Bloodwork Basics: What does it all Mean? (Handout)

Outline

Ontario Lab Requisition Form

Ontario — Ministry of Health and Long-Term Care

Laboratory Requisition
Requisitioning Clinician / Practitioner

Name

Address

Laboratory Use Only

Clinician/Practitioner's Contact Number for Urgent Results ( )

Service Date yyyy mm dd

Clinician/Practitioner Number | CPSO / Registration No.

Health Number | Version | Sex ☐ M ☐ F | Date of Birth yyyy mm dd

Check (✓) one: ☐ **OHIP/Insured** ☐ **Third Party / Uninsured** ☐ **WSIB**

Province | Other Provincial Registration Number | Patient's Telephone Contact Number ( )

Additional Clinical Information *(e.g. diagnosis)*

Patient's Last Name *(as per OHIP Card)*

Patient's First & Middle Names *(as per OHIP Card)*

☐ Copy to: Clinician/Practitioner
Last Name First Name

Address

Patient's Address *(including Postal Code)*

Note: Separate requisitions are required for cytology, histology / pathology and tests performed by Public Health Laboratory

x	Biochemistry
	Glucose ☐ Random ☐ Fasting
	HbA1C
	Creatinine (eGFR)
	Uric Acid
	Sodium
	Potassium
	ALT
	Alk. Phosphatase
	Bilirubin
	Albumin
	Lipid Assessment (includes Cholesterol, HDL-C, Triglycerides, calculated LDL-C & Chol/HDL-C ratio; individual lipid tests may be ordered in the "Other Tests" section of this form)
	Albumin / Creatinine Ratio, Urine
	Urinalysis (Chemical)
	Neonatal Bilirubin:
	Child's Age: days hours
	Clinician/Practitioner's tel. no. ( )
	Patient's 24 hr telephone no. ( )
	Therapeutic Drug Monitoring:
	Name of Drug #1
	Name of Drug #2
	Time Collected #1 hr. #2 hr.
	Time of Last Dose #1 hr. #2 hr.
	Time of Next Dose #1 hr. #2 hr.

I hereby certify the tests ordered are not for registered in or out patients of a hospital.

X
Clinician/Practitioner Signature Date

x	Hematology
	CBC
	Prothrombin Time (INR)
	Immunology
	Pregnancy Test (Urine)
	Mononucleosis Screen
	Rubella
	Prenatal: ABO, RhD, Antibody Screen (titre and ident. if positive)
	Repeat Prenatal Antibodies
	Microbiology ID & Sensitivities (if warranted)
	Cervical
	Vaginal
	Vaginal / Rectal – Group B Strep
	Chlamydia *(specify source)*:
	GC *(specify source)*:
	Sputum
	Throat
	Wound *(specify source)*:
	Urine
	Stool Culture
	Stool Ova & Parasites
	Other Swabs / Pus *(specify source)*:

Specimen Collection
Time *24 hour clock* | Date *yyyy/mm/dd*

Fecal Occult Blood Test (FOBT) *(check one)*
☐ FOBT (non CCC) ☐ ColonCancerCheck FOBT (CCC) no other test can be ordered on this form

x	Viral Hepatitis *(check **one** only)*
	Acute Hepatitis
	Chronic Hepatitis
	Immune Status / Previous Exposure *Specify:* ☐ Hepatitis A ☐ Hepatitis B ☐ Hepatitis C or order individual hepatitis tests in the "Other Tests" section below

Prostate Specific Antigen (PSA)
☐ Total PSA ☐ Free PSA
Specify one below:
☐ Insured – Meets OHIP eligibility criteria
☐ Uninsured – Screening: Patient responsible for payment

Vitamin D (25-Hydroxy)
☐ Insured - Meets OHIP eligibility criteria: osteopenia; osteoporosis; rickets; renal disease; malabsorption syndromes; medications affecting vitamin D metabolism
☐ Uninsured - Patient responsible for payment

Other Tests - one test per line

Laboratory Use Only

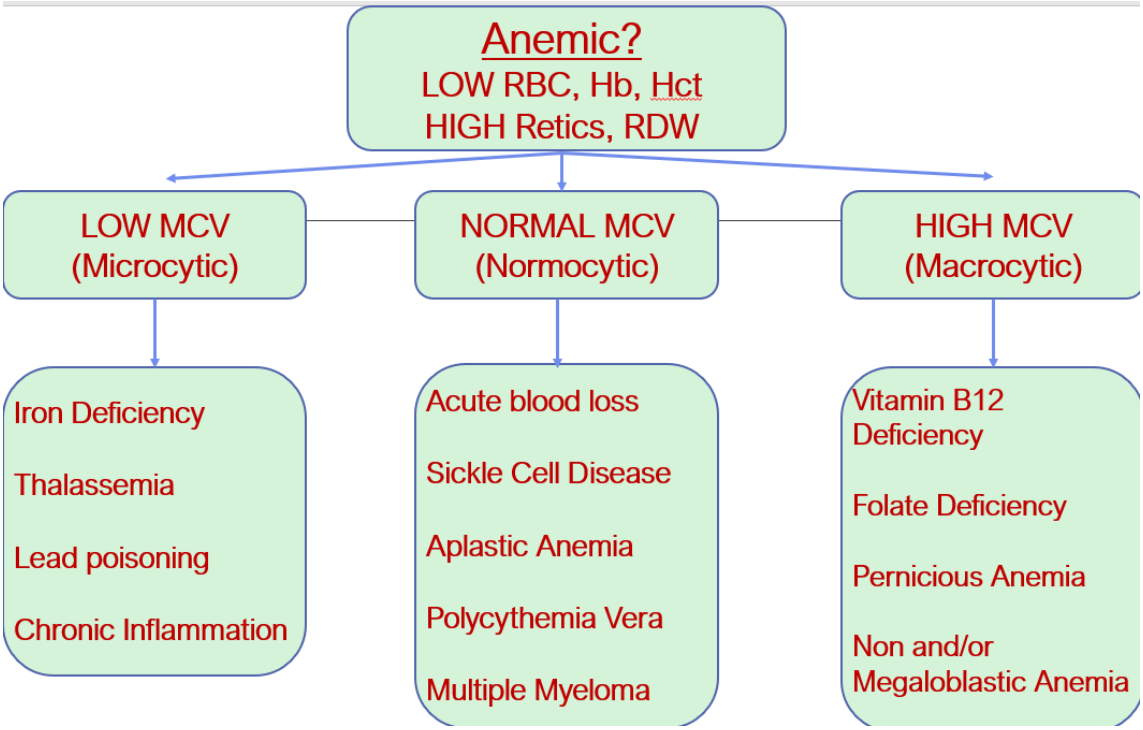
CBC with Diff.

Components of the CBC with Diff. include:

Red Blood Cell Tests	White Blood Cell Tests	Platelet Tests
RBC count Hemoglobin (Hb) Hematocrit (Hct) Red cell indices - Mean Corpuscular Volume (MCV) - Mean Corpuscular Hemoglobin (MCH) - Mean Corpuscular Hemoglobin Concentration (MCHC) - Red Cell Distribution Width (RDW) Reticulocytes	WBC count WBC Differential - Neutrophils - Lymphocytes - Monocytes - Eosinophils - Basophils	Platelet count Mean Platelet Volume (MPV) Platelet Distribution Width (PDW)

Lab Test	Low Results	High Results
RBC count	*Refer to low Hb*	*Refer to high Hb*
Hb	Anemia - Acute or chronic bleeding - RBC destruction - Nutritional deficiencies - Bone marrow disorders - Inflammatory diseases	Polycythemia - Dehydration - Kidney tumors producing excess EPO (RBC-producing hormone) - Living at high altitudes / altitude training - Genetics
MCV	RBCs are SMALLER than normal (Microcytic)	RBCs are LARGER than normal (Macrocytic)
WBC count	Leukopenia - Bone marrow disorders / damage / failure - Autoimmune conditions - Sepsis - Immunodeficiency (e.g. HIV / AIDS)	Leukocytosis - Infection (usually bacterial or viral) - Inflammation - Leukemia - Allergies - Tissue death
Neutrophil count	Neutropenia - Severe infection (sepsis) - Immunodeficiency - Bone marrow failure	Neutrophilia - Acute bacterial infections - Inflammation - Trauma, burns… - Stress - Leukemias
Eosinophil count	Normally low, not significant.	Drug reactions

		Parasite infections Inflammatory disorders (IBD)
Platelet count	Thrombocytopenia - Cirrhosis - Autoimmune disorders - Chemoradiation	Thrombocytosis - Cancers (lung, breast, lymphoma…)



Coagulation

PT (Extrinsic)	PTT (Intrinsic)	Potential Causes
Prolonged	Normal	Liver Disease. Vitamin K deficiency. Anticoagulation therapy (e.g. Warfarin). Defective / low Factor 7.
Normal	Prolonged	Defective / low Factors 8, 9, 11, or 12. von Willebrand Disease.
Prolonged	Prolonged	Defective / low Factors 1, 2, 5, or 10. Severe liver disease. Acute Disseminated Intravascular Coagulation. Warfarin overdose (inactivates Prothrombin).
Normal	Normal or slightly prolonged	May indicate normal hemostasis. Mild coagulation factor deficiencies. Mild von Willebrand…

Abdominal Labs

1. **Liver Labs**

    a. **Liver Enzymes** (acute injury)

Enzyme	Location	Causes for Increased Levels
AST (Hepatic)	Heart* Liver* Kidneys and muscle	Hepatitis Liver drug toxicity Cirrhosis Alcoholism Pancreatitis Muscle damage
ALT (Hepatic)	Liver* Kidney*	Early detection of liver damage POS before other liver injury s/s like jaundice
ALP (Gallbladder)	Bone* Liver*	Biliary obstruction Biliary duct injury Bone growth / metastasis
GGT (Gallbladder)	Liver**	Most sensitive test for detecting bile duct injury

    b. **Liver Function Tests** (accumulated injury)

Despite what you may think, the liver has several important functions in protein-production, and maintenance of coagulative factor. The liver is responsible for:

- ***Platelet*** production
- ***INR*** maintenance (INR is an indication of how well the blood coagulates and is used to monitor anticoagulation Tx – low values mean it is too thin, while high INR values means it coagulates too easily)
- ***Albumin*** production (albumin helps maintain our BP and pulls fluid into our vessels)
- ***Bilirubin*** production (used to emulsify / break fats we consume in our diet)

There is an order to which LFTs will begin to deteriorate, depending on the stage of liver damage. The order and resulting deficits are:

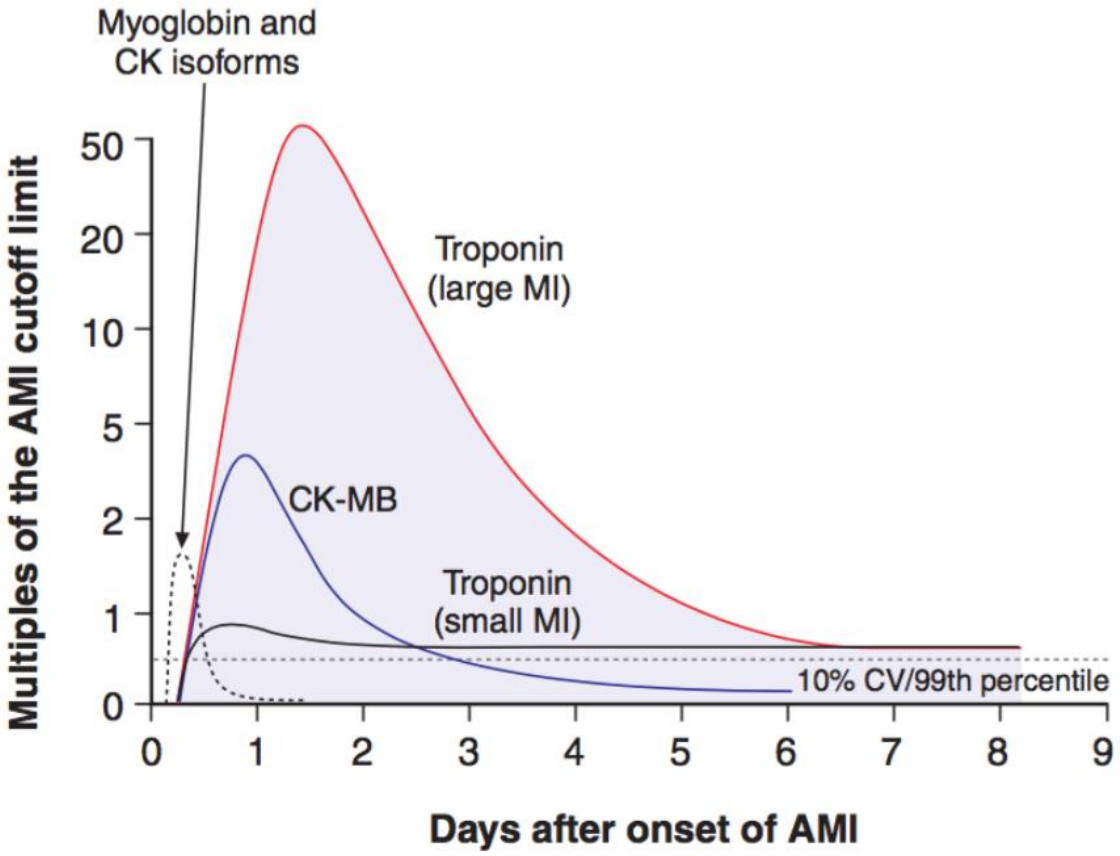
LOW Platelets → HIGH INR → LOW Albumin → HIGH Bilirubin

2. **Lipase**: This enzyme is stored in the PANCREAS. In response to injury (e.g. Pancreatitis, Cystic Fibrosis, gallstone blockage of the Pancreatic Duct), pancreatic cells will break down and release LIPASE into the blood, which can then be detected.

Cardiac Tests

Acute MI Biomarkers

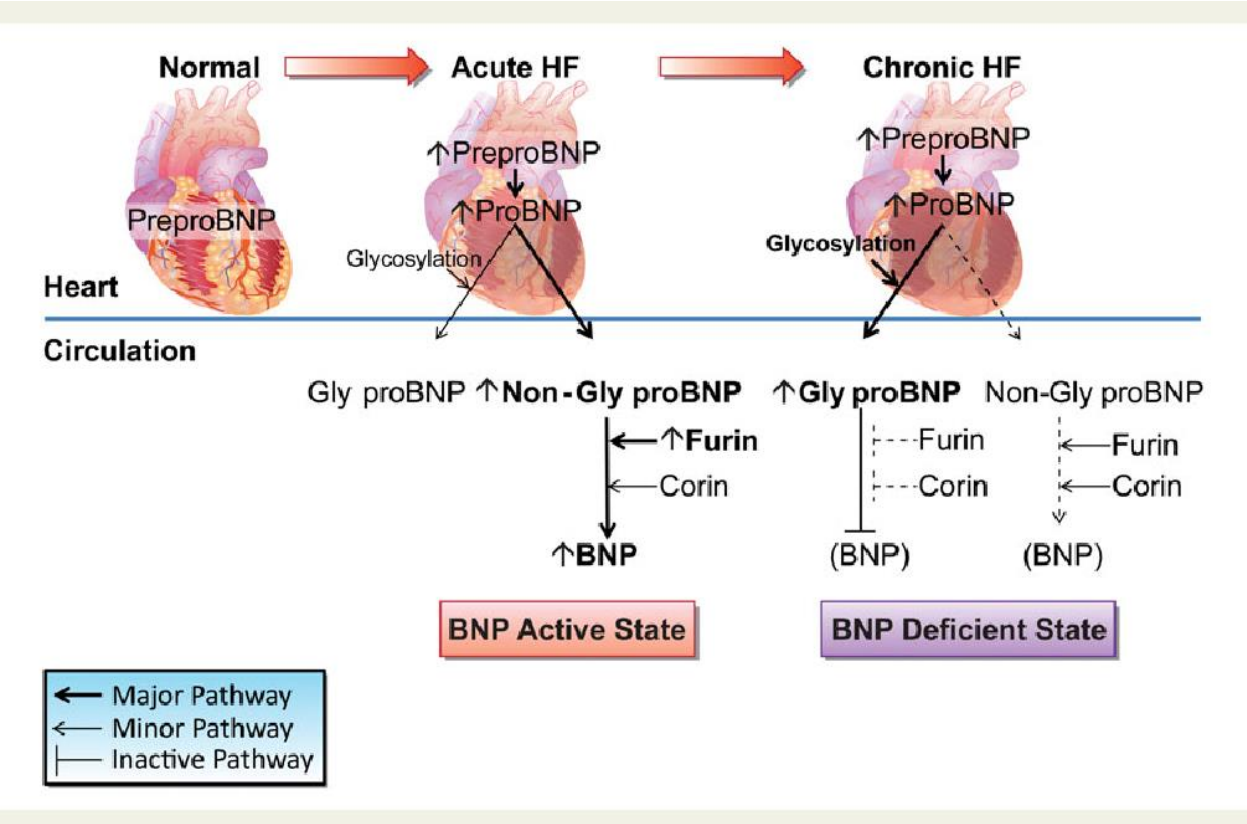
Marker	Tissue of Origin	Time to Increase	Time to Return to Normal	When the Biomarker is Used
Troponin	Heart	2-8hrs	7-14d	Gold Standard
Creatine Kinase	Heart Skeletal Muscle	4-6hrs after injury (peaks at 12-20hrs)	24-48hrs (unless continued damage)	Less SPECIFIC than Troponin Used when Troponin not available.
CK-MB	Heart Skeletal muscle Brain Smooth Muscle	4-6hrs after injury (peaks at 18-24hrs)	48-72hrs (unless continued damage)	Performed in combination with CK-MB



BNP – The Biomarker of Heart Failure

Brain Natriuretic Peptide (BNP) is produced in the ventricles of the heart. When the ventricles are stretched, as in CHF, BNP is released into the blood and is able to be detected.

BNP can be used to monitor progression of Heart Failure.



Urine Studies

Urine studies are often ordered when a pt presents with s/s of urinary frequency and urgency, suprapubic pain, back pain where the kidneys are located, abdominal discomfort, hematuria, proteinuria, or other changes in urination which can be d/t a UTI.

Analysis of urine consists of x3 stages:

Visual Exam		Chemical Analysis		Microscope Analysis
Color (colorless to amber, bloody) **Clarity** (clear vs. cloudy)	→	**Specific** Gravity (indicator of concentration) - Low SG indicates urine is too dilute - High SG indicates urine is too concentrated **pH** (reflects systemic acidosis vs. alkalosis) **Bilirubin** (indirect indicator of liver disease or significant RBC destruction) **Protein / Albumin** (indicator of Kidney Damage) **Glucose** (indicator of Glucose levels in the blood and presence of Kidney Disease) **Ketones** (present when there is insufficient glucose-use in body, as in Insulin deficiency DKA) **Hb** (indicates kidney damage) **Leukocyte Esterase** (enzyme released during inflammation, attracts WBCs) **Nitrite** (some bacteria can convert Nitrate to Nitrite)	→	RBCs WBCs Bacteria, yeasts, parasites Casts (clumped proteins) Crystals

Test	Result
Leukocyte Esterase	POS
Nitrites	POS
pH	5.0
Blood	NEG
Glucose	NEG
Protein	NEG
Ketones	NEG
Color	Yellow
Clarity	Cloudy
Specific Gravity	1.010 (NEG)

Kidney Function

Creatinine (Cr) is produced by muscles as a by-product of function and is then excreted into the urine. If the kidneys are damaged and cannot excrete the Cr, then it accumulates in the blood. Measuring serum Cr indicates whether the kidneys are functioning properly, and can be used to diagnose Acute Kidney Injury.

Cr is an easy lab test that can be used to assess for AKI, and monitor CKI in the context of chronic conditions of DM and HTN.

Inflammatory Markers

CRP and ESR are 2 tests used to assess for the presence of inflammation.

Thyroid Tests

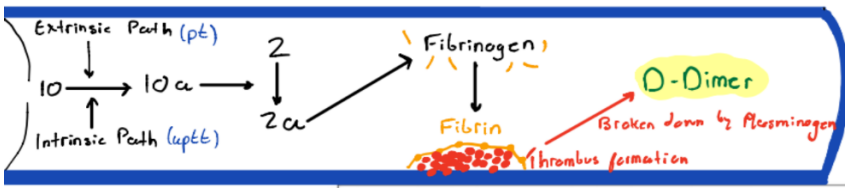
TSH is produced by the Anterior Pituitary Gland in response to low T4 levels. TSH stimulates the production and release of T4 from the Thyroid Gland, which then produces a Negative Feedback Pathway to ultimately limit the production of T4.

In HYPERTHYROIDISM, TSH will be suppressed d/t over-production of T4 from the Thyroid Gland.

In HYPOTHYROIDISM, TSH will be high d/t the under-production of T4 from the Thyroid Gland.

D-Dimer

The D-Dimer is used to assess for PE in the acute setting. The D-Dimer detects clot breakdown, which means it will detect a PE, but it may be positive as well by picking up a clot anywhere else in the body (i.e. high sensitivity, low specificity). A POS D-Dimer, in the context of DVT or where PE is the most suspected Dx based on CTA or US of the lower leg, thrombolytic therapy can be commenced.



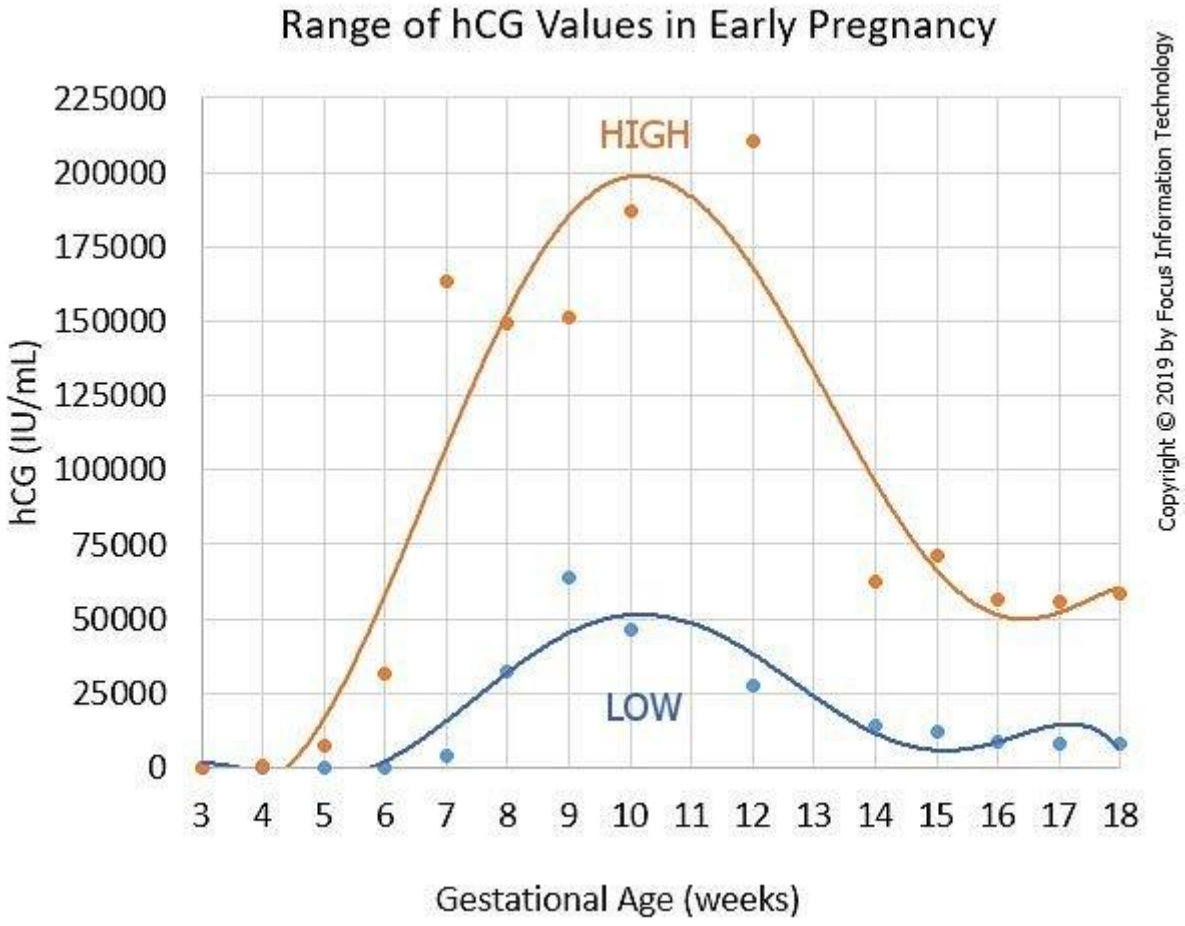
Iron Studies

Transferrin	Transferrin transports Fe around the body. In states of HIGH Transferrin saturation, there is an ABUNDANCE / TOO MUCH Fe in the body.
Total Iron Binding Capacity	TIBC indicates how many free spots Transferrin has to carry Fe. Usually, 1/3 of Transferrin's binding spots are filled. In states of LOW TIBC, there is an abundance of Fe in the body being transported.
Serum Ferritin	Ferritin is the primary STORAGE protein for Fe. Low Ferritin can be d/t anemia, high Ferritin indicates TOO MUCH Fe in the body.

Pregnancy Test

The b-hCG is hormone produced by the placenta. B-hCG is used to confirm pregnancy, used to assess how the pregnancy is progressing (rises throughout pregnancy). In levels where levels are TOO HIGH, causes can include Molar Pregnancy (a non-viable fertilized egg implants and develops into a mass), or multiple fetuses (as in twins).

This is an important test to be conducted in all females or child-bearing age presenting with CP, abdominal pain, or urinary symptoms.



Electrolytes

Refer to slides 8-16 of the 2018 Dynamic Practice Guidelines for Emergency General Surgery