Hematology/Oncology Pearls for the Hospitalist

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- I don’t have any financial disclosures.

Objectives:

- Recognize, define, and/or treat various hematologic and oncologic emergencies (tumor lysis syndrome, neutropenic fever, ICI toxicities, spinal cord compression, etc.).
- Define what is BiTE therapy and CAR-T and how they differ from one another.
- Recognize CRS and ICANS related to BiTE and CAR-T.
- Evaluate immune checkpoint inhibitor (ICI) related toxicities and when to consider steroids.
- Identify patients at risk for malignant spinal cord compression and when to refer for surgery vs radiation.

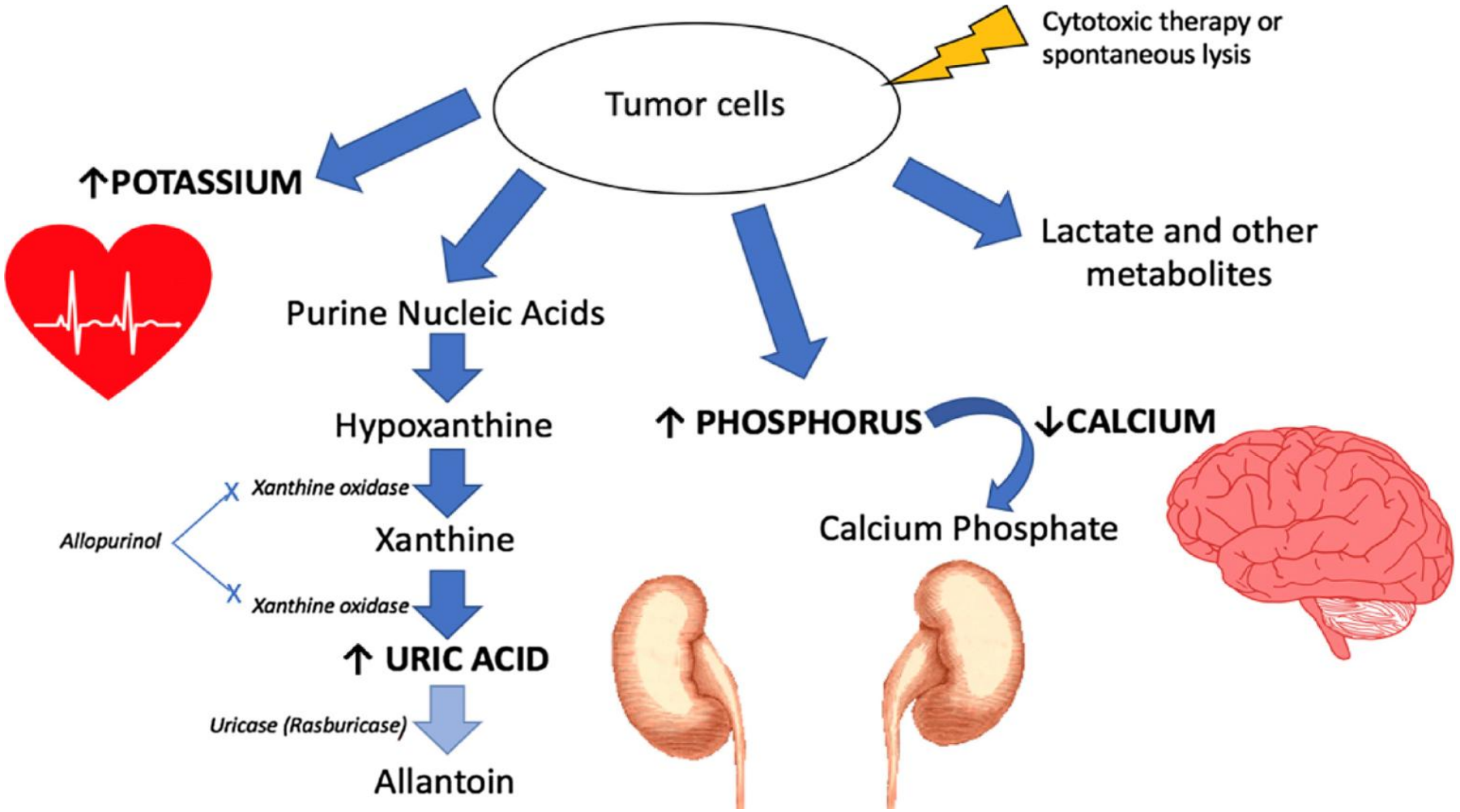

HEMATOLOGY
IS COMING
memegenerator.es

74 yo F with PMH of recently diagnosed cancer (she thinks lymphoma) who presented with increasing weakness and decreased PO intake over the last several weeks. CBC shows WBC 13.68, Hgb 10.7, platelets 127k. CMP shows potassium 5.4, creatinine 1.68, phosphorus 4.9, calcium 7.0, normal LFTs. LDH elevated at 1513. Uric acid 11.4. CT C/A/P shows extensive lymphadenopathy consistent with lymphoma.

- Diffuse large B cell lymphoma (DLBCL) with extensive disease burden and tumor lysis syndrome (TLS).

So what is TLS and who gets it?

- TLS can be defined by labs and/or symptoms.
  - Labs: hyperkalemia, hyperphosphatemia, hyperuricemia with possible hypocalcemia (2 or more)
  - Symptoms: N/V, dyspnea, palpitations/arrhythmia, decreased UOP, lethargy (1 or more)
- Can happen spontaneously (i.e. rapidly growing/aggressive malignancy) or after treatment with chemotherapy/radiation/immunotherapy.



https://coreem.net/core/tumor-lysis-syndrome/

Table 1 Cairo-Bishop Laboratory and Clinical Diagnostic Criteria for Tumor Lysis Syndrome

Laboratory TLS (≥2 present)	Clinical TLS (≥1 present)
Uric acid ≥8 mg/dL, or 25% increase from baseline	Creatinine >1.5 times the upper limit of normal
Potassium ≥6 mmol/L, or 25% increase from baseline	Cardiac arrhythmia/sudden death
Phosphorus ≥4.5 mg/dL (adults), or 25% increase from baseline	Seizure
Calcium <7 mg/dL, or 25% decrease from baseline	

TLS indicates tumor lysis syndrome.
Sources: Parsi M, et al. *Cureus*. 2019;11:e6186[5]; Cairo MS, Bishop M. *Br J Haematol*. 2004;127:3-11.[6]

	Low risk	Intermediate risk	High risk
ALL +/- WBCs < 100k		X	
ALL + WBCs > 100k			X
AML + WBCs < 25k		X	
AML + WBCs > 25k			X
Burkitt's leukemia/lymphoma			X
CLL (generally)		X	
CML (excluding blast crisis)	X		
DLBCL		X	
DLBCL + high LDH and bulky disease			X
Follicular, Hodgkin's lymphoma	X		
Most lymphomas (varies based on extent of disease)		X	

Modified from Expert consensus guidelines for the prophylaxis and management of tumor lysis syndrome in the United States: Results of a modified Delphi panel

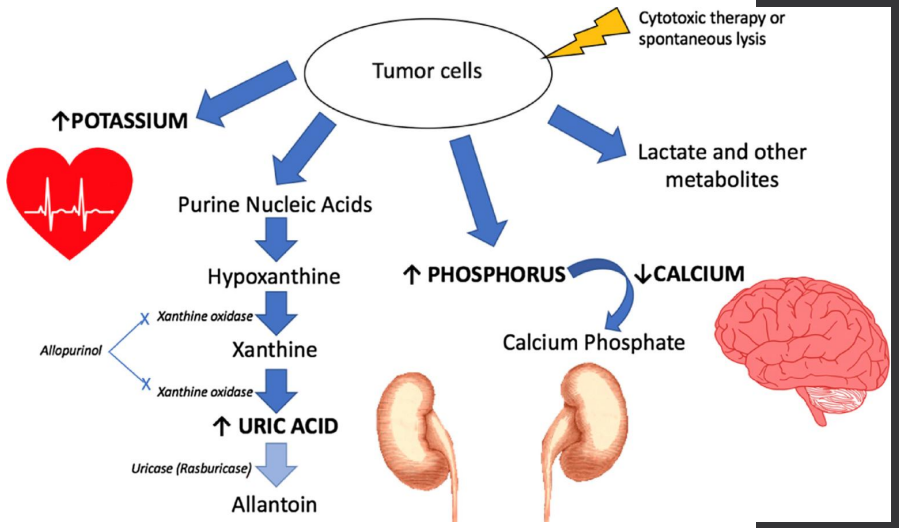
	Low risk	Intermediate risk	High risk
MDS	X		
Myeloma (generally)	X		
Germ cell tumors		X	
SCLC		X	
Solid tumors (excluding SCLC, germ cell, neuroblastomas)	X		

Modified from Expert consensus guidelines for the prophylaxis and management of tumor lysis syndrome in the United States: Results of a modified Delphi panel

	Low concern	Some concern	High concern
CAR-T		X	
Dasatinib	X		
Etoposide		X	
Ibrutinib		X	
Lenalidomide	X		
Ponatinib	X		
Rituximab		X	
Venetoclax			X

Modified from Expert consensus guidelines for the prophylaxis and management of tumor lysis syndrome in the United States: Results of a modified Delphi panel

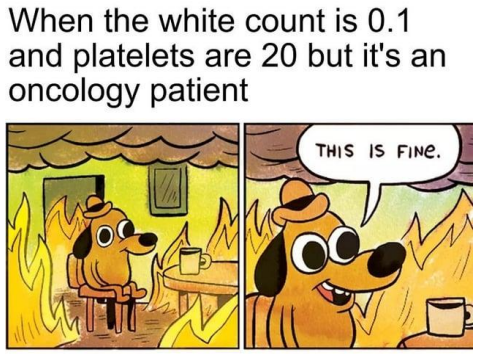
Treatment



- Intermediate risk
  - TLS labs (RFP, uric acid, LDH) q12h or daily
  - IV fluids (typically NS) for 2-3L/m^2 daily before starting chemotherapy and usually continued until chemotherapy finished or day after
  - Allopurinol (or febuxostat if unable to take allopurinol)
- High risk
  - TLS labs q6-8h
  - IV fluids
  - Allopurinol
  - Rasburicase – if uric acid > 7.5 + confirmed TLS, high risk for TLS, AKI, bulky disease, and high WBCs

Our 74 yo F was confirmed DLBCL and treated for her TLS with aggressive IV fluids and rasburicase with resolution of AKI and correction of electrolytes. She has received C1 of R-CHOP and is now D9. Her ANC has decreased and is now 800. You are notified by her nurse that she has a temperature of 100.6F.

- Is this a neutropenic fever?



Okay…what is considered "neutropenic" and a "fever"?

- Neutropenia
  - ANC < 500 cells/mm^3 or expected to be < 500 cells/mm^3 in the next 48 hours.
- Fever
  - Single oral temperature > 101F OR temperature > 100.4F sustained over 1 hour.
  - Axillary likely inaccurate and rectal avoided due to risk of infection.
- How common is it?
  - Hematologists say not "if" but "when" (> 80%)
  - Less common in solid tumors (10-50%)
- So, in our case, we need to know if the temperature is sustained for 1 hour. Her ANC is expected to be < 500 in the next 48 hours.

Most common causes

- Common sources are GI, lung, and skin. Bacteremia in 10-25% (usually prolonged or profound neutropenia).
- Gram negatives used to be more common. Gram positives being seen more often now (i.e. coag-negative Staph). Drug-resistant Gram negatives on the rise, though.
  - Gram negative tends to cause more serious infections.

Work up and treatment

Work up:

- CBC, CMP
- Blood cultures
  - One peripheral + EACH lumen of CVC
  - 2 peripheral sticks if no CVC
- Typically CXR and UA/urine culture also obtained
- Any symptom specific culture/work up

Treatment:

- Initial treatment typically with anti-Pseudomonal coverage (cefepime, piperacillin-tazobactom) or carbapenem.
- Vancomycin or Gram-positive coverage not routinely recommended for initial regimen unless clinically indicated.

43 yo M with PMH of B-ALL admitted for blinatumomab C1. His labs are remarkable for pancytopenia with ANC of 500. He is currently D2 of blinatumomab. In the afternoon, he develops a fever of 102F. The neutropenic fever protocol is activated. His nurse walks by your work station and wonders if the fever is due to CRS. Having never taken care of someone on blinatumomab, you quickly message the pharmacist…

- CRS?
- Infection?
- What do you do?

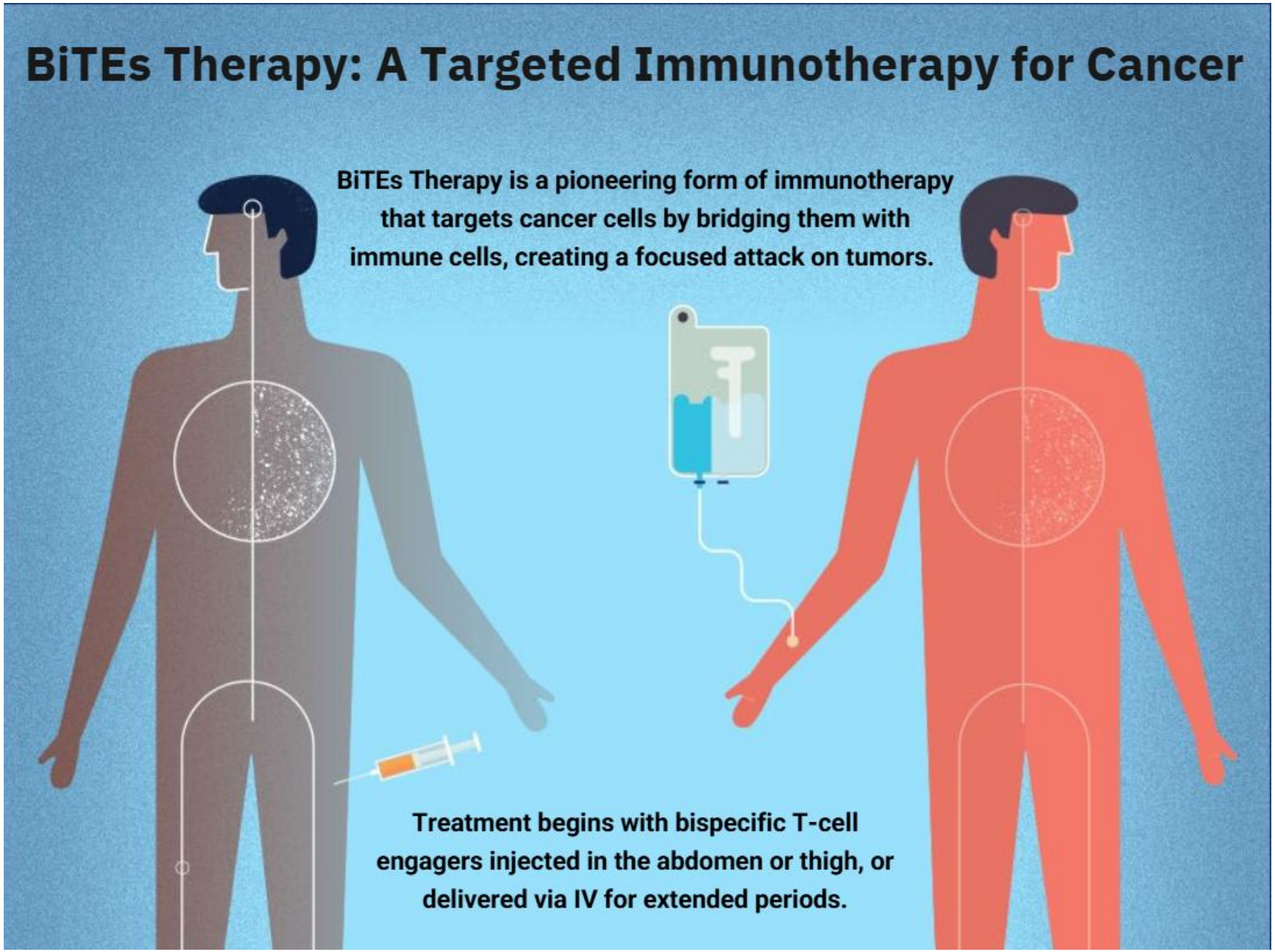
What is this BiTE therapy? I've also heard of this thing called CAR-T that is similar…

BiTE (bispecific T cell engagers)

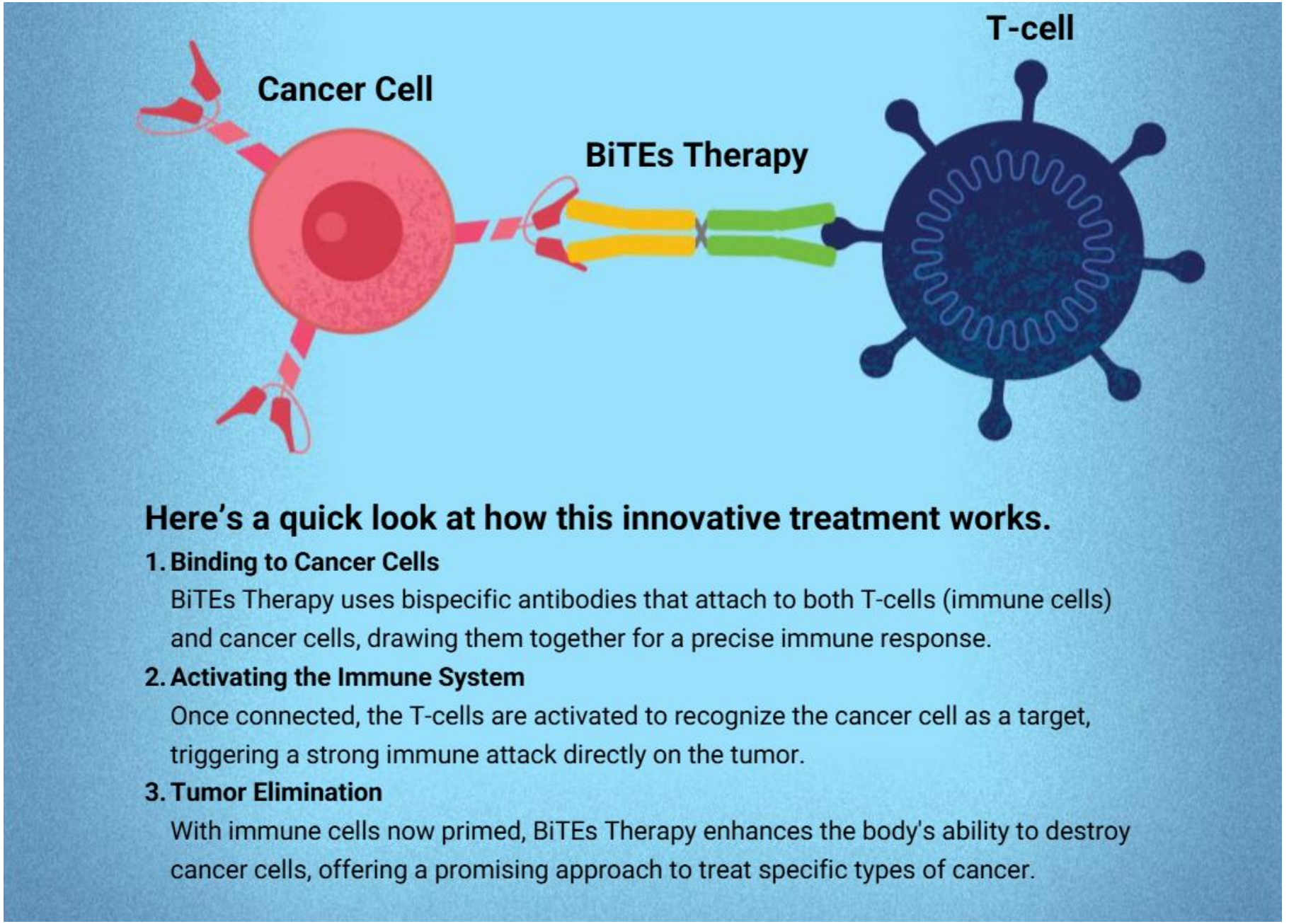
- Essentially taking immunotherapy to the next level. Lab-made antibodies are made with 2 binding sites – one to T cells, the other to cancer cells. This activates the T cell to attack the cancer cell.
- More readily available.
- Blinatumomab: ALL, up and coming
  - Being used more often and could become first line.
  - There are other BiTEs for multiple myeloma, non-Hodgkin's lymphoma, and being developed for other leukemias.
- Tarlatumab: new kid on the block for SCLC

CAR-T (chimeric antigen receptor T cell)

- Similar to BiTE but genetically modifies patient's own cells to express specific receptors that recognize cancer cells. Infused back into the patient after modification.
- More personalized.
- Requires collecting the patient's cells.
- Can be used for DLBCL, mantle cell, ALL, multiple myeloma, follicular and transformed follicular lymphoma.



https://www.moffitt.org/treatments/immunotherapy/bispecific-t-cell-engagers/



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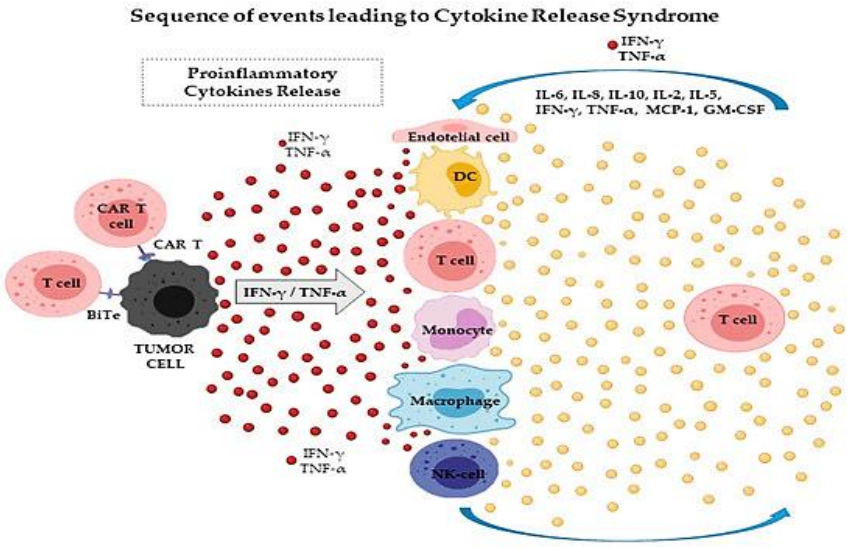
- CRS?
- Infection?

CRS (Cytokine Release Syndrome)

Symptoms:

- Fever
- Hypotension
- Tachycardia
- Arrhythmias
- Renal insufficiency
- Cardiac arrest/failure



Treatment:

- Grade 1-2: supportive
- Grade 3-4: call hematologist/oncologist, stop medicine, dexamethasone +/- tocilizumab

https://www.mdpi.com/1422-0067/22/14/7652

Overnight, our patient becomes hypotensive to 70/42 with recurrent fevers to 102F. Heart rate is in the 120s but mental status is normal. Your overnight cross cover colleague gives 3L of fluid boluses without significant improvement in heart rate or hypotension.

- ICU consulted for vasopressors and discussed with hematology about steroids.
- Started on IV dexamethasone and tocilizumab given.

Adverse reaction	Severity	Patients ≥ 45 kg	Patients < 45 kg
CRS	Grade 1-2	Supportive care only, continue blinatumomab	
	Grade 3	Interrupt blinatumomab therapy. Administer dexamethasone 8 mg IV or orally every 8 hours for up to 3 days, then taper over 4 days. Tocilizumab may be considered. When CRS is resolved, resume blinatumomab at 9 mcg/day and escalate to 28 mcg/day after 7 days if the adverse reaction does not recur.	Interrupt blinatumomab therapy. Administer dexamethasone 5 mg/m^2 (maximum: 8 mg) IV or orally every 8 hours for up to 3 days, then taper over 4 days. Tocilizumab may be considered. When CRS is resolved, resume blinatumomab at 5 mcg/m^2/day and escalate to 15 mcg/m^2/day after 7 days if the adverse reaction does not recur.
	Grade 4	Discontinue blinatumomab permanently. Administer dexamethasone as instructed for grade 3 CRS. Tocilizumab may be considered.	

CRS Grade	Management with Corticosteroids	Management with Anticytokines[3,4]
Grade 1 Symptoms are not life threatening and require symptomatic treatment only (i.e. fever, nausea, fatigue, headache, malaise)[1]	Supportive care[1] and rule out infection. Can be managed outpatient at provider discretion. Consult product-specific treatment plan and/or package insert for guidance on whether subsequent doses should be held until CRS resolves.	
	If persistently febrile x 24 hours despite supportive care, administer dexamethasone 10 mg PO q12h prn. *Steroid use highly recommended if concurrent ICANS symptoms.	Tocilizumab not indicated
Grade 2* Symptoms require and respond to moderate intervention: - Oxygen requirement ≤6L/min nasal cannula or blow-by - Hypotension not requiring vasopressors - **Note:** Hypoxia and/or hypotension should be a worsening from the patient's baseline to meet these criteria	Supportive care[1] and rule out infection. Admit to inpatient. **Hold dose if CRS occurs prior to administration.** Attending physician will determine if current dose should be held and clear patient for next dose. Manage recurrent Grade 2 CRS as Grade 3 CRS	
	Administer dexamethasone 10mg IV every 6 hours. Continue until Grade 1 or less, taper over 3 days.	Administer tocilizumab IV once (can use prior to steroids or if no response within 24 hours of steroids initiation) or anakinra or siltuximab (if tocilizumab unavailable or concurrent ICANS); may repeat tocilizumab every 8 hours. Limit tocilizumab therapy to a maximum of 3 doses in 24 hours and up to 4 total doses.
Grade 3* Symptoms require and respond to aggressive intervention: - Oxygen requirement > 6L/min nasal cannula, facemask, nonrebreather mask, or Venturi mask - Hypotension requiring vasopressor with or without vasopressin	Hold dose if CRS occurs prior to administration or currently infusing. Admit to inpatient. Provider will determine if current dose should be held and clear patient for next dose. Contact provider and RRT for STAT ICU evaluation. Manage recurrent grade 3 CRS as Grade 4 CRS.	
	Administer dexamethasone 10mg IV every 6 hours. Continue until Grade 1 or less, taper over 3 days. Dose may be increased to 20mg IV every 6 hours for refractory CRS.	**Administer tocilizumab IV once (preferred) or anakinra or siltuximab (if tocilizumab unavailable or concurrent ICANS);** may repeat tocilizumab every 8 hours. Limit tocilizumab therapy to a maximum of 3 doses in 24 hours and up to 4 total doses.
Grade 4* Life threatening symptoms: - Requiring positive pressure (eg, CPAP, BiPAP, intubation and mechanical ventilation) - Requiring multiple vasopressors (excluding vasopressin)	Hold dose and permanently discontinue therapy. Admit to inpatient to ICU. Contact provider and RRT for STAT ICU evaluation.	
	Administer methylprednisolone 1 g/day IV for up to 3 days until resolved to grade 1 or less followed by dexamethasone taper.	Administer **tocilizumab IV once (preferred) or anakinra or siltuximab (if tocilizumab unavailable, concurrent ICANS, or CRS refractory to tocilizumab);** may repeat tocilizumab every 8 hours. Limit tocilizumab therapy to a maximum of 3 doses in 24 hours and up to 4 total doses.

CRS Grade
Grade 1 Symptoms are not life threatening and require symptomatic treatment only (i.e. fever, nausea, fatigue, headache, malaise)[1]
Grade 2* Symptoms require and respond to moderate intervention: – Oxygen requirement ≤6L/min nasal cannula or blow-by – Hypotension not requiring vasopressors – Note: Hypoxia and/or hypotension should be a worsening from the patient's baseline to meet these criteria
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Grade 4* Life threatening symptoms: – Requiring positive pressure (eg, CPAP, BiPAP, intubation and mechanical ventilation) – Requiring multiple vasopressors (excluding vasopressin)

ICANS (Immune Effector Cell-Associated Neurotoxicity Syndrome)

Symptoms:

- Somnolence, agitation, confusion
- Headache
- Encephalopathy
- Seizure
- Inability to write/speak coherently
- Dizziness
- Weakness
- Tremor
- Incontinence

ICE (immune effector cell-associated encephalopathy) score for grading ICANS:

- Orientation x 4: up to 4 points
- Name 3 objects: up to 3 points
- Following commands: 1 point
- Ability to write standard sentence: 1 point
- Count backwards from 100 by 10: 1 point

Grading of ICANS				
Neurotoxicity Domain‡	**Grade 1**	**Grade 2**	**Grade 3**	**Grade 4**
ICE score^	7-9	3-6	0-2	0 (patient is unarousable and unable to perform ICE)
Depressed level of consciousness[o]	Awakens spontaneously	Awakens to voice	Awakens only to tactile stimulus	Patient is unarousable or requires vigorous or repetitive tactile stimuli to arouse; Stupor or coma
Seizure	---	---	Any clinical seizure focal or generalized that resolves rapidly; or non-convulsive seizures on EEG that resolve with intervention	Life-threatening prolonged seizure (>5 min); or repetitive clinical or electrical seizures without return to baseline in between
Motor findings§	---	---	---	Deep focal motor weakness such as hemiparesis or paraparesis
Raised intracranial pressure/cerebral edema	---	---	Focal/local edema on neuroimaging#	Diffuse cerebral edema on neuroimaging; decerebrate or decorticate posturing; or cranial nerve VI palsy; or papilledema; or Cushing's triad

ICANS Grade[5]	Management
Grade 1 ICE Score = 7 – 9 Awakens spontaneously	- Supportive care[1] and rule out infection. - If concurrent CRS, treat CRS per Table 1. - Send patient to ED if outpatient and contact hematology/oncology fellow or attending. Contact hematology/oncology fellow or attending to discuss whether to hold therapy and consult product-specific treatment plan and/or package insert for guidance. - If prolonged grade 1 ICANS, consider **dexamethasone 10 mg IV x 1.** - Monitor neurological symptoms, consider neurology consult and levetiracetam 750 mg BID for seizure prophylaxis.
Grade 2 ICE Score = 3 – 6 Symptoms include: - Somnolence – moderate, limiting instrumental ADLs - Confusion – moderate disorientation - Encephalopathy – limiting instrumental ADLs - Dysphasia – moderate impairing ability to communicate spontaneously - Awakens to voice	- Admit to inpatient. - If concurrent CRS, treat CRS per Table 1 (alternative to tocilizumab preferred). - Hold therapy (except for blinatumomab) and contact provider. Provider will determine if it should be discontinued and clear patient for next dose. - Administer **dexamethasone 10mg IV every 6 hours**. Continue until Grade 1 or less, taper over 3 days. - Monitor neurological symptoms, consult neurology, and consider levetiracetam 750 mg BID for seizure prophylaxis.
Grade 3 ICE Score = 0 – 2 Symptoms include: - Somnolence – obtundation or stupor - Confusion – severe disorientation - Encephalopathy – limiting self-care ADLs - Dysphasia – severe receptive or expressive characteristics, impairing ability to read, write, or communicate intelligibly - Awakens only to tactile stimulus - Any clinical seizure focal or generalized that resolves rapidly or non-convulsive seizure on EEG that resolves with intervention - Focal/local edema on neuroimaging	- Admit to inpatient and provide supportive therapy, which may include intensive care. - If concurrent CRS, treat CRS per Table 1 (alternative to tocilizumab preferred) - Hold therapy and contact provider. Provider will determine if it should be discontinued and clear patient for next dose. - Administer **dexamethasone 10mg IV every 6 hours**. Continue until Grade 1 or less, taper over 3 days. - Monitor neurological symptoms, consult neurology, and initiate levetiracetam 750 mg BID for seizure prophylaxis. - Consider anakinra SQ 100 mg q12h if symptoms persist beyond 24 hours and continue until resolution.
Grade 4 ICE Score = 0 Patient critical or obtunded on exam Life threatening consequences: - Urgent intervention indicated - Requirement for mechanical intervention - Consider cerebral edema	- Admit to ICU with neurology consult. Call stroke code for STAT neurology evaluation. Administer levetiracetam 750 mg BID for seizure prophylaxis. - If concurrent CRS, treat CRS per Table 1 (alternative to tocilizumab preferred) - Permanently discontinue therapy. - Administer **methylprednisolone 1000mg IV every 24 hours for 3 days.** If improves, manage as above. Continue until Grade 1 or less, taper as appropriate. - Consider anakinra SQ 100 mg q12h if symptoms persist beyond 24 hours and continue until resolution.

ICANS Grade[5]

Grade 1

ICE Score = 7 – 9

Awakens spontaneously

Grade 2

ICE Score = 3 – 6

Symptoms include:

- Somnolence – moderate, limiting instrumental ADLs
- Confusion – moderate disorientation
- Encephalopathy – limiting instrumental ADLs
- Dysphasia – moderate impairing ability to communicate spontaneously
- Awakens to voice

Grade 3

ICE Score = 0 – 2

Symptoms include:

- Somnolence – obtundation or stupor
- Confusion – severe disorientation
- Encephalopathy – limiting self-care ADLs
- Dysphasia – severe receptive or expressive characteristics, impairing ability to read, write, or communicate intelligibly
- Awakens only to tactile stimulus
- Any clinical seizure focal or generalized that resolves rapidly or non-convulsive seizure on EEG that resolves with intervention
- Focal/local edema on neuroimaging

Grade 4

ICE Score = 0

Patient critical or obtunded on exam

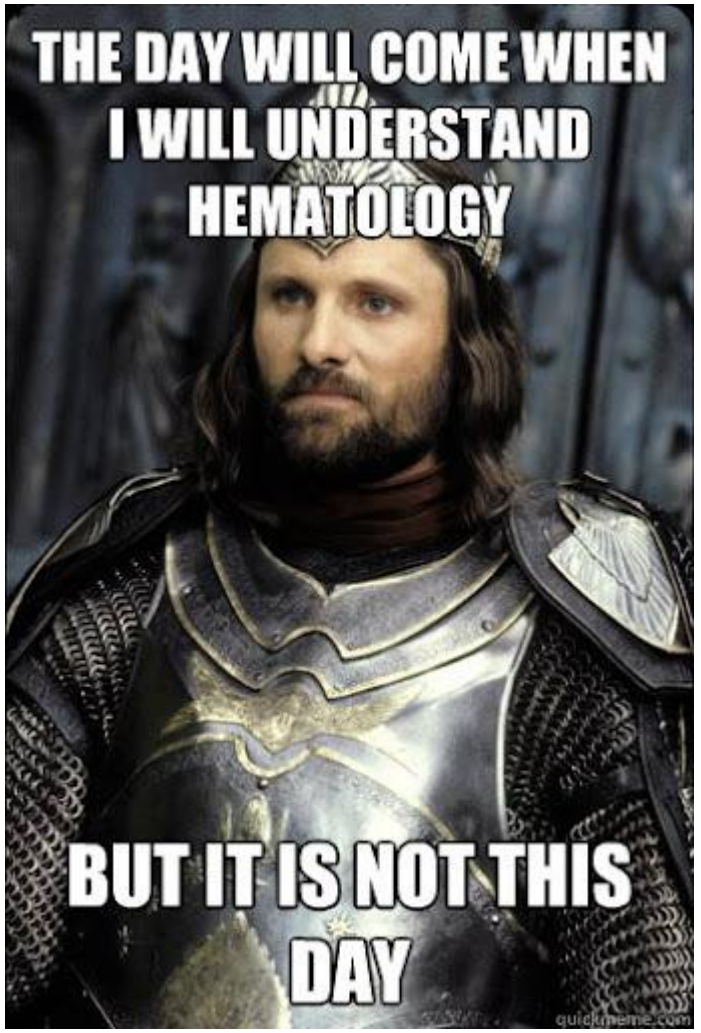
Life threatening consequences:

- Urgent intervention indicated
- Requirement for mechanical intervention
- Consider cerebral edema

Treatment of ICANS

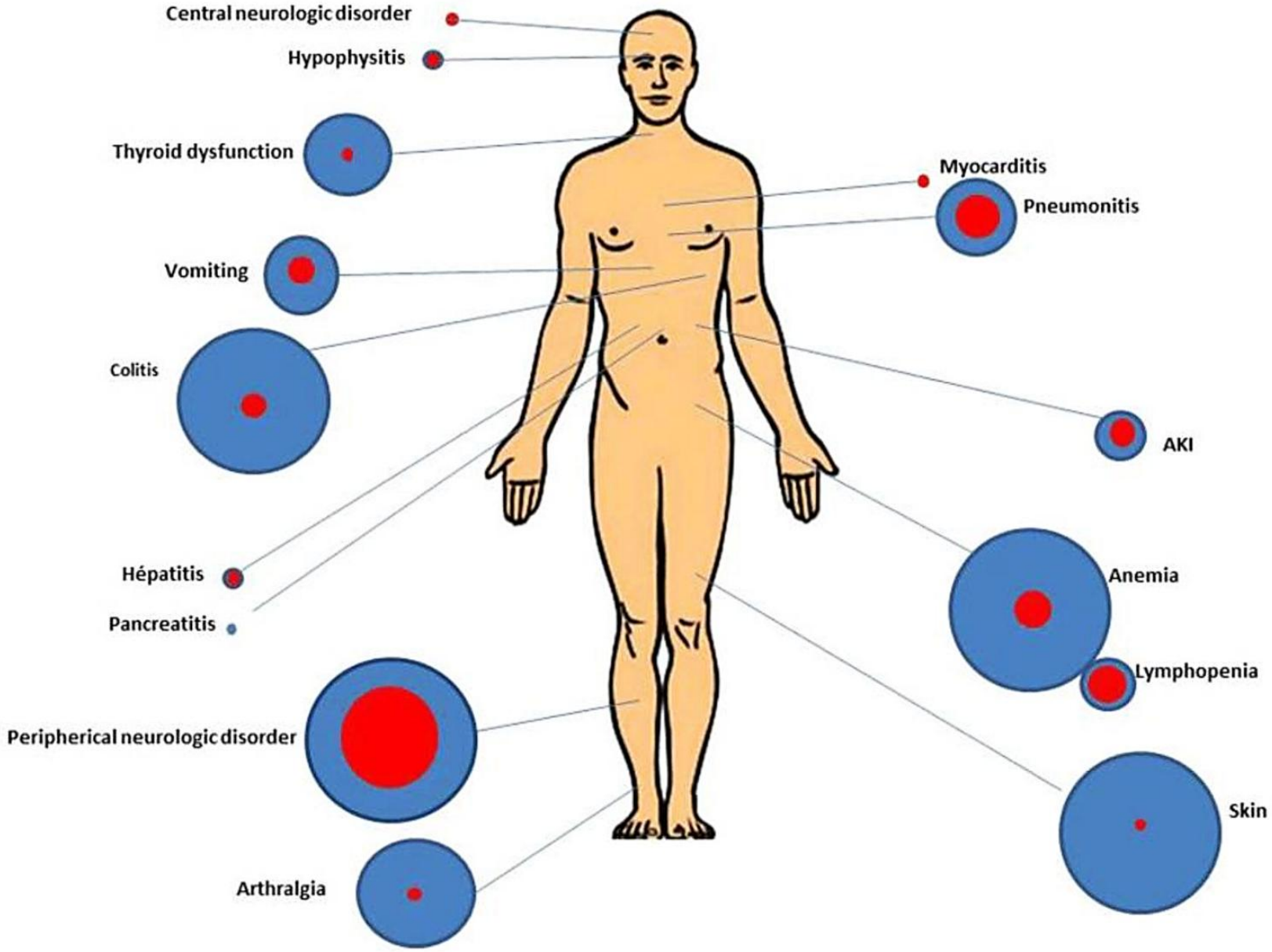
- Grade 1: supportive care
- Grade 2: dexamethasone (10 mg), hold medication (except blinatumomab)
- Grade 3: dexamethasone (10 mg), hold medication (including blinatumomab), neurology consult, start levetiracetam 750 mg BID for seizure ppx
- Grade 4: methylprednisolone (1000 mg) x 3 days, ICU admission with neurology consult, levetiracetam for seizure ppx


IM LIKE
SO CONFUSED MAN
HISTORY.COM
MEMES & FUNNY PICS FRABZ.COM


THE DAY WILL COME WHEN I WILL UNDERSTAND HEMATOLOGY
BUT IT IS NOT THIS DAY

37 yo F with PMH of metastatic melanoma on ipilimumab and nivolumab who presented from oncology clinic for newly elevated LFTs. Patient recently admitted for new onset dyspnea, thought due to immunotherapy induced pneumonitis and discharged on prednisone taper as well as recently started on mycophenolate. LFTs from 1 week prior to presentation were AST 36, ALT 79, T bili and alk phos normal. AST 695 and ALT 1147 on presentation. T bili and alk phos normal. Acute hepatitis panel negative. EBV, CMV negative. CT abd/pelvis, RUQ US/Doppler negative.

- Immunotherapy related?
- -Itises related to immunotherapy usually happen several weeks later and after multiple doses.



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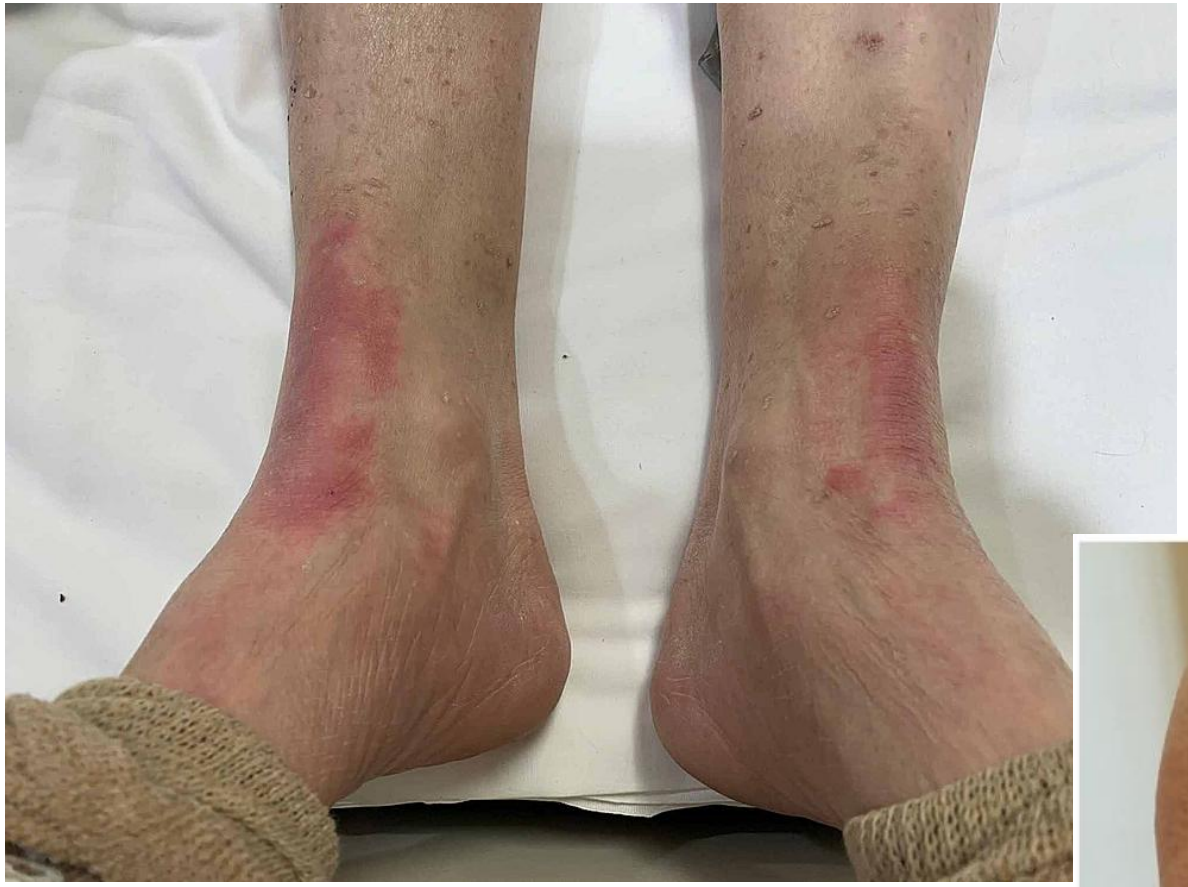

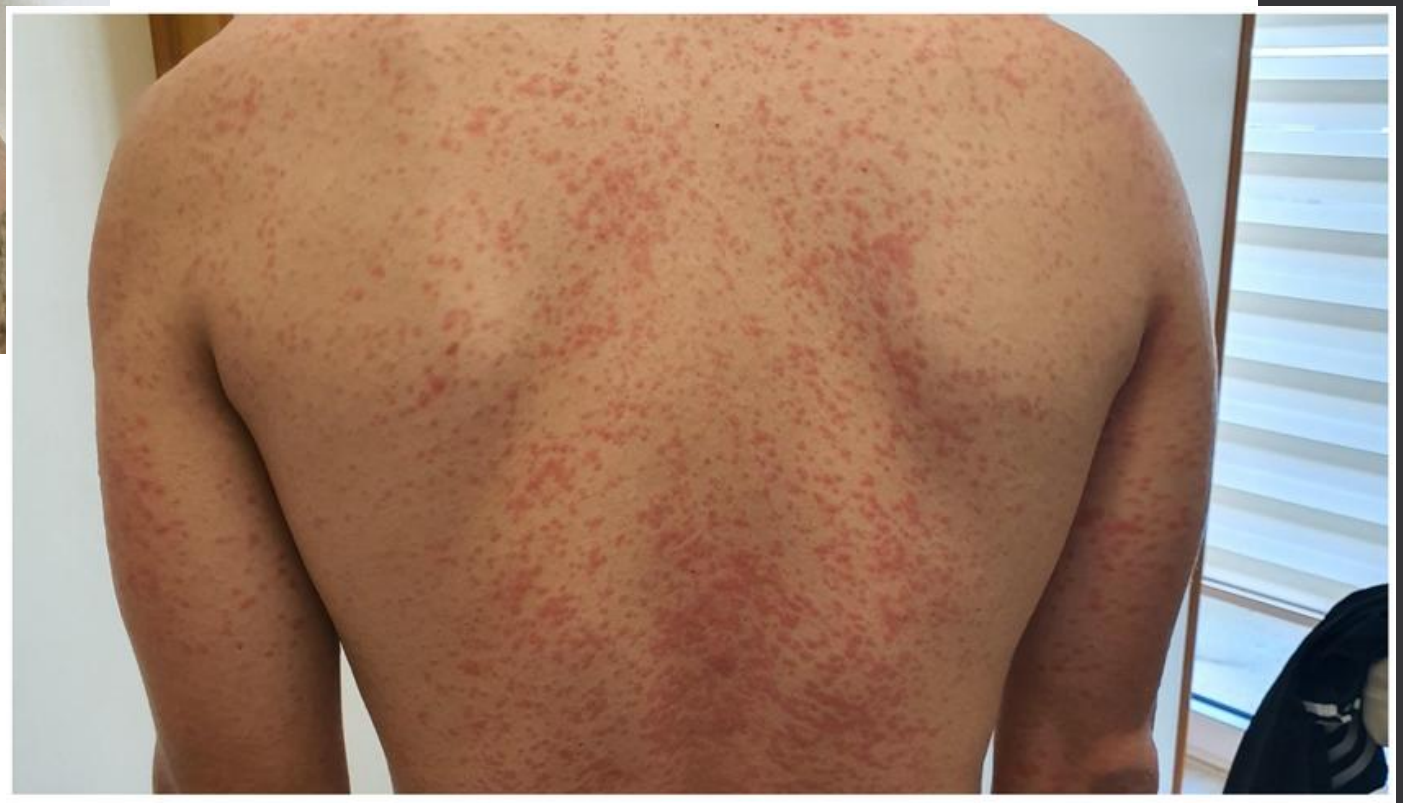

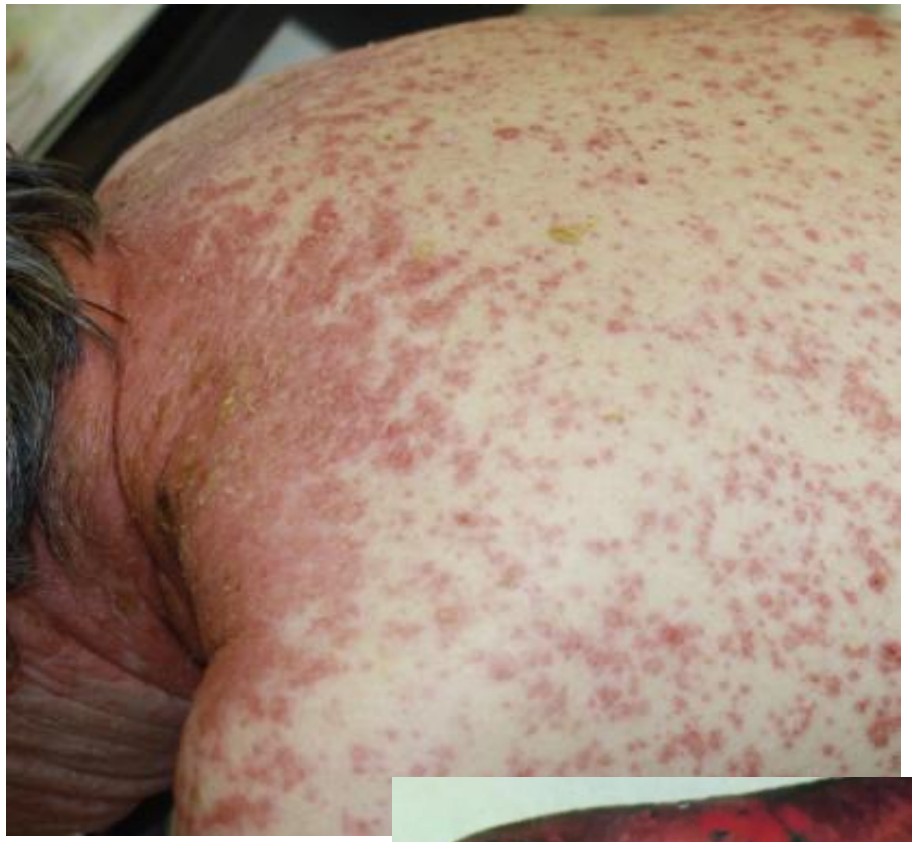

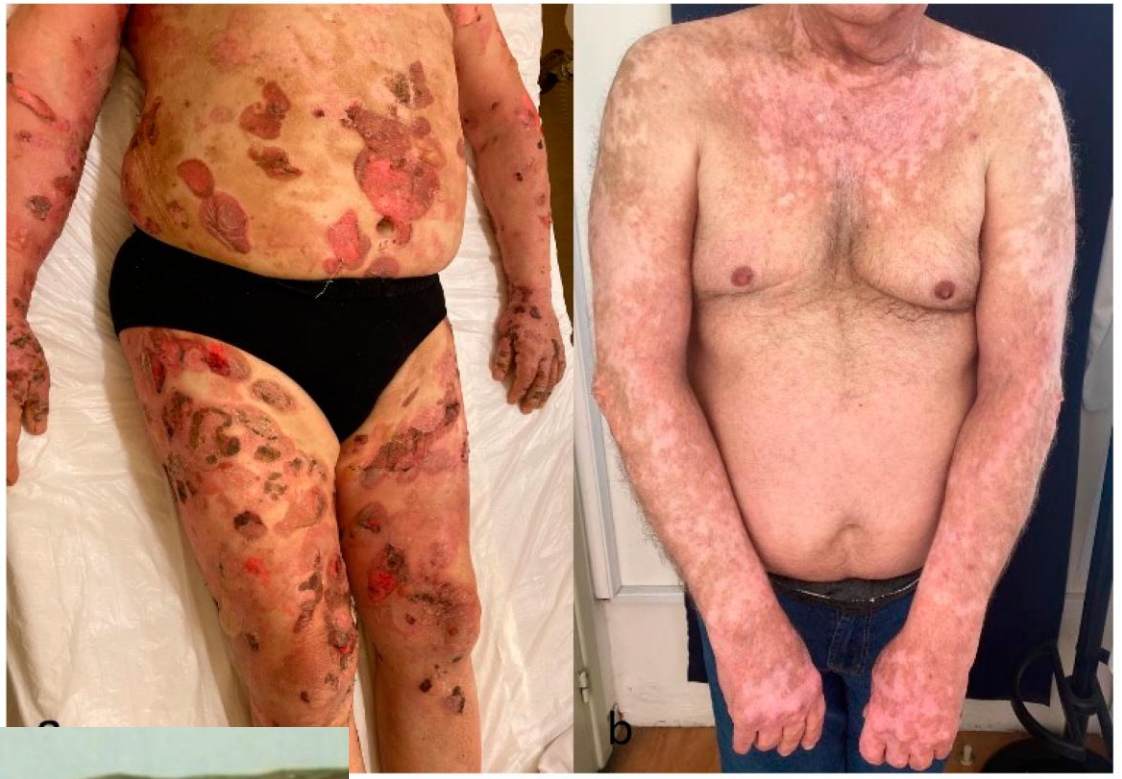
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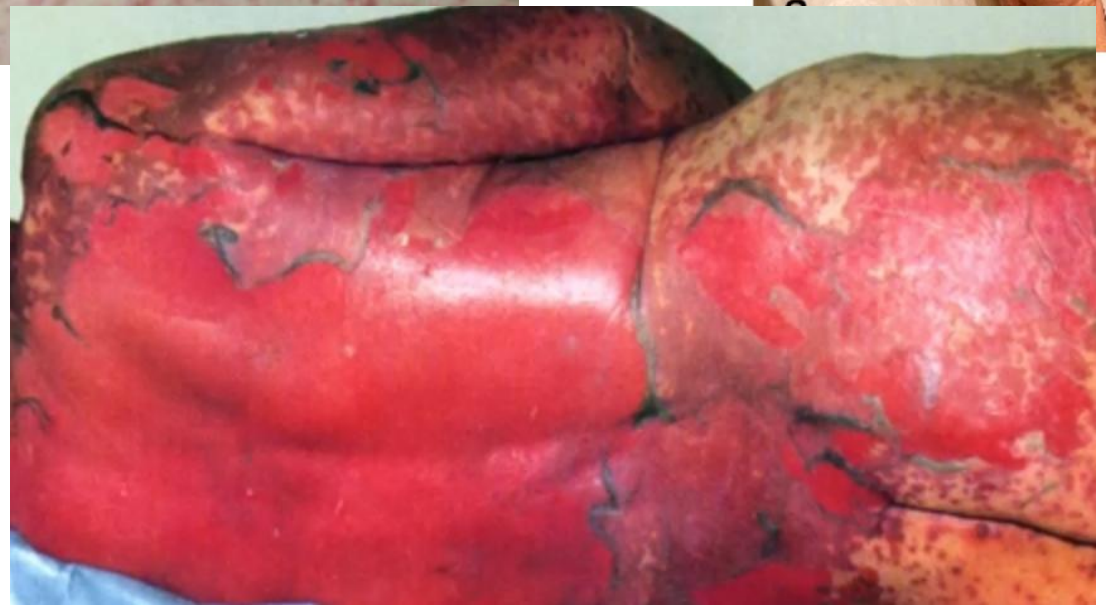


Treatment

- Depends on the grade.
  - Grade 1: can continue immune checkpoint inhibitor (ICI) with close observation (generally)
  - Grade 2: hold ICI and consider resuming when ≤ grade 1 toxicity, consider corticosteroids
  - Grade 3-4: hold ICI and give high dose corticosteroids
    - Usually 0.5 mg/kg-1 mg/kg of prednisone or methylprednisolone
    - Prolonged steroid taper over several weeks
    - Sometimes need immunosuppression

63 yo M with PMH of extensive stage SCLC who presented with bilateral lower extremity weakness x 1 week but acutely worsened in the last 2-3 days. Patient stated he was unable to get off the couch due to weakness and endorses inability to urinate. CT spine negative for fracture but showed diffuse sclerotic lesions throughout T/L spine. STAT MRI T/L spine ordered.

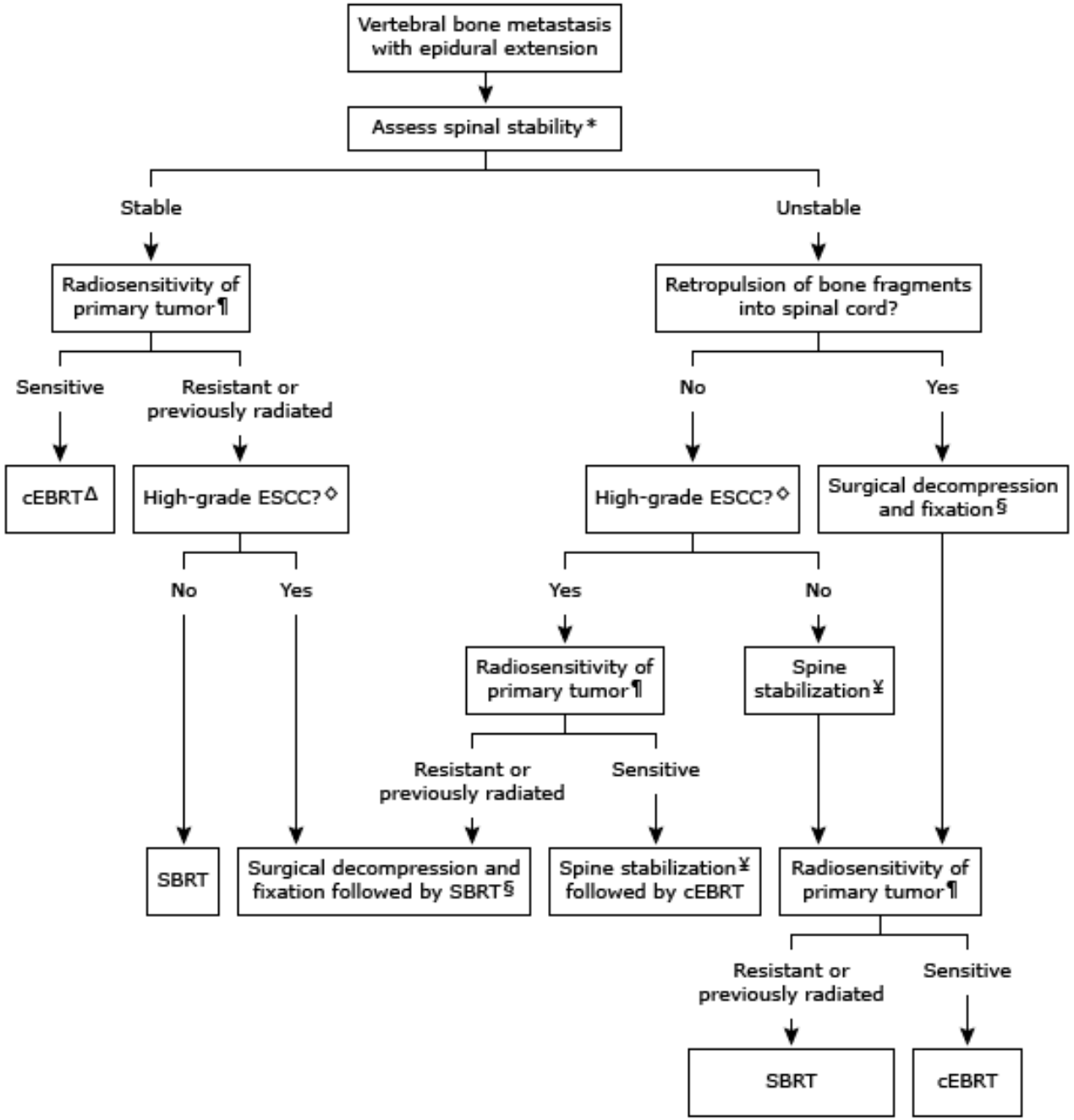
- MRI showed diffuse osseous metastatic disease with severe spinal canal stenosis at T6.

Malignant spinal cord compression

- Not uncommon and seen in 3-5% of patients with advanced malignancy.
- Most common in cancers that metastasize to bone (lung, prostate, breast) and multiple myeloma.
- Symptoms:
  - Pain actually initial symptom oftentimes.
  - Weakness, numbness/tingling, bowel/bladder incontinence/retention

Treatment

- Dexamethasone
  - Usually 10 mg x 1 followed by 4 mg q6 for vasogenic edema.
  - Needs GI prophylaxis while on high dose steroids.
  - Typically tapered depending on surgery vs radiation.
- Surgery
  - Spine stability determined by imaging (SINS score). Score $\geq$ 7 needs evaluated for surgery.
  - Typically followed by radiation. Typically 2 weeks later.
- Radiation
  - Some tumors more radiosensitive than others and may respond better/less invasively to radiation rather than surgery.
    - SCLC, lymphoma, prostate, breast, etc.



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56 yo F with PMH of breast cancer who presented with abdominal pain, nausea, and confusion. Labs remarkable for creatinine of 3.0, phosphorus of 5.0, calcium of 14.0. CT abd/pelvis shows diffuse vertebral involvement of malignancy as well as sclerotic lesions in the bony pelvis.

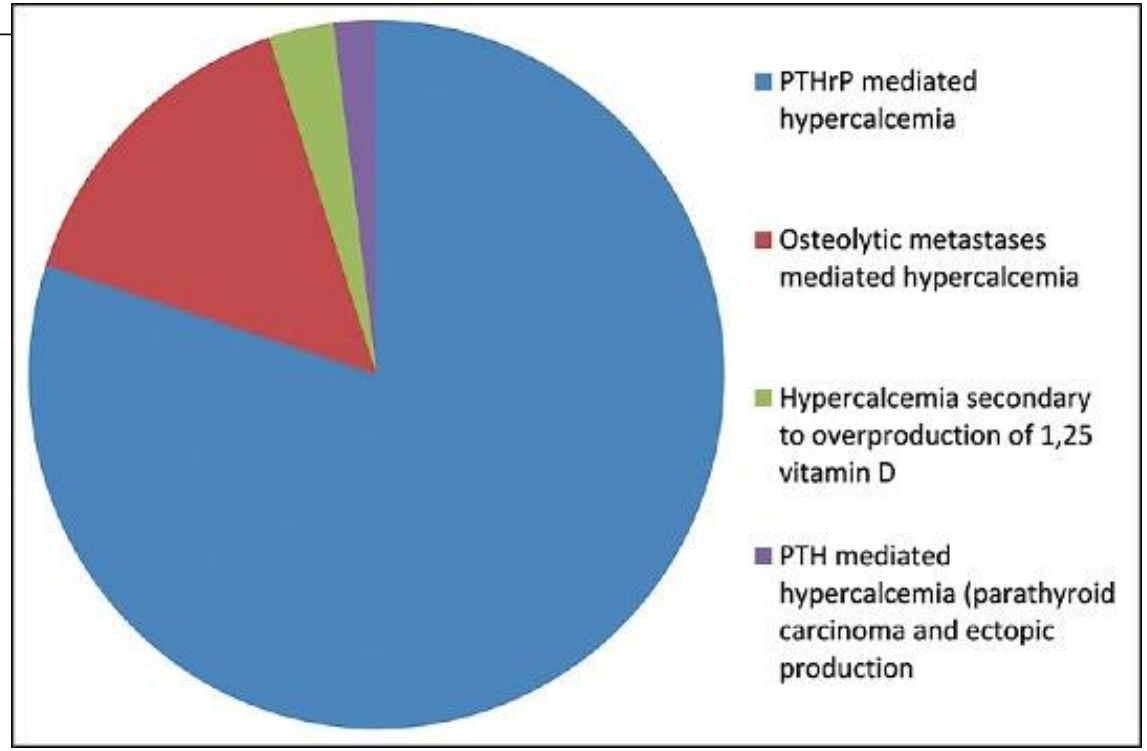
- Hypercalcemia of malignancy
  - Mild: ~ 10.5-11.9
  - Moderate: ~ 12.0-13.9
  - Severe: ~ 14.0+
- Very common
  - Estimated anywhere from 3-30% among all malignancies. Usually occurs later on.
  - Most common in breast and lung cancer and multiple myeloma.

Table 1. Types of Hypercalcemia Associated with Cancer.*

Type	Frequency (%)	Bone Metastases	Causal Agent	Typical Tumors
Local osteolytic hypercalcemia	20	Common, extensive	Cytokines, chemokines, PTHrP	Breast cancer, multiple myeloma, lymphoma
Humoral hypercalcemia of malignancy	80	Minimal or absent	PTHrP	Squamous-cell cancer, (e.g., of head and neck, esophagus, cervix, or lung), renal cancer, ovarian cancer, endometrial cancer, HTLV-associated lymphoma, breast cancer
$1,25(OH)_2D$-secreting lymphomas	<1	Variable	$1,25(OH)_2D$	Lymphoma (all types)
Ectopic hyperparathyroidism	<1	Variable	PTH	Variable

* PTH denotes parathyroid hormone, PTHrP PTH-related protein, $1,25(OH)_2D$ 1,25-dihydroxyvitamin D, and HTLV human T-cell lymphotrophic virus.

https://www.nejm.org/doi/10.1056/NEJMcp042806?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%20%200pubmed



https://pmc.ncbi.nlm.nih.gov/articles/PMC4683803/

Symptoms

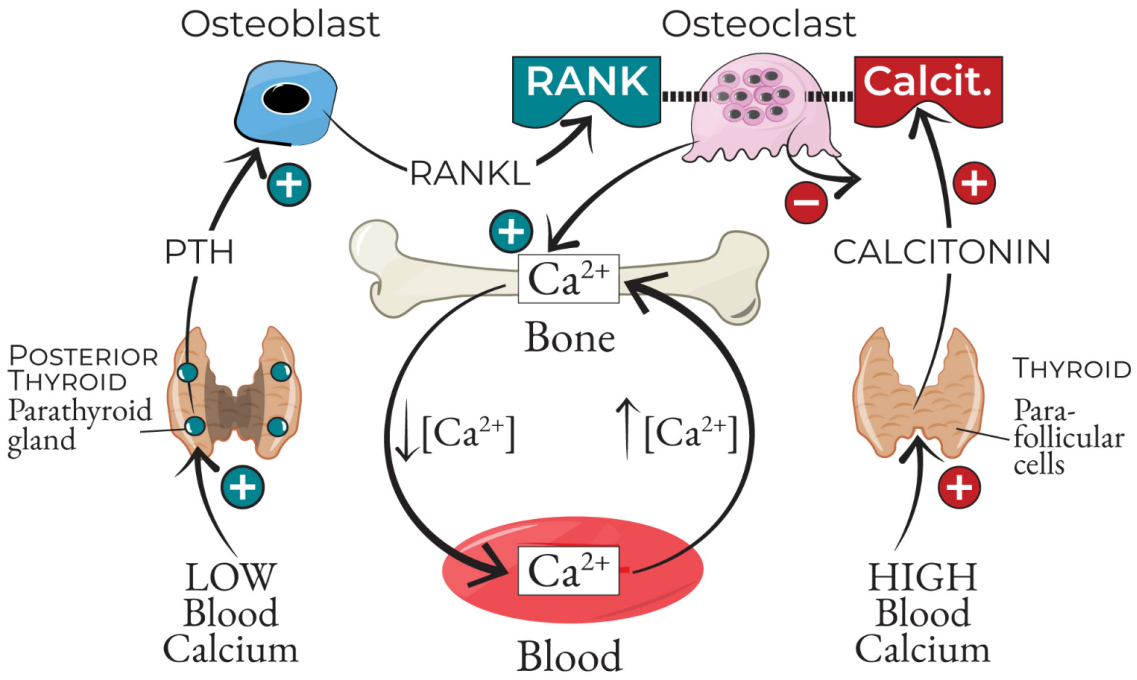
- Moans, bones, stones, groans, and psychiatric overtones

Organ system	Clinical features
Neurologic	Fatigue, altered mental status including coma, posterior reversible leukoencephalopathy
Gastrointestinal	Nausea, vomiting, constipation, peptic ulcer disease, and pancreatitis
Cardiovascular	Short QT interval on ECG, ST segment abnormalities including ST segment myocardial infarction mimic, malignant ventricular arrhythmias, and hypertension
Renal	Nephrogenic diabetes insipidus, acute kidney injury

ECG = Electrocardiogram

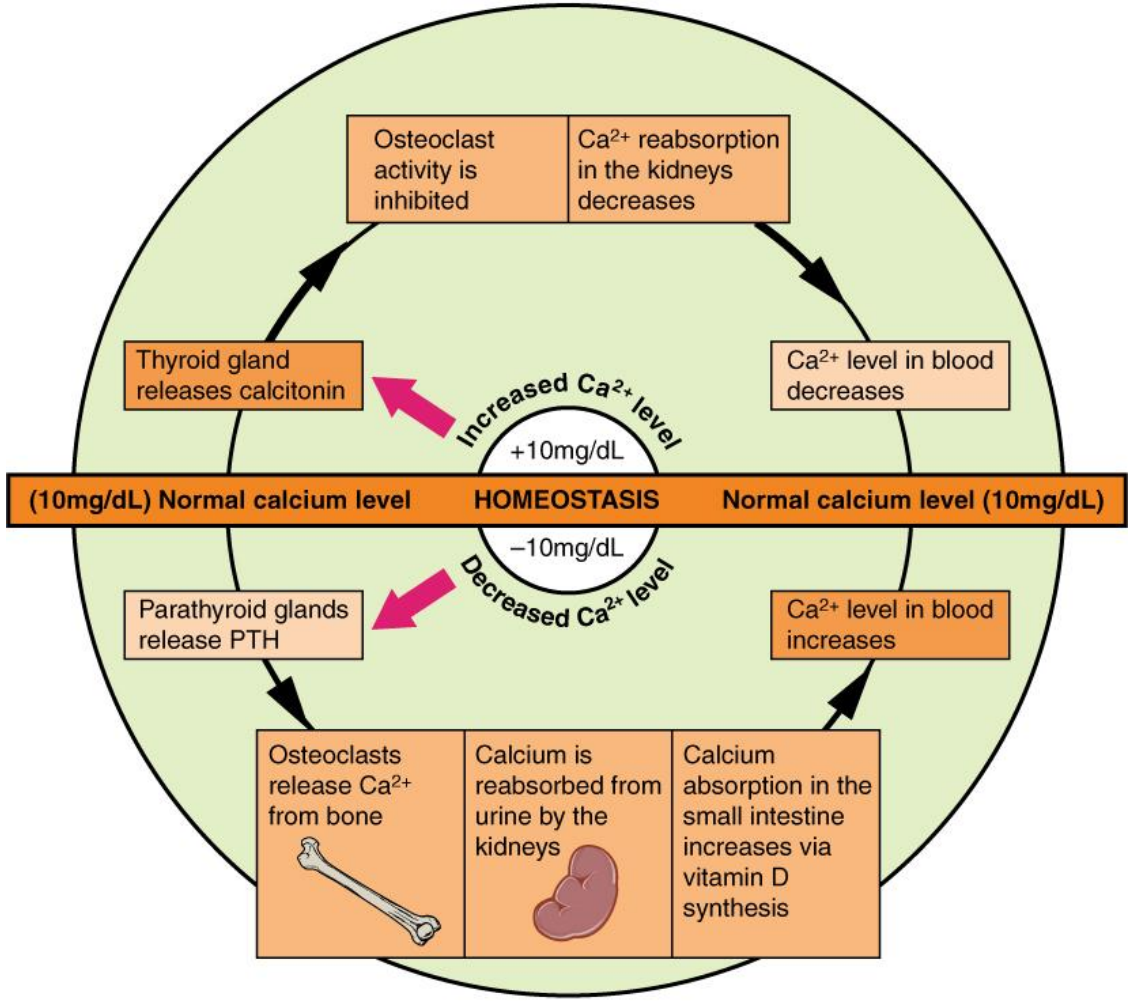
https://pmc.ncbi.nlm.nih.gov/articles/PMC4683803/

Calcium Homeostasis



Serum Calcium Range

$[Ca^{2+}]$ = 8.5 to 10.5 mg/dL



https://ditki.com/course/physiology/glossary/physiological-process/calcium-regulation

https://en.wikipedia.org/wiki/Calcium_metabolism

Treatment

- Stop medications that can contribute to hypercalcemia
  - Vitamin D/supplements, thiazide diuretics
- Aggressive IVF
  - Typically NS at least at 150 ml/hr
  - Avoid LR due to calcium in fluid
- Loop diuretics once volume resuscitated
- Bisphosphonates
  - Pamidronate or zoledronic acid
- Denosumab

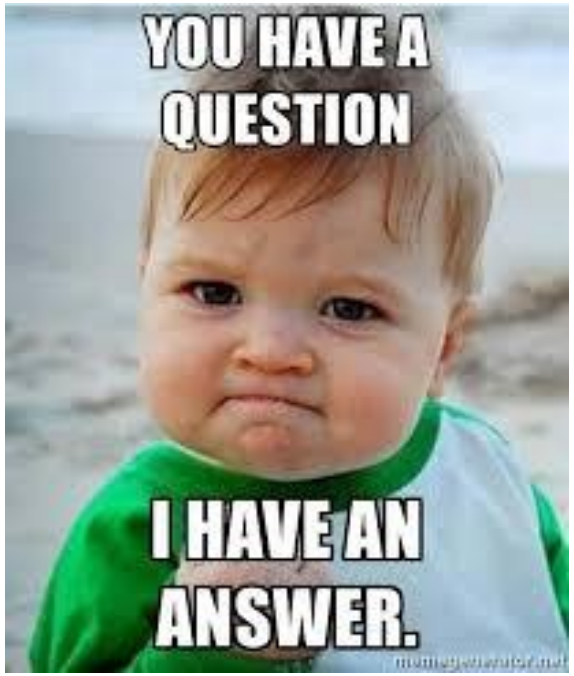
Take home points

- TLS: NS and, at least, allopurinol 300 mg BID +/- rasburicase.
- Neutropenic fever: Get all the cultures and start the Gram negative/anti-Pseudomonal coverage ASAP.
- CRS and ICANS: Think about them if unexplained symptoms. If sick…talk to a hematologist/oncologist and give dexamethasone (8-10 mg). If really sick…call ICU.
- Itises from immunotherapy: Again, steroids (methylprednisolone or prednisone 0.5-1 mg/kg).
- Spinal cord compression: Pain usually first. Determine if spine stable. Dexamethasone (10 mg) for cord edema. Surgery and/or radiation.
- Hypercalcemia of malignancy: Aggressive NS + bisphosphonate.

Questions?


THANKS FOR YOUR ATTENTION
CLAP AND DON'T ASK ANY QUESTION, PLEASE


End of Presentation
ANY QUESTIONS?


YOU HAVE A QUESTION
I HAVE AN ANSWER.

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