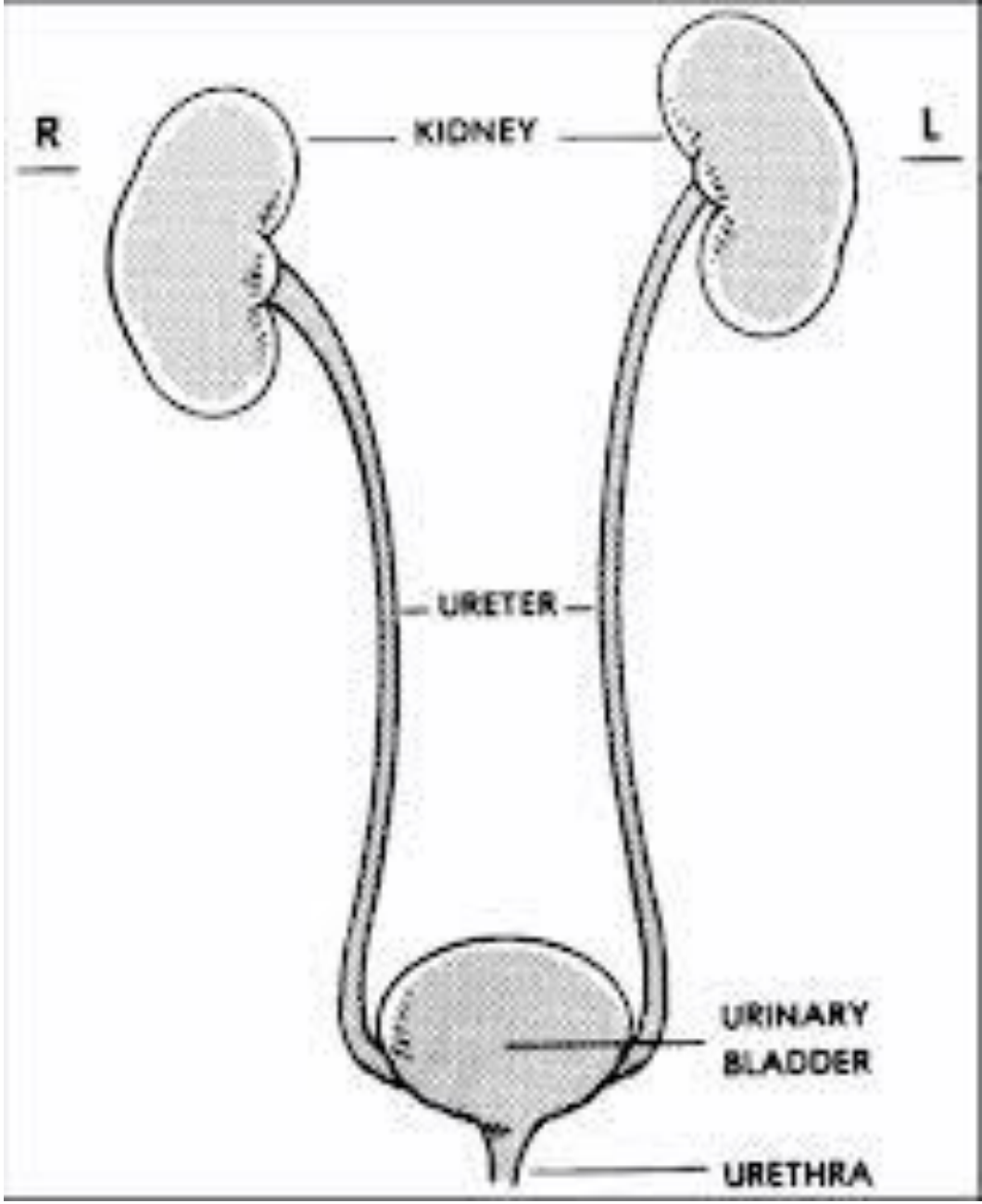
URINE EXAMINATION MBS 240



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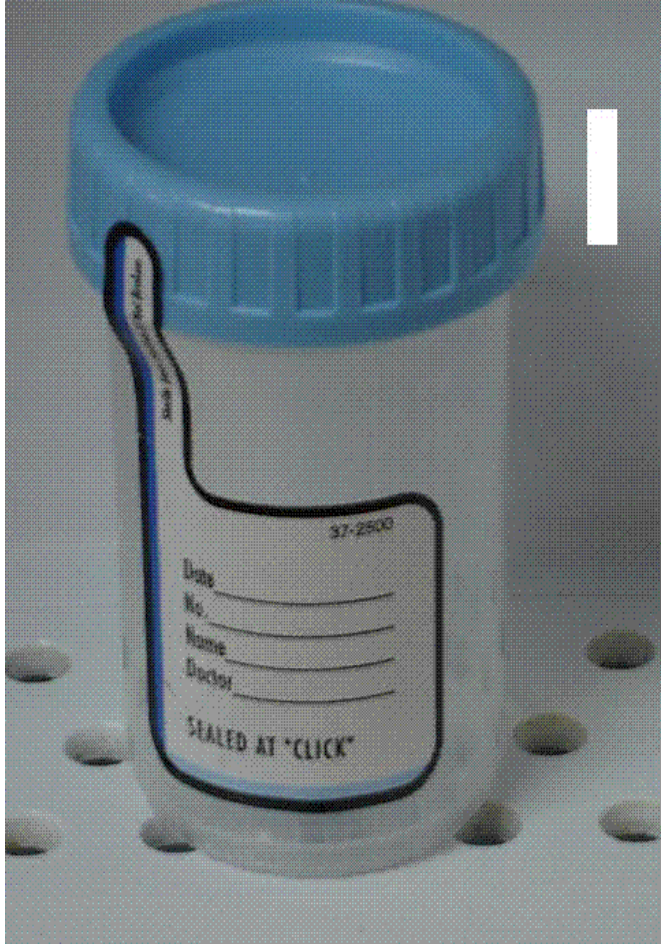
Objectives

- After this lecture, you will be better able to know and understand:
  - The pathogens that cause UTIs (Bacteria, Parasites, Viruses)
  - The signs and symptoms of UTIs
  - The description of terms used in the urinary tract
  - The specimen collection for diagnosis of UTI
  - The specimen collection for pregnancy test
  - The stages involved in lab diagnosis of a UTI
  - The different stages of urine examination
  - The test used for pregnancy testing

Introduction

- Urine:
- is a watery, yellowish fluid, stored in the bladder and discharged from the body through the urethra
- is one of the body`s chief means of eliminating excess water and salt, and also contain nitrogen compounds such as urea and other waste substances removed from the blood by the kidneys



UTI signs and symptoms

- UTIs do not always cause sign and symptoms, but when they do, they may include:
  - A strong, persistent urge to urinate
  - A burning sensation when urinating
  - Passing frequent, small amounts of urine
  - Urine may appear cloudy
  - Strong-smelling urine
  - Pelvic pain in women
  - Rectal pain in men

Types of UTIs

- Typing of UTIs depend on the part of the urinary tract affected:

Part of urinary tract affected	Signs and symptoms
Kidneys (Pyelonephritis)	upper back and side pain, high fever, shaking and chills, nausea and vomiting
Bladder (cystitis)	Pelvic pressure, lower abdomen discomfort, frequent and painful urination, blood in urine
Urethra (Urethritis)	Burning sensation when urinating

Description of terms

- **Cystitis**-infection of the bladder
- **Haemorrhagic cystitis**-inflammation of the bladder, causing blood in urine, abdominal pain and problems with urination
- **Dysuria**-pain when passing urine
- **Pyuria**-increased number of pus cells in urine
- **Pyelonephritis**-infection of the kidney

Description of terms

- ****Normal urine** volume is 600-1550ml
- **Polyuria**-excessive or abnormally large production or passage of urine i.e. >2000ml
- **Oliguria**-decreased output of urine, usually below 400ml
- **Anuria**- lack or non passage of urine, if so, about <100mls a day
- **Haematuria**-Red cells in urine
- **Glomerulonephritis**-inflammation of the glomeruli of kidneys
- **Calculi**-Stones in the UT

Organisms that cause UTI`s

- **Bacteria**
  - **Gram positive**
    - Staphylococcus
    - Haemolytic streptococci
    - Saprophyticus
  - **Gram negative**
    - *Escherichia coli*
    - Proteus spp
    - Klebsiella spp
    - *Pseudomonas aeriginosa*

- Salmonella typhi, Salmonella paratyphi and Neisseria gonorrhoeae are not primarily urinary tract pathogens, BUT they may be found in urine
- Other bacteria like Mycobacteria tuberculosis, Chlamydia, Candida and Mycoplasma can be found in the urinary tract
- **Parasites**
  - Schistosoma haematobium
  - Trichomonas vaginalis

Some facts

- Urinary tract infections are more common in females than in males due to the shortness of the female urethra
- *E.coli* is the most common urinary pathogen accounting for about 60-90% of UTIs
- UTIs caused by Klebsiella, Proteus, Pseudomonas spp and *S. aureus* are associated with hospital acquired infection, following catheterization or gynaecological surgery

Some facts

- *Staphylococcus saprophyticus* infections are usually found in young women who are sexually active
- Candida caused urinary infection is usually found in diabetic patients and the immunosuppressed

1. Urine analysis for UTI

- Day 1: Stage 1:
  - Urine collection
    - Urine should be collected in a sterile, dry, wide neck, leak proof container
    - Early morning urine is preferred
    - Mid stream urine is recommended
    - Container should be labeled with Name and Patient number, date and time of collection
    - The specimen should be sent to he lab ASAP
    - If not possible, refrigerate at temps of 4-6^{o}C

Day 1: Stage 2:

- Macroscopic examination
  - Volume normal is about 600-1550ml
  - Color of the urine (specimen)
  - Odour
  - Whether cloudy (turbid) or clear

Colour and appearance

Appearance of urine	Possible cause
Normal appearance is clear & pale yellow	
Colorless	dilution, diabetes mellitus,
Cloudy with unpleasant smell and has WBCs	Bacterial urinary infection
Red or cloudy due to RBCs	Urinary shistosomiasis Bacterial infection
Yellow-brown or green-brown due to Bilirubin	Acute viral hepatitis Obstructive jaundice
Brown or cloudy due to haemoglobin	Malaria haemoglobinuria As well as other conditions that cause intravascular hemolysis
Yellow-orange due to oxidized Urobilinogen	Haemolysis Hepatocellular jaundice
Milky-white Due to chyle	Bancroftian filariasis purulent genitourinary tract infection

Day 1: Stage 3: Chemical analysis

The squares on the dipstick represent the following components in the urine:

- specific gravity (concentration of urine),
- acidity of the urine (pH),
- protein in the urine (mainly albumin),
- glucose (sugar),
- ketones
- blood
- bilirubin
- nitrite
- urobilinogen
- leukocyte esterase

Results from chemical analysis

- **Glucose**- normally glucose in urine is too low to be detected. Detectable levels maybe due to Diabetes mellitus or Renal glycosuria.
- **Ketones**- like glucose, ketones levels are too low in urine. Detectable levels may be due to Diabetic ketoacidosis or Prolonged fasting
- **Bilirubin**-is a product of RBCs breakdown. Normally, it is carried in the blood and passes into the liver, where it is removed and becomes part of bile. Presence of bilirubin in urine, may indicate liver damage or disease
- **Urobilinogen**-High: increased hepatic processing of bilirubin -Low: bile obstruction

Results from chemical analysis

- **pH**- Acidic (less than 4.5): metabolic acidosis, high-protein diet

  - Alkaline (greater than 8.0): renal tubular acidosis (>5.5)

- **SG**-this is a measure of urine concentration. Increased levels may be due to diabetes or not drinking enough fluids
- **Protein-**High levels may signify Proteinuria and the nephrotic syndrome i.e. kidney problems
- **Nitrite**- if detected, it may be a sign of a UTI especially by Gram negative bacteria
- **Blood**-increased levels maybe a sign of kidney damage, infection, kidney or bladder stones, cancer or blood disorders. It can also be Schistosoma infection
- **Leukocyte** esterase-a product of WBCs my be a sign of a UTI

- Day 1: Stage 4: Microscopy
  - To examine a wet prep, urine is put in a centrifuge tube, centrifuged and supernatant discarded. The sediment is mixed, put on a clean slide ,a cover slip on top and examined under a microscope at 10X and 40X
  - Under a wet prep exam, the following can be seen:
    - Casts
    - Yeast cells
    - Pus cells
    - RBCs
    - WBCs
    - T.vaginalis motile trophozoites
    - S.haematobium eggs
    - Bacteria
    - Epithelial cells
    - Sperm
    - Crystals

Microscopic results

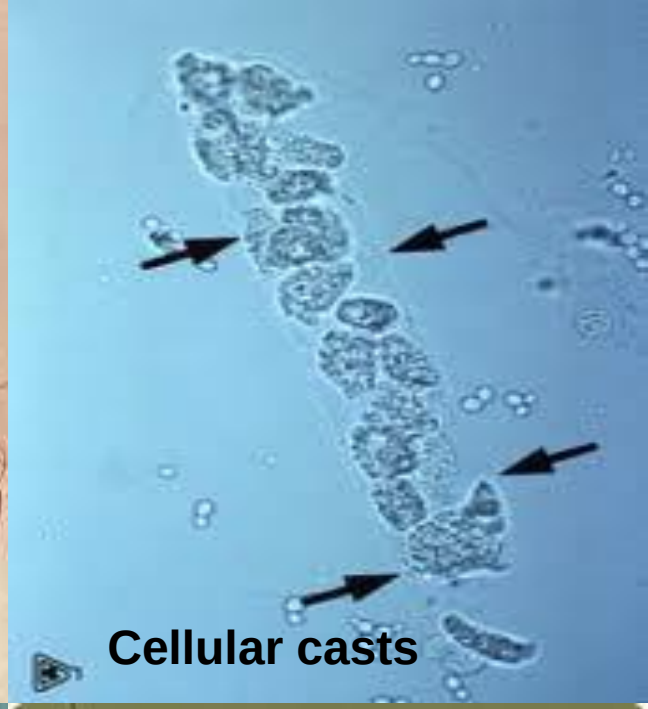
- Casts: usually indicate kidney disease
  - **Hyaline casts** are associated with damage to the glomerular filter membrane
  - **Waxy casts** indicate tubular damage and can be seen sometimes in renal failure
  - **Cellular casts** with white cells indicate inflammation of the kidney pelvis or tubules. Red cells indicate haemorrhage into the renal tubes or glomerular bleeding
  - **Granular casts** are associated with renal damage

- Yeast cells
    - Can be seen in women with vaginal candidiasis and specimens of the immunosuppressed
- Pus cells
    - Indicate a UTI
- RBCs
    - Haematuria may indicate urinary shistosomiasis, bacterial infection calculi (stones), glomerulonephritis etc
- T.vaginalis
    - Commonly found in urine of women with acute vaginitis and can occasionally be seen in men
- S. haematobium egg
    - They are large, with a terminal spine

- **Bacteria**
    - Can be reported as seen only if the urine is freshly collected
    - Can be seen as rods, cocci and a gram stain of urine can reveal more
    - It is usually accompanied by pus cells in urine
- **Epithelial cells**
    - When seen in large numbers may indicate inflammation of the UT or vaginal contamination of the urine
- **Sperm**
    - Can be seen in urine of men. If seen in female urine, it may need answers according to the provisional diagnosis
- **Crystals**
    - Finding of crystals in urine may not be of importance because they may form from the many chemicals found in urine, but crystals should be looked for in **FRESH** urine when calculi (Stones) in the UT are suspected

S. Haematobium egg

Cystine crystals

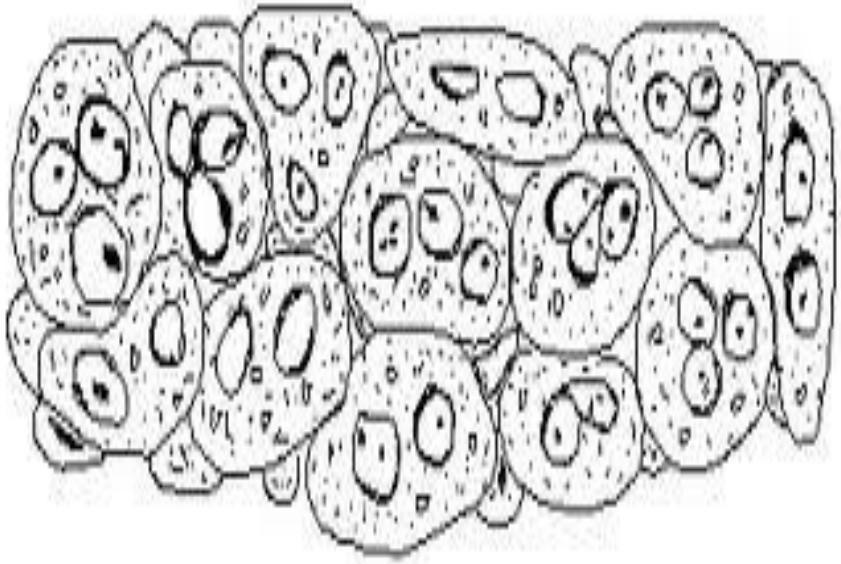


Cellular casts

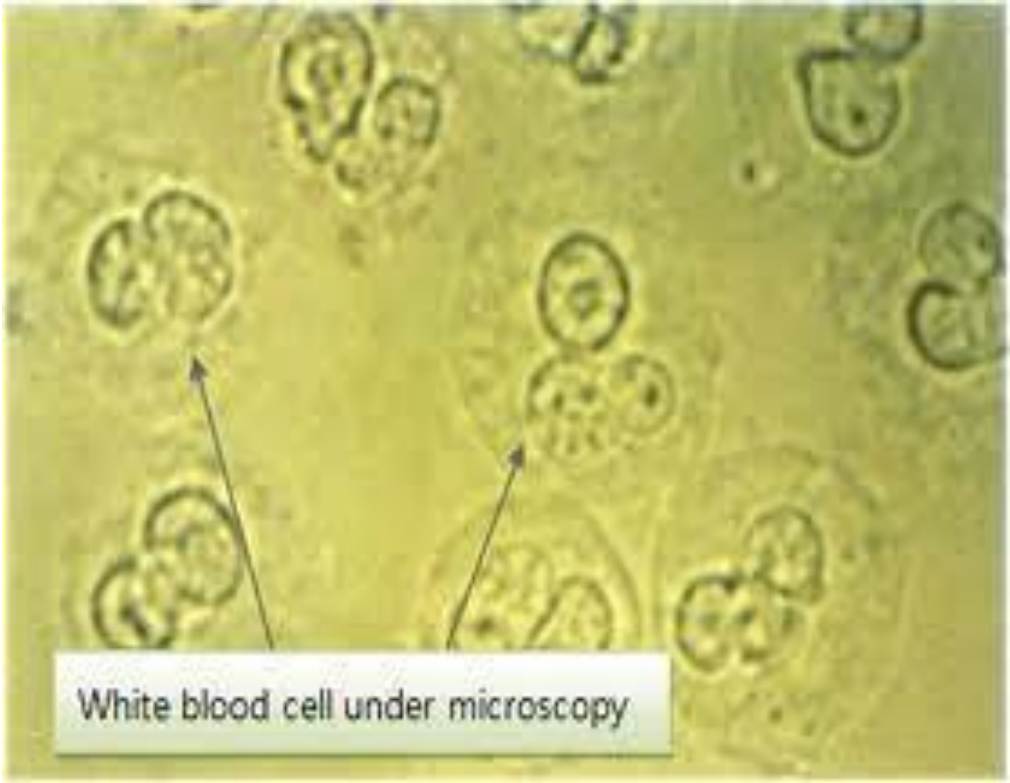
Calcium oxalate crystals

Waxy cast

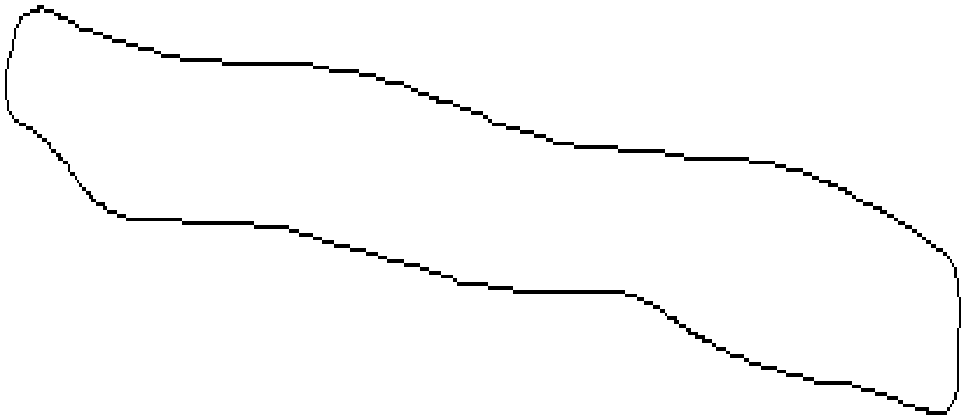
Sperm



White Blood Cell Cast



Granular Cast



Hyaline Cast

Day 1: Stage 5: Culture

- It is NOT necessary to culture urine which is NORMAL macroscopically, microscopically and biochemically
- Culture is done when the urine contains bacteria (as seen even in gram stain), pus cells, casts, protein, nitrite or has a MARKEDLY acidic or alkaline reaction
- Cystine lactose electrolyte-deficient (CLED) agar is used to culture urine
- After urine inoculation on CLED, the plate in incubated aerobically at 35-37°C overnight

Day 2: Stage 6

- Examine and report the cultures
- Bacteria that cause UTIs have an appearance on CLED that will enable the identification of the pathogen
- For example, *E.coli* on CLED will appear as Yellow opaque colonies with a slightly deeper colored center
- Klebsiella spp will appear as large mucoid yellow or yellow white colonies
- Proteus spp will appear as transluscent blue-grey colonies with a fishy smell

Day 2: Stage 7

- After obtaining a growth on culture, the next step is to do antimicrobial susceptibility testing
- The disk diffusion susceptibility test is the most used susceptibility test. Another test is a dilution technique.
- By disc diffusion test, the grown bacteria is sub cultured on another plate, like on Mueller Hinton Agar
- The choice of the antimicrobial disc to use in the susceptibility tests will depend on the specimen, the pathogen isolated, the range of locally available antimicrobials and the local prescribing polices.
- Therefore, consultation between the laboratory, medical and pharmacy staff is required and important

2. Urine analysis for Pregnancy

- Human chorionic gonadotrophin (hCG) is a glycoprotein hormone produced by the placental cells soon after the fertilized ovum is implanted in the uterine wall.
- Laboratory pregnancy tests are based in rapidly rising levels of hCG in urine or serum
- The urine specimen used for a pregnancy test should be the first morning urine because this will contain the highest level of hCG
- Urine should be collected in a clean container, and tested immediately. If not it should be refrigerated but not for more than 24 hrs


Pregnant


wiseGEEK


pregnant
not pregnant


Pregnant
Not Pregnant

References and further reading

- Monica Cheesbrough, Part 2 (2nd Edition), *District Laboratory Practice in Tropical Countries* (currently in library)
- Patrick .R. Murray, (5th Edition),*Medical Microbiology* (currently in library)
- Mims et al, (4th Edition), *Medical Microbiology* (currently in library)