

Pearls & Pitfalls in Neurocritical Care

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Disclosures

- US Department of Defense (HT9425-24-1-1072): to study outcomes in patients with TBI
- US Department of Defense: to study blood-based biomarkers in TBI
- Abbott Laboratories to advance development of Abbott's TBI test for diagnosis and determination of severity of brain injury in adults and children

Plan

- Cases

Case 1: “gastroparesis”

HPI

Certified interpreter used in Spanish

HPI

56M h/o DM on insulin who presents with one day of nausea and vomiting. Vomiting started yesterday after a bowl of cereal with milk, which he has tolerated many times before. Emesis was non-bilious and non-bloody. He estimates that he vomited approximately 20 times between yesterday and today, most recently about 40 minutes before arriving at the ED. He has not been able to tolerate food since the vomiting began. No associated abdominal pain.

On review of systems, denies any fevers, chills, chest pain, shortness of breath, abdominal pain, dysuria, hematuria, diarrhea, constipation.

Case 1: “gastroparesis”

Vitals

ED Triage Vitals [12/20/25 1034]

Temp	37.1 °C (98.8 °F)
Heart Rate	89
Resp	18
BP	132/75
SpO2	95 %
Temp src	
FiO2	
BP Palpated	

Physical Exam

Constitutional:

General: He is not in acute distress.

Appearance: Normal appearance. He is not ill-appearing.

HENT:

Mouth/Throat:

Mouth: Mucous membranes are moist.

Pharynx: Oropharynx is clear. No oropharyngeal exudate or posterior oropharyngeal erythema.

Eyes:

Extraocular Movements: Extraocular movements intact.

Conjunctiva/sclera: Conjunctivae normal.

Pupils: Pupils are equal, round, and reactive to light.

Case 1: “gastroparesis”

Cardiovascular:

Rate and Rhythm: Normal rate and regular rhythm.

Pulses: Normal pulses.

Heart sounds: Normal heart sounds.

Pulmonary:

Effort: Pulmonary effort is normal.

Breath sounds: Normal breath sounds.

Abdominal:

Palpations: Abdomen is soft.

Tenderness: There is no abdominal tenderness. There is no right CVA tenderness, left CVA tenderness or guarding.

Musculoskeletal:

Cervical back: Normal range of motion.

Skin:

Capillary Refill: Capillary refill takes less than 2 seconds.

Neurological:

General: No focal deficit present.

Mental Status: He is alert.

Psychiatric:

Mood and Affect: Mood normal.

Behavior: Behavior normal.

Case 1: “gastroparesis”

ED Course & Medical Decision Making

#VOMITING

Most c/f diabetic gastroparesis iso non-bilious non-bloody emesis without diarrhea, fever, abdominal pain, or infectious symptoms. Patient uses insulin for diabetes however glucose is elevated into the 200's so likely not well controlled. Also considered infectious gastroenteritis given mild leukocytosis, however likely inflammatory leukocytosis given mild to 14 and no infectious symptoms. Can't miss diagnoses include SBO however patient is without abdominal pain, ttp and emesis is non-bilious.

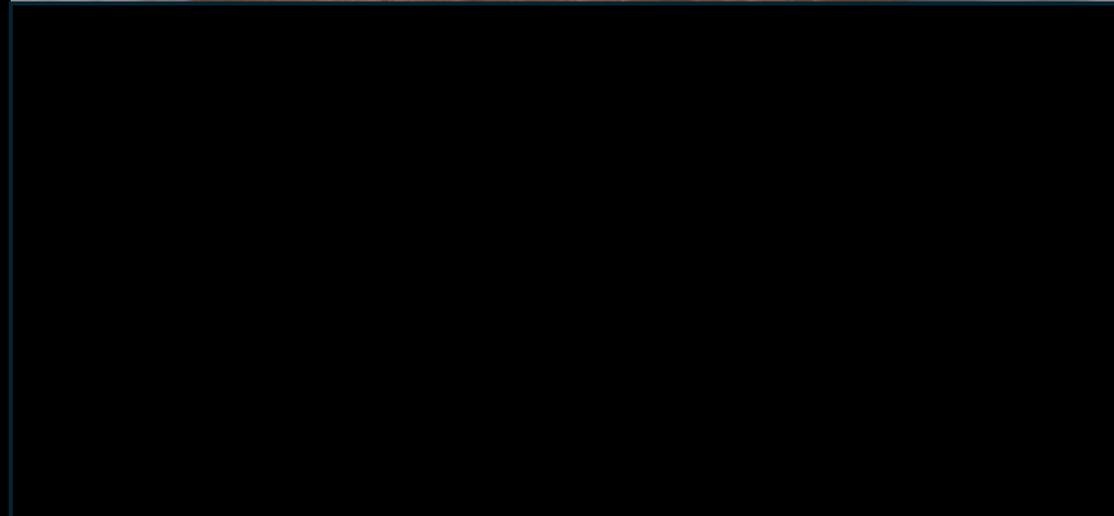
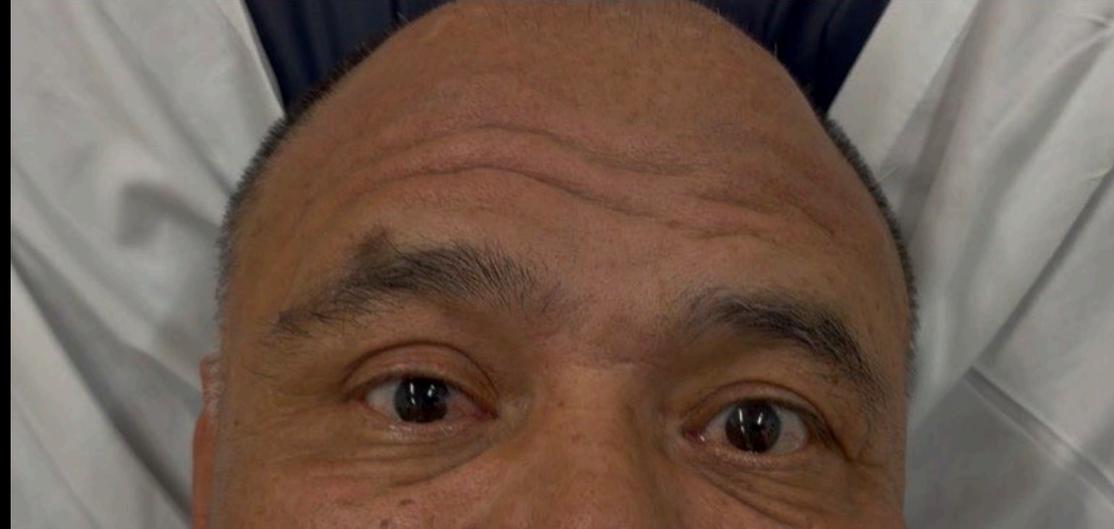
Plan:

- Labs: CBC, CMP, Lipase, UA
- Imaging: EKG
- Dispo: likely dc if can PO

Case 1: “gastroparesis”

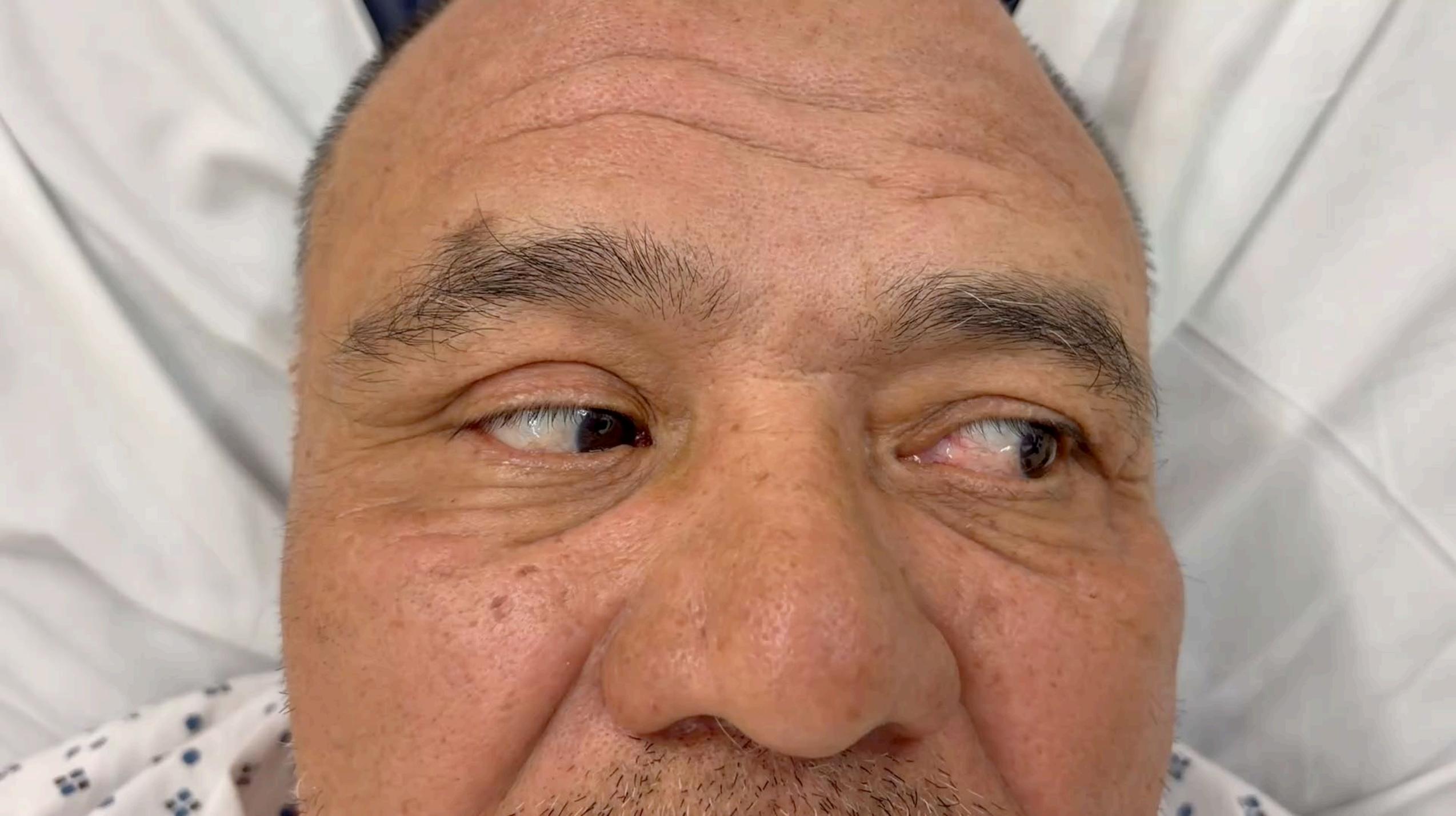
Signout: received signout from Dr. XX. 56M h/o DM2 c/b gastroparesis, received Zofran and reglan. Plan for PO challenge and DC.

Case 1: “gastroparesis”



Case 1: “gastroparesis”

I received sign out from Dr. XX regarding patient with gastroparesis, n/v. Has baseline R ptosis and mild R sided weakness from prior stroke.



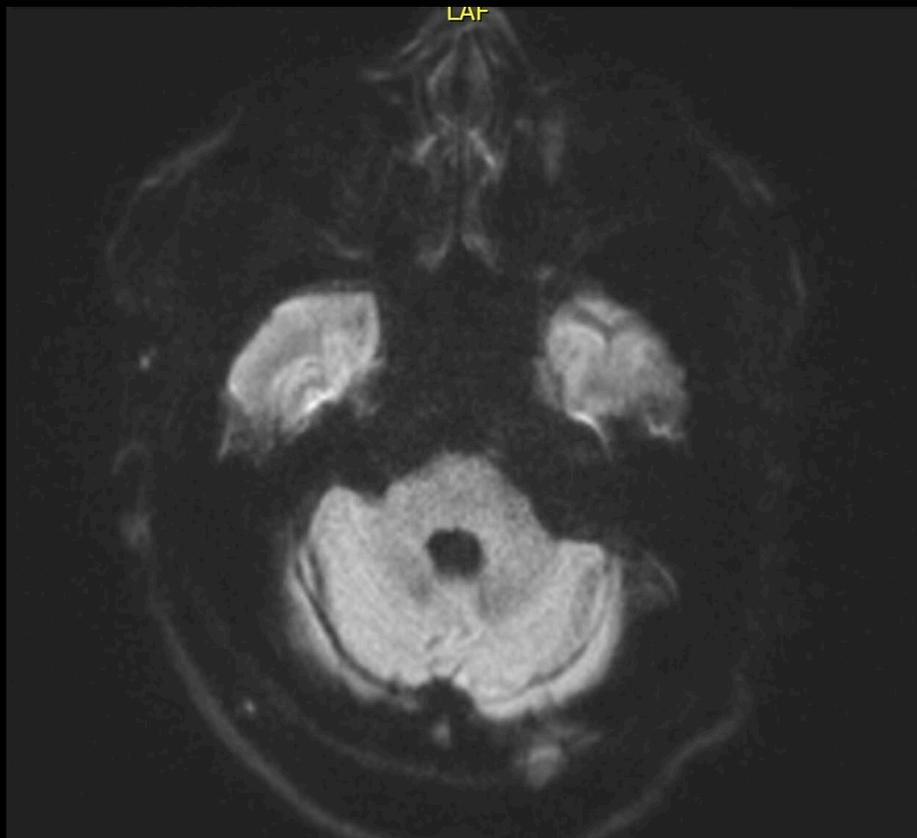
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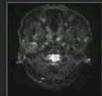
Upon reassessment, I walked the patient, and he was ataxic and could not take 10 steps.

On exam: direction changing nystagmus, mild lack of coordination on FNF on R and HTS on R. Has ataxia and cannot gait. High concern for stroke. Plan for MR rapid stroke and neuro consult.

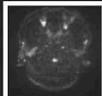
Case 1: “gastroparesis”



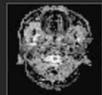
Dec 20, 2014 9:31 P



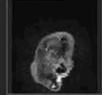
1: resolve_4scan_trace_tra_s2_224_TRA CEW (Series 5)



2: resolve_4scan_trace_tra_s2_224_TRA CEW (Series 5)



3: resolve_4scan_trace_tra_s2_224_ADC (Series 6)



4: t2_space_flair_fs_dark-fluid_sag_caipi4 (Series 7)

SE: 4 mr

8

Pearls

- If your patient comes in with dizziness, vomiting, or imbalance → walk your patient

Case 2: “headache”

HPI

Certified interpreter used in Spanish

HPI

43 yo female BIBA for stroke like sx. Activated mission protocol. Woke up and had breakfast this morning at 9am without issues. At 11 am, which she confirms multiple times, she had sudden onset of severe headache, left sided weakness, and loss of sensation on left side. All of her sx came on suddenly and at once. No prior episodes of this happening. Also having n/v. She reports occasional alcohol use but no other drugs. Has a PMH of what appears to be resistant HTN, on many medications. Not on AC. Per EMS, initial glucose 156, BP 234/120. On my assessment, she is responsive to questions, Aox3. She has complete weakness of the left arm and left leg, flaccid and unable to hold up against gravity. No sensation to light touch. Intact sensation to pinch/painful stimulus left arm and leg. Pupils 3-4mm, equal and reactive to light. Face symmetric, no nasolabial fold flattening. NIHSS 7. Endorses PMH of HTN and on many meds.

Case 2: “headache”

Vitals

ED Triage Vitals [11/06/25 1205]

Temp

Heart Rate

(!) 112

Resp

18

BP

(!) 213/122

SpO2

98 %

Temp src

FiO2

BP Palpated

Physical Exam

Constitutional:

General: She is not in acute distress.

Appearance: She is normal weight. She is not toxic-appearing.

HENT:

Head: Normocephalic and atraumatic.

Nose: Nose normal.

Eyes:

Extraocular Movements: Extraocular movements intact.

Pupils: Pupils are equal, round, and reactive to light.

Comments: **Pupils 3-4 mm, ERRLA. EOMI. Face symmetric. Smile and brow raise symmetric**

Case 2: “headache”

Cardiovascular:

Rate and Rhythm: Normal rate and regular rhythm.

Pulses: Normal pulses.

Heart sounds: No murmur heard.

Pulmonary:

Effort: Pulmonary effort is normal.

Breath sounds: Normal breath sounds.

Abdominal:

General: Abdomen is flat.

Palpations: Abdomen is soft.

Musculoskeletal:

Cervical back: Normal range of motion and neck supple.

Skin:

General: Skin is warm and dry.

Neurological:

Mental Status: She is alert.

Comments: **Left arm flaccid weakness, no sensation to light touch.**

+Sensation to pinch/painful stim

Left leg flaccid weakness, no sensation to light touch. +Sensation to pinch/painful stim. Unable to hold against gravity

Positive drift on left arm.

Aox3. Voice clear. Eyes crossmidline

Case 2: “headache”

ED Course & Medical Decision Making

Medical Decision Making

Amount and/or Complexity of Data Reviewed

Labs: ordered.

Radiology: ordered.

ECG/medicine tests: ordered.

Risk

Prescription drug management.

43 yo F with PMH of resistant HTN coming in with sudden onset of severe headache, left sided paralysis, loss of sensation on left, and n/v. LKN 11am, within TNK window. Initial EMS glucose 156. HTN 230/120s. No drug use. BP not responsive to labetalol 10mg IV.

Considering ischemic stroke, hemorrhagic stroke, TIA, hypertensive emergency, SAH, encephalitis, meningitis, vascular etiologies.

Plan:

- CT head and neck stroke protocol
- rainbow stroke labs, UA, UTox
- nicardipine drip, titrate SBP <180
- pending neurology recs

Case 2: “headache”

13:23

Free Text

43-year-old with history of hypertension who presents with headache and left-sided weakness and sensory changes. Patient reports was in her usual state of health this morning, had breakfast, feeling well. At approximately 11 or 11 30 had onset of left-sided weakness, sensory changes and headache, severe maximal at onset. No history of this in the past. Nausea with emesis. Per patient's report, she reports is nonadherent with her antihypertensives for at least the past week. Reports significant anxiety and stress yesterday at work. Vital signs notable for hypertension with systolics to 240s, hovering at 220s. Exam notable for complete left-sided paresis of the arm and leg and subtle nasolabial flattening on the right side. Diminished sensation of LUE/LLE. Cranial nerves intact otherwise, active nausea. Normal cardiopulmonary exam, benign abdominal exam, nontoxic appearing. No obvious signs of trauma.

Neuro at bedside for Mission protocol/stroke activation, recommended Labetalol for severe HTN. Patient was in CT scanner and had improvement of her neurologic deficits after receiving 10mg Labetalol with resolving sensory changes and resolved motor weakness.

CT non-con negative for bleed, CTA negative for large vessel occlusion. Given her rapidly resolving neuro symptoms, was not a TNK candidate, per Neuro. Patient received 1 dose of labetalol with mild improvement of her blood pressure to low 200's. Neuro recommend further BP management with Nicardipine drip with SBP goal <180.

DX: Hypertensive emergency given improvement of symptoms with BP management versus complex migraine versus TIA/Stroke versus posterior fossa ICH, seizure, neoplasm, infection.

Neuro feels this is unlikely TIA, given lack of risk factors and resolution with BP management and therefore if MRI negative, can potentially go home if remains symptoms free. Recommend MRI brain and labs.

Case 2: "headache"

15:50	Vitals Assessment		Ki
15:50	Free Text	Re evaluated pt, pt with nearly resolved sx. Plan for MRI and close loop with neuro for recs. Pt would like to go home today. Discussed and counseled pt on adherence to PO HTN meds, she understood importance of taking them and being adherent, reports intermittent adherence with her PO meds	Ra
15:50	Vital Signs	Vital Signs BP: 151/89 (Device Time: 15:50:00) MAP (mmHg): 104 mmHg (Device Time: 15:50:00) Heart Rate: 82 (Device Time: 15:49:42) Pulse (SPO2): 89 (Device Time: 15:49:42) Resp: 16 (Device Time: 15:49:42) SpO2: 98 % (Device Time: 15:49:42) Oxygen Therapy: Route: Intravenous , Scheduled Time: 1422	Ki
14:22	Vitals	Vitals Heart Rate: 83 BP: 137/82	Kimberly
14:22:53	ED Quick Updates	Quick Updates Quick Updates - Free Text: discussed with Attending , BP concerns , will clear through Neuro to put on PO meds . all symptoms have resolved	Kimberly
14:45	Free Text	Will gradually resume home anti HTN meds including amlodipine 5, HCTZ/Telmisartan 25/80mg (or equivalent), spironolactone 50	

Case 2: “headache”

- 1504: Amlodipine 5mg
- 1551: spironolactone 50mg

16:11	Intake/Output	Intake (mL) P.O. (mL): 200 mL
		Output (mL) Voided Urine (mL): 1000 mL ▼ (after diuretic)

- 1540 ordered: Losartan-HCTZ 100mg-25mg (documented given at 2215)
- All BP medications stopped ultimately at 2327

Case 2: “headache”

18:00	Vitals	Vitals Heart Rate: 71 (Device Time: 18:00:12) Resp: 16 (Device Time: 18:00:12) SpO2: 99 % (Device Time: 18:00:12) BP: 149/95 ! (Device Time: 18:00:00)	Pat
18:06	Vitals Assessment		Pat
18:06	Vital Signs	Vital Signs MAP (mmHg): 129 mmHg (Device Time: 18:05:54) Pulse (SPO2): 92 (Device Time: 18:06:17)	Pat
18:06	Vitals Reassessment	Vitals Timer Restart Vitals Timer: Yes	Pat
18:06	Vitals	Vitals Heart Rate: 93 (Device Time: 18:06:17) Resp: 18 (Device Time: 18:06:17) SpO2: 99 % (Device Time: 18:06:17) BP: 182/105 ! (Device Time: 18:05:54)	Pat
18:15	Vitals Assessment		Pat
18:15	ED Quick Updates	Quick Updates Updates: Patient identified Quick Updates - Free Text: Pt reporting sudden onset HA and decreased sensation to left side. ED MD and Neuro aware. Pt then had acute change in mentation and became diaphoretic, slurred speech. MD at bedside. EKG performed and expedited to CT for repeat scan. ABCs intact. BG checked 138. ▼	Pat

Case 2: “headache”

- 1615 BP 111/68
- 1620 BP 107/61

Addendum:

Alerted by primary team that she had become acutely altered. On arrival to bedside, pt was encephalopathic, had a new dysconjugate gaze, and was not withdrawing as briskly on the L compared to R. Her SBP was 100 at this time. Recommended repeat STAT CT stroke protocol. Discussed with ED that the most likely cause of deficits was relative hypotension (initial SBP was 240) iso of noted vessel stenoses

-- pending MRI as above

-- would avoid further BP lowering, preferred SBP floor iso her presenting HTN would be 180

Case 2: "headache"

A FABIOLA

AM



Nov 6, 202
12:09 P

1: PA Topogram

2: LAT Topogram

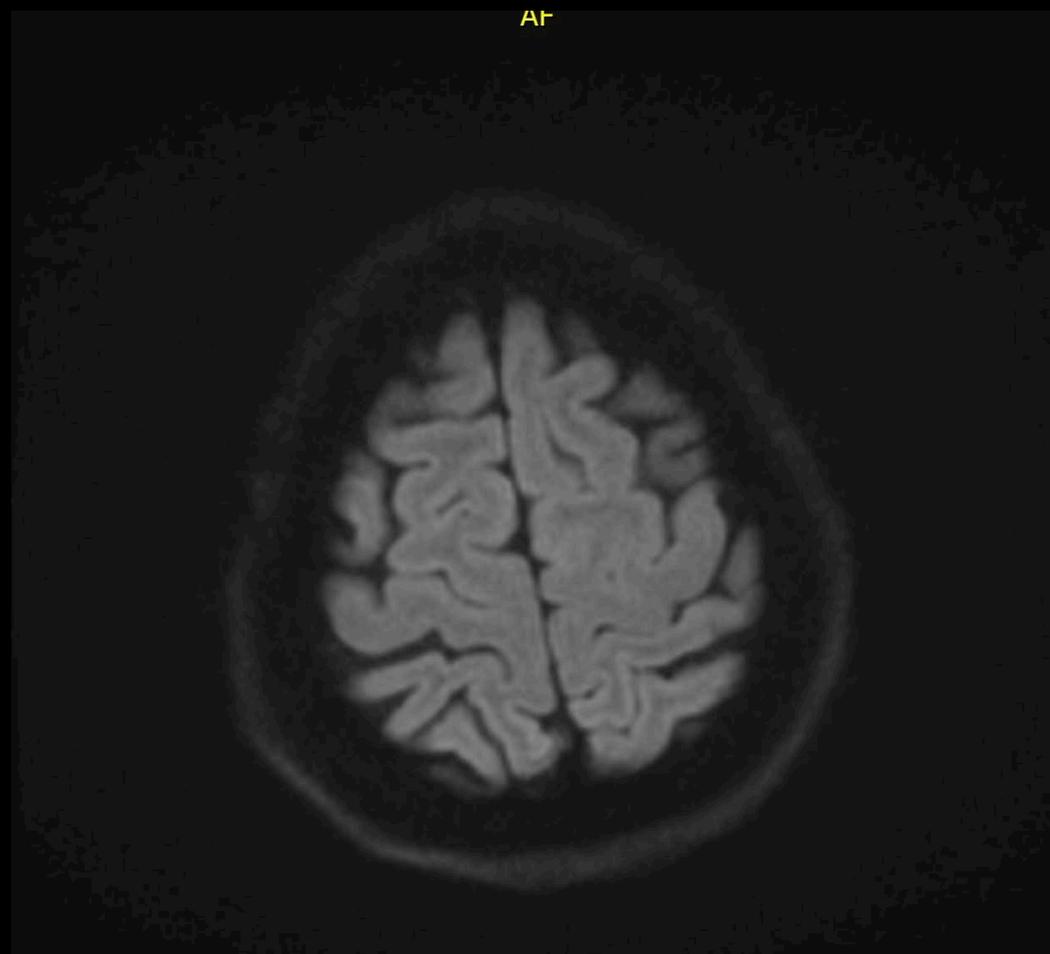
3: 2mm Axial non
con Brain

4: 0.6mm Axial Bone
Alg. (Series 5)

5: 5mm Axial non
con Brain (Series 6)

G
Hr38f
FLA
23
-11

Case 2: "headache"



20

Nov 6, 2024
8:26 P

2: resolve_4scan_trace_tra_s2_224_TRA CEW (Series 5)

3: resolve_4scan_trace_tra_s2_224_ADC (Series 6)

4: t2_space_flair_fs_dark-fluid_sag_caipi4 (Series 7)

5: t2_space_flair_fs_dark-fluid_sag_caipi4_MP_R_Cor (Series 8)

SE:
4 mm

Case 2: “headache”

Final physical exam:

Alert. Fluent speech. Significantly improved one-and-a-half syndrome-- now with only ?R CN VI palsy. Delayed left facial activation. Mild dysarthria. RUE/RLE appear full. LUE is flaccid and without movement. LLE is at least 3/5.

Pearls

- 10-30% of ischemic strokes experience a headache
- Headaches are more likely to occur with posterior circulation strokes
- “Hypertensive emergency”
- If it looks and smells like a stroke, it’s a stroke (until proven otherwise)
- Lowering BP in an acute stroke patient is risky

Case 3: “fall”

HPI

Certified interpreter used in Spanish

HPI

85yo M with hx of HTN and HLD who presents as code stroke for L-sided upper and lower extremity weakness and loss of sensation.

Patient was carrying groceries down the stairs, tripped and had a mechanical fall. No prodromal symptoms. + HS, no LOC. Not on AC. Fell onto his face and L side. Daughter found at the bottom of the stairs.

BG 118. 144/76

Lives with family.

On benzonate and atorvastatin. Has been coughing for the past several days

Case 3: “fall”

Physical Exam

Constitutional:

General: He is not in acute distress.

Appearance: He is not toxic-appearing.

HENT:

Head: **Right periorbital erythema** present.

Comments: **R forehead hematoma**

Nasal bridge tenderness and small 0.5cm laceration

Eyes:

General:

Right eye: No discharge.

Left eye: No discharge.

Extraocular Movements: Extraocular movements intact.

Pupils: Pupils are equal, round, and reactive to light.

Cardiovascular:

Rate and Rhythm: Normal rate and regular rhythm.

Pulmonary:

Effort: Pulmonary effort is normal. No respiratory distress.

Breath sounds: Normal breath sounds.

Abdominal:

General: There is no distension.

Palpations: Abdomen is soft.

Tenderness: There is no abdominal tenderness.

Case 3: “fall”

Musculoskeletal:

Cervical back: No tenderness.

Thoracic back: No tenderness.

Lumbar back: No tenderness.

Right lower leg: No edema.

Left lower leg: No edema.

Comments: **Marked left shoulder tenderness.**

No midline spinal tenderness, intact rectal tone.

Skin:

General: Skin is warm and dry.

Neurological:

Mental Status: He is alert and oriented to person, place, and time.

GCS: GCS eye subscore is 4. GCS verbal subscore is 5. GCS motor subscore is 6.

Cranial Nerves: Cranial nerves 2-12 are intact.

Sensory: **Sensory deficit** present.

Motor: **Weakness** present.

Comments: **NEURO:**

Mental status/Psych: Alert and oriented to person place and time. Fluent language. Naming intact to high and low frequency objects. Repetition intact. Follows three step and cross body commands. Memory intact to the details of the history.

Cranial nerves: VFFTC. PERRL. No RAPD. EOMI. Facial strength and sensation intact and symmetric. No dysarthria.

Motor: Normal bulk and tone. RUE and RLE 5/5 strength. 0/5 in LUE and LLE.

Sensory: absent in distal LUE and entire LLE

Coordination: Intact FNF

Gait: deferred

Case 3: “fall”

ED Course & Medical Decision Making

Medical Decision Making

#Code Stroke

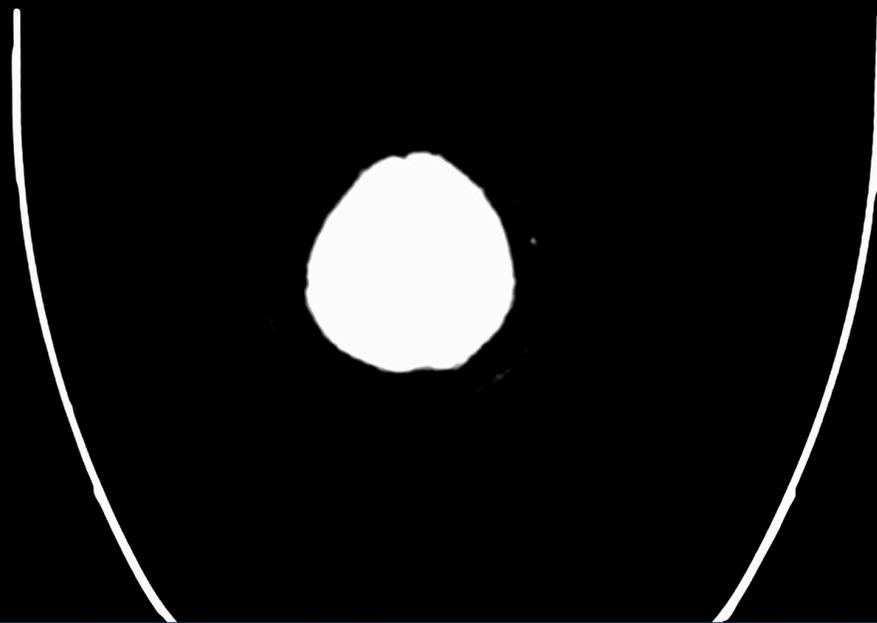
85yo M BIBA as Code Stroke for L-sided upper and lower extremity weakness after a fall. LSN: 1 hour prior to presentation. Initial NIHSS 11, FSBG 118, CT stroke with right frontal bone fracture but otherwise no bleeding, LVO or herniation. Given overall clinical picture and CT imaging results, decision made to defer tPA.

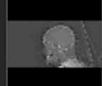
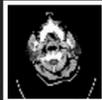
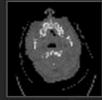
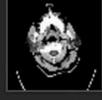
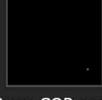
Given patient's L-sided extremity hemiparesis without involvement for the face, higher concern for spinal cord injury as opposed to intracranial stroke. Decision made to activate Spinal Cord Pathway to further evaluate for spinal injury. On repeat physical exam, patient had improvement in LLE strength and sensation however had persistent weakness and loss of sensation in LUE. No saddle anesthesia or loss of rectal tone.

Ddx includes, CVA vs MSK trauma. Low suspicion for seizures given no prior history, no LOC or postictal period and no witnessed seizure-like activity by family. Per history provided suspect that current presentation is a result of the fall, given that patient did not have any sort of prodromal symptoms before his fall and is very clear that it was a mechanical trip.

- Labs: VBG, CBC, CMP, Coags
- Imaging: EKG, LUE Xrays, CT stroke, MRI brain and spine
- appreciate neurology consult
- appreciate spine and Neurosurgery consult

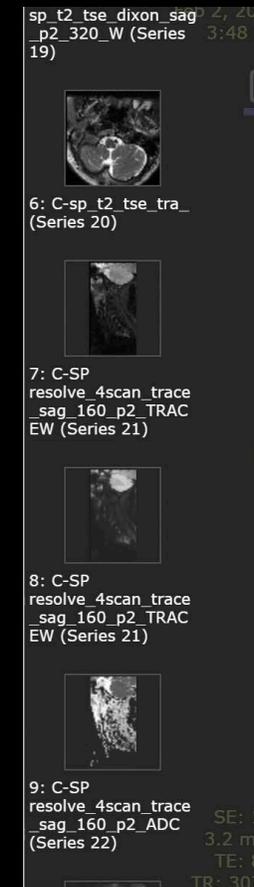
Case 3: "fall"



- 
1: LAT Topogram
- 
2: 2mm Axial non con Brain
- 
3: 0.6mm Axial non con Bone Alg.
- 
4: 5mm Axial Brain Std Alg
- 
5: 2mm COR non con Brain (Series 6)



Case 3: "fall"



Pearls

- Strokes fall but what came first: the fall or the deficit?
- Localization should make sense.

Yesterday's 1 Slide for Localization

- MCA = face/arm > leg weakness
- ACA = leg weakness
- PCA = visual deficit
- Brainstem = crossed findings

Musculoskeletal:

Cervical back: No tenderness.

Thoracic back: No tenderness.

Lumbar back: No tenderness.

Right lower leg: No edema.

Left lower leg: No edema.

Comments: **Marked left shoulder tenderness.**

No midline spinal tenderness, intact rectal tone.

Skin:

General: Skin is warm and dry.

Neurological:

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Motor: Normal bulk and tone. RUE and RLE 5/5 strength. 0/5 in LUE and LLE.

Sensory: absent in distal LUE and entire LLE

Coordination: Intact FNF

Gait: deferred

Case 4: “stroke”

82 y.o. with a history of HLD, DM who presents with unwitnessed fall and hemiparesis.

Unwitnessed fall, LSN 1600. Family found with left sided hemiparesis. Baseline dementia A&O2.

EMS Vitals: HR 95, BP 73/52

Pt unable to provide hx iso baseline dementia and difficulty hearing.

Per additional history from family, pt was in her usual state of health and was witnessed falling onto her back as she was about to climb the stairs. She was found to have new L sided weakness but otherwise appearing at her mental status baseline per them.

Case 4: “stroke”

- Eyes: bilateral pinpoint pupils
- Neck: No C spine step offs
- CV: normal rate, normal pulses
- Pulm: normal breath sounds
- Neuro: alert, L sided hemiparesis

Case 4: “stroke”

MDM: 82 y.o. with a history of HLD, DM who presents with fall and hemiparesis.

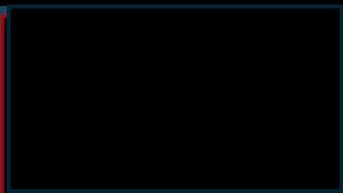
Ddx: Unclear if deficits preceded and caused the fall, or if the fall initiated the deficits. Consider intracranial bleed or other traumatic injury as well as primary stroke.

Pt also noted to be somewhat hypotensive, which may be a potential trigger for her fall iso infection, orthostasis/dehydration, or a sequelae of the fall such as bleeding or neurologic damage. Physical exam and mechanism overall reassuring against significant traumatic injury to thorax or torso but cannot rule out.

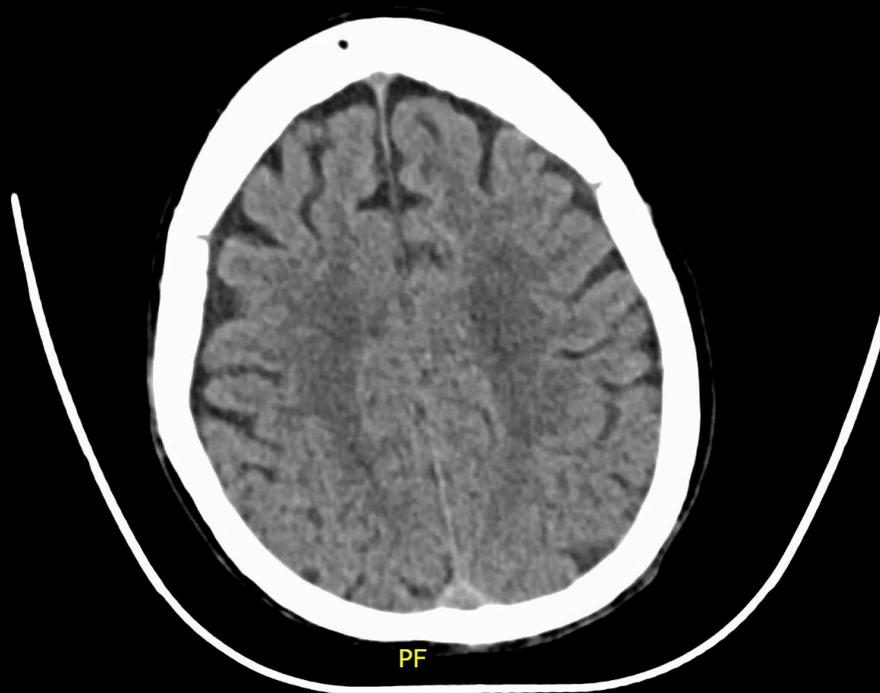
Plan:

- Code stroke given pt with new deficits and within the window for acute intervention
- CT stroke, neuro consult
- Trop, cbc, cmp, mag, coags

Case 4: "stroke"



AH



R

120

2
-605.2
SFGH1004EDCT1
2mm Axial non con Brain
ZSFG RAD

PF

Nov 26, 202
5:48 P

1: PA Topogram

2: LAT Topogram

3: PA Topogram

4: LAT Topogram

5: 2mm Axial non
con Brain

CT STROKE PRO AD AND NEC

Case 4: “stroke”

1801: TNK in conjunction with neurology

Case 4: “stroke”

1819: Writer noted HR of 130's on monitor, BP 80's/50's, RR 35. ED attending notified and called to CT room. At bedside writer noted trace blood in mouth, dentures removed from pt and mouth suctioned, breathing remained rapid and pressured. EtCO₂ NC collection device showed specks of blood occluding tubing, unable to obtain EtCO₂ reading. Writer and secondary RN began to move pt from CT table to stretcher as VS were unstable post TNK admin. ED attending directed staff to hold and to pursue CTA.

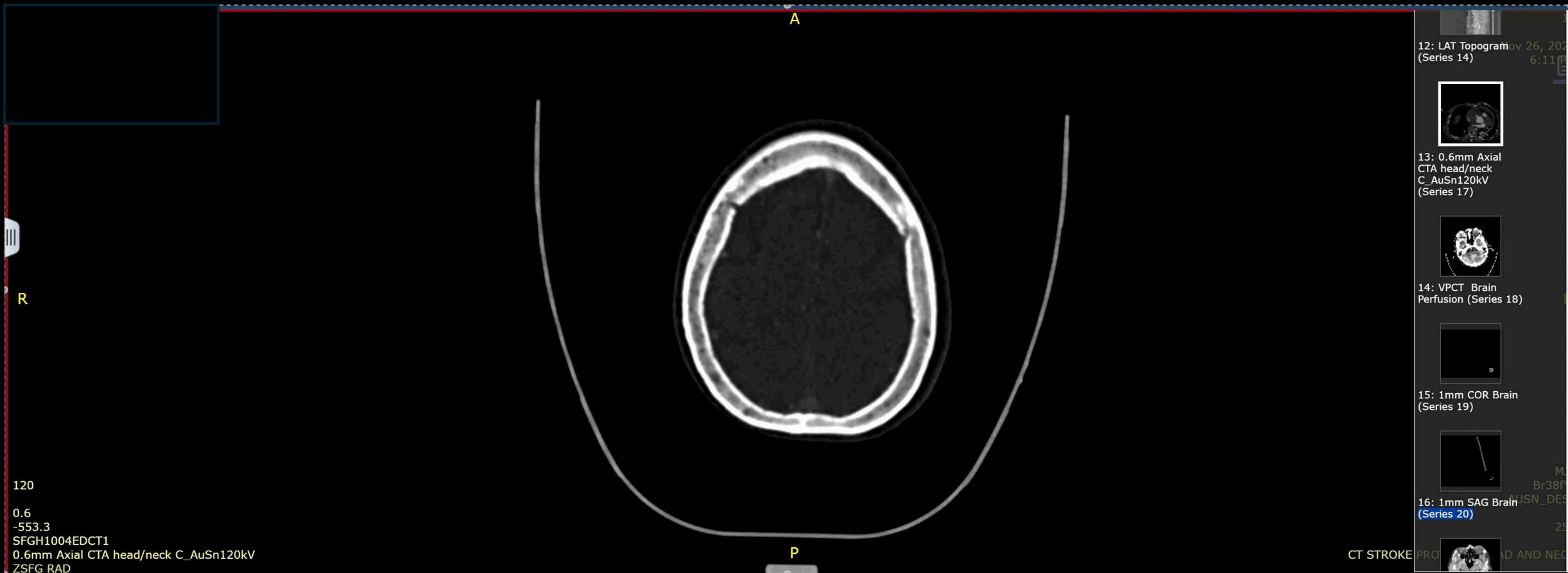
Case 4: “stroke”

1831: ED attending notified of BP 45/33, HR 46

Case 4: “stroke”

1841: Writer entered room as pt did not appear to be breathing on CT table. No breaths noted, no pulse detected. Chest compressions initiated at 1832 by secondary RN on CT table. Pt connected to zoll pads. After 3 rounds of compressions with 2 doses of 1 mg epi IVP given, ROSC achieved. Pt transferred to Resus bay.

Case 4: "stroke"



Case 4: “stroke”

While obtaining CT chest she became progressively hypotensive, apneic and lost pulses. Patient intubated, ACLS measures initiated for >30 minutes without sustained ROSC. Resuscitative measures discontinued @1905.

Pearls

- Strokes don't come in with low blood pressure
- Low blood pressure is the sequela of another problem
- That other problem or the subsequent low blood pressure can cause the stroke
- If something doesn't make sense: gather more information and PAUSE

Pearls

Pearls

- If your patient comes in with dizziness, vomiting, or imbalance → walk your patient for 10 steps in a straight line.
- 10-30% of ischemic strokes experience a headache.
- Headaches are more likely to occur with posterior circulation strokes.
- If it looks and smells like a stroke, it's a stroke (until proven otherwise).
- Take the extra few minutes to ascertain an accurate history.
- Strokes don't come in with low blood pressure unless they're a sequelae of another problem.
- Lowering BP in stroke patients is risky.

Questions?

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