Cardiovascular Disease in the Dialysis Patient : A view through the lens of the transplant evaluation

Janani Rangaswami, MD

Associate Clinical Professor of Medicine, Sidney Kimmel College of Thomas Jefferson University

Associate Program Director, Department of Medicine

Einstein Medical Center Philadelphia

Delaware Valley Nephrology and Hypertension Associates , Philadelphia.

Key components of the cardiovascular evaluation

- Cardiomyopathy and its management in ESKD
- Optimization of volume status
- Pulmonary hypertension
- Valvular heart disease in CKD
- Introduction to atherosclerotic cardiovascular disease in ESKD

Cardiomyopathy in the dialysis patient

- A resting echocardiogram should be performed on all patients at the initiation of dialysis once the patient has achieved their dry weight (1-3 months) [1,2]
- Baseline echocardiographic abnormalities are common [3]. These include : LVH in 73%, dilated LV in 36% and systolic dysfunction in 15%.

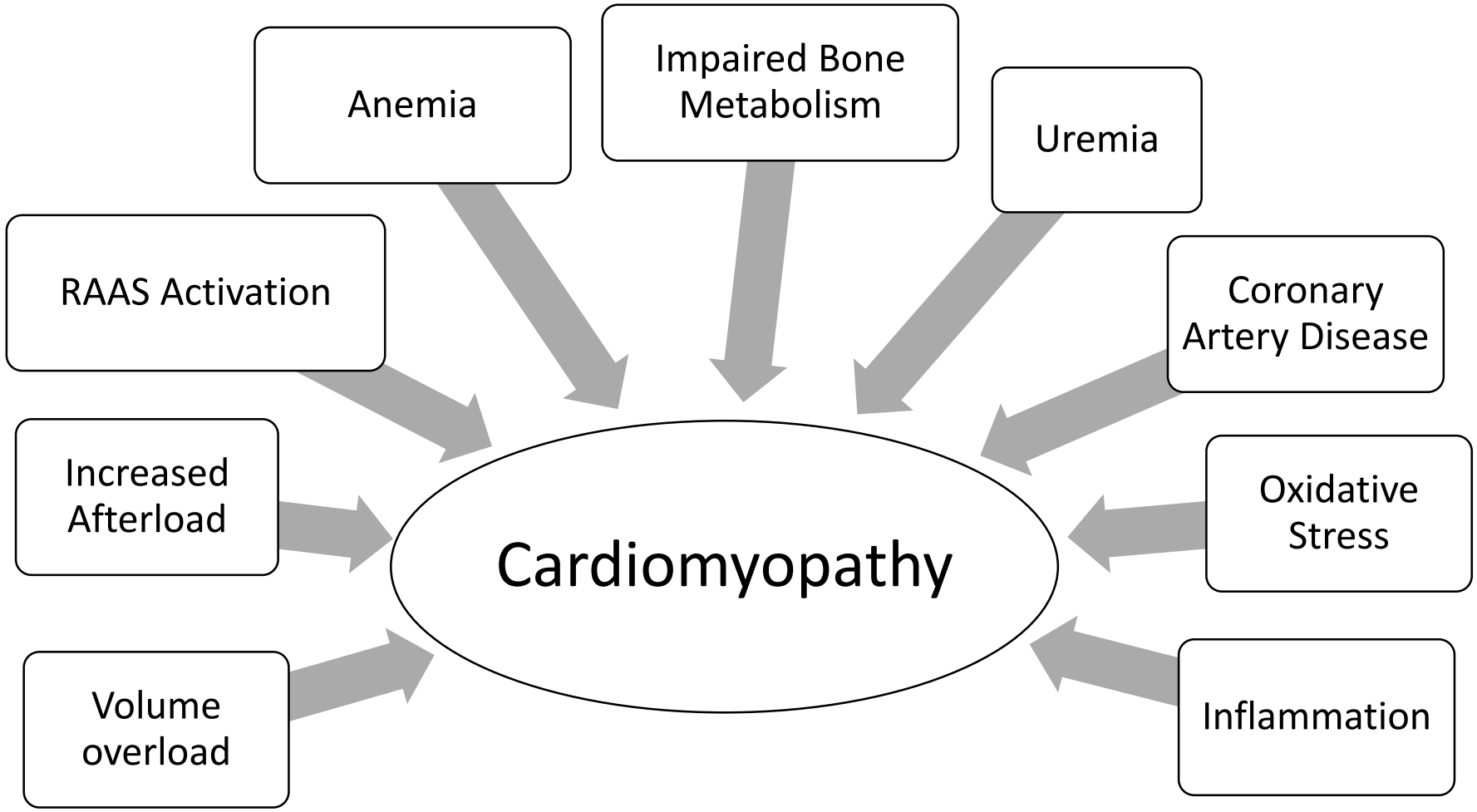
- 1. NKF/K DOQI Clinical Practice Guidelines for Cardiovascular Disease in Dialysis Patients
- 2.Lentine KL, Costa SP et al : Cardiac Disease Evaluation among Kidney and Liver Transplantation Candidates. Circulation 2012.
- 3. Bergeron S et al . Prognostic value of Dobutamine stress echocardiography in patients with chronic kidney disease. Am Heart J 2007.

Cardiomyopathy in the dialysis patient

- In another large single center experience, EF< 40% was associated with a median survival of 49 months compared to 72 months with higher EF [4]. After adjustment for ischemia and other risk factors, the RR of mortality increased by 2.5% with each percent decline in LVEF.

- In one of the largest series of 1254 dialysis patients [5], Yamada et al reported 7 year event free rates from CV death were 84.2%, 83.7%, 73.6%, 59.4% and 30.9% respectively for each 10% decline in EF .

- 4. de Mattos AM et al. Systolic dysfunction portends increased mortality amongst those waiting for renal transplant. J Am Soc Nephrol 2008.
- 5.Yamada S et al. Prognostic value of reduced left ventricular ejection fraction at strart of hemodialysis therapy on cardiovascular and all cause mortality in end stage renal disease patients . Clin J Am Soc Nephrol 2010.


Anemia
Impaired Bone Metabolism
Uremia
RAAS Activation
Coronary Artery Disease
Increased Afterload
Oxidative Stress
Cardiomyopathy
Volume overload
Inflammation

Volume status optimization : The 5 B s

- Balance of fluids
- Blood Pressure
- Biomarkers
- Bio Impedance
- Blood Volume

- Ronco et al . Seminars in Nephrology Vol 32, No 1 Jan 2012 .

Zoccali C et al Blood Purification
2013

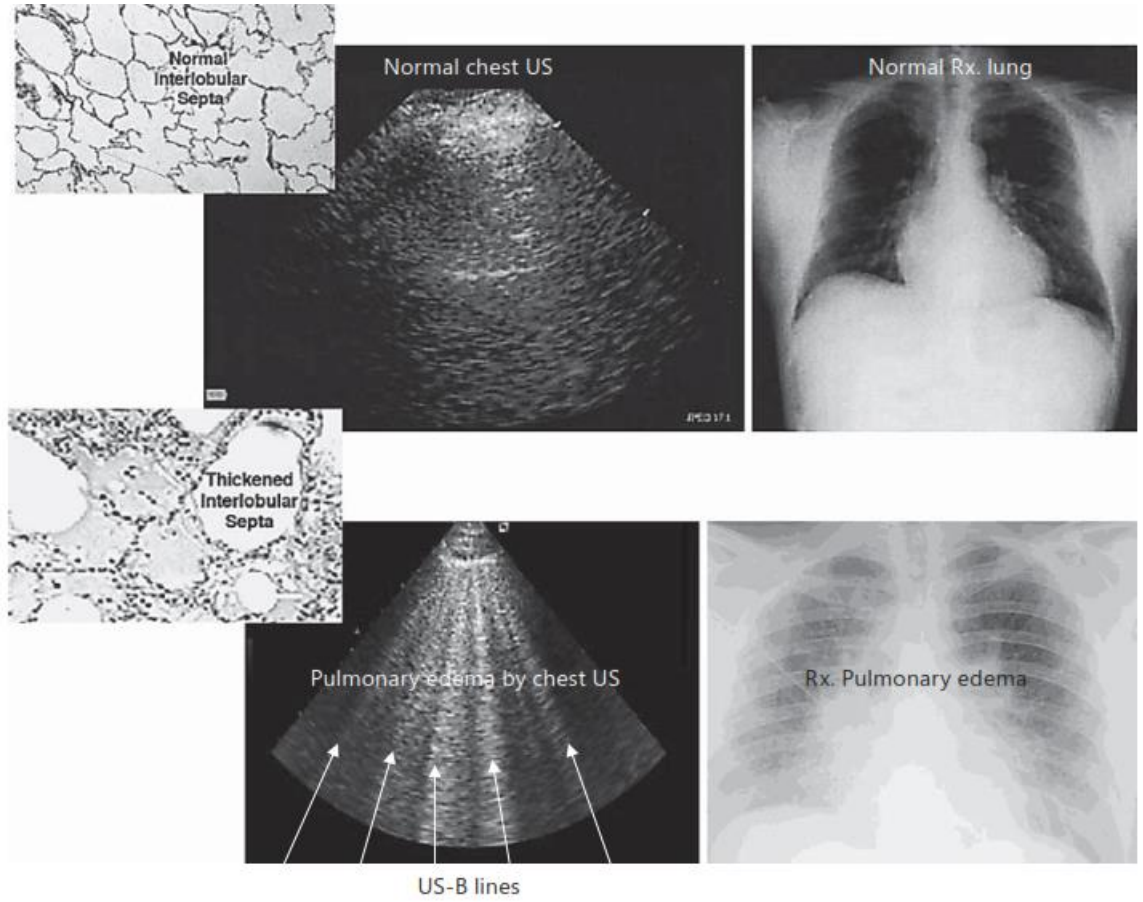


Fig. 2. Chest US in normal condition and in pulmonary edema. In normal condition, US beams are not or minimally reflected by the normal interalveolar septa and the scan gives a uniformly black image. In pulmonary edema, the reflection of the US by edematous, thickened alveolar septa produces characteristic reverberations that represent the US equivalent of B lines in the standard chest radiogram.

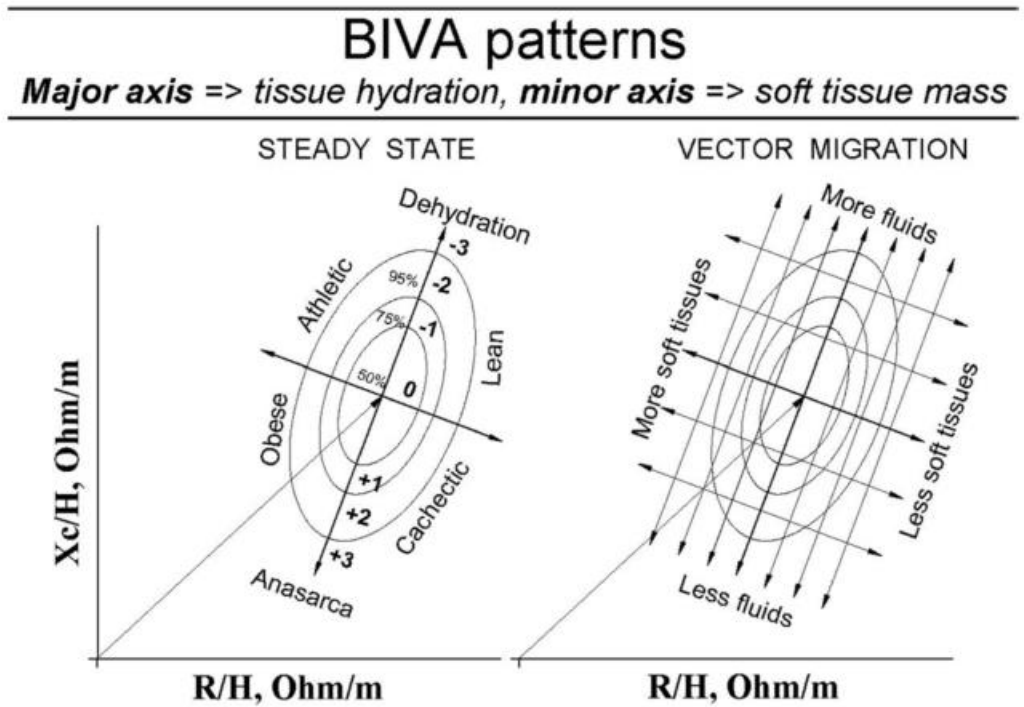


Figure 7. BIVA. The ellipsis describes the hydration and nutrition status domain. Optimal status is at the center of the domain and vector migration toward different directions represents an alteration of the nutritional/hydration status of the patient. Subsequent examinations are useful to establish a trend.

Ronco et al Seminars in Nephrology
2012

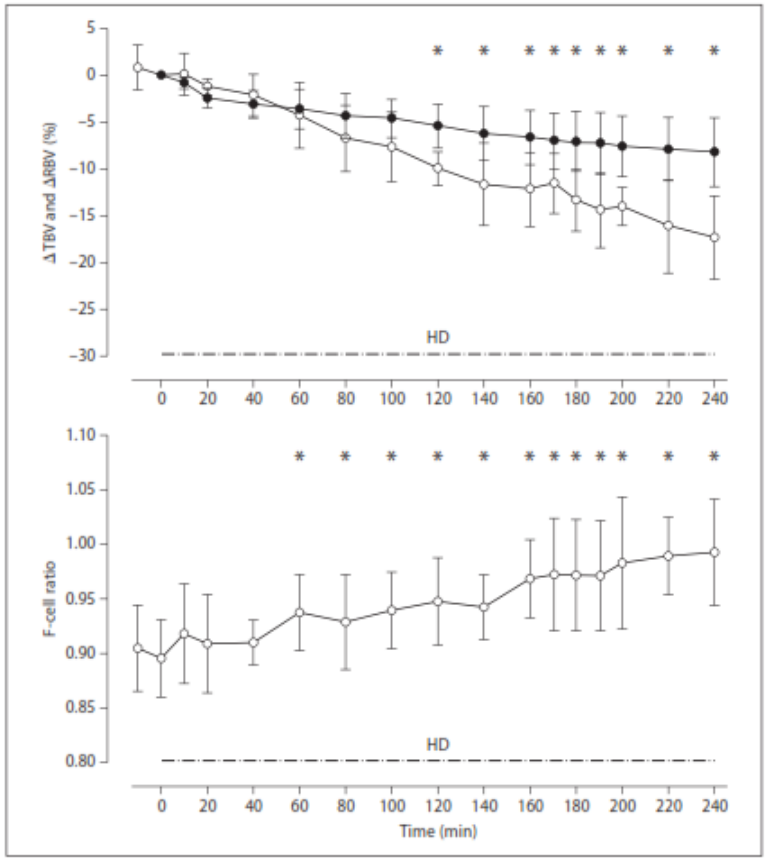


Fig. 2. Upper panel: course of total blood volume changes (ΔTBV;○) and RBV changes (ΔRBV;●) during HD. Data represent the means ± SD of 7 patients. * Indicates $p < 0.05$ between the two curves. Lower panel: course of the F-cell ratio (○) during HD. * Indicates $p < 0.05$ in comparison with the start of HD.

Dasselaar et al Blood Purification 2012

Segmental Synchronicity Page

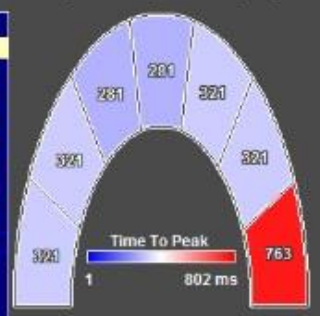
Velocity | Displacement | Strain | Strain Rate

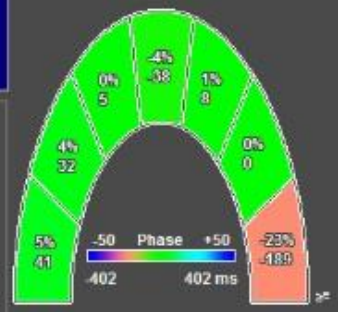
Back

Transverse Strain

Seg.	Pk %	TPk ms
03-basal septal	43.068	321
09-mid septal	62.916	321
14-apical septal	55.354	281
17-apex	23.649	281
16-apical lateral	45.463	321
12-mid lateral	47.494	321
Average	38.993	321

Maximum Opposing Wall Delay : 442 ms

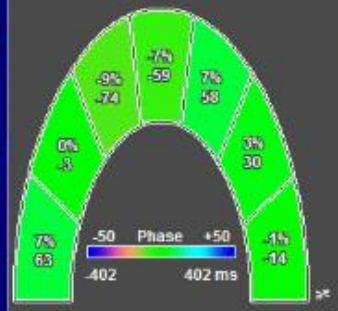


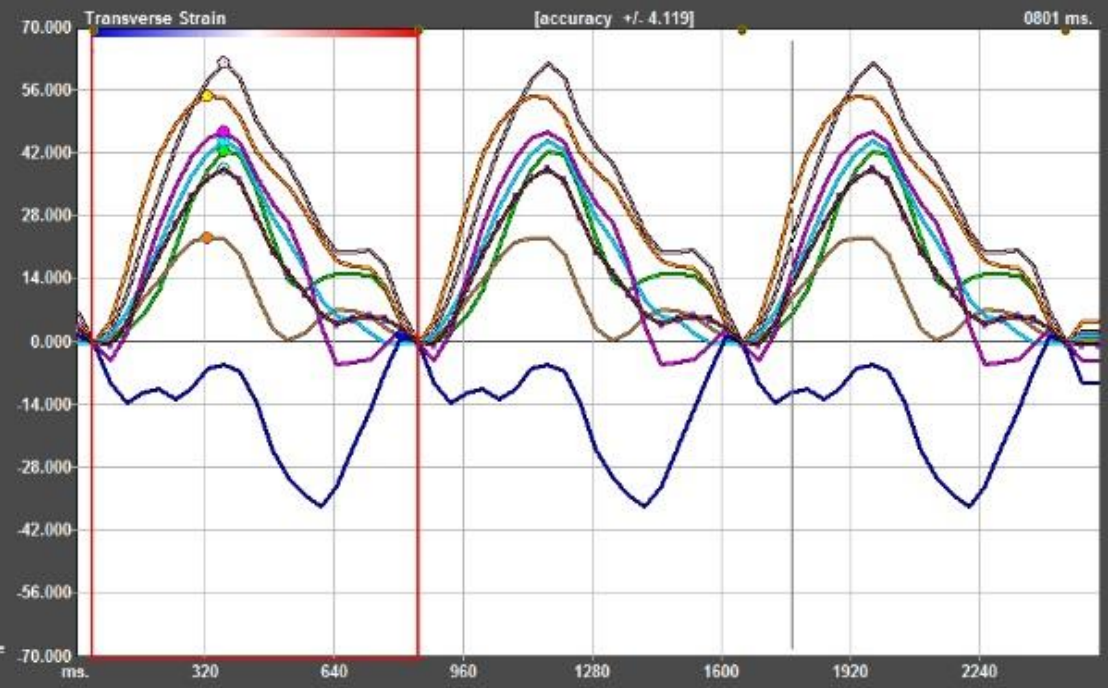


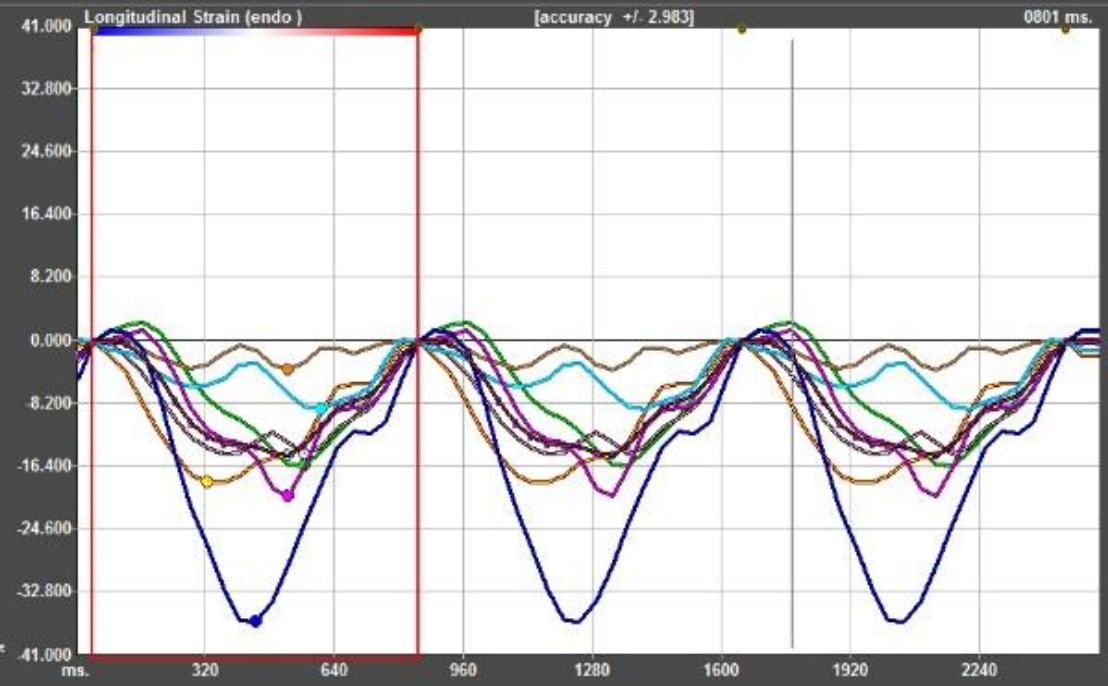
Longitudinal Strain (endo)

Seg.	Pk %	TPk ms
03-basal septal	-16.269	522
09-mid septal	-14.848	522
14-apical septal	-18.593	281
17-apex	-3.734	482
16-apical lateral	-8.842	562
12-mid lateral	-20.332	482
Average	-15.006	482
GLS	-17.78%	482

Maximum Opposing Wall Delay : 281 ms







R-R

Average

Reverse Peak

Radial | Long/Rot

Segment Model

16 | 17

History

1 Endo

2 Endo

3 Endo

Joint Evaluation for cardiomyopathy in ESKD

Cardiology

- Baseline 2 D echocardiography
- Speckle echocardiography
- CMR
- Evaluation for coronary ischemia
- Optimize medical management of HFrEF

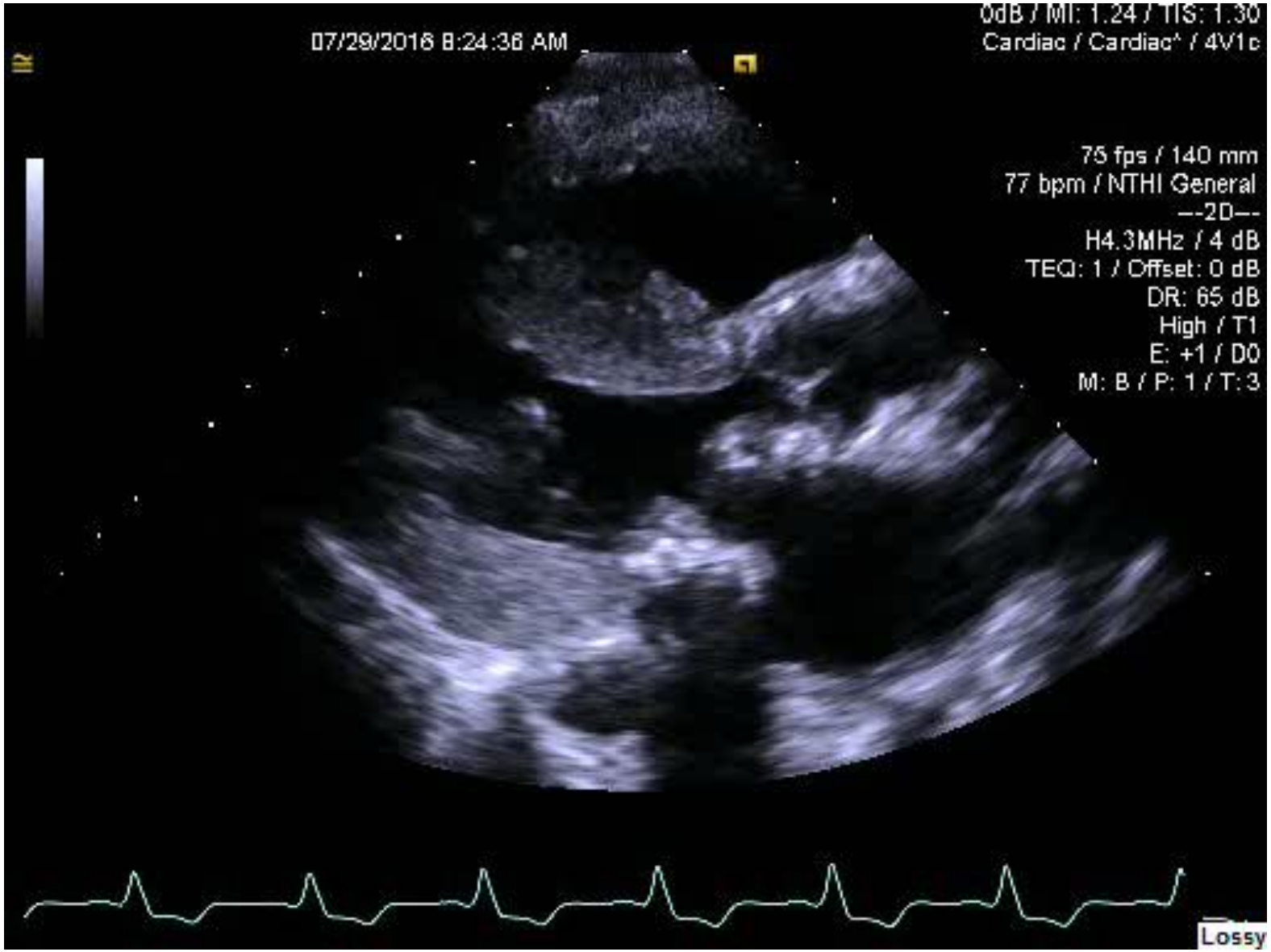
Nephrology

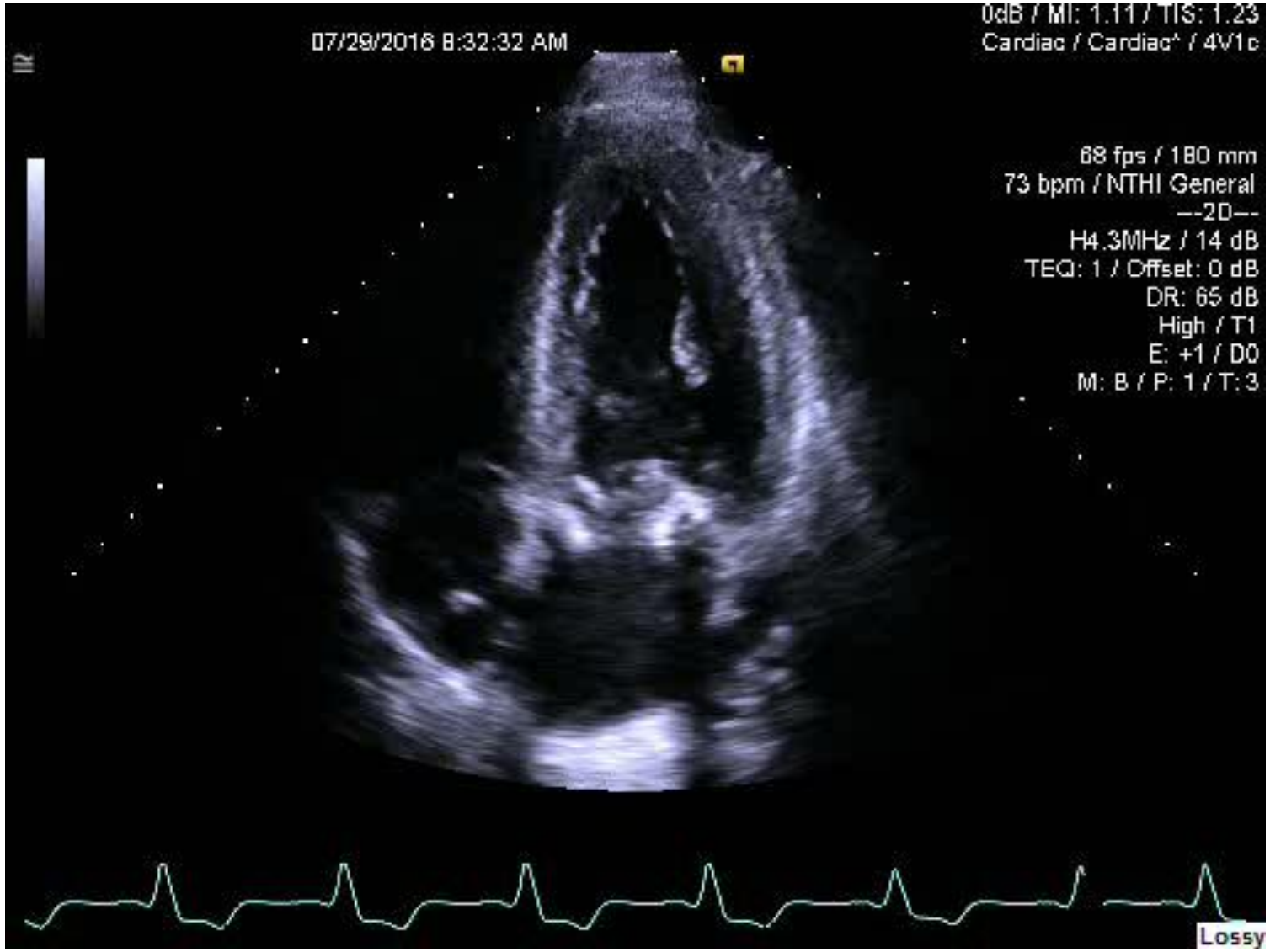
- Baseline 2D echocardiography
- Input on interdialytic and intradialytic hemodynamics
- Optimization of drug choice and dosing
- Adjunct use of novel techniques for optimal volume management

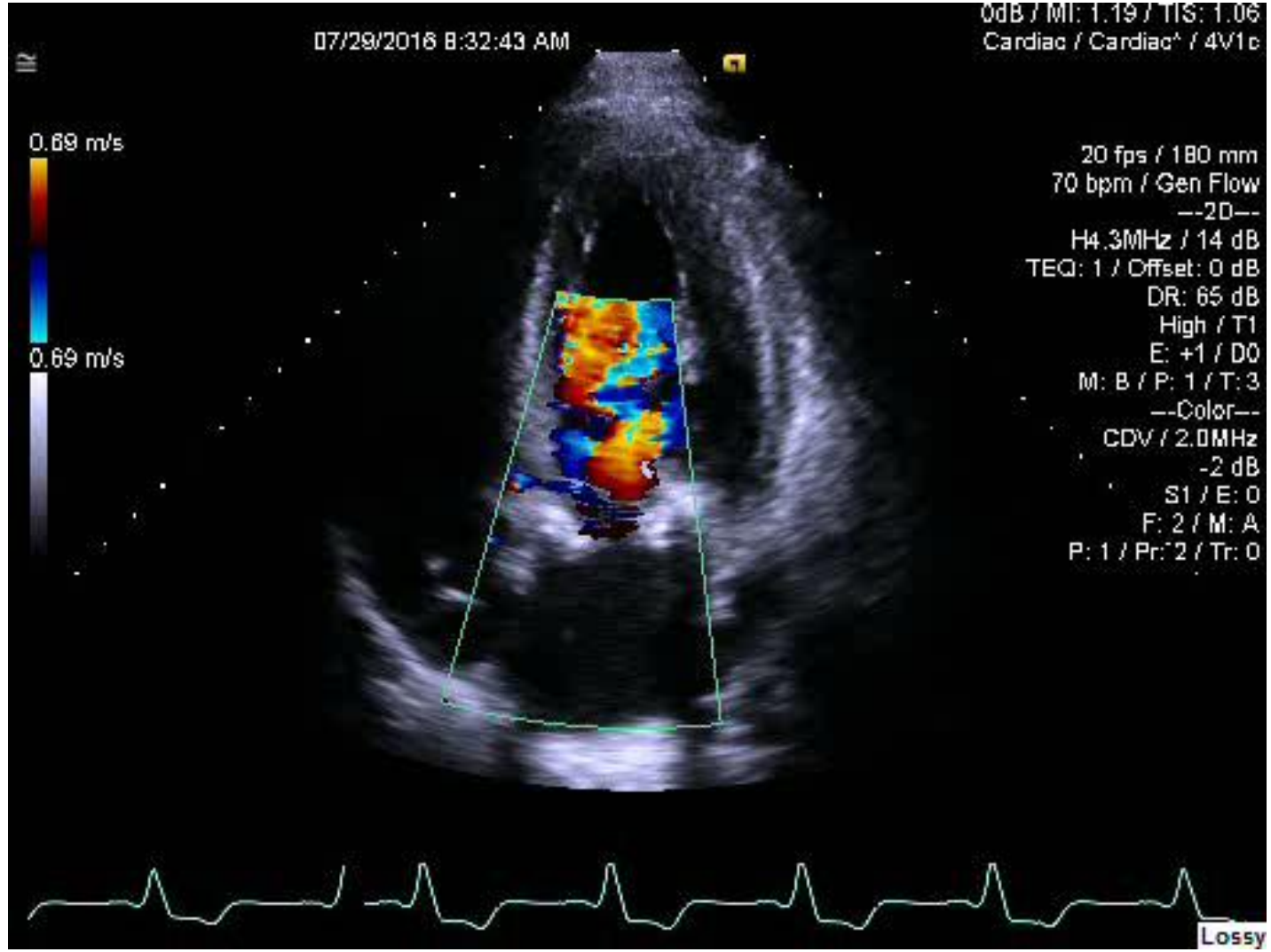
Valvular calcification in ESKD

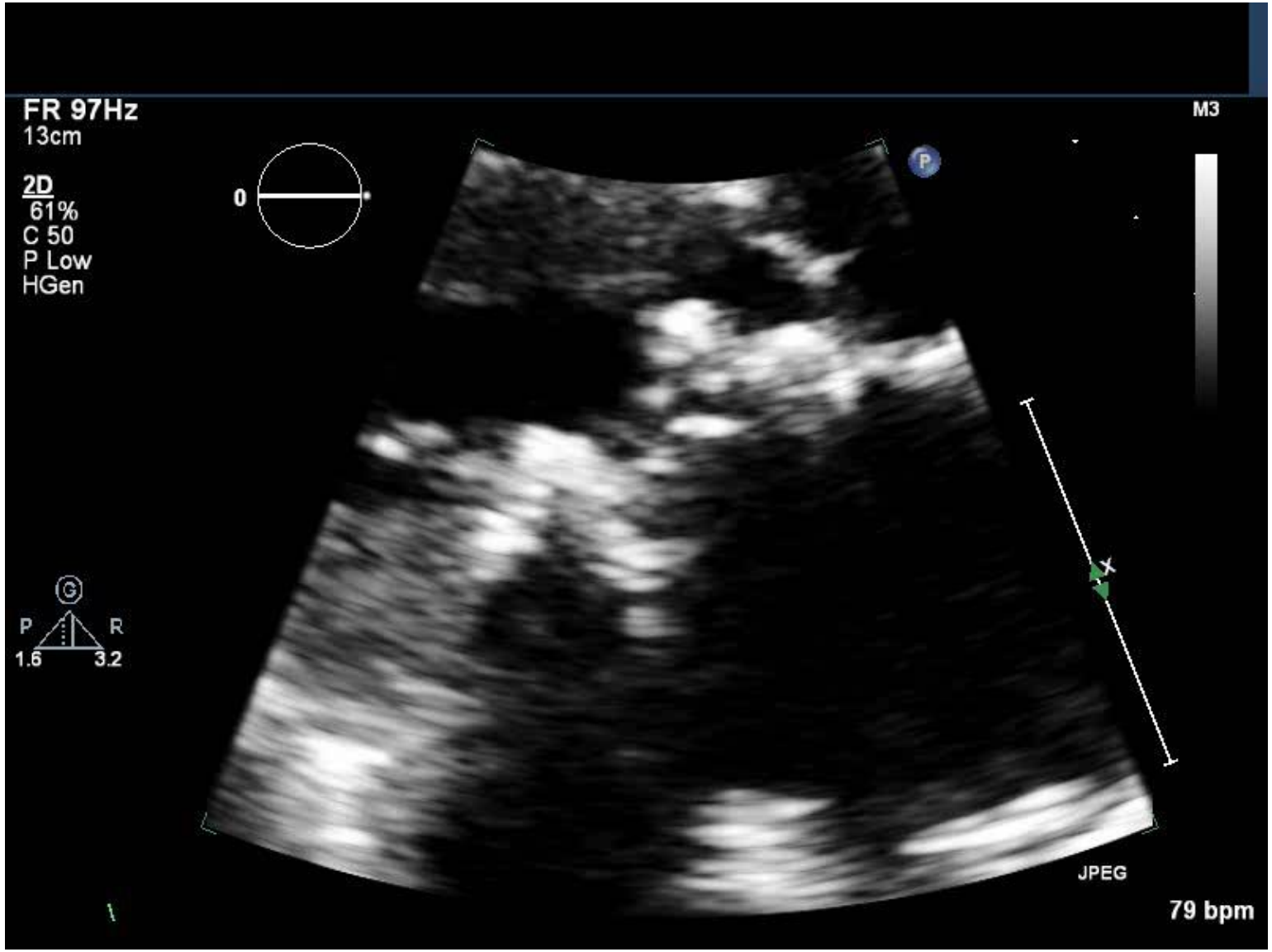
- The CKD inflammatory milieu combined with abnormal calcium/phosphate metabolism is a set up for accelerated valvular calcification in ESKD, based on several observational studies
- Thee progression of aortic stenosis is approximated to be 0.23 cm/yr as compared to 0.05-0.1 cm/yr, classifying these patients as “ rapid progressors .” [6]
- Optimal prosthetic valve choice for replacement should involve input from the nephrologist with respect to bleeding risk and indications/contra indications for warfarin.

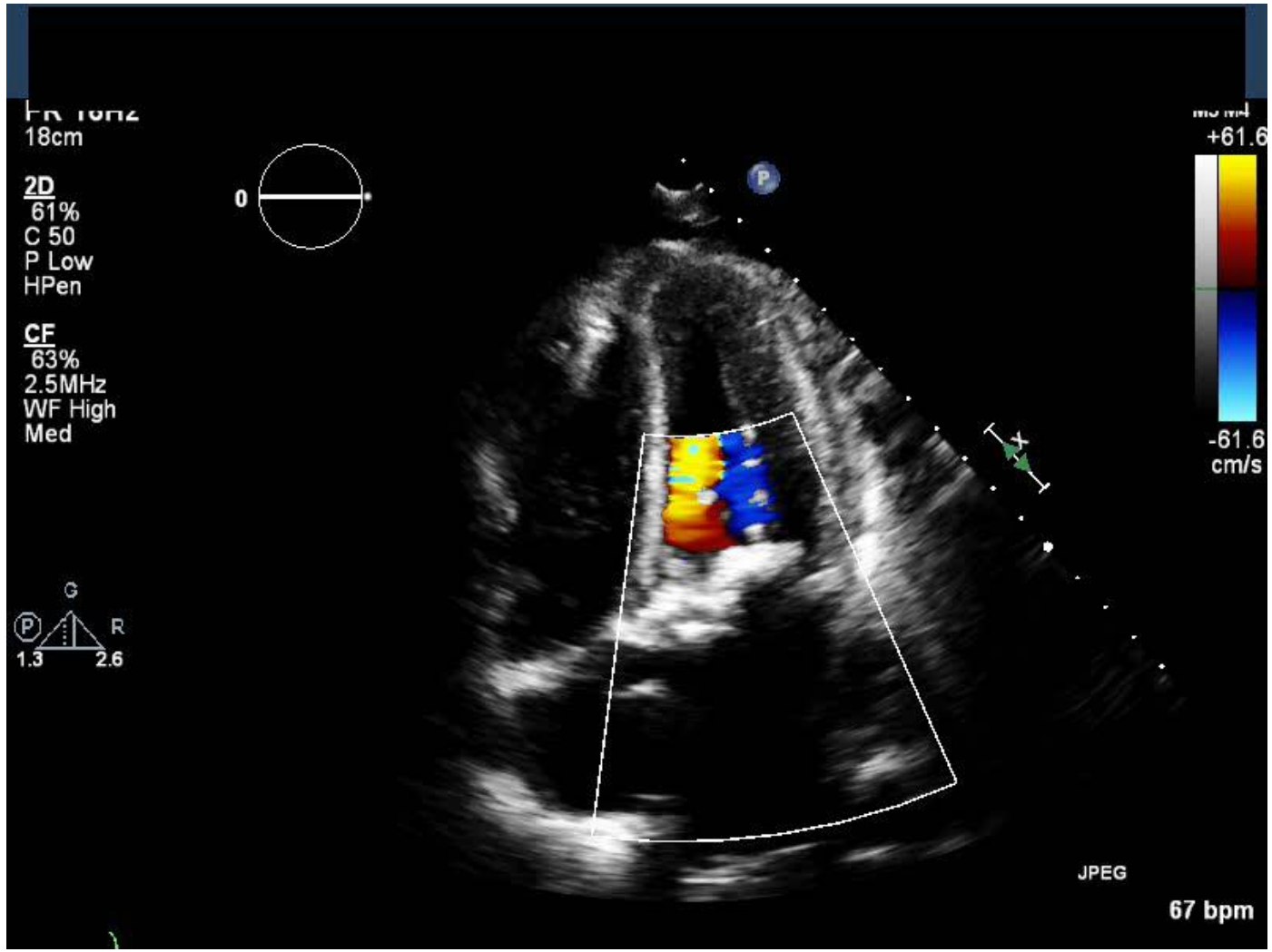
- 6. K/DOQI Workgroup. K/DOQI clinical practice guidelines for cardiovascular disease in dialysis patients . Am J Kidney Diss 2005.


07/29/2016 8:24:36 AM
0dB / MI: 1.24 / TIS: 1.30
Cardiac / Cardiac^ / 4V1c
75 fps / 140 mm
77 bpm / NTHI General
--2D--
H4.3MHz / 4 dB
TEQ: 1 / Offset: 0 dB
DR: 65 dB
High / T1
E: +1 / D0
M: B / P: 1 / T: 3
Lossy


07/29/2016 8:32:32 AM
0dB / MI: 1.11 / TIS: 1.23
Cardiac / Cardiac^ / 4V1c
68 fps / 180 mm
73 bpm / NTHI General
--2D--
H4.3MHz / 14 dB
TEQ: 1 / Offset: 0 dB
DR: 65 dB
High / T1
E: +1 / D0
M: B / P: 1 / T: 3
Lossy


07/29/2016 8:32:43 AM
0dB / MI: 1.19 / TIS: 1.06
Cardiac / Cardiac^ / 4V1c
0.69 m/s
0.69 m/s
20 fps / 180 mm
70 bpm / Gen Flow
--2D--
H4.3MHz / 14 dB
TEQ: 1 / Offset: 0 dB
DR: 65 dB
High / T1
E: +1 / D0
M: B / P: 1 / T: 3
--Color--
CDV / 2.0MHz
-2 dB
S1 / E: 0
F: 2 / M: A
P: 1 / Pr: 2 / Tr: 0
Lossy


FR 97Hz
13cm
2D
61%
C 50
P Low
HGen
0
M3
P
X
G
P
R
1.6
3.2
JPEG
79 bpm


18cm
2D
61%
C 50
P Low
HPen
CF
63%
2.5MHz
WF High
Med
0
+61.6
-61.6
cm/s
G
R
1.3
2.6
JPEG
67 bpm

Joint approach to optimization of valvular heart disease

Cardiology

- Recognize the high prevalence of rapid progressors
- Optimize timing of follow up for progression of VHD and timely intervention based on risk/benefit ratio.
- Discuss anticoagulation strategy with the nephrologist to minimize bleeding risk.

Nephrology

- Recognize the impact of progressive VHD and hemodynamics at dialysis
- Optimize risk factors for calcification based on dialysis prescription and BMD guidelines

Pulmonary hypertension in ESKD

- PH is increasingly recognized as an important predictor of survival in patients with ESKD
- Many of the comorbidities for PH groups 1-5 are highly prevalent in ESKD. Given that many of these also increase in prevalence with age, it is not surprising that the prevalence of PH is significant in the elderly with ESKD [7]

- 7.EBPG Expert Group on Renal Transplantation. European Best Practice Guidelines for Renal Transplantation. Nephrol Dial Transplant 2000.

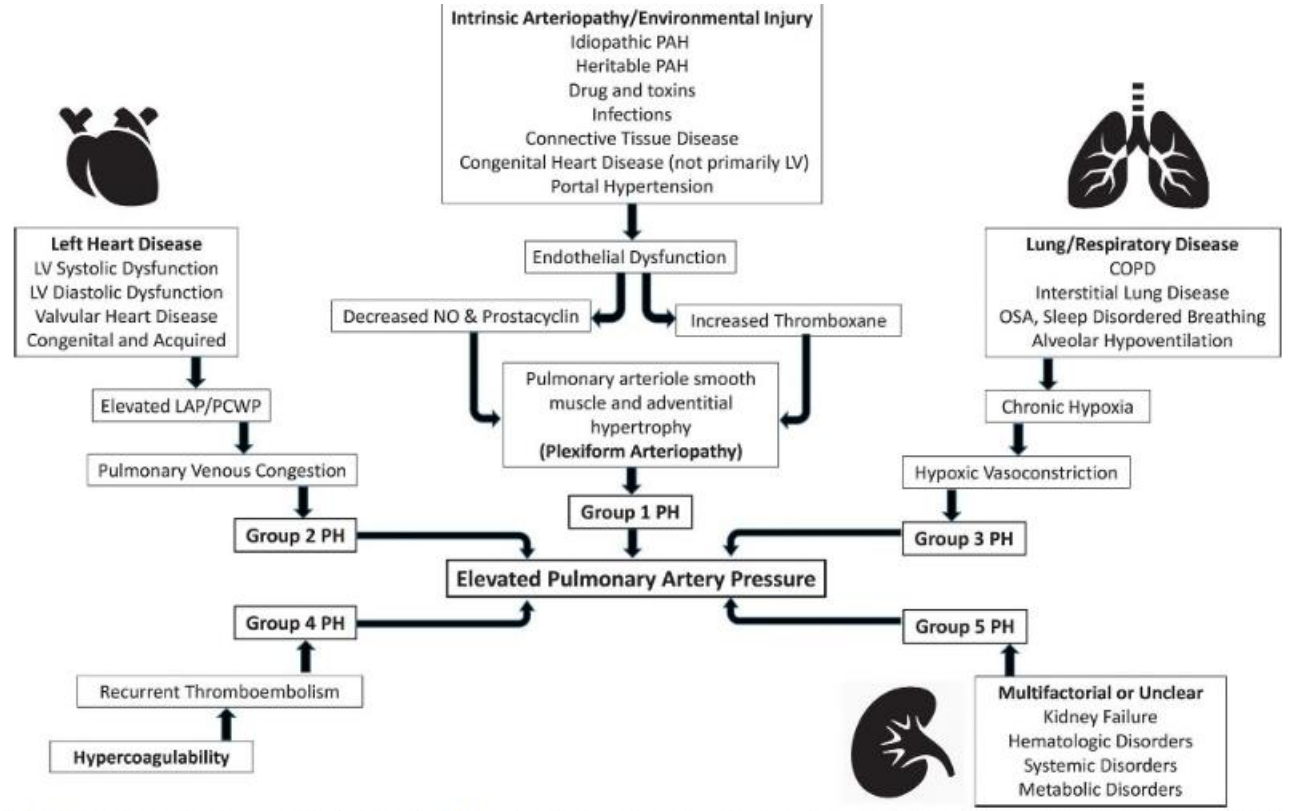


FIGURE 1. Conceptual framework for the physiology of pulmonary hypertension based on underlying disease states intrinsic to or affecting the pulmonary vasculature, as currently categorized by the WHO.[13] COPD, chronic obstructive pulmonary disease; NO, nitric oxide.

Lentine KL et al : Transplantation
2017

Joint Cardio Nephrology evaluation of Pulmonary Hypertension in ESKD

Cardiology

- 2 D echocardiography to estimate PA pressures
- Appropriate use of right heart catheterization to define etiology of PH
- Appropriate interventions based on probable etiology

Nephrology

- Optimization of volume status
- Monitoring of blood flows in AV access
- Monitoring for thrombo-embolic events contributing to PH
- Screening for OSA in the dialysis clinic

Introduction to CAD in ESKD

- The transplant evaluation might be the portal to identifying ischemia in the asymptomatic ESKD patient .
- Symptoms for ischemia are underwhelming in the dialysis population. Chest pain is less common as the initial presenting symptom, dyspnea is more likely to be present. [8,9]
- Hemodynamics at dialysis may help identify patients with potential ischemia[10] .

- 8. Sosnov J et al. Differential symptoms of acute myocardial infarction in patients with kidney disease. Am J Kidney Disease 2006.
- 9. Almehmi A et al. Silent myocardial ischemia is more prevalent in patients undergoing multi vessel coronary angioplasty. J Am Soc Nephrol 2009.
- 10.Soliman RA et al. Assessment of hypotension during dialysis as a manifestation of myocardial ischemia in patients with chronic renal disease. Egy Journal Crit Care. 2014

All stress tests are not created equal in CKD

- While stress testing is used widely in ESKD for risk stratification, there is significant controversy over its use compared to invasive angiography[11]
- Underlying abnormal baseline ECG findings limit the utility of exercise ECG testing[12] .
- Across a wide collection of studies , DSE and MPS had sensitivities ranging from 0.44 to 0.89 and 0.29 to 0.92 respectively, and specificities ranging from 0.71-0.94 and 0.67-0.89 respectively .

- 11.Wang LW et al. Cardiac testing for coronary artery disease in potential kidney transplant recipients. Cochrane Database Syst Reviews.2011.
- 12. Sharma R et al. Dobutamine exercise echocardiography and resting but not exercise electrocardiography predict severe coronary artery disease in renal transplant candidates. Nephrol Dial Transpl 2005.

Cardio Nephrology Oriented Quality Improvement Projects in the Dialysis Clinic

- Establish baseline echocardiography in all patients 1-3 months after dialysis initiation
- Establish cardiology communication pathways for each patient
- Bleeding risk assessment based on antiplatelet and anticoagulation therapy .
- Use of adjunct techniques for volume status monitoring .
- Establish center based cardio-nephrology programs that facilitate the cardiovascular risk stratification and optimization of risk factors on dialysis .