

# Thyroid disease and the heart

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# Patient AC 1

- AC is 45 yo WM with palpitations, SOB, sweating, and chest pains x 2 weeks
- DOE over past month, worsening x 2 weeks
- Palpitations last a few minutes followed by diaphoresis, lightheadedness, and chest pain
- Chest pain is substernal chest pressure, radiates to left arm, 8/10 intensity; exertional in nature and relieved with rest or leaning forward

# Patient AC 2

- Chest pain occurred 3 times on day of admission
  - 2 episodes while walking dogs
  - 1 episode when climbing steps
- No orthopnea or paroxysmal nocturnal dyspnea
- No pleuritic nature of chest pain

# Patient AC

## Past Cardiac History

- Admitted to Good Sam 2 years ago, diagnosed with atrial fibrillation and started on coumadin
- On coumadin x 3 months then DC'd by physician
- Stress test 2 years ago, negative per pt

# Patient AC

## Past Medical History

- Negative for hypertension, diabetes, hyperlipidemia
- Past Surgical – appendectomy in 1976
- Social
  - Maintenance worker
  - 50 pack/year smoking history, quit in 2001
  - Occasional alcohol
  - No illicits
- Family
  - Mother with DM, MI age 62
  - Father with CVA
  - Sister with DM

# Patient AC

- Medications
  - Naprosyn 500mg po bid prn
- Physical Exam
  - T 97.1 P 94 BP 129/60 R 20 sat 98% on ra.
  - Gen NAD
  - HEENT: Perrla, eomi, MMM
  - Neck: Supple, no LAD, no JVD, no bruits
  - Heart: RRR, normal S1 + S2, no MRG, normal PMI
  - Lungs: CTA Bilaterally
  - Abdomen: BS+, soft, nontender, nondistended
  - Extremities: No C/C/E
  - Neurological: No focal deficits

# Patient AC

## Labs

6.1  $\frac{11.0}{32.4}$  188

$\frac{140}{3.9}$  |  $\frac{107}{29}$  |  $\frac{16}{0.8}$  117

LFT's normal  
BNP 541

Chest Xray – Mild Pulmonary Vascular congestion but no CHF

# Patient AC

## EKG 1

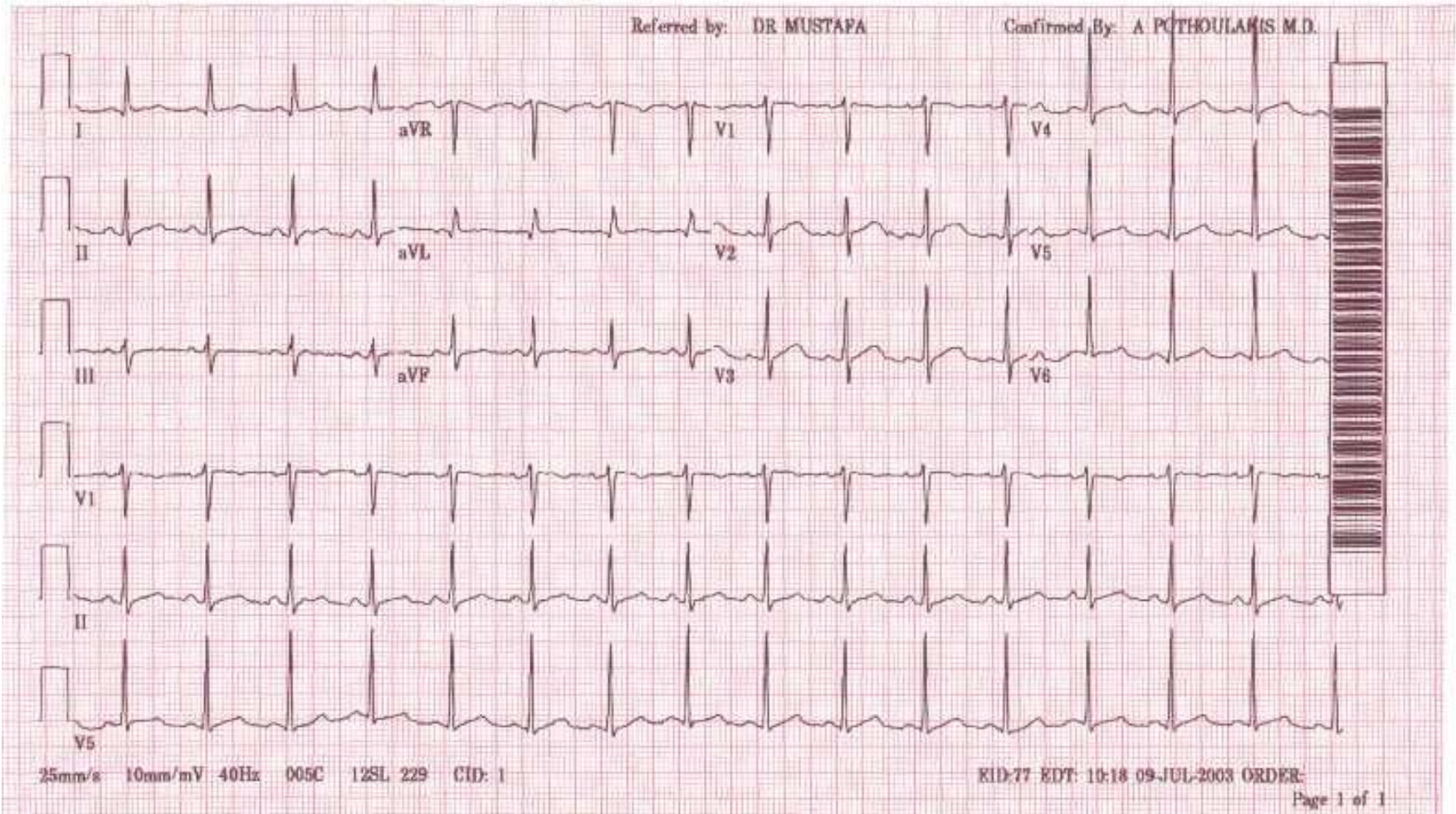
06-JUL-2003 21:46:44

VA MEDICAL CENTER, DAYTON-OUT ROUTINE RETRIEVAL

Vent. rate	94	BPM
PR interval	132	ms
QRS duration	82	ms
QT/QTc	388/485	ms
P-R-T axes	60 29 46	

Referred by: DR MUSTAFA

Confirmed By: A PCTHOULARIS M.D.





# Patient AC

## Initial Treatment

- Unstable Angina
  - ASA
  - Lovenox
  - Metoprolol 25 mg bid
- Further therapies
  - Lisinopril 5mg
  - Simvastatin 10 mg
  - Isordil 10 mgt.i.d

# Patient AC

## EKG 2

09-JUL-2003 08:44:45

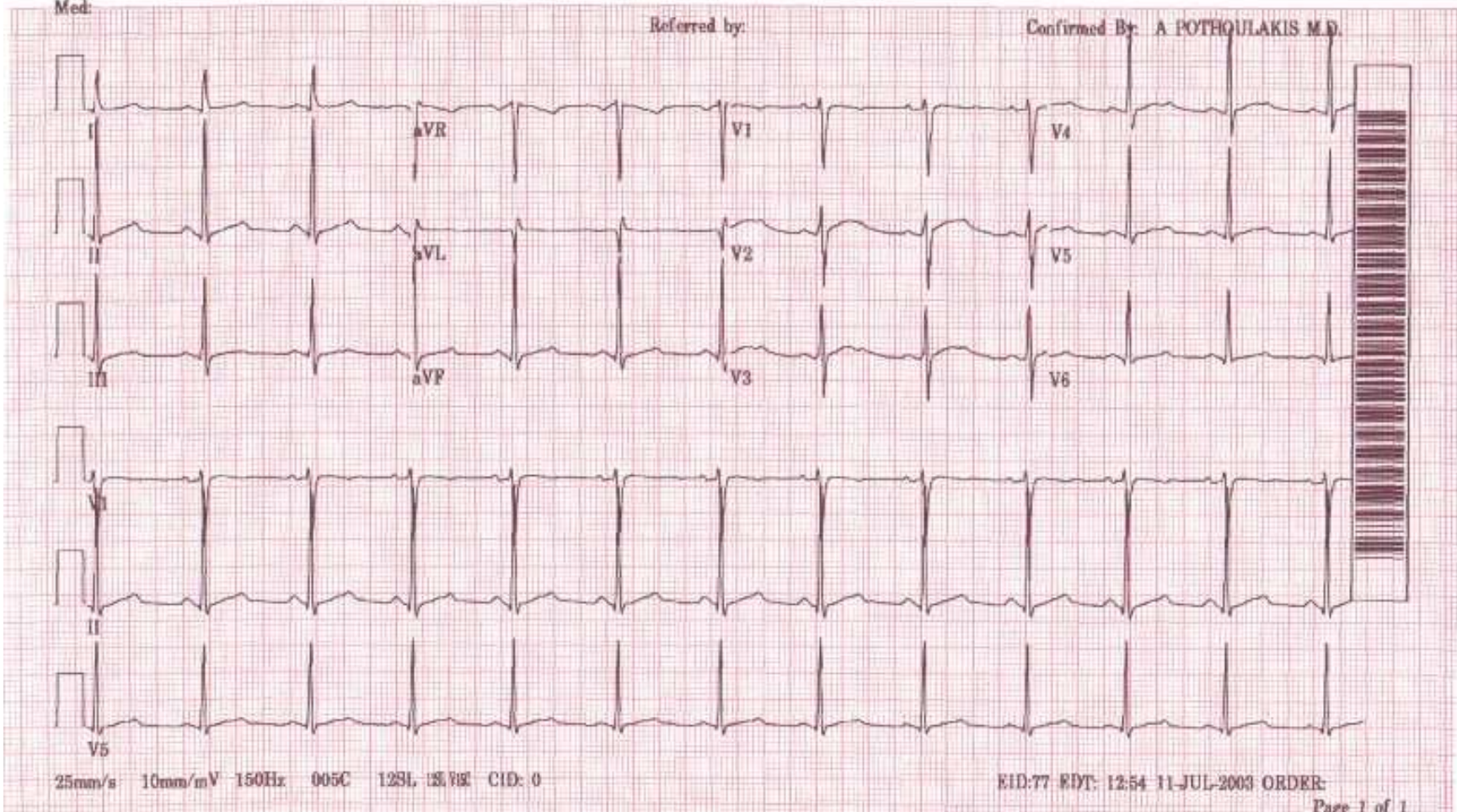
VA MEDICAL CENTER, DAYTON-IN ROUTINE RETRIEVAL

Vent. rate	74	RPM
PR interval	140	ms
QRS duration	96	ms
QT/QTc	362/401	ms
P-R-T axes	67 68 63	

Med:

Referred by:

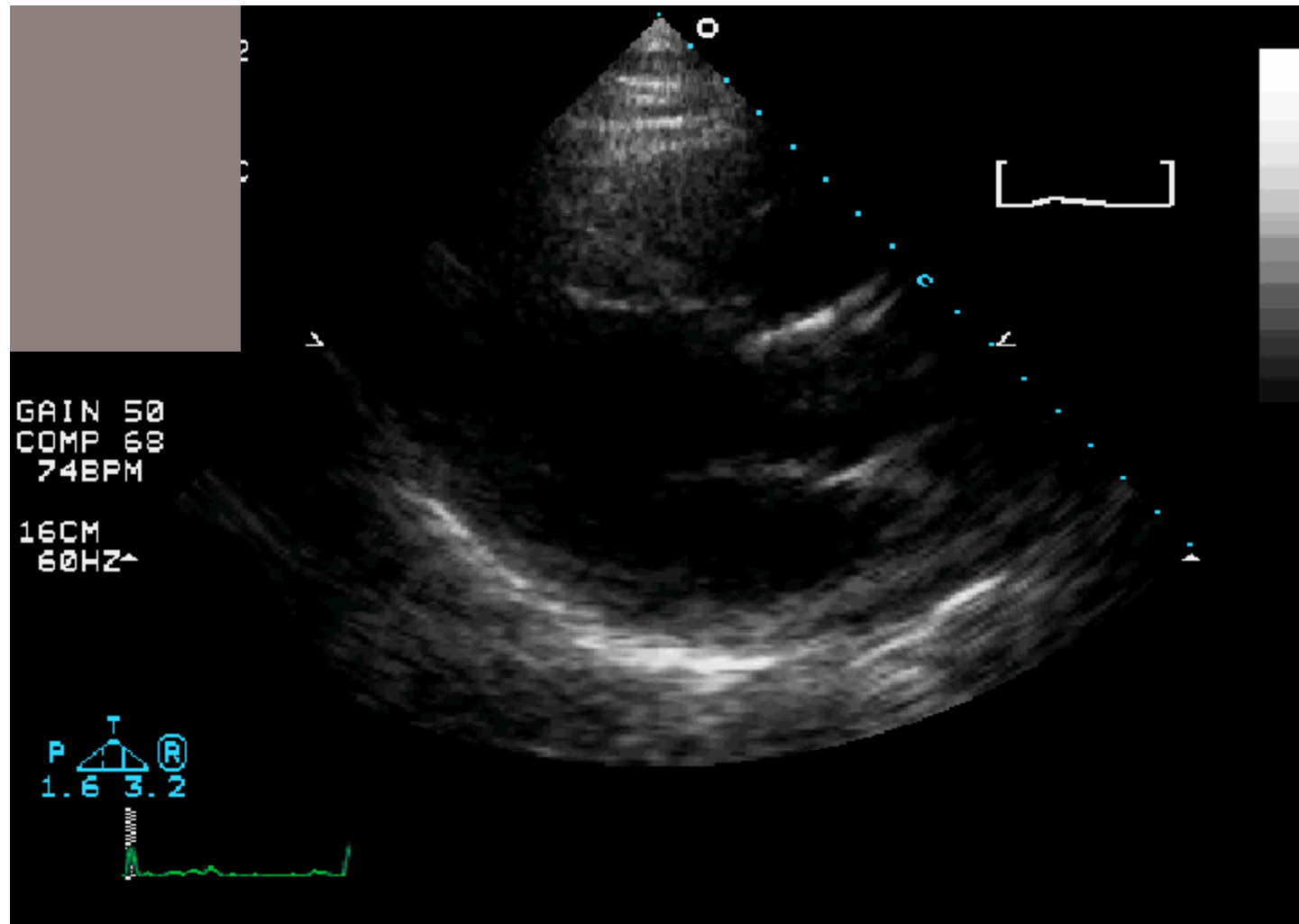
Confirmed By: A POTHOLAKIS M.D.



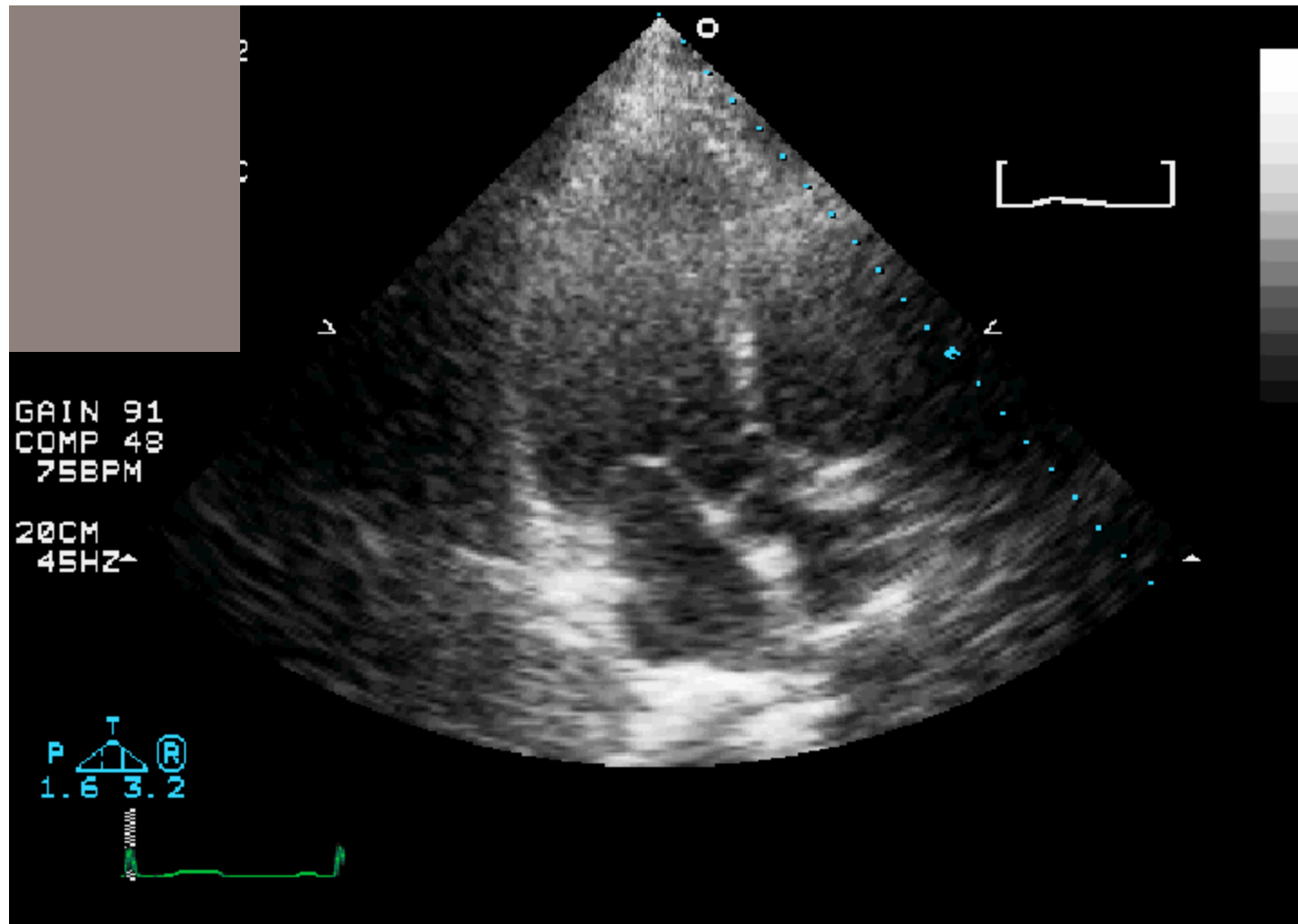
25mm/s 10mm/mV 150Hz 005C 128L 128R CID: 0

EID:77 EDT: 12:54 11-JUL-2003 ORDER:

# Patient AC Echocardiogram



# Patient AC Echocardiogram



# Patient AC

## Cardiac Catheterization

- Catheterization
  - LV 111/10
  - LVEDP 10
  - Post LVEDP 12
  - AORTA 107/50 mm hg
  - Left Main: Mild plaque 10%
  - Left Anterior Descending: Osteal 40-50% stenosis
  - Left Circumflex: mild plaque
  - Right Coronary Artery: mild plaque
  - Left Ventriculogram: EF 65%

# Patient AC

## Subsequent Labs

- Cardiac Enzymes negative
  - CPK's 37-38
- TSH 0.006
- Free T<sub>4</sub> 4.78 (normal 0.75-1.54)

# Patient AC

## Further history

- 30 pound weight loss recently
- Frequently diaphoretic at home
- Re-examination reveals mild hand tremor

# Patient AB

- 46 yo WM with SOB x 1 month, increasing over past week
- Felt well until 1 month ago, symptoms progressively worse
- Noticed fatigue with yard work – had to rest in bed
- No chest pains or palpitations



# Patient AB

## Cardiac History

- Stress thalium 3 years ago
  - Reversible inferoapical ischemia
- Cardiac Catheterization 3 years ago
  - Normal coronaries
  - Normal LV function

# Patient AB

## Other Past Medical History

- Seizure secondary to Motor vehicle accident in 1997.
- Depression
- HLP
- ETOH abuse
- Surgical Hx:
  - Hx Knee surgery for trauma during sports
  - Hx Head surgery from MVA ?? Burr holes long time ago

# Patient AB

- Medications
  - Elavil 75 mg qhs
  - Dilantin 300 mg qd
- Family History
  - Father died of emphysema
  - Otherwise unremarkable, no CAD

# Patient AB

## Physical Exam

- T:97.2 P:95 RR:16 BP:103/60 sat 92% RA
- Gen: NAD
- HEENT: Perra, Eomi, MMM, no OP lesions
- Neck: Supple, no LAD, no bruits, no JVD
- Heart: RRR, normal S1+S2, no MRG, normal PMI
- Lungs: CTA Bilaterally
- Abdomen: BS+, soft, nontender, nondistended
- Extremities: 1+ B LE edema
- Neuro: CN 2-12 intact, DTR's 2+ Bilaterally, Cerebellar function normal

# Patient AB

## Labs

9.1  $\frac{16.4}{47.9}$  206

ALT – 90

AST – 37

Alk Phos – 145

T. Bili – 0.4

Trigs 1064

HDL 28

LDL 100

Total Cholesterol 338

$\frac{141}{4.5}$  |  $\frac{102}{30}$  |  $\frac{9}{1.0}$  90

Chest Xray – Increased  
interstitial markings, no CHF

CPK – 280's

MB – 5-6

Troponin T – all <0.01

# Patient AB

## EKG

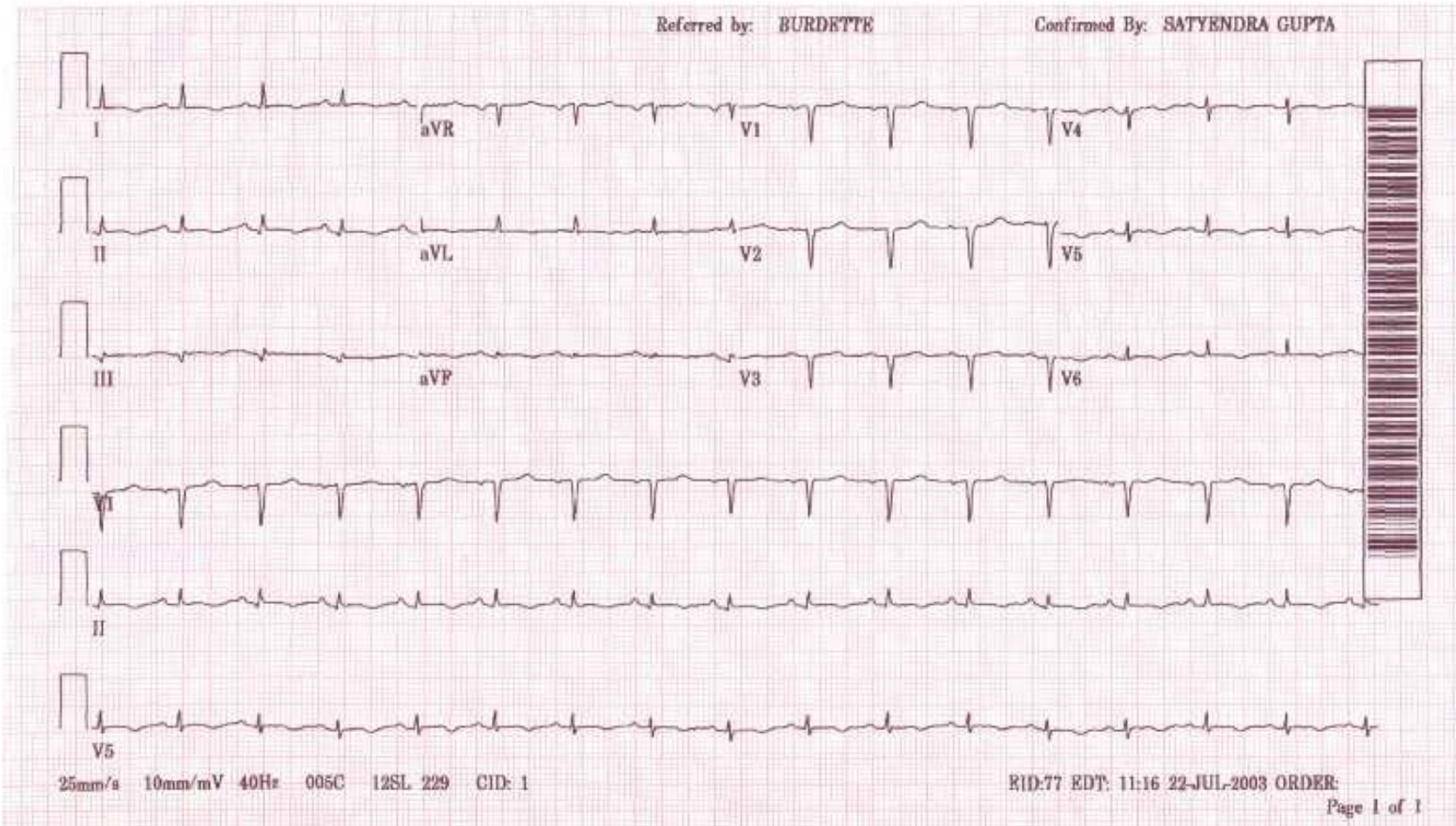
17-JUL-2003 07:38:34

VA MEDICAL CENTER, DAYTON-OUT ROUTINE RETRIEVAL

Vent. rate	97	BPM
PR interval	158	ms
QRS duration	56	ms
QT/QTc	322/408	ms
P-R-T axes	51 27 82	

Referred by: BURDETTE

Confirmed By: SATYENDRA GUPTA



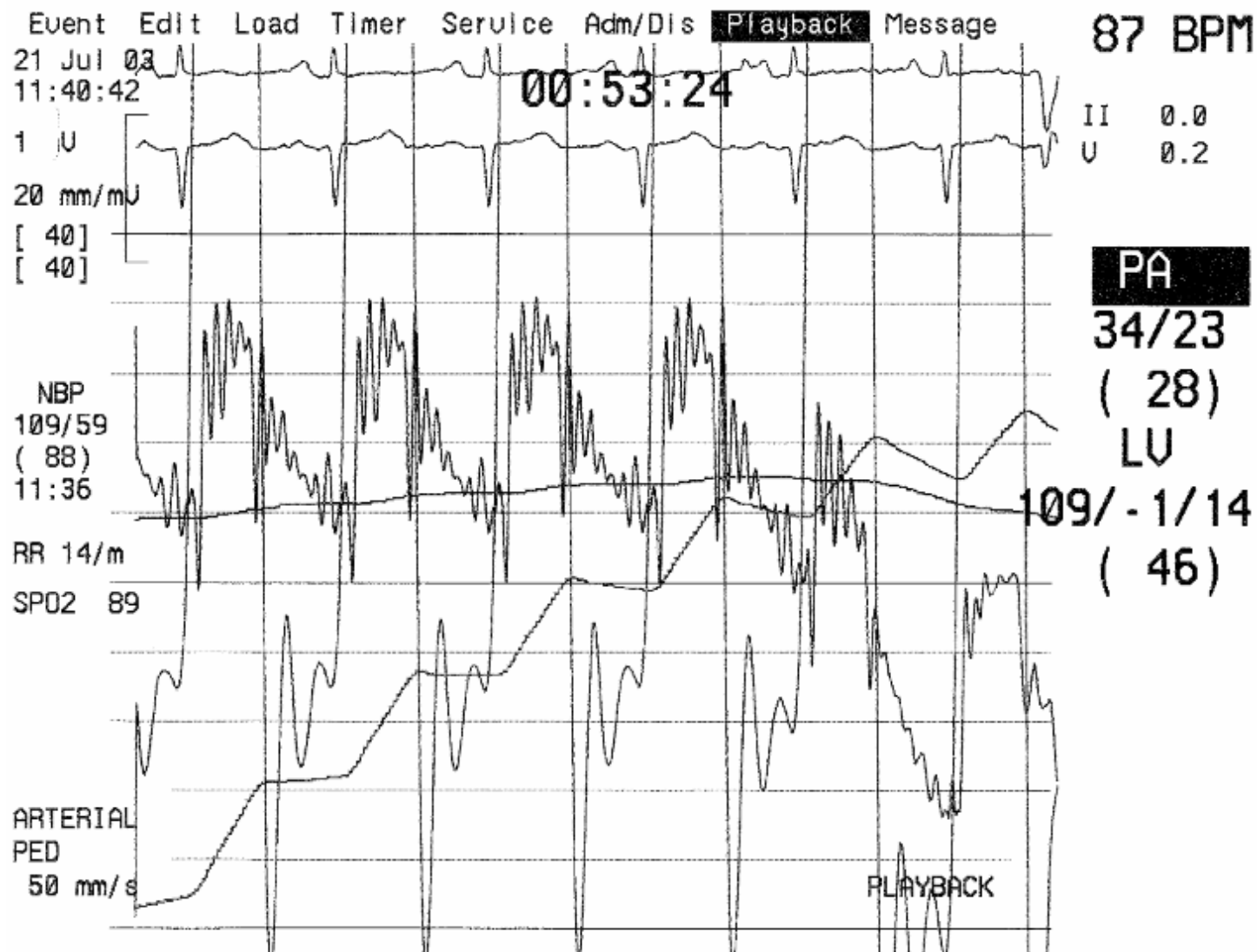
# Patient AB

## Initial Treatment

- CHF Exacerbation
  - Lasix 40 mg po bid
  - Echo
  - Right and Left Heart Cath

# Patient AB

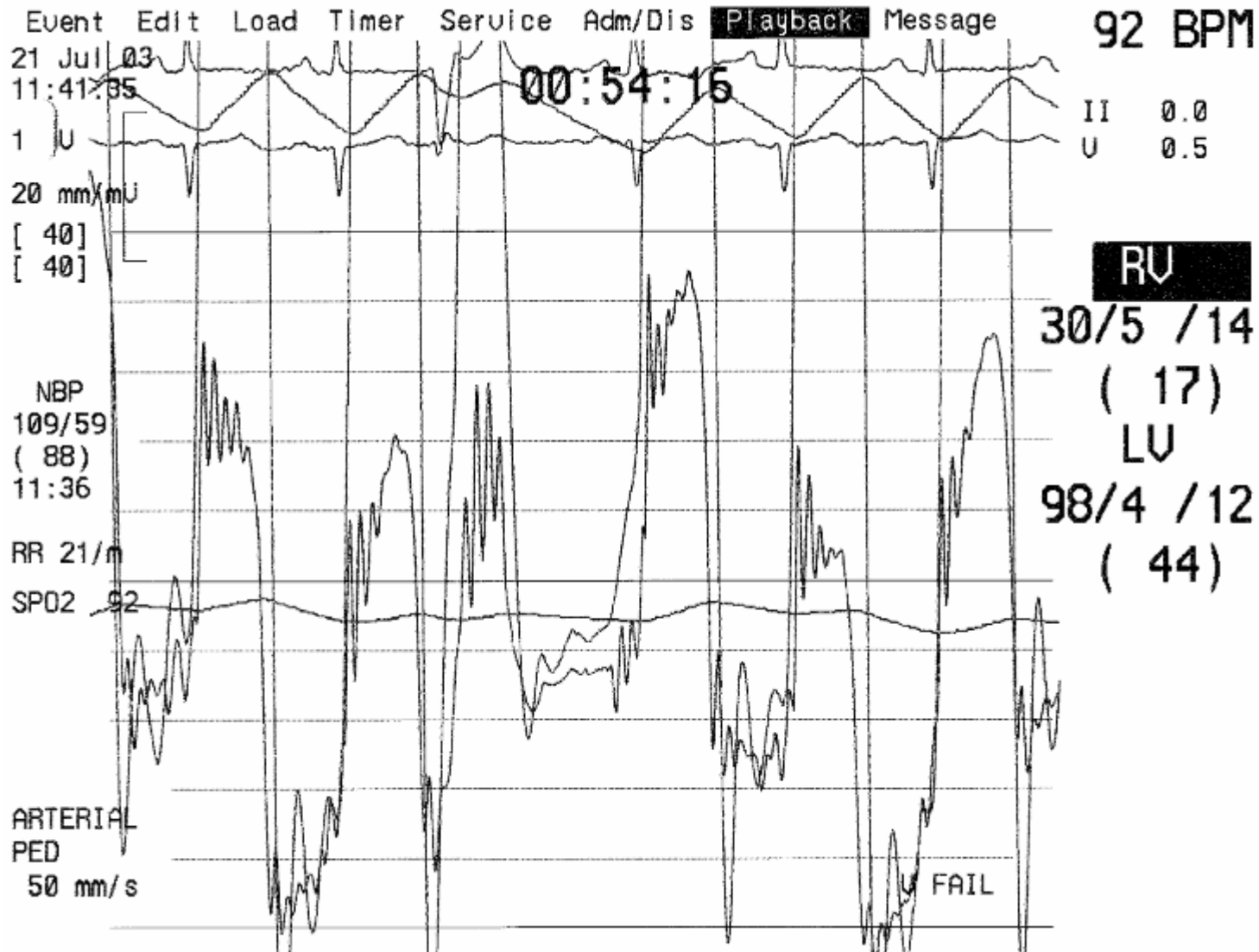
## Hemodynamics – PA/LV





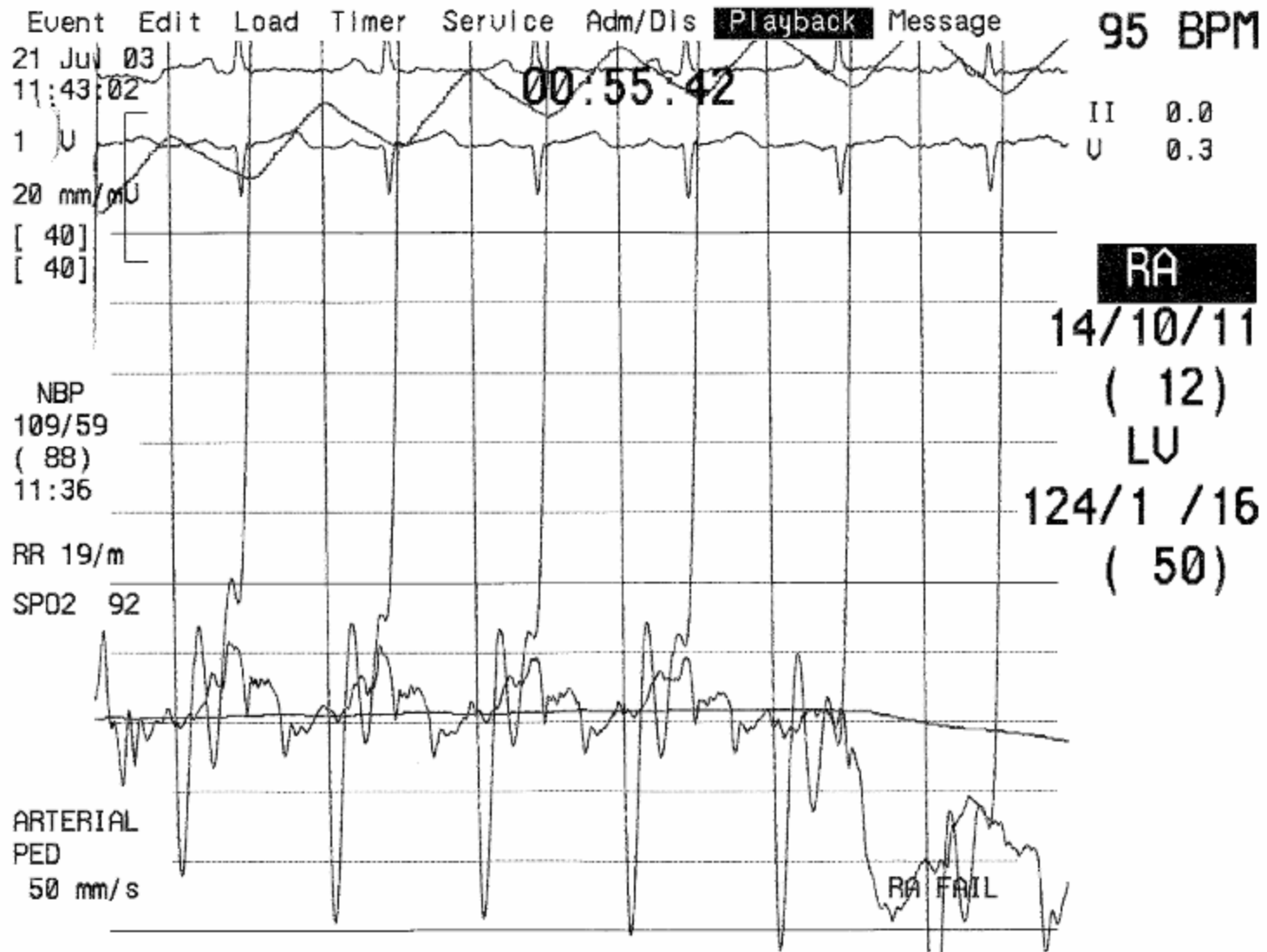
# Patient AB

## Hemodynamics – RV/LV



# Patient AB

## Hemodynamics – RA/LV

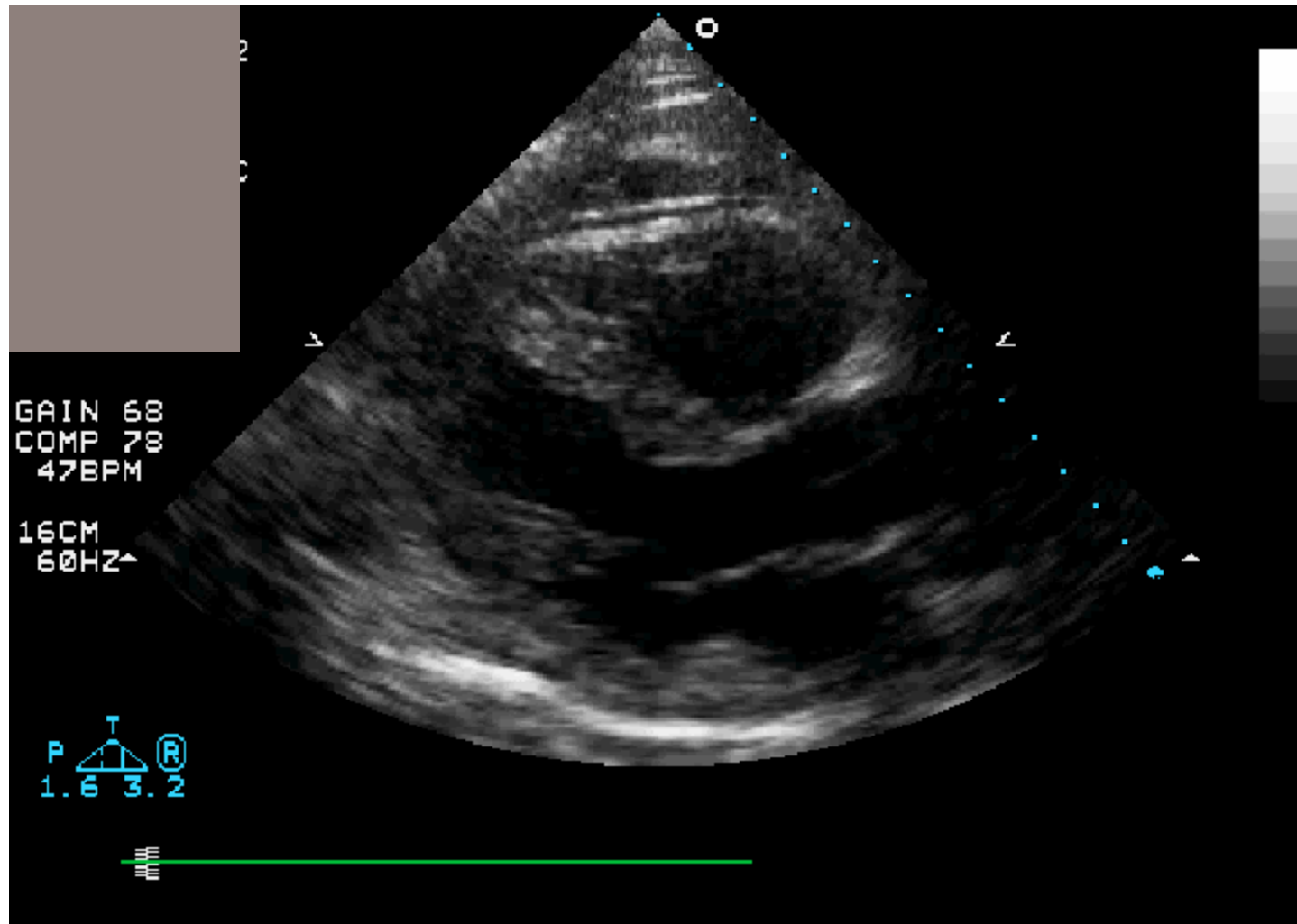


# Patient AB

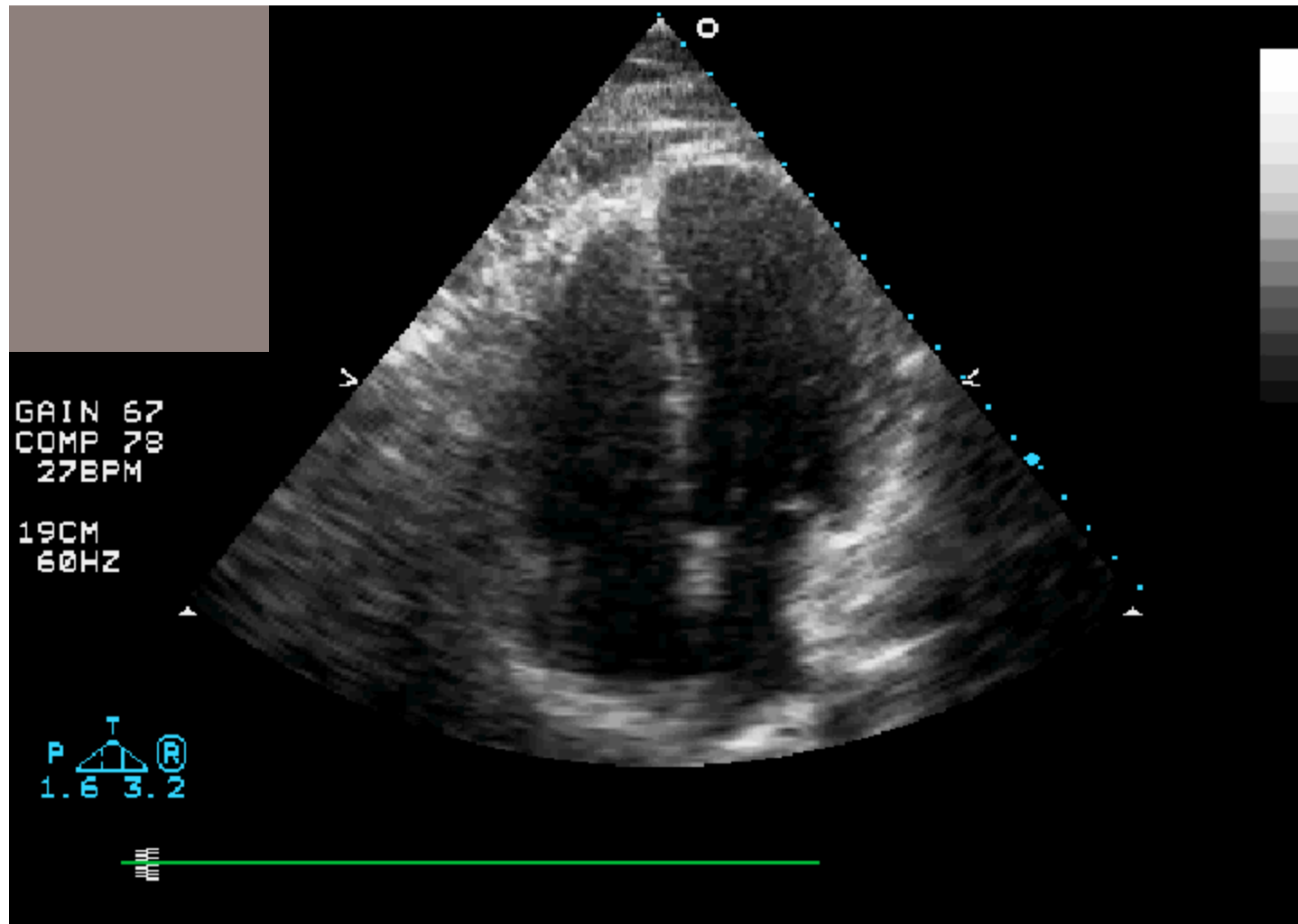
## Left Cardiac Catheterization

- LM – patent
- LAD – patent
  - D1, D2, D3 – patent
- L Cx – small, patent
  - OM 1 – patent
- RCA – dominant, patent
- LV gram – LVEF 55%, no wall motion abnormalities or regurgitation

# Patient AB Echocardiogram

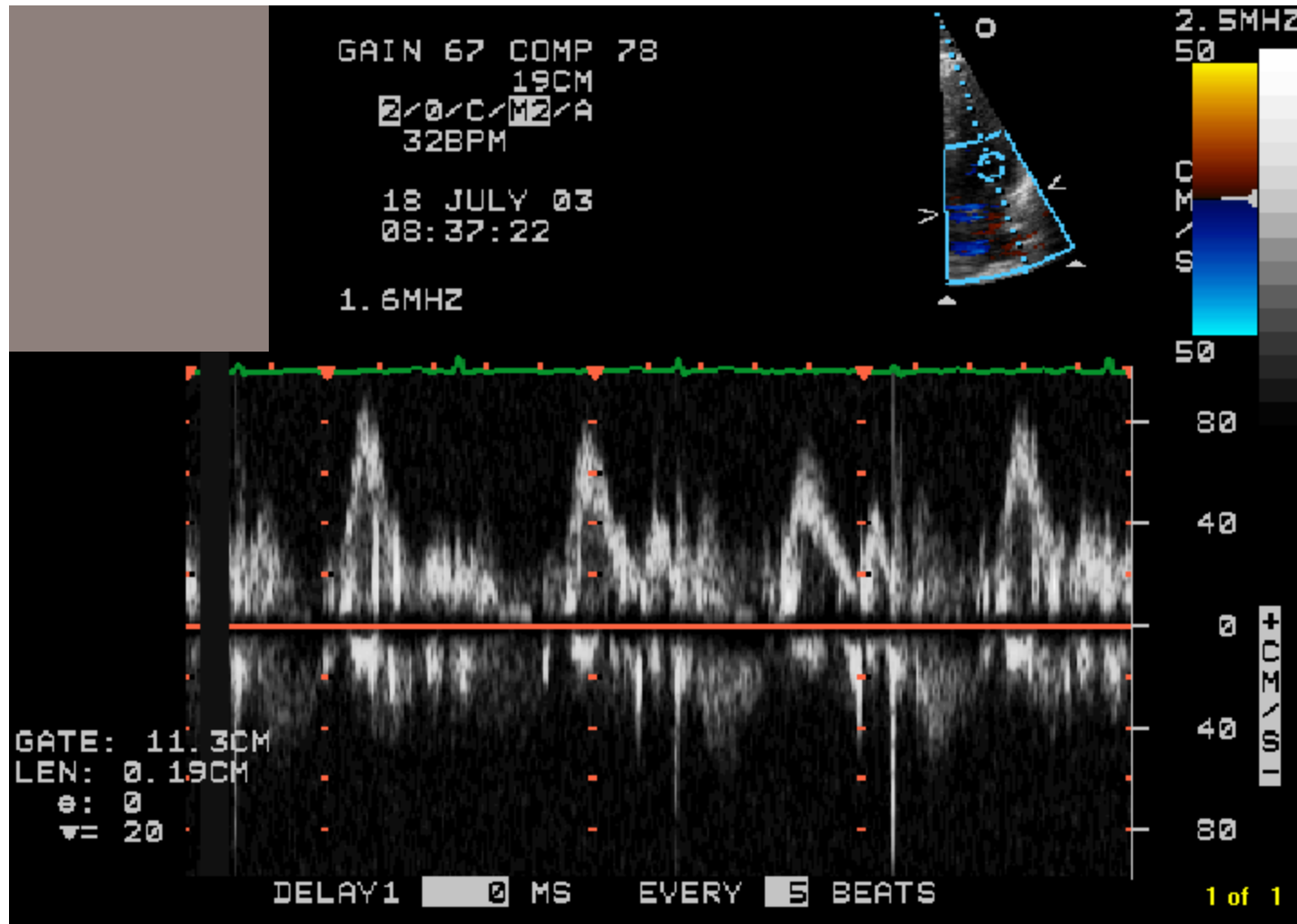


# Patient AB Echocardiogram



# Patient AB

## Echocardiogram – Mitral Doppler



# Patient AB

## Echocardiogram

- Pericardial thickening
- Mild pericardial effusion
- Systolic function preserved
- ? Diastolic dysfunction

# Patient AB

## PFT's

- There is an obstructive ventilatory defect which is Mild.
- A significant response to bronchodilators indicates a reversible component to the obstruction.
- There is a restrictive ventilatory defect which is Moderate.
- There is a gas exchange abnormality which is Moderate.



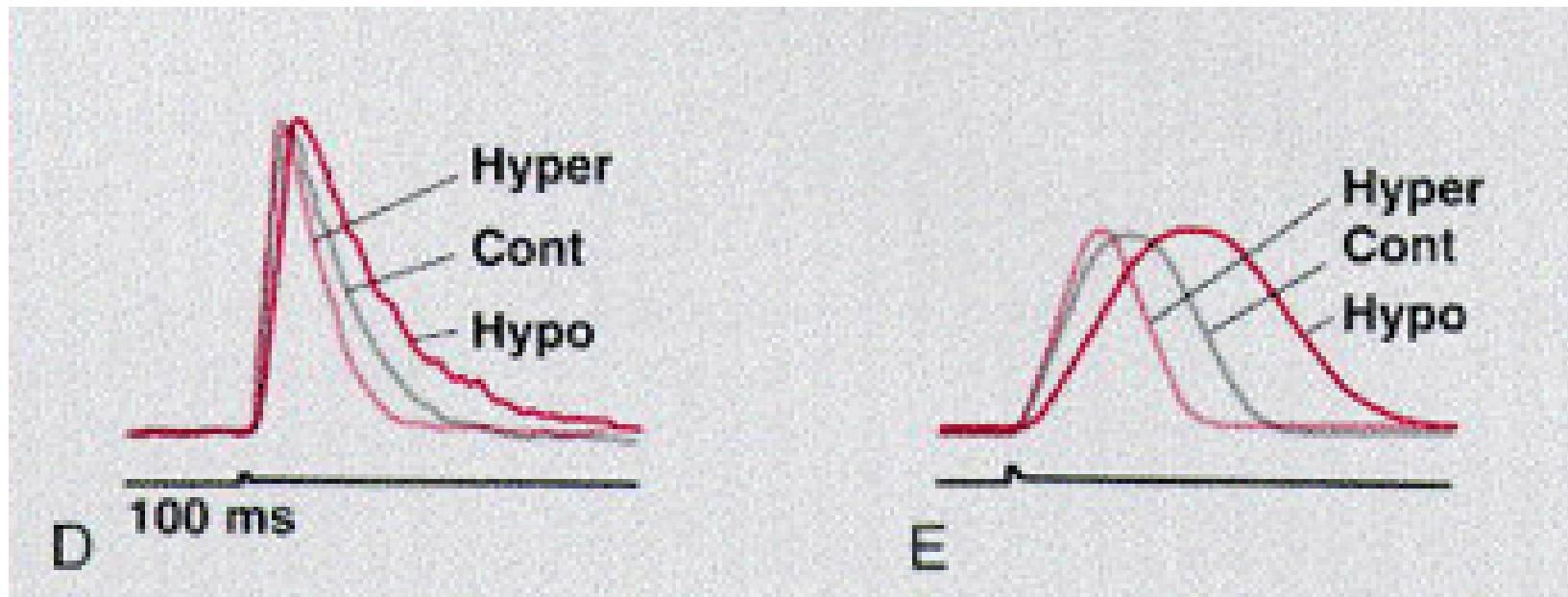
# Patient AB

- TSH – 189
- Free T<sub>4</sub> – 0.16
- Further history revealed only cold intolerance.
- Further exam demonstrated a small L thyroid nodule but did not reveal any neurologic findings
- Thyroid uptake scan revealed decreased uptake in a heterogeneous pattern consistent with Hashimoto's thyroiditis

# Thyroid hormone

- $T_4$  prohormone converted to  $T_3$  active
- Animal studies demonstrate
  - Direct positive inotropic effect
    - Increases sodium-calcium-ATPase which increases calcium influx
  - Increase in LV cavity without change in EDP
- Increases rate of depolarization
- Decreases refractory period

# Effect on Myocardium



Myocardial calcium  
concentration

Myocardial tension

# Hyperthyroidism

- Symptoms
  - Palpitations
  - Dyspnea
- Signs
  - Tachycardia
  - Systolic hypertension
  - Hyperactive precordium
  - Loud S1, accentuated P2, S3
  - Occasional systolic click, midsystolic murmur
  - Means-Lerman scratch – systolic scratch near LUSB

# Hyperthyroidism

- ↑ Cardiac and stroke volume index
- ↑ Mean systolic ejection rate
- ↑ Coronary blood flow
- ↓ Systolic ejection period
- ↓ Systemic vascular resistance
- Widened pulse pressure

# Prevalence of Symptoms and Signs

tachycardia	90	dyspnea on exertion	50
palpitations	85	fatigue	50
exercise intolerance	65	systolic murmurs	50
bounding pulses	75	systolic hypertension	30
wide pulse pressure	75	atrial fibrillation	15
hyperactive precordium	75	angina pectoris	5

# Hyperthyroidism and Atrial Fibrillation

- Previously thought that hyperthyroid patients have 5-15% incidence of atrial fibrillation
  - Studies involved older patients with known structural heart disease
- 1996 study demonstrates only 1% of new onset atrial fibrillation is caused by overt hyperthyroidism
- Treatment involves restoration of euthyroid state

# Hyperthyroid Angina & CHF

- Previously thought only to occur in presence of coronary disease
  - CHF occurs experimentally in animals by administering  $T_4$
  - CHF has developed in children with thyrotoxicosis and no coronary disease
  - Angina has been reported in a patient with normal coronaries, thought to be thyroid mediated coronary arterial vasospasm
  - Abnormal exercise LV function not reversed with  $\beta$  blockade, but is reversed by treating hyperthyroidism
  - Thyroid mediated cardiomyopathy may not be reversible

Dillman WH: Thyroid hormones and the heart: Basic mechanistic and clinical issues. *Thyroid Today* 19:1, 1996.

Larson PR, Davies TF, Hay ID: The thyroid gland. *In Williams Textbook of Endocrinology*. 9<sup>th</sup> ed. Philadelphia, WB Saunders, 1998, p 389.

Woeber KA: Thyrotoxicosis and the heart. *N Engl J Med* 327:94, 1992.



# Treatment of Hyperthyroidism

- Resistance to cardiac glycosides
  - Increased volume of distribution
  - Reduced inotropic effect, decreased prolongation of AV refractory period
- $\beta$  blockers
- Propylthiouracil (inhibits conversion  $T_4 \rightarrow T_3$ )
- Surgical or radioactive thyroid ablation

# Hypothyroidism

- Myxedema
  - Pale, flabby, dilated heart
  - Myofibrillar swelling, loss of striations, interstitial fibrosis
  - Pericardial effusion ( $\uparrow$  capillary permeability)
- Sinus bradycardia, prolonged QT interval
- Low P wave amplitude
- AV/intraventricular conduction block
  - RBBB

# Hypothyroidism

- Hypertension
  - Hypothyroidism found in 4% of hypertensive patients
  - Severe hypothyroidism results in normo- or hypotension
- Increase in SVR
- Diastolic relaxation is slowed

# Myxedema vs CHF

- CHF rare in absence of cardiovascular disease
- Dyspnea, edema, effusions, cardiomegaly, T wave changes occur in both
- Left sided heart failure
  - PA pressure elevated with exercise
  - CO fails to rise
  - Valsalva response is normal
- Myxedema
  - PA pressure low with exercise; CO rises
  - Hemodynamic changes resolve with thyroid hormone

# Atherosclerosis and Hypothyroidism

- Hypercholesterolemia and hypertriglyceridemia common
- Treatment of hypothyroidism corrects lipids
- MI and angina uncommon in hypothyroidism
  - Decreased metabolic demand
  - Initiate therapy slowly in patients with CAD

# References

- Braunwald E, Zipes DP, Libby P: Heart Disease 6<sup>th</sup> ed. Philadelphia, WB Saunders:, 2001, p2155-58
- Epstein, FH. Thyroid Hormone and the Cardiovascular System. NEJM 344(7):501-509, 2001.
- <http://www.medslides.com>