50-year-old woman with thyrotoxicosis

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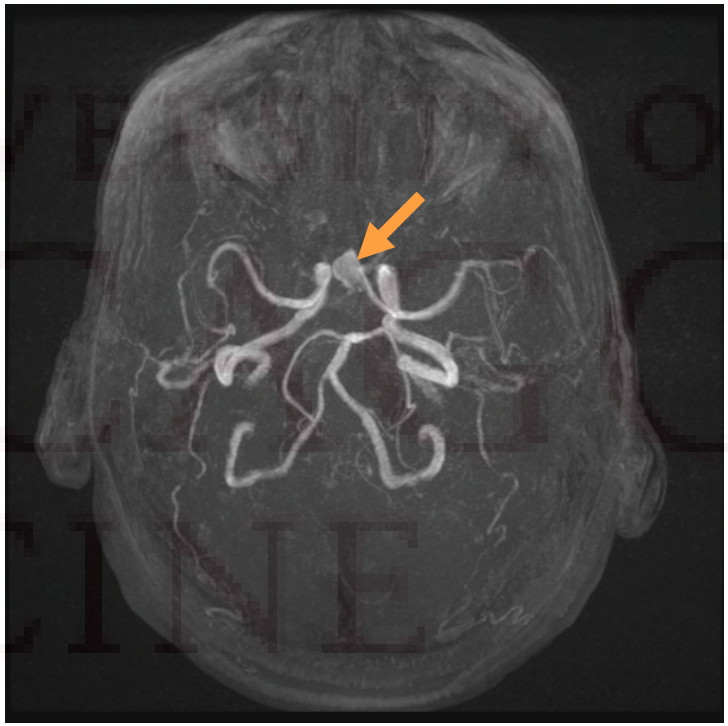
History of Present Illness

- Hospitalized at OSH for dyspnea thought secondary to COPD exacerbation with a component of pulmonary edema (CHF)
- Pt reported worsening and increased frequency of headaches
- Known history of hyperthyroidism, untreated
- CT Head and then CTA revealed large anterior communicating artery aneurysm
- Referred to neurosurgery here and admitted for clipping on 09/20/2012

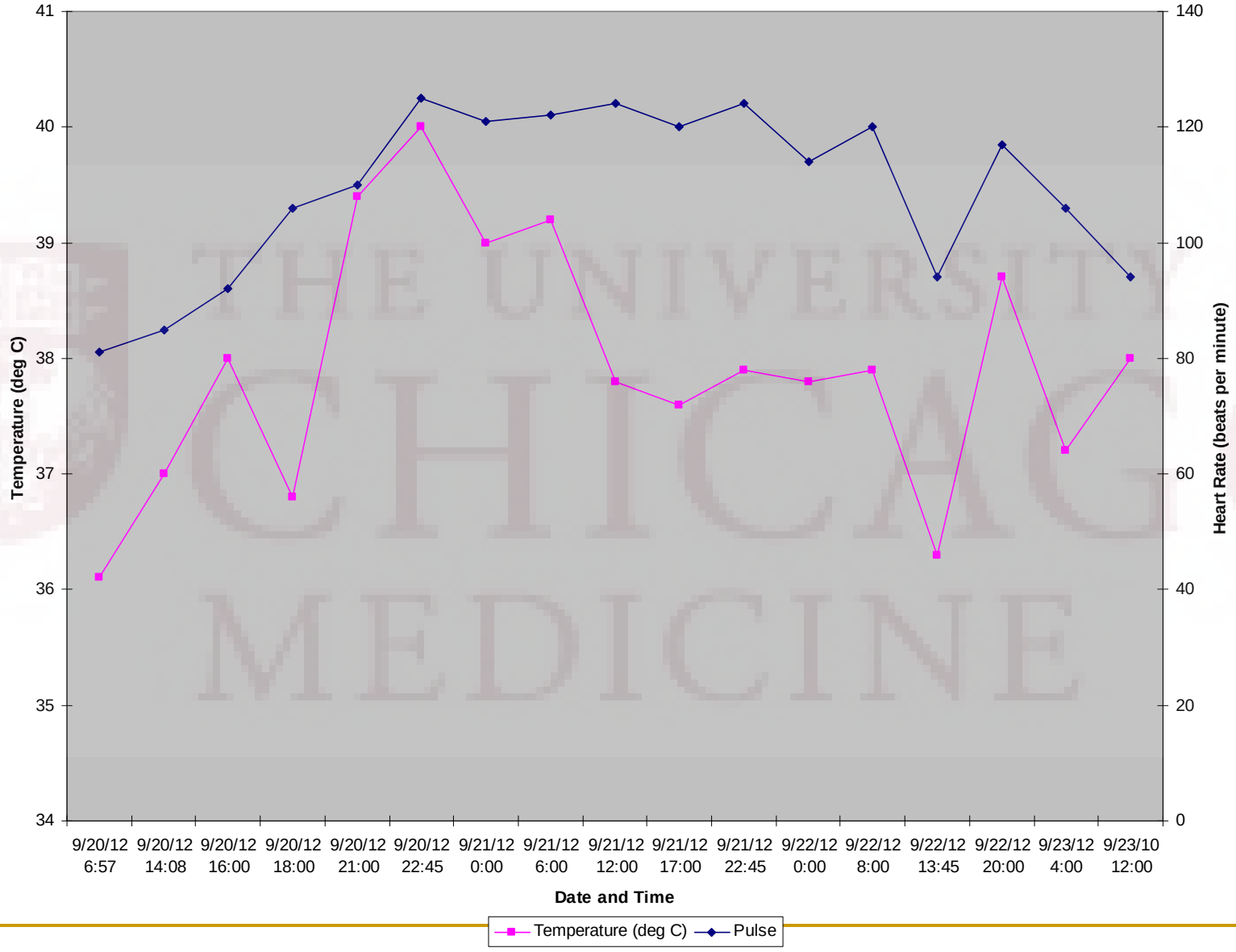


MRA Brain

History of Present Illness

- Operative note reports aneurysm with thin walls and multiple lobulations requiring complex clip reconstruction
- Post-operative complications included
  - Ischemic stroke in the distal anterior cerebral artery territory
  - Tachycardia
  - Fevers
- Thyroid function tests ordered, Endocrine Service consulted

Peri-Operative Temperature and Heart Rate



Interview with Sister

- **Hyperthyroidism diagnosed 2 years ago, untreated because patient was afraid of treatment**
- **Pt had previously reported to sister**
  - **Anxiety**
  - **Frequent bowel movements**
  - **Palpitations**
  - **100-pound weight loss**

History

- **Past Medical History**
  - COPD/Asthma
  - CHF
  - Hypertension
  - Hyperthyroidism diagnosed 2 years ago, untreated
  - Paroxysmal atrial fibrillation
  - Tobacco Use
- **Past Surgical History**
  - None
- **Allergies: NKDA**
- **Prior to admission medications**
  - Albuterol
  - Tiotropium
  - Carvedilol 12.5 mg daily
  - Diltiazem 120 mg daily

History

- **Family History**
  - **Sister with history of hyperthyroidism secondary to toxic nodule s/p resection**
  - **Mother with history of hypothyroidism**
- **Social History**
  - **Not currently working**
  - **Previous smoker 0.5 ppd x 20 years, quit after recent hospitalization with diagnosis of COPD**
  - **Occasional alcohol**
  - **No illicit drugs**
  - **Adult son is decision maker**

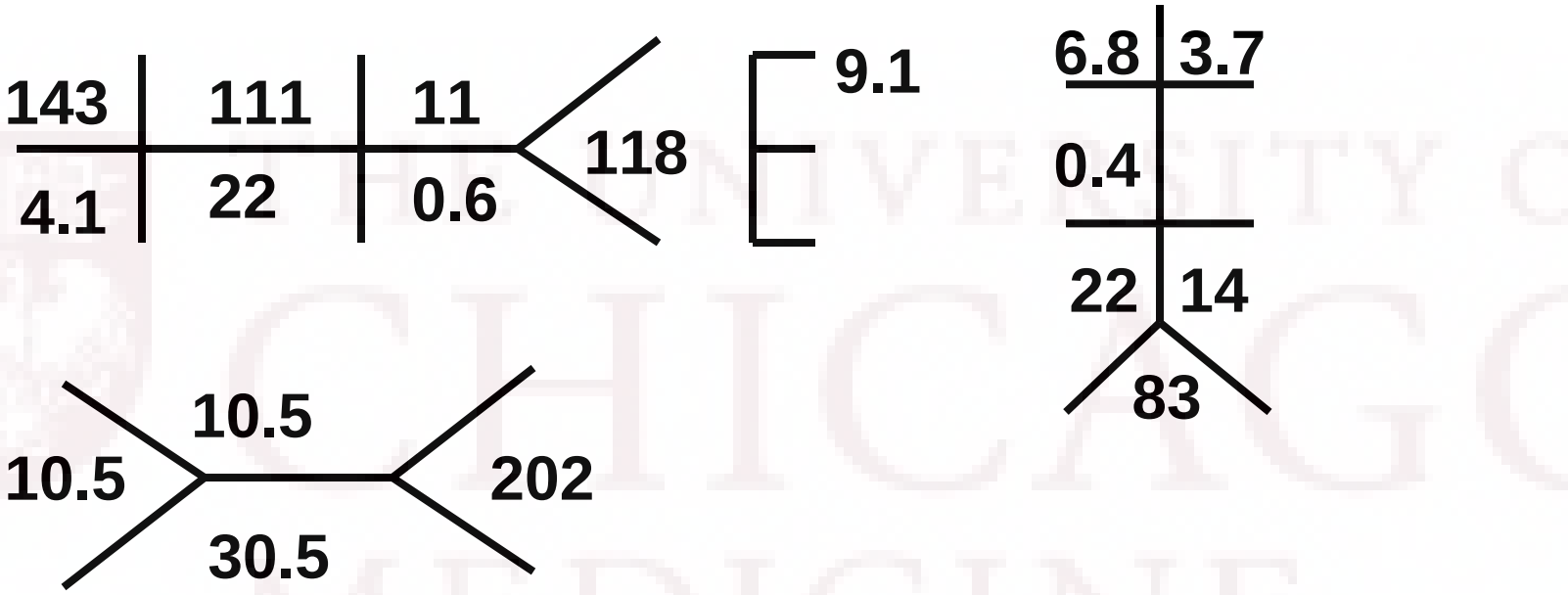
Current Hospital Medications

- carvedilol 25 mg BID
- cefepime 2 g Q8H
- diltiazem 30 mg Q6H
- famotidine 20 mg Q12H
- heparin 5,000 Units Q12H
- levetiracetam 1,000 mg Q12H
- montelukast 10 mg QPM
- sennosides-docusate sodium 1 Tab QHS
- tiotropium 18 mcg DAILY
- vancomycin 1,500 mg Q8H

Physical Exam

- Vitals: BP 131/63 | Pulse 109 | Temp(Src) 38.8 °C (101.8 °F) (Tympanic) | Resp 22 | Ht 162.6 cm (5' 4.02") | Wt 105.23 kg (231 lb 15.8 oz) | BMI 39.80 kg/m2 | SpO2 98% | LMP 09/20/2010
- General: no apparent distress. Appears stated age.
- HEENT: no pharyngeal erythema. PERRL, EOMI.
- Neck: **+ thyroid bruit, 30 - 45 grams, heterogeneous in texture but no discrete nodules**
- Cardiovascular: tachycardic, regular rhythm
- Pulmonary/Chest: clear to auscultation bilaterally.
- Gastrointestinal: soft, non-tender, non-distended abdomen. No rebound or guarding.
- Musculoskeletal: normal range of motion of joints.
- Neurological: **alert & oriented x 0.**
- Skin: No rash. No alopecia

Initial Post-Operative Laboratory Studies



Thyroid Function Tests

- **POD #2**
  - **TSH 0.01 mcU/mL**
- **POD #3**
  - **TSH <0.01 mcU/mL**
- **POD #4 (day of consultation)**
  - **Free T4 3.76 ng/dL (0.9 – 1.7)**
  - **Free T3 1095 pg/dL (230 – 420)**

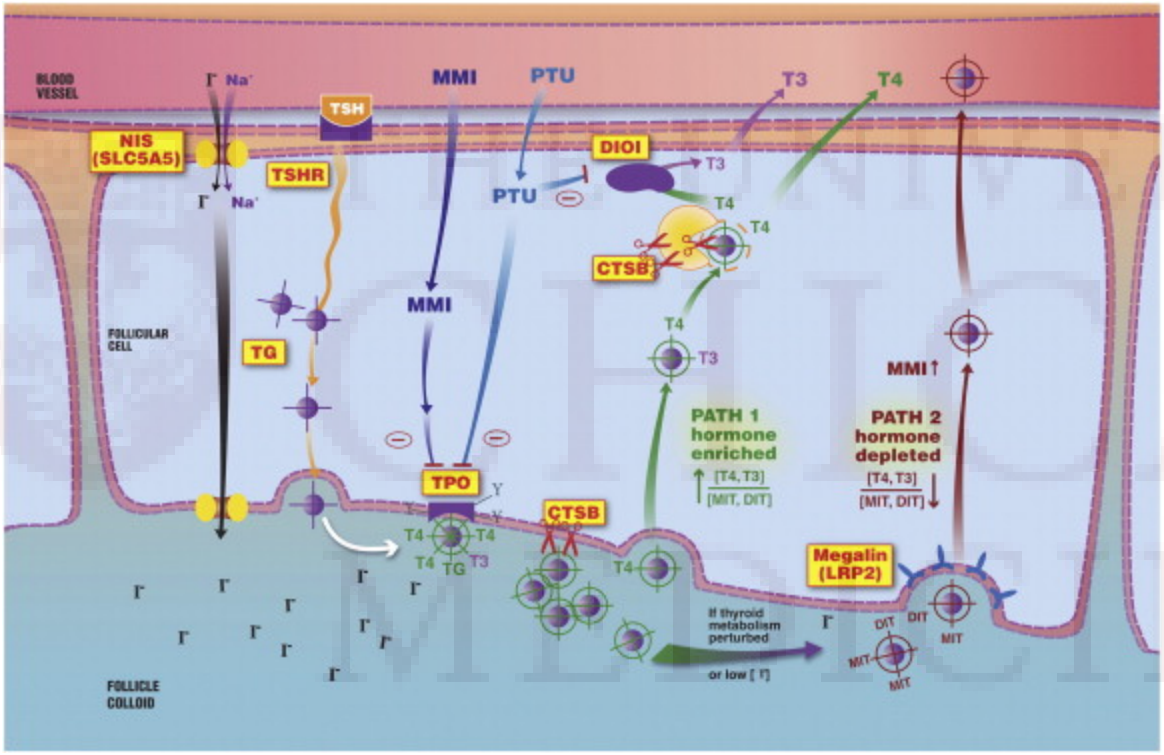
Initial Recommendations

- **Uncontrolled hyperthyroidism: Suspect thyroid storm**
  - **Start PTU 200mg PO Q4H**
  - **SSKI 5 drops diluted in H20 Q6H (give the first dose 2hrs after PTU is given)**
  - **Hydrocortisone 100mg IV Q8H**
  - **Propranolol 20mg PO Q6H**
  - **Obtain daily TSH, free T4 and T3**
  - **Obtain LFTs with next labs because PTU is known to cause liver dysfunction**
- **Paroxsymal Atrial Fibrillation: Currently in sinus rhythm.**
  - **As above, please start propranolol 20mg PO Q6H**

Saturated Solution of Potassium Iodide

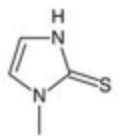
- **Uptake and organification of iodine are inhibited in the presence of iodine excess (Wolff-Chaikoff effect)**
- **The thyrotoxic gland is especially sensitive to this action of iodide**
  - **Raising the plasma iodide concentration to a level above 5 µg/dl results in a complete temporary inhibition of iodide organification by the thyrotoxic gland**
  - **When the plasma concentration is above 20 µg/dl, organification is also inhibited in the normal gland**

PTU Mechanism of Action

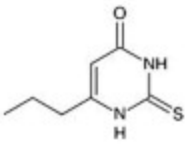


- **Prevents thyroid hormone synthesis by inhibiting thyroid peroxidase catalyzed reactions & blocking iodine organification**
- **Inhibits deiodination of T4 to T3 at the periphery**

Methimazole (mw 114.17)



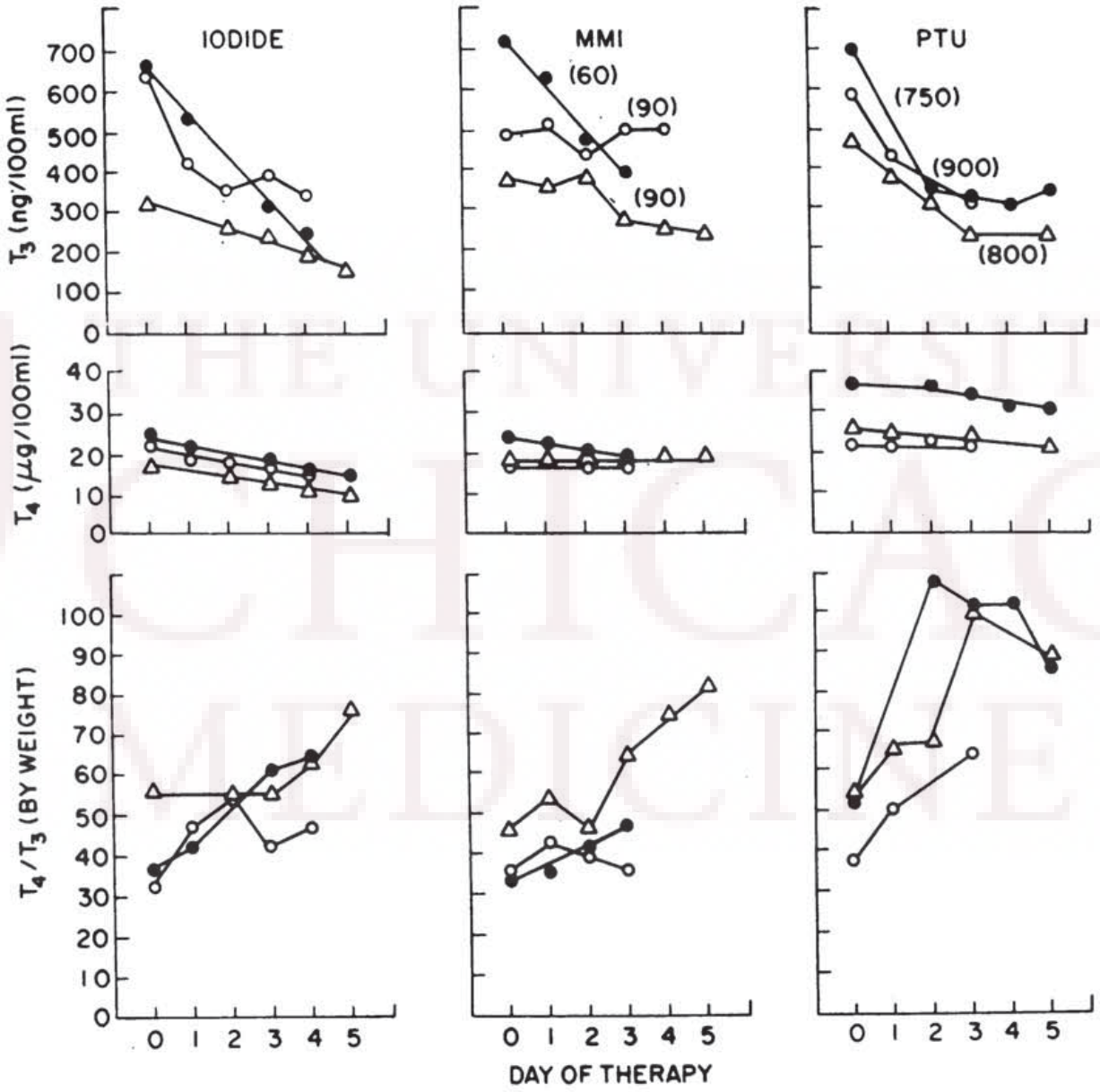
Propylthiouracil (mw 170.23)

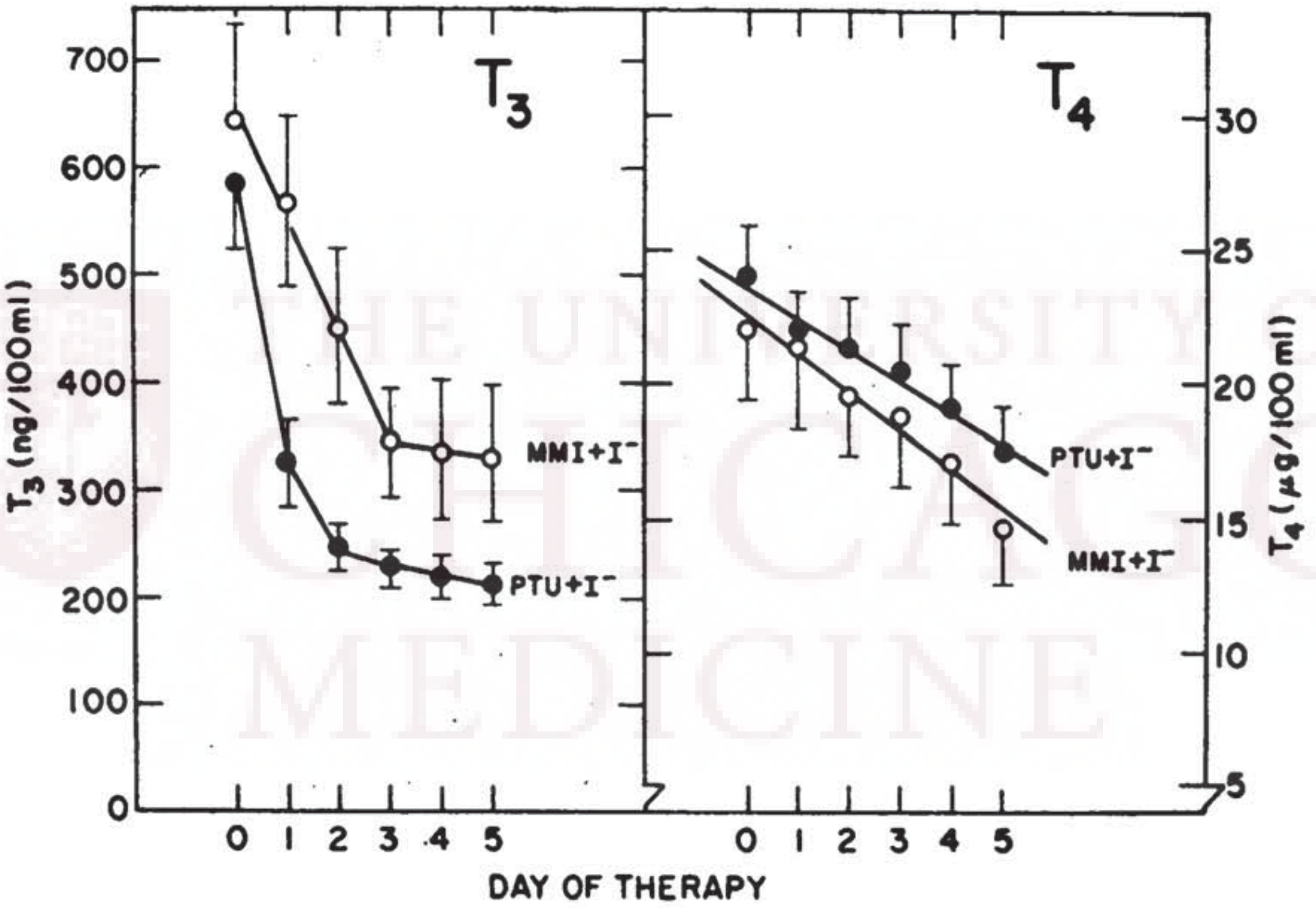


Alison E.M. Vickers , Jason Heale , John R. Sinclair , Stephen Morris , Josh M. Rowe , Robyn L. Fisher. Thyroid organotypic rat and human cultures used to investigate drug effects on thyroid function, hormone synthesis and release *pathwaysToxicology and Applied Pharmacology* Volume 260, Issue 1 2012 81 - 88

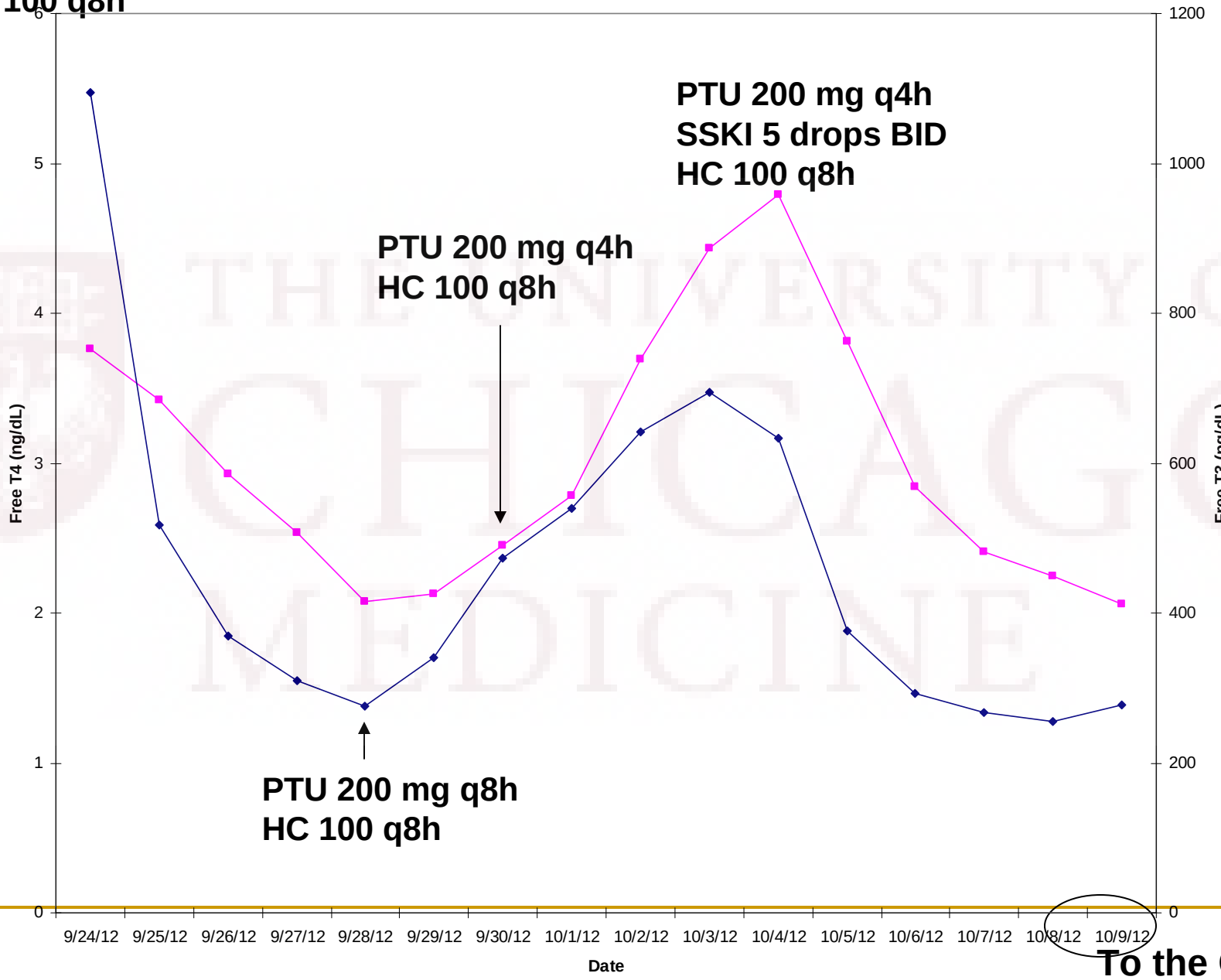
T3 and T4 in Hyperthyroidism

- 1974 Study – J. Abuid and P.R. Larsen
- 66 untreated patients with hyperthyroidism
- T4/T3 ratio in hyperthyroid patients lower than that in euthyroid patients
  - Increases in circulating T3 in hyperthyroidism not accompanied by proportionate increases in serum T4
- 28 patients with Graves' Disease were studied during therapy


IODIDE
MMI
(60)
(90)
(90)
PTU
(750)
(900)
(800)
T3 (ng/100ml)
T4 (μg/100ml)
T4/T3 (BY WEIGHT)
DAY OF THERAPY


T3
T4
MMI+I⁻
PTU+I⁻
PTU+I⁻
MMI+I⁻
T3 (ng/100ml)
T4 (µg/100ml)
DAY OF THERAPY
0
100
200
300
400
500
600
700
5
10
15
20
25
30
0 1 2 3 4 5
0 1 2 3 4 5

PTU 200 mg q4h
SSKI 5 drops q6h
HC 100 q8h



To the OR

Why Refractory to Medical Therapy

- If inhibition of the thyroid hormone formation was initially incomplete with the PTU → additional amount of iodide could lead to synthesis of greater amounts of hormone
- If patient had relative iodine deficiency, administration of iodine could induce autonomous secretion of excess thyroid hormone (Jod-Basedow phenomenon)