

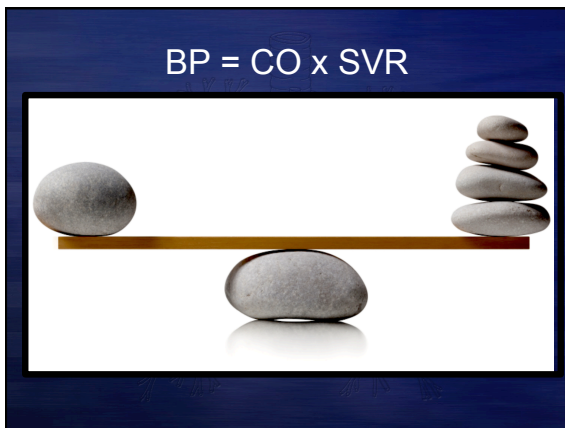
Vascular Society of Michigan

The Effect of Cardiac Pathology on Vascular Flow

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- Cardiac pathology affects vascular flow
 - $BP = CO \times SVR$
 - Common cardiac lesions
- What we share
 - Genetic lesions
 - Cellular level
 - Affects valve function
 - BAV
 - Dissection
 - Repair
 - Case
 - Acquired lesions
 - Stiffness
 - Plaque
 - Aneurysms
 - Case



Any cardiac disease may affect flow through the cardiovascular system

Left ventricular and aortic valve abnormalities mainly affect arterial hemodynamics and are seen throughout the entire system.

Normal Pulse
 smooth upstroke

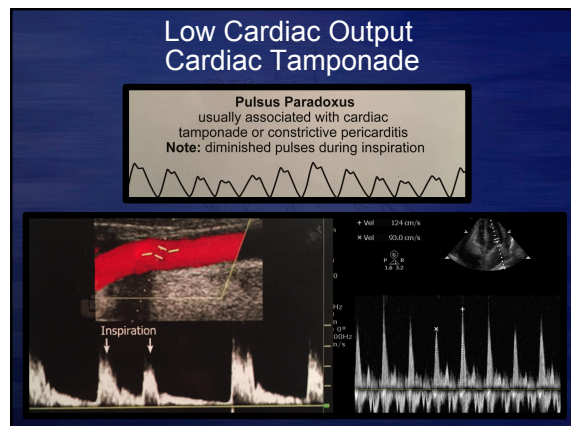
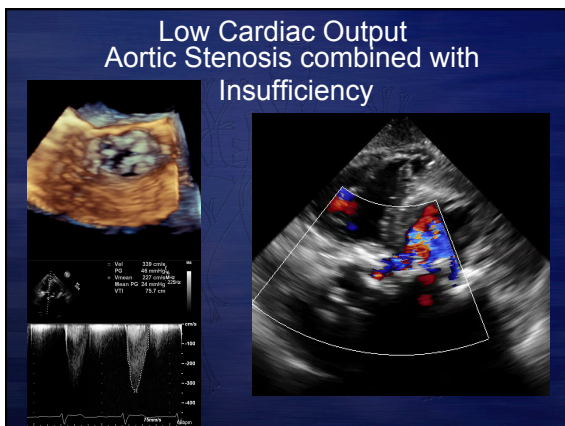
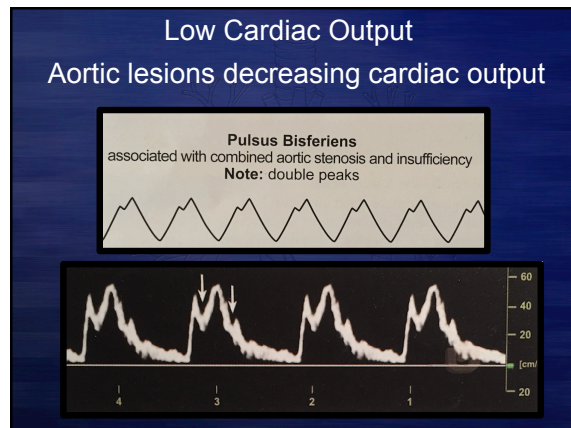
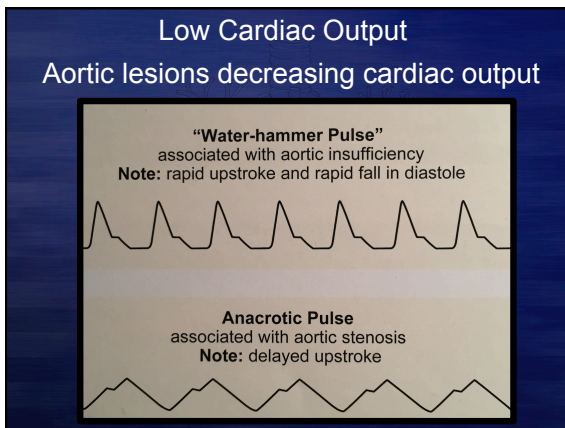
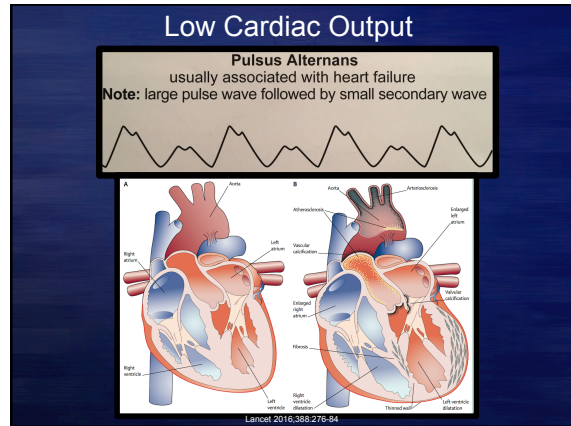
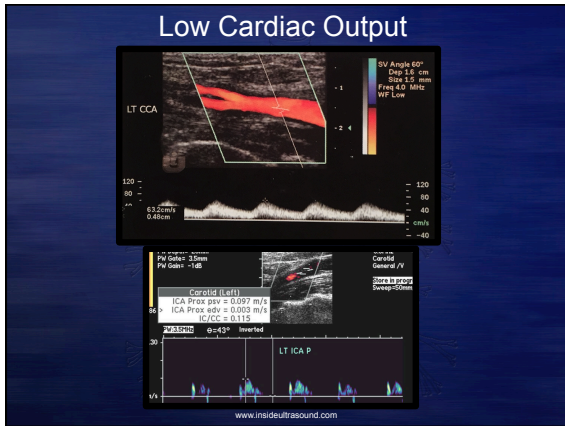
www.insideultrasound.com

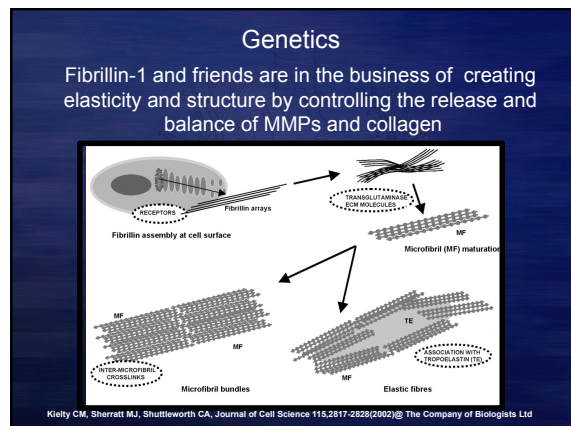
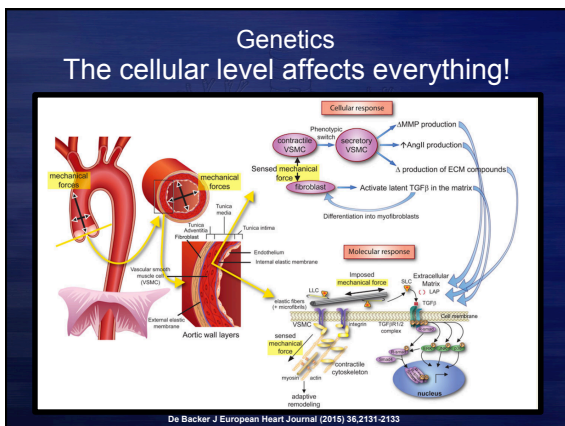
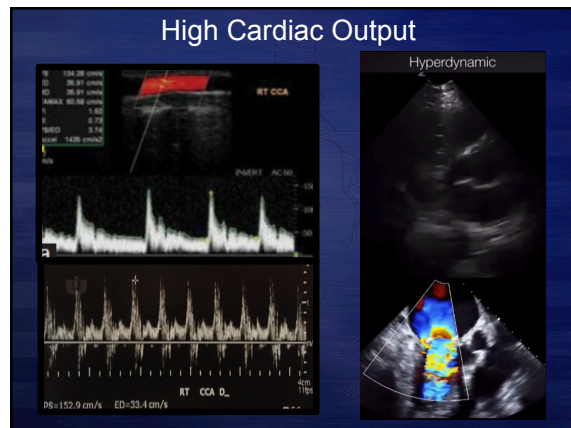
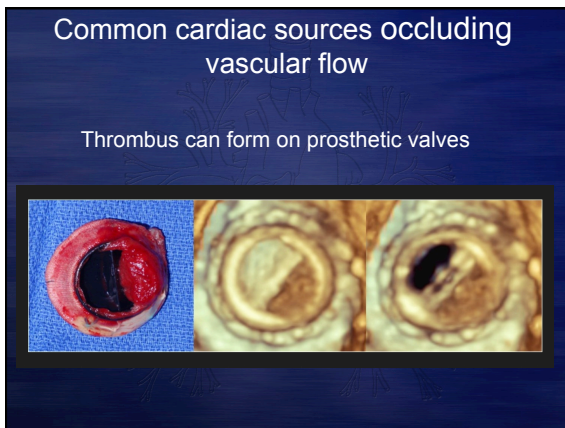
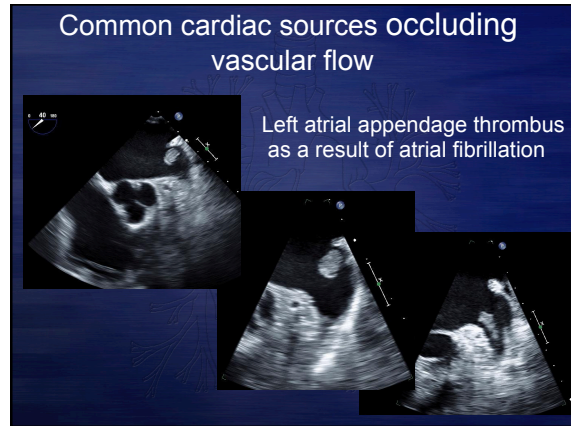
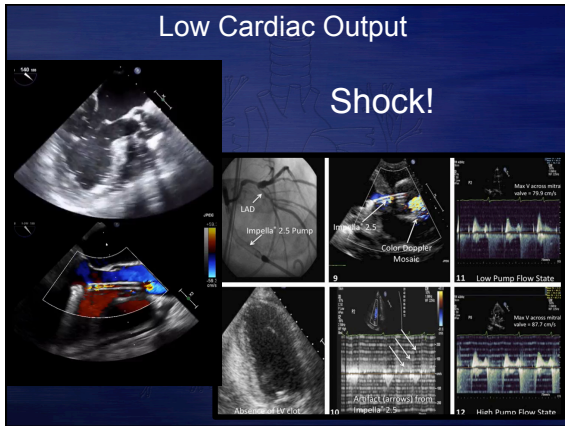
Left Sided Pathology

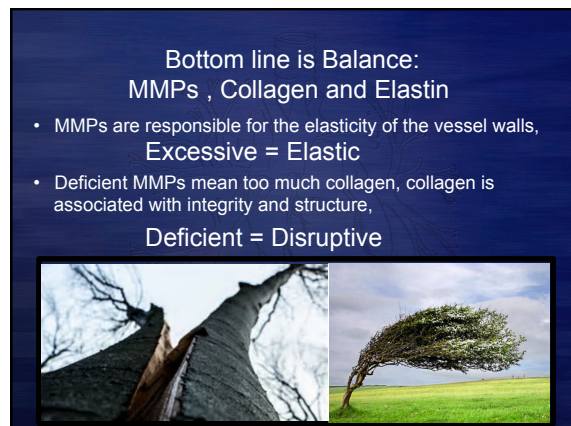
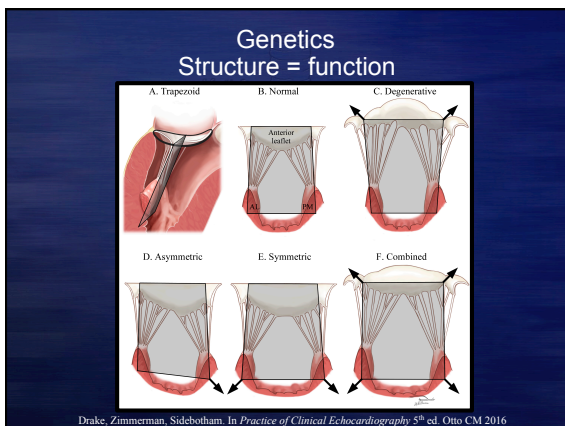
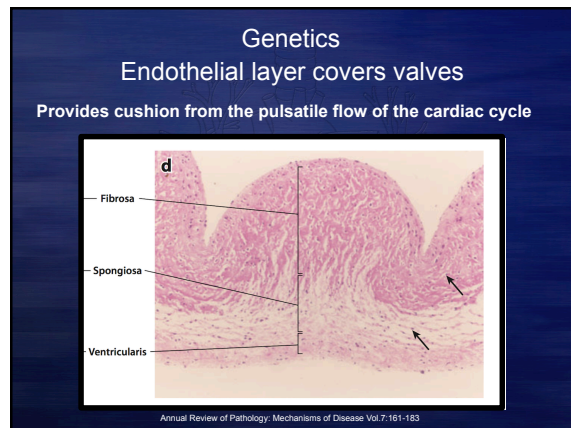
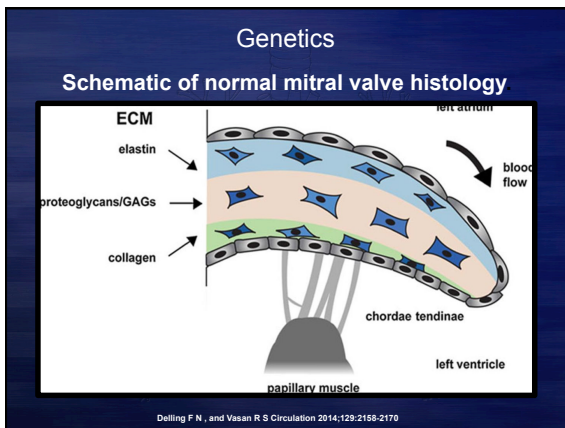
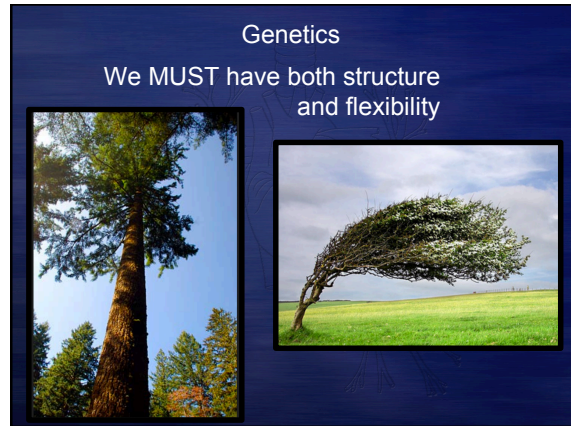
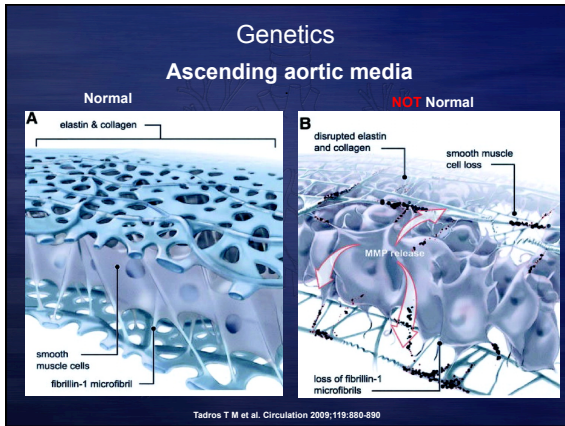
| Aortic | Cardiac output |
|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Aortic regurgitation: "Water-Hammer Pulse" Rapid upstroke and rapid fall in diastole. | CHF, cardiomyopathies, tamponade, Low CO seen throughout cv system. Large pulse wave followed by small secondary wave |
| Aortic Stenosis Anacrotic Pulse: delayed upstroke associated with aortic stenosis Note: delayed upstroke | Dicrotic Pulse associated with decreased arterial tone Note: accentuated secondary pulse wave (may feel like heart rate is twice as fast as normal) use direct method with stethoscope |
| Combined ASIAR: Pulsus Bisferiens Double peaks associated with combined aortic stenosis and insufficiency Note: double peaks | Pulsus Alternans usually associated with heart failure Note: large pulse wave followed by small secondary wave |
| | Cardiac Tamponade or constrictive pericarditis: Diminished pulses during inspiration Pulsus Paradoxus usually associated with cardiac tamponade or constrictive pericarditis Note: diminished pulses during inspiration |

Factors affected by Cardiac output

| High cardiac output | Low cardiac output |
|------------------------|--------------------------|
| Chronic anemia | Congestive heart failure |
| Carcinoid syndrome | |
| Chronic hypercapnia | Cardiac valve problems |
| Multiple myeloma | Atrial fibrillation |
| Sepsis | CAD low EF |
| Beriberi heart disease | Diastolic dysfunction |
| Sickle cell anemia | pericarditis |
| Pregnancy | Anemia |
| Obesity | cardiomyopathy |
| Hepatic disease | Systemic hypertension |
| Cardiac arrhythmias | Cardiac tamponade |







Valve Function

Collagen is our friend,.. most of the time

a Systole
Aorta
Blood
Ventricle
Aortic perspective
Collagen orientation

b Diastole

c

Cardiovascular calcification: current controversies and novel concepts J.L. Ruiz et al./Cardiovascular Pathology 24(2015)207-212

Bicuspid aortic valve

A B C
D E F

Hemodynamic flow changes from raphe location

A healthy volunteer B aortic valve control C HL-BAV D HL-B2AV

Rishi Mahadevia et al. Circulation. 2014;129:673-682

Aortic Dissection

Hemodynamic cycle

```

    graph TD
      HS[Hemodynamic Stress] --> MT[Mechano-Transduction]
      MT --> HA[Histologic Abnormalities]
      HA --> DW[Dilatation, Wall Thinning]
      DW --> HS
      subgraph Center
        ESM[Endothelium Vasc. Smooth Muscle Matrix]
      end
      HS --- ESM
      MT --- ESM
      HA --- ESM
      DW --- ESM
  
```

Circulation. 2008;117:2802-2831

Aortic Dissection

Location determines treatment

AORTIC ANEURYSM AND DISSECTION

Aortic aneurysm
Normal thoracic aorta
Kidney
An aortic aneurysm is a bulge in a section of the aorta caused by an underlying weakness in the aortic wall.

Aortic dissection classification (two systems)

Stanford A (tear in the ascending aorta)
DeBakey I (tear in the ascending aorta that propagates to the arch)
DeBakey II (tear confined to the ascending aorta)
DeBakey III (tear in the descending aorta)
Stanford B (tear in the descending aorta)

Surgical options
Endovascular: Minimally invasive insertion of a stent graft
Open repair: traditional open surgery with replacement of the damaged section with a tube graft

Stiffness

Stiffness comes from Arteriosclerosis

Aging of the Arteries

Endothelium
Vessel wall
Atherosclerotic plaque

- Arteriosclerosis:** general term for degeneration changes in arteries making them less elastic; **'hardening of the arteries'**; increases resistance to blood flow causing **increased BP** and **increased work to heart**

