2018

Dynamic Practice Guidelines for Emergency General Surgery

Committee on Acute Care Surgery, Canadian Association of General Surgeons

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DIAGNOSTIC LABORATORY TESTS

Dynamic Practice Guidelines for Emergency General Surgery

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DIAGNOSTIC TESTING: LABORATORY TESTS

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CBC – Complete Blood Count

Information on white and red cells and platelet numeration
General screening that can orient toward infection, bleeding, coagulopathy

Red blood cell count (RBC) – total number of cells

- Mean corpuscular volume (MCV): average size of a single red blood cell
- Mean corpuscular hemoglobin (MCH): average amount of hemoglobin inside a single red blood cell
- Red cell distribution width: calculation of the variation in the size of the red blood cells
- Reticulocyte count: absolute count or percentage of young red blood cells in the blood
- Hematocrit: percentage of a person's blood volume is composed of red blood cells
- Hemoglobin: amount of oxygen-carrying protein in the blood

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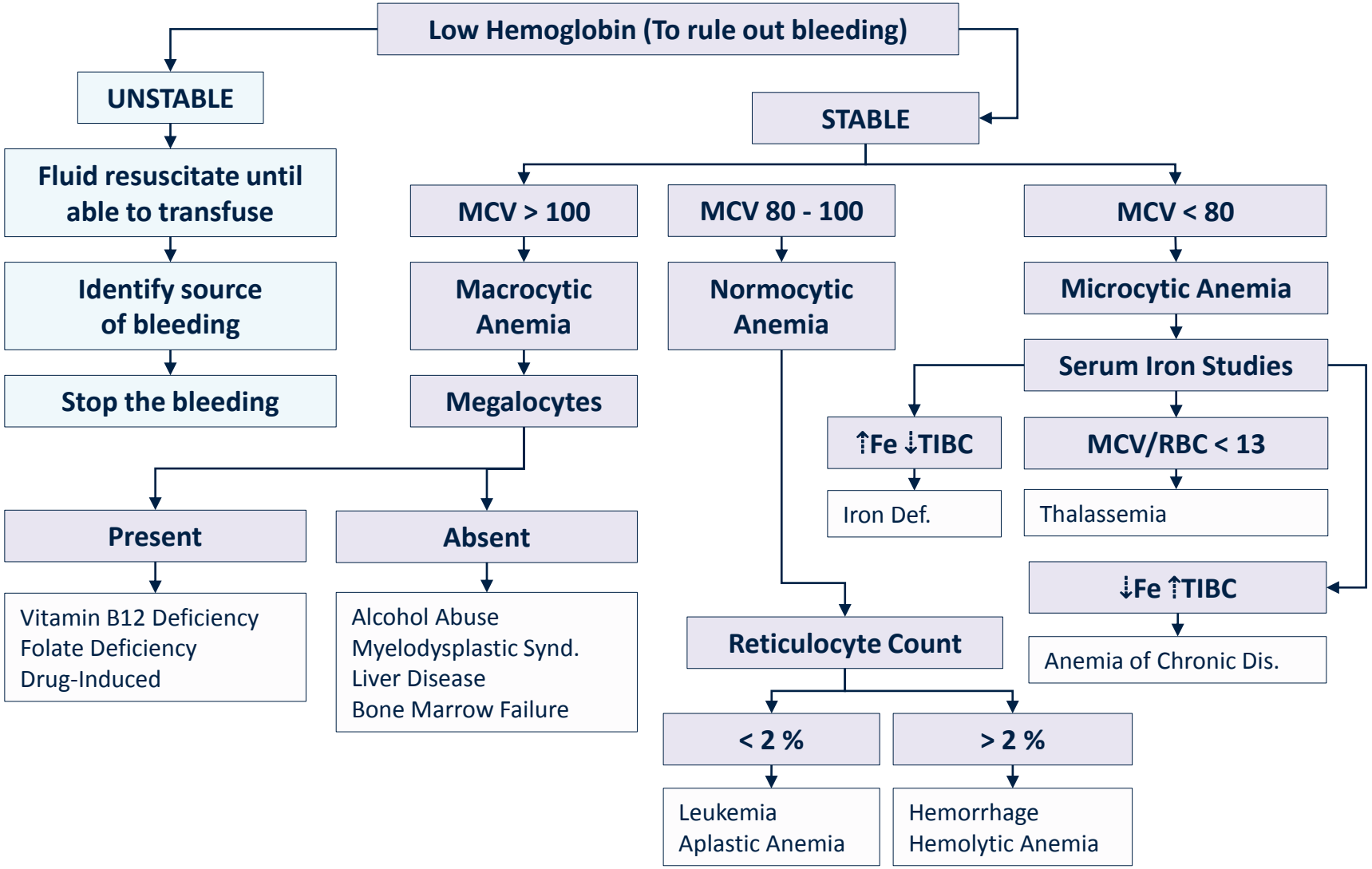

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CBC – Complete Blood Count

White blood cell count (WBC)

- Differential: differentiates type of white cell and the quantity (neutrophils, lymphocytes, basophils, eosinophils and monocytes)
- Large amount of band usually marks acute infection
- High WBC
  - Infection, Inflammation
  - Leukemia/ Myeloproliferative Disorders
  - Tissue death (trauma/ burns/ ischemia)
- Low WBC
  - Bone marrow disorders, Lymphoma
  - Autoimmune conditions
  - Severe Infection/ Sepsis
  - Dietary deficiencies
  - HIV/AIDS

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CBC – Complete Blood Count

Platelet Count

- Mean Platelet Volume (MPV): average size of the platelets
- Platelet Distribution Width: reflects how uniform the platelets are in size

Low Platelet Count

Low bone marrow production
- Neoplasm
- Marrow suppression

Excess distribution
- ITP
- TTP/ DIC/ HITT
- Hypersplenism (sequestration)
- Sepsis
- Drug-induced thrombocytopenia

Consumption
- Coagulopathy

High Platelet Count

- Chronic Infection
- Inflammatory State
- Post Splenectomy

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Electrolytes

When to order? General screening of metabolic state
Evaluation of fatigue/weakness, confusion, dehydration/fluid status, nausea/vomiting, kidney/lung disease or heart conditions/arrhythmias

Components

- Sodium
- Potassium
- Chloride
- Bicarbonate
- Extended Electrolytes: Ca^{+2}, Mg^{+2}, PO_4^{+3}

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HYPERNATREMIA (High Na+)

SYMPTOMS: seizures, coma, thirst, dry mucus membranes, oliguria, fever

CAUSES: *click here to see approach to etiologies of Hyper Na+*

MANAGEMENT

- This is a water deficit state. Therefore treat with saline to address the water deficit state before attempting to correct the sodium value.
- Oral water replacement preferred if possible.
- **Correct slowly**
  - Rapid correction can lead to cerebral edema
- Less common than hyponatremia but has a worse prognosis and is a predictor of mortality in critical illness

WATER DEFICIT	=	(Serum Na^+ - 140)/140	X	TBW = weight in kg x 0.6 (males) or 0.5 (females)

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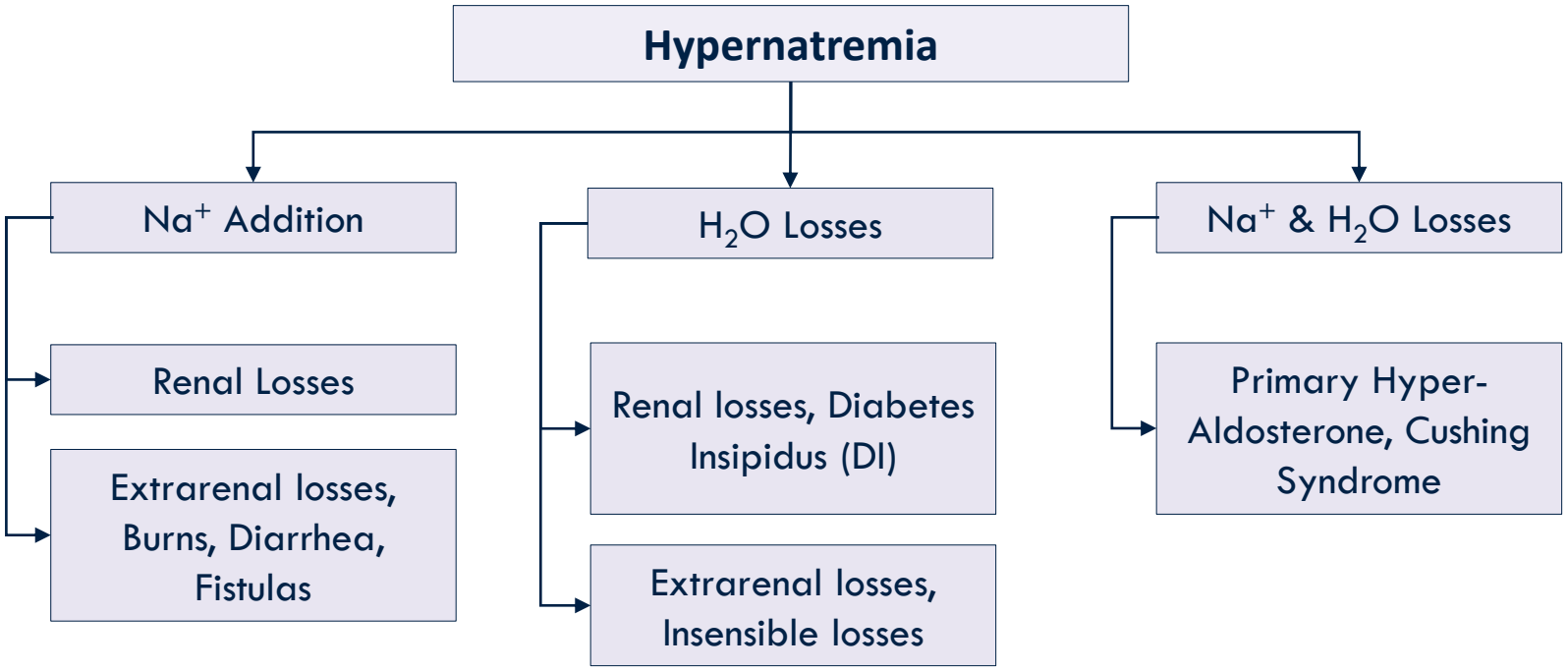
HYPERNATREMIA (High Na+)



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HYPONATREMIA (Low Na+)

SYMPTOMS: nausea/vomiting, headache, confusion, fatigue, muscle weakness/ spasm/ cramps, seizures/coma

CAUSES

- Volume status is the key to determine the etiology:
  - Hypovolemic
    - Urine Na < 10 = volume loss (sweating, diuretics, third spacing and water replacement without electrolytes)
    - Urine Na > 20 = salt wasting
  - Euvolemic – SIADH (malignancy i.e. SCLC or pancreatic cancer, pulmonary infection, CNS diosrders, medications, post op), AI, or primary polydipsia.
  - Hypervolemic – CHF, nephrotic syndrome, cirrhosis

MANAGEMENT

- **Correct slowly** as rapid correction can lead to pontine myelinolysis, permanent brain damage and even death
  - If Na < 120 or neurological symptoms treat with 3% saline but aim to increase by no more than 1 meq/hr
  - If asymptomatic then correct by 0.5 meq/hr to a max of 12meq/day if acute and even slower if chronic

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HYPERKALEMIA (High K+)

SYMPTOMS: nausea/vomiting/diarrhea/abdominal pain, weakness leading to paralysis, respiratory failure, ECG changes, arrhythmias and eventually cardiac arrest.

CAUSES:

- Potassium Supplement
- Renal Failure
- ACE Inhibitor, NSAID
- Massive tissue breakdown, trauma, burns, rhabdomyolysis

DIAGNOSIS: ECG Changes

- Early shows peaked T waves
- Widened QRS
- Flattened P wave
- Prolonged PR interval (1st degree block)
- Eventually sine wave and ventricular fibrillation

MANAGEMENT

- Calcium gluconate immediately (stabilizes cardiac membrane)
- Bicarbonate OR insulin and dextrose (shift)
- Dialysis if refractory to treatments
- Kayexalate takes hours to days to correct potassium.

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HYPOKALEMIA (Low K+)

SYMPTOMS: Ileus, decreased reflexes, fatigue, paralysis, cardiac arrest.

CAUSES:

- Increase excretion
  - Diarrhea
  - Renal losses, diuretics, NG drainage, hyperaldosteronism, Mg^{+} depletion
- Shift of Potassium into cells
  - Medication: Beta-agonists, insulin
  - Delirium tremens

DIAGNOSIS: ECG Changes described as essentially stretching out of the ECG

- Broad flat T waves
- ST depression
- QT prolongation
- U waves

MANAGEMENT

- Replace either IV (faster) 10mEq/100cc x 3 over 1h each or PO (safer) 40mEq TID
- Replete magnesium level if not responding to treatment.

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HYPERCALCEMIA (High Ca+)

SYMPTOMS: Anorexia, nausea/vomiting, abdominal pain, weakness/ confusion/ coma, bone pain, polydipsia, HTN, arrhythmias.

- "Painful bones, renal stones, abdominal groans, and psychiatric moans"

CAUSES:

1. Hyperparathyroidism (parathyroid adenoma)
2. Malignancy (metastases) – osteolysis
3. Granulomatous disease, Sarcoidosis, Tuberculosis
4. Vitamin D Intoxication
5. Familial Hypocalciuric Hypercalcemia

DIAGNOSIS: ECG Changes

- Shortened QT
- Prolonged PR and QRS
- Flat and wide T waves
- AV block progressive to complete heart block

MANAGEMENT

- Forced diuresis (Normal Saline and Lasix)
- Bisphosphonates/ PO_4
- Calcitonin (DO NOT GIVE THIAZIDES)

HYPOCALCEMIA (Low Ca+)

SYMPTOMS: Hyperreflexia, spasms, seizures

CAUSES:

1. Renal Disease
2. Vitamin D deficiency
3. Pancreatitis
4. Massive transfusion
5. Post-op thyroidectomy

DIAGNOSIS: ECG Changes

- Prolonged QT
- T wave inversion
- Eventually ventricular fibrillation and heart block

MANAGEMENT

- **IV**
  - 10% Calcium gluconate contains 90mg/10ml of calcium, give 2 or 3
  - 10% calcium chloride contains 360mg/10ml, give 1, be careful to avoid extravasation, can cause skin slough
- **PO:** Calcium carbonate 240mg of calcium per 600mg tablet
- May be refractory to treatment if Mg+ is low so ensure to also replace Mg+

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HYPERMAGNSEMIA (High Mg+) – Very Rare

SYMPTOMS: Nausea/vomiting, weakness, lethargy, hyporeflexia, hypotension, arrest

CAUSES: Could be seen in renal failure and magnesium containing antacid abuse.

DIAGNOSIS: ECG Changes similar to hyper K+

HYPOMAGNSEMIA (Low Mg+)

SYMPTOMS: Hyperreflexia, tremors, tetany, seizures, arrhythmias

CAUSES: Parallel the effect on calcium (i.e. diarrhea, aggressive diuresis, alcohol abuse, DM with persistent osmotic diuresis, pancreatitis)

DIAGNOSIS: ECG Changes

- Prolonged QT & PR with ST depression
- Flat or inverted T waves leading to Torsades de Pointe & other arrhythmias

MANAGEMENT

- Needs aggressive replacement and requires potassium and calcium corrected to restore homeostasis

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BUN/ CREATININE

- BUN and creatinine are the primary tests used to assess kidney function (through calculation of creatinine clearance can determine how well kidneys are functioning)
- BUN levels increase with age
- **Elevated BUN/Creatinine Ratio:**
  - Seen in situations where there is decreased flow of blood to the kidneys (i.e. CHF, dehydration, GI bleeding, increased protein in the diet, malnutrition)
  - Ratio more than 20 is usually a sign of dehydration
- **Low levels of BUN and creatinine** are typically seen in very petite individuals or malnourished persons with decreased muscle mass

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Lactate

When to order?

- Signs and symptoms of inadequate oxygenation/hypoxia (shortness of breath, increased respiratory rate, nausea, abdominal pain, decreased LOC, fatigue/paleness).
- Repeat to monitor resuscitation efforts or monitor progression of the condition. It is not diagnostic on its own.

Conditions in which lactate can be elevated is lengthy and includes:

- Sepsis
- Bowel ischemia
- Heart attack/CHF
- Severe lung disease/ Resp. failure
- Pulmonary edema
- Anemia
- Liver/kidney disease
- Diabetes, Leukemia or AIDS
- Strenuous exercise
- Thiamine deficiency

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Blood Gas

When to order?

When a patient is experiencing:

- Shortness of breath
- Decreased LOC
- Shock
- Requiring increasing amounts of supplemental oxygen
- Nausea/vomiting
- Known respiratory, metabolic or kidney disease and is experiencing some respiratory or metabolic distress.

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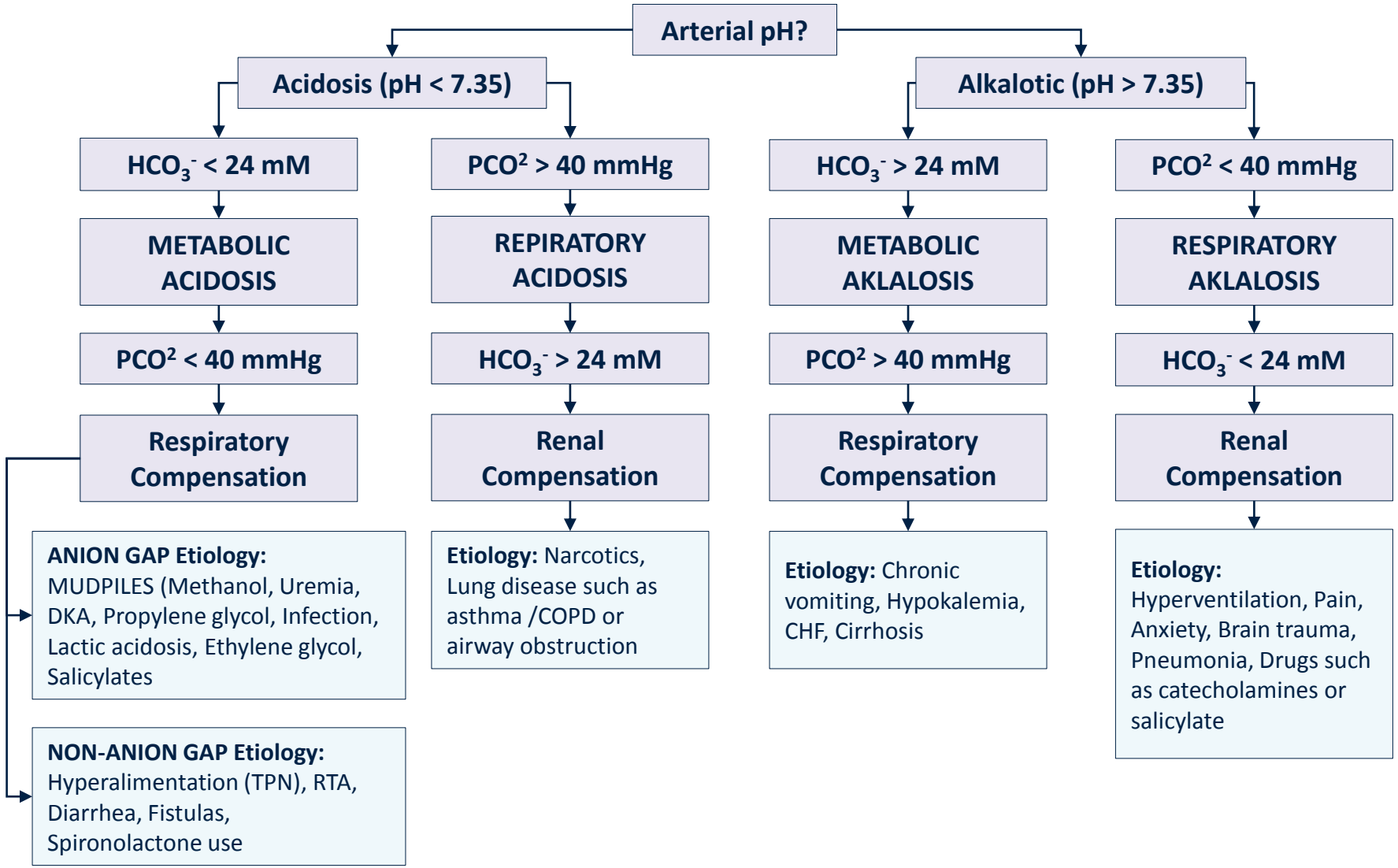

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Liver Panel (Enzymes and Function Tests)

Evaluation of jaundice, heavy alcohol use, pruritus, nausea/ vomiting/ diarrhea, abdominal swelling or pain, dark urine

Components:

- Bilirubin
  - Unconjugated – increased with hemolysis or dysfunction of the liver conjugation
  - Conjugated – increased with biliary obstruction
- ALT and AST = hepatocellular dysfunction
  - Very high levels seen in acute hepatitis, moderately elevated or normal with biliary disease/cirrhosis/cancer, liver damage is due to alcohol the AST is often increased much more than the ALT
- ALP: can be elevated in bone disease and in biliary obstruction
- GGT: more specific to the biliary tree than ALP
- Albumin: decreased in malnourished patients, it is often normal in liver disease but may be low due to decreased production
- INR: prolonged with liver disease, Vitamin K deficiency, warfarin

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Urinalysis

When to order?

Lower abdominal or back pain, urinary frequency/dysuria or hematuria, to determine the presence of urinary tract infection, assess electrolyte abnormalities and kidney function, liver abnormalities, diabetes and other metabolic conditions

Components:

- Color: i.e. red (can be blood, secondary to dietary or medication changes), brown/tea (jaundiced), feculent (?colovesicular fistula)
- Clarity: i.e. cloudy can mean infection vs colonization
- pH: normal range 4.8-8, can be altered in times of acidosis/alkalosis and this can predispose patients to forming stones
- Protein: elevation can be seen in kidney disease, diabetes, HTN
- Glucose: elevated in uncontrolled diabetes
- Ketones: produced when there is not enough carbohydrates available such as in DKA and can be an emergency
- Myoglobin: seen in muscle breakdown

Click for Continuation

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Urinalysis (continued)

Components:

- Blood: can be vaginal bleeding, rectal bleeding, secondary, infection, physical injury to kidney/bladder, NSAIDs/blood thinners, stones, BPH, urethritis/prostatitis, exposure to toxins, or cancer (prostate, bladder, kidney)
- Leukocyte Esterase: may indicate inflammation in the urinary tract or kidneys such as a UTI
- Nitrite: many bacteria can convert nitrate into nitrite thus making this test positive in the presence of certain bacteria common to the urinary tract
- Urobilinogen: presence may indicate liver diseases such as viral hepatitis, cirrhosis, liver damage such as from toxins/EtOH
- Bacteria/Yeast/Parasites: may be contaminate from skin or vaginal flora or colonization from chronic catheterization but often points to infection depending on clinical context