Provided by IC-OS International Cardio-Oncology Society

The France Foundation

amyloidosis foundation

SEEING THE FOREST FOR THE TREES:

Recognizing Potential AMYLOIDOSIS in Your Patients

Patient Perspective

Delays in diagnosis and treatment can be fatal

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Faculty Disclosures

- Charles Vega, MD has a Non-CE Consulting relationship with Boehringer Ingelheim, GlaxoSmithKline

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Syllabus

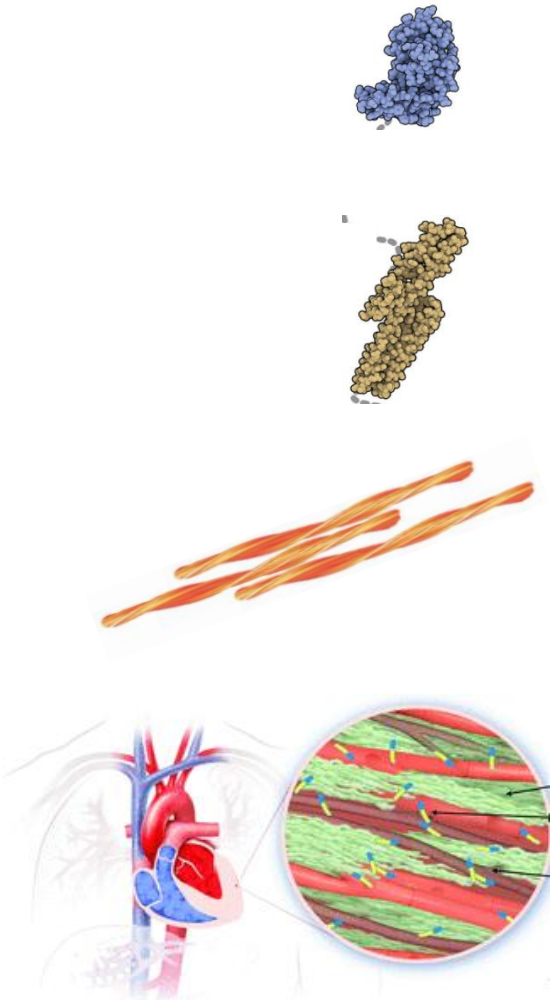
The full syllabus is available here: https://www.francefoundation.com/9370-icos-cme-live

Learning Objectives

- Recognize the symptomatology characteristics of amyloidosis
- Refer patients with suspected amyloidosis for diagnosis and treatment
- Prepare patients for referral for suspected amyloidosis

Introduction to Amyloidosis

What Is Amyloidosis?



Normal protein overproduction

↓

Misfolding into a β-pleated sheet structure

↓

Binding together to form amyloid fibril

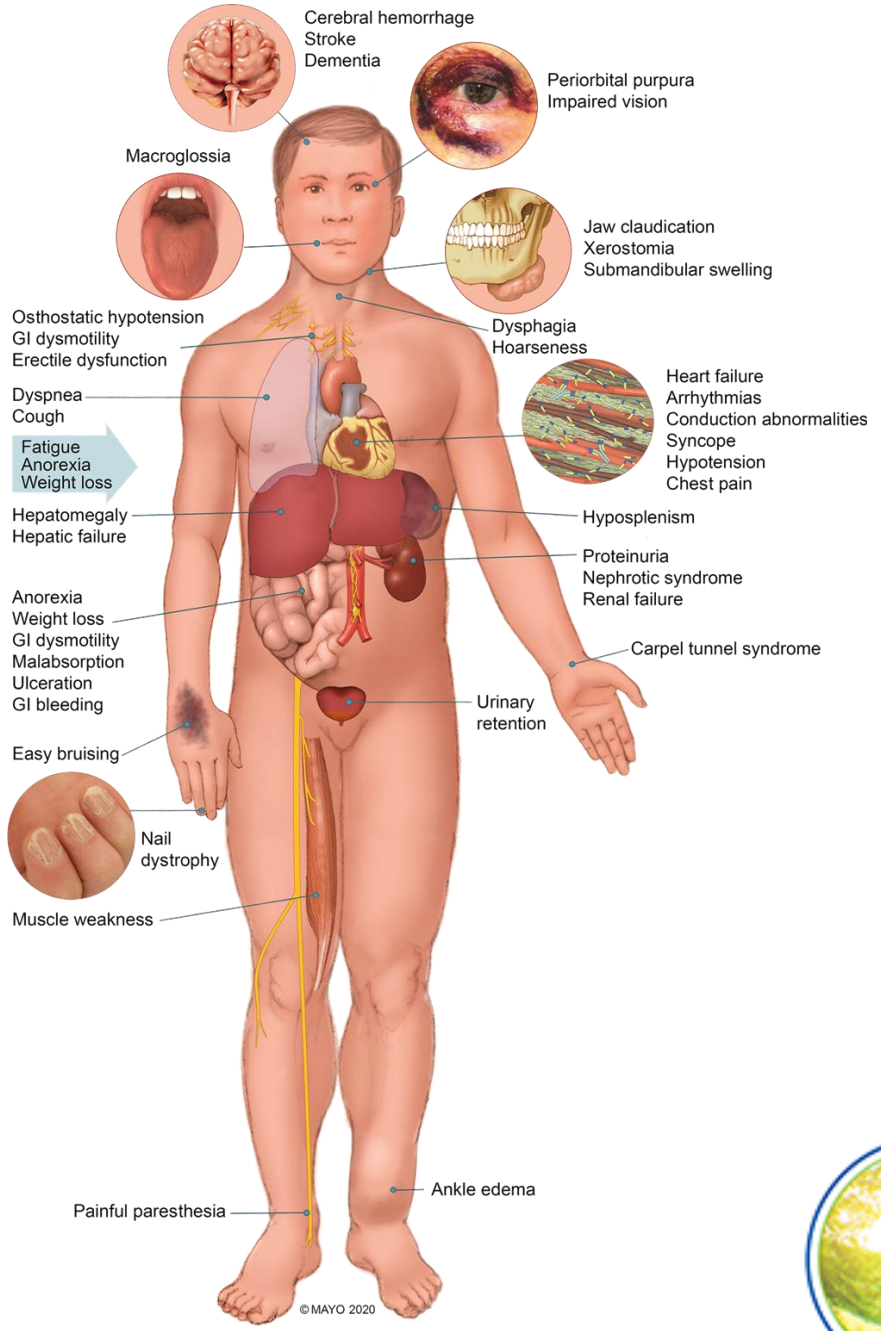
↓

Deposition in organs and tissues

Sperry BW, et al. *J Am Coll Cardiol*. 2018;72(17):2040-2050.

Clinical Manifestations

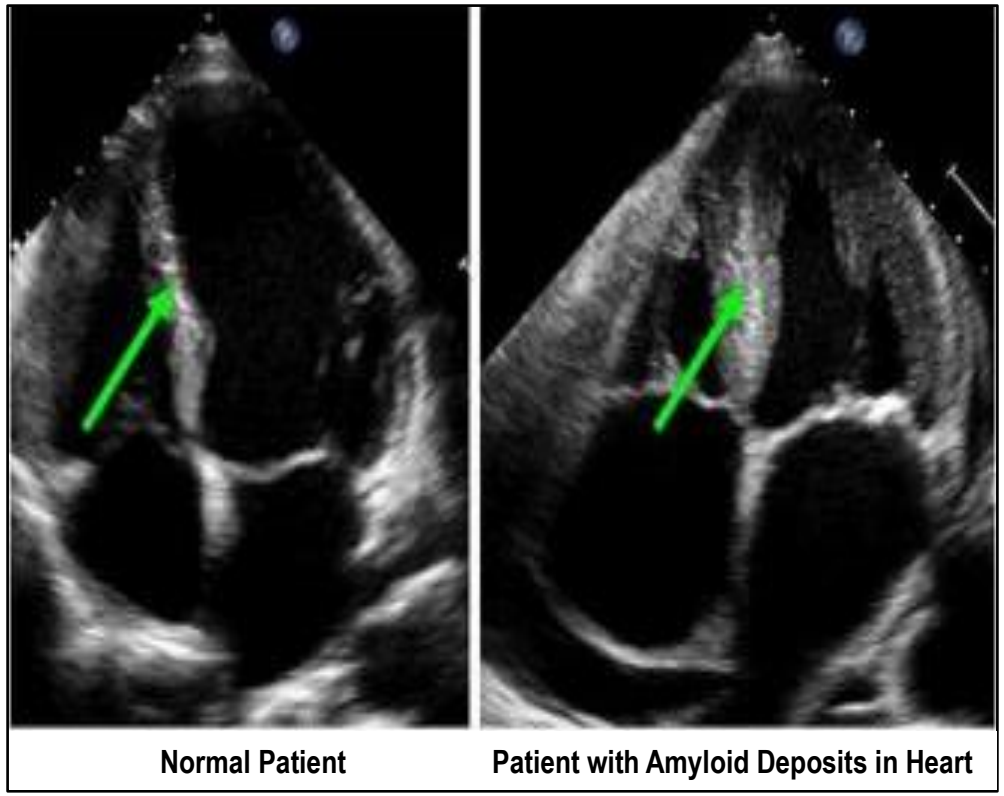
- Over 30 types of amyloidosis disorders
- Each caused by a different precursor protein that promotes fibril formation and tissue deposition
- Discussing today (>95% of all) :
  - Amyloidosis light chain (AL)
  - Amyloidosis transthyretin (ATTR)



Muchtar E, et al. *J Intern Med*. 2021;289(3):268-292.

What Is Cardiac Amyloidosis?

- Characterized by the deposition of extracellular amyloid protein in the myocardium
- Two types primarily affect the heart:
  - Amyloid light chain (AL)
  - Amyloid transthyretin (ATTR)
    - Hereditary
    - Wild-Type

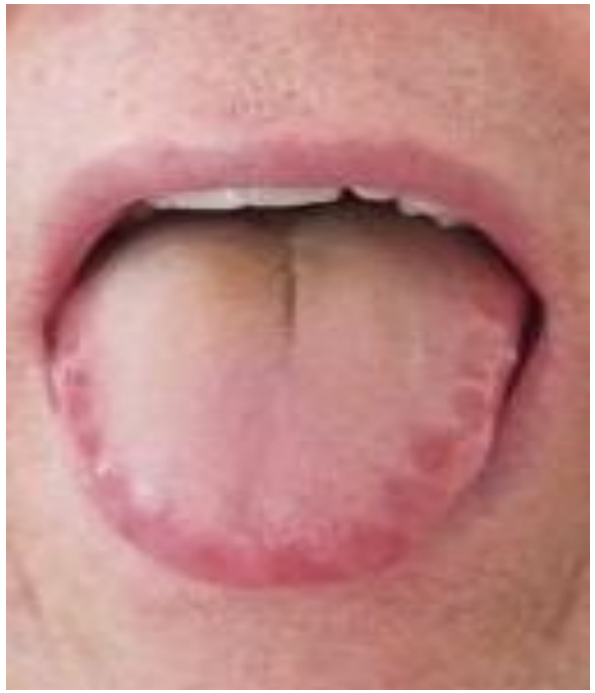


"Amyloid cardiomyopathy should be suspected in any patient who presents with heart failure and preserved ejection fraction."

Gertz MA, et al. *J Am Coll Cardiol.* 2015;66:2451-2466.

Case 1: Patient Description

- 47-year-old Caucasian woman
- Hx of AF (on DOAC)
- Hx of urinary incontinence (on oxybutynin)
- Dysphagia/hoarseness/macroglossia
- Noted occasional dizzy spells
- Sent to the ED for angioedema



https://mm713.org/macroglossia/

AF, atrial fibrillation; DOAC, direct oral anticoagulants; Hx, history; ED, emergency department

What do you know: Which of the patient characteristics below is/are most suggestive of AL amyloidosis?

A. History of AF (and on DOAC)
B. History of incontinence (on oxybutynin)
C. Dysphagia/hoarseness/macroglossia
D. Unsteadiness

Scan to answer

Amyloidosis Light Chain (AL)

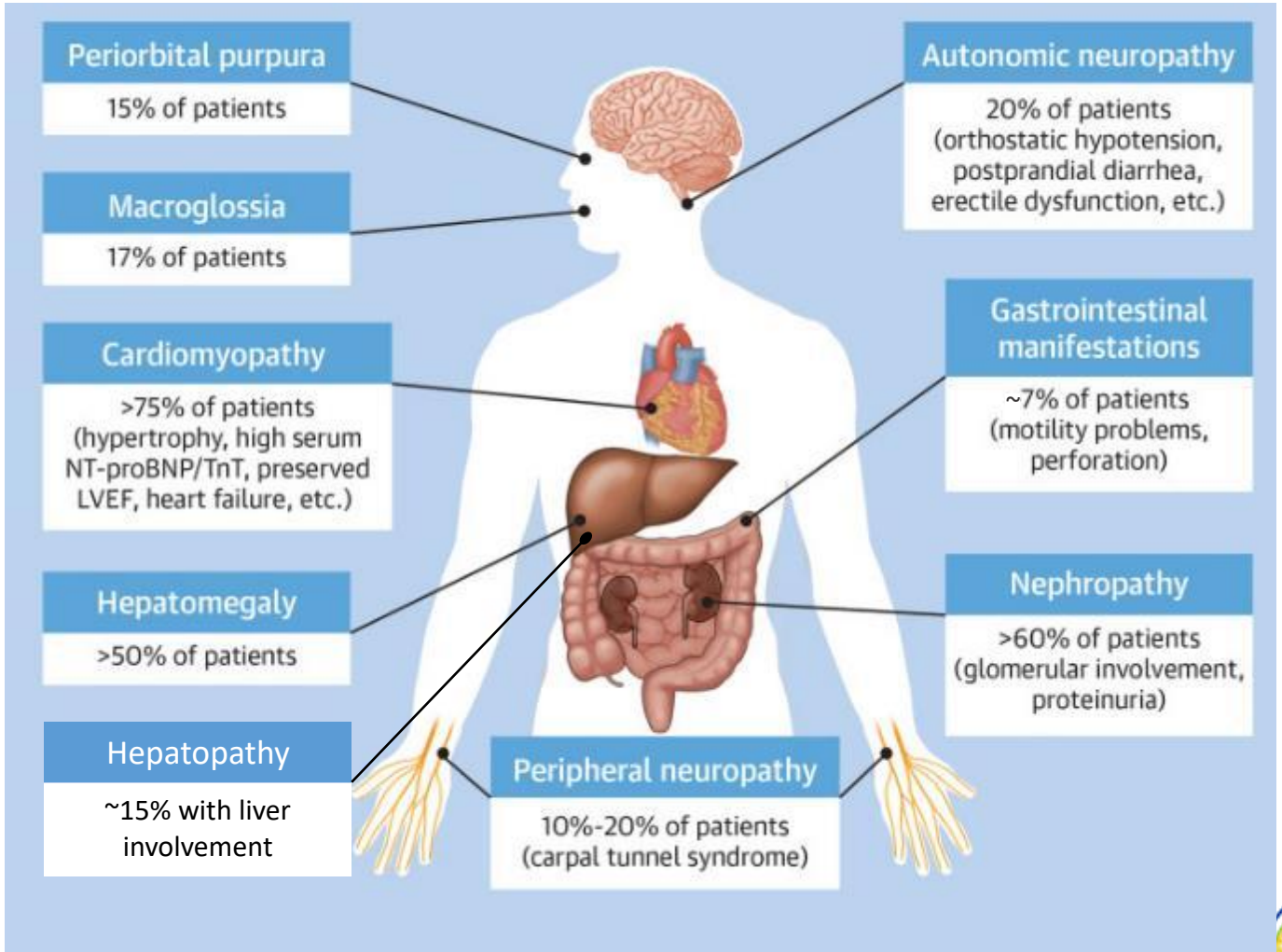
EPIDEMIOLOGY

There are approximately 4,000 new cases in the U.S. diagnosed every year (ASCO.org)

It usually affects people from ages 40-80 years

Without treatment → death occurs within 6 months of diagnosis

Urgency to Treat



From Wechalekar, AD et al. *J Am Coll Cardiol: CardioOncology.* 2022;4(4):427-441.

What did you learn: Which of the patient characteristics below is/are most suggestive of AL amyloidosis?

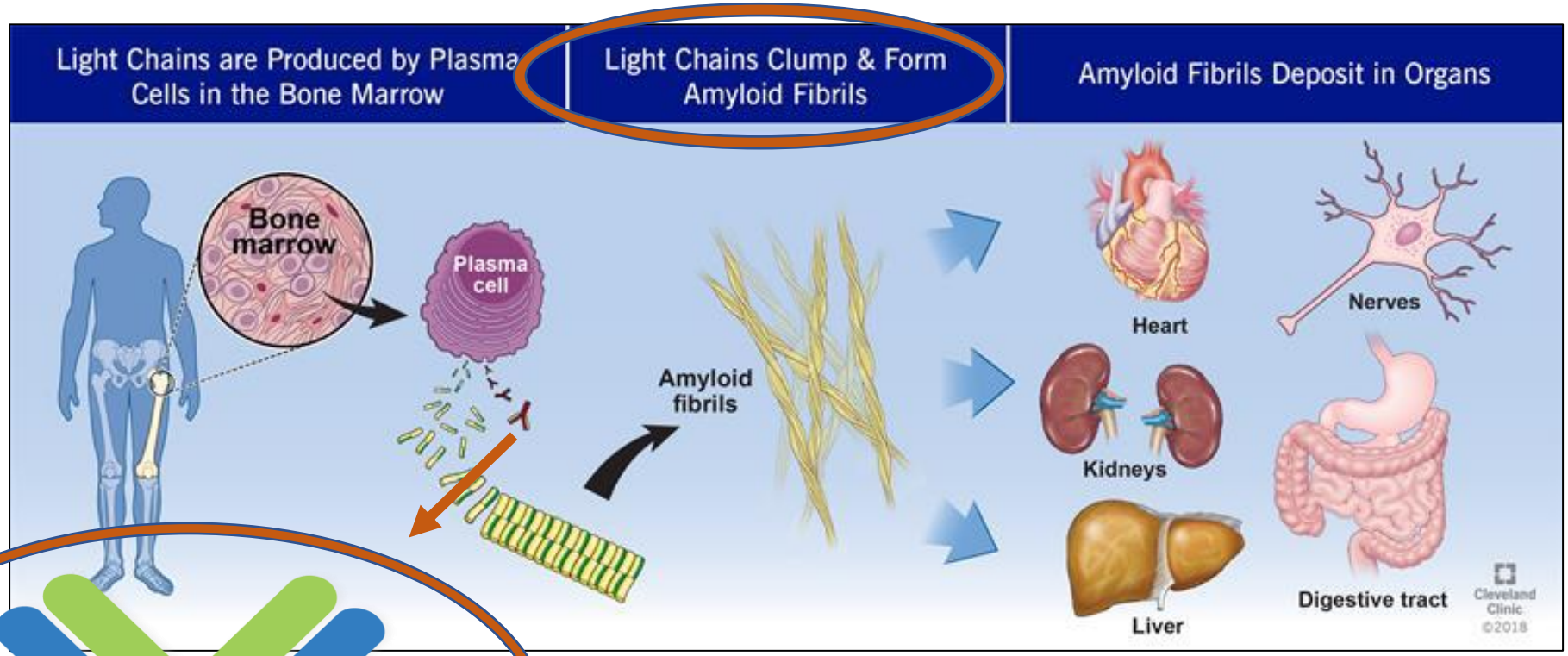
A. History of AF (and on DOAC)
B. History of incontinence (on oxybutynin)
C. Dysphagia/hoarseness/macroglossia
D. Unsteadiness

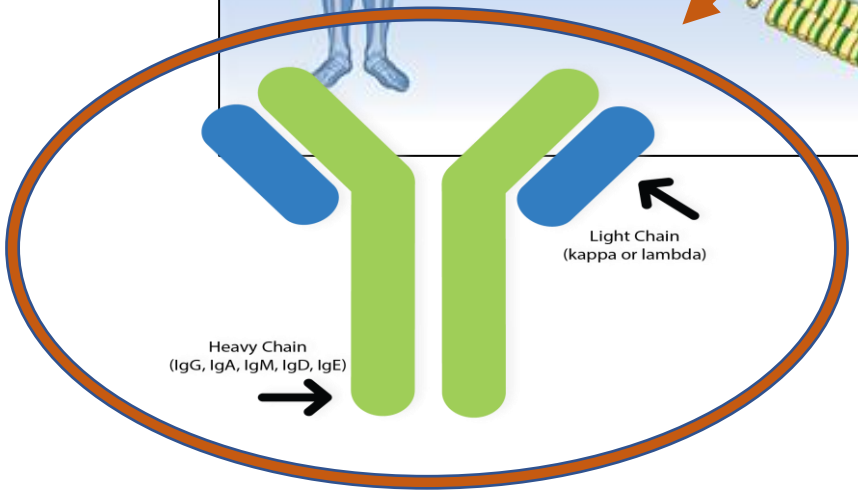
Scan to answer

What did you learn: Which of the patient characteristics below is/are most suggestive of AL amyloidosis?

A. History of AF (and on DOAC)
B. History of incontinence (on oxybutynin)
C. **Dysphagia/hoarseness/macroglossia**
D. Unsteadiness

AL Amyloidosis Pathophysiology





Modified from Mackenzie's mission (March 15, 2023) https://mm713.org/amyloidosis-a-brief-overview/

What do you know: Which of the following is the most appropriate test to diagnose Amyloidosis Light Chain (AL)?

A. Tc99m-Pyrophosphate (PYP) scan
B. Echocardiogram
C. Cardiac MRI
D. Endomyocardial biopsy

Scan to answer

Modified Diagnostic Algorithm for Cardiac Amyloidosis

Clinical Presentation of Amyloidosis
- ECG voltage discordance; Echocardiogram: IVSD > 1.2mm; Bi-atrial enlargement; Elevated NT-proBNP and Troponin
- Neuropathy; Autonomic Dysfunction; Orthostasis; Macroglossia; Dysphagia; Periorbital Purpura
- N/V/D/C; Albuminuria; Elevations in alkaline phosphatase

Does clinical suspicion for amyloidosis exist?

Yes

Screen for the presence of monoclonal light chain
- Serum kappa/lambda free light chain ratio (abnormal if < 0.26 or > 1.65)
- Serum IFE/urine IFE (abnormal if monoclonal protein detected)

Consider referral to Amyloidosis Center of Excellence

No → AL unlikely

Yes → Hematology Consult
- **Bone Marrow Biopsy**
- **Fat Pad Biopsy** (20-83% Sen)
- Tissue typing by mass spectrometry

Yes* → **AL Amyloidosis**

Yes

Endomyocardial biopsy
- Positive Congo red
- Tissue typing by mass spectrometry or immunostaining

Yes → **AL Amyloidosis**

No → Cardiac amyloidosis extremely unlikely

AL unlikely

cMRI
- LGE transmural pattern

Followed by: ^{99m}Tc-PYP
- Grade 2/3 uptake + H/CL ratio > 1.5

Yes → **ATTR amyloidosis**

No → Cardiac amyloidosis unlikely but **still possible**

No → **Consider heart biopsy if suspicion high**

*Diagnosis by fat pad biopsy and classic ECHO alone is only possible in select cases

IVSD, intraventricular septal thickness; LGE, late gadolinium enhancement; H/CL ratio, heart-to-contralateral lung

Modified from Kittleson MM, et al. *Circulation*. 2020;142:e7-e22.

Deciphering the Light Chains in AL

Serum FLC Assay (Kappa/Lambda Chains)

- To detect excess light chains in the blood
- Free Light Chains are removed by renal clearance
- Result must be corrected for CKD-EPI eGFR:
  - eGFR > 90 ml/min–FLC ratio 0.26-1.65
  - eGFR 60-90 ml/min–FLC ratio 0.26-2.00
  - eGFR 30-60 ml/min: FLC ratio 0.26-2.50
  - eGFR < 30 ml/min: FLC ratio 0.26-3.10

- **Abnormal**
  - Etiology: AL, MGUS, MM

FLC, free light chain; MGUS, monoclonal gammopathy of unknown significance; MM, multiple myeloma; AL, amyloidosis light chain

Rauf MU, et al. *Eur Heart J*. 2023;44(24):2187-2198.

Deciphering the Light Chains in AL (cont.)

Serum Immunofixation Studies

- To detect monoclonal immunoglobulin (protein) in the blood
  - Normal level: No M-Spike Present
  - **Abnormal: M-Spike AKA Monoclonal Gammopathy**
    - Etiology: Plasma Cell Dyscrasia ie, **MGUS vs. MM vs. AL vs. MM & AL**
  - **Abnormal:** Polyclonal Gammopathy–non-specific 2/2 Inflammation, infections, and malignancy

Urine Immunofixation Studies

- To detect monoclonal immunoglobulin (protein) in the urine
  - Normal level: No M-Spike Present
  - **Abnormal: M-Spike AKA monoclonal gammopathy**
    - Etiology: Plasma Dyscrasia ie, **MM or AL vs. MM & AL vs. Bence Jones Proteinuria**
  - **Abnormal:** Polyclonal Gammopathy–non-specific 2/2 Inflammation, infections, and malignancy

If either Serum FLC, SIFE, or UIFE are abnormal => Histologic proof of amyloid involvement **MUST** be pursued

MGUS, monoclonal gammopathy of unknown significance; MM, multiple myeloma; AL, amyloidosis light chain

Rauf MU, et al. *Eur Heart J*. 2023;44(24):2187-2198.

Histologic Evaluation for AL

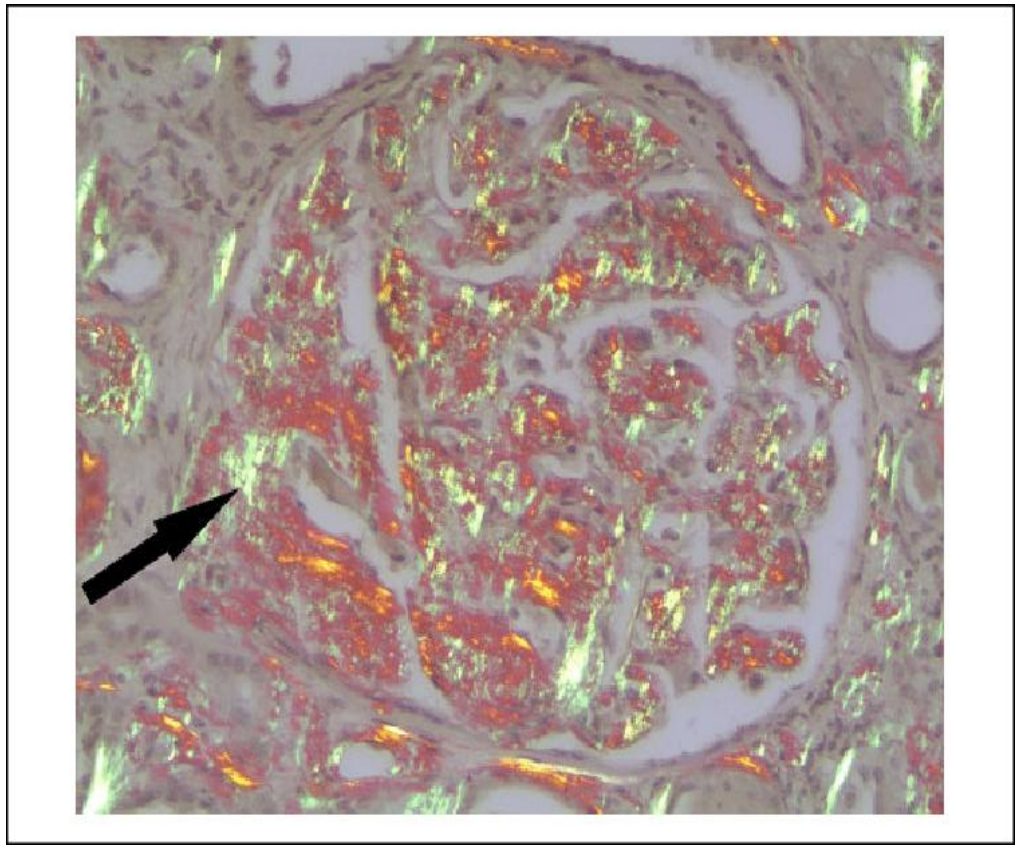
"Target" organ biopsy, fat pad biopsy, and/or bone marrow biopsy

Endomyocardial Bx Risks: Bleeding, Infection, Tamponade, Death < 1% in **experienced** Centers (Seferović PM, et al, 2021)

Tissue is stained with a dye called "Congo-red stain"

Amyloid protein turns apple-green color under microscope

Mass spectrometry **MUST be done** to confirm Amyloid Type ie, AL versus ATTR versus AA etc



EMB–Will dx **both** AL and ATTR

EMB, endomyocardial biopsy; Bx, biopsy

Maleszewski JJ. *Diagn Histpathol*. 2022;28(4):181-190; Seferović PM, et al. [published correction appears in Eur J Heart Fail. 2022 Apr;24(4):732. doi: 10.1002/ejhf.2474]. *Eur J Heart Fail*. 2021;23(6):854-871.

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B. Echocardiogram

C. Cardiac MRI

D. Endomyocardial Biopsy

Scan to answer

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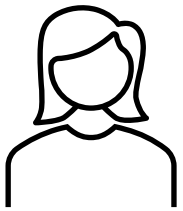
B. Echocardiogram

C. Cardiac MRI

D. **Endomyocardial Biopsy**

Patient Journey



Clinical Presentation

- AF, fatigue, dizzy spells
- Macroglossia, hoarseness, dysphagia
- Urinary incontinence

Symptom Progression

- Angioedema ruled out in ED
- Dizzy spells worsened => patient told to “drink more fluids”
- Incontinence worsened => referred to urology

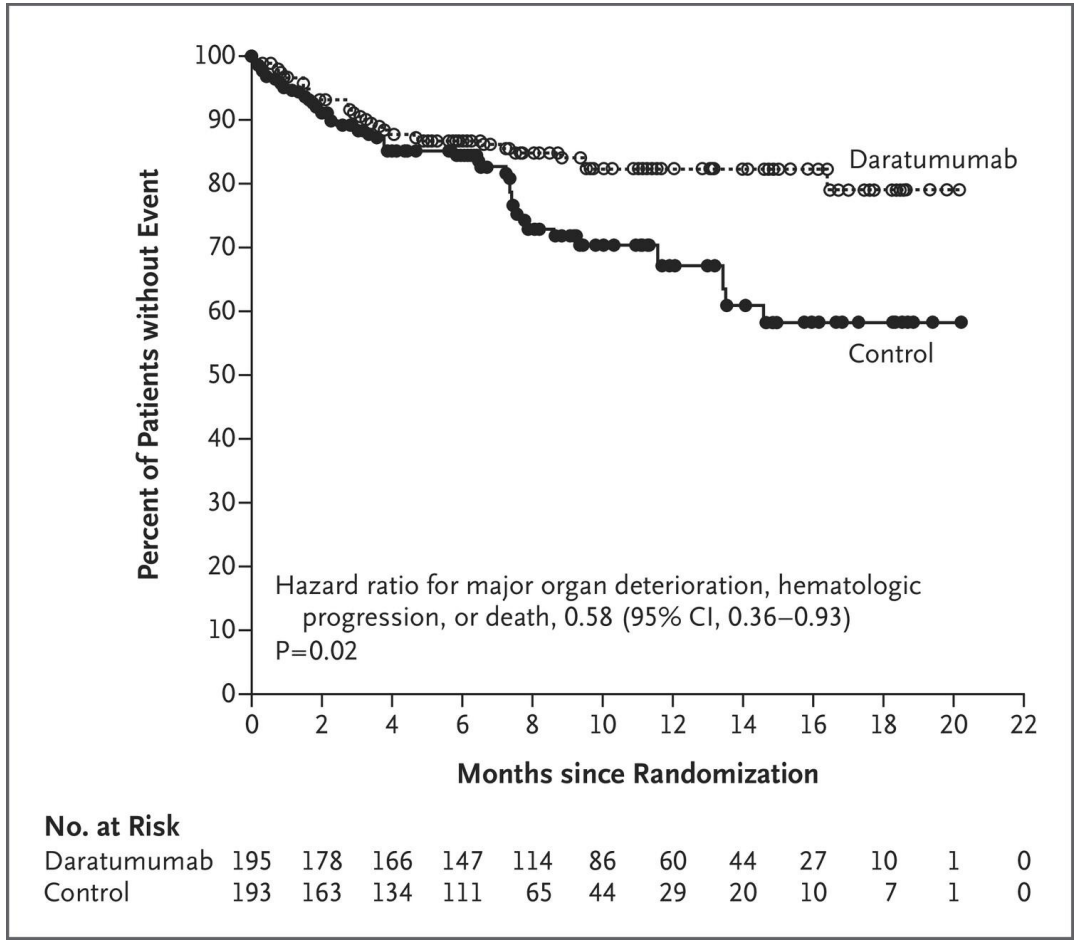
Incidental Diagnosis

- Patient mentioned enlarged tongue to dental hygienist during a routine cleaning
- Tongue Bx (+) amyloid deposits–tissue **NOT** sent for Mass Spec
- Patient googled amyloidosis and self-referred to a Center of Excellence
- Patient underwent an EMB that confirmed AL deposition in the heart

AF, atrial fibrillation; ED, emergency department; EMB, endomyocardial biopsy; AL, amyloid light chain

Targeted Disease Therapies for AL–ANDROMEDA

- Treatments **target plasma cells,** and are similar to treatment for multiple myeloma
- Goal is to prevent new amyloid protein development (**hematologic response**) and to improve organ involvement function (**organ response**)
- **Standard of care is to give a 4-drug combination (dara + CyBorD)**
  - daratumumab
  - cyclophosphamide
  - bortezomib
  - dexamethasone
- Autologous stem cell transplant (ASCT) in certain patients



Kastritis E, et al. *N Eng J Med*. 2021;385(1):46-58.

Therapy Responses

Hematological Response

COMPLETE RESPONSE (Requires both of the following)

- Serum and urine negative monoclonal proteins by immunofixation
- Normal K/L chain ratio **OR** the uninvolved free light chain is greater than the involved concentration w/wo abnormal ratio

VERY GOOD PARTIAL RESPONSE

- Reduction in the difference between the involved and uninvolved free light chain < 40mg/L

PARTIAL RESPONSE

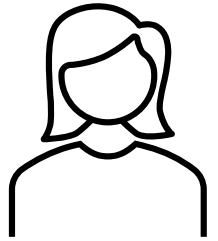
- Reduction in the difference between the involved an uninvolved free light chain of at lease 50% compared to baseline

Organ Response

HEART 	• NT-proBNP Response (> 30% and > 300ng/L decrease in pts with baseline NT-proBNP ≥ 650ng/L) **OR** • NYHA Class response (≥ 2 Grade decrease in pts with baseline NYHA class 3 or 4)
LIVER 	• ≥ 2cm decrease in liver size in radiography • ≥ 50% decrease in abnormal serum alkaline phosphatase level
KIDNEY 	• ≥ 30% decrease in 24h urine protein or drop below 0.5g/day • eGFR must not have worsen by ≥ 25% over baseline
PERIPHERAL NERVOUS SYSTEM 	• Resolution of abnormal physical findings • Improvement of abnormal EMG and/or nerve conduction velocity findings (rare)

Wechalekar AD, et al. *Amyloid*. 2023;30(1):3-17.

Case 1: Outcome



- Started on treatment but autonomic dysfunction and cardiac involvement debilitated her
- She died despite heroic efforts to withstand therapy

AL: Key Points to Remember

- AL is a medical emergency (life expectancy of ~6 months without treatment) and MUST be ruled out ASAP
- Remember diagnostic pitfalls:
  - AL cannot be diagnosed/distinguished from ATTR via imaging (Echo, PYP scan, cMRI) or bloodwork alone
  - Gold standard for diagnosis for ALL types of amyloidosis (but particularly for AL) is still target organ biopsy (heart, liver, kidney) followed by Congo red stain
  - Delays in evaluation may result in high index of mortality
  - Not all amyloidosis is ATTR
- AL is a serious but treatable disease IF diagnosed early enough to allow for successful therapies, including autologous stem cell transplant (ASCT)

What is different about ATTR Cardiac Amyloidosis (ATTR-CM)?

What do you know: ATTR deposition is seen in up to what percentage of patients with HFpEF?

A. 5%
B. 17%
C. 29%
D. 41%

Scan to answer

ATTR CM: Is it Common?

"ATTR deposition is seen in up to…
17% of patients with HFpEF."

Kittleson MM, et al. *Circulation.* 2020:142:e7-e22.

What did you learn: ATTR deposition is seen in up to what percentage of patients with HFpEF?

A. 5%
B. 17%
C. 29%
D. 41%

Scan to answer

What did you learn: ATTR deposition is seen in up to what percentage of patients with HFpEF?

A. 5%

B. 17%

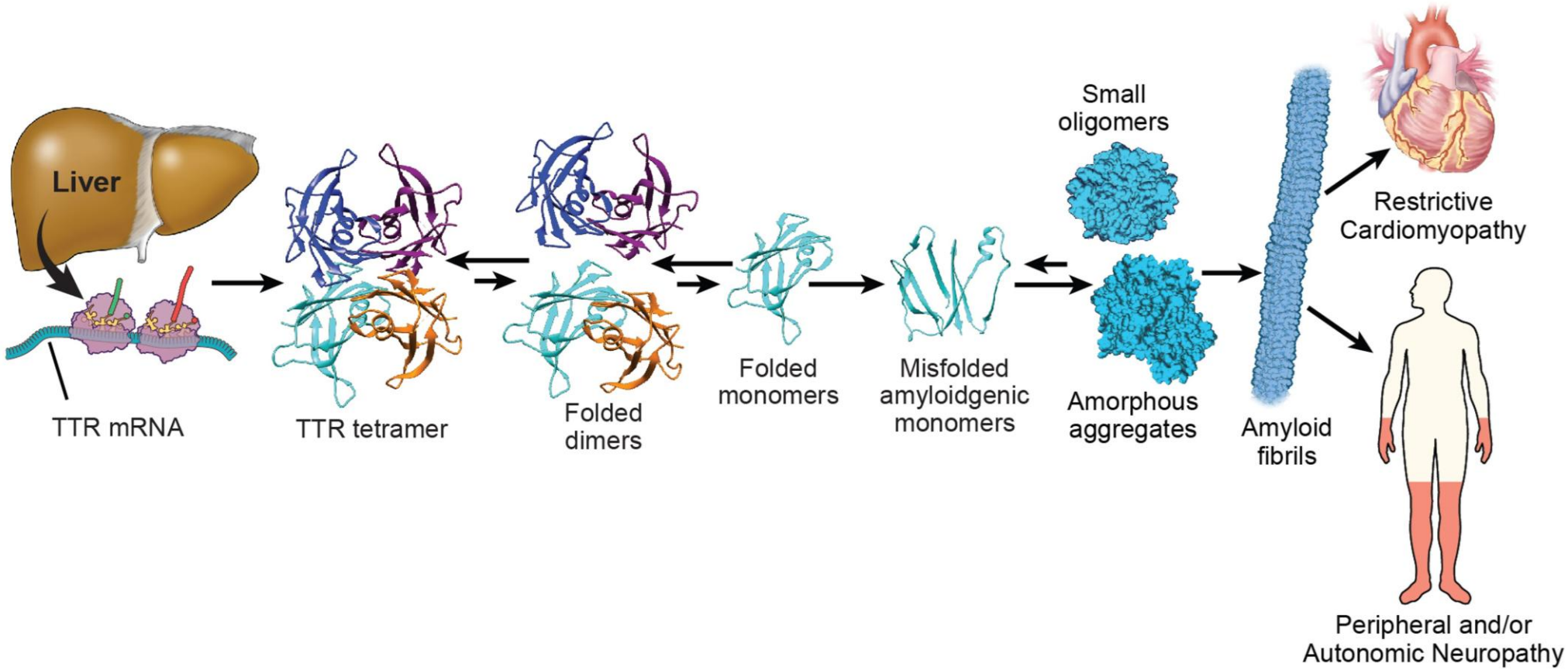
C. 29%

D. 41%

Nomenclature: ATTR

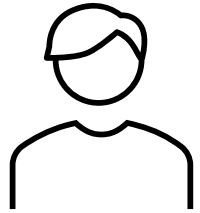
- ATTR = Transthyretin amyloidosis
- Transthyretin: a protein transport carrier for
  - Thyroid hormones T_3 and T_4 (the “thy” of transthyretin)
  - Retinol (the retin of transthyretin)
- *Transthyretin* = *trans*ports *thy*roxine and *retin*ol

The Formation of Transthyretin Amyloid



Ruberg FL, et al. *J Am Coll Cardiol*. 2019;73(22):2872-2891.

A Typical Patient With HFpEF



- A 72-year-old African American male is seeing his PCP for an annual review. He has no new specific symptoms but is “getting older.”
- ROS: NYHA II based symptoms with moderate activity
- PMH:
  - Carpal tunnel syndrome surgery (bilateral) age 62
  - HTN in past (currently well controlled 120/80)
- Current Meds:
  - Empagliflozin 10 mg qd
  - Lisinopril 20 mg qd
  - ASA 81 mg qd
  - Recent Echo: LVEF 56%, mild LVH, intraventricular septum 1.3 cm, and impaired diastolic function by report

Would you investigate this patient for ATTR?

A. Yes
B. No
C. I’m not sure

Scan to answer

Hereditary ATTR: Valine-142-Isoleucine

- Most common genetic ATTR-CM in US
- 3.43% Black Americans (1.5 million persons)
  - Compared to 0.3-1.6% in the general population
- Clinical penetrance is variable and age dependent
- ↑Risk of HF (RR 2.62)
- ↑Mortality rate with ATTR-CM

Buxbaum J, et al. *Am Heart J.* 2010;159(5): 864-870.
Shah KB, et al. *Circ Heart Fail*. 2016;9(6):e002558.
Chandrashekar P, et al. *Circ Genom Precis Med*. 2021;14(5):e003356.

Wild-Type ATTR (wtATTR): Not so Rare…

- MORE common than hereditary ATTR
- Increases with age; male predominance
- 25% of pts > 80-years-old had Bx evidence of cardiac wtATTR[1]
- Spanish study (n = 120): 13% of pts ≥ 60-years-old admitted for HFpEF found to have wtATTR[2]

[1]Mohammed SF, et al. *J Am Coll Cardiol: Heart Fail*. 2014;2(2):113-22.
[2]González-López, E, et al. *Eur Heart J*. 2015;36(38):2585-2594.

Mandatory slide for live

ATTR Clinical Presentations

	hATTR	wtATTR
Onset	**Variable** (per Genotype); > 20-year-old	Median age **>** 70-year-old
Gender	Male = Female	Male > Female
Clinical Presentations	**Cardiac** and **PNS**	**Cardiac** and **Tenosynovial**
	Heart Failure (HFpEF) **Arrhythmia (Afib/Aflutter)** **Aortic Stenosis** **Conduction System Disease/Ventricular Arrhythmias**	
	Bilateral carpel tunnel syndrome **Polyneuropathy** **Autonomic Neuropathy**	**Bilateral carpel tunnel syndrome** **Lumbar Spinal Stenosis** **Hip/Knee DJD**
Dx Delay	~3 years	~2 years

DJD, degenerative joint disease

Color key: blue–associated with hATTR; green–associated with wtATTR; white–common to both hATTR and wtATTR

Ruberg FL, et al. *J Am Coll Cardiol*. 2019;73(22):2872-2891.

Prevalence of ATTR-CM in Patients Undergoing TAVR

Author or Study Name, Year	N	Prevalence of CA (%)
Nietlispach F, et al., 2012	17	29.0
Longhi S, et al., 2016	43	11.6
Treibel TA, et al., 2016	146	4.1 in whole cohort 6.0% in age > 65 years
Castaño A, et al., 2017	151	16.0
Cavalcante JL, et al., 2018	113	8.0 in whole cohort 16.0 in age > 74 years
Scully PR, et al., 2018	101	13.9
ATTRact-AS, 2019	250	Study is ongoing
Amylo-CARTESIAN, 2020	180	Study is ongoing

Adapted from Ternacle J, et al. *J Am Coll Cardiol*. 2019;74(21):2638-2651.

TAVR, transcatheter aortic valve replacement

What do you know: For a patient with confirmed aortic stenosis and LVH by Echo, what are the next best tests that should be performed to exclude amyloidosis?

A. AL monoclonal proteins, Tc-99m-PYP scan
B. Genetic testing for TTR mutations, Tc-99m-PYP scan
C. Transesophageal Echo, Tc-99m-PYP scan
D. Coronary angiography, Tc-99m-PYP scan

Scan to answer

Mandatory slide for live

Proposed Diagnostic Algorithm for ATTR-CA Among Patients With Severe AS Undergoing TAVR (Transaortic valve replacement)

Step 1–Monoclonal proteins*; if negative…

Step 2–Tc-99m-PYP scan with SPECT imaging; if positive…

Step 3–Genetic testing (hereditary versus wild type TTR gene)

*Monoclonal proteins include immunofixation of the urine and serum as well as the kappa/lambda serum free light chain test

AS and ATTR: Remember This…

- Among patients with significant aortic stenosis (AS) undergoing TAVR, 1 in 7 (~15%) have concomitant ATTR-CM
- Identification of cardiac amyloidosis in the setting of AS can be challenging, look for the many clinical clues that can raise suspicion of this dual diagnosis

What did you learn: For a patient with confirmed aortic stenosis and LVH by Echo, what are the next best tests that should be performed to exclude amyloidosis?

A. AL monoclonal proteins, Tc-99m-PYP scan
B. Genetic testing for TTR mutations, Tc-99m-PYP scan
C. Transesophageal Echo, Tc-99m-PYP scan
D. Coronary angiography, Tc-99m-PYP scan

Scan to answer

What did you learn: For a patient with confirmed aortic stenosis and LVH by Echo, what are the next best tests that should be performed to exclude amyloidosis?

A. **AL monoclonal proteins*, Tc-99m-PYP scan**
B. Genetic testing for TTR mutations, Tc-99m-PYP scan
C. Transesophageal Echo, Tc-99m-PYP scan
D. Coronary angiography, Tc-99m-PYP scan

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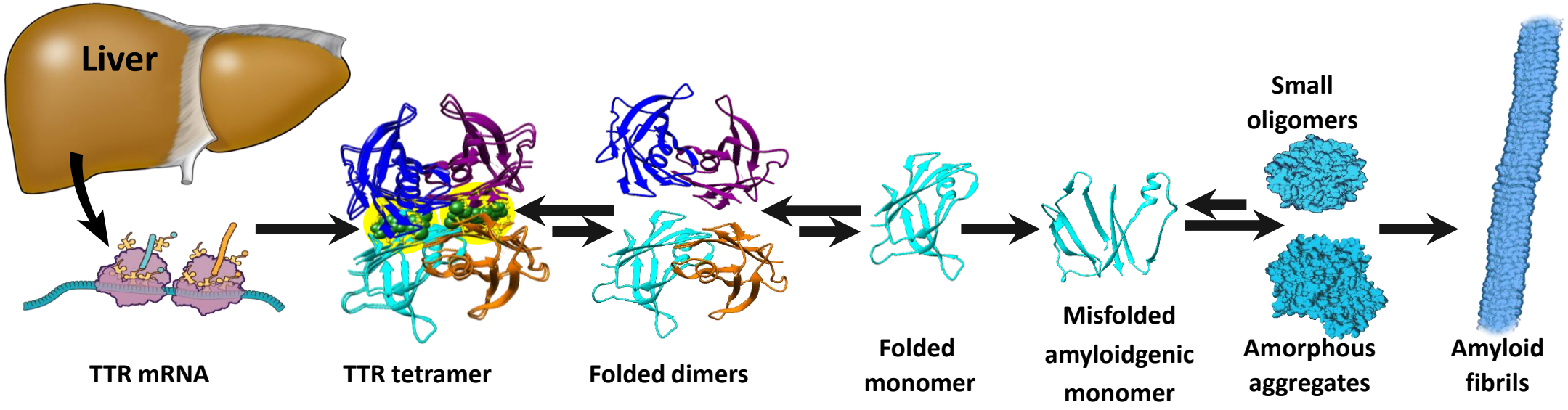
Amyloidosis Treatments



Block Protein Synthesis

- Patisiran#
- Vutrisiran#*
- Inotersen#

Stabilize Tetramer

- Tafamidis* (hATTR, wtATTR)
- Diflusinal
- Acoramidis*

Remove Fibrils

- NNC6019
- AT-02
- NI1006

*approved for ATTR-CM; #approved for ATTR-PN

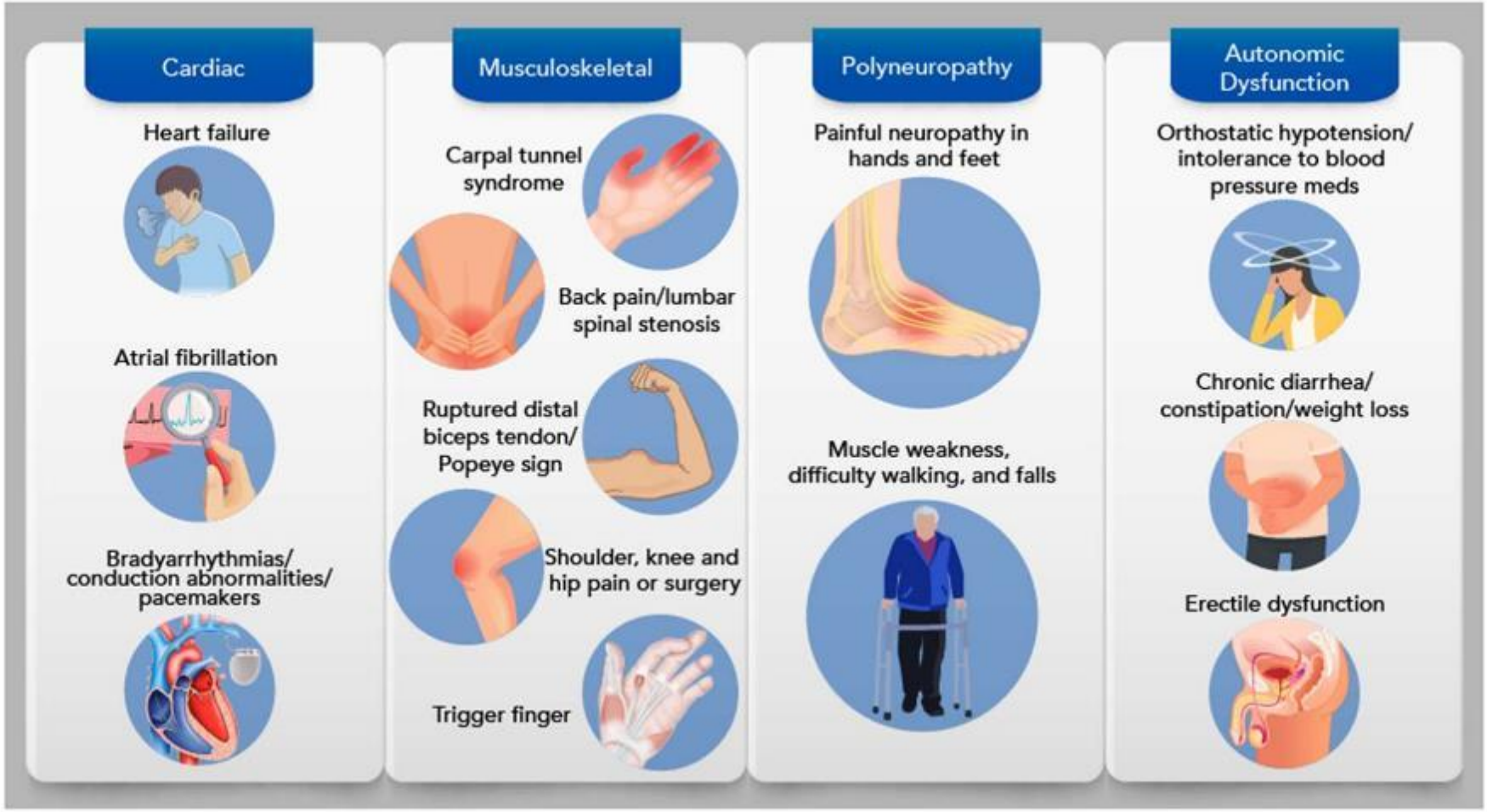
Ruberg FL, et al. *J Am Coll Cardiol*. 2019;73(22):2872-2891.
Prescribing Information acoramidis. www.accessdata.fda.gov/drugsatfda_docs/label/2024/216540s000lbl.pdf

ATTR-CM: Key Point to Remember

"Advances in noninvasive diagnosis, coupled with concurrent demonstration of efficacy and … approval of specific ATTR-CM therapies, has shifted ATTR-CM from a rarely encountered and untreatable 'zebra,' to a condition that clinicians should consider on a daily basis."

Ruberg F, et al. *J Am Coll Cardiol.* 2019;73(22):2872-2891.

Amyloidosis: A Large Array of Non-Specific Symptoms



Heart failure with **thick septum** (IVSd ≥ 1.2mm) **regardless of LVEF**

One other **cardiac** or **non-cardiac** symptom

Screen for cardiac amyloidosis*

* Surgical clearance requests provide an opportunity for surrogate site biopsy

Nativi-Nicolau JN, et al. *Heart Fail Rev*. 2022;27(3):785-793.

IVSd, intraventricular septum diameter

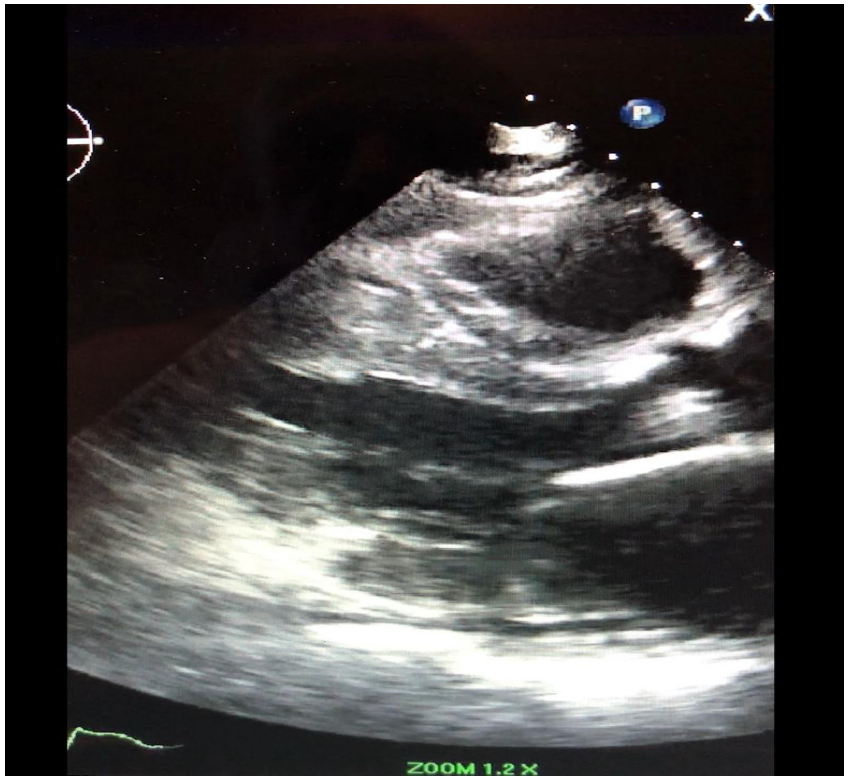
Challenges in Patient Diagnosis, Referral, and Support

What do you know: What are the biggest challenges to refer patients for follow-up of suspected amyloidosis? (select all that apply)

A. Ordering the correct available testing to evaluate for suspected amyloidosis
B. Knowing which centers/providers to refer to in my region
C. Providing proper information for my patients to be prepared for next steps after referral
D. Receiving excellent guidance for high quality follow-up from the referral center
E. Understanding how to deal with day-to-day issues that may arise after the diagnosis

Scan to answer

Urgency Is Needed to Complete Diagnostic Workup



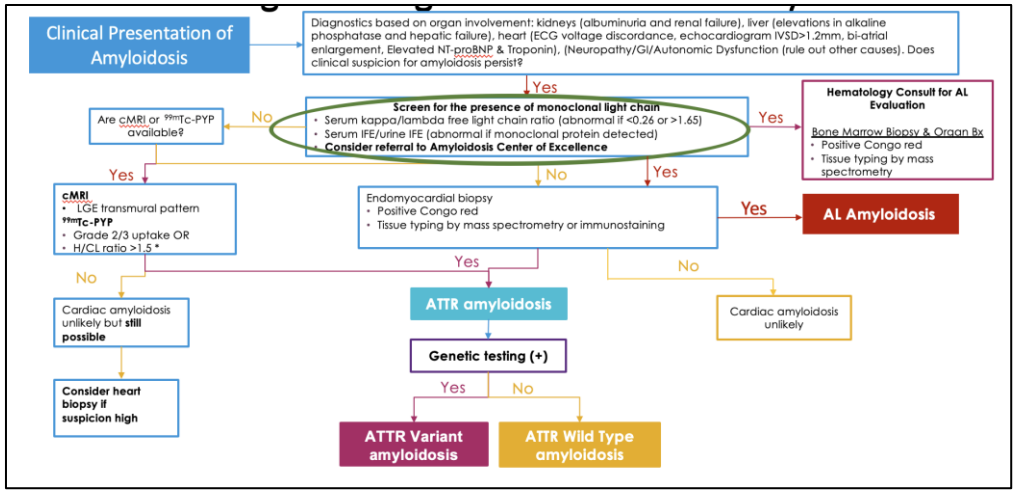
AL Amyloidosis

A Medical Emergency

Is it HTN? Is it AL? Is it ATTR? Is it Me?

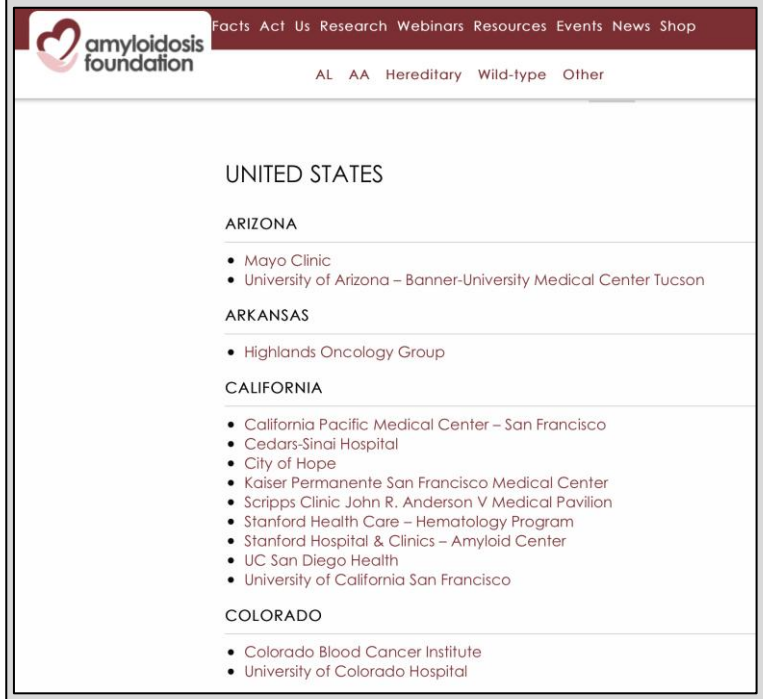
- Consider Amyloidosis in ALL cases unless reasonably ruled out
- When in doubt, pursue workup
- HTN may co-exist with amyloidosis
- Remember that patients are allowed to have as many diagnoses as they'd like!

Multistep Diagnostic Algorithm



Call a Friend-> You don't have to make the diagnosis alone!

Referral Resources:

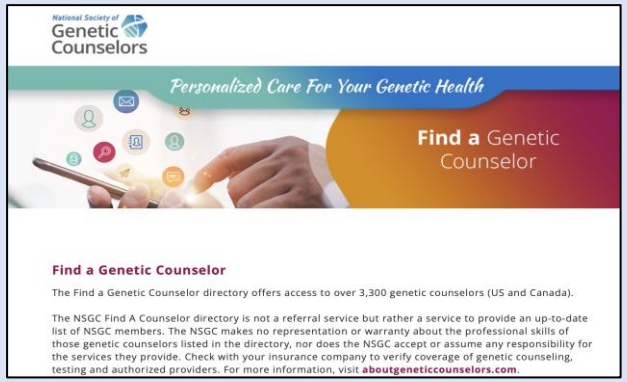


Amyloidosis support groups. https://www.amyloidosissupport.org/

Ethical Considerations With Genetic Testing

- Must be performed for any suspected ATTR
- Lack of family history does ***NOT*** rule out hereditary disease
- Free or affordable through industry partners
- Multiple financial, emotional, and psychological repercussions in patients and families

- **Consider referring to a Genetic Counselor PRIOR to sending lab sample**
- Pre-testing discussion **should** include:
  - Basic pathophysiology of the disease
  - GINA (Genetic Information Nondiscrimination Act)
  - Repercussions on Life Insurance Policies
- **If positive:**
  - Who should be tested in the family
  - Reproductive decisions
  - Survivor's guilt
  - How to share information with other family members



Supporting Patients: Key Points to Remember

- Amyloidosis is a multisystem disease that presents **numerous challenges** to both patients and providers alike
- **Centers of Excellence can** supervise strategic, coordinated, and cost-effective care to the amyloidosis population but we need to reach providers broadly
- Amyloidosis Centers of Excellence may facilitate diagnosis and access to treatment options **ONLY IF** regional partners (YOU) **screen patients** on a regular basis and make the diagnosis and/or make **timely referrals**

#TogetherAgainstAmyloidosis

Patient Perspective

Timely diagnosis and treatment can lead to favorable outcomes

Download the Clinical Companion to today's session now!

Evaluate this Session

Evaluation

Optional Bonus Material

A Case of Cardiac Amyloidosis and Aortic Stenosis: Partners in Crime

Another case if time permits

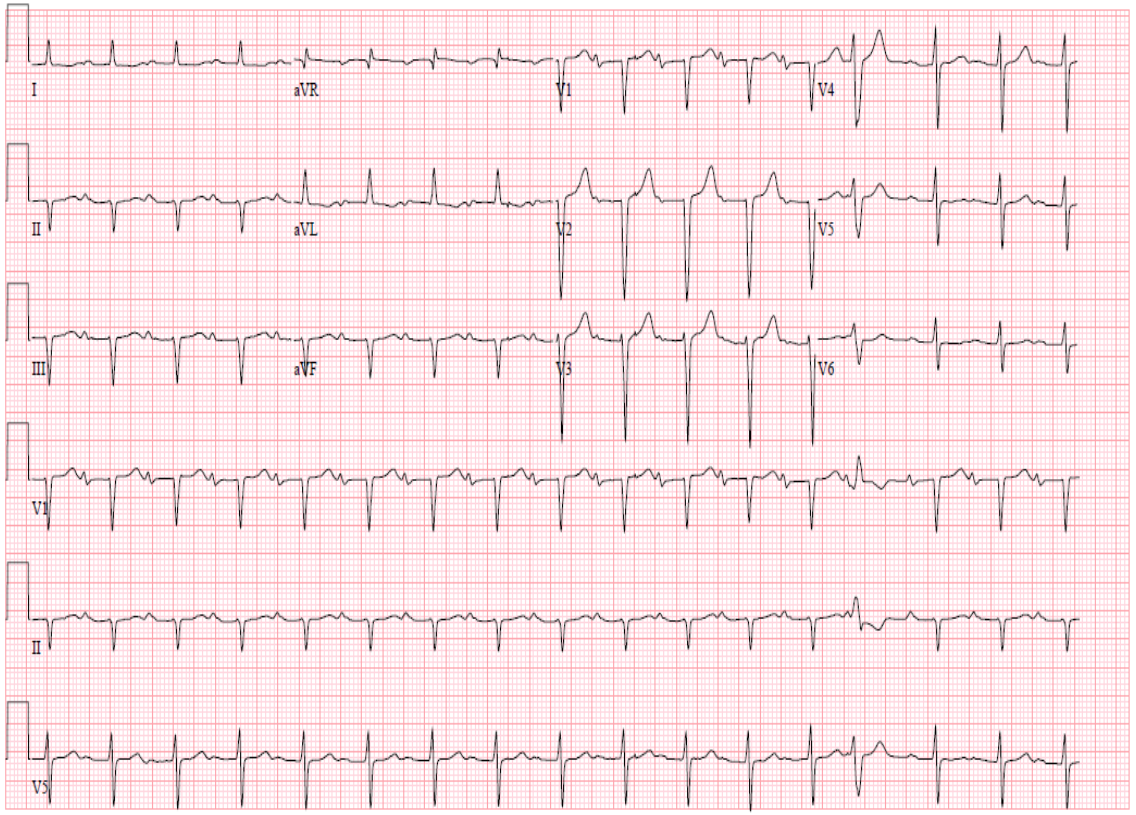
Case: Aortic Stenosis

- 87-year-old male veteran with worsening shortness of breath with systolic murmur
- PMHx: HTN, DM, CKD, anemia, atrial fibrillation, CAD, Lumbar spinal stenosis, and biceps tendon rupture
- PSHx: Previous R hip and L shoulder replacement

- Exam: BP 126/76, HR = 90, BMI = 24 kg/m^2
  - JVP > 10 cm (normal < 8)
  - 3/6 systolic murmur at base, soft S2
  - Hepatomegaly with 2+ lower extremity edema

Case: Laboratory Results and EKG

- Creatinine = 1.2 mg/dl
- Hemoglobin = 11.8 g/dl
- Albumin = 3.9 g/dl
- eGFR = 57 ml/min/m2
- Troponin T = 0.18 ng/ml
- NTproBNP = 3,220 pg/ml

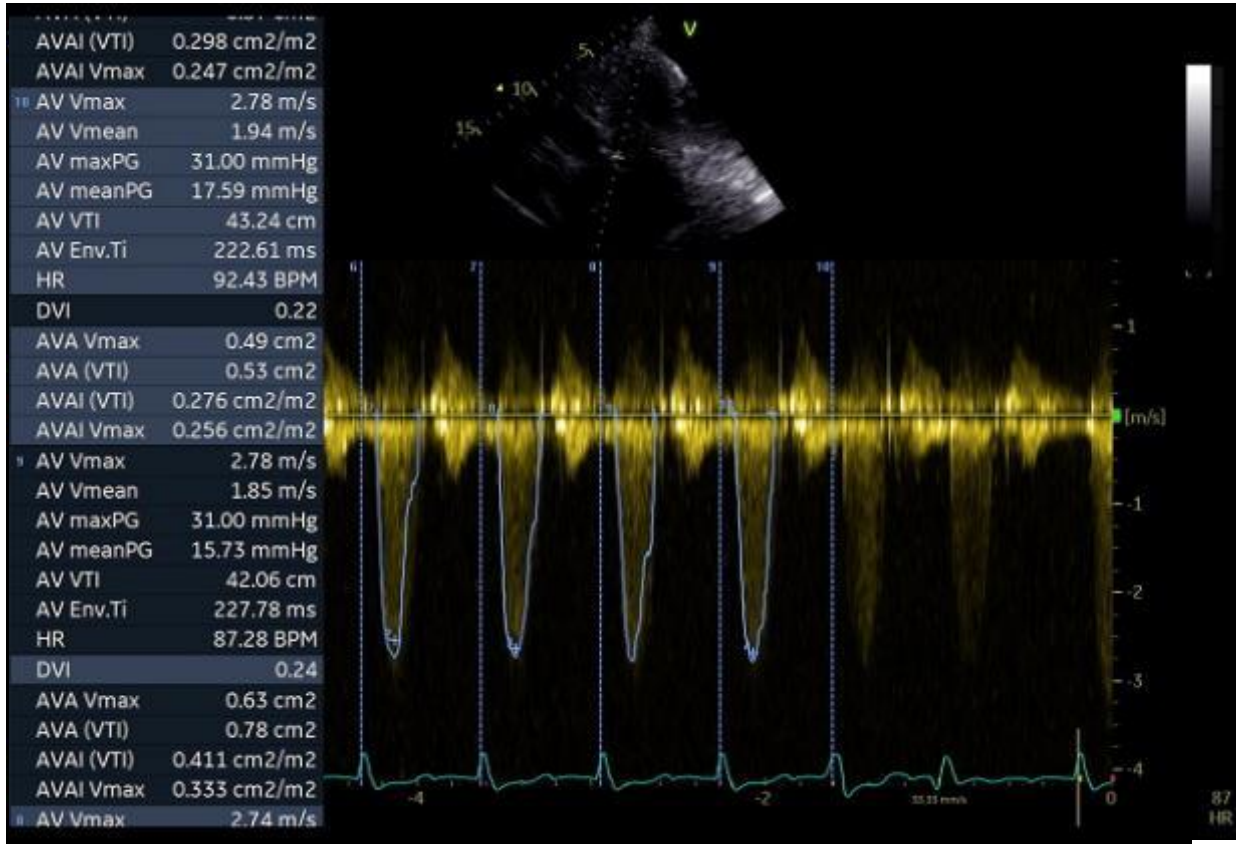


Case: What should be the next step in the diagnostic work up for this patient?

A. Tc99m-Pyrophosphate (PYP) Scan
B. Echocardiogram
C. Cardiac MRI
D. Endomyocardial Biopsy

Scan to answer

Case: Paradoxically Low Flow Aortic Stenosis



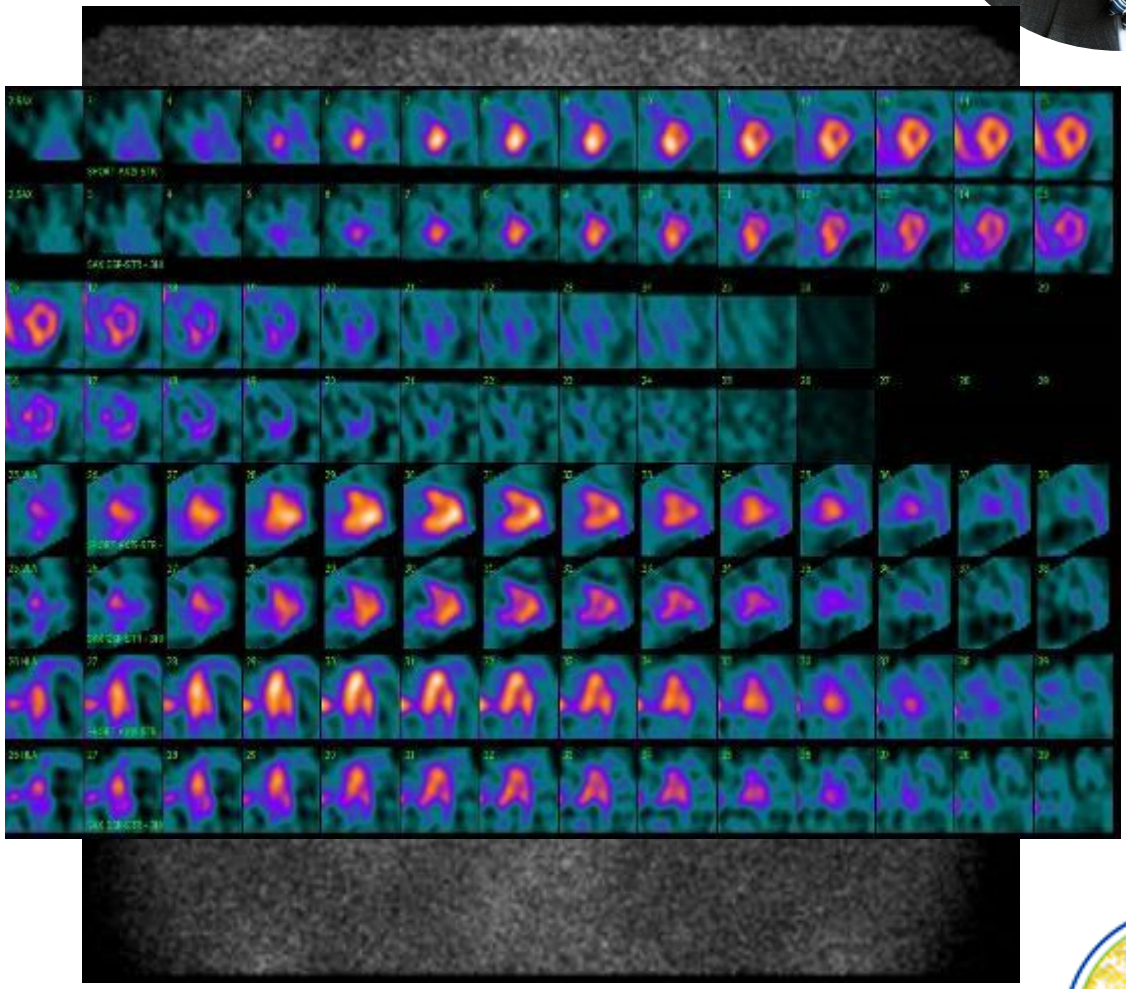
Echo:

- EF = 56%, IVS 18 mm, RWT 0.6
- Mitral S' < 6 cm/sec
- AVA = 0.6 cm^2, gradient 35 mm Hg, peak velocity 2.8 m/sec

AVA, aortic valve area; IVS, interventricular septum; RWT, relative wall thickness.

Case: Treatment Choices

- After long discussions, in part, driven by a desire to be at his grandson's bar mitzvah, he pursued TAVR
- Post TAVR had Tc^{99} PYP Scan with SPECT/CT imaging
- Monoclonal protein assessment showed:
  - Kappa of 4.3 mg/dl, Lambda of 2.1 mg/dl, K/L ratio of 2
  - Immunofixation of serum and urine showed no monoclonal proteins
- Treated with tafamidis



TAVR, transcatheter aortic valve replacement