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"URINE ANALYSIS METHODS IN VEDIC ERA VS MODERN ERA"

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Abstract: "Laboratory medicine began with the analysis of human urine, which was called uroscopy and today is termed urinalysis. Uroscopy was the mirror of medicine for thousands of years. From a liquid window through which physicians felt they could view the body's inner workings. Numerous, somewhat accurate, physiologic theories arose from uroscopy. Then the importance of urinary diagnosis became exaggerated, and increasingly complex, until physicians required only the presence of urine, not patients, to diagnose disease. Uroscopy then escaped medical control, becoming first a home health aid and then a tool of uneducated practitioners. Urinalysis is the chemical, physical and microscopic examination of urine via procedures performed in an expeditious, reliable, accurate and safe manner. In ancient times, urine was poured on the ground and the attraction of insects to it indicated an abnormal urine sample. For centuries, the utility of urinalysis as a diagnostic tool is well known in medicine. Since the kidney is involved in maintenance of homeostasis in the body, any deviation from the normal urine composition can be of great diagnostic significance to the healthcare provider."

Keywords: Urinalysis, Vedic Era, Uroscopy, Test Strips, ODT.

I. INTRODUCTION:

1.1 Physical Examination:

CharakaSamhita contains several sections on urologic ailments.[1]The entire fourth chapter of volume 2 is devoted to **urinalysis and clinical interpretations based upon the color, consistency, turbidity, stickiness, presence of blood, semen, pus and fat in urine**. Charaka analyzed the urinary findings with the symptoms of frequency, dysuria, polyuria, intermittency, fever, malaise, nausea etc to arrive at an etiopathological explanation of the individual ailments. Later in the same volume he discussed urinary retention precipitated by dietary and alcoholic indiscretions.

1.2 Uroscopy:

Laboratory medicine began 6000 years ago with the analysis of human urine, which was called **uroscopy until the 17th century and today is termed urinalysis**. Today physicians use urine to diagnose selective conditions but from ancient times until the Victorian era, **urine was used as the primary diagnostic tool**.[2] Physicians spoke of urine as a 'divine fluid', or a window to the body. Babylonian and Egyptian physicians began the art of uroscopy. Uroscopy, from the word 'uroscopia,' means 'scientific examination of urine.

Medical doctrines are first encountered in the religious texts of that period called the Vedas compiled in successive generations from 3000 to 1000 BC.[3]In chronological order, the four Vedas namely the Rig, Yajur, Sam and Atharva Veda chronicle the Vedic hymns as oral religious literature that are still recited during weddings, funerals and other socio-religious occasions in contemporary India.

The seminal reference to urologic ailments in human history is encountered in the Atharva Veda dealing with urinary retention. It specifies the management with camphor and indigenous herbs to be anointed on the abdomen along with chanting of the appropriate hymns.

Although Hippocrates is credited with being the original uroscopist, urine diagnosis is believed to pre-date Hippocrates.[4] In ancient times the symbol for urine was a pairing of water and phallus. **Sumerian and Babylonian physicians of 4000 BC recorded their assessment of urine on clay tablets.** Ancient Sumer, one of the earliest civilizations, recognized that urine characteristics were altered with different diseases.[2] Sanskrit medical works from 100 BC describe 20 different types of urine.

1.3 Identification of Diabetes by Taste of Urine:

Hindu cultures were aware that some people's urine tasted sweet, and that black ants were attracted to this sweet urine, a characteristic of the disease now known as diabetes mellitus. The word diabetes, which stems from the Greek word *siphon*, was coined by Areteus the Cappadocian in the second century. Areteus did not mention the sweetness of urine, but described the disease, poetically, as, 'A melting down of flesh and limbs into urine'.[5]

Fig 1.Physician holding matula into the light for inspection.

Fig 2.A chart used to categorize urine.

The predominant theory of disease causation, accepted into the 16th century, was that of the four humors: blood, phlegm, yellow bile, and black bile, each of which was thought to originate from a different region of the body. It was the physician's responsibility to keep the four humors in balance; disruption caused disease.[6]

1.4 Bubbles Methods:

In *Aphorisma*, Hippocrates describes **bubbles that lay on the surface of fresh urine** as an indication of long-term kidney disease. Bubbles on the surface of urine are in fact often owing to proteinuria and can, in fact, indicate kidney disease or urinary tract infection.[7] In *Aphorisma* Hippocrates also associated urinary sediment with fever, and noted that sediment increased as the fever worsened. The observed sediment may well have been due to white blood cells and bacteria from a urinary tract infection. The presence of blood in the urine was attributed to kidney or bladder ulceration. Hematuria can indeed be due to ulceration, although we now know that it can also be caused by, among other conditions, urinary tract

infection, glomerulonephritis, nephrolithiasis, cystolithiasis, cystic kidney disease, sickle cell anemia, bladder cancer, several other diseases, and even exercise.[5] Not all ancient diagnoses and theories have borne the test of time. The doctrine of urine did not change until six centuries later, when Galen (AD 129–200) began his scientific findings in Rome. Galen refined Hippocrates' ideas, theorizing that urine represented, not a filtrate of the four humors and overall condition, but rather, a filtrate of the blood. Galen sought to make urine diagnosis more specific. He used the phrase, 'diarrhea of urine' to describe excessive urination, and noted that it was an atypical symptom. We now know that polyuria is a symptom of diabetes and other conditions. Galen thought that the liquid ingested equaled the urine expelled in a healthy person.

Historically, urinalysis involved an evaluation of color, transparency (cloudiness or turbidity), odor and taste. In modern medicine, while all of these (except taste) are still evaluated, the evaluation is generally done via test strips. Specifically, the strips are interpreted by watching the various sections (pads or reagent areas) on the strip for color changes and comparing to them to the color-coded key on the bottle label. The specific gravity and pH of urine are additional parameters measured separately.[8]

The pivotal highlight of Susruta's surgical repertoire was the surgery of nasal reconstruction or rhinoplasty His technique was later revived by the Italian surgeon Tagliacozziand the first description in English appeared in The Gentleman's Magazine in 1794.[9]Ackernecht has aptly observed -"There is little doubt that plastic surgery in Europe which flourished in medieval Italy is a direct descendant of classical Indian surgery".Even today plastic surgeons refer to the pedicled forehead flap as the Indian flap. SusrutaSamhita contains descriptions of laparotomy, repair of intestinal injuries as well as numerous other surgeries for hernia, hydrocele, anal fistula, fractures, amputations, cataract couching etc to mention a few.

1.5 Vinegar Method:

Five hundred years after Galen, Protospatharius, who had the idea that adding heat to urine might present more insight, invented the first documented laboratory technique. Heat would precipitate proteins, causing proteinuria to manifest through cloudiness. Hundreds of years later, in the **16th century Paracelsus used vinegar** to bring out cloudiness; acid, like heat, will precipitate or 'cook' proteins.[10]

The technique of collecting urine was thought to be important for accurate interpretation. Ismail of Jurjani, an 11th century physician, recommended collecting the full amount over 24 hours in a large clean vessel and keeping it out of the sun or heat, which could alter color. The vessel was to be shaped in the form of a bladder, in the belief that a more accurate diagnosis would arise if the urine could conform to the vessel in the same way that it conformed in the body. Ismail also recognized that food and aging altered urine, and required a good nights sleep and empty stomach before collection. He wrote about this in the most comprehensive instructional book on urine collection and examination.

1.6 Sediment Method:

Gilles de Corbeil (1165–1213), royal physician to King Philippe-Auguste of France, built on Protospatharius' and Judaeus' writings. His teachings related 20 different types of urine to conditions of the body, he noted differences in **sediment and color**. De Corbeil also introduced the matula, also called a jorden, a glass vessel in which a physician viewed urine, assessing color, consistency, and clarity.[11]Rounded at the bottom and shaped like a bladder, the matula was made of clear, thin glass, and was held up to the light for proper inspection.[11] During the 13th century, William of Saliceto, an Italian physician, noted and accurately described what would later be known as chronic nephritis. He stated, 'The signs of hardness in the kidneys are that the quantity of the urine is diminished, that there is heaviness of the kidneys, and of the spine with some pain.

1.7 Oil Test for Urine(ODT**):**

Ayurvedic physician traditionally have been testing urine by dropping a drop of oil on the surface of the urine. It is very useful in testing the density of the urine. We can easily come to know by following this method that the presence of bile in urine (as the surface tension decreases), the abnormalities in vata, pitta and kapha conditions and also many other types of abnormalities. It is also mentioned that when powdered gandhak (sulphur) is sprinkled on the surface of urine, sinks if the urine contains bile salts.[12]

1.8 Neerkuri test:

A Siddha literature TheraiyarNeerkuri and Neikuri, illustrated the method to collect the urine sample from the patients to perform the Neerkuri test. Urine shall be collected in the early morning in the Padigapaathiram (Crystal vessel) and examined within 90 minutes. On the day before collection of urine, the patients shall have the diet containing balanced six tastes and consume up to his appetite level at the regular time. In more severely ill patients, above criteria is not to be applied during the collection of urine and could be done instantly. The collected urine sample would be examined for five parameters such as Niram (color), Nirai (Density), Naatram (odor), Nurai (Froth) and Enjal (Volume decrease).[13]

During the renaissance, uroscopy entered the household through the best selling book *FasiculusMedicinae*, published in 1491 by Johannes de Ketham from Germany. De Ketham explained current theories and included a self-diagnostic color wheel, with which individuals could self-diagnose their condition.[17] This book became exceedingly popular. Some authors have compared it to the *Merck Manual* (which is sold in consumer bookstores and arguably used more by consumers than physicians). During this era, physicians began to adopt aggressive therapies, treating many ailments with bloodletting and purging.

Susruta provided the most fascinating details about urinary calculus disease. He described several varieties of urinary calculi, their clinical manifestations and emphasized dietary indiscretion as the main etiological factor.

After describing the surgical anatomy and complications that may arise from vesicolithotomy, Susruta concluded - "The surgeon who is not well cognizant of the nature and position of the vulnerable parts in the 8 srotas (ducts) namely the perineal raphe, spermatic cords, ducts of the testes, Yoni (vagina), the rectum, the urethra, urine carrying ducts or ureters and the urinary bladder and is not practiced in the art of surgery, brings about the death of many innocent victims".

The origin of visual urine diagnostics, can be traced back to ancient Egypt. Hippocrates (approx. 400 BC) recognized that urine characteristics (odor / color) were altered with different diseases. He hypothesized that urine was a filtrate of the four humors (blood, phlegm, yellow bile and black bile), which came from the blood and was filtered through the kidneys and pointed out the importance of examining the patient's urine. Six centuries later, Galen (AD 129– 200) refined Hippocrates ideas, theorizing that urine represented is not a filtrate of the four humors and overall condition, but rather, a filtrate of the blood. This doctrine dominated medical thinking up to the 16th century.[14,15]

II. MODERN ERA:

Today Towards the end of the 18th century doctors became more interested in chemistry and turned their attention to a scientific basis of urinalysis. The first "test strips" were developed by the Parisian chemist Jules Maumené (1818–1898) when, in 1850, he impregnated a strip of merino wool with "tin protochloride" (stannous chloride). On application of a drop of urine and heating over a candle the strip immediately turned black if the urine contained sugar and it took another 70 years before the Viennese chemist Fritz Feigl (1891–1971) published his technique of "spot analysis." Urine test strips in the sense used today were first made on industrial scale and offered commercially in the 1950s. The company Boehringer Mannheim, today a top leader on the world market under the name of Roche, launched its first Combur-Test® strips (Fig. 3) in 1964. New impregnation techniques, more stable color indicators and the steady improvement in color gradation have all contributed to the fact that the use of urine test strips has now become established in clinical and general practice as a reliable diagnostic instrument.[16] Urinary Tract Infection is classified as the most common and occurring nosocomial bacterial infection in human populations around the world. UTI is a condition caused by pathogenic invasion of the epithelium, which lines the urinary tract from the minor calyx to prostatic urethra. The proliferation of bacteria in the urothelium can be asymptomatic or symptomatic, which causes inflammatory response and symptomatic case characterized by a wide range of symptoms including, fever, lethargy, anorexia and vomiting [24]

2.1 Chemical Analysis of Urine:

Obtain 50 ml from each of the three simulated urine samples transfer them into a beaker. Label each beaker accordingly. Read the directions (if any) on the strip container. Dip a urinalysis test strip into each beaker and record your results in table A below.[17]

Table A

Test	**Normal values**	**Abnormal values**
Color	Colorless	Milky
	Straw	Brownish yellow
	Amber	Green
	Smoky	Brown
Transparency	Clear	+) Slight (++) Moderate (+++) Cloudy (++++) Very Cloudy
pH 8.0	(4.5-8.0; av 6.0)	<4.5, >8.0
Protein	None to trace	see color chart
Glucose	none	see color chart
Ketones	none	see color chart
Hemoglobin/Occult Blood	none	see color chart

2.2 Specific Gravity Measurement – The Urinometer Method

The specific gravity of a urine sample (i.e., urine density) indicates the solute concentration in urine – it reveals how concentrated or dilute the urine is. Normal values are 1.003 to 1.035 (normal value ranges may vary slightly among laboratories).[18]

2.3 Microscopic Examination – The Sedi-Stain Method:

Normal urine is sterile. Urine may contain one or many "formed elements" which must be reported quantitatively. As part of a urinalysis, the urine sediment is centrifuged and examined microscopically for various crystals, casts, cells, threads, microbes (protozoa, bacteria, yeast, etc.). Examination of sediment provides a direct sampling of urinary tract morphology. In a healthy individual, urine contains some cells (e.g., epithelial cells from the kidney, ureter, bladder, and urethra) and other formed elements from the entire urinary tract. However, in renal disease, the urine often contains increased numbers of substances discharged from the kidney. The specimen used for microscopic examination should be as fresh as possible. For example, red blood cells and many formed solids tend to disintegrate upon standing, particularly if the specimen is warm or alkaline. Additionally, microbes may grow in urine stored at room temperature.[19]

The presence of numerous leucocytes and bacteria is characteristic of a urinary tract infection (UTI). The Gram stain showed the absence of bacteria and the Ziehl Neelsen stain was negative for acid fast bacilli [23]. However, since urine specimens for routine examination are not usually obtained via sterile techniques old specimens may contain many bacteria with few leukocytes. The presence of many squamous cells may indicate an external genital source for the bacteria. A positive nitrite test result may indicate a UTI but a safe diagnosis is only possible by a positive culture obtained with a midstream urine specimen. Bacteria associated with UTIs are mostly bacilli (E. coli).[20]

Microscopic examination:

- Red blood cells: 0-5 (high-power field)
- White blood cells: 0-5 (high-power field)
- Bacteria (spun specimen): absent Casts: 0-4 hyaline (low-power field)

2.4 Composition and benefits of test strips:

Contaminants in the urine may lead to falsepositive or false-negative results. Results can also be influenced by many external and internal factors, which may then lead to a missed or false diagnosis. External factors may include contamination by preservatives or cleaning substances which enter the urine during or after sample collection. The main internal factor which may interfere with the result is the presence of ascorbic acid.[21]

2.5 Nylon mesh technology:

To prevent external and internal interference, Roche has developed an unique test strip technology using a nylon mesh layer on each strip. This net sealing technology compromises a reagent and underlying absorbent paper which are fixed to a plastic carrier foil by a thin nylon mesh. The strip therefore comprises several layers hold together without glue, which might interfere with the result.[22]

Fig 3.Roche test strip

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