Impact of cardiac 99mTc-HMDP uptake on myocardial function and left ventricular filling pressure in patients with transthyretin amyloidosis

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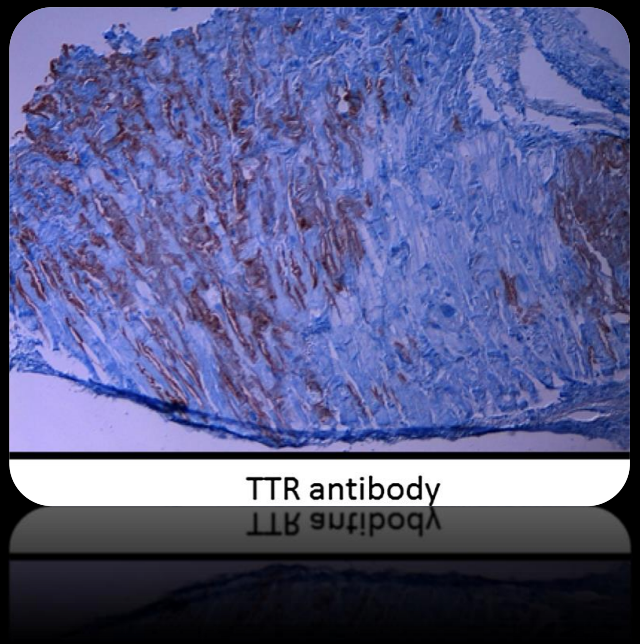
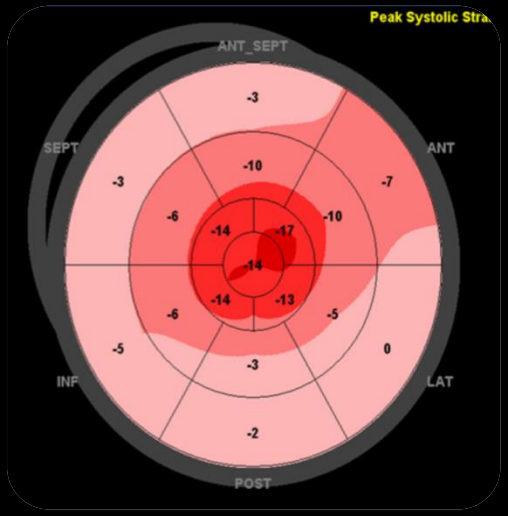
Transthyretin amyloidosis ?

- Amyloidosis is an infiltrative disease characterized by extracellular deposition of fibrillary protein into one (localized) or multiple organs (diffuse or systemic).
- Important cause of restrictive cardiomyopathy and congestive heart failure.
- Two major types of cardiac amyloidosis:
  - Cardiac amyloid light-chain (AL),
  - Transthyretin-related cardiac amyloidosis (ATTR)



- Differentiating the type of cardiac amyloidosis (AL vs ATTR) is crucial in guiding patient care.
- Endomyocardial biopsy with immunohistochemistry staining is the gold standard for the diagnosis.
- Electrocardiogram, echocardiography, and cardiac magnetic resonance imaging (CMR)
- *Nuclear imaging:*
  - 99m Tc-DPD (technetium-3,3-diphosphono-1,2-propanodicarboxylic acid) and 99m Tc-PYP (technetium pyrophosphate)
  - PET…

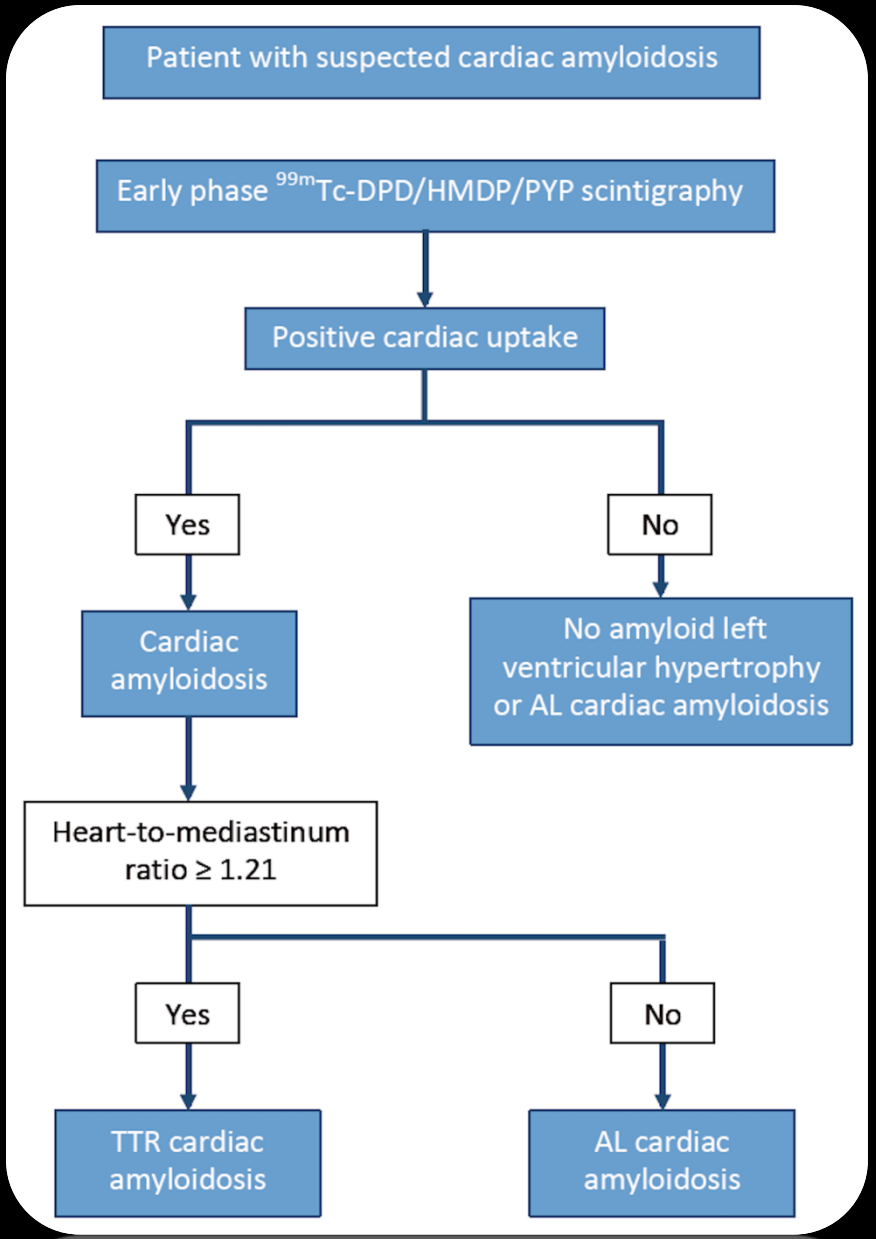


Bone scintigraphy with transthyretin amyloidosis

- Multicenter study 1200 patients
- >99% sensitive and 86% specific for TTR CA,
- With false positives almost exclusively from uptake in patients with AL CA.
- The combined findings of visual score 2 or 3 myocardial radiotracer uptake on bone scintigraphy and the absence of a monoclonal protein in serum or urine has a specificity and positive predictive value for TTR CA of 100%

Gillmore JD, Maurer MS, Falk RH, et al. Nonbiopsy Diagnosis of Cardiac Transthyretin Amyloidosis. *Circulation.* 2016;133:2404-2412.

Galat A, Van der Gucht A, Guellich A, et al. Early Phase 99Tc-HMDP Scintigraphy for the Diagnosis and Typing of Cardiac Amyloidosis. *JACC Cardiovasc Imaging*. 2016;8:30352-30357.



Methods

- Fifty patients with TTR cardiac amyloidosis

- **^{99m}Tc- hydroxymethylene-diphosphonate (^{99m}Tc-HMDP) scintigraphy**:

Cardiac retention by scintigraphy was assessed by visual scoring and the heart/whole body (H/B) ratio was calculated by dividing counts in the heart by counts in late whole body images.

- **Echocardiography:**

Measure of LV morphology, longitudinal strain (LS), systolic and diastolic functions.

0= absent cardiac uptake and intense bone uptake;

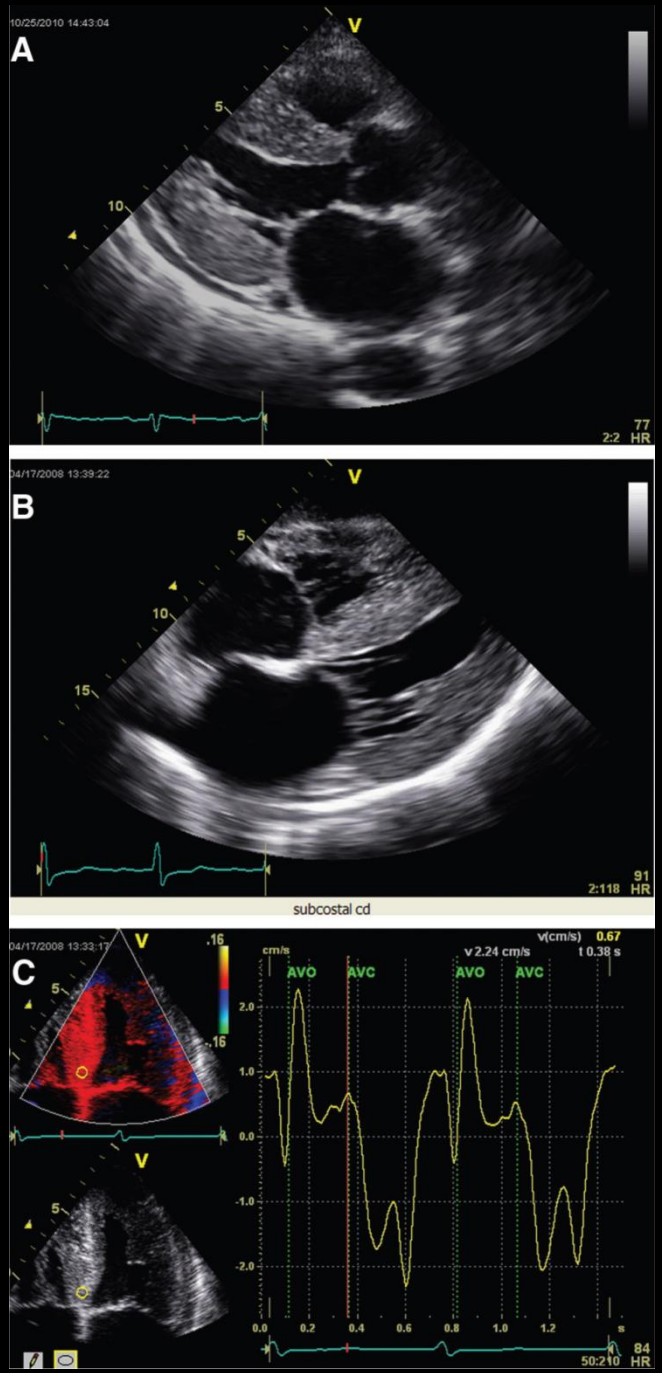
1 = mild cardiac uptake < bone uptake

2 = moderate cardiac uptake = bone uptake

3 = high cardiac uptake >bone uptake.

Quantitative assessment using heart retention, and heart to whole body retention, is assessed using counts in the region of interest.

Bone scintigraphy for cardiac amyloidosis imaging: Past, present and future
Médecine Nucléaire, Volume 41, Issue 2, Pages 108-114



Increased LV wall thickness (ATTR/AL); overlap with other infiltrative disease such as hypertrophic CM, severe LVH, Fabry's disease

Increased interatrial septal thickness, pleural and pericardial effusion, valve thickening (non-specific)

Apical sparring on Bull's eye plot of Global Longitudinal strain: SN 96%, SP 88% (in patients without CAD). Does not differentiate AL vs ATTR

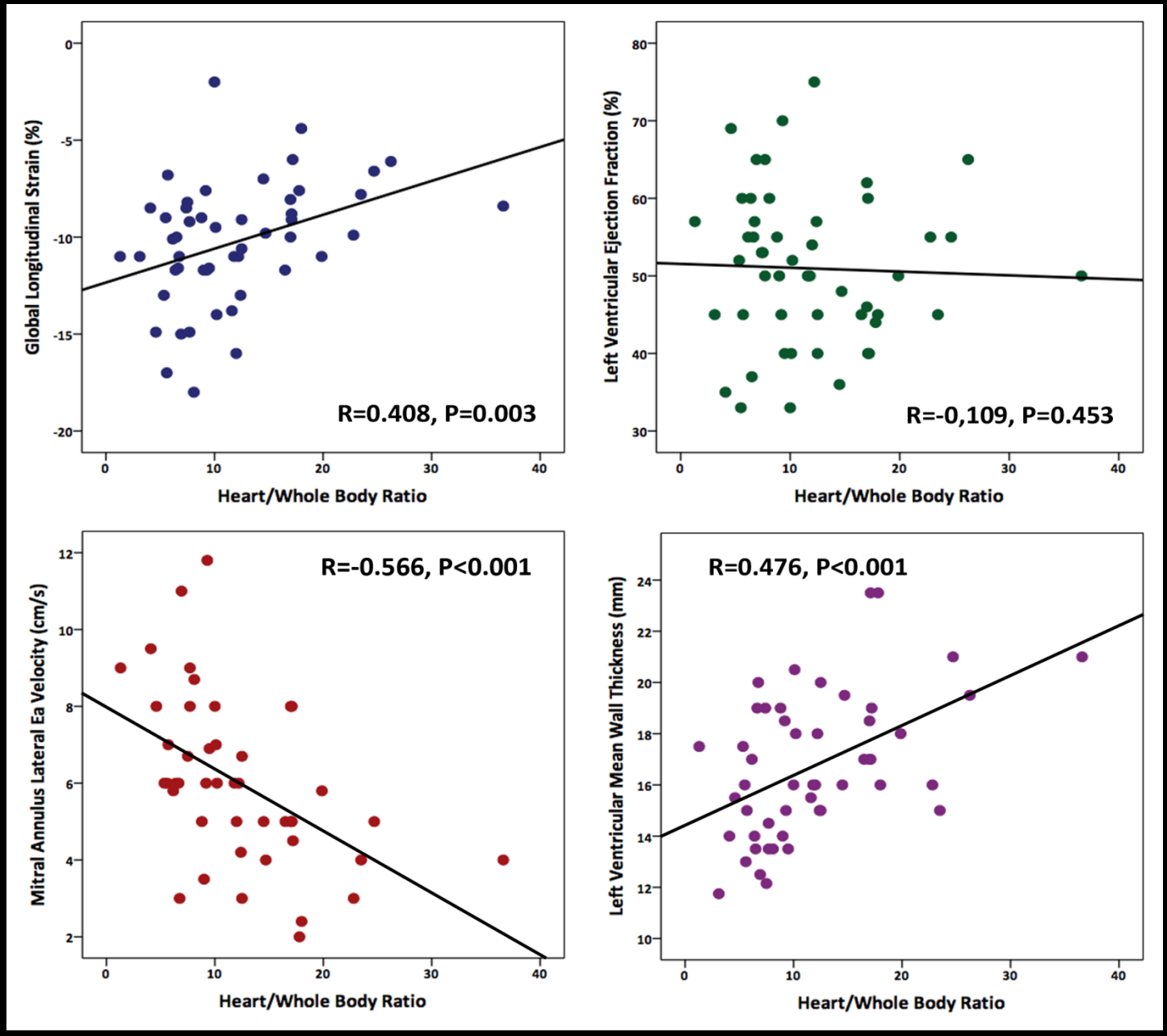
Strain longitudinal
Ea
mean left ventricular wall thickness
E/Ea ratio
LVEF

Results

- Mean population age : 79±10 years.
- Visual score:
  - 2 for 6 patients (12%)
  - 3 for 44 patients (88%)
- Mean H/WB ratio: 12±7.
- Mean LV ejection fraction and global LS were 51±10% and -10±3%, respectively.

Results (2)

- H/WB ratio was correlated with:
  - global LS (R=0.408, P=0.003),
  - Ea (R=-0.566, P<0.001)
  - mean left ventricular wall thickness (R=0.476, P<0.001)
- ….but not with LV ejection fraction (R=-0,109, P=0.453).
- Segmental myocardial uptake normalized by H/WB ratio was correlated with segmental LS (n = 850 segments, R = 0.162, P<0.001).
- H/WB ratio was not correlated with NT-proBNP levels (R=0.219, P=0.148) neither E/Ea ratio (R=0.204, P=0.184).


Global Longitudinal Strain (%)
0
-5
-10
-15
-20
R=0.408, P=0.003
0
10
20
30
40
Heart/Whole Body Ratio
Left Ventricular Ejection Fraction (%)
80
70
60
50
40
30
R=-0,109, P=0.453
0
10
20
30
40
Heart/Whole Body Ratio
Mitral Annulus Lateral Ea Velocity (cm/s)
12
10
8
6
4
2
R=-0.566, P<0.001
0
10
20
30
40
Heart/Whole Body Ratio
Left Ventricular Mean Wall Thickness (mm)
24
22
20
18
16
14
12
10
R=0.476, P<0.001
0
10
20
30
40
Heart/Whole Body Ratio

Conclusion

In patients with TTR cardiac amyloidosis, myocardial uptake by ^{99m}Tc-HMDP scintigraphy is correlated with decrease of myocardial LS.