

The Challenging CRT Non-Responder

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Case 1

- 42 year old white man referred for transplant evaluation
- Hospitalized 3 times in 3 months for decompensation; treated each time with IV diuretics and inotropes
- PMH
 - S/P remote MI; CABG
 - Abdominal aortic aneurysm repair
 - Aorto-bifemoral repair
 - Diabetes

Review of Symptoms

- CC: “chronic, never-ending fatigue”
- Sleeps on 4 pillows, + PND, + nocturia x 3
- Appetite fair, frequent bloating, early satiety
- Able to walk only short distances before SOB, fatigue occurs
- Denies dizziness, palpitations, angina

Medications

- Lisinopril 20 mg qd
- Furosemide 100 mg bid
- KDur 40 mEq bid
- Spironolactone 25 mg qd
- Carvedilol 25 mg bid
- Digoxin 0.125 mg qd
- Atorvastatin 40 mg qd
- Glucotrol XL 10 mg qd

Examination

- Ht 74 inches, wt 220 lbs, BMI 28
- BP sitting 98/64, standing 90/66
- HR 64 reg, +S₃, systolic murmur of MR
- Lungs clear, slightly decreased in bases
- JVD 8-10 cm with +HJR
- Abdomen benign
- No peripheral edema

Tests

- CXR: cardiomegaly
- ECG: QRS 140 msec
- Echo: LVEF 20%, anterolateral akinesis, LVEDD 60 mm, 3+ mitral regurgitation
- 6 Minute Walk 205 m (+SOB, leg fatigue)
- CPX: VO_2 16 ml/kg/min
- Labs WNL, BNP 880 pg/mL

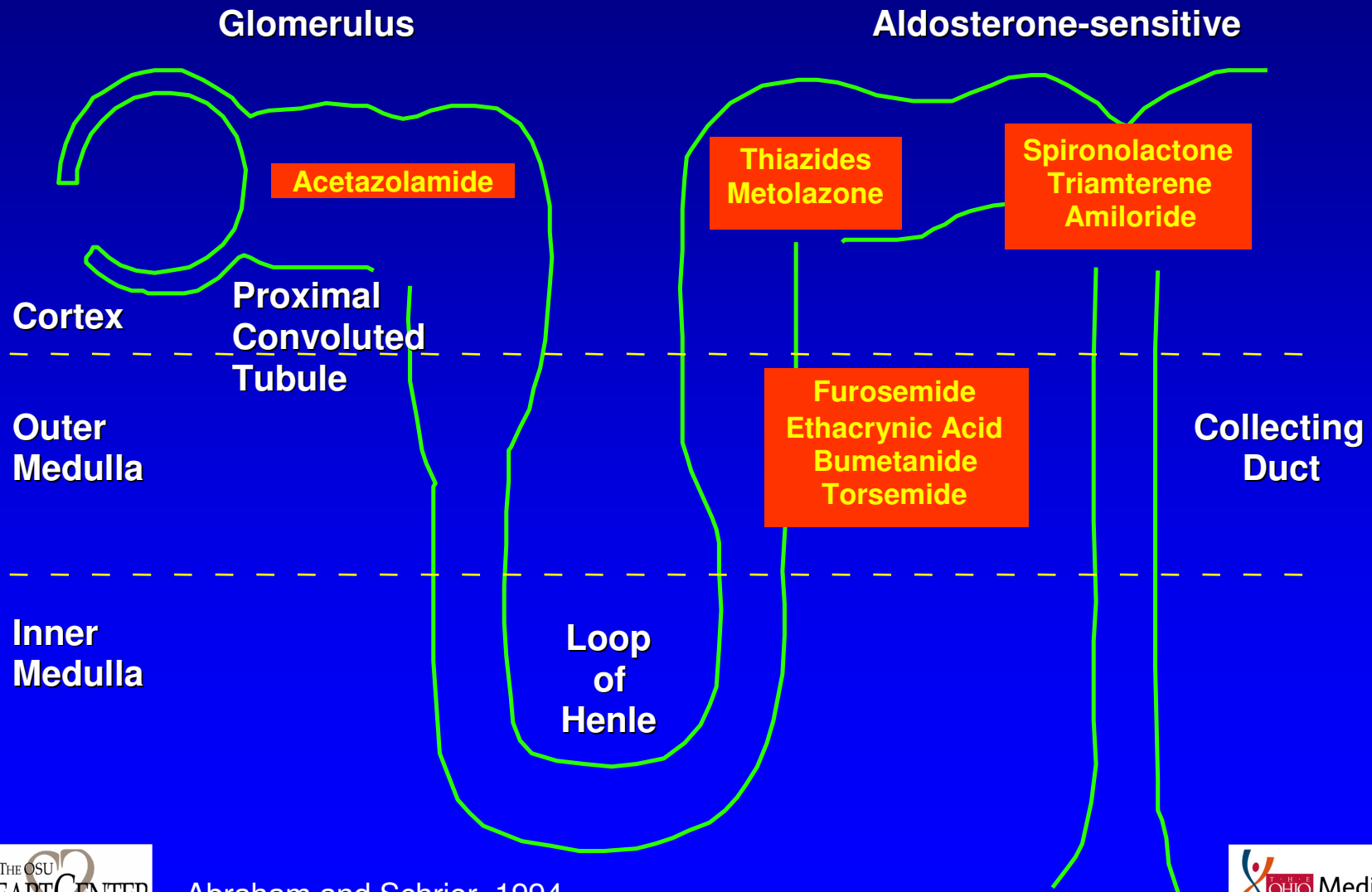
What would you do initially to treat this patient?

1. Increase furosemide
2. Change or add diuretics
3. Implant a CRT-D device
4. Evaluate for transplantation
5. Refer for an LVAD

Answer: Change or Add Diuretics

- Serial Assessment and Management of Volume Status is a Level I recommendation in the 2005 ACC/AHA heart failure guidelines
- Assessment of all patients in all stages
 - *“Assessment should be made at each visit of volume status...”*
- Therapy for patients with symptomatic HF
 - *“Diuretics and salt restriction are indicated in patients...who have evidence of volume retention”*
- Advanced disease
 - *“Meticulous identification and control of fluid retention is recommended”*

Tubular Sites of Action of Commonly-used Diuretics



Case 1 Continued

- Diuretic is switched from furosemide to torsemide and low-dose thiazide is added with good response
- Exam improves with resolution of JVD but +S₃ persists
- Sleeps on 2 pillows with infrequent PND
- Able to walk only short distances before SOB, fatigue occurs

What would you do next to treat this patient?

1. Increase torsemide
2. Add long-acting nitrate \pm hydralazine
3. Implant a CRT-D device
4. Evaluate for transplantation
5. Refer for an LVAD

Answer: Implant a CRT-D Device

- Class I Indication: Patients with LVEF $\leq 35\%$, sinus rhythm, and NYHA functional Class III or ambulatory Class IV symptoms despite recommended optimal medical therapy and who have cardiac dyssynchrony, which is currently defined as a QRS >120 msec, should receive CRT, unless contraindicated

Level of Evidence: A

ICD Indication for This Patient

- Class I Indication: Implantable cardioverter defibrillator therapy is recommended for primary prevention to reduce total mortality by a reduction in sudden cardiac death in patients with ischemic heart disease who are at least 40 days post-MI, have an LVEF less than or equal to 30%, with NYHA functional class II or III symptoms while undergoing chronic optimal medical therapy and have a reasonable expectation of survival... (Level of Evidence: A)



Hunt SA, Abraham WT, Chin MH, et al., Circulation and JACC, Sept. 2005



Case 1 Continued

- CRT-D device is implanted with “out of the box” settings
- 1 month later, patient complains of feeling worse since CRT
- Sleeps on 4 pillows with nightly PND
- Increasing JVD, +S₃, and 2+ edema
- Unable to walk even short distances before SOB, fatigue occurs

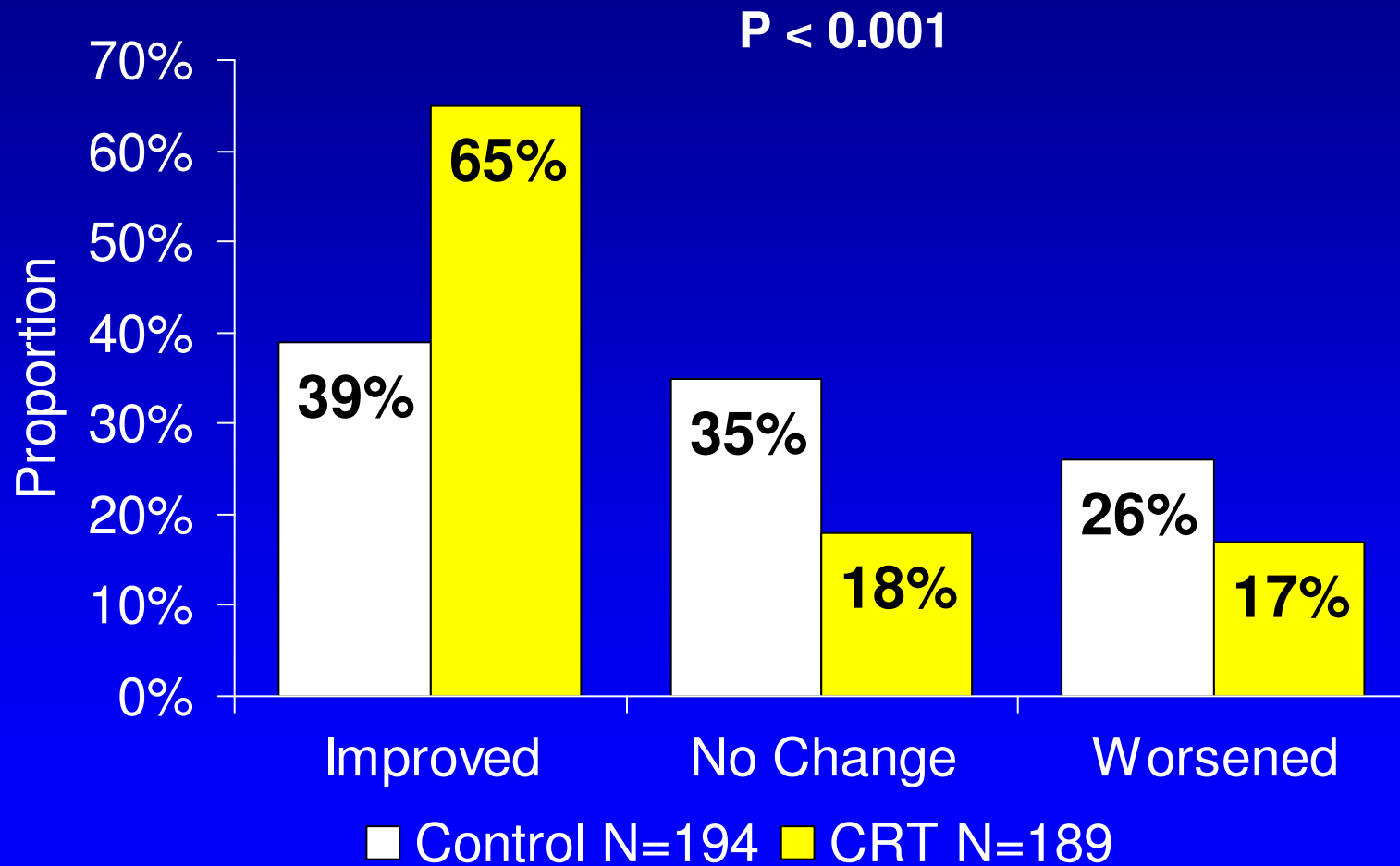
What is the probable cause of his decompensation?

1. Medical non-compliance
2. Dietary indiscretion
3. Suboptimal CRT
4. A new “event” (ischemia, arrhythmia)
5. All of the above

Answer: All of the Above

- Many factors may lead to worsening heart failure
 - Further damage to the myocardium
 - Increased workload (e.g., hypoxia, anemia, pulmonary embolism, infection)
 - Dietary or pharmacological noncompliance
 - Negative inotropes (e.g., anti-arrhythmics, Ca⁺⁺ antagonists)
 - Worsening renal function (esp., NSAIDs)
 - Arrhythmias
 - Worsening valvular dysfunction
- It is important to determine and treat the cause and DON'T forget the device

Non-Responders to CRT



Which may cause non-responsiveness to CRT?

1. Wrong AV/VV timing
2. Poor lead placement
3. Failure to deliver therapy
4. CHF disease progression
5. All of the above

Answer: All of the Above

- Fact of the matter is we don't know for sure what predicts responsiveness to CRT

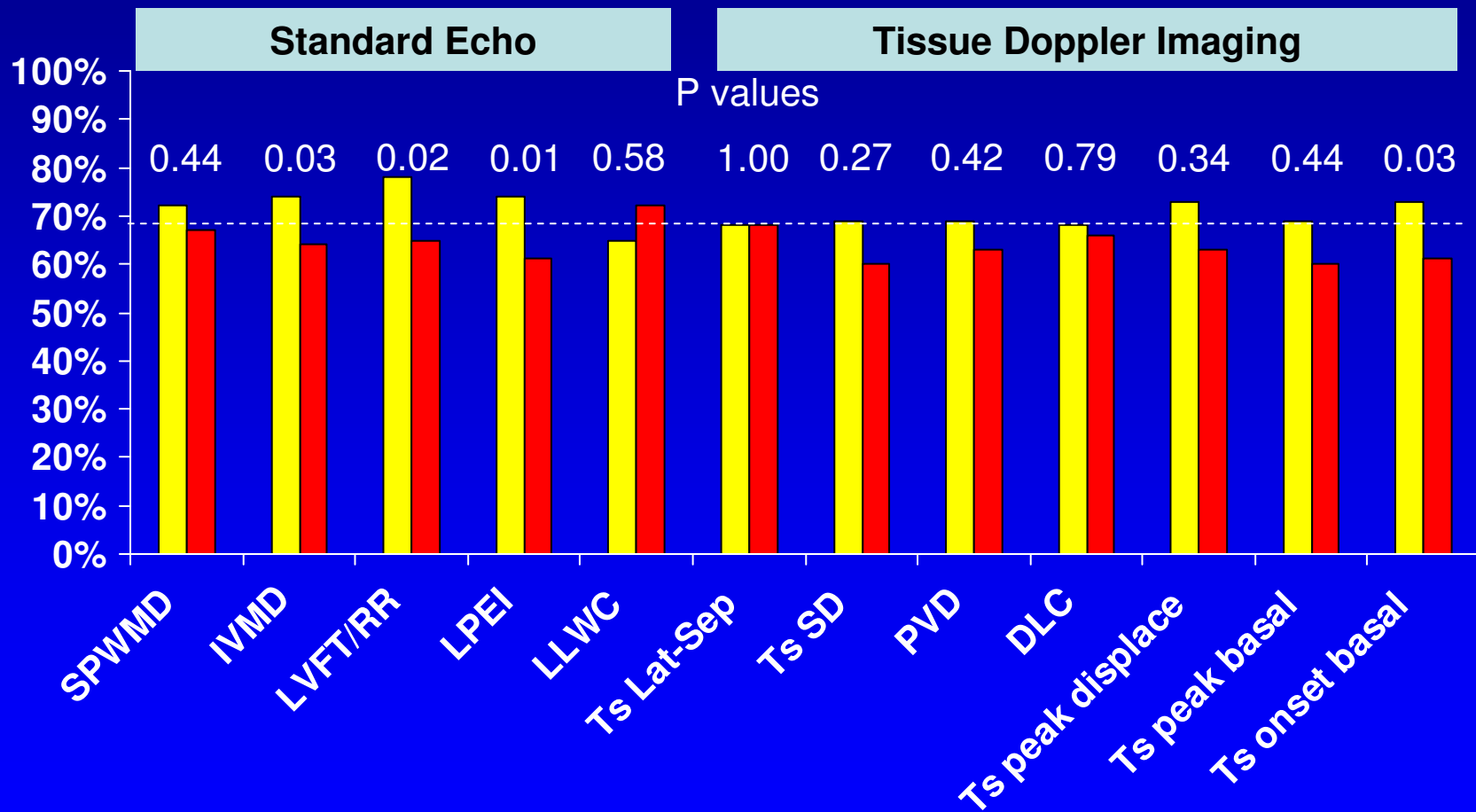
Possible Determinants of CRT Response

- Patient Selection
 - Clinical characteristics
 - Assessment of dyssynchrony
- Ventricular Lead Placement
 - Anatomical location
 - Electrical activation pattern
 - Segment of dyssynchrony
 - Tissue characteristics
 - Local myocardial response

Possible Determinants of CRT Response

- CRT Optimization
 - AV delay
 - VV delay
 - Percent pacing
- Follow-Up Care
 - Optimization of drug therapies
 - Ongoing device optimization

Predictive Value of Echo Dyssynchrony Measures for an Improved Clinical Composite Score



■ Cut-off criteria met
■ Cut-off criteria not met



Case 1 Continued

- Patient admitted to hospital
- RHC: RA 12, PA 50/24 (35), PCWP 22, CO 4.5, CI 2.0
- Device interrogation revealed intrinsic QRS 140 ms, paced QRS 180
 - Additional testing revealed loss of capture with LV lead (VVI)
- Device reprogrammed to optimized DDD pacing mode
 - Patient reports immediate improvement in fatigue

Discussion

- VVI pacing in CHF
 - Decreases systolic blood pressure
 - Increases right heart pressures
 - In some studies as much as 25%¹
 - Decreases cardiac index
 - Results in worsened heart failure morbidity and mortality

Now what?

1. Increase carvedilol to 50 mg bid
2. Schedule for LV lead revision
3. Work-up for cardiac transplantation
4. Refer for an LVAD
5. No changes necessary

Answer: Revise LV Lead

- Clinical improvement following lead revision and 3 months of actual CRT
- NYHA class II
- LVEF 32%
- 6MHW 323 m, VO₂ 18.4 mL/kg/min