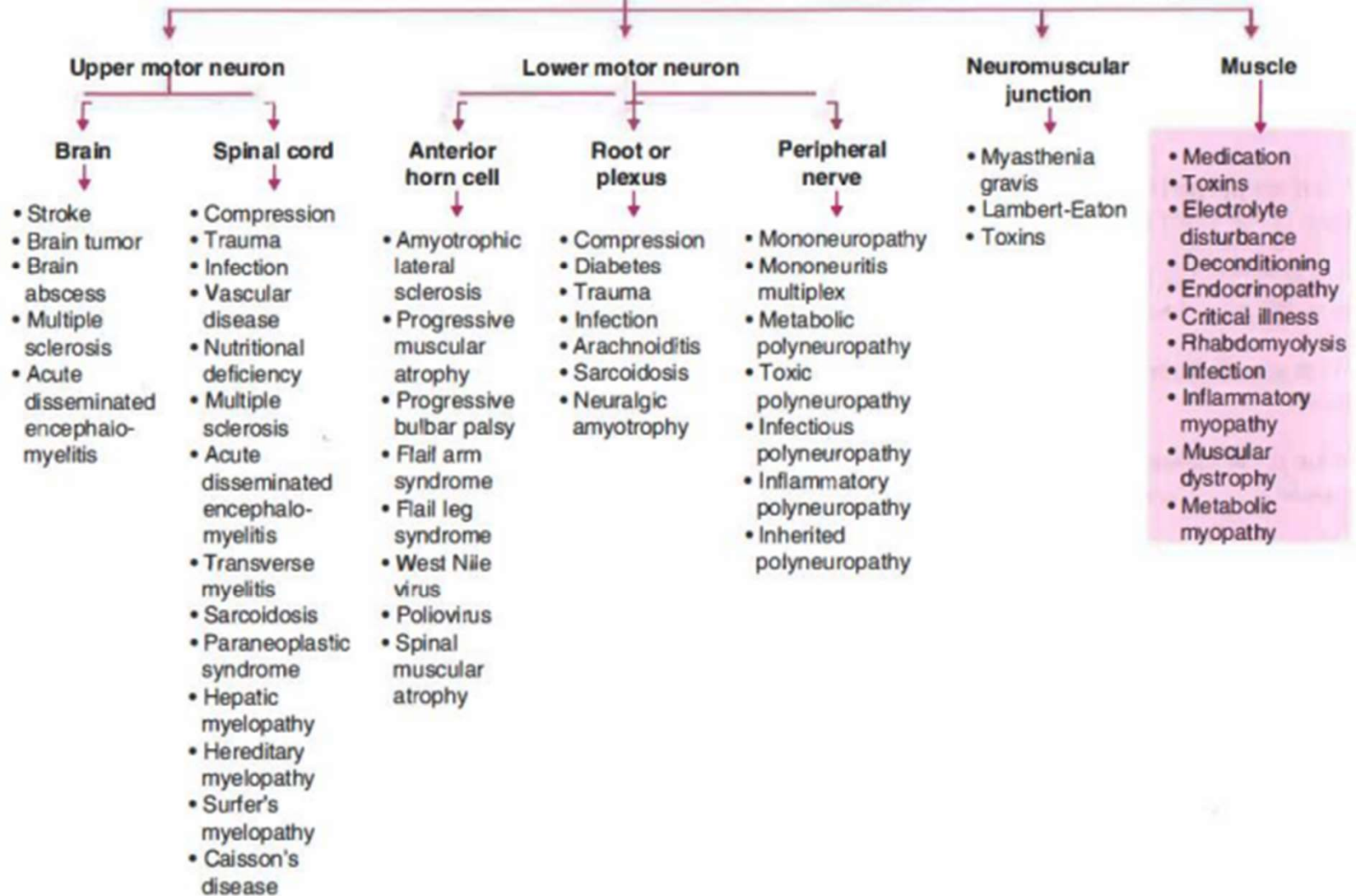


# Framework for weakness

# Weakness



# Thyrotoxic Periodic Paralysis

# TPP Illness Script

Epidemiology	Asian men ages 20-30 with hyperthyroidism of any etiology
Pathophysiology	Channelopathy due to hypersensitization of the Na-K ATPase by excess thyroid hormone

It causes **INTRACELLULAR SHIFTS** of K.

Low serum K level does **NOT** reflect a total body K deficit.

# TPP Illness Script

<b>Treatment</b>	Gradual potassium repletion (prevent rebound hyperkalemia) Treat hyperthyroidism Avoid triggers
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Remember, it's **INTRACELLULAR SHIFTS** of K.  
So, if you treat the underlying cause, K shifts back out of the cell.

**GRADUAL K REPLETION** (90mEq K in 24 hrs) to avoid **REBOUND HYPERKALEMIA**.

# TPP Illness Script

Epidemiology	Asian men ages 20-30 with hyperthyroidism of any etiology
Pathophysiology	Channelopathy due to hypersensitization of the Na-K ATPase by excess thyroid hormone
Trigger	High-carb meals, stress, heavy exercise, alcohol, cold exposure, infection
Symptoms / Signs	Episodic, sudden onset muscle weakness Lasting hours May have symptoms of thyrotoxicosis
Labs	Hypokalemia Low TSH with high FT4 or high T3
Treatment	Gradual potassium repletion (prevent rebound hyperkalemia) Treat hyperthyroidism Avoid triggers

Serum K <sup>+</sup> (mmol/L)	Std Scale KCl Replacement	Aggressive Scale KCl Replacement
4-4.5	10 mEq IV	20 mEq IV
3.5-3.9	40 mEq PO or 20 mEq IV	40 mEq IV
< 3.5	40 mEq IV	40 mEq IV and 20mEq PO

♦ Check K<sup>+</sup> level periodically especially if using aggressive scale  
 ♦ Arterial pH affects K<sup>+</sup> level  
 ♦ Check Mg<sup>++</sup> level if having difficulty repleting K<sup>+</sup>  
 ♦ Each 10mEq KCl will inc. serum K<sup>+</sup> by ~0.2 if given IV & ~0.1 if given PO  
     \*\*Use caution with renal insufficiency\*\*  
 ♦ KCl can be infused at 10mEq/hr via peripheral IV (burns → add lidocaine) & 20mEq/hr via central line (doesn't need lidocaine)  
 ♦ If given via peripheral IV write as "KCl 10mEq IV w/ 1% lidocaine 1cc/bag" x number of doses  
 ♦ Use PO when possible. K-Dur (PO) = sustained release (less stomach upset), K-lor (PO) = fast acting powder (more stomach upset). Only replete a max total PO of ~60mEq at a time as K can cause severe diarrhea/upset stomach

Serum Mg <sup>++</sup> (mmol/L)	Magnesium Sulfate Replacement	♦Remember Mg is essential for most other <u>lytes</u> to be utilized properly. Replete aggressively to at least 1.0 if having trouble keeping other <u>lytes</u> normal. Use caution with renal insufficiency ♦Check <u>pt's</u> K <sup>+</sup> & Ca <sup>++</sup> levels ♦Give initial 2g followed by 1g/hr to avoid excess renal loss ♦Can take 36-48 <u>hrs</u> to re-equilibrate serum Mg <sup>++</sup> levels
0.7-0.8	1 gm	
0.6-0.7	2 gm	
< 0.6	3-4 gm	



**CC:** BUE and BLE weakness, muscle pains

**HPI:** 38 y/o M. Sporadic, episodic BLE > UE weakness starting 6 months ago. Associated with muscle soreness/pains. Weakness gets so severe that he can't lift or move his legs. Came to ED today because of worsening BUE symptoms.

Endorsed ~50lb unintentional wt loss over 6 months, intermittent body tremors, fatigue. Denied fevers, chills, recent sick contacts or travel.

**PMH:** None

**Surg Hx:** R knee surgery from sporting injury

**SH:**

Occupation: works in IT

ETOH: denied current or past use

Tobacco: ½ PPD since 10 y/o

Drugs: denied current or past use

**FH:**

Father: deceased due to kidney failure

Mother: alive, emphysema due to smoking

Oldest brother: alive, T2DM

No known FH of thyroid disease or potassium problems

**Allergies:** NKDA

**Meds:** None

**Physical Exam:**

Tmax 37.1C, BP 151/99, HR 104, RR 23, BMI 19.2

General: very thin man, in NAD

HEENT: PERRL, dry mucous membranes, mildly diffusely enlarged thyroid (nontender to palpation, no discrete nodules palpated, no bruits)

CV: tachycardic, regular rhythm, no M/R/G

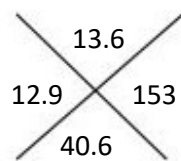
Pulm: CTAB, no wheezes, no rales, no rhonchi

GI: soft, nontender, nondistended

MSK: no edema, warm extremities with palpable distal pulses

Neuro: AOX3, answering questions appropriately, BUE 5/5 str, b/l upper thighs 2/5 str, b/l knee flexion & extension 4/5, sensation intact throughout

**Labs:**

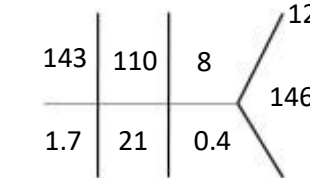


CK: 1532

Utox: negative

Aldosterone: 2 (nml)

Plasma renin: 2.44 (nml)



TSH: <0.01

FT4: 6.0 (nml: 0.9-1.7)

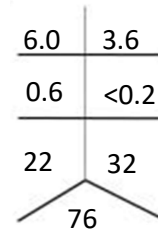
TT3: 430 (nml: 80-200)

Thyroglobulin: 0.8 (low)

Anti-thyroglobulin: 107 (elevated)

TPO: 32 (elevated)

TSI: 451 (elevated)



**Thyroid US:**

Right lobe: 6.4x2.0x2.6 cm

Left lobe: 6.5x1.7x2.2 cm

Diffusely increased vascular flow throughout the thyroid parenchyma, can be seen in acute thyroiditis.

**RAI NM Study:**

Diffusely increased tracer uptake, consistent with Graves' disease

**Problem Representation:**

Young man with no sig PMH, who presents with chronic, sporadic, episodic, self-resolving BUE and BLE weakness and pain; as well as unintentional weight loss.

**Diagnosis:** Thyrotoxic Periodic Paralysis (TPP) due to Graves' Disease

**Learning points:**

1. Weakness framework grouped into UMN, LMN, NMJ, and Muscle etiologies
2. TPP is a channelopathy. It causes **intracellular shifts** of potassium. Low serum potassium does not reflect a total body potassium deficit.
3. Repletion of potassium should be **gradual** (~90mEq K in 24hrs) to prevent rebound hyperkalemia.
4. Triggers for TPP include: **high-carb meals** (insulin-mediated), **stress** (adrenergic state), **intense exercise**