

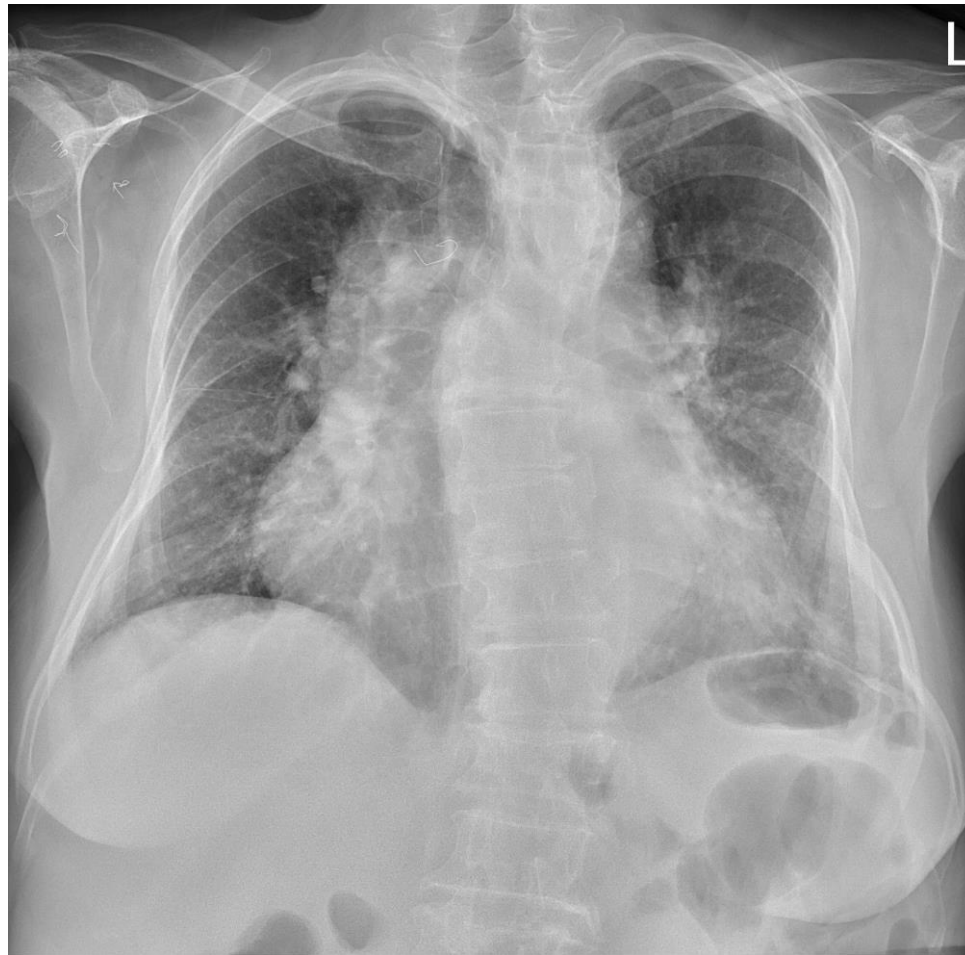
A case of heart failure with preserved ejection fraction

Kyungpook National University Hospital
Se Yong Jang

Brief history

- F/75
- C/C Dyspnea of exertion
 - 6개월전부터 시작되는 운동 시 호흡곤란을 주소로 내원
 - 1-2주전부터 감기증상이 있으면서 증상 심해짐
 - HTN/DM(-/-)
 - Non-smoker
 - Compression fracture 병력
 - BP 141/63 mmHg , HR 100 bpm
 - RR 17회/min, BT 36.5'C

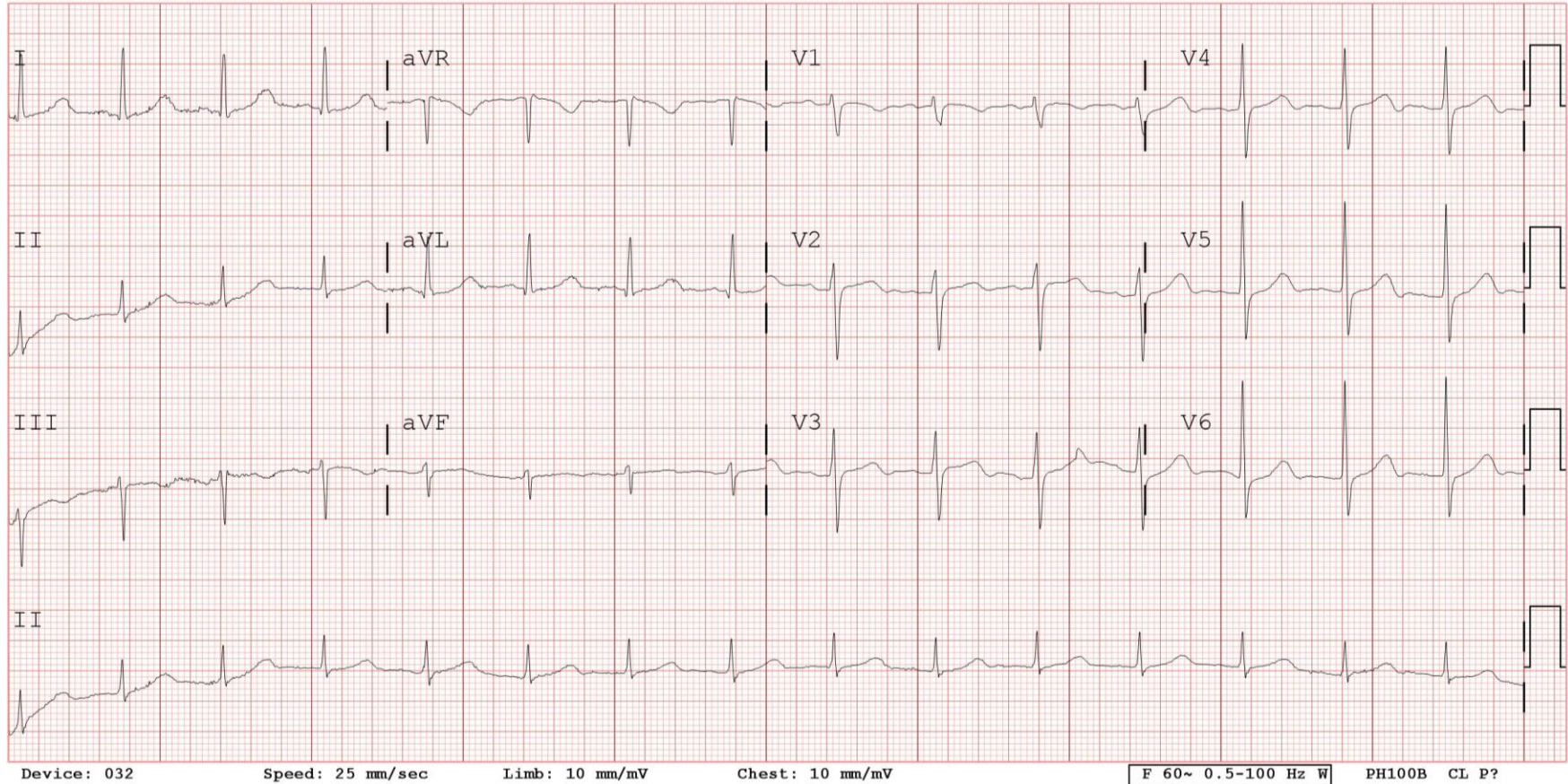
Chest x-ray



Initial ECG

KNUH - KNUH (500-50000-00)

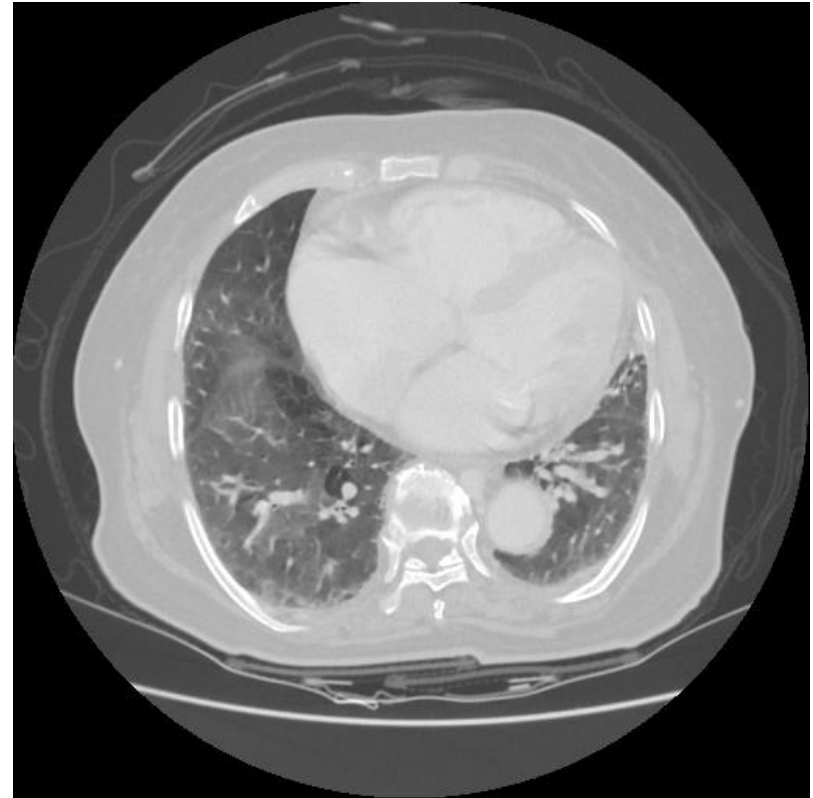
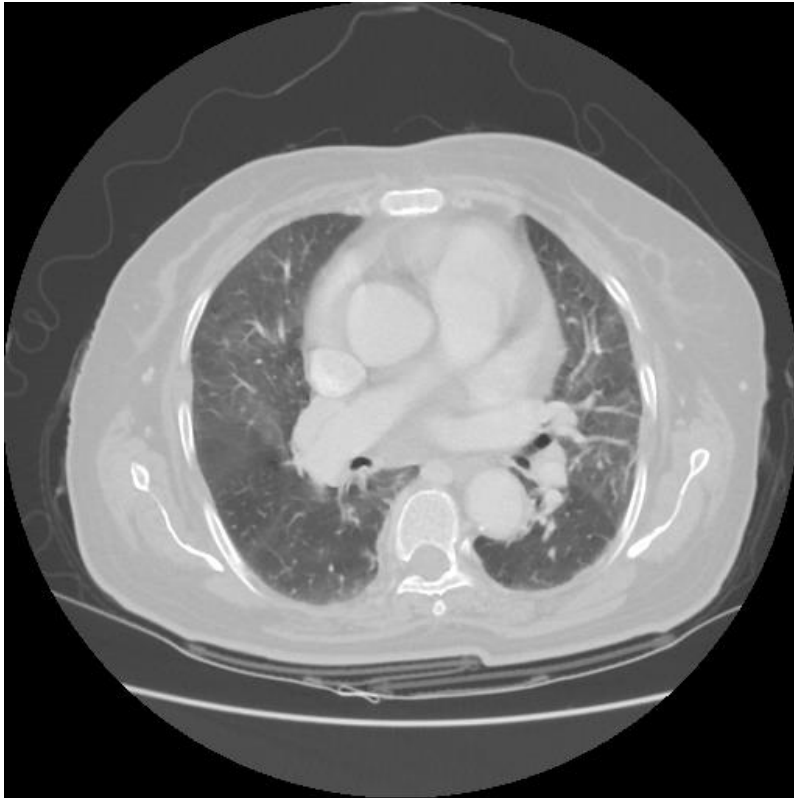
Not confirmed



Laboratory test

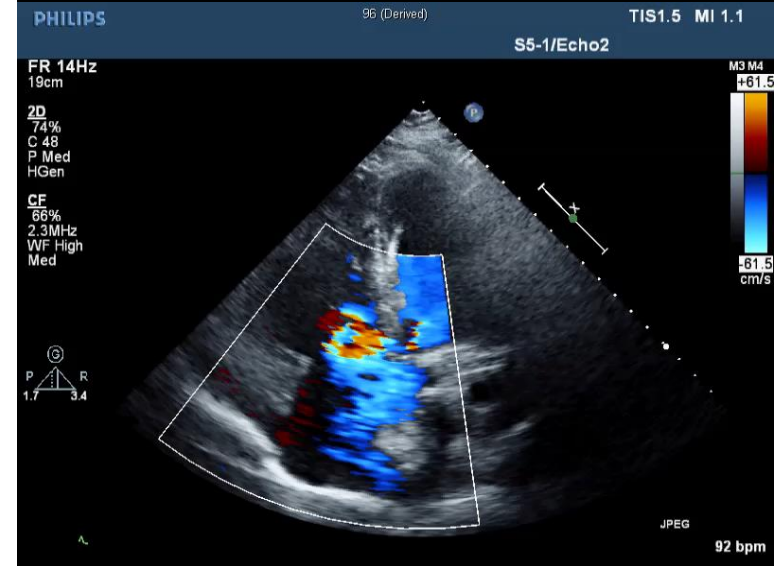
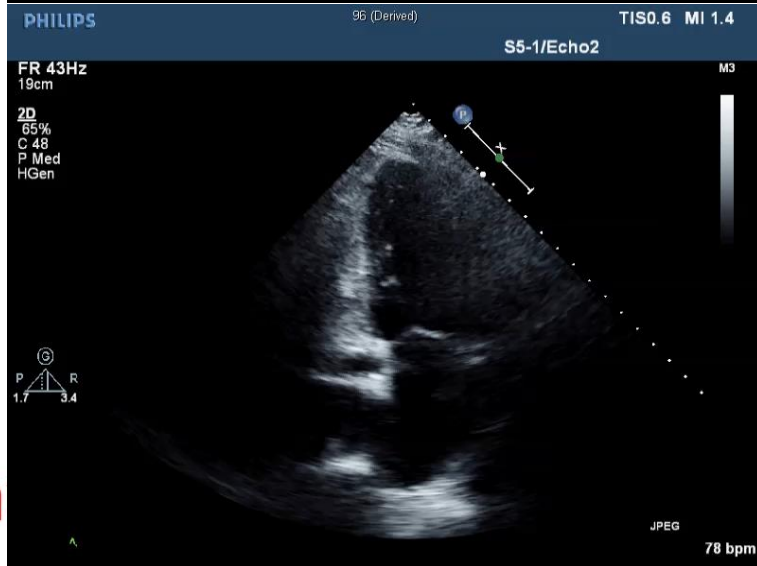
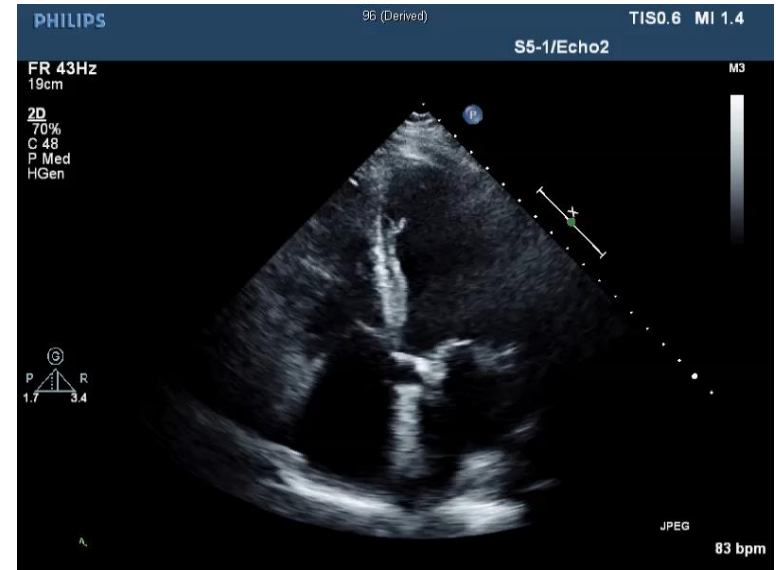
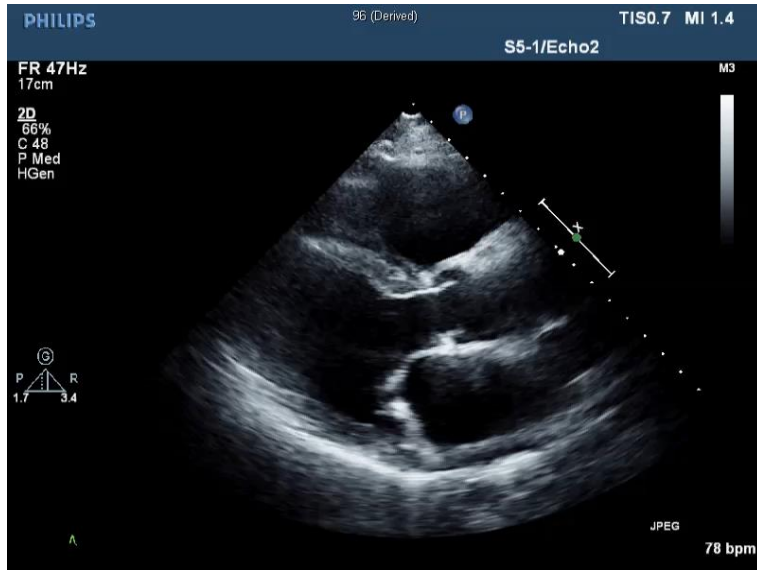
- WBC 7450 /uL
- Hemoglobin 9.7 g/Dl
- Platelet 109k/uL
- AST/ALT 34/15 U/L
- BUN/Cr 10.6/0.76 mg/dL
- Na/K 136/3.7 mmol/L
- Troponin I/CK-MB 0.018/4.6 ng/mL
- proBNP 5615 pg/ml
- Procalcitonin negative
- TFT euthyroid state

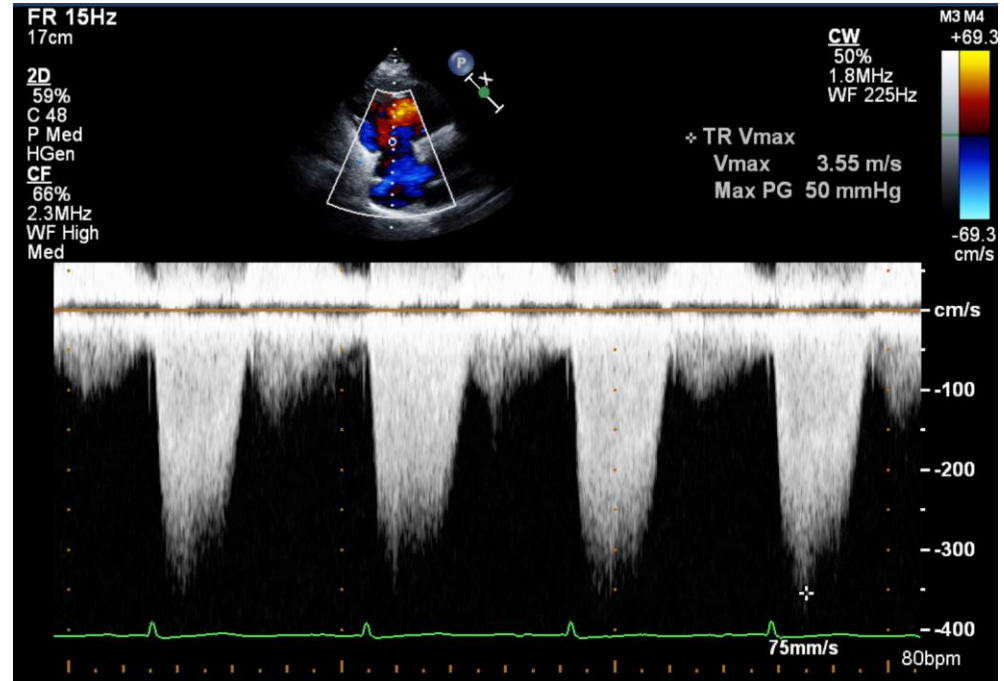
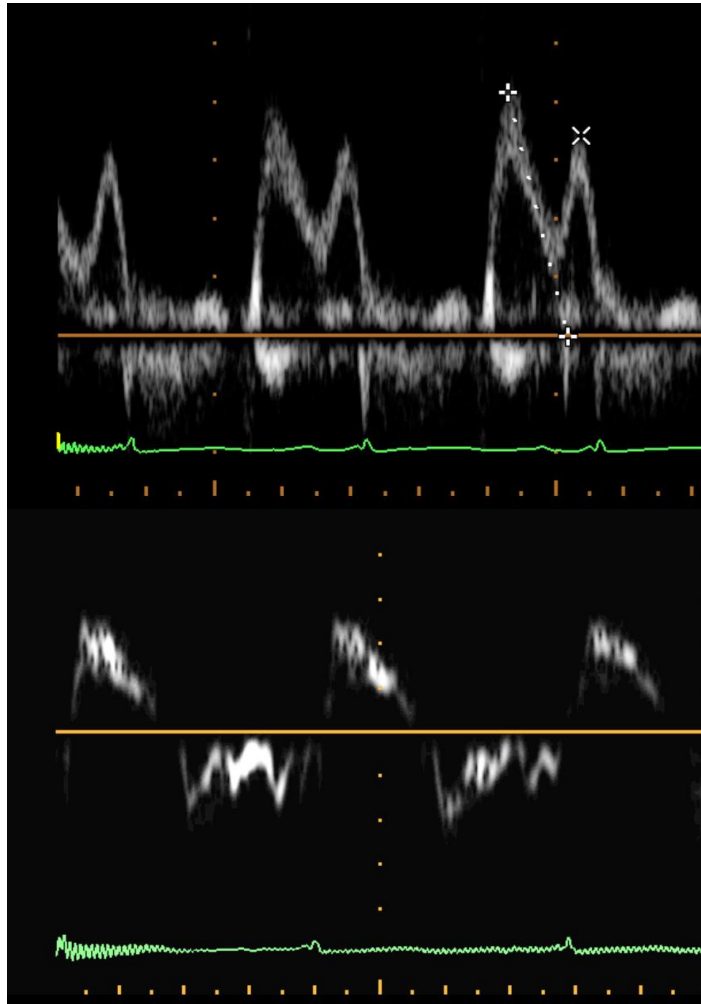
Chest CT



Hepatic vein dilatation
Bronchial wall thickening 및 luminal narrowing
▶ **cardiac congestion, r/o small airway disease**

Echocardiography





LVEF 66%
LA 4.9 cm
E=124.6 sec , A 102.6cm/sec, E/A 1.2, DT 176 msec
e'=5.0, a'=5.2, s'=7.5, E/e'=25
Dilated RA, RV
Moderate TR, RVSP 58mmHg

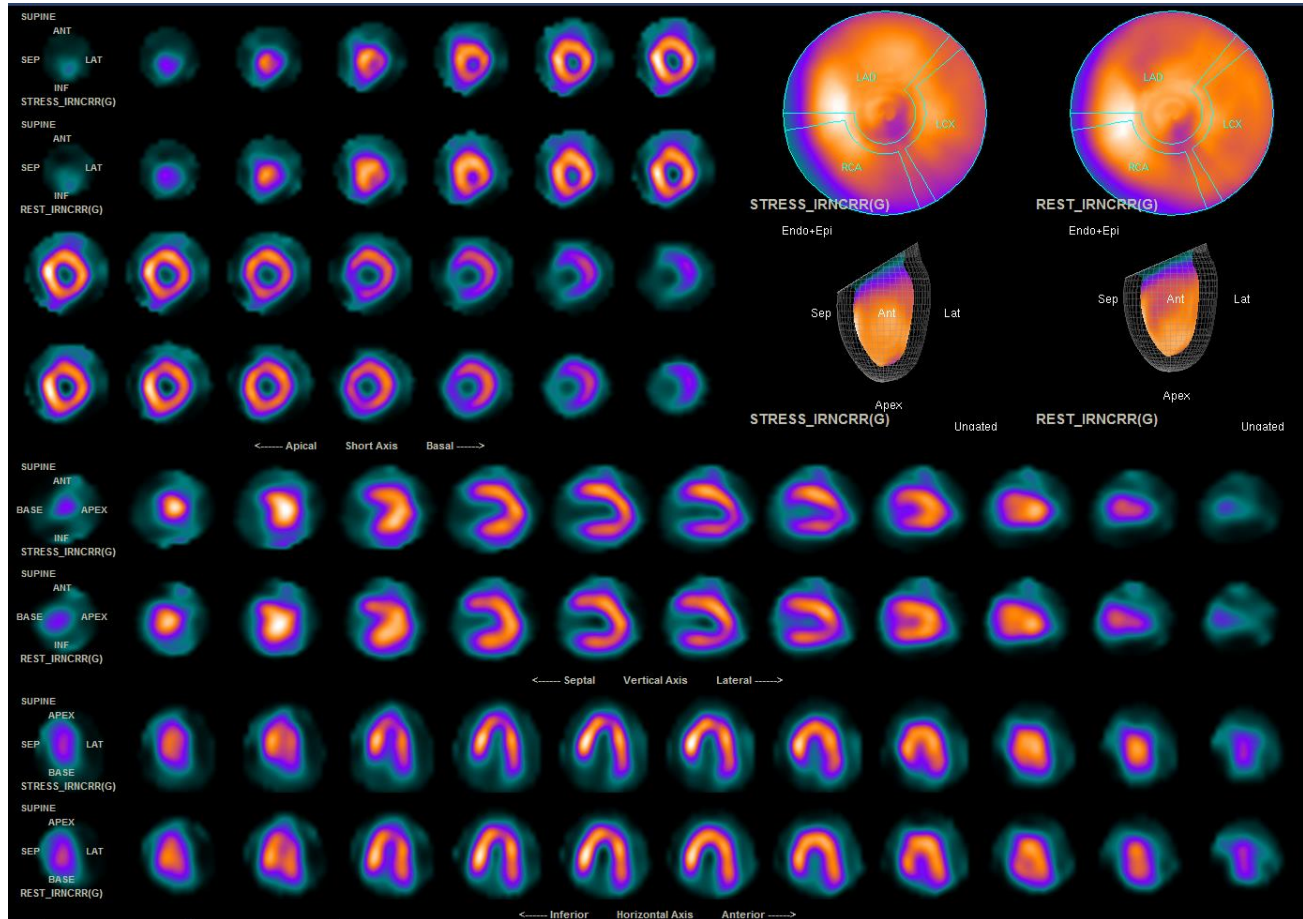
Diagnosis

#Heart failure with preserved ejection fraction
with Pulmonary congestion

#Pulmonary hypertension

#Anemia

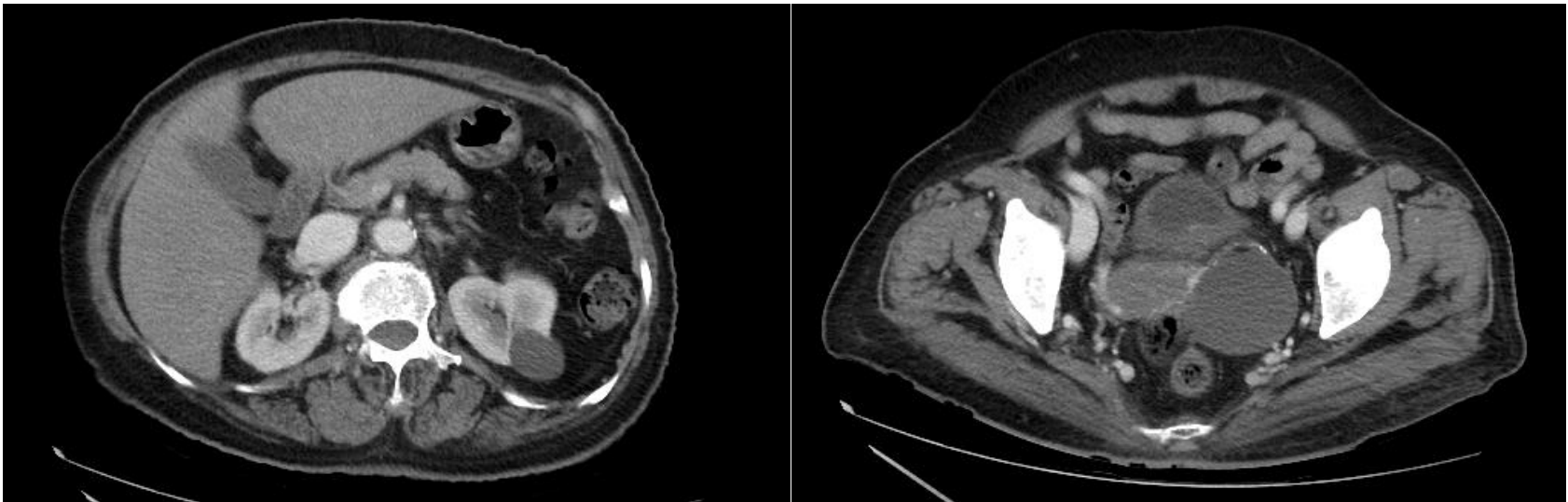
MIBI SPECT



No inducible ischemia

Anemia w/u

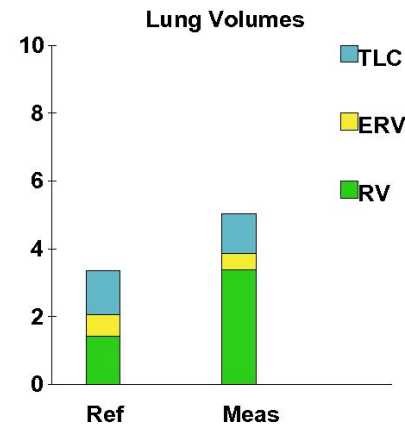
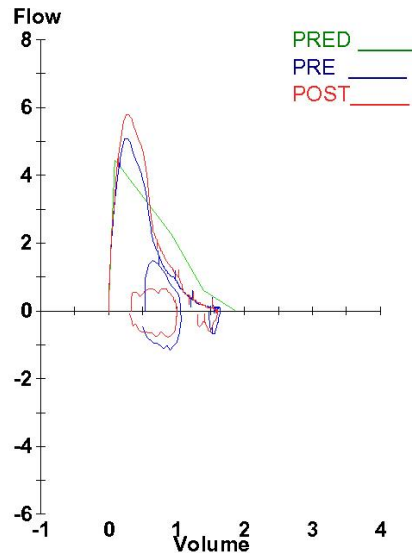
- EGD
 - atrophic gastritis
- Colonoscopy
 - nonspecific colitis
- Abdomen CT



Simple renal cyst left
Bladder wall thickness r/o inflammation or tumor
Left pelvic cavity mass r/o teratoma

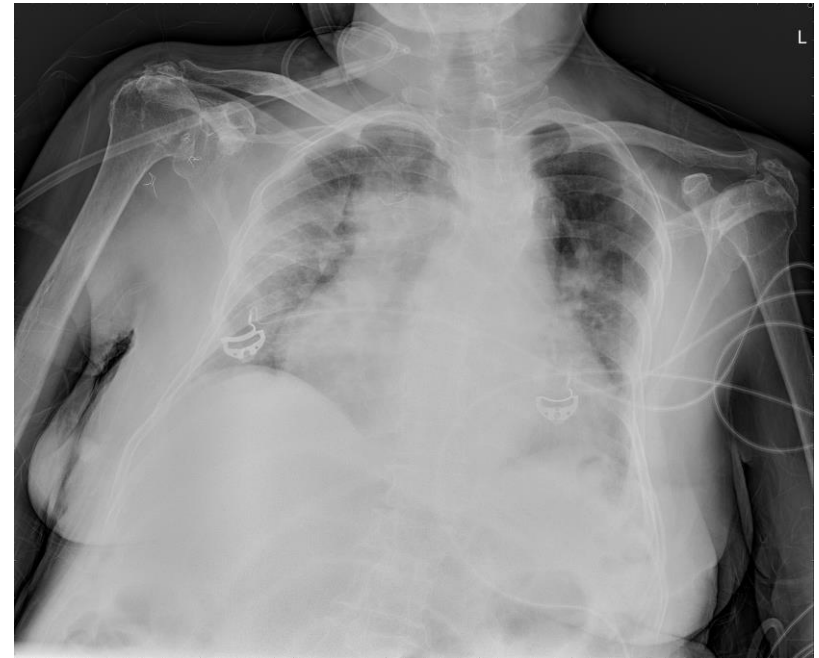
Pulmonary function test

| | | | Ref | Pre | % Ref | Post | % Ref | %Chg |
|------------------|--------|--|------|------|-------|------|-------|------|
| Spirometry | | | | | | | | |
| FVC | Liters | | 1.88 | 1.65 | 88 | 1.61 | 85 | -2 |
| FEV1 | Liters | | 1.24 | 1.27 | 102 | 1.27 | 102 | 0 |
| FEV1/FVC | % | | 71 | 77 | | 79 | | |
| FEF25-75% | L/sec | | 1.69 | 0.97 | 57 | 1.19 | 70 | 22 |
| FEF75-85% | L/sec | | 0.15 | 0.21 | 139 | 0.25 | 167 | 20 |
| FEF25% | L/sec | | | 4.99 | | 4.97 | | -0 |
| FEF50% | L/sec | | 2.22 | 1.39 | 63 | 1.68 | 75 | 21 |
| FEF75% | L/sec | | 0.59 | 0.33 | 56 | 0.37 | 63 | 12 |
| FEF200-1200L/sec | L/sec | | 3.00 | 1.20 | 40 | 1.31 | 44 | 9 |
| PEF | L/sec | | 4.46 | 5.23 | 117 | 5.79 | 130 | 11 |
| FET25-75% | Sec | | 0.45 | 0.87 | 194 | 0.72 | 160 | -17 |
| FET100% | Sec | | | 4.90 | | 5.86 | | 20 |
| FEF/FIF50 | | | | 2.19 | | 4.96 | | 126 |

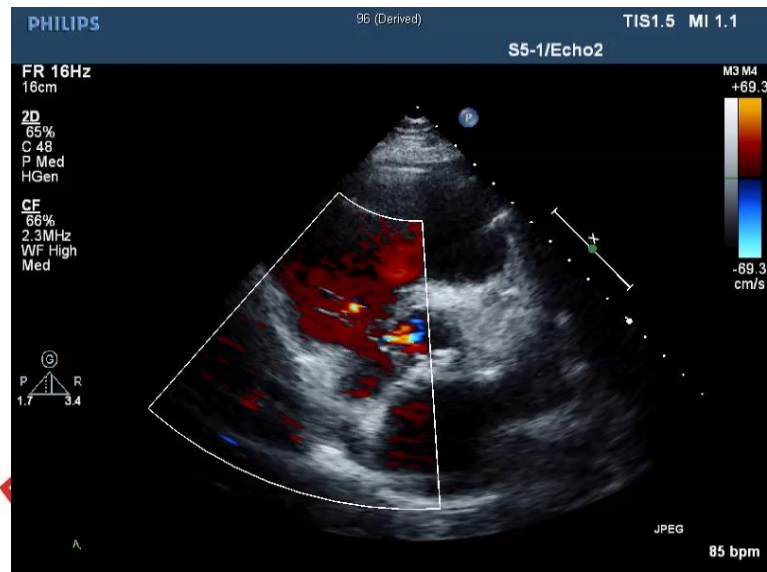
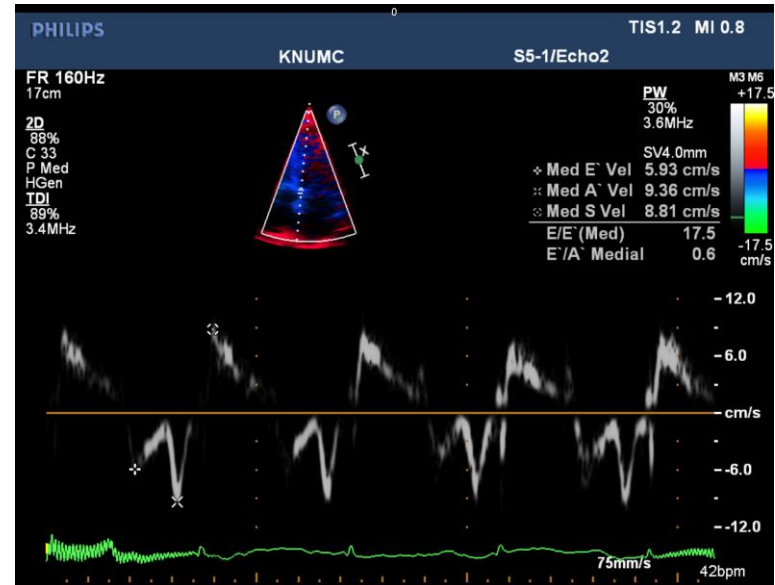
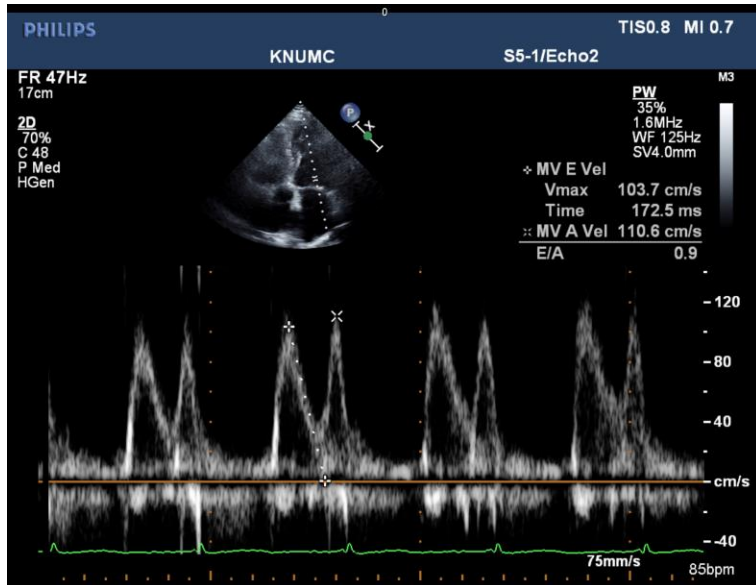


In-hospital course

- Furosemide iv 80mg/day 사용하면서 f/u
- Day7
 - Torsemide 10mg qd
- Day11
 - Dyspnea aggravation
 - ICU admission



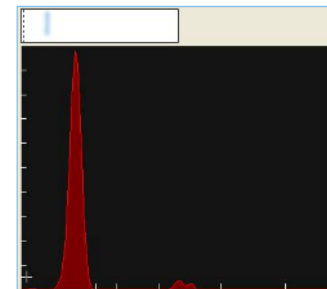
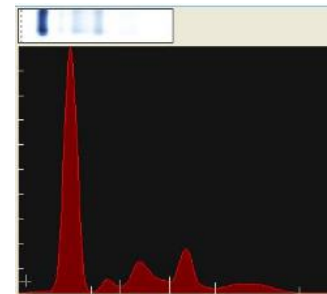
Echocardiography f/u



E=103.7 sec , A 110.6cm/sec
 E/A 0.9, DT 172 msec
 e'=5.9, a'=9.4, s'=8.8, E/e'=17.5
 Mild to moderate TR
 RVSP 51mmHg

Lab findings

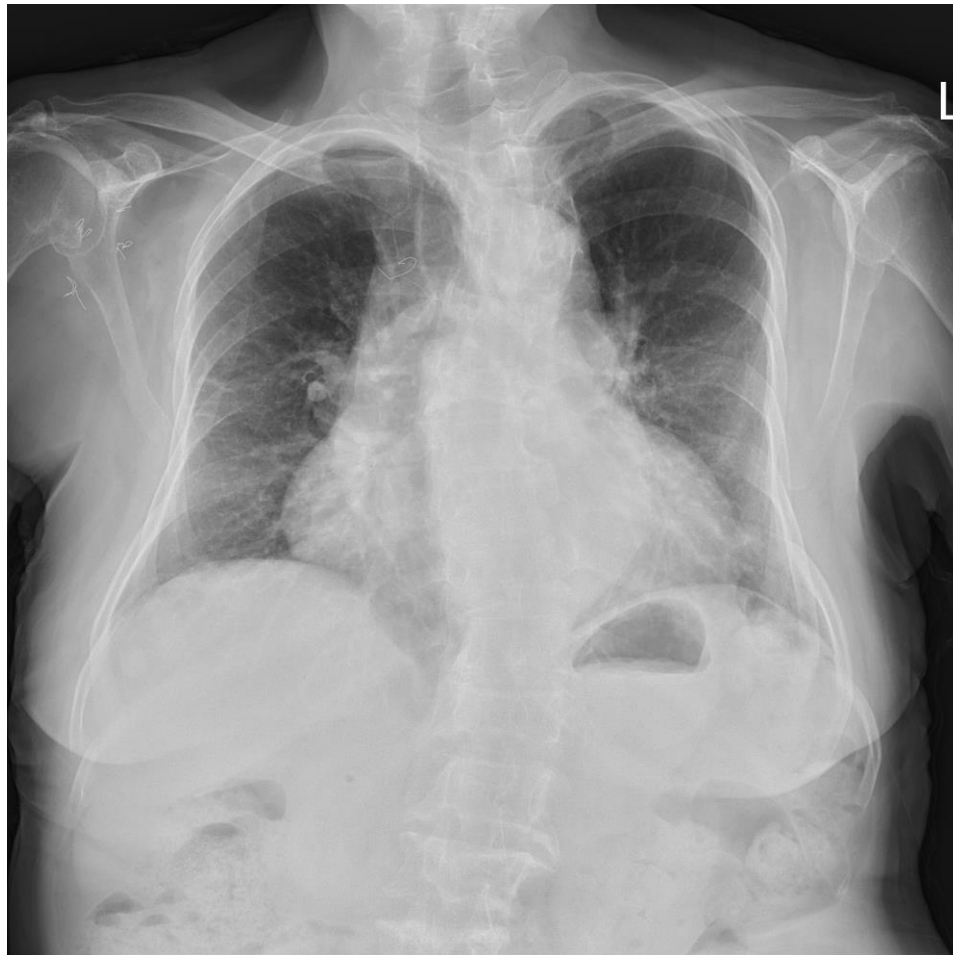
- Kappa 6.23 mg/L (5.7-26.3)
- Lambda **110** mg/L (3.3-19.4)
- PB smear
 - WBC; neutro 51%, band 2%, lymph 36%, Eosi 1%, Baso 0%,
reactive lympho 3%
- Serum PEP
 - decreased gammaglobulin
- Urine PEP
 - albuminuria with proteinuria in beta region



경과

- 퇴원하여 타병원 진료 원함
- 3주뒤
 - Aggravation of dyspnea under
 - Torsemide 10mg/5mg
 - Aldactone 1T bid
 - “몇걸음만 걸어도 숨이 차다.”

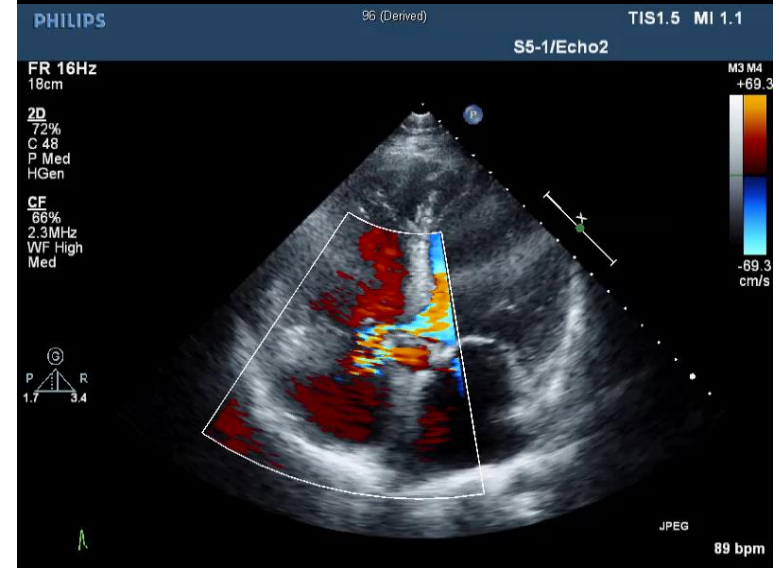
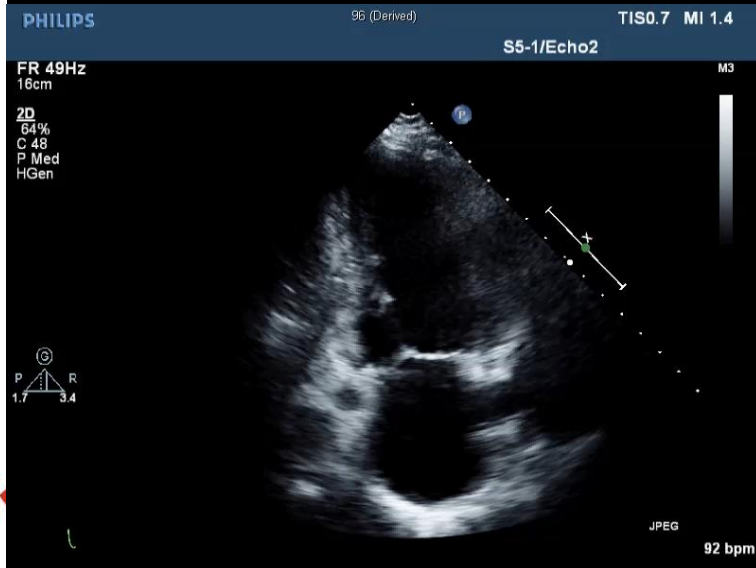
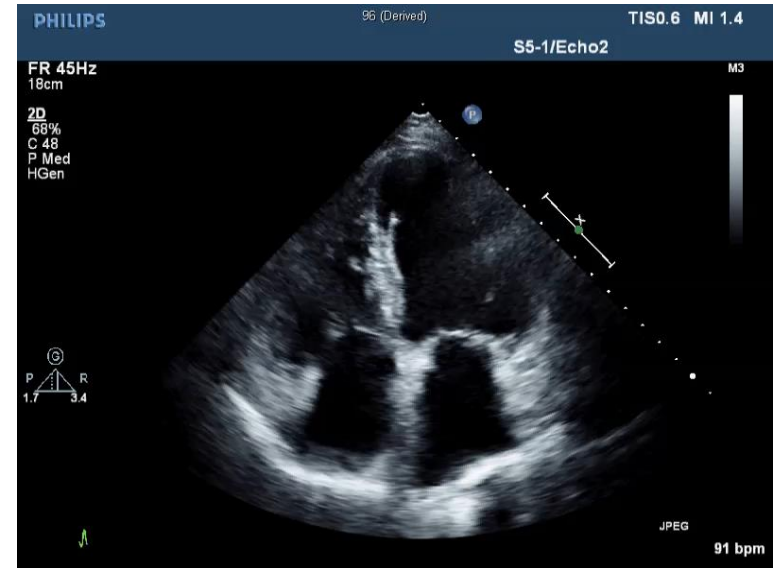
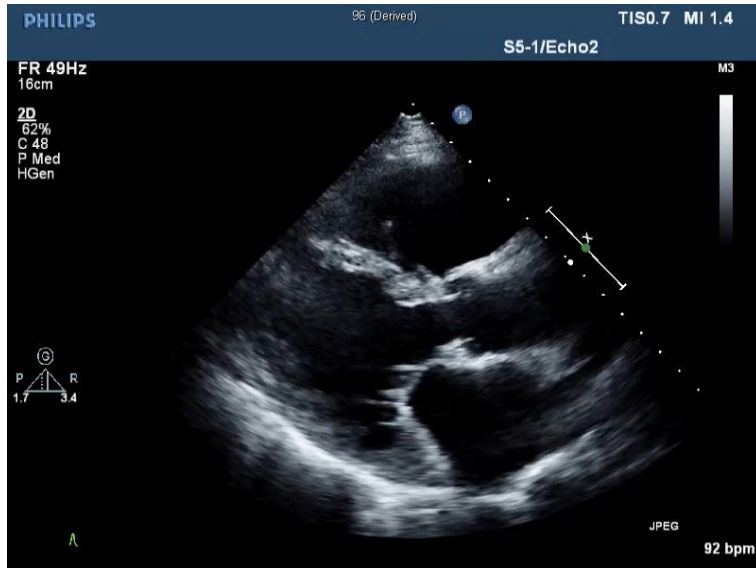
Chest X-ray



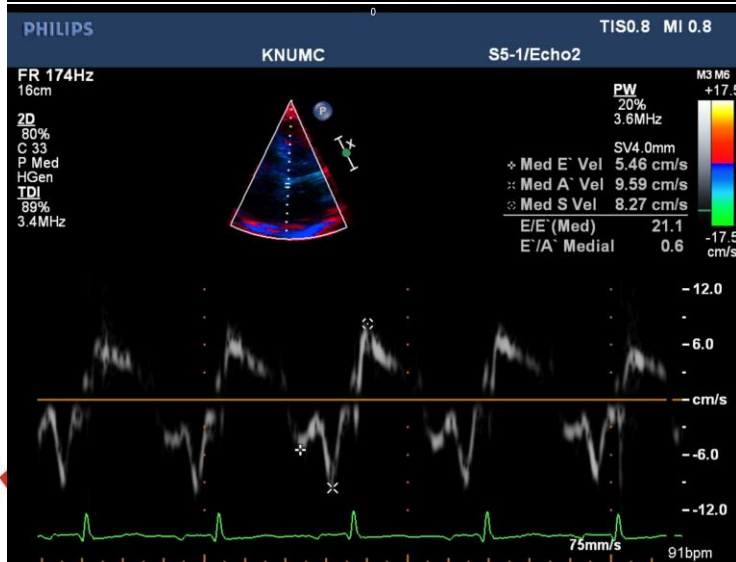
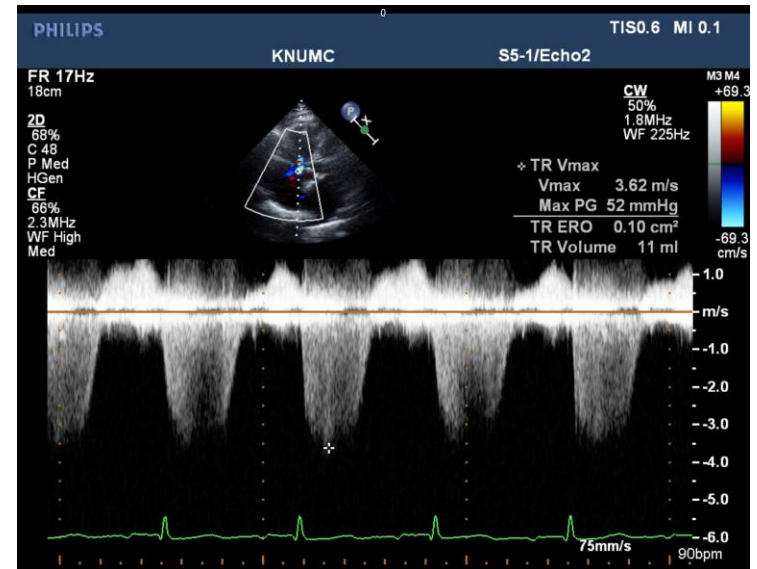
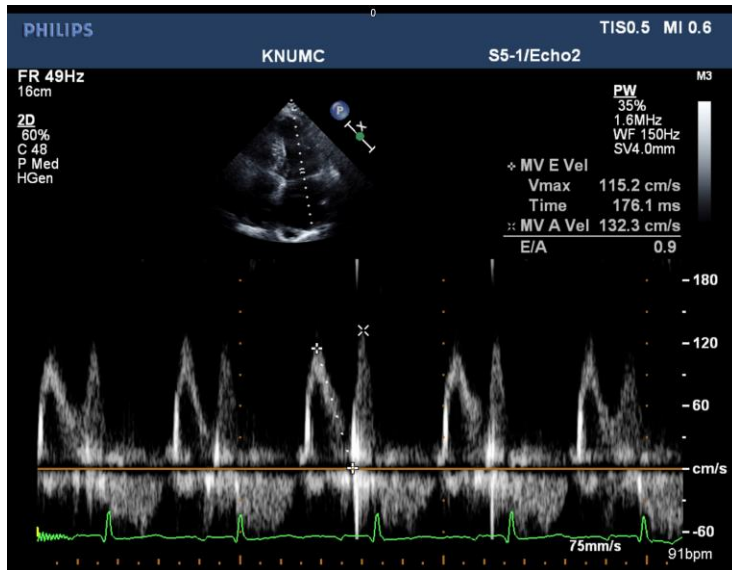
Lab

- WBC 7730 /UI
- Hemoglobin 8.9 g/dL
- Platelet 124k /dL
- BUN/Cr 47.5/1.37 mg/dL
- Na/K 131/4.8 mmol/L
- CK-MB/TnI 1.5/<0.015 ng/mL
- NT-proBNP 2305 pg/ml (<526)
- Leukocyte undifferentiated count 12.8% (0-4)
- PB smear - plasma cell 4%
- kappa 285 mg/L (3-19)
- Lambda 10.8 mg/L (5.71-26.3)
- Bone marrow biopsy
 - hypercellular marrow with 59% plasma cells

Echocardiography



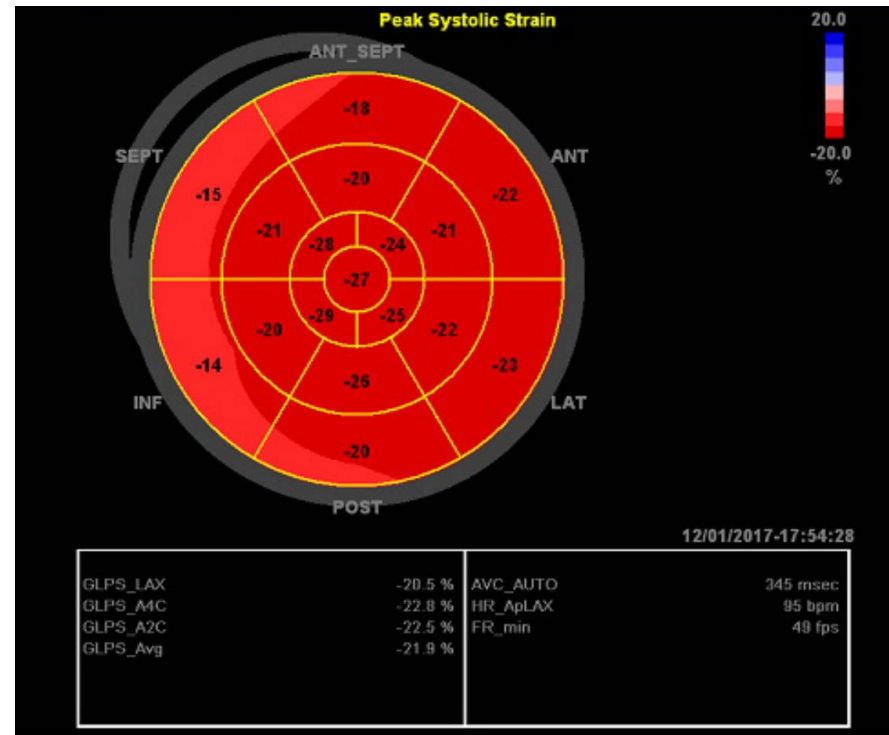
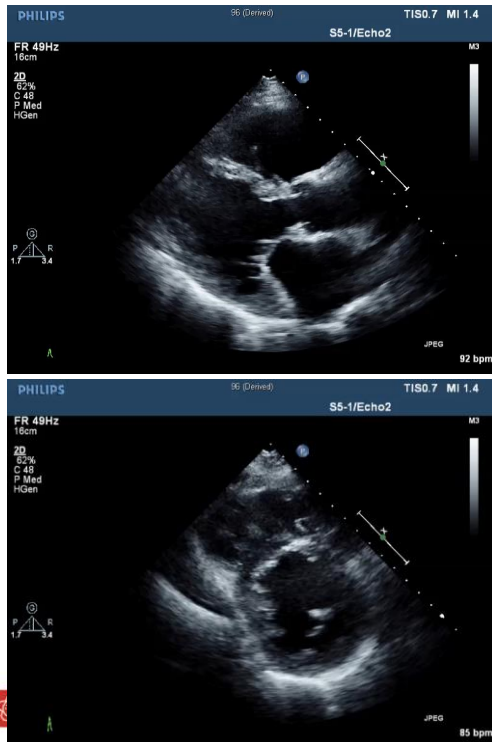
Echocardiography



LVEF 71%
 E=115, A 132, E/A 0.87, DT 176
 e`=4.5, a`=0.6, s`=8.3, E/e`=21.1
 mild to moderate TR
 RVSP 67

Diagnosis

- Heart failure cause?
 - Multiple myeloma
 - Restrictive cardiomyopathy d/t amyloidosis ????
 - Primary pulmonary HTN???



Cardiac catheterization

| Pressures Used in Calculation (mmHg) | |
|--------------------------------------|-------------|
| PCW | 20/18 (17) |
| RA | 22/17 (16) |
| AO | 104/44 (66) |
| PA | 49/20 (34) |
| LV | 103/0/19 |
| RV | 56/6/17 |

Left heart disease

| Resistance Results | |
|---|---------------|
| PVR dsc^{-5} , (wu) | 212.57 (2.66) |
| SVR dsc^{-5} , (wu) | 422.43 (5.28) |
| PVR-I $dsc^{-5} * m^2$, (wu * m ²) | 301.12 (3.76) |
| SVR-I $dsc^{-5} * m^2$, (wu * m ²) | 598.41 (7.48) |

(<250 dsc^{-5})
(800-1200 dsc^{-5})
(255-285 dsc^{-5}/m^2)
(1970-2390 dsc^{-5}/m^2)

| Cardiac Output | |
|-----------------------|------|
| Fick C.O. l/min | 9.47 |
| Fick C.I. $l/min/m^2$ | 6.68 |
| Fick HR BPM | 88 |

(4-8L/min)
(2.5-4.0 L/min/m²)

Diagnosis

#Multiple myeloma

#Heart failure d/t high cardiac output state

Case report

Open Access

Reversible high-output cardiac failure, an unusual marker of disease status in multiple myeloma

NUCLEAR ONCOLOGY

Arteriovenous Shunting in Patients with Multiple Pulmonary hypertension complicating multiple myeloma

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Abstract: Pulmonary hypertension (PH) is an infrequently reported complication of multiple myeloma (MM). PH has been more commonly associated with amyloidosis, myeloproliferative diseases, and the POEMS (polyneuropathy, organomegaly, endocrinopathy, monoclonal protein, skin changes) syndrome. PH in MM is typically mild to moderate and may be secondary to a variety of conditions, which include left ventricular dysfunction, high-output cardiac failure, chronic kidney disease, treatment-related toxicities, and precapillary involvement. We describe 3 patients with MM and severe PH. Each patient underwent right heart catheterization. All patients demonstrated elevated pulmonary pressures, transpulmonary gradients, and pulmonary vascular resistance. Each patient was ultimately treated with pulmonary vasodilator therapy with improvement in cardiopulmonary symptoms. Additional studies are needed to define the prevalence, prognosis, and pathogenesis of PH in this complex population and to help clarify who may benefit from targeted PH therapy.

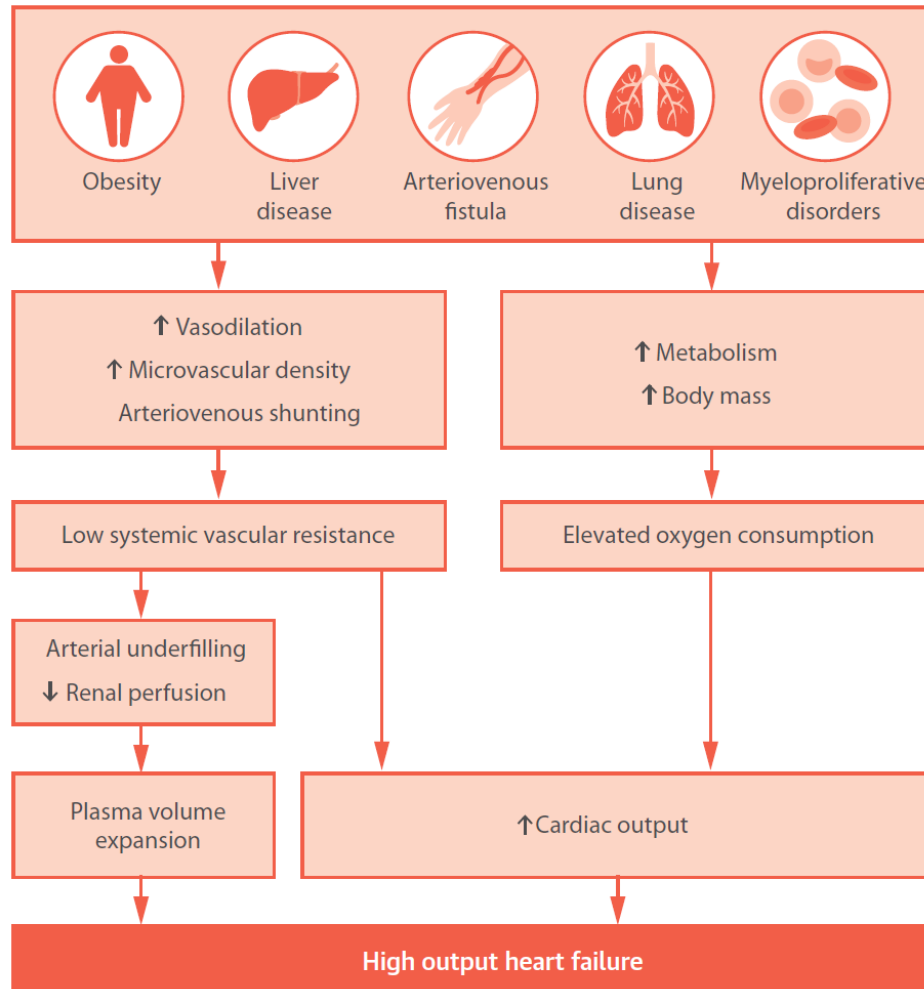
Keywords: pulmonary hypertension, multiple myeloma, pulmonary vasculature, amyloidosis.

Pulm Circ 2015;5(3):590-597. DOI: 10.1086/682430.

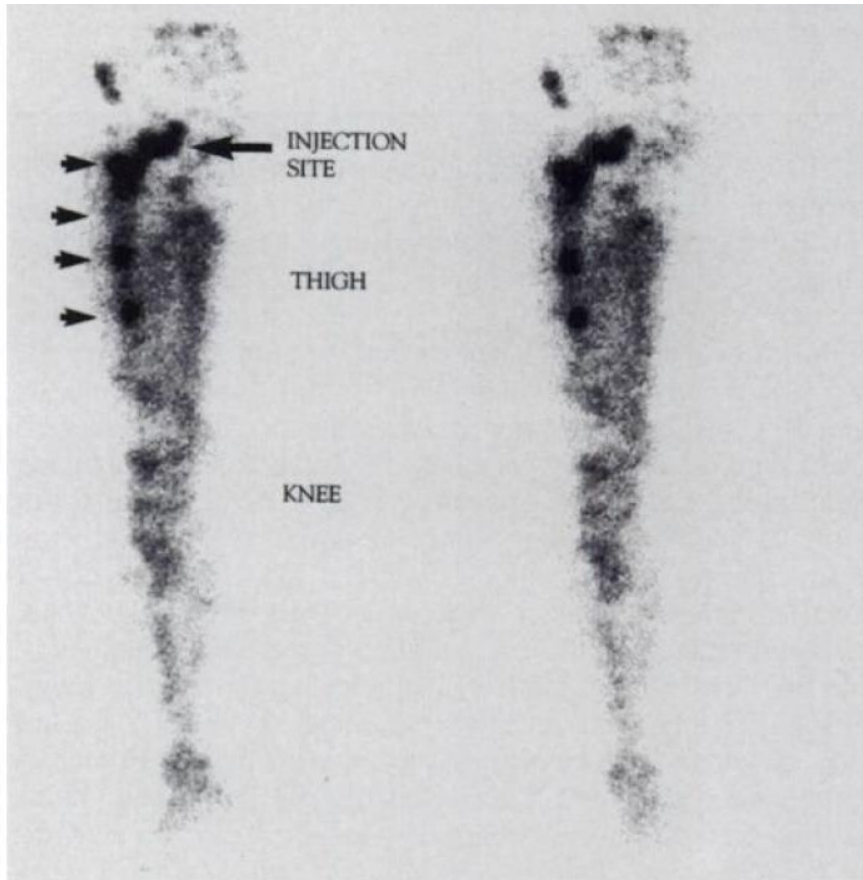
Causes of high output heart failure (HOHF)

- Morbid obesity
- Systemic AV shunt
- Hepatic disease
(cirrhosis)
- Lung disease
(COPD, connective tissue disease)
- Myeloproliferative disease
(myelofibrosis, **multiple myeloma**, leukemia)
- Sepsis
- Hyperthyroidism
- Anemia
- Beriberi (vit B1 or thiamine deficiency)
- Dermatoid disease (psoriasis)
- Carcinoid syndrome

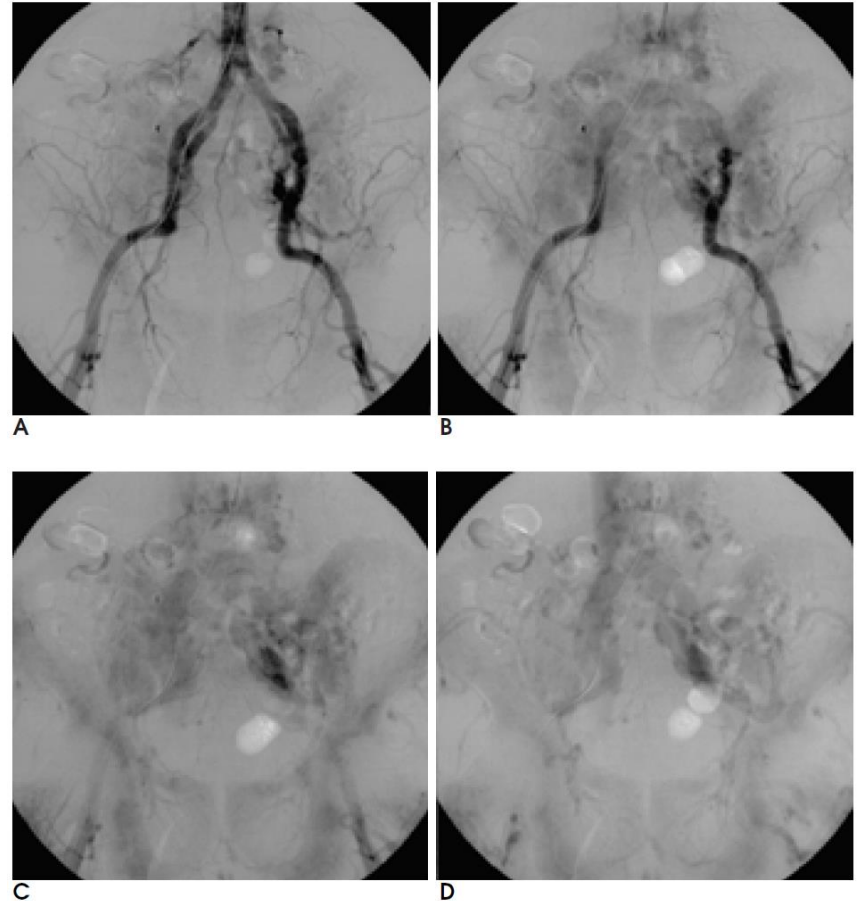
Pathophysiology of HOHF



AV shunting in patients with multiple myeloma

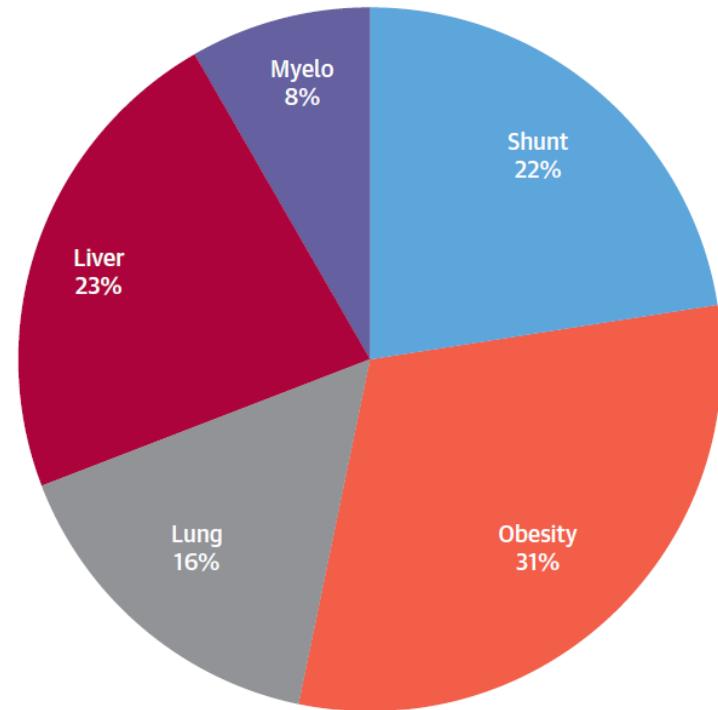
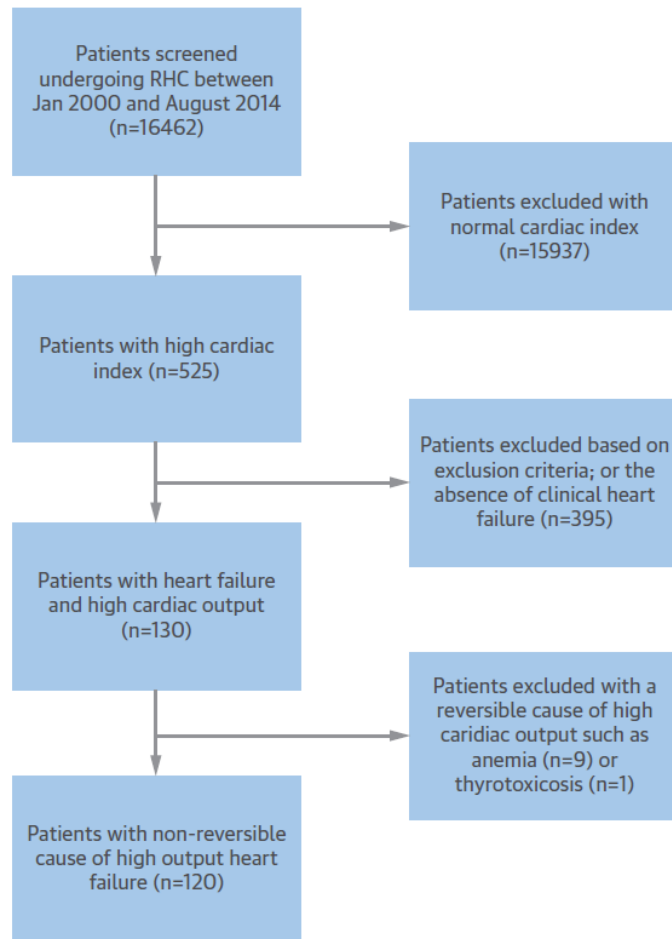


Inanir et al. J Nucl Med 1998; 39:1-3

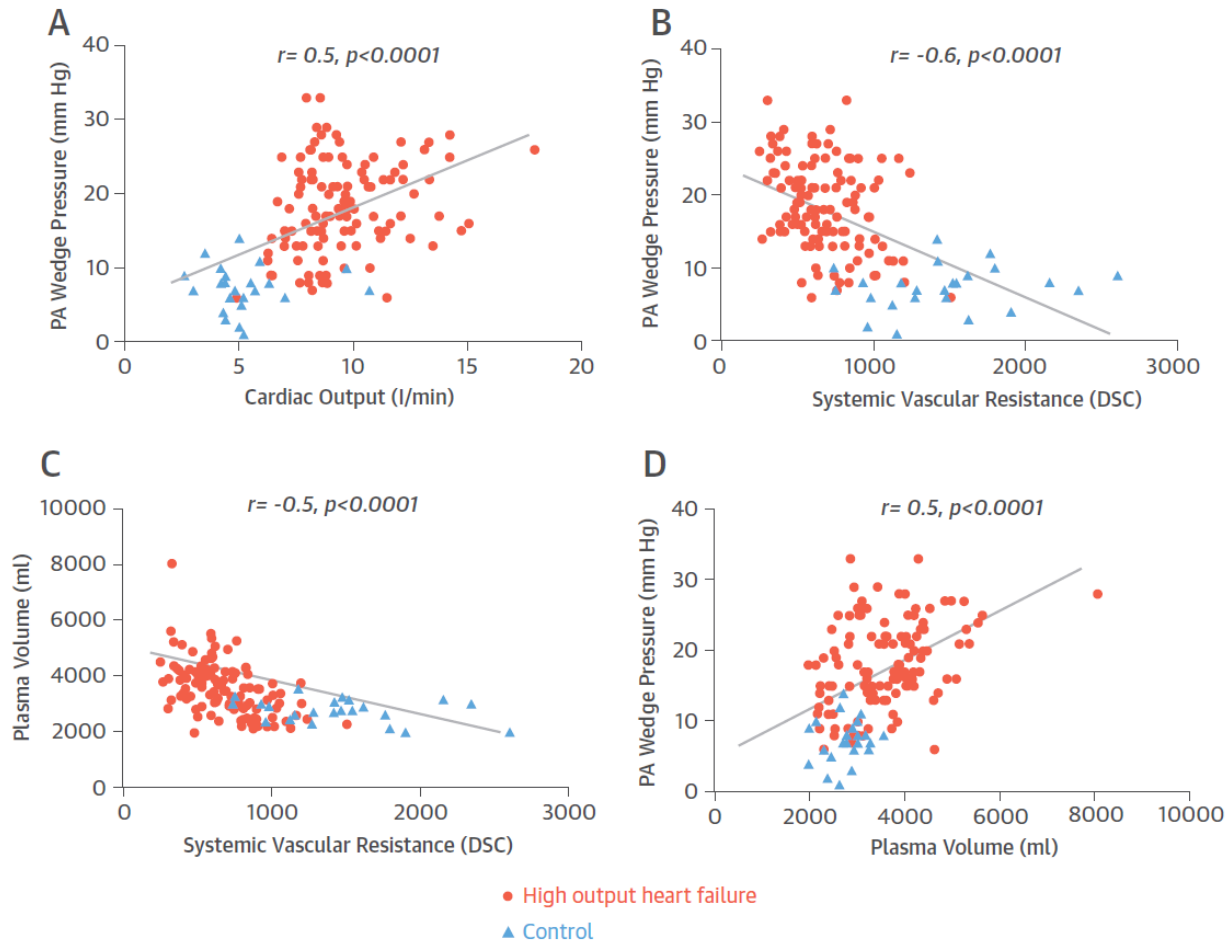


김정호 외. 대한방사선의학회지 2002;47:597-600

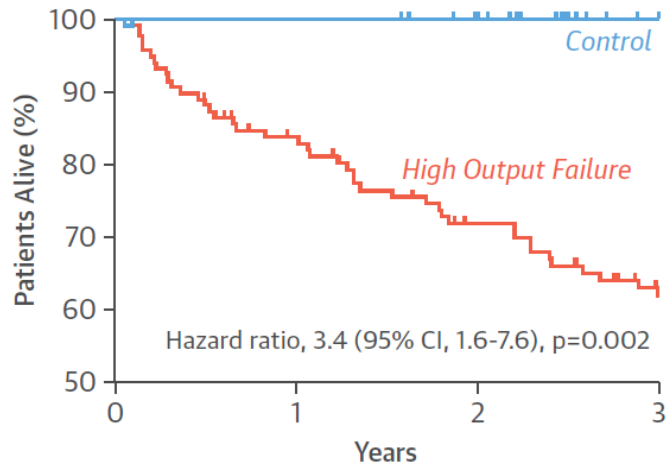
Myo Clinic data, a 15 years experience



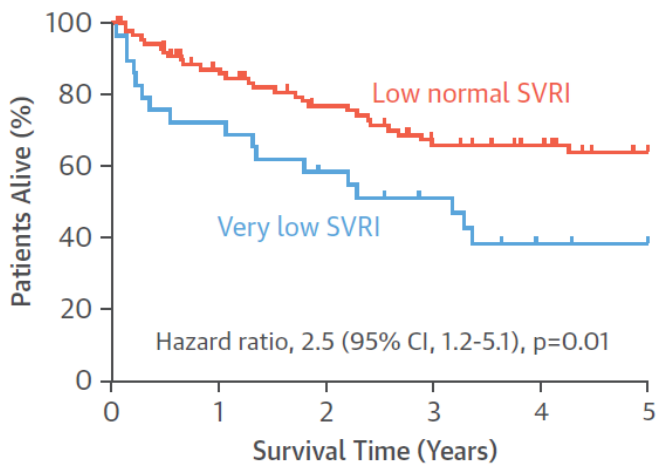
Character of HOHF



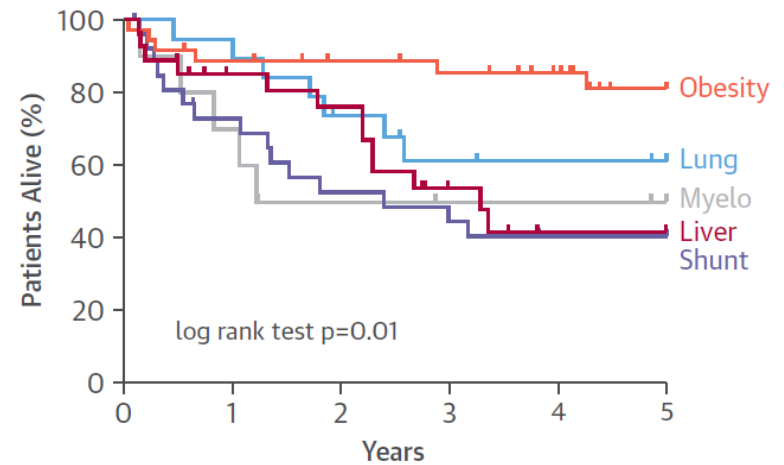
Survival of HOHF



| No at risk | 0 | 1 | 2 | 3 |
|------------|-----|----|----|----|
| HOHF | 120 | 94 | 76 | 58 |
| Control | 24 | 24 | 21 | 4 |



| No at risk | 0 | 1 | 2 | 3 | 4 | 5 |
|---------------|----|----|----|----|----|----|
| Very low | 29 | 22 | 17 | 13 | 8 | 7 |
| Low or normal | 89 | 71 | 59 | 46 | 39 | 32 |



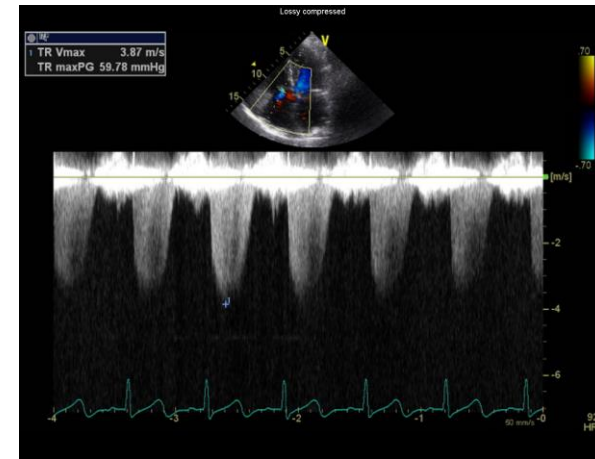
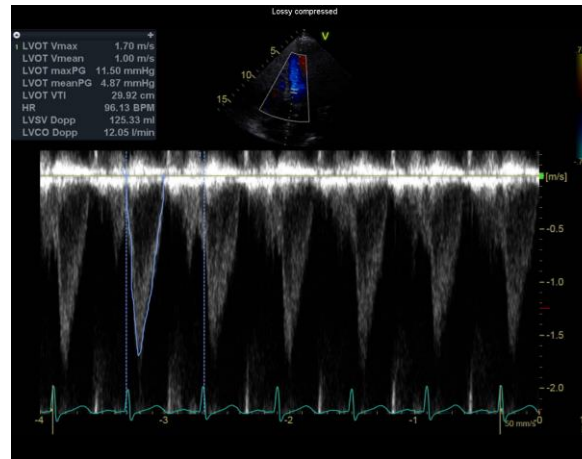
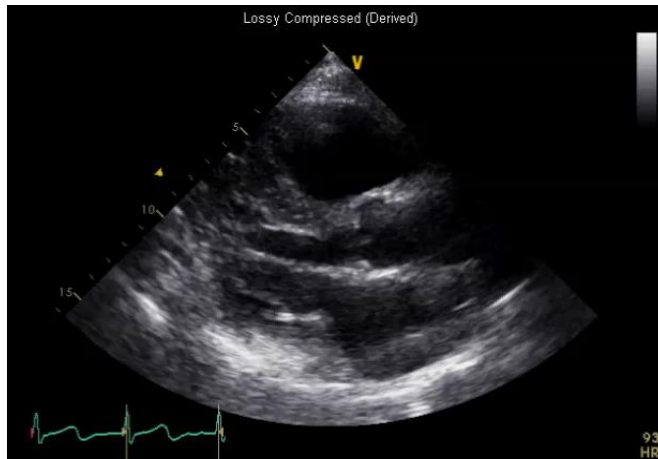
| No at risk | 0 | 1 | 2 | 3 | 4 | 5 |
|--------------------|----|----|----|----|----|----|
| Obesity | 37 | 32 | 29 | 27 | 23 | 15 |
| Liver | 27 | 19 | 14 | 12 | 10 | 9 |
| Myeloproliferative | 10 | 8 | 5 | 4 | 4 | 2 |
| Shunt | 27 | 20 | 18 | 10 | 6 | 5 |
| Lung | 19 | 19 | 14 | 10 | 9 | 7 |

Treatment of HOHF in multiple myeloma

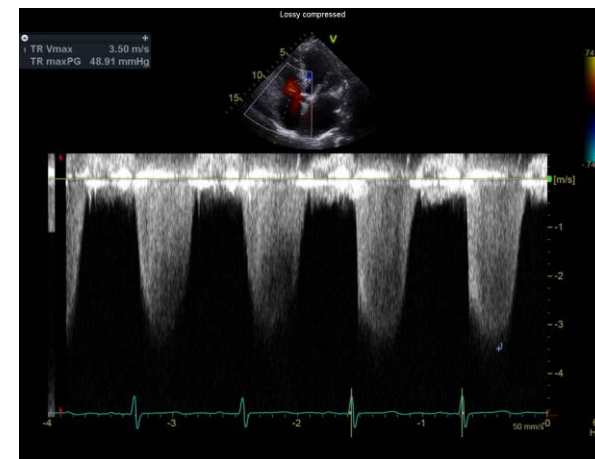
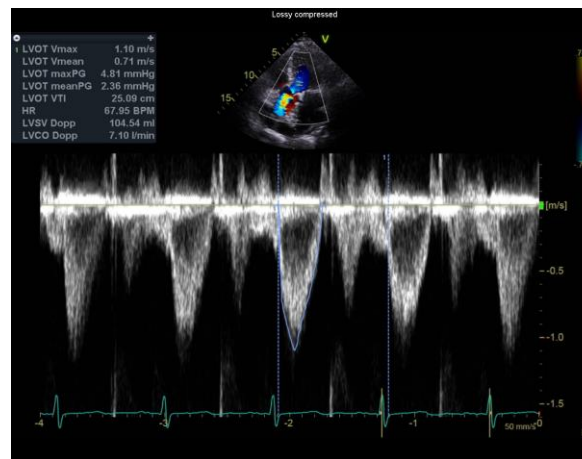
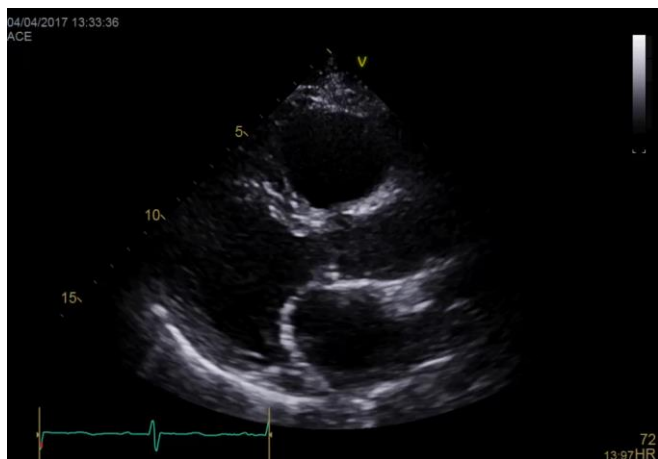
- Challenging
- Traditional heart failure therapy in not effective
- Chemotherapy agent
 - cytokine suppression
 - enhance host immune response
 - inhibit angiogenesis
- Percutaneous shunt embolization

환자 경과 Bortezomib+Mephalan+Steroid (2month)

Before



2 month after



Summary

- Clinical syndrome of HF includes not only pump failure, but also functional impairment and **abnormalities external to the heart affecting vascular loads and metabolism**
- HOHF may be under-diagnosed in patients with myeloproliferative disease like multiple myeloma
- HOHF must be considered in the differential diagnosis of patients presenting with the clinical syndrome of HFpEF

경청해 주셔서 감사합니
다.

