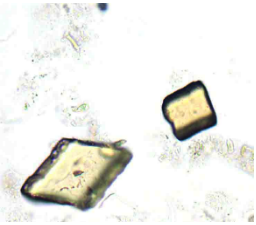
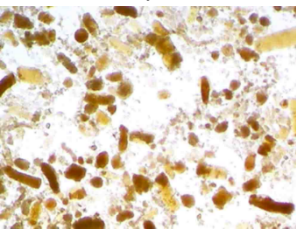


- 1) Vomiting leads to metabolic alkalosis and volume depletion.
- 2) **Hepatorenal syndrome** is a direct result of **splanchnic arterial vasodilation**, which causes shunting of circulation away from the kidneys to the gut, causing renal vasoconstriction, leading to rise in creatinine, decreased urine output, benign urinalysis, low urine sodium <20 mEq/L, and lack of response to intravenous normal saline.
- 3) Acetazolamide causes bicarbonate diuresis and loss of buffer, **reducing renal acid excretion but increasing urine excretion of sodium, potassium, and bicarbonate.**



- 4)
 - a) Uric acid stones are **radiolucent on plain x-ray** but **seen on CT and ultrasound.**
- 5) The etiology of nocturnal enuresis is most likely multifactorial due to **genetics, maturational delay, and small bladder capacity**, but medical disorders should be ruled out.
- 6) Lithium is used to treat bipolar disorder and acts as an ADH antagonist, preventing water resorption from the collecting tubules.
 - a) Lithium can cause nephrogenic DI in up to 20% of patients.
 - b) In nephrogenic DI, patients present with **dilute urine (urine osmoles <200 mOsm/kg and urine specific gravity <1.010)**, polyuria, and polydipsia
- 7) ADPKD complications include **cerebral aneurysms, hepatic cysts, and cardiac valvular lesions.**
- 8) **Perinephric abscess** formation is a possible complication of pyelonephritis.
- 9) Postinfectious GN may cause edema, proteinuria, and hematuria **2 to 3 weeks after bacterial infection** such as strep throat.
 - a) Postinfectious GN results from a **type III hypersensitivity** reaction with antigen-antibody complex deposition in the glomerulus.
- 10) **NSAIDs reverse the afferent arteriolar dilation** needed to maintain GFR in low-flow states like dehydration or heart failure, and thus may cause reversible **increases in serum creatinine.**



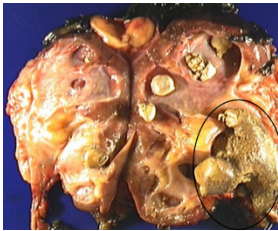
- 11)
 - a) Common drug causes of ATN are aminoglycosides, contrast dyes, vancomycin, and cisplatin.
- 12) Thiazide diuretics such as **chlorthalidone decrease the urine calcium concentration.**
 - a) **Thiazide** diuretics can cause **severe hyponatremia**, especially in the setting of **high water and poor solute intake.**
 - b) Thiazide diuretics lower blood pressure by inducing sodium diuresis and by acting **as mild vasodilators.**
- 13) Loop diuretics are potent diuretics that may cause **hypokalemia, metabolic alkalosis, hypocalcemia, hypomagnesemia, and hyperuricemia.**
 - a) And low urine chloride
 - b) include rapid volume contraction (hence the name “contraction alkalosis”) due to **secondary hyperaldosteronism** and by also stimulating renal hydrogen ion excretion. Loop diuretics inhibit the $\text{Na}^+/\text{K}^+/\text{2Cl}^-$ loop transporters, causing sodium chloride diuresis, **increasing sodium delivery to the distal nephron, and by causing volume depletion.**
- 14) **Vitamin D deficiency can cause hypophosphatemia** by decreasing intestinal absorption of phosphate and **increasing urinary phosphate excretion.**
- 15) **Indinavir**, a protease inhibitor, can cause **crystal-induced nephropathy (needle-shaped crystals in the urine)**, which presents with AKI with crystalluria and hematuria.
- 16) ADH activates V2-receptors in the collecting duct cells to increase renal water reabsorption, leading to **dilute serum (<275) and concentrated urine (>300).**
- 17) In patients with **central DI**, the kidneys make large amounts **of dilute urine** due to a **lack of ADH.**
 - a) Central DI is associated with **low urine osmolality, hyponatremia** (when patients can’t drink water), and **positive free water clearance.**
- 18) **Nephrogenic DI** is the most common renal adverse effect of **lithium** therapy and presents as **polyuria and polydipsia.**
 - a) NDI causes **hyponatremia, low urine sodium, and low urine osmolality.**

- b) With ADH resistance and concurrent volume depletion, there will be **increased serum ADH levels**. This is because the volume depletion seen in NDI is a stimulus for ADH secretion.
- c) does not improve with water restriction or administration of desmopressin.
- d) Causes of NDI include lithium, **hypercalcemia, hypokalemia, and interstitial kidney disease**.



19)

- a) Kidney stones with **alkaline urine pH** and evidence of chronic UTIs due to **Proteus or Klebsiella** suggest struvite stones, causing staghorn calculi.
- 20) **Lupus nephritis** presents with hematuria, proteinuria, and decreased renal function and shows **subendothelial** immune deposits.
- 21) **Probenecid** is a medication used to prevent gout; it functions by inhibiting urate absorption in the proximal tubule. It also **inhibits the organic anion transporter** in the kidneys, **reducing the excretion of several drugs**, such as penicillin, and raising their serum levels.
- 22) **CKD can be caused by diabetic nephropathy**, leading to nephrotic syndrome and progressive renal failure.
- a) A complication of CKD is renal osteodystrophy with bone pain, increased **risk for fractures, hyperphosphatemia**, and secondary **hyperparathyroidism**.
 - b) Advanced CKD commonly causes **hypocalcemia** due to low calcitriol and hyperphosphatemia.
- 23) Euvolemic hyponatremia can be due to **SIADH, CKD, or thiazides**.
- a) Thiazide diuretics may cause hyponatremia by **inhibiting NaCl absorption** and **limiting the ability of the kidney to dilute the urine**.



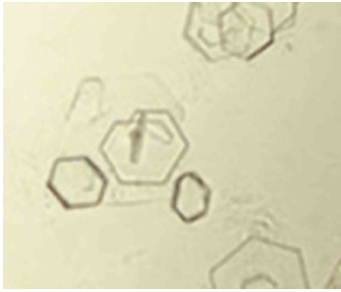
24)

- chronic diabetes** and long-term use of a **urinary catheter**, likely developed **recurrent urinary infections** and **chronic pyelonephritis**, leading to a kidney that shows blunting and thickened dilation of the calyces and uneven scarring.
- 25) Lab findings of **prerenal AKI** include **urine sodium <10 mEq/L, FeNa <1%, urine osmolality of >500 mOsm/kg**, or serum **BUN:creatinine ratio of >20**.
- 26) IgA nephropathy often presents with **gross hematuria** in **young** patients concurrent with or a few days **after a viral** respiratory or gastrointestinal tract illness.
- a) Serum IgA levels may be elevated in patients with IgA nephropathy.
 - b) **Mesangial deposits of IgA are seen on biopsy** of IgA nephropathy.
- 27) **Bartter syndrome** is a rare inherited cause of **hypokalemia and metabolic alkalosis** due to mutations in the $\text{Na}^+/\text{K}^+/\text{2Cl}^-$ transporters in the thick ascending loop of Henle.
- a) Bartter syndrome causes tubular effects **similar to furosemide**, including increased urine calcium excretion and impaired ability to concentrate urine.
- 28) The $\text{Na}^+/\text{K}^+/\text{2Cl}^-$ **cotransporter in the ascending loop of Henle reabsorbs sodium chloride** to contribute to the interstitial concentrating gradient, essential for water reabsorption.
- 29) **High urine Na^+ , high FENa**, and the presence of renal tubular **epithelial cells in the urine suggest ATN**.
- a) **Renal ischemia is a cause of ATN**. The reduced blood pressure and renal blood flow induce ischemic injury to the tubules, which leads to their necrosis.
- 30) Patient with **altered mental status** and **elevated plasma osmolality** (320 mOsm/kg) most likely has **ingested a nonethanol** alcohol like methanol, propylene glycol, or ethylene glycol (ie, has **elevated exogenous osmoles** in the blood).
- 31) Poststreptococcal glomerulonephritis can present with proteinuria, hematuria, and hypertension **1 to 3 weeks after streptococcal pharyngitis**.
- 32) Characterized by **enlarged hypercellular glomeruli**, with **dense subepithelial humps** on the basement membrane.
- 33) Spironolactone may cause **hyperkalemia and metabolic acidosis**.
- a) Spironolactone inhibits aldosterone at its receptor.

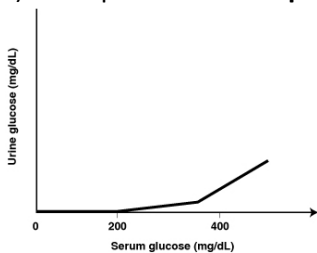
- 34) **Enterococcus** is a common cause of **catheter-associated** and other nosocomial urinary tract infections. Its presence is confirmed by the **lack of nitrite** on urinalysis and by culture on **bile esculin agar**.
- 35) Primary polydipsia can cause hyponatremia with **low plasma and low urine osmolality**.
- a) The free **water clearance would be positive**, reflecting the kidney's **excreting free water** in the setting of excessive water intake.

	Type I	Type II	Type IV
Location	Distal (collecting tubule)	Proximal (proximal convoluted tubule)	Adrenal OR collecting tubule
K ⁺	Low	Low	High
Mechanism	No H ⁺ secretion	No HCO ₃ ⁻ reabsorption	Hypoaldosteronism (low aldosterone secretion OR lack of response)

- 36)
- 37) **Central DI is due to a lack of ADH production** (and thus less binding to V2 receptors) and may be due to **head trauma, brain surgery, or pituitary tumors**.
- a) Dilute urine that corrects with administration of ADH
- b) Central DI is also treated with **arginine vasopressin (DDAVP)**, providing an ADH-like agent that concentrates the urine.
- i) DDAVP also **releases von Willebrand factor** from endothelial cells, helping to **aggregate platelets**.
- 38) **Patients with DKA have initial hyperkalemia that drops during treatment**, sometimes leading to **overt hypokalemia**.
- a) **low total body potassium due to urine losses from osmotic diuresis**. Potassium replacement should be initiated early in the treatment of DKA in anticipation of this hypokalemia.



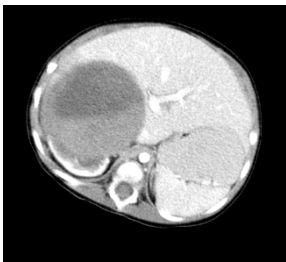
- 39)
- a) Cystinuria is a consequence of a **defect in amino acid reabsorption in the proximal tubule**.
- i) Leads to cystine crystals in the urine
- 40) **Acute (allergic) interstitial nephritis** presents with acute onset of acute kidney injury, **maculopapular rash**, urine WBC, WBC casts, or eosinophils **following recent medication exposure (cipro)**.
- a) Common causes of acute interstitial nephritis include **nonsteroidal inflammatory drugs** and antibiotics such as **penicillins, cephalosporins, and sulfonamides**.
- 41) The renal complications of **IgA vasculitis (HSP)** present similarly to those of IgA nephropathy, but the association with recent viral infection (1 to 3 days) is not as strong as in IgA nephropathy.
- a) Can present with **nephritic syndrome** presents with hematuria with or without RBC casts.



- 42)
- a) At plasma levels between 200 and 375 mg/dL, glucose begins to appear in the urine, and at **levels exceeding 375 mg/dL, transport at PCT becomes saturated**.
- 43) **postinfectious glomerulonephritis (GN)**, also called "**staphylococcal-associated GN**" when associated with staphylococcal infection. It is similar to poststreptococcal GN seen in children, causing nephritic syndrome with hematuria, proteinuria (often >3 g/24 h), renal failure, edema, and hypertension. The serum complement is low.
- 44) *Staphylococcus saprophyticus*, a common cause of UTIs in women, would **NOT be nitrite positive**.
- a) *Escherichia coli*, the most common pathogen in UTIs, would be **nitrite positive because it is gram negative**
- 45) Administration of **5% dextrose to a healthy subject is equivalent to administering pure water**, because the dextrose is quickly metabolized.
- a) Pure water ingestion causes low serum osmolality, decreasing ADH release from the posterior pituitary.

- b) Low ADH will decrease collecting duct aquaporins, decrease water reabsorption, and **decrease urea reabsorption from the collecting duct.**
- 46) Most cases of renal failure in myeloma are due to formation of large, eosinophilic tubular casts that obstruct tubular flow (bence-jones proteins)
- 47) End stage renal disease leads to **reduced filtration of phosphate (hyperphosphatemia)**, which contributes to **hypocalcemia**, secondary hyperparathyroidism, and ultimately to bone disease.
- 48) Vincristine is a chemotherapy drug that works by **causing arrest of the cell cycle during metaphase** by inhibiting microtubule polymerization.
- a) Neurotoxicity is the most common adverse effect of vincristine.
- 49) **Primary polydipsia** is characterized by excessive water intake in the setting of normally functioning kidneys. It is seen in patients taking **psychoactive medications who present with hyponatremia, polyuria, and dilute urine.**
- 50) Nonrenal water (sweating, exposure, vomiting, or diarrhea) losses cause hypernatremia with urine osmolality >300 mOsm/L and low urine sodium.
- a) Hypernatremia can be caused by renal water loss (diabetes insipidus), but this would cause low, not high, urine osmolality.
- 51) Hyperventilation leads to respiratory alkalosis, which is characterized by high pH and low PCO₂ levels on blood gas analysis.
- a) may be caused by **pain**, anxiety, aspirin overdose, and pulmonary embolus.
- 52) Hematuria is evaluated by ruling out **glomerular disease, stones, and infection. Cystoscopy is then done in appropriate patients to evaluate for bladder cancer.**
- 53) Brain natriuretic peptide acts on the **renal collecting duct to decrease sodium reabsorption and increases glomerular filtration rate**, leading to urinary sodium loss.
- 54) Uremia (seen in ESRD) is associated with a **high anion gap metabolic acidosis.** (MUDPILES)
- 55) Patients with diabetes and albumin levels in the urine of 30 to 300 mg/24h have early diabetic nephropathy.
- a) **Diabetic nephropathy is best treated with ACE inhibitors.**
- b) ACE inhibitors preferentially **decrease efferent arteriolar tone**, reducing intraglomerular pressure.
- 56) Hepatorenal syndrome (HRS) is characterized by rapid-onset AKI **without evidence of renal ischemia or other renal insult.**
- a) HRS is a direct result of **splanchnic arterial vasodilation**, which in turn **causes renal vasoconstriction.** The kidney appears **normal histologically.**
- b) Also normal anatomically because it is prerenal
- 57) Cases of **nephrotic** syndrome commonly show abnormal GBM structure, **particularly loss of heparan sulfate proteoglycans.** This change **increases passage of negatively charged proteins** through the GBM.
- 58) A radical nephrectomy leads to a proportionate decrease in renal function. **If 50% of the renal mass is removed, then renal function is immediately reduced to approximately 50% of its prenephrectomy value.**
- a) Renal function can **increase to 75% to 80% of prenephrectomy baseline** renal function due to renal hypertrophy and increased filtration.
- 59) Aspirin overdose causes a mixed acid-base disorder of **respiratory alkalosis** with **high anion-gap metabolic acidosis.**
- 60) **Hyperglycemic hyperosmolar syndrome (HHS)** is a hyperglycemic crisis seen in **type 2 DM** that causes extremely **high blood glucose levels without high ketone levels.**
- a) In hyperglycemia, **movement of potassium from the cells to the blood** occurs due to solvent drag as water leaves cells due to the osmolar gradient, pulling potassium with it.
- 61) Nitrofurantoin is the first-choice treatment for UTIs in pregnant women, and it **damages bacterial DNA** and ribosomal proteins after intracellular reduction into reactive molecules.
- 62) A normal anion gap metabolic acidosis presents with low pH, low bicarbonate, and low pCO₂ combined with a normal anion gap.
- a) **Diarrhea can cause normal anion gap metabolic acidosis and hypokalemia** via gastrointestinal HCO₃⁻ and potassium loss. (HARDASS)
- 63) **Renal cell carcinoma commonly causes paraneoplastic syndromes**, leading to weight loss, hypercalcemia, increased hepatic alkaline phosphatase, fevers, and **erythrocytosis**, with anemia occurring due to a decline in erythropoietin levels.
- a) Paraneoplastic syndromes cause diverse complications such as anemia, polycythemia, fevers, hypercalcemia, elevated hepatic alkaline phosphatase, or secondary amyloidosis.
- 64) Mannitol is an osmotic diuretic that causes the excretion of water and sodium. It may cause **volume overload and hyponatremia if used in patients with poor renal function.**
- 65) Acute rejection is seen most often in the **first 3 months** after transplantation due to human leukocyte antigen discrepancies.
- a) **Acute transplant rejection** is predominantly mediated by **cytotoxic T cells (CD8)**, leading to cytotoxic graft cell death and release of proinflammatory cytokines.
- 66) Wilms tumor presents as a palpable flank mass, sometimes with hematuria and abdominal pain.

- a) Wilms tumor complications include **metastases to the lung and liver**.
- 67) Binding of ADH to the V2 receptors in the kidney causes **activation of adenylyl cyclase** and sets off **subsequent cAMP-mediated signaling cascades**, ultimately resulting in an increased reabsorption of water.
- 68) **Angiotensin (AT) II in low doses** constricts both the afferent and efferent arterioles (increases tone), **but constricts the efferent arteriole more**, leading to an increase in the GFR. In contrast, **high doses of AT II** lead to more intense **afferent vasoconstriction** with a drop in GFR.
- 69) Ethylene glycol toxicity causes elevated serum osmolality, high anion gap metabolic acidosis, confusion, hematuria, and crystalluria.
- 70) Patients with **severe symptomatic hyponatremia** due to SIADH secretion may be treated **with hypertonic 3% normal saline**.
- 71) Fanconi syndrome describes renal proximal convoluted tubular dysfunction.
- a) Includes failure to thrive (poor growth), hypokalemia (muscle weakness or spasms, fatigue, palpitations), and hypophosphatemia (rickets, abnormal growth).
- 72) Alkaptonuria is an autosomal recessive disorder with **urine that turns dark after several hours when exposed to oxygen or alkali**.
- a) **homogentisic acid** builds up in the tissue and is excreted in the urine
- 73) The uremic environment of ESRD accelerates atherosclerosis, **causing more frequent death from MI**.
- 74) ACE inhibitors dilate both the afferent and efferent arteriole, with preferential dilation of the efferent arteriole. This effect lowers glomerular pressure and exerts renal-protective effects in glomerular diseases like type 2 diabetes mellitus.
- 75) BUN can increase without an increase in serum creatinine when there is **heavy protein ingestion, gastrointestinal bleeding, or massive trauma with blood loss**.
- 76) **Mixed cryoglobulinemia** is a small vessel vasculitis caused by antigen-antibody deposition. Patients present with fever, fatigue, malaise, joint pain, peripheral neuropathy, and palpable purpura with elevated serum cryoglobulins.
- a) The renal involvement in mixed cryoglobulinemia typically shows **membranoproliferative glomerulonephritis** with glomerular immune complex deposition and **subendothelial** electron dense deposits.
- b) Shows positive **anti-nuclear antibodies and low levels of C4**
- 77) Aldosterone causes increased **renal sodium reabsorption**, increased **renal potassium excretion**, and **increased renal hydrogen ion secretion**. Its inhibition (eg, use of spironolactone) causes the reverse effects.
- 78) Prerenal AKI is characterized by a normal urinalysis, with fractional excretion of sodium <1%, urine sodium <20 mEq/L, and serum BUN:creatinine ratio >20.
- a) Prerenal AKI can be caused by a reduction in renal perfusion, including causes like **volume depletion, heart or liver failure, or bilateral renal artery stenosis**.
- 79) **ESRD may cause hyperkalemia**, which can induce fatal arrhythmias.
- a) Magnesium homeostasis is regulated by the kidney. Patients with **ESRD are at risk for hypermagnesemia**. Symptoms include nausea, lethargy, weakness, diminished deep tendon reflexes, and changes on ECG.
- b) Patients with **ESRD have little to no glomerular filtration**; therefore they lack the ability to filter fluid or electrolytes. This can lead to the accumulation of total body water, total body sodium, and potassium leading to hyponatremia, volume overload, and hyperkalemia, respectively.
- 80) Both **urea** and sodium chloride contribute to the ability of the renal medullary interstitium to concentrate urine and are essential to **maximize renal free water reabsorption and urine concentration**.
- 81) The most common cause of **non-renal stone urinary obstruction** in women is a **pelvic tumor** such as **uterine, cervical, or ovarian cancer**, any of which may grow to obstruct the ureters and cause urinary obstruction.



- 82)
- a) Wilms tumor may present as an abdominal mass and is the most common renal malignancy in childhood.
- b) Wilms tumors originate from **residual metanephric blastema**.
- 83) Preventing diabetic nephropathy is best done **by screening for microalbuminuria** with annual measurement of urine albumin, most easily done with a **urine albumin:creatinine ratio**.
- 84) Substances are handled by the nephron by filtration, reabsorption, and/or secretion; handling is variable depending on the substance.
- a) Inulin clearance is the most precise estimate of the GFR.

Start of proximal tubule: 50 mEq/L

End of proximal tubule: 0

End of ascending loop of Henle: 0

End of distal convoluted tubule: 0

End of collecting duct: 70 mEq/L

85)

Examining the table, substance X is **filtered**, based on its presence at the start of the proximal tubule. Its disappearance by the end of the proximal tubule suggests that it has been **reabsorbed** in the proximal tubule. Its reappearance between the end of the distal convoluted tubule and the end of the collecting duct suggests it is **secreted** by cells in that segment.

86) RAS may be due to fibromuscular dysplasia **in young or middle-aged women. In these cases, nonatherosclerotic**

arterial stenosis results from fibromuscular dysplasia of the renal arteries.

87) RCC may be due to von Hippel-Lindau (VHL) syndrome, resulting from a mutation in the gene encoding VHL tumor suppressor protein.

a) VHL leads to **renal cysts, RCC, cerebellar hemangioblastomas, retinal hemangioblastomas, pancreatic cysts, pancreatic carcinomas, and pheochromocytomas.**

63%