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((تحليلات مرضية))

Stage (-3-)

LEC- ((2))

URINE Analysis

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Urinary system:

Urinary system consists of pair of kidneys and urinary tracts which includes (two ureters, urinary bladder and urethra). Each kidney contains 1.3 million urinary units called nephrons. Each nephron consist of glomerulus and urinary ducts (Bowman's capsule, proximal convoluted tubule, Henley loop, distal convoluted tubule and collecting duct).

Nephrons responsible of urine formation through three sequence process:

- 1- Glomerular filtration, the Glomerular filtration rate(GFR) reach 180 liter /day.
- 2- Reabsorption
- 3- Secretion

The kidneys extract the soluble wastes from the blood stream, as well as excess water, sugars, and a variety of other compounds. The resulting urine contains high concentrations of urea and other substances, including toxins. Urine flows from the kidney through the ureter, bladder, and finally the urethra before passing from the body.

Urination: is a voluntary process depends on person's choice to the suitable time and place to empty the urinary bladder from storage urine, without pain.

Disturbances in urination include:

- 1- Painful urination, frequency, Urgency. Because of microbial UTI.
- 2- Impairment of urine flow, hesitancy, dribbling urine, incomplete emptying. Because of urinary bladder obstruction.
- 3- Urinary retention, a sign of benign prostate enlargement (hypertrophy), urinary incontinence (enuresis) due to dysfunction of bladder muscles or sphincter muscles.

Urinary tract infection (UTI):

A urinary tract infection occurs where bacteria and white blood cells are present in the urine of a patient with symptoms of infection of the urethra, urinary bladder, or the kidney.

Bacteriuria occurs when bacteria are present in the urine;



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pyuria occurs when white blood cells are present in the urine.

The lower urinary tract includes the urethra (urethritis) and urinary bladder (cystitis).

The upper urinary tract includes the ureters and kidneys, infection in the upper urinary tract called (pyelonephritis). The bacteria that cause urinary tract infections are usually of fecal origin (e.g., *Escherichia coli*).

Etiology:

The most common cause of urinary tract infections (i.e., urethritis, cystitis, and pyelonephritis) is *E coli*. *Staphylococcus saprophyticus* is the second most common

cause of these infections in females between the ages of 13 and 40. In complicated cases of urinary tract infections such as those resulting from anatomic obstructions or from catheterization, the most common causes are *E coli*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Enterococcus*, and *Pseudomonas aeruginosa*.

Manifestations:

•**Urethritis:** is an infection of the urethra that causes pain and discomfort during voiding (dysuria).

•**Cystitis:** is an infection of the urinary bladder. Signs and symptoms of cystitis include urgency and frequency of urination, voiding small volumes of urine, and supra pubic tenderness just before or immediately after voiding.

•**Pyelonephritis:** is an infection of the lower urinary tract ascends the ureters to enter the kidneys, the signs and symptoms include fever, flank pain and tenderness, cost vertebral angle tenderness, and nausea and vomiting. Bacteria that gain access to the kidney can cause damage by production of polysaccharide, hemolysins, and endotoxin. Polysaccharide inhibits phagocytosis, hemolysins can directly cause tissue damage and endotoxin contributes to inflammation and damage of renal parenchyma. Endotoxin can gain entry into the bloodstream and induce white blood cells into the bloodstream to produce interleukin 1 (IL-1), which causes fever. Fever is seen only in patients who have pyelonephritis and is not seen in patients with only urethritis and cystitis.



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•Kidney stones can serve as a location in which bacteria can escape antibiotics and cause recurrent urinary tract infections. Proteus can cause stones to form when it produces an enzyme called urease, which can catalyze the breakdown of urea to ammonia and carbon dioxide. The ammonia that results from this reaction will increase the pH of urine and cause formation of kidney stones.

Epidemiology:

- Urinary tract infections rank second only to respiratory infections in their incidence.
- Most cases of urinary tract infection occur in women (female to male ratio is 30:1). The incidence of urinary tract infections increases with age.
- Postmenopausal women have higher rates of infection because of bladder or uterine prolapse; loss of estrogen, which causes a change in the vaginal flora; loss of lactobacilli in the vaginal flora, which results in periurethral colonization with gram-negative aerobes (e.g., E coli); and higher of concomitant medical illness (e.g.,diabetes mellitus).
- Males experience a rapid increase in the incidence of urinary tract infections sometime in the fifth decade of life due to obstruction of the urethra following development of benign prostatic hypertrophy.
- Urinary tract infections are usually endogenous; infection follows contamination of the distal end of the urethra with bacteria from the patient's own fecal organisms.
- Urinary tract infections occasionally occur following bacteremia or due to hematogenous spread of a distant infection to the urinary tract.

Host factors that are important in protection from urinary tract infections:

These include: the normal daily flow of urine, the constant sloughing of the uroepithelial cells lining the urinary tract, and the presence of large numbers of Lactobacillus in the vaginal mucosa.

Kidney Function Test (URINE ANALYSIS)

Gross examination of urine:



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Physical examination:

1- Urine volume: This is dependent normally up on fluid intake, environmental condition, diet and activity of the human.

Value above or below the normal value (1.5 L/Day) can be considered as pathological disorder but it should be combined with clinical and laboratory examination.

- above normal (polyuria) urine volume (< 2.5-3L/Day) due to large quantities intake of liquids, diuretics, alcohol, in sufficient of urinary ducts in reabsorption of water and urine concentrated as in diabetes mellitus or diabetes insipidus.

- under normal (Oligourea) urine volume (< 400 ml/Day)

- Anuria, urine volume (< 50 ml/Day), due to: hot weather, sweating, low water intake, or due to disease in kidney or urinary ducts.

2- Color: Can be observed in a test tube or in a urinometer tube. The following designations are used to observe the sample and correlated to the following terms.

*Colorless, Greenish yellow, Blue, Pale yellow, Green, Milky, Yellow, Red, Dark yellow, Reddish brown, Yellow brown, Brown.

Interpretation

- **Yellow to amber (Normal);** the color comes primarily from the presence of urobilin. Urobilin is a final waste product resulting from the breakdown of heme from hemoglobin during the destruction of aging blood cells.

- **Colorless to pale yellow;** dilute urine with low specific gravity and polyuria.

- **Dark yellow or yellow brown;** concentrated urine with a high specific gravity and small quantity.

- **Yellow brown or greenish yellow;** yellow green foam when urine is shaken Urobilinoids – chromagon derived from heme green biliverdin yellow-brown- bilirubin-and urobilin.



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- Cloudy; hematuria (clearer after centrifugation).
- Translucent; hemoglobinuria.
- Brown to brownish black; hemoglobin up on standing bile large amounts.
- Green; bile biliverdin
- Red to pink; phenothiazine (beet root)
- Blue; medication contain methylene blue or food with blue dyes.

3- Transparency (clarity):

Clear – freshly voided urine is clear.

Cloudy – not necessarily pathological as many samples may become cloudy.

Epithelial cells – present in large numbers.

Blood – red to brown color and smoky.

Leukocytes – may produce milky, ropy appearance if large number.

Bacteria – produce a uniform turbidity if in large number; the turbidity doesn't settle out and cannot be removed by filtration.

4 -Mucus.

5-Crystals: a salt compounds organized in geometrical shapes and looks like crystals, important in stones formation (cysteine crystals and oxalate crystals).

Amorphous urate – white or pink cloud in acid urine
Amorphous phosphate – white cloud in alkaline urine

6- Specific gravity (SG): determined by refractometer and indicator paper stripes. Normal value in Man 1.010 – 1.030(Average normal = 1.025). depending on SG the urine will be diluted ($SG < 1.002$) or concentrated ($SG > 1.065$) depend on the solvents in urine.SG used to determine the kidney efficiency keeping water balance in urine.

7-Odour: Normal odor – aromatic or acetone

Abnormal odor – aromatic odor of ketone bodies (sweet fruit odor) as in starvation and diabetes.In UTI the odor of urine is bad smell.



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8- Foam:

Shake the sample and observe:

- If the amount of foam produced is in excess and slow to disappear – proteinuria
- If the color of the foam great – yellow or brown – bile pigments
- If the color of the foam red to brown – hemoglobinuria