

## Hippocrate's Contribution Exploring the Tashrih-Al-Nizam-E-Baul (Anatomy of Urinary System): A Comprehensive Review

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Article History: | Received: 03.04.2024 | Accepted: 10.05.2024 | Published: 13.05.2024 |

**Abstract:** Hippocrates' early contributions to the understanding of urinary physiology continue to inform contemporary research and medical practice, emphasizing the enduring relevance of his observations in the history of anatomical studies. Hippocrates significantly contributed to understanding the kidneys and urinary system, including the urethra. Furthermore, he recognized the tubes carrying urine from the kidneys to the bladder and the bladder's role in storing and expelling urine. However, his knowledge of blood vessels and the urethra remains limited. Hippocrates, a key figure in the development of clinical nephrology, outlined four renal diseases, including kidney colic, renal tuberculosis, renal vein thrombosis, bilateral papillary necrosis, and chronic suppurative renal infection. In addition, he also described bladder stones, urinary conditions like painful, difficult urination, incontinence, urinary retention, renal colic, and renal tuberculosis. Treatment for urinary disorders included warm applications, baths, plant-derived diuretics, diet, and incision over the kidneys. Urine symptoms included bubbles on the surface, colorless urine, and sudden increases of blood in urine. The Corpus Hippocraticum, a study of the urinary tract, has significantly contributed to urology, particularly in uroscopy and renal stone formation. The study of the urinary tract provides valuable insights into anatomy, physiology, etiology, and treatment of urological diseases. Hippocrates introduced the concept of high-risk operations, advising specialists to perform them and avoiding untrained healers. He differentiated between upper and lower urinary tract infections, identifying blood clots in urine as kidney discharge and bladder infections as bladder stones. This article highlights the fundamental contributions of Hippocrates to the field of nephrology and to the understanding of renal anatomy and shows how his teachings influenced later medical practices and advances in the understanding of renal function and pathology. This review aims to uncover the significance they hold in the historical literature, showcasing the historical impact of his pioneering work on the Tashrih-al-Nizam-e-Baul (Anatomy of Urinary System).

**Keywords:** Hippocratic Corpus, Ureter, Nephrolithiasis, Renal Tuberculosis, Pyonephrosis.

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## INTRODUCTION

Hippocrates, often hailed as the father of medicine, made significant contributions to the field of anatomy, particularly in exploring the Tashrih-al-Nizam-e-Baul, or the Anatomy of the Urinary System. This comprehensive review delves into the key anatomical discoveries made by Hippocrates in relation to the

urinary system, shedding light on how his observations have influenced our understanding of this intricate system. By examining Hippocrates' findings, we aim to uncover the significance they hold in the history of anatomical studies, showcasing the enduring impact of his pioneering work on the field of medicine.

**Citation:** Rukhsar Hashim, Mohd. Abu Bakr Qadri, Abdul Malik, Nafasat Ali Ansari, Md. Imran Khan (2024). Hippocrate's Contribution Exploring the Tashrih-Al-Nizam-E-Baul (Anatomy of Urinary System): A Comprehensive Review, *SAR J Anat Physiol*, 5(2), 20-24.

Hippocrates, a prominent figure in ancient Greek medicine, made significant contributions to the understanding of the urinary system through his anatomical discoveries. He classified urine based on various characteristics, such as color, thickness, clarity, and sediment content. Hippocrates believed that urine could be categorized as "good" or "bad" depending on its attributes, such as being white or yellow with smooth sediment versus black, thin, fetid, watery, or with branny sediment [1]. Moreover, he identified different states of urine, including "concocted" or "unconcocted", watery, colorless, bloody, clotted, and purulent, demonstrating a keen observational skill in discerning the different presentations of urine [1]. Hippocrates also noted correlations between color and consistency, observing that white urine tended to be thick while black urine was typically thin [1]. These findings not only laid the foundation for understanding urinary disorders but also reflected Hippocrates' meticulous approach to anatomical studies and diagnostic reasoning.

Classification of disease was based upon criteria such as fevers or seizures or according to organs that might be affected, such as liver disease, lung disease, or kidney disease, and symptoms were noted as being hot or cold, wet or dry, or according to the four primary humors [3-5]. Hippocrates demonstrated a sophisticated understanding of the urinary system that paved the way for further advancements in the field. Following Hippocrates, numerous Greek scholars enriched the anatomical knowledge base, particularly in areas like retention of urine and gonorrhoea, showcasing a collaborative effort to expand understanding and improve medical practices [4].

Hippocrates highlighted the interconnectedness of various components of the renal system, such as the glomerulus, tubules, collecting ducts, and capillary blood supply in each nephron, underscoring the holistic nature of urinary function and regulation [2, 3]. Hippocrates' early contributions to the understanding of urinary physiology continue to inform contemporary research and medical practice, emphasizing the enduring relevance of his observations in the field of urology. Hippocrates laid the foundation for a more comprehensive approach to assessing urinary system function and identifying potential issues. Furthermore, the findings presented in this research paper shed light on the historical significance of Hippocrates' contributions to the understanding of the urinary system.

### Historical Background

The history of the kidney is a fascinating journey through the annals of medical knowledge. Ancient civilizations like the Egyptians and Greeks recognized the importance of the kidneys in bodily functions. They believed the kidneys played a crucial role in maintaining health through the balance of bodily fluids. In the 4th century BCE, the Greek physician Hippocrates made significant contributions to the

understanding of renal anatomy and function. He described the kidneys as vital organs for regulating bodily fluids. Throughout the middle Ages, various cultures expanded on this knowledge, with figures like Galen of Pergamon contributing to the understanding of kidney function. The Renaissance marked a period of renewed interest in anatomy and physiology, with notable figures like Leonardo da Vinci making detailed anatomical drawings of the kidneys. In the modern era, the advent of microscopy and advances in medical science led to a deeper understanding of renal anatomy and physiology, including filtration and excretion processes. Today, the study of the kidney, known as nephrology, continues to be a vital field in medicine, with ongoing research aimed at treating kidney diseases and improving renal health.

### Hippocrates Contribution to Anatomy of Urinary System

Hippocrates' understanding of anatomy was based on observations of external features, palpation (touch), and rudimentary dissections. He recognized the importance of understanding the body's structure and its role in health and disease. Hippocrates recognized the significance of the kidneys. A huge amount of clinical observation is offered by Hippocratic texts [1]. The corpus describes how the kidney develops at the end of renal arteries. This shows the observation of the anatomical connection of spermatic arteries with the kidneys, a fact that led to the belief that sperm is produced initially inside the kidneys and then travels through the spermatic vessels to the testicles before finally exiting the body. The similarity in the shape of both kidneys and their apple-like color is also described. A description includes the texture of the kidneys, which is granular and viscous, and the excess moisture in their internal structure. It is also noted that the ureters go down from the kidneys and terminate in the bladder [13-15]. It is written that renal vessels transfer blood that has liquid waste products formed after metabolic reactions to the kidneys, and the purified blood returns to the entire body [13].

Hippocrates made contributions to the understanding of the kidneys in ancient medicine. He recognized the importance of the kidneys in maintaining bodily fluids and balancing humors, which were fundamental concepts in ancient Greek medicine. Hippocrates believed that the kidneys played an important role in the excretion of waste products. He also associated certain symptoms and conditions with kidney dysfunction. Hippocrates made some observations and contributions related to the urinary system, which includes the ureters. He recognized the existence of tubes that carried urine from the kidneys to the bladder. Hippocrates understood the basic function of these tubes in transporting urine. The term "ureter" itself is derived from the Greek word "oureter," which means "to carry urine."

It's worth noting that the detailed anatomical and physiological understanding of the ureters and the entire urinary system has been greatly expanded upon through centuries of medical research and advancements. He recognized the role of the bladder in storing and expelling urine, which was an important aspect of his understanding of bodily functions and health. Hippocrates believed that the bladder played a crucial role in maintaining the balance of bodily fluids.

If the neck of the bladder has inflammation, it does not allow the urine to pass. The dense and cloudiest parts of urine are collected together. The aggregation of crystals combined to form a stone prevents the urine from passing and leads to great pain [1]. Hippocrates had some understanding of the urethra, which he referred to as the "urethron" in ancient Greek. He recognized its role in the passage of urine from the bladder out of the body. It is critical to confess that Hippocrates' knowledge of the urethra did not provide a detailed anatomical understanding. Hippocrates said that the female urethra is short and wide, so the female children have fewer tendencies to develop a stone, and the urine is passed easily. However, in males, the urethra is not straight, and it is narrow as well [1].

He was well acquainted with blood vessels, and in his research on the nature of man, he presents a highly conceptual explanation of human blood vessels and suggests locations for venesection [12]. The thickest blood vessels, which are four pairs in the body, are arranged in such a way that the third pair goes from the temples through the neck under the shoulder blades, then to the lungs and extends from the right to the left and the other from the left to the right. And on the right-hand side, one of them goes from the lungs below the breast and into the spleen and the left kidney, while the other one from the left goes into the right-hand side through the lungs below the breast and into the liver and the right kidney, and they both end in the anus [8-12].

### **Hippocrates Contribution to Clinical Anatomy of Urinary System**

Hippocrates' approach to clinical anatomy laid the groundwork for the integration of anatomical knowledge into medical practice, a principle that continues to be a cornerstone of modern medicine. His legacy continues to influence medical education and practice to this day. Hippocrates, often regarded as the father of Western medicine, made significant contributions to the understanding and treatment of various medical conditions, including kidney-related issues. The term "nephritic" is used to mark out those patients who have a variety of renal ailments, such as strangury, anuria, and hematuria.

He clearly distinguished blood in the urine as a sign of hemorrhage, i.e., a ruptured vessel from the bladder or kidneys [13, 14], and the "fleshy substances" as originating from the kidneys. A patient may have

bladder disease if they pass blood and clots and have discomfort and stiffness in their pubic area and perineum. An excellent indication of Hippocratic anatomy knowledge is provided by the topographic localization and correlation with anatomic structures [13]. The "tubercles" are probably tuberculous granulomata from genitourinary tuberculosis or any other chronic infection. Their location inside the urethra would cause pain, dysuria, and difficulty voiding [13]. The weakening of the Quwwate masika in the duct connecting the kidney and bladder is a contributing factor to the gradual release of urine drop by drop. This weakening prevents the duct from effectively stopping the flow of fluid from the kidney towards the bladder, resulting in a continuous discharge of urine. Consequently, the patient experiences a persistent feeling of thirst, comparable in intensity to hunger. In cases where the patient also experiences severe pain alongside their thirst, they may refuse any form of treatment, indicating that their condition is incurable and their chances of survival are diminished [14].

### **Renal Diseases in Hippocratic Period**

Galen discusses the close relationship between Knidian physicians and the four renal diseases, as outlined in the book 'Inner Sufferings', whose author remains unknown but is often attributed to the Hippocratic work. The first renal ailment described in the text is nephrolithiasis, which is characterized by the presence of kidney stones and accompanied by renal colic [4]. The second disease is renal tuberculosis; the third is either renal vein thrombosis or bilateral papillary necrosis. The fourth disease, described in detail a chronic suppurative renal infection or a sexually transmitted urethritis, complicated by renal involvement. The follow up treatment is diet modification, physical exercise, ingestion of extracts of herbs and surgery, as a last option. It is the evidence that Hippocrates is the father of clinical nephrology and that Hippocratic medicine develops the basis for the advancement of clinical nephrology [4]. He described symptoms of bladder stones, as well as describing various urinary conditions such as painful, difficult urination, incontinence, urinary retention, renal colic, and renal tuberculosis, as well as chronic renal infection. According to Hippocrates, the cause of kidney stones was drinking water containing high levels of minerals, and he concluded that urine is made at the bladder. The treatment for urinary disorders varied and included a combination of conclusions from Cnidus and Kos schools of medicine: warm applications, baths, medicinal products like plant derived diuretics, diet, and incision over the kidneys were suggested for urinary stones. According to Hippocrates (Buqraat), the presence of fat in the urine along with a rapid flow indicates an overheating of the kidney. This excessive heat causes the breakdown of kidney fat, resulting in the lubrication of the urine by this fat [14]. Bubbles on the surface of urine are a sign of kidney disease and a long-term illness. Colorless urine is bad. A sudden increase in blood in the urine is a sign that a small kidney vessel has

burst [6]. If inflammation is present around the anus or in uterus and similarly even the pus forms inside the kidney, leads to dribbling of urine and the cause of dribbling of urine due to inflammation around anus or in uterus is affection of bladder by distressfulness of waram-e-har [11].

### Hippocrates' Contribution to Urology

The Hippocratic texts have made significant contributions to the field of urology, particularly in the areas of uroscopy and the theory of renal stone formation [1]. Through a study of the *Corpus Hippocraticum*, various disorders of the urinary tract have been identified, providing valuable insights into the anatomy, physiology, etiology, and treatment of urological diseases. The diagnostic explanations of urine examination provided in these texts continue to be highly regarded, as no other system or organ in the human body offers as much diagnostic or prognostic information through its excretion as the urinary tract does [1]. However, due to the restrictions on anatomic dissections during that time, the analysis of the urinary system was challenging [1].

While some kidney operations were performed, such as drainage for pyonephrosis and renal abscess through deep loin incision, cystectomy, a procedure involving the incision of the bladder, often resulted in severe disability or even death. Complications such as urine leakage, gangrene, and necrosis of the testis due to the cut of the spermatic cord were observed. Recognizing the risks involved, Hippocrates introduced the concept of high-risk operations, advising that only specialists should perform them and urging physicians to avoid the procedure if possible to protect patients from untrained healers [1].

Hippocrates also provided insights into differentiating between upper and lower urinary tract infections. He noted that the presence of small fleshy substances like hair in thick urine indicated a discharge from the kidneys, while the presence of blood clots in the urine accompanied by strangury (painful urination), abdominal pain, and perineal pain indicated an infection originating from the bladder. Bladder stones were a prevalent and troublesome condition during that time, and remedies for stone-related pain included positional changes during voiding, medication, catheterization, and lithotomy (surgical removal of stones). Hippocrates acknowledges that he was unable to cure every individual, indicating a certain level of ineffectiveness within the Hippocratic healing practices. However, despite this limitation, providing a prognosis offered solace by allowing the patient and their family to gain a deeper comprehension of the situation [2].

He says if someone occasionally has slightly bloody urine without fever, it is nothing to worry about, it may just be feeling of tiredness but if frequent and

accompanied by fever, it is the sign that he is going to have purulent urine soon [11].

According to Hippocrates, the presence of a hard bladder accompanied by severe pain and constant fever indicates swelling in the bladder, which signifies an incurable disease with a very low survival rate for the patient. Symptoms of bladder inflammation include persistent fever, insomnia, delirium, and bile discharge during vomiting. The color of the skin can also provide clues about the cause of the bladder swelling, with a white hue indicating a cold (*Barudat*) origin, while a yellow or red skin tone suggests a heat (*Hararat*) related cause [14].

The analysis of the fifth commitment under Hippocratic Oath indicated two key points. Surgeons and lithotomists, who were highly esteemed professionals during that time, specialized in treating bladder stones, a prevalent and serious ailment [2].

### CONCLUSION

Hippocrates (*Buqraat*), a renowned ancient Greek physician often hailed as the progenitor of medicine, played a pivotal role in advancing our comprehension of the human body, including the intricate workings of the urinary system. He placed great emphasis on the significance of observing and comprehending the body's innate processes. Regarding the anatomical aspects of the urinary system, it is plausible that Hippocrates possessed a fundamental understanding of the kidneys, bladder, and the general flow of urine. Nevertheless, it is important to acknowledge that his knowledge would have been considerably limited in comparison to the vast wealth of information available to us today.

The observations made by Hippocrates likely served as a foundation for subsequent breakthroughs in comprehending the urinary system. Over the course of centuries, anatomists and physicians have built upon his initial findings, resulting in the comprehensive knowledge we currently possess regarding the structure and function of the urinary system.

In conclusion, while Hippocrates' contributions were invaluable during his era, contemporary anatomical understanding of the urinary system has undergone significant expansion and refinement. His work laid the groundwork for further research and exploration, ultimately culminating in the comprehensive understanding we have at present. Overall, Hippocrates' impact on the field of medicine, including his contributions to our understanding of the urinary system, cannot be overstated.

**Conflict of Interest:** There are no conflicts of interest that the authors can disclose with the publication of this manuscript.

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