



Lab Values Course
Lab Values Case Studies

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Contents

Case Study: ABGs	4
Case Study: Heparin	7
Case Study: Insulin	12
Case Study: Gastrointestinal	16
Case Study: Myocardial Infarction	18
Case Studies: Renal Patients	20
Case Study: Septic Shock.....	23

Case Study: ABGs

Your patient is a 30 year old male who was brought to the ED by his wife with complaint of Altered Mental Status. Patient is alert and oriented to person only. Patients skin is warm and flushed, EKG shows tented T waves, blood pressure is hypotensive and pulse is weak and thready. Patient is experiencing Kussmaul Respirations and cannot stand without assistance.

Question: What Labs would you anticipate the doctor ordering?

- Answer: CBC, BMP, Coagulation studies, ABGs, Blood Cultures, Lactic Acid, Trop I and a urinalysis.

Question: What color tubes will you grab to draw these?

- Answer: Lavender, Dark Green, light blue top, ABG syringe, 2 sets of Blood Cultures (red and blue) and a red top.

Question: What order would you draw the labs?

- Answer: Blood cultures, light blue, red, green, lavender.

The doctor comes in the patients' room and orders the following: Chest XR, Head CT, and a liter of NS.

The results of the CT come back negative, as well as the chest XR. The lab work comes back with the following results:

Sodium	141
Potassium	6.1
Chloride	105
PaCO ₂	45
Glucose	675
BUN	15
Creatinine	1.1
GFR	>60
pH	7.31
HCO ₃	29
Lactic Acid	3.4
Calcium	8.5
Total protein	6.7
Alkaline phosphate	60

Trop I	0.00
Anion gap	14
PT/INR	3.9
PTT	116
Urine Ketones	+
Urine Glucose	+

Question: What do you suspect is happening to your patient based on the results of the patients' testing?

- Answer: Your patient is in DKA and Metabolic Acidosis

Question: What do you suspect will be implemented next?

- Answer: DKA protocol: fluids, insulin, hourly glucose checks, electrolyte check every 6 hours.

Your patient is starting to come around, alert and oriented time 2, breathing tachypneic but even, non-labored breaths. Patient has started to be able to string together some words. The doctor puts in orders for a re-check on certain labs.

Question: What lab values do you think the doctor is interested in?

- Answer: All electrolytes, glucose, anion gap, lactic acid, ABGs

Your patients redraw results come back with the following results:

Electrolytes	
Sodium	145
Potassium	5.6
Chloride	100
Calcium	8.4
Magnesium	2.1
Phosphorus	3.9
ABG	
pH	7.35
HCO ₃	22
PaCO ₂	39
Anion Gap	11
Lactic Acid	1.2

Your patient is now alert and oriented times four, breathing is even and non-labored, skin is pink warm and dry, PERRLA, and patient does not appear in any distress. Congratulations! You saved your patient! They will be admitted for glucose monitoring and adequate fluid replacement.

Case Study: Heparin

Your patient is a 56 year-old male who is recovering from a femoral-popliteal bypass graft that occurred yesterday. To maintain patency of the graft, he will be started on a heparin drip post-operatively and will eventually bridge to Warfarin before discharge. The cardiovascular surgeon's PA has put in an order set for you to initiate a heparin drip with a bolus.

Per your hospital's policy, your heparin drip will be based off of partial thromboplastin time (PTT). Please refer to the heparin drip protocol to answer the following questions.

Question 1 – What baseline labs will you obtain?

Answer: PT/INR, PTT, CBC, serum creatinine (unless completed within the last 24 hours post operatively)

Question 2 – What color lab tubes will you draw these labs into, in which order, and how long do you have after drawing them to get them to the lab for processing?

Answer: blue top (PT/INR, PTT), lavender top (CBC), green top (serum creatinine), 30 minutes (30 min to get there, 30 min for them to process the sample, therefore 60 minutes total)

Question 3 – Which medications should be discontinued prior to initiating a heparin drip?

Answer: any other forms of anticoagulation, ASA, any intramuscular meds

Question 4 – What additional current patient information is necessary prior to initiating this drip?

Answer: accurate patient weight in kilograms

Your baseline labs are back and within normal limits. Your patient's weight is 70 kg.

Question 1 – What is your bolus dose?

Answer: 4600 units

Question 2 – At what rate (in both units/hour and mL/hour) will you initiate your drip?

Answer: 1300 units/hr or 13 mL/hr

Question 3 – When will you draw your next PTT?

Answer: in 6 hours

Your next PTT is 98.

Question: What is your new rate (in both units/hour and mL/hour)?

Answer: 1250 units/hr or 12.5 mL/hr

Question: When will you draw your next PTT?

Answer: 6 hours

Your next PTT is 159.

Question: What will you do?

Answer: Hold drip for one hour, recheck PTT, and continue to hold drip until next PTT results.

Your next PTT is 151.

Question: What will you do?

Answer: Hold drip for one hour, recheck PTT, and continue to hold drip until next PTT results.

Your next PTT is 115.

Question: What will you do?

Answer: Restart the infusion at 1050 units/hr or 10.5 mL/hr and recheck a PTT in 6 hours.

Heparin Drip Protocol

First, you must obtain an accurate measured patient weight.

Baseline labs that must be ordered and resulted prior to initiation of drip include: PT/INR, PTT, CBC, and serum creatinine (if not completed within last 24 hours). Discontinue all other forms of anticoagulation, ASA, and any intramuscular injections.

Once bolus has been given and drip has been initiated, order a TIMED PTT for 6 hours after the bolus administration. Please follow the chart for all subsequent PTT draws. If the PTT is at goal (60-85 seconds), the PTT can be timed for the next AM.

Notify MD for a PTT less than 40 or greater than 110, or any signs of bleeding.

Please note that the concentration of IV heparin infusions is 100 units/mL.

WEIGHT

BOLUS DOSE (70 units/kg)

41-50 kg	3200 units
51-60 kg	3900 units
61-70 kg	4600 units
71-80 kg	5300 units
81-90 kg	6000 units
91-100 kg	6700 units
101-110 kg	7400 units
> 110 kg	7700 units

WEIGHT**INFUSION RATE****INFUSION RATE****18 units/kg/hour****mL/hr**

41-50 kg	800 units/hour	8 mL/hr
51-60 kg	1000 units/hour	10 mL/hr
61-70 kg	1200 units/hour	12 mL/hr
71-80 kg	1300 units/hour	13 mL/hr
81-90 kg	1500 units/hour	15 mL/hr
91-100 kg	1700 units/hour	17 mL/hr
> 101	1900 units/hour	19 mL/hr

PTT	Bolus units	Hold time	Rate Change in Units/hour	Next PTT
Less than 40	3000	0	Increase 300 units/hr	6 hours
40-49	2000	0	Increase 200 units/hr	6 hours
50-59	0	0	Increase 100 units/hr	6 hours
60-85	0	0	0	Next am
85-95	0	0	Decrease 50 units/hr	12 hours
96-110	0	30	Decrease 100 units/hr	6 hours
111-149	0	60	Decrease 200 units/hr	6 hours

If the PTT is greater than 150, hold the infusion for 1 hour. Check at PTT after 1 hour of hold time and continue holding until the PTT has resulted.

If PTT is still greater than 150, continue to hold and recheck another PTT in one hour. Notify MD if again greater than 150.

If PTT is less than 150, restart the infusion and decrease the rate by 200 units/hr.

If you have three PTT's greater than 150 in a 24-hour period, notify the MD.

Case Study: Insulin

Your patient is a 94 year-old with long-standing type II diabetes. Her admission HgbA1c is 6.2. She was admitted to your unit for pneumonia and will require her blood sugar to be monitored. Some of her current orders include (but are not limited to):

- Diabetic Diet
- Monitor fingerstick blood sugars AC/HS + 0300
- Offer bedtime snack
- Start IV
- If patient has three consecutive readings of FSBS over 180, initiate insulin drip protocol
- Hypoglycemia Order Set
 - For FSBS less than 70 mg/dL and patient can tolerate PO intake:
 - Give 4 oz milk or juice
 - Recheck FSBS in 15 minutes.
 - Repeat treatment until FSBS greater than 90 mg/dL
 - For FSBS less than 70 mg/dL and patient is unresponsive:
 - Administer 50 mL D50W IV push (if no IV access, give 1 mg glucagon SQ) immediately
 - Recheck FSBS in 15 minutes
 - Repeat treatment until FSBS greater than 90 mg/dL

Blood Glucose Value	Humalog Dose
Less than 70	No insulin, initiate Hypoglycemia Protocol
70-80	No insulin
81-100	4 units
101-140	5 units
141-180	6 units
181-220	8 units
221-260	10 units
261-300	12 units
301-350	14 units
Greater than 350	18 units and notify prescribing MD

*Hold mealtime Humalog if FSBS is less than 120 and NPO or on clear liquids

*Hold bedtime Humalog if FSBS is less than 160 and not eating bedtime snack

All orders have been placed. It is 1130. Your patient's blood sugar is 182. Her food tray has not arrived yet. She is requesting her insulin so that she may begin eating as soon as it arrives.

Question: How much insulin will you give her?

Answer: 8 units

You administered the insulin, per the patient's request. There was a mix up with lunch trays and they have been delayed. It is now 1215 and your patient has not eaten yet. Her skin is cool and clammy, she is shaky and her heart rate was in the 80's and now it is in the 110's. She appears to be falling asleep.

Question: What do you do?

Answer: Assess! Get a new FSBS and check vital signs

Your patient's blood sugar is now 58. She is going in and out of consciousness.

Question: What do you do?

Answer: Implement the hypoglycemia orders. Give her 50 ml D50W IV push.

Question: When do you reassess her blood sugar?

Answer: in 15 minutes

Her next blood sugar is 79. She is waking up.

Question: What do you do now?

Answer: Get her food and do not treat blood sugar per protocol

Nurse tip! Never give mealtime insulin if the patient's meal is not present. You never know what kind of delays may occur. Even if the patient requests the medication, do not administer it until you physically see the food in front of them.

It is two days later and you are caring for this patient again. Her blood sugars have been stable in the last 48 hours since that last hypoglycemia episode. However, her pneumonia has gotten worse and she was intubated overnight. Her blood sugars have begun to climb and as you were getting report from the night shift nurse, the physician rounded and put in new orders to start an insulin drip protocol on her. She has a central line located in her right subclavian. Her blood pressures plummeted and she has been on a norepinephrine drip since yesterday evening to maintain a MAP greater than 65. Her MAP is currently running 68-72. You have obtained the medication, primed the tubing, and are ready to go. Your first blood sugar is 244. Please utilize the attached insulin protocol to answer the following questions.

Question: Where will you obtain your samples?

Answer: Her central line

Question: At what rate will you start your drip?

Answer: 3 units/hour

One hour later her blood sugar is 212.

Question: What is your new rate and when will you check another blood sugar?

Answer: 2 units/hr, check again in 1 hour.

Her next blood sugar is 128.

Question: What is your new rate and when will you check another blood sugar?

Answer: 1 unit/hr, check again in 1 hour.

Her next 3 blood sugars are 124, 144, 129.

Question: How often will you now take blood sugars?

Answer: Every 2 hours

Insulin Drip Protocol

Keep hypoglycemia order set active and utilize when indicated. If blood sugar is less than 80, discontinue the drip and follow the protocol. If blood sugar is less than 40, give two amps of D50W immediately. Recheck blood sugar every 15 minutes until blood sugar is greater than 80 for two consecutive readings. Restart drip on Algorithm 2 (not shown).

Obtain sample from consistent source; if patient is hypotensive, obtain your blood sample from an indwelling catheter if possible.

Check and treat blood sugar every hour. If insulin drip has been maintained at 1 unit/hr for four consecutive readings, then begin to check blood sugars every two hours. If the drip continues to be at 1 unit/hr for two additional readings, decrease frequency of checking and treating to every 4 hours. Once patient has been at 1 unit/hr for a total of 12 hours, notify provider and obtain further orders.

Insulin Drip Algorithm 1

Blood Glucose	Units/hour
Less than 70	OFF – follow hypoglycemia order set
71-109	0.2
110-119	0.5
120-149	1
150-179	1.5
180-239	2
240-299	3
300-359	4
Greater than 360	6

Case Study: Gastrointestinal

Your patient is a 76 year-old male with hepatitis C, obtained from a blood transfusion. He is a former IV drug user and has been clean, per his report, for 18 months. He drinks approximately 1 bottle of wine per night after he gets off work at a local car wash. Other significant history includes uncontrolled mild diabetes, current smoker, hypertension, and is here today for rectal bleeding.

Question: What labs/diagnostics do you anticipate?

Answer: CBC, CMP, AFP, liver ultrasound, lipid profile

Question: What labs do you anticipate being abnormal?

Answer: Glucose, AST, ALT, AFP, lipids, ultrasound

Question: What tubes will you grab from the supply room to draw these labs?

Answer: Light green (or yellow) for CMP, red top for AFP, lavender or green for lipid profile

Question: What order will you draw these labs?

Answer: yellow, green, purple

Your patient is a 72-year-old African American male who came in “throwing up blood”. This came on suddenly when he was at a nearby McDonalds. He states he feels like he could pass out, but denies any pain or any other symptoms. His only medication is 400 mg Ibuprofen q6hrs for “joint pain”. Reports being told he has high blood pressure, but does not take anything for it.

Question: What orders do you anticipate?

Answer: Obtain a full set of vitals, fluid bolus, start IV, STAT labs (CMP, CBC, PT/INR/PTT, type and cross), administer blood if hemoglobin is less than 8 mg/dL

Question: What color tubes will you obtain?

Answer: green (or yellow), lavender, blue, pink/red

Question: What order will you draw these labs?

Answer: blue, pink/red, green, lavender

His hemoglobin is 6.4 mg/dL. The physician wants you to administer 3 units PRBC's and start him on a Protonix drip. You start the first unit and he is transferred to the ICU.

Case Study: Myocardial Infarction

Your patient is a 52 year-old woman with flu-like symptoms, minor chest “discomfort” and dull pain in both arms. This started yesterday, she tried to sleep it off, and when she woke up feeling worse, her husband made her come into the ED.

Question: What lab and diagnostic orders do you anticipate?

Answer: ECG, baseline vital signs (pulse, respiratory rate, oxygen saturation, blood pressure, temperature), troponin I and T, CK, CK-MB, myoglobin, CPK, CBC, CMP, lipid panel, CRP. And you throw in a flu swab just to make the doc feel better ;-)

Question: What order will you complete these tasks?

Answer: ECG, delegate vitals, draw labs

Question: What color tubes will you need to grab from the supply room?

Answer: red top (troponins, CK, CKMB, CRP, myoglobin), lavender top (CBC, lipid panel), green top (CMP)

**Can also be drawn in an SST or yellow top*

Question: What order will you draw these labs?

Answer: red (or yellow), green, purple

Your labs are the following:

Troponin I: 10.2 ng/mL (24 hrs later 22.2)

Troponin T: 11.8 ng/mL

CK: 129 U/L

CK-MB: 22 U/L

CRP: 139 U/L (24 hrs later 222)ú

Myoglobin: 162 ug/mL

CBC unremarkable

BMP unremarkable

Lipid panel is elevated slightly above normal

ECG showed an NSTEMI

Your patient is going to be admitted to the cardiac unit for further testing and monitoring.

Question: What orders do you anticipate?

Answer: aspirin, beta blocker, nitrate PRN for pain, heparin drip with loading dose, cardiac monitoring, serial ECG's, serial cardiac markers, oxygen as needed, bedrest

Question: How often will follow-up cardiac markers (troponins, CK-MB, CK, and myoglobin) be ordered?

Answer: Every 2 hours after the initial set

Case Studies: Renal Patients

CASE STUDY 1

A 75 year-old patient is admitted to your unit to rule out stroke. Symptoms upon admission include confusion, right arm and right leg weakness and slurred speech that resolved. Due to her use of anticoagulants (on Warfarin for chronic afib), she was not a candidate for tPA. She also has a pacemaker and is unable to get an MRI. During her work-up in the ED, her symptoms resolved and her NIHSS went from a 4 to a 0.

Her first CT was negative. Her admission lab work is as follows:

Sodium	141
Potassium	4.9
Chloride	105
Total CO2	22
Glucose	119
BUN	23
Creatinine	1.8
GFR	>60
Albumin	3.8
AST	18
Total Bilirubin	0.9
Calcium	8.5
Total protein	6.7
Alkaline phosphate	60
ALT	22
Anion gap	15

PT/INR	3.9
PTT	116

It is the next day and she has the following orders:

Swallow evaluation by a speech therapist (NPO until cleared), BMP, PT/PTT/INR, follow up CT brain w/ and w/o contrast, normal saline 50 ml/hr, sequential compression devices, evaluation by PT/OT.

Question: Which order(s) would question?

Answer: CT *with* contrast

All orders are completed. CT comes back unremarkable. Later that evening, you realize that she has not voided all day. You scan her bladder and find approximately 35 ml. Her fluids have been infusing for approximately 8 hours. You note that she received contrast for her CT, despite her elevated BUN/creatinine.

You notify the physician, who orders a BMP.

The follow-up BUN is 52 and creatinine is 2.01. You notify the physician. She gives you the following orders:

N-Acetyl cysteine, follow up BMP in 4 hours

Your patient is responsive to treatment and her contrast-induced nephropathy resolves.

CASE STUDY 2

Your patient is a 32-year-old male with end stage renal disease (ESRD) secondary to diabetes. He was diagnosed with type I diabetes when he was a teenager and subsequently was noncompliant for various amounts of time with the treatment regimen. He was having trouble breathing at home, lethargy, insomnia, and increased difficulty controlling sugars. He stated his sugars had been “real good,” stating it was about 250 before they got bad.

Question: What lab orders do you anticipate?

Answer: CMP, CBC (H&H specifically), serum creatinine and 24-hour creatinine clearance

Question: What color tubes will you grab to draw these?

Answer: Light green (or yellow), lavender, red, and collection container for 24 hours urine collection

Relevant labs:

Potassium	6.3
BUN	48
Creatinine	3.9
Hemoglobin	6.0
Hematocrit	17.2

Question: What intervention do you anticipate the physician ordering next?

Answer: Initiate dialysis

The physician decides to initiate dialysis. A catheter is inserted and hemodialysis is initiated. With dialysis, dietary changes, and medication modifications, your patient has avoided the need of a kidney transplant.

Case Study: Septic Shock

Your patient is a 50-year-old female. She was originally admitted a five days ago for new-onset uncontrolled atrial fibrillation. Due to an inability to obtain IV access despite multiple attempts, a central line was inserted 24 hours after admission.

She is now being admitted to your intensive care unit with the differential diagnosis of sepsis. She was on the med-surg floor earlier today and was up walking with her husband when she passed out. Her blood pressure was 78/44 and her temp was 102.4F. She was minimally responsive to fluids (two liter boluses given).

Question: What labs do you anticipate the physician ordering for the sepsis work up?

Answer: CMP with anion gap, magnesium, phosphorus, ABG, PT/INR, CBC, lactatic acid, blood cultures (two sets), troponin, urinalysis with reflex

Question: Which tubes will you draw for these labs?

Answer: blood culture bottles, blue for PT/INR, red (yellow or green) for CMP, magnesium, and phosphorus. Lavender for CBC, and grey for lactatic acid.

ABG kit for ABG draw

UA cup for UA

Question: In what order will you draw these labs?

Answer: blood cultures, PT/INR, CMP/Mag/Phos, CBC, lactate. ABG and UA will/can be collected simultaneously by other staff members or after these are completed.

Question: Where will you draw your two sets of blood cultures?

Answer: One set will be drawn peripherally; one set will be drawn from the central line

Question: From what source will you draw these labs?

Answer: Central line

Question: How much will you waste before drawing?

Answer: NONE, you want the blood from the central line to be drawn to determine if that is the source of the infection.

Question: What must you do before you start antibiotics?

Answer: Draw blood cultures

Question: Which lab requires special handling to transport to lab and what will you need?

Answer: Lactic acid; it must be put on ice before transport