuries could lead to life-threatening complications or the risk of rapid death due to bladder spasms because of such injuries. (Celsus, 1935, Vol. 7, p. 26).

While Soranus (98-138 AD) was explaining the procedures to be done in cases that strained the birth canals due to stones in the urinary tract, he mentioned some treatment approaches, such as pushing the stone into the bladder with the help of a catheter (Soranus. Gynaecology. IV. 7). Celsus explained that in cases where removing the stone would risk damaging the bladder, the stone should be removed by breaking it into pieces within the bladder (Celsus, 1935, Vol. 7, p. 26; Özçift, et al., 2013, p. 63). The process of breaking the stone into smaller fragments internally was named after its inventor, Ammonius Litotomus (Celsus, 1935, Vol. 7, p. 26). The surgical approach

2- In treating urethral stones, the size of the stone and the presence of local and urethral pathology should be considered as important criteria. Stones, especially in the posterior urethra, are treated by pushing them into the bladder. In cases where lithotripsy is unsuccessful, open cystolithotomy may be required. Pushing the stone into the bladder is not recommended for anterior urethral stones; the "milking method" may be preferred for small and soft stones. Direct removal of the stone by entering with a cystoscope can be performed particularly in small-sized stones (Göğüş, 2016, pp. 410-411).



taken for removing the stone from the bladder was the open surgery. However, in modern surgery, the endoscopic technique is employed to break the bladder stone. This treatment method, Endoscopic Cystolithotomy, compared to the traditional surgical interventions, is less traumatic. The state-of-the-art digital endoscopic lithotomy procedures used in bladder stone removal are associated with the name of ancient medical practitioners, like Lithotomos, who invented them. As a matter of fact, in treating kidney stones, technological developments made minimally invasive surgical methods, with less morbidity and lower surgical complication rates, possible. Such methods as PNL (Percutaneous Nephrolithotome) (Evan, 2010, pp. 831-835; Özçift et al., 2013, pp. 62-64), Extracorporeal Shock Wave Lithotripsy (ESWL) and Retrograde Intrarenal Surgery (RIRS) are used in treating urinary tract stones thanks to advances made in technology (Aybek, et al., 1997, p. 57; Özçift et al., 2013, p. 62; Akçay, et al., 2016, p. 40).

In addition, Celsus mentioned that it would be beneficial to allow bleeding to continue after the stone was removed, clearing any residual blood clots. He stated that intervention was necessary if the bleeding did not stop. If the patient lost a lot of blood, Celsus prescribed preparing a vinegar and salt bath in which the patient is advised to sit down. This would help the patient's recovery by reducing possible inflammation. Following the operation, the patient was recommended to be positioned with the head down and the hip up and to be dressed and compressed with linen soaked in vinegar (Celsus, 1935, Vol. 7, p. 26). The next day, if the following complications, such as respiratory difficulties, challenges with urination, and swelling in the groin area, are observed, the doctor may suspect the presence of a blood clot in the patient's bladder. Then, the clot must be removed manually. Afterward, according to Celsus, hot baths would be beneficial. Furthermore, he mentioned some possible complications, including muscle spasms, bilious vomiting, and cancer, as the most dangerous complication. Celsus also stated that fever, if persisted, might indicate the presence of some post-surgical complications, such as foul-smelling discharge from the wound or urinary tract, swollen testicles, pain when touched, and hardening in the legs and hips (Celsus, 1935, Vol. 7, p. 26). He also recommended bowel cleansing with laxatives or enemas as well as bath treatments in cases of Urinary Tract diseases³ (Nickel, 2005, p. 23). Bladder lavage was also recommended to flush out ulcers in the bladder or urethra (Milne, 1907, p. 107). Excretion therapy, which ancient physicians, including Hippocrates, occasionally prescribed, was considered beneficial because it would help

3- It is known that laxatives and purgatives are used in pediatric urinary tract infections in modern medicine. See (Kibar, Ergin, and Köprü, 2016, pp. 932-935).



large quantities of white and thick urine. Hippocrates also described the uterine enema in his work (Hippokrates, 2020, Vol. 4, p. 74; Milne, 1907, p. 107). Aretaeus also recommended diuretics and baths for urinary retention associated with conditions, such as cystitis. In line with this, Arataeus mentioned catheterization and perineal cystotomy (Nickel, 2005, p. 23).

For some complaints in the urinary tract, Celsus recommended cleaning the wound externally with substances such as blackberries, olive leaves, and wine⁴ (Celsus, 1935, Vol. 7, p. 27). Celsus made external treatment applications by administering a specialized mixture of medication through a feather to the patient after the patient was placed in a proper position. When the wound started to heal, it was washed with honey wine. At this stage, attention was paid to the patient's nutrition. Only liquid food was recommended at first, followed by greens and fish. It was recommended not to give beverages other than water (Celsus, 1935, Vol. 7, p. 26).

Pliny the Elder mentioned that bladder stones were dissolved by drinking spring water (Elder Plinius, 1855, Vol. 31). He mentioned that the waters of the island of Ænaria (Italy) were good for urinary tract stones. He also mentioned that the spring water in the Tungri state in Gaul dissolved the stones in the urinary tract (Elder Plinius, 1855, Vol. 31, pp. 5-8).

As herbal treatment methods for bladder diseases, Pliny suggested wine made from sweet grapes called cocolobis (Elder Plinius, 1855, Vol. 1, p. 4; Vol. 14, p. 22). The wine named oinomeli was recommended by Dioscorides due to its diuretic properties (Elder Plinius, 1855, Vol. 5, p. 16). Aretaeus also emphasized the importance of a regular diet in kidney diseases (Aretaeus, 1972, Vol. 2, p. 2).

In his work *De Materia Medica*, Dioscorides mentioned that taking a very small amount of the cardamom plant into the body would dissolve the stones in the urine and kidneys (Table 1). Dioscorides mentioned that the plant called koreis should be made into small particles and placed externally in the urinary tract to treat painful urination. While he talked about taking some plants with wine, he mentioned the use of some plants by eating them directly or boiling their roots and drinking them (Aretaeus, 1972, Vol. 1, p. 5; Vol. II, p. 36; Vol. I, p. 39; Vol. V, p. 67). Today, in addition to the various treatment strategies developed by modern medicine in treating urinary system stone diseases, especially countries with low economies prefer and benefit from herbal medicines. As a matter of fact, it is accepted that many plants can dis-

4- He recommended using the popular balsam plant, known as Balsam of Gilead, for external cleaning of wounds, as an anti-inflammatory and to soften the wounds, and recommended it to be taken orally as a diuretic. See (Celsus. II. 22).



solve stones, or their protective effects may be beneficial in phytotherapy (Çolakerol, and Yörük, 2020, pp. 37-45).

Table 1: Dioscorides, Drugs recommended by Dioscorides for use in urinary tract infections in his work *De Materia Medica*

Latin name of the plant:	Usage:	Use in Urinary tract infections (UTI):
Elaion Amygdalinon (Dioscorides, 2000, Vol. 1, p. 39). Erebinthos, Erusimon, Peganon To Kapaion, Peganon To Oreion, Kuminon Agrion, Koriann, Krinon Basilikon, Erigeron, Staphis, Geodes Lithos, Samia, (Dioscorides, 2000, Vol. 2, pp. 126, 188; Vol. 3, pp. 52, 68, 71, 116; Vol. 4, p. 97; Vol. 5, pp. 4, 169, 172).		It has been used to treat inflammation caused by kidney and urinary tract stones.
Kuamos Hellenikos (Dioscorides, 2000, Vol. 2, p. 127)	with wine	
Asphodelos (Dioscorides, 2000, Vol. 2, p. 199)	boiling the roots with wine.	
Aspharagos (Dioscorides, 2000, Vol. 2, p. 152).	boiling and consuming roots.	
Kentaurion Makron (Dios., <i>De Materia Medica</i> , III. 8), Alkuonion (Dioscorides, 2000, Vol. 5, p. 136), Kuminon Emeron (Dioscorides, 2000, Vol. 2, p. 69)		It has been used in complaints of frequent and painful urination.
Sion To En Odasin (Dioscorides, 2000, Vol. 2, p. 154)	to be consumed by eaten	
Tribolos Enudros (Dioscorides, 2000, Vol. 4, p. 15a)	roots	
Kotuledon, Adianton, Kimolia Dioscorides, 2000, Vol. 4, pp. 92, 136; Vol. 5, p. 176). Strouthion, Ippomarathron, Lithospermon (Dioscorides, 2000, Vol. 2, p. 193; Vol. 3, pp. 82, 158). Bdelion, Daphne (Dioscorides, 2000, Vol. 1, pp. 80, 106).		It has been used to break down and excrete Stones in the kidneys and urinary tract.
Artemisia Monoklonos Artemisia Monklonos Etera (Dioscorides, 2000, Vol. 3, p. 127)	boiling	
Kerasia, Kokkumelia (Dioscorides, 2000, Vol. I, pp. 157, 174). Ampelos Oinophoros (Dioscorides, 2000, Vol. 5, p. 1)	with wine	
Anagallis, Korkoros (Dioscorides, 2000, Vol. 2, p. 209)	with wine	
Tordulin (Dioscorides, 2000, Vol. 3, p. 63)*.	Reception with raisin wine (when unripe)	
Glukoriza (Dioscorides, 2000, Vol. 3, p. 7), Oinos Meletites, Oinos Kudonites, Oinos Dia Nardou Kai Malabathrou, Oinos Apsinthites (Dioscorides, 2000, Vol. 5, pp. 15, 28, 49, 67).		It has been used to treat bladder and kidney disorders.

* Dioscorides provided a detailed description of the methods for collecting plants and emphasised the importance of collecting and storing them during the appropriate season to ensure the efficacy of the medicine. The information can be found in Dioscorides' preface. See also. Charles Singer, "The Herbal in Antiquity and its Transmission to Late Ages", *The Journal of Hellenic Studies*, C XLVII/ S. 1, 1927, s. 1-52.

Conclusion

A treatment approach has been developed within the scope of empirical medical practices in diagnosing and treating ancient urinary tract infections. Symptomatic symptoms of Urinary Tract diseases were first conceptualized in Mesopotamia and turned into a



rational discipline with the Greek and Roman Civilizations. It is understood that the subject on which ancient physicians, from Hippocrates to Galenos, provided most of the information regarding the diagnosis and treatment of urinary tract diseases was about the formation of stones in the urinary tract. It is very important that the Egyptian Civilization recognized the connection reminiscent of Cardiorenal Syndrome, which has not been clearly defined even today. The ancient depths of medical solutions similar to the treatment practices of urinary tract infections in modern medicine are quite remarkable. The application performed by Ammonius litotomus in the treatment of stones in the bladder can be considered as the primitive version of the Endoscopic Cystolithotomy procedure, which is performed by using state-of-the-art digital endoscopic equipment to break the stones in the bladder in modern medicine.

Prognosis records for the condition, which we liken to the black urine disorder defined as Alkaptonuria in modern medicine, were found in the prescriptions on Mesopotamian clay tablets. In Greece and Rome, prescriptions were applied using the symptomatic treatment method for this disorder. Hippocrates observed and detected the symptoms of proteinuria, one of the findings of protein leakage in the urine, which indicates a urinary tract anomaly. Hippocrates made interesting predictions about the prognosis of the disease.

In his work *De Materia Medica*, Dioscorides used approximately forty plants that we have been able to identify to treat kidney and bladder disorders, especially stones in the urinary tract and inflammation caused by stones. In modern medicine, the conservative medical treatment applied to stone patients today is similar in terms of dietary recommendations, fluid intake, and lifestyle recommendations.

While Hippocrates rarely preferred surgical methods in treating urinary tract stones, it can be said that Celsus frequently used surgical procedures to treat this disease. The information Celsus gave about the details of this operation is essential for people studying medicine today. Especially today's practices in the treatment of inflammation that may develop after the Lithotomy procedure are interesting. In addition, intriguing practices have been used in treating a wound in the bladder, such as the position given to the patient with ankles tied until the wound heals. However, it is valuable as it meets the needs of Greek and Roman society. And a more comprehensive investigation of ancient medicine will make significant contributions to modern literature by increasing the number of studies conducted by sciences such as paleopathology (the science that examines abnormalities on human and animal remains from ancient times) and osteoarcheology (the science that examines bones, one of the essential study materials of archaeology).

As with *UTIs*, examining prescriptions and treatment methods documented in historical texts can inspire modern medical research avenues and alternative treatment approaches.

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Conflict of Interest

None.

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