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Review Article

INTERPRETATIVE URINALYSIS A STUDY REVIEW

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ABSTRACT

Kidneys excrete the unwanted substance including metabolic end products and those substances which are present in excessive quantities in the body, through urine. In general the concentration of substances found in the urine is affected also by factors such as dietary intake, body metabolism, endocrine function, physical activity, body position.

Urinalysis can reveal diseases that have gone unnoticed because they do not produce striking signs or symptoms. The urinalysis is used as a screening and or diagnostic tool because it can help detect substances or cellular material in the urine associated with different metabolic and kidney disorders. It is ordered widely and routinely to detect any abnormalities that require follow up. Often, substances such as protein or glucose will begin to appear in the urine before people are aware that they may have a problem

Examination of urine is an indispensable part of evaluation of patients with impaired kidney function. It is used to detect urinary tract infections (UTIs) and other disorders of the urinary tract. In those with acute or chronic conditions, such as kidney disease, the urinalysis may be rapidly provides important information about primary kidney disorder and systemic diseases.

There are three portions of a complete Urinalysis: physical, chemical, and microscopic examinations. The urinalysis (UA) is critically important in the diagnosis of renal and urologic diseases.

This article reviews the correct interpretation for performing urinalysis

Keywords: Disease, Kidney disease, Urinary tract, Urinalysis, Urine, Urinary tract etc.

INTRODUCTION

The word is a portmanteau of the words urine and analysis. The oldest of Laboratory procedure used in medicine is the inspection of urine for diagnostic purpose. The ancients paid great attention to the character of urine in disease. According to the Disease prognosis, a careful examination of all excreta was used as a basis for estimating the course of disease.

With the progress of medical science through interpretation of urine examination is possible. Routine urine analysis is mainly performed for the purpose i.e. to detect intrinsic conditions that may adversely affect the urinary tract or the kidneys and to find out metabolic or endocrine disturbances of the body.

Routine urine analysis is mainly performed –To find out metabolic or endocrine disturbance of the body. The second purpose of urine analysis is to be detecting intrinsic condition that may adversely affect the urinary tract or the kidney.

Examination of the urine is an invaluable procedure in the detection of function and abnormalities of the kidney and the Disease. It is one of the most important screening procedures in clinical medicine because it can give diagnostically important information about the presence of diseased states even outside the urinary tract.[1]

METHODS OF URINE COLLECTION

Urine should be collected with minimum contamination.

Clean-catch, midstream urine specimen collected after cleansing the external urethral meatus.

- If not feasible, bladder catheterization is appropriate for adults—risk of contracting a urinary tract infection is negligible for a single catheterization
- Suprapubic aspiration is used in infants
- High urine osmolality and low pH favour cellular preservation; hence first voided morning urine is preferred
- Chemical composition of urine changes with standing and formed elements degrade over time. Hence, urine is best examined when fresh but a brief period of refrigeration is acceptable
- Bacteria in urine multiply at room temperature; hence bacterial counts from unrefrigerated urine are unreliable.

The specimen must be properly labelled. For urine routine examination, any fresh specimen of urine is adequate.

The sample should be examined immediately because on keeping at room temperature, the reaction might change (from acidic to alkaline), casts might disintegrate, crystalline precipitate not originally present may appear and bacterial growth may make the sample turbid.

Urinalysis becomes a basic investigation in condition characterized by derangements of metabolism. Cultural examination is done for diagnosis of urinary carriers of these infections. In general, the quantity, quality and the content of urine reflects the state of metabolic products of circulatory dynamics, water and electrolyte balance, the structure and functions of the Kidneys and the post renal urinary passage. The mechanism of urine formation includes various processes. Other substances found in urine include pigment, enzymes hormones. Red blood cells, white blood cells, epithelial cells, crystals, mucus and bacteria also may found in urine.[6]

ROUTINE URINALYSIS

The Visual or Physical Examination

Visual examination of the urine, observes the urine's colour, clarity, and concentration. Urine can be a variety of colours, most often shades of yellow, from very pale or colourless to very dark or amber.

1. The depth of urine colour is also a crude indicator of urine concentration:
2. Pale yellow or colourless urine indicates dilute urine where lots of water is being excreted.
3. Dark yellow urine indicates concentrated urine and the excretion of waste products in a smaller quantity of water, such as is seen with the first morning urine, with dehydration, and during a fever.

Urine clarity refers using one of the following terms: clear, slightly cloudy, cloudy, or turbid. Substances that cause cloudiness but that are not considered unhealthy include mucus, sperm and prostatic fluid, cells from the skin, normal urine crystals, and contaminants such as body lotions and powders. Other substances that can make urine cloudy, like red blood cells, white blood cells, or bacteria, indicate a condition that requires attention. Urine colour and clarity can be a sign of what substances may be present in urine.

Total volume/Quantity:

Normally 700 to 2000ml per day (average 1200ml/day) of urine passed in 24 hours and most of it passed during day time. The quantity of the urine varies inversely with the amount of fluid eliminated by lungs, bowels and physiological factors like fluid intake diet (high protein), exercise, environmental temperature and humidity, body weight and age. Infants and children excrete, for their weight 3-4 times more than adults.

a) Polyuria: is increased in urine output (>2000/24 hours) physiological due to excess water intake, may be seasonal (in winter) and pathologically in diabetes mellitus, diabetes insipidus, early stage of chronic nephritis, during recovery from oedema.
b) Oliguria: is decreased in urine output (<500ml/24 hours) physiologically due to less intake of water, dehydration pathologically in acute and chronic glomerulonephritis, shock, congestive cardiac failure, fever, renal ischemia.
c) Anuria: is suppression of almost complete urine formation, the output falling to less than 100ml/24hours, pathologically in acute glomerulonephritis, chronic renal disease, renal stones, tumours, after a mismatched blood transfusion.
d) Nocturnal: means when urine is passed in excess of 500ml during night. This is a sign of early renal failure.

Colour/ Appearance

Normally colour of urine is pale, yellow, clear, and transparent. The colour of urine is due to the urobilin and urochromes.[2]

Color change	Substance and Pathological states occurring in
White	Chyle, pus, phosphate crystals
Pink/red/brown	Erythrocytes, hemoglobin, myoglobin, porphyrins, beets, senna, cascara, levodopa, methyldopa, deferoxamine Phenolphthalein and congeners, food colorings, metronidazole, phenacetin, anthraquinones, doxorubicin, Phenothiazines
Yellow/orange/ brown	Bilirubin, urobilin, phenazopyridine urinary analgesics, senna, cascara, mepacrine, iron compounds, nitrofurantoin, riboflavin, rhubarb, sulfasalazine, rifampin, fluorescein, phenytoin, metronidazole
Brown/black	Methemoglobin, homogentisic acid (alkaptonuria), melanin (melanoma), levodopa, methyldopa
Blue/green, green/brown	Biliverdin, pseudomonas infection, dyes (methylene blue and indigo carmine), triamterene, vitamin B complex, methocarbamol, indicant, phenol, chlorophyll, propofol, amitriptyline, triamterene
Purple	Infection with Escherichia coli, pseudomonas, enterococcus, others
Odor	Substance or condition
Sweet or fruity	Ketones
Ammoniacal	Urea splitting bacterial infection
Maple syrup	Maple syrup urine disease
Musty or mousy	Phenylketonuria
“Sweet feet”	Isovaleric or glutamic acidemia or excess butyric or hexanoic acid
Rancid	Hypermethioninemia, tyrosinemia

Odour:

- Normal fresh urine has a slight aromatic odour. Stale urine has an ammoniac odour due to the decomposition of urea.
- Urine containing acetone has a fruity or sweetish odour.
- Pyuric urine gives a putrid odour from the decomposition of pus.
- Faecal contamination gives a faecal odour.
- Fruity odour is present when the urine contains ketone bodies.

Specific Gravity (SG)

The normal specific gravity is usually between 1.015 and 1.025 in a 24 hours specimen (distilled water is 1.000).

Specific gravity of urine is determined by the presence of solutes represented by particles of varying sizes, from small ions to larger proteins. Urine osmolality measures the total number of dissolved particles, regardless of their size. Urine specific gravity (U-SG) is directly proportional to urine osmolality (U-Osm). If there were no solutes present, the SG of urine would be 1.000 – the same as pure water.

Any urine having a specific gravity over 1.035 is either contaminated contains very high levels of glucose, or the patient may have recently received high density radiopaque dyes intravenously for radiographic studies.

Generally the greater the volume, the lower is the specific gravity, except in diabetes mellitus. The substances influencing the specific gravity of urine are urea, sodium chloride and phosphates and abnormally albumin and sugar.

Reaction:

Blue and red litmus papers are put in urine. If blue turns red, urine is acidic. If red turns blue, urine is alkaline.

Acidic urine: due to high protein intake, e.g. Meat, Ingestion of acidic fruits, Respiratory and metabolic acidosis, UTI by E-coli bacteria Alkaline urine: due to citrus fruits, vegetables, respiratory and metabolic alkalosis. UTI byproteus, pseudomonas.

On standing at room temperature, the urine becomes alkaline due to the formation of ammonia.

pH

Urinary pH can range from 4.5 to 8 but normally is slightly acidic (i.e., 5.5 to 6.5) because of metabolic activity. Diet can be used to modify urine pH. A high-protein diet and a vegetarian diet, or the ingestion of citrus fruits will make the urine more alkaline respectively.

Urinary pH generally reflects the serum pH, except in patients with renal tubular acidosis (RTA). The inability to acidify urine to a pH of less than 5.5 despite an overnight fast and administration of an acid load is the hallmark of RTA. In type I (distal) RTA, the serum is acidic but the urine is alkaline, secondary to an inability to secrete protons into the urine. Alkaline urine in a patient with a UTI suggests the presence of a urea-splitting organism, which may be associated with magnesium-ammonium phosphate crystals and can form calculi. Uric acid calculi are associated with acidic urine.[3]

The Chemical Examination

1. Protein

Albumin is smaller than most other proteins and protein that is seen in the urine when kidney dysfunction begins to develop.

The protein test pad measures the amount of albumin in the urine. When urine protein is elevated called proteinuria early sign of kidney disease.A small amount of filtered plasma proteins and protein secreted by the nephron (Tamm-Horsfall protein) can be found in normal urine. In rough terms, trace positive results (which represent a slightly hazy appearance in urine)

Disorderwhich produce high amounts of proteins in the blood such asmultiple myeloma, conditionsthat destroy red blood cells. Inflammation of bladder, prostate, or urethra, malignancies (cancer), injury of the urinary tract.vaginal secretions that get into urine.

2. Glucose

Glucose is normally not present in urine. A reduction in the "renal threshold" When blood glucose levels reach a certain concentration, the kidneys begin to excrete glucose into the urine. Less than 0.1% of glucose normally filtered by the glomerulus appears in urine (< 130 mg/24 hr).

Glycosuria (excess sugar in urine) generally means diabetes mellitus.Some other conditions that can cause glycosuria include hormonal disorders, liver disease, medications, and pregnancy.

3. Ketones

Ketones (acetone, aceotacetic acid, beta-hydroxybutyric acid) resulting from either diabetic ketosis or some other form of calorie deprivation (starvation), Ketones are not normally found in the urine. They are intermediate products of fat metabolism. When a person's body cannot use carbohydrates properly, the body metabolizes fat instead to get the energy it needs to keep functioning.

Ketones in urine can give an early indication of insufficient insulin in a person who has diabetes. Severe exercise, exposure to cold, and loss of carbohydrates, such as with frequent vomiting, can also increase fat metabolism, resulting in ketonuria.

4. Blood (Hemoglobin)

This test is used to detect hemoglobin in the urine (hemoglobinuria). Even small increases in the amount of RBCs in urine can be significant. Its presence in the urine indicates blood in the urine (known as hematuria). This test cannot determine the severity of disease nor be used to identify where the blood is coming from.

Numerous diseases of the kidney and urinary tract, as well as trauma, medications, smoking, or strenuous exercise can cause hematuria or hemoglobinuria.Sometimes a chemical test for blood in the urine is negative, but the Microscopic Exam shows increased numbers of RBCs.

5. Leukocyte Esterase

Leukocyte esterase is an enzyme present in most white blood cells (WBCs). Normally, a few white blood cells (see microscopic examination) are present in urine and this test is negative. WBCs in urine increases significantly, it means that there is inflammation in the urinary tract or kidneys.There is common cause for WBCs in urine (leukocyturia) is a bacterial urinary tract infection (UTI), such as a bladder or kidney infection.

6. Nitrite

Normally the urinary tract and urine are free of bacteria. When

bacteria find, they can cause a urinary tract infection (UTI). A positive nitrite test result can indicate a UTI. Gram negative rods such as E. coli are more likely to give a positive test.

7. Bilirubin

Bilirubin is not present in the urine of normal, healthy individuals. Bilirubin is a waste product that is produced by the liver .In certain liver diseases, such as biliary obstruction or hepatitis, bilirubin leaks back into the blood stream and is excreted in urine. The presence of bilirubin in urine is an early indicator of liver disease and can occur before clinical symptoms

8. Urobilinogen

Urobilinogen is normally present in urine in low concentrations. Positive test results help detect liver diseases such as hepatitis and cirrhosis and conditions associated with increased RBC destruction (hemolyticanemia). When urine urobilinogen is low or absent in a person with urine bilirubin and/or signs of liver dysfunction, it can indicate the presence of hepatic or biliary obstruction.

The Microscopic Examination

It will typically be done when there are abnormal findings on the physical or chemical examination. It is performed on urine sediment.

Microscopic examination is an indispensable part ofurinalysis; the identification of casts, cells, crystals, andbacteria aids in the diagnosis of a variety of conditions. To prepare a urine specimen for microscopic analysis; afresh sample of 10 to 15 mL of urine should be centrifugedat 1,500 to 3,000 rpm for five minutes. The supernatantthen is decanted and the sediment resuspendedin the remaining liquid. A single drop is transferred toa clean glass slide, and a cover slip is applied.

In addition, some entities, if present, are estimated as "few," "moderate," or "many," such as epithelial cells, bacteria, and crystals. The numbers of casts seen are usually reported 5-10 hyaline casts/L casts/LPF. Next, examination is carried out at high power to identify crystals, cells, and bacteria. The various types of cells are usually described as 1-5 WBC/HPF.[4,5,7]

SUMMARY

To summarize, a properly collected clean-catch, midstream urine after cleansing of the urethral meatus is adequate for complete urinalysis. In fact, these specimens generally suffice even for urine culture. A period of dehydration may precede urine collection if testing of renal concentration is desired, but any specific gravity > 1.022 measured in a randomly collected specimen denotes adequate renal concentration so long as there are no abnormal solutes in the urine.

CONCLUSION

Another important factor is the interval of time which elapses from collection to examination in the laboratory. Changes which occur with time after collection include: 1) decreased clarity due to crystallization of solutes, 2) rising pH, 3) loss of ketone bodies, 4) loss of bilirubin, 5) dissolution of cells and casts, and 6) overgrowth of contaminating microorganisms. Generally, urinalysis may not reflect the findings of absolutely fresh urine if the sample is > 1 hour old. Therefore, get the urine to the laboratory as quickly as possible.

A urinalysis (UA), also known as routine and microscopy, is an array of tests performed on urine, and one of the most common methods of medical diagnosis. The target parameters that can be measured or quantified in urinalysis include naked-eye (gross) examination for color and smell plus analysis for many substances and cells, as well as other properties, such as specific gravity.

Urinalysis can reveal diseases that have gone unnoticed because they do not produce striking signs or symptoms. Examples include diabetes mellitus, various forms of glomerulonephritis, and chronic urinary tract infections.[6]

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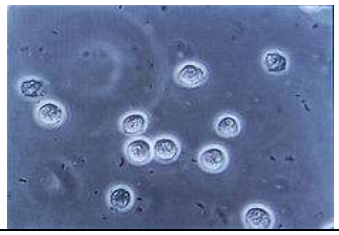
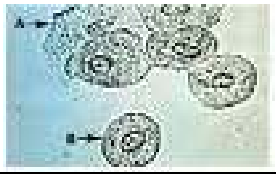
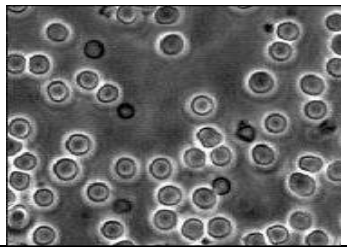
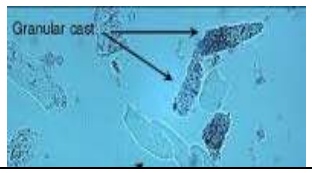
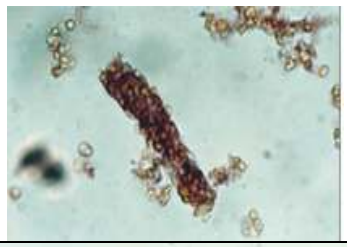
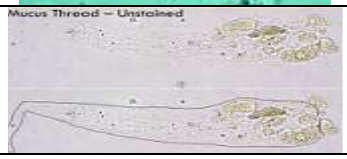
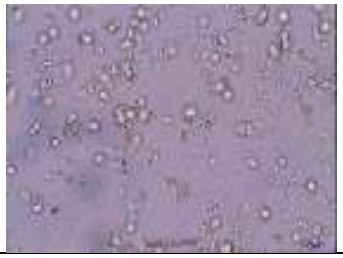
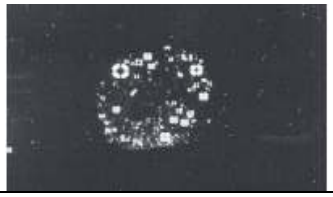
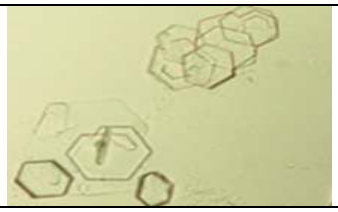
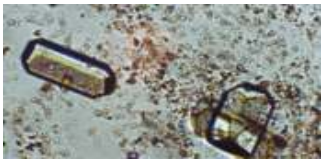
Leukocytes	The pus cells can enter in urine anywhere from the glomerulus to the urethra. The number of WBCs in urine sediment is normally low. Normal Urine can contain 2-3 pus cells/h. p. f. These are mostly neutrophils. Pyuria refers to the presence of abnormal numbers of leukocytes that may appear with infection in urinary tract or with acute glomerulonephritis. When the number is high, it indicates an infection or inflammation somewhere in the urinary tract. WBCs can also be a contaminant, such as those from vaginal and cervical	

	secretions. If two or more leukocytes per each high power field appear in non-contaminated urine, the specimen is probably abnormal.	 
Epithelial Cells	These cells may originate from any site in the Genitourinary tract from the proximal convoluted tubule to the urethra or from vagina. Epithelial cells are usually reported as "few," "moderate," or "many" present per low power field (LPF). "Three main types of epithelial cells :- **a)Tubular epithelial cells** Slightly larger than leukocytes and large round nucleus. **b)Transitional epithelial** cells from the renal pelvis, ureter, or bladder have more regular cell borders, larger nuclei, and smaller overall size than squamous epithelium They have pear shaped or round with two nuclei. **c)Squamous epithelial cells** from the skin surface or from the outer urethra can appear in urine. They are large, flat and irregularly shaped with small central nuclei.	 Squamous Epithelial Cells 
Erythrocytes (Red Blood Cell)	Red cells in urine due to: glomerular damage, tumors which erode the urinary tract anywhere along its length, kidney trauma, urinary tract stones, renal infarcts, acute tubular necrosis, nephrotoxins, Inflammation, injury in the bladder or urethra, can cause RBCs to leak out of the blood vessels into the urine,and physical stress.In addition, red cell ghosts may simulate yeast. RBCs can also be a contaminant due to an improper sample collection and blood from hemorrhoids or menstruation.	
Casts	Urinary casts are formed in the lumen of the tubules of the kidney. Casts can form as the result of precipitation of gelatin of Tammslorsfallmucoprotein. Clumping of cells on other material with in protein matrix. Coagulation of material with in the lumen.	
A) Granular Casts	When cellular casts remain in the nephron for some time before they are flushed into the bladder urine, the cells may degenerate to become a coarsely granular cast Significant renal disease, present due to the degeneration of cellular casts.	 Granular cast
B) Hyaline Casts	Casts are cylindrical particles sometimes found in urine that are formed from coagulated protein secreted by kidney cells. They are	

	formed in the long, thin, hollow tubes of the kidneys known as tubules and usually take the shape of the tubule, Colourless, homogenous, transparent and with round ends. Under the microscope, they often look like the shape of a "hot dog" and in healthy people they appear nearly clear. This type of cast is called a "hyaline" cast. Increased in the mildest kind of renal disease.	
C) Red cell casts	When a disease process is present in the kidney, other things such as RBCs can become trapped in the protein as the cast is formed. Red blood cells may stick together and form red blood cell casts. Contain few RBCs in protein matrix and always pathogenic. Found in acute glomerulonephritis, sub-acute endocarditis and also in severe pyelonephritis and in renal infraction. Glomerular inflammation with leakage of RBC's to produce a red blood cell cast	
D)White cell casts	Appear in polymorphonuclear neutrophils. The cells may be few or many, tightly packed together. Present in renal infection and inflammation. White blood cell casts are most typical for acute pyelonephritis, but they may also be present with glomerulonephritis. Their presence indicates inflammation of the kidney, because such casts will not form except in the kidney.	
E)Epithelial cell casts	Arranged haphazardly and vary in size and shape and rarely seen in urine. Presence of casts indicates tubular degeneration and necrosis. Also present in severe chronic renal disease.	
F)Waxy Casts	Have very high refractive index, yellow grey or colourless and have a homogenous appearance found in degeneration of granular casts.	
G)Fatty casts	Formed by incorporated free fat droplets or oral fat bodies. These are seen when there is fatty degeneration of the tubular epithelium, nephritic syndrome and toxic renal poisoning.	
Mucus threads	Long, thin, waxy threads of ribbon like structures. Found in condition of inflammation or irritation of urinary tract.	
Yeast cells	Smooth colourless and usually ovoid cells, vary in size and have doubly retractile walls. Yeast cells may be contaminants or represent a true yeast infection. They are often difficult to distinguish from red cells and amorphous crystals but are distinguished by their tendency to bud. Most often they are Candida, which may colonize bladder, urethra, or vagina. Found in urinary tract infection, Diabetes Mellitus and present as a result of vaginal contamination.	
Bacteria	Normally urine is free of bacteria. Less frequently, bacteria from a blood infection (septicaemia) may move into the urinary tract. This also results in a UTI Bacteria are common in urine specimens	

	because of the abundant normal microbial flora of the vagina or external urethral meatus and because of their ability to rapidly multiply in urine standing at room temperature. Therefore, microbial organisms found in all but the most scrupulously collected urines should be interpreted in view of clinical symptoms. Present in large number with pus cells indicate Urinary Tract Infections.A colony count may also be done to see if significant numbers of bacteria are present. Generally, more than 100,000/ml of one organism reflects significant bacteriuria.	
Spermatozoa	Sperms are present in urine. They are present in urine of male after epileptic convulsions, nocturnal emissions and in diseases of genital organ. After coitus they may be present in urine of both sexes. Spermatozoa can sometimes be seen. Rarely, pinworm ova may contaminate the urine.	
Oval fat bodies and fat droplets	When lipiduria occurs, these cells contain endogenous free fat droplets in urine i.e.lipiduria (excretion of lipids in urine). Present in nephrotic syndrome, D.M. lipoid nephrosis and in fat embolism.	
Crystals	Urine contains many dissolved substances (solutes) – waste chemicals that the body needs to eliminate. Found in urine, in calculus formation, metabolic disorders and in medication. These solutes can form crystals, solid forms of a particular substance, in the urine if: The urine pH is increasingly acidic or basic; The concentration of dissolved substances is increased; and The urine temperature promotes their formation. Crystals are identified by their shape, color, and by the urine pH. Abnormal crystals may indicate an abnormal metabolic process. Crystals found in acid Urine:-	
a) Uric acid	In diamond rhomic or roselt form stained with urinary pigments as yellow or red brown. These are found in gout, chronic nephritis, and acute febrile conditions.	
b)Calcium Oxalate	Colourless and octahedral shaped and dumb-bell shaped also frequently found in acid and neutral urine. These can be present after ingestion of tomatoes, spinach, garlic, and Vit. C Increased of crystals in D.M. Liver disease and chronic liver disease and suggest the possibility of oxalate calculi.	
c) Amorphous urates	There are urate salts of sodium, potassium, magnesium and calcium. Appearance is yellow-red granular. They have no clinical significance.	
d) Cystine crystals	Colourless, retractile, hexagonal plates with equal or unequal sides. They can form calculi. Cystine crystals in urine of neonates with congenital cystinuria or severe liver disease, tyrosine crystals with congenital tyrosinosis or marked liver impairment.	

		
e) Tyrosine	these appear in the form of fine, vefractile needles occurring in clusters or shaves. Found in liver disease and tyrosinosis.	
f) Leucien	These are oily, highly retractile spheroids with radial and concentric striations, havind yellow or brown colour found in severe hepatitis and acute yellow atrophy Leucine crystals in patients with severe liver disease or with maple syrup urine disease.	
	Crystals found in alkaline urine:-	
a) Triple phosphate	Colourless prisms with 3 or 6 sides and frequently with oblique end . They can form calculi, found in chronic cystitis, chronic pyelitis, enlarged prostate.	
b) Calcium Carbonate	small, colourless and in the form of spherical, dumbbell shape or as granular type.	
c) Calcium phosphate	Long, thin, colourless and prism like with one pointed end, arranged as rosettes. These appear as irregular, granular plates. They may also form calculi.	
d) Ammonium biurates	yellow brown spherical bodies with or without long, irregular spicules. Presence of ammonium bio rates is abnormal if found in fresh urine.	
Cholesterol	These are large, flat and transparent plates with notched corners. Found in nephritis, chyluria, excessive tissue breakdown.	
Parasite, Microorganisms (bacteria, trichomonads, yeast)	In health, the urinary tract is sterile; there will be no microorganisms seen in the urine sediment. Microorganisms are usually reported as "none," "few," "moderate," or "many" present per high power field (HPF). In women (and rarely in men), yeast can be present in urine. They are most often present in women who have a vaginal yeast infection, because of contamination with vaginal secretions during collection. Trichomonads are parasites that may be found in the urine of women or men (rarely). As with yeast, the trichomonads are actually infecting the vaginal canal and their presence in urine is due to contamination. 1.Trichomonas VaginalisTrophozoites 2.Enterobius Vermicularis 3.SchistosomaHematobium Ovum.	

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