

# 5/7/18

## Pathophysiology of Urogenital System

Urinary system consists of

2 kidneys & Excretory passages.

↓  
which pass urine from kidney  
to Exterior.

Urinary system — is the organ system

↓ that

produces, stores & eliminates urine

— Together with lungs, Intestines & skin, kidneys  
participate in elimination of wastes.

Each kidney contains 1 million filtering units called  
nephron → consists of

Glomerulus

Network of capillaries

Tubules.

— Blood filtered by glomerulus and resultant  
filtrate passes through tubular system

where water & nutrients are reabsorbed (2)

Humans produce 1.5 lit of urine/24 hrs.  
↑ sed fluid intake ↑ ses urine production  
while ↑ sed perspiration & respiration ↓ se the amount  
of fluid excreted.

Reduced intake of water will normally result  
in less urine production.  
Sometimes Medications interfere w production of  
urine.  
Ex           ?

Kidney plays a role in regulating electrolytes  
in human blood  
eg  $Na^+$ ,  $K^+$ ,  $Ca^+$ , PH balance regulated  
by removal of excess  
of  $H^+$ .

In addition → They remove urea  
Nitrogenous waste  
from Metabolism of  
proteins.

During Metabolic process  
ammonia is transported by blood to liver  
& detoxified to byproduct called urea.



ureters = Collected urine in renal pelvis (3)  
Carried down to bladder through ureters on both sides.

8 to 10 inches long & smooth muscular tissue in the walls which forces urine downward  
Small amounts of urine emptied into bladder for every 10-15 secs

Bladder : Urinary bladder → "Hollow Muscular organ"

- bladder stores ~~some~~ urine
- Swells into round shape when it is full
- Gets smaller when emptied
- Can hold upto 500ml of urine for 2-5 hrs
- Epithelial tissue in bladder is \_\_\_\_\_
- which allows the bladder to stretch & accommodate urine.
- Sphincter - circular muscle fibres regulate flow of urine from bladder.
- Bladder has got Muscular layer (detrusor muscle) when contracted ↑ pressure on bladder and create urinary flow.

- Micturition is initiated by stretch receptors in bladder wall
- which signals brain that bladder is full

↓

It is felt like an urge to urinate

- When micturition is initiated sphincter relaxes and detrusor contracts producing flow.

Term Uropathy: Refers to a disease of urinary tract

Nephropathy: Refers to a disease of kidney.

There are numerous kidney diseases

- Kidney stones → Painful & cause long term kidney damage
- Proteinuria → Indicates renal disease
- Stenosis → Blockage
- Reflux → Back flow of urine into kidney
- UTIs
- Incontinence → Involuntary loss of urine
- BPH
- Prostatitis
- Urinary retention
- Bladder } cancer
- Kidney } cancer
- Prostate } cancer



Acute renal failure : Occurs when illness } damages  
infection } the  
injury } kidneys.

Then the kidney function becomes impaired  
fluids & toxins begin to accumulate  
in blood streams

As they build up in the blood stream

Pat's may become puffy & swollen face, hands  
edematous

& feet.

Their Bp typically begins to rise.

- Ac. renal failure is temporary condition  
to proper & timely treatment, can be reversed  
with no permanent damage to kidneys.

Ac. renal failure may occur as a complication of  
serious illness like Heart failure

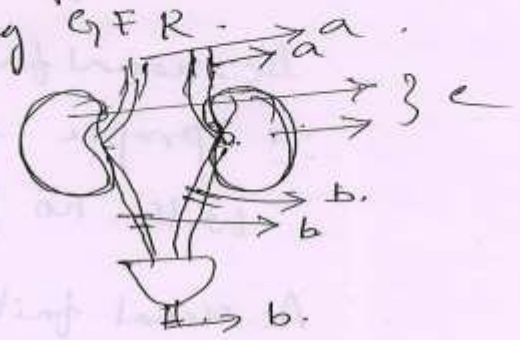
- Liver failure
- Dehydration
- Severe burns
- Excessive bleeding
- Adverse reaction to a medicine
- Injury / kidney disease

Pathophysiology: Glomerular filtration is due to Pressure gradient

Glomerular pressure is primarily dependant on renal blood flow and controlled by combined resistances of renal afferent & efferent arterioles.

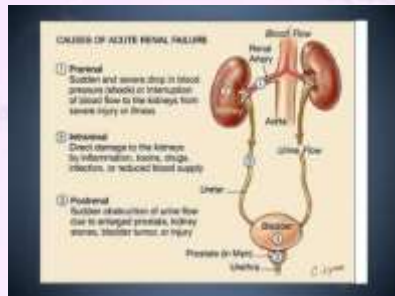
Hence cause of Ac Renal failure is Reduction of Renal blood flow is common pathologic pathway for ↓ eGFR.

Picture :- Pre renal  
Intra renal  
Post renal.



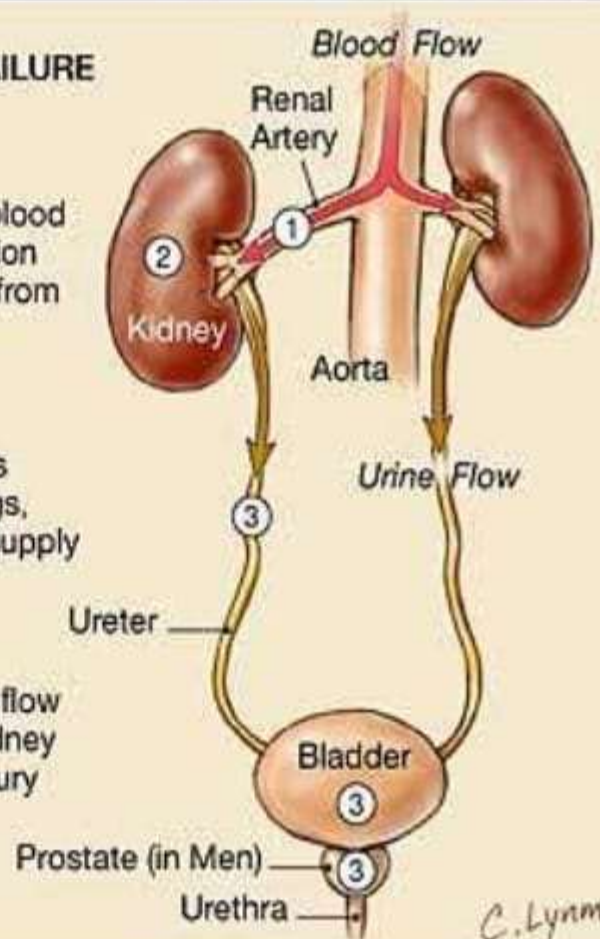
a) Pre renal failure :

- Heart failure
- arrhythmias
- MI
- Bleeds
- Dehydration
- Hypovolemic shock
- Malignant Hypertension



## CAUSES OF ACUTE RENAL FAILURE

- ① **Prerenal**  
Sudden and severe drop in blood pressure (shock) or interruption of blood flow to the kidneys from severe injury or illness
- ② **Intrarenal**  
Direct damage to the kidneys by inflammation, toxins, drugs, infection, or reduced blood supply
- ③ **Postrenal**  
Sudden obstruction of urine flow due to enlarged prostate, kidney stones, bladder tumor, or injury





## c) Intra renal failure:

①

- Poorly treated prerenal failure
- Nephrotoxins
- Transfusion reaction
- Ac. pyelonephritis
- Papillary necrosis
- Renal myeloma
- Systemic lupus Erythematosus.

## b) Post renal

Bladder obstruction  
Ureteral       "  
Urethral       "

Three phases + oliguric phase  
1. Ischaemic       "  
2. Ischaemic       "  
3. Recovery phase.

in  
ARF

- Recovery from Ac. Renal failure is dependent upon restoration of renal blood flow.
- Early normalization  
↓  
Better prognosis for recovery of renal function.



In pre renal failure : Restoration of circulating blood volume is sufficient. (8)

In post renal failure : Obstruction removal  $\rightarrow$  relieves

In intrinsic renal failure : Removal of tubular toxins  
 $\times$   
Initiation of therapy for disease  
decreases to affect vasoconstriction

⑨

Symptoms of AKF : Common symptom is anemia.

1. Anemia : As kidney is responsible for producing

Erythropoietin



Hormone which stimulates RBC production

If kidney disease cause shrinking of kidney  
RBC production is reduced leading to Anemia

2. Bad breath or bad taste in mouth :

Urea in saliva cause ammonia  
like taste

3. Bone & joint problems : Kidney produces  
Vit D which

helps in absorption of Ca  
and keeps bones strong

In Absence → bones becomes → brittle

4. Edema : Puffiness or swelling in the  
arms, hands, feet and around  
the eyes

5. Foamy or bloody urine: protein in urine causes it to foam. (10)  
Blood indicates bleeding from diseased or obstructed kidneys bladder or ureter.

6. Head aches: High blood pressure triggers Headaches.

7. Hypertension or high blood pressure: Retention of wastes & fluids  $\uparrow$  blood volume which makes Rise in B.P.

8. Used fatigue: Toxic substances in blood & presence of anemia cause the part to feel Exhausted.

9. Itching: Phosphorus, normally eliminated in urine accumulates in the blood & cause skin to itch.

10. Low back ache: Pat's suffering from kidney stones have pain where the kidneys are located.

11. Nausea: Urea in gastric juices may cause stomach upset.



Prerenal Diagnosis

- 1. Elevated : BUN , serum creatinine & K<sup>+</sup> levels  
 Decreased : Bicarbonates , Hb % & acid pH
- 2. Urine analysis : Presence of protein  
 Sign of infection
- 3. Ultrasound : To know any problems of kidney or urinary tract .
- 4. KUB → Plain radiography
- 5. Pyelography → To study of the urinary system .

Treatment : . . Prerenal condition treated by replacing fluids.  
Blood transfusion, that had triggered kidney failure

Post renal condition and intra renal condition  
may require surgery or medication .

Frequently require Haemodialysis, Hemofiltration or  
Peritoneal dialysis . . to filter wastes from blood stream .

⑫ - Haemodialysis: where circulation of patient's <sup>open</sup> blood outside the body through Extracorporeal circuit (ECC) or Dialysis circuit.

Circuit is made up of ① Plastic blood tubing, ② filter (Dialyzer) <sup>Artificial Kidney</sup>

③ Dialysis Machine

↳ which monitors, maintains

blood flow and administers dialysate which is sterile chemical solution that is used to draw waste products out of the blood.

Pat blood leaves the body through vein and travel through ECC & the dialyzer where the fluid & waste removal takes place.

& electrolytes & other chemicals are added to the blood then purified blood is ~~then~~ returned to the body.

Dialysis lasts for 3-4 hrs. Depending on type of dialyzer &

Physical condition of Pat.

Used several times a wk until Acute kidney failure is reversed.

Hemofiltration: used in critically ill patients who have Heart problems & circulatory problems.

It is a continuous process & fluids to be given without risk of fluid overload.

Like Hemodialysis uses ECC → Hemofilter instead of dialyzer, so blood pump which makes the blood flow through ECC instead of Dialyzer Machine. The vol of blood circulating through ECC here is less than in Dialysis. Filtration is slow doesn't affect circulatory system. <sup>is given until - filtered & reversed.</sup>



① 6/7/18

## Chronic Renal failure

Chronic renal failure is <sup>slow</sup> progressive loss of renal function over a period of time with low glomerular filtration rate which is indirectly by the creatinine level in blood stream

Six months  
or  
years

Most common causes of CRF are:

1. Diabetic Nephropathy
2. Hypertension
3. Glomerulonephritis

According to renal anatomy: Kidney disease has been classified.

### 1. Vascular

Large vessel disease: Bilateral aortic stenosis  
Small vessel disease: Ischemic nephropathy  
Hemolytic-uremic syndrome & Vasculitis

### 2. Glomerular: comprising

Focal segmental glomerulosclerosis  
& IgA Nephritis

### 3. Sec Glomerular diseases:

Diabetic Nephropathy &  
Lupus nephritis



4. Tubulointerstitial = Polycystic Kidney disease (2)  
Drug & toxin induced ch tubulo-  
interstitial nephritis & reflux  
nephropathy  
Obstructive due to bil kidney stones  
and diseases of prostate  
prostate

5. Blood pressure is raised due to fluid overload and  
production of vasoactive hormones leading  
to hypertension & congestive Heart failure

6. Urea accumulates leading to azotemia & ultimately  
Uremia

Pathophysiology → About 1 million nephrons  
Present in Each kidney  
Contributes to total GFR.

→ Regardless of the renal injury  
with progressive destruction  
of nephrons } Kidneys  
has ability  
to  
Maintain  
GFR by 1, 2

1. Hypertension &  
2. compensatory  
Hypertrophy of remaining  
nephrons.

Now the diseased Nephron slows down its <sup>(3)</sup> clearance of plasma solutes so that urea & creatinine start to rise in plasma levels.

that too - - - when ~~50%~~ GFR is decreased to 50%.

- Creatinine value will double @ 50% reduction in GFR.

↑ of plasma creatinine from baseline of value of 0.6 mg/dl to 1.2 mg/dl in a patient who is still within the range actually represents a loss of 50% of functioning Nephron mass.

Diagnosis

It is Chronic renal failure have to differentiate from Ac. renal failure b'coz ARF is reversible & Ch. R.F is irreversible.

(1) Abx USG <sup>now to</sup> ~~shows~~ performed to Measure its size

Kidneys in CRF — Smaller than normal  
i.e.  $< 9\text{cm}$

~~1~~ Gradual rise of serum creatinine

(2) By Measuring urinary dispeptidase activity & serum creatinine

Eg: Mass test of 246 individuals. Examined on 2 dimensional plot of  $\text{Udase}$  Y-axis versus  $\text{Scr}$  X-axis with data from Healthy individuals.

$N = 189$

$\text{ARF} = 19$

$\text{CRF} = 38$

Healthy individuals are distributed along Y-axis

ARF patients along X-axis

CRF Pat's are scattered away from both X & Y axis.

"This is very useful tool."  
to differentiate

"Udase is New Marker Enzyme of Renal disease"



(5)

Treatment : Goal is to slow down / stop the

Progression of CRF into ESRD.

Broad principles of treatment are:

• Controlling BP & treatment of original disease.

— ACE inhibitors (ACEi's)  
Angiotensin II receptor blockers (ARB's)  
→ used to prevent or slow the progression of ESRD.

— Replacement of Erythropoietin } which are produced by kidney.  
Vit D3 }

— Also calcium

— Phosphate binders to control the serum phosphate levels.

— Above treatment is to prevent ESRD.  
Once ESRD occurs, Renal replacement is required.

