LECTURE 1:
ACUTE KIDNEY INJURY

OBJECTIVE

- At the end of this lecture student should be able to:

- **Congenital and hereditary diseases**
- **Recognize the different types of acute kidney injury.**
- **Recognize the clinical manifestations of acute kidney injury.**
- **Describe the pathological findings in acute kidney injury.**
- **Describe the guidelines for performing renal biopsy.**

For more information you can read:
ROBBINS : - P537 – 538 (ATI)
- P542 – 544 (Cystic diseases)
Pathology made ridiculously simple:
- P127- 129

1- Congenital and hereditary kidney diseases:

A) Renal agenesis: malformation of one or both kidneys. It has two types:

1- Unilateral renal agenesis: absence of one kidney and the patients usually live.

2- Bilateral renal agenesis: absence of both kidneys and the infant usually dies within uterus or immediately after birth. usually associated with other congenital disorders.

B) Cystic Renal dysplasia:

- **Dysplasia** here, does not mean premalignant cells.

It is only wrong name of this disease but it is used.

- Non-hereditary.
- Congenital.
- Malformation of kidney which shows a lot of **non-functional cysts** with **undifferentiated island of mesenchyme*** (you can see cartilage, bones and other tissues).it causes recurrent infection and atrophied kidney. It's usually unilateral
- Usually affect very **young children**
- Often associated with **poorly formed ureter**.
- Management: Remove the kidney, because it non functional, and causes recurrent infection

***Mesenchyme:** primitive connective tissue which give rise of connective tissue.

C) INFANTILE POLYCYSTIC KIDNEY DISEASE(ARPKD):

Polycystic **autosomal recessive disease** due to mutation in **chromosome 6.**
(PKHD-1 gene)

- Usually **develop renal failure** shortly after birth and live for short time.
- **Management:** kidney transplant

D) ADULT-TYPE POLYCYSTIC KIDNEY DISEASE(ADPKD):

- polycystic **autosomal dominant disease** due to presence of abnormal gene **(PKD-1 in chromosome 16 or PKD-2 in chromosome 4)**
- **Stages: secondary to hypertension > bilateral enlargement of kidney > acute renal failure.**
- **Usually starts develop symptoms in "40-50 years"**

To make sure the cause you have to do: urea and creatinine test + exclude pheochromocytoma and renal artery hypertension

- Patients can develop:
  1-Pancreas cysts
  2-Liver cysts
  3-Berry Aneurysm (Aneurysm of circle of Willis)

- **Management:** kidney transplant **or** dialysis.

E- Horseshoe kidney:

fused of lower lobes of both kidneys usually **does not cause problems** "asymptomatic".

This is common anomaly. Usually associated with turner syndrome or any other chromosomal abnormalities .

- Acquired polycystic: like (Leave me alone lesion*)

- ❑ all tests are normal.
- ❑ It occur in people who are in dialysis for a long-term

*Named like that because if there is any medical intervention will make it worse .

2- Acute kidney injury (Acute renal failure*):

***There are two types of renal failure: chronic and acute.** We will discuss only acute renal failure.

- **Definition of ARF: Acute medical emergency usually due to acute tubular injury which is reversible* cellular injury.**
- **Clinical presentation:** patient will present very sick: "anemic and earthy look skin"
- **The patient will pass these steps:**

1- Oliguria: "when a patient passing less than 400 ml per 24 hours"

2- Anuria: "no urine"

3- Polyuria: "the patient's loss a lot of urine and lead to disturbance of electrolyte. So, we have adjacent everything".

- **Diagnosis of acute renal failure by:**

1. **Check of urine volume**
2. **Blood urea*and creatinine levels in the blood "the patient will have azotemia which is blood urea nitrogen"**
3. **Measure the electrolytes (you will find electrolytes disturbance).**
4. **Urine test stick**

* This is the old name

*Tubular epithelium cells are stable cells that have capability to **regenerate** after injury.

*The urea is highly affected by dehydration, so it is not specific test.

The causes of Acute Renal Failure :

Prerenal:

- Any cause that lead to ischemic of the kidney "poor blood supply to the kidney"
- 1- Shock "septic shock by gram –ve bacilli or hypovolemic shock such as excessive hemorrhage in accident"
- 2- Postoperative
- 3- Trauma after delivery
- 4- Severe burns
- 5- Crushing of skeletal muscles which lead to accumulate of myoglobin in renal tubule and cause myoglobinuria

Renal

- Damage of kidney structures such as tubules and glomerulus
- 1- Drugs : mostly NSADIS and antibiotics such as gentamycin and methicillin
- 2- Toxins: mercury and anti-freeze (ethylene glycol)
- 3- Interstitial nephritis

Postrenal

- obstruction of urinary flow by stones or tumors.
  ex. benign prostatic hypertrophy

- **Morphology:** hemorrhagic with pale cortex and degenerated nuclei in proximal and distal tubules
- **Treatment and prognosis:** Dialysis usually for two weeks to have complete recovery

Urine test stick:

- is one of the simplest bed site tests that used to **diagnose renal diseases** by analyzing a urine sample:

- Nitrate , proteins , pH of urine, blood in urine, specific gravity of urine* and presence of ketones.

- Presence of ketones **"ketoacidosis"** is a **sign of uncontrolled diabetes which may lead to diabetes coma.**

*Gravity of urine means the ability of kidney to condensation of urine

Renal biopsy*

- Non neoplastic renal diseases investigated by
  - ❑ **Optic microscope (routine):**

    By using stains like Eosin, Haematoxylin and **(sliver to see glomerular basement membrane)** etc..
  - ❑ **Immunofluorescence :**

    Uses the specificity of antibodies to their antigen to target fluorescent dyes.
  - ❑ **Electron microscopic :**

    Uses an electron beam to produce a magnified image.

*Take it under ultrasound from cortex not medulla

MCQs

Q1: A child who has Turner's syndrome which one of these kidney abnormality can be found in this child:

A. Unilateral agenesis

B. Bilateral agenesis

C. Horseshoe kidney

D. None of the above

Q2: The commonest cystic renal disease in children is:

A. Cystic renal dysplasia

B. Autosomal recessive polycystic renal disease

C. Autosomal dominant polycystic renal disease

D. A&B

Q3: A patient on dialysis for a long time treatment Can develop:

A. Tumors in kidney

B. Acquired cysts in kidney

C. Stones in kidney

D. B&C

Q4: In cystic renal dysplasia the kidney shows:

A. Enlargement

B. Shrinking

C. Undifferentiated mesenchyme cells

D. B&C

1- C
2- A
3- B
4- D

Q5: A 40 years old female is suffering from hypertension and urinary tract infection. The physician did a clinical examination for the abdominal region and asked for x-rays and other tests, He felt a large and palpable mass in the abdomen, and in X-ray image he discovered large kidneys with variable cysts. What is the most likely diagnosis?

A. Autosomal recessive polycystic renal disease

B. Autosomal dominant polycystic renal disease

C. Cystic renal dysplasia

D. Horseshoe kidney

5- B
6- D
7- D
8- D

Q6: In the previous question, which chromosome is containing a mutated gene?

A. Chromosome 16

B. Chromosome 6

C. Chromosome 4

D. A&C

Q7: In the previous question, the serious complication is:

A. Renal failure

B. Berry Aneurysm

C. Cysts in liver, pancreas, and spleen

D. All of the above

Q8: Which gene is mutated in Autosomal recessive polycystic renal disease:

A. PKD1 on chromosome 16

B. PKD2 on chromosome 4

C. PKD3

D. PKHD1 on chromosome 6

Q9: 18 years old girl came to the ER after sever trauma to her muscles, what will be elevated in the urine that indicates acute tubular necrosis:

A. Urea

B. Myoglobin

C. Aniline

D. Both B&C

9- B
10- A
11- A
12- C

Q10: When the urine output is less than 400 ML per 24 hours, this is the definition of:

A. Oliguria

B. Anuria

C. Polyuria

D. A&B

Q11: Which one of cystic kidney disease is often associated with poorly formed ureter ?

A. cystic renal dysplasia.

B. autosomal dominant polycystic kidney disease.

C. autosomal recessive polycystic kidney disease.

D. medullary spongy kidney.

Q12: Which one of cystic kidney disease is often associated with large kidney at birth?

A. cystic renal dysplasia.

B. autosomal dominant polycystic kidney disease.

C. autosomal recessive polycystic kidney disease.

D. medullary spongy kidney.

Q13: Which technique uses antibodies to check for the presence of kidney diseases?

A. Optic microscope

B. Electron microscope

C. Immunofluorescence

D. biopsy

Q14: Which type of stain is used in staining the glomerular basement membrane?

A. Hemosiderin

B. Eosin

C. Sliver

D. Hematoxylin

Q15: What diagnostic tool (bedside testing) is used frequently to determine the PH of the urine, specific gravity of urine & the presence of blood, proteins and ketone in the urine?

A. Creatinine clearance

B. Serum urea

C. Glomerular Filtration rate

D. Urine test stick

Q16: Which one of these diseases has a good prognosis?

A. Acute glomerulonephritis

B. Bilateral renal agenesis

C. Acute tubular necrosis

D. Infantile polycystic renal disease

13- C
14- C
15- D
16- C

Q17: A patient came to the general practitioner because of abdominal pain, an x-ray image showed only a one kidney at the right side, while the left kidney was missing. The doctor asked the patient if he ever donate one of his kidneys before, But the patient denied that, what congenital disease he might has?

A. Autosomal dominant renal disease

B. Cystic renal dysplasia

C. Unilateral renal agenesis

D. Acute tubular necrosis

Q18: What are the predominant features associated with cystic renal dysplasia in addition to the presence of cysts at the kidney?

A. Malformed & atrophied kidneys + undifferentiated mesenchyme cells

B. Enlarged + Hemorrhagic kidneys

C. Fibrotic kidneys + atrophied kidneys

D. presence of renal cell carcinoma

Q19: A 7 days old newborn who died because of renal failure, The report indicated that the infant had enlarged kidney with present of cysts, the liver also was affected so what renal congenital disease could be the reason of his death?

A. Acute renal failure

B. Autosomal dominant polycystic renal disease

C. Autosomal recessive polycystic renal disease

D. Acquired polycystic renal disease

17- C
18- A
19- C

Q20: A teenager girl has been admitted to the ER department at KKUH after trying her to suicide by ingestion of mercuric substance (mercuric chloride) her lab results showed increase in serum creatinine and serum urea levels and decrease in urine output rate (oliguria). She developed acute renal failure as a result from ingestion of the toxic substance so in this case which part from the nephron can be affected the most?

20- A
21- A
22- B

A. Proximal tubule

B. Glomerulus

C. Distal tubule

D. Thin part from the loop of Henley

Q21: A patient went to KKUH hospital for checkup an ultrasound image showed a one single cyst in his left kidney, The doctor asked for serum creatinine and serum urea levels.. The results were within the normal range and the lab report confirmed that the kidney function was excellent and the cyst seems to be not related to any other structures or diseases, so what is the most likely diagnosis in this case?

A. Leave me alone lesion

B. Cystic renal dysplasia

C. Unilateral renal agenesis

D. Acute tubular necrosis

Q22: A 44 old male patient came to the hospital because of abdominal pain, in examining the patient, he had a huge mass in his abdomen just below the rib cage, the doctor decided to take an ultrasound image, it showed enlargement of the kidney with presence of cysts.. The doctor checked his hospital profile an early incidence of hypertension was recorded in his medical history, What is the diagnosis of this condition?

A. Cystic renal dysplasia

B. Adult-type polycystic renal disease

C. Pheochromocytoma

D. Renal cell carcinoma

Q23: In examining of a patient after she had a difficult delivery, she had elevated serum creatinine and serum urea levels also the urine output was less than 400 ml\24h "oliguria" then she developed anuria due to hypovolemic shock, what is the most likely diagnosis?

A. Acute renal failure due to post-renal cause

B. Acute renal failure due to renal cause

C. Chronic renal failure

D. Acute renal failure due to pre-renal cause

23- D
24- B
25- B

Q24: A 52 male patient who has got history of enlarged prostate came to the hospital with sever pain after examination the patient, he presented with oliguria and azotemia what is the most likely diagnosis and cause?

A. Unilateral renal agenesis-

B. Acute renal failure due to post-renal cause

C. Horseshoe kidneys

D. cystic renal disease

Q25: A biopsy has been taken from a patient who was suspected to have a non-neoplastic kidney disease.. The section showed intact nephrons & medullary tubules, in which region do you think the needle was inserted to take this section?

A. Suprarenal gland

B. Cortex of kidney

C. Medulla of kidney

D. Hilum of kidney

Questions

Q1: Why do we consider the condition of acute renal failure reversible?

Because the renal cells are stable cells so they have the capacity to regenerate after injury, so the patient with acute renal failure after treatment can recover within 2 weeks.

Q2: Why do we take the biopsy from the cortex in the case of kidney diseases?

Because the cortex contain a medullary rays but the medulla doesn't contain any structure related to the cortex.

Q3: What are the causes of nephrotoxic acute tubular necrosis?

- Poisons including heavy metals such as mercury
- Organic solvents e.g. carbon tetra-chloride
- Antibiotics such as gentamicin, methicillin, ampicillin, and rifampin.
- Diuretics e.g. thiazides
- NSAIDs

Q4: What are the renal causes of acute kidney disease?

- Vascular causes
- Glomerular causes e.g. RPGN
- Tubular such as ischemia, toxins, and pigments
- Interstitial

Q5: In the non-neoplastic kidney diseases, what is the important instrument to assess the diagnosis?

We have to use 3 things:

1. Light microscope
2. Electron microscope
3. Immunofluorescence microscopy e.g. IgA disease

Q6: List some of the congenital cystic kidney diseases?

- Cystic renal dysplasia.
- autosomal dominant polycystic kidney disease.
- autosomal recessive polycystic kidney disease.

Q7: What is the cause of cystic renal dysplasia?

Disorganized renal development.

Q8: What is the cause of autosomal dominant polycystic kidney disease ?

Mutation in two gens PKD1 (on chromosome 16), or PKD2 (on chromosome 4), also PKD3 in rare cases

Q9: Where does the gene which is responsible for autosomal recessive polycystic kidney disease locate ?

On chromosome 6.

Q10: Name two endogenous pigments can be harmful on renal tubules and can cause acute tubular necrosis?

Hemosiderin & Myoglobin

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