43 year old F w/untreated hyperthyroidism presents with nausea/vomiting

8/22/13

Jess Hwang

HPI

- 50 lb weight loss over 12 months
- 12 months of palpitations
- Noticed mild LE edema in the 2 months
- Recently has needed to take days off of work
- Occasional blurry vision, no diplopia
- +chills/+subjective fevers
- +nausea, emesis, diarrhea at home
- +dry cough

HPI cont.

- 2 months ago diagnosed with hyperthyroidism by OB, was not started on any treatment
- No recent surgery, travel, exposure to contrast, new meds
- No personal history of thyroid problems
- LMP 5/19/13 (<1 month prior to encounter)

More history

PMH
- Fibroids
- G3P3

SHx
- No smoking
- No EtOH
- Lives with 3 kids
- Works at steel plant

FHx
- 2 sisters- unspecified thyroid problems
- Father- CAD

Medications
- None

ROS

Constitutional: +fevers, +weight loss. No fatigue.

HEENT: +occasional blurry vision

CV: +palpitations

Resp: +dyspnea on exertion

GI: +diarrhea, +nausea, +vomiting

MSK: +LE edema

Neuro: +tremor

Psych: no anxiety

Physical Exam

Vitals: 37.8, **139**, 20, **151/105**, 97% RA

Constitutional: no apparent distress.

HEENT: **+proptosis**, no pharyngeal erythema

Neck: nontender, +nodular thyroid. **+thyroid bruit**. **+thyromegaly**

CV: **+tachycardia**, no murmurs. No S3. No JVD.

Pulm: mild tachypnea, no appreciable crackles, not on O2

GI: soft, nontender, no palpable ascites

MSK: **mild LE edema**

Neuro: alert and oriented

Psych: normal mood

Labs on admission

137	104	14
3.3	19	0.6

97

8.3

1.7

3.8

7.1	3.2
0.5	121
27	25

11.2

11.6 374

Urine, Blood cultures neg

TSH < 0.01

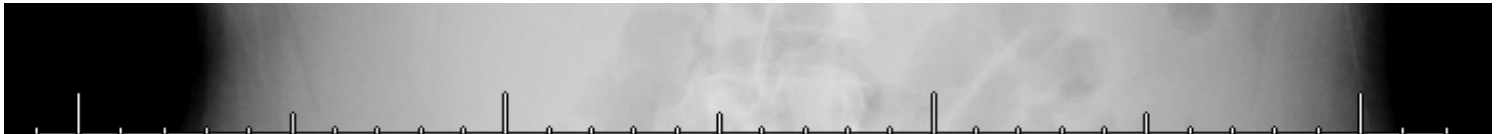
FT4 4.21 (0.9-1.7)

TT3 434 (80-195)

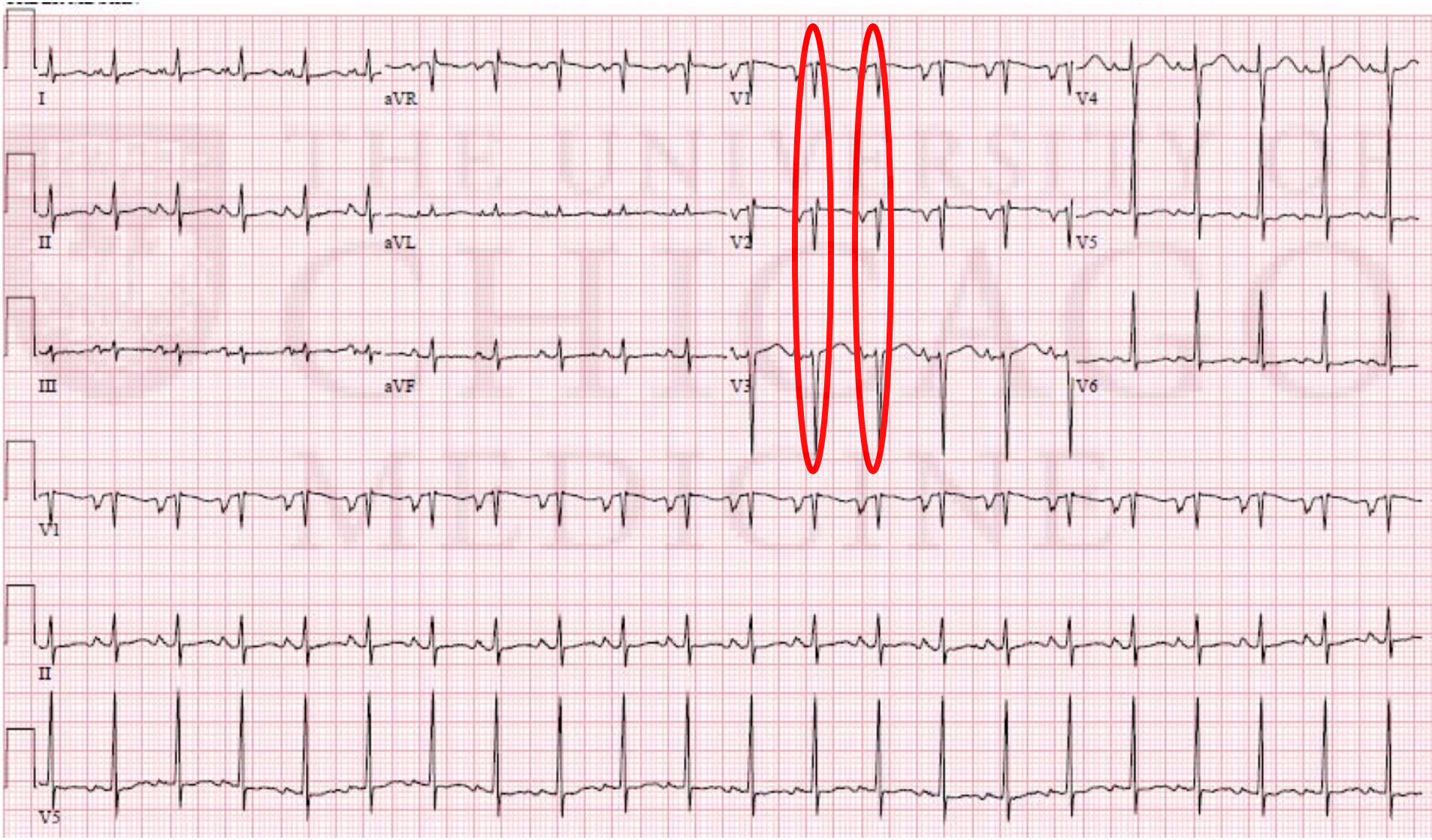
TT4 19.1 (5-11.6)

BNP 7250 (<125)

Cardiomegaly. No specific evidence of infection or heart failure.



Sinus tachycardia, L atrial enlargement
Possible anterior infarct, age undetermined



Initial therapy

- PTU 300 mg q8h
  - No loading dose.
- Propanolol 40 mg q6h
  - ICU for monitoring, recommended cards c/s
- SSKI 100 mg q6h (2 drops).
  - Given >1h after first dose of PTU.
- Hydrocortisone 100 mg q8h

Echo

- **LVEF 24.6%-** severely reduced. There is **severe tricuspid regurgitation**. There is **moderate-severe mitral regurgitation**. LV systolic dusfunction is global. **RV is moderately dilated. RV performance is moderately reduced**. LA is severely dilated.

CT abd/pelvis

- **Small R pleural effusion**. **Heart is mildly enlarged**. Liver is normal. Gallbladder wall is thickened with hyperdense material within the lumen. **Mild perihepatic ascites**. Spleen normal size. Mild perinephric fluid which is symmetric. **Small amount of abdominal ascites**. Uterus is enlarged with coarse calcifications.

Thyroid US

B lobes enlarged and heterogeneous in echotexture. L- 1.1 x 0.8 x 1.5 cm lobulated solid nodule with microcalcifications in the superior pole

Cardiac arrest

- Aspiration→Hypoxia→PEA Arrest x 3
- ROSC x 3

Labs during code

135	104	22
7.2	8	1.2

56

7.9

2.2

7.9

Lactic acid 9.4

INR 7.2

4.4	2.0
1.4	101
2362	1248

TSI: 3.2 (RR <1.3)

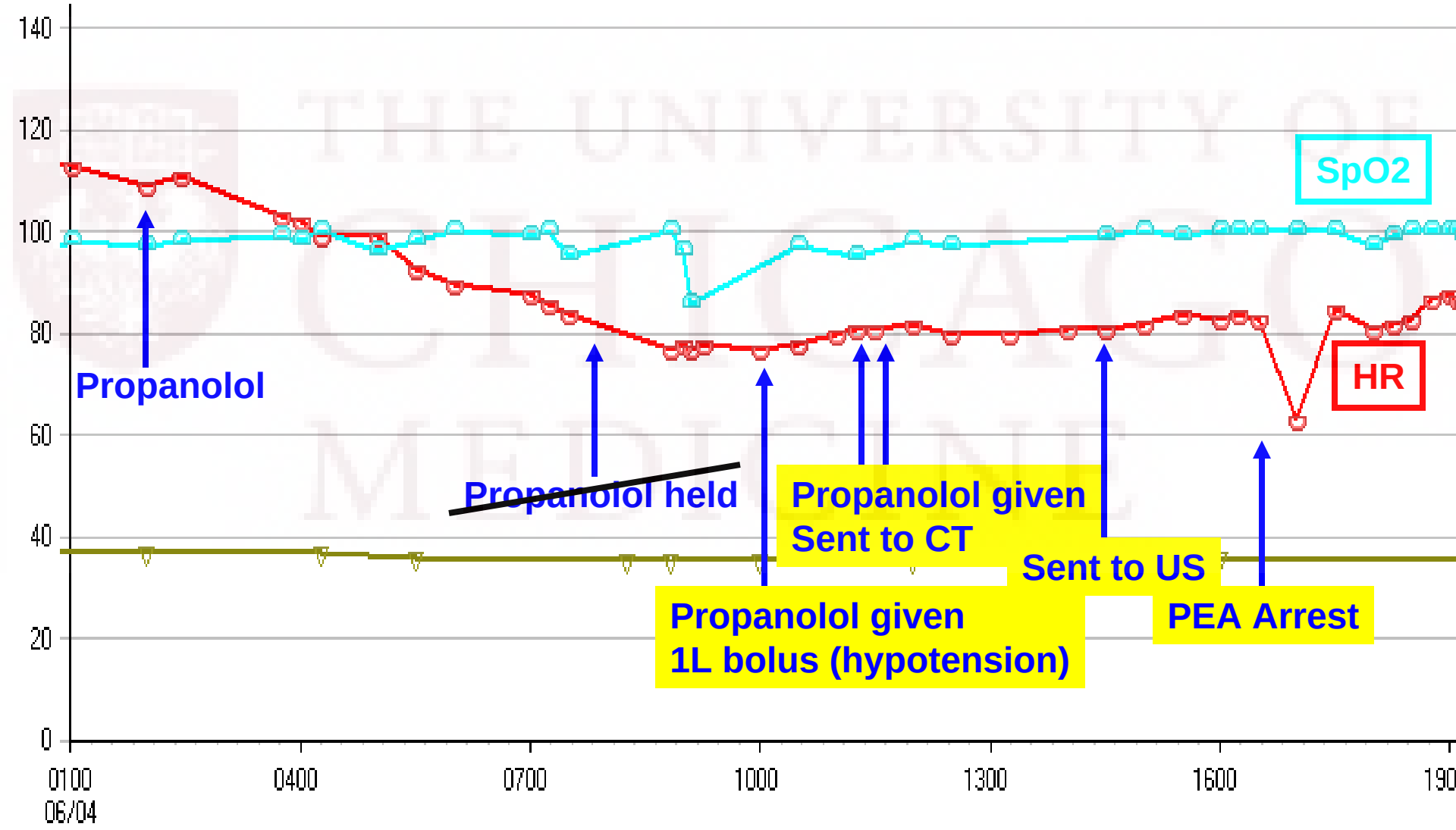
FT4 2.47, TT3 158

CK 147→364→460

MB 2.7→4.4→4.7

Troponin <0.03→0.03

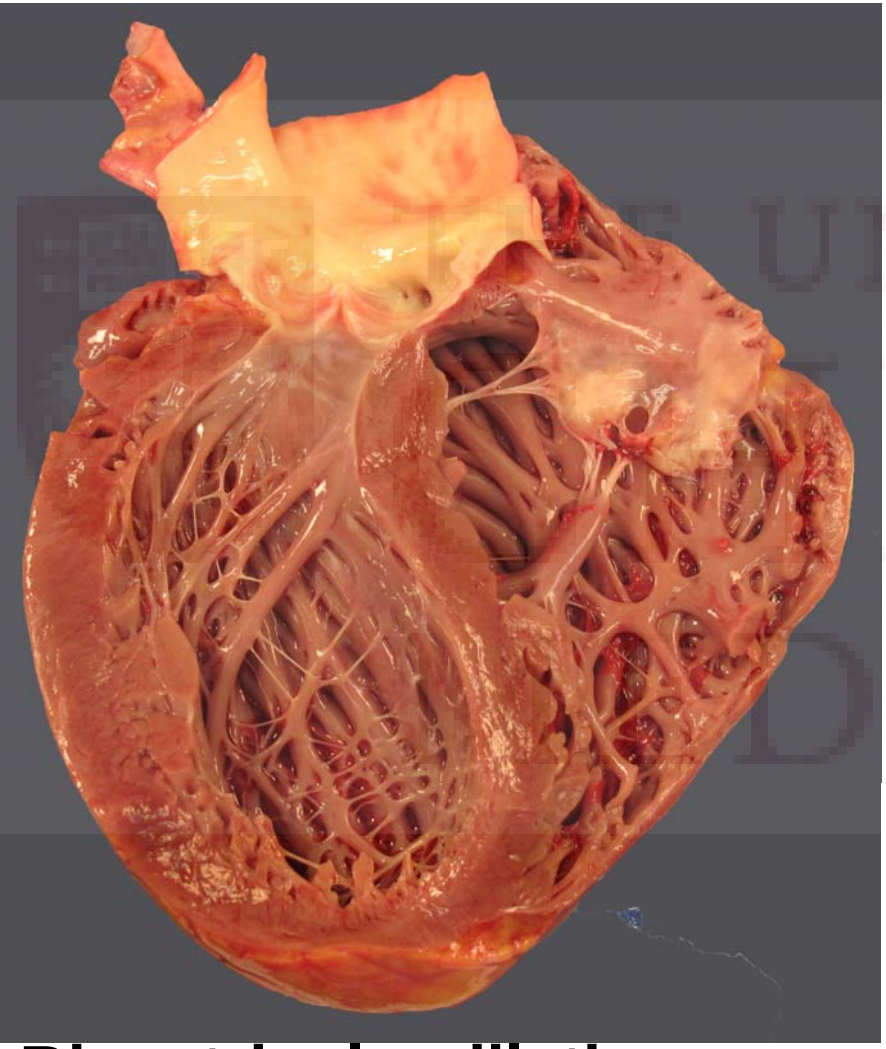
Time course

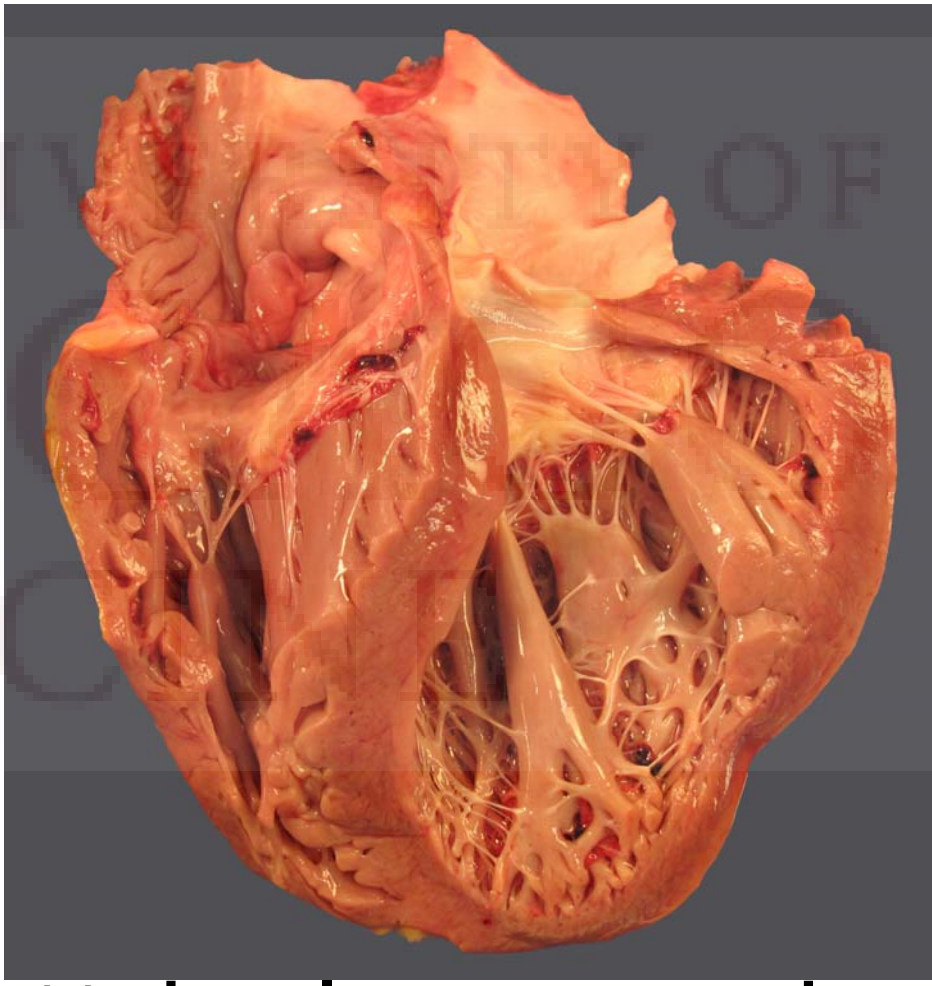

140
120
100
80
60
40
20
0
0100
06/04
0400
0700
1000
1300
1600
SpO2
HR
Propanolol
Propanolol held
Propanolol given
Sent to CT
Sent to US
Propanolol given
1L bolus (hypotension)
PEA Arrest

Post-cardiac arrest

- To cath lab for emergent IABP and possible LVAD
- Transferred to CCU
- Expired the following morning

392g (avg 310g)





Biventricular dilation, prominent trabeculae carneae and cardiomyocyte hypertrophy

32.9g (avg 15-25g)

Histopath unavailable: Follicular hyperplasia and histological features c/w the clinical history of Grave's

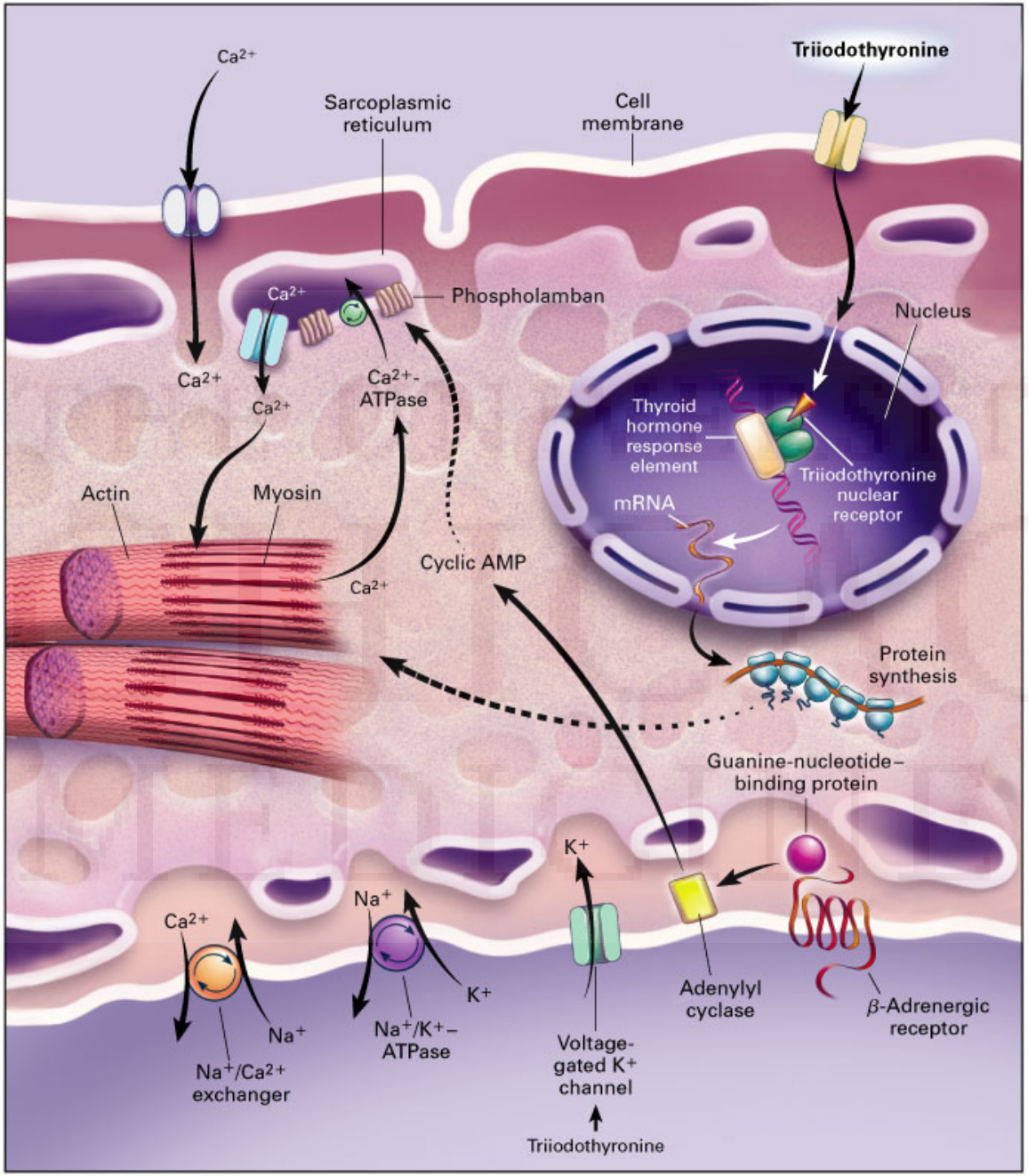
Autopsy

- Final anatomic diagnosis:
- Lungs 763g/748g (avg 350-400g)
- Liver with early passive congestion and centrilobular necrosis
- Clinical history of aspiration: pulmonary edema with bilateral lobar pneumonia and focal emphysema

Clinical questions

- Thyroid hormone effect on heart
- Hyperthyroidism-related cardiomyopathy
- BB associated with CV collapse in thyrotoxic HF
- Thyrotoxicosis causing 2^0 pulmonary HTN

Sarcoplasmic reticulum: involved in Ca release and reuptake



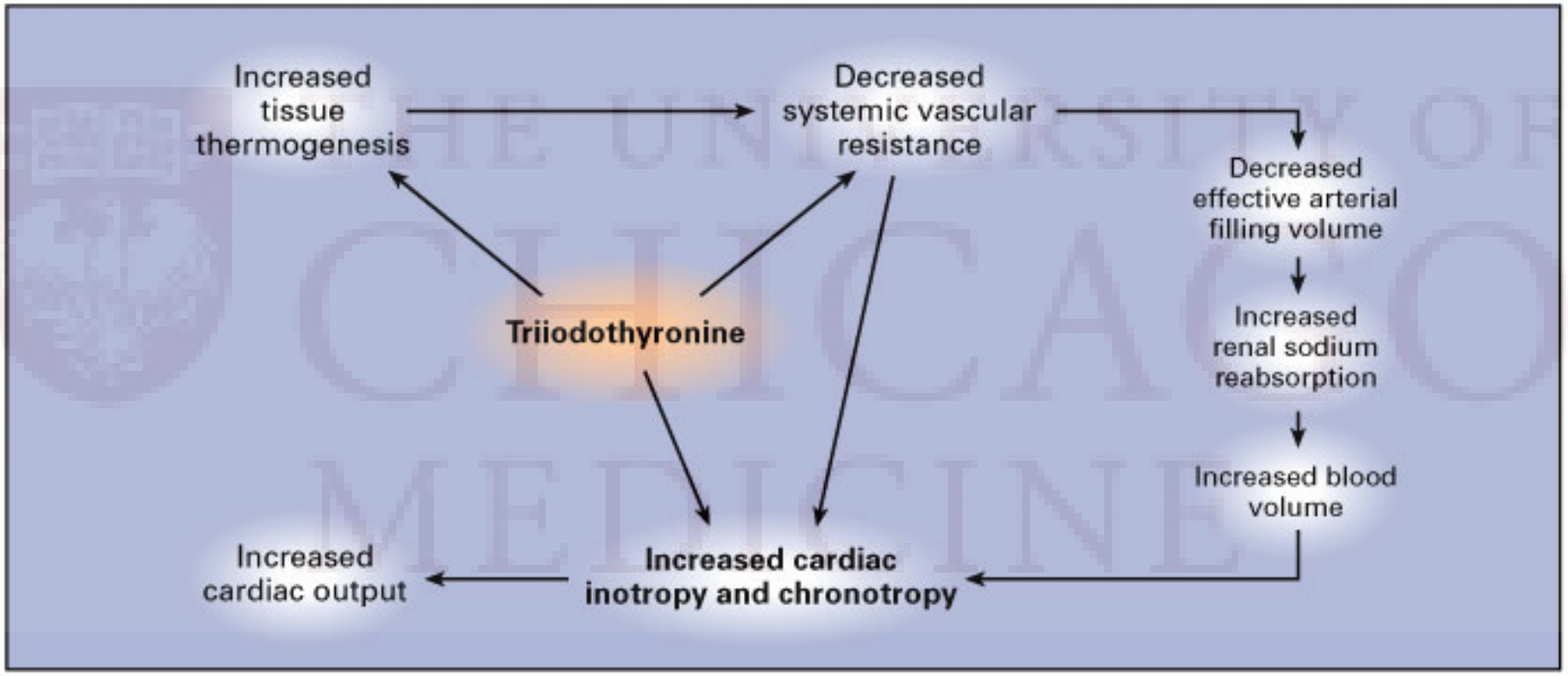
Cell membrane specific transport proteins for T3

Nuclear receptors and target genes

Non-nuclear effects on ion channels

Klein I, Ojamaa K. NEJM 2001;344(7):501-509

Effect of T3 on CV hemodynamics



MAP = **CO** x TPR

CO = SV x HR

Klein I, Ojamaa K. NEJM 2001;344(7):501-509

Hyperthyroidism-related CM

- In 1943, estimated 5% of patients with thyrotoxicosis had CHF
  - Actual incidence is difficult to assess
- Mechanism debated:
  - Tachycardiomyopathy vs
  - Thyrotoxic cardiomyopathy
- Only definitive way to make diagnosis: control of the tachyarrhythmias, monitoring for improvement of LV dysfunction

BB effect in thyrotoxicosis

- Ikram H. BMJ 1977.
- 17 patients
  - 10 uncomplicated thyrotoxicosis
  - 7 thyrotoxic heart failure
- After 2 mg IV propanolol→
  - 13% ⇩CO in uncomplicated hyperthyroidism
  - 30% ⇩CO in thyrotoxic heart failure
- Increased autonomic activity as a compensatory phenomena in hyperthyroid HF

BB effect in thyrotoxicosis

	Uncomplicated		Heart Failure	
	Before BB	After BB	Before BB	After BB
CI (L/min/m2)	6.3±1.8	5.5±1.7	4.18±1.0	2.9±1.2
HR (bpm)	112.4±19.8	98.0±18.1	99.1±8.5	75.3±6.2
Mean RAP (mmHg)	1.3±2.5	2.2±1.6	11.9±2.5	20.6±7.3
MAP (mmHg)	86.8±18.6	84±32.4	85±17.8	78±16.6

Ikram H. BMJ 1977;1:1505-1507.

CV collapse after BB

- Case series of 3 patients who developed cardiopulmonary arrest soon after initiation of therapy
- In pure thyrotoxicosis, tachycardia is not mediated by autonomic sympathetic activity
  - Likely due to increased density of myocardial β-receptors

Dalan R et al. Exp Clin Endocrinol Diabetes 2007;115: 392-396

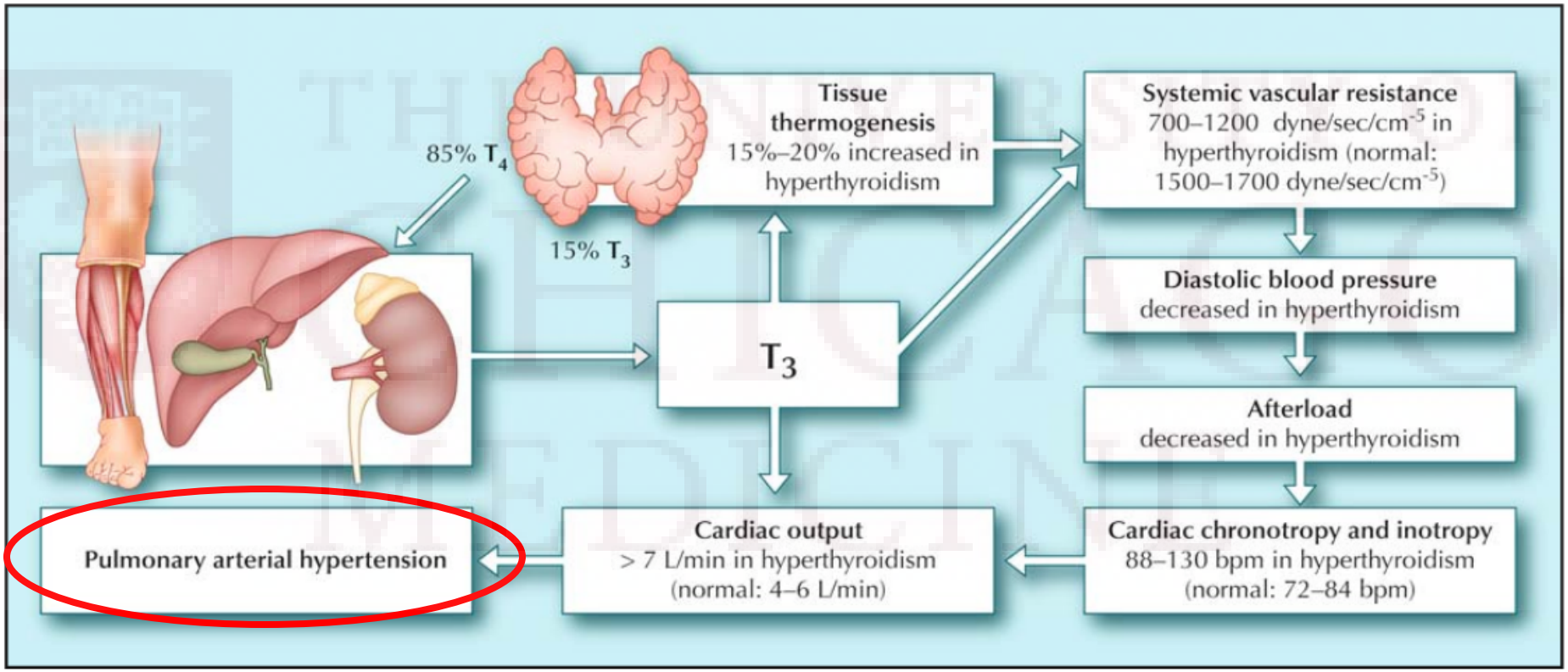
CV collapse after BB

	Boccalandro et al., Endocr Prac, 2003	Fraser & Green, Emerg Med, 2001	Vijayakumar et al., Anaesthesia 1989	Ashikaga et al., Ann Intern Med 2000
Age	46	52	85	50
Race	african American	caucasian	african	not known
Sex	female	female	female	female
Co-morbidities	none	none	pneumonia	none
Diagnosis	Graves' disease	Graves' disease	toxic multinodular goiter	Graves' disease
Free T4 (FT4) or Total T4 (T4)	231 nmol/L (18 ug/dL) T4	33.6 pmol/L (2.6 ng/dL) FT4	213 nmol/L (16.5 ug/dL) T4	increased
TSH	<0.02 mIU/L	0.006 mIU/L	<0.2 mIU/L	decreased
Thyroid storm	yes	yes	yes	yes
Beta-blocker dose	propranolol 40 mg	sotalol 1 mg/kg for 15 min	IV propranolol 1.0 mg followed by propranolol 20 mg 8 hourly	propranolol dose not specified
Number of doses administered	one	one	four doses of IV propranolol and one dose of oral	not specified
Type of collapse	hypotensive	ventricular tachycardia and sinus bradycardia	asystole	hypotensive collapse requiring inotropes
Time from beta-blockade to collapse	few hours (exact no. not specified)	5 minutes	12 hours	hypotension 3-4 hours after each dose of propranolol
Outcome	recovered after inotropic support in the ICU after 24 hours	recovered after inotropic support in the ICU after 24 hours	circulatory collapse recovered after IV inotropes. Subsequently had a thyroidectomy after preparation with IV esmolol	recovered after inotropic support in the ICU after 24 hours

To what extent is tachycardia contributing to HF?
Consider short-acting BB in these cases.

Dalan R et al. Exp Clin Endocrinol Diabetes 2007;115: 392-396

Mechanism of PAH in Thyrotoxicosis



Lozano HF, Sharma CN. Cardiology in Review Nov/Dec 2004;12(6):299-305.

Reversible PAH in Thyrotoxicosis

TABLE 5. Echocardiogram/Right Catheterization Findings in Reported Cases

Variable		Cases (n=11)	Our Patient
Method to evaluate PAP	echocardiogram only	5	echocardiogram
	right heart catheterization only	0	
	both	5	
	N/A	1	
Severe TR	present	6 (55%)	yes
	absent	1 (9%)	
	N/A	4 (36%)	
Initial PAP (mm Hg)	range	33–71	51
	average	41.5	
PAP after treatment	range	15–35	26
	average	24.1	
Drop in PAP	average	17.4 (42%)	25 (49%)

PAP, pulmonary artery pressure; TR, tricuspid regurgitation; N/A, information not available.

Lozano HF, Sharma CN. Cardiology in Review Nov/Dec 2004;12(6):299-305.

Take Home Points

- Mechanism of cardiomyopathy in hyperthyroidism is unclear.
- Thyrotoxicosis and low output heart failure- beta blockers can cause CV collapse. If essential, consider short-acting beta blockers.
- Hyperthyroidism can cause reversible pulmonary hypertension and R heart failure.

References

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- Dalan R, Leow M. Cardiovascular Collapse Associated with Beta Blockade in Thyroid Storm. Exp Clin Endocrinol Diabetes 2007;115: 392-396.

TABLE 5. POINT SCALE FOR THE DIAGNOSIS OF THYROID STORM

Criteria	*Points*
Thermoregulatory dysfunction	
Temperature (°F)	
99.0–99.9	5
100.0–100.9	10
101.0–101.9	15
102.0–102.9	20
103.0–103.9	25
≥104.0	30
Cardiovascular	
Tachycardia (beats per minute)	
100–109	5
110–119	10
120–129	15
130–139	20
≥140	25
Atrial fibrillation	
Absent	0
Present	10
Congestive heart failure	
Absent	0
Mild	5
Moderate	10
Severe	20

Criteria	*Points*
Gastrointestinal-hepatic dysfunction	
Manifestation	
Absent	0
Moderate (diarrhea, abdominal pain, nausea/vomiting)	10
Severe (jaundice)	20
Central nervous system disturbance	
Manifestation	
Absent	0
Mild (agitation)	10
Moderate (delirium, psychosis, extreme lethargy)	20
Severe (seizure, coma)	30
Precipitant history	
Status	
Positive	0
Negative	10

Scores totaled	
>45	Thyroid storm
25–44	Impending storm
<25	Storm unlikely

Table 6. Thyroid Storm: Drugs and Doses

Drug	*Dosing*	*Comment*
Propylthiouracil[a]	500–1000 mg load, then 250 mg every 4 hours	Blocks new hormone synthesis Blocks T_4-to-T_3 conversion
Methimazole	60–80 mg/day	Blocks new hormone synthesis
Propranolol	60–80 mg every 4 hours	Consider invasive monitoring in congestive heart failure patients Blocks T_4-to-T_3 conversion in high doses Alternate drug: esmolol infusion
Iodine (saturated solution of potassium iodide)	5 drops (0.25 mL or 250 mg) orally every 6 hours	Do not start until 1 hour after antithyroid drugs Blocks new hormone synthesis Blocks thyroid hormone release
Hydrocortisone	300 mg intravenous load, then 100 mg every 8 hours	May block T_4-to-T_3 conversion Prophylaxis against relative adrenal insufficiency Alternative drug: dexamethasone