

How to measure Left ventricular function by echocardiography

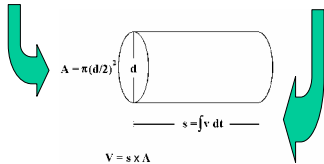
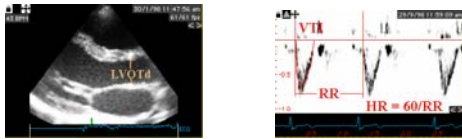
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<http://www.ntnu.no/~stoylen/lectures>

Stroke volume:

- $SV = EDV - ESV$
- $CO = SV \times HR \Rightarrow SV = CO / HR$
- $EF = SV / EDV$

Stroke volume by Doppler:

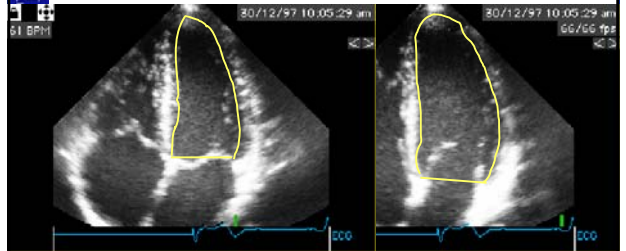


$$V = s \times A$$

$$SV = s \times A = \int v dt \times \pi(d/2)^2$$

$$CO = SV \times HR = \int v dt \times \pi(d/2)^2 \times HR$$

Ejeksjonsfraksjon:

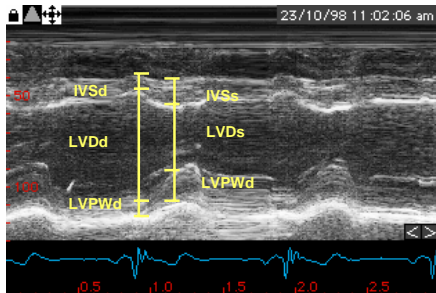


Systole

Diastole

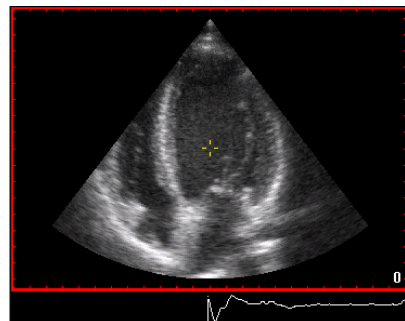
$$SV = EDV - ESV$$

Fractional shortening:

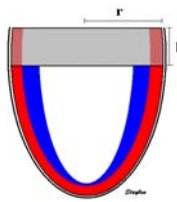


$$FS = (LVDd - LVDs) / LVDd$$

Long axis function:

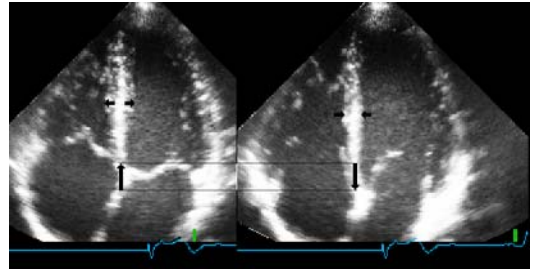


Egg shell mechanism:

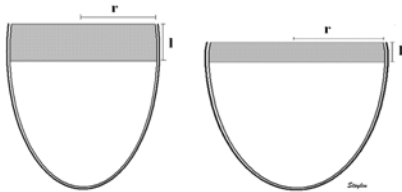


- Hamilton 1932
- Hoffmann 1985
- Lundbäck 1986

Incompressibility:

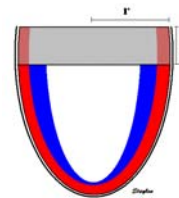


EF

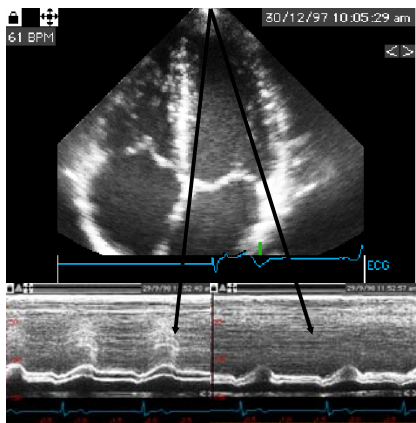


- Schiller -89
- Alam 92

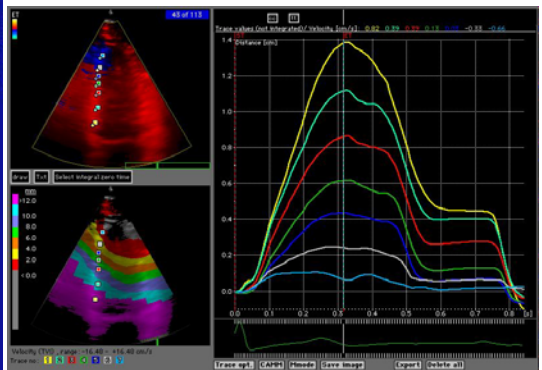
Stroke volume:

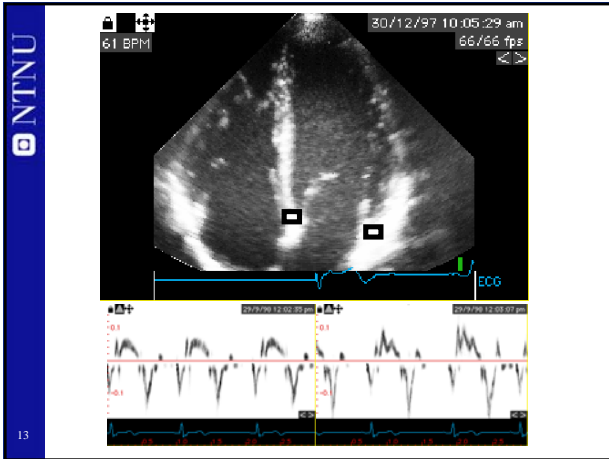


- Emilson 2000
- Carlhall 01



Tissue tracking:



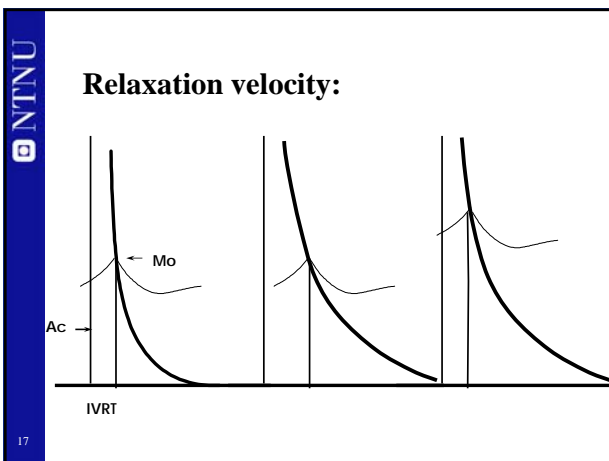
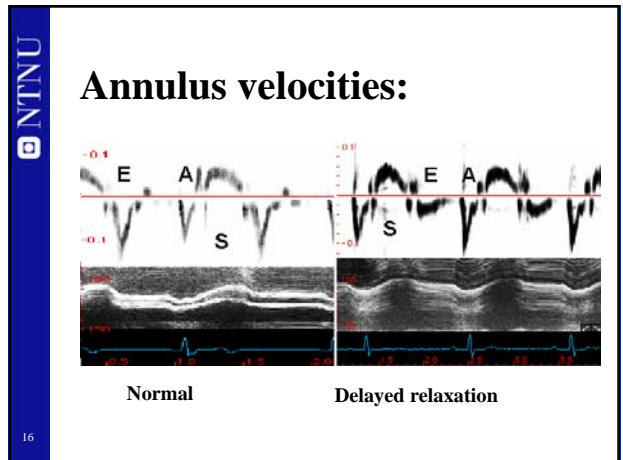
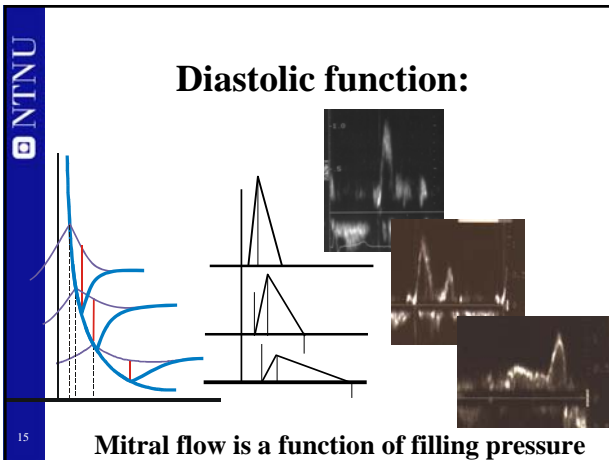


Systolic funktion:

Peak systolic velocity:

- Gulati et al 1996:
 - Peak velocity correlates with EF: $R=0.86$
 - Peak velocity $> 5,4$ cm/s \rightarrow EF $> 50\%$
- Støylen et al 1999: $R = 0,69$ (MAE: 0,80)
- Vinereanu et al 2001:
 - Peak velocity > 9 differentiates normal from pathological hypertrophy
 - Normal value > 8
- Bach 1996:
 - Correlation with dP/dt under dobutamine

Peak systolic velocity an index of contractility



Diastolic funktion

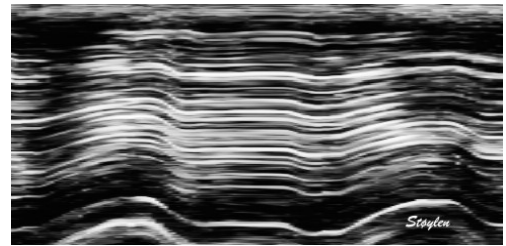
- Oki et al 1997:
 - Peak E_a correlates with τ
- Sohn et al 1997:
 - Peak E_a is independent of filling pressure
 - Peak E_a correlates with τ
- Nagueh et al 1997:
 - Peak E_a no pseudo normalisation
 - E/E_a correlates med PCWP

E/Ea and filling pressure:

	E/e(lm)	PCWP (mmHg)	Sens. (%)	Spes. (%)
Nagueh 1997 *	>10	>10	91	81
	>10	>15	97	78
Nagueh 1998 **	>10	>12	78	95
	>10	>15	85	93
Sundareswaran 1998 ***	>8	>15	87	81
	Ending >2.5	Øking ≥5	77	75
Nagueh 1999 ****	>10	>15	92	85
Sohn 1999 *****	E/e(septal)			
	>11	>15	75	93

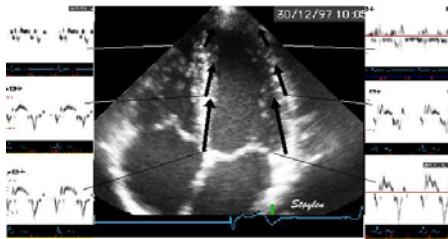
Tabell: Vegsundvåg

Longitudinal strain:

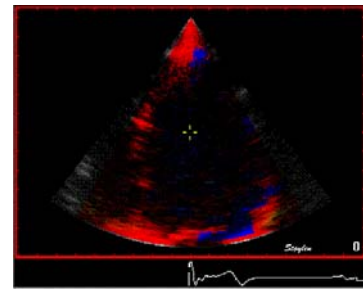


$$\epsilon = \frac{L - L_0}{L_0} = \frac{\Delta L}{L_0}$$

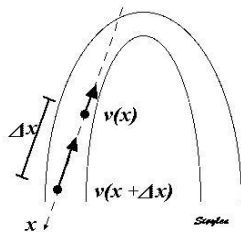
Longitudinal velocities:



Colour tissue Doppler:



Strain rate



$$SR = \frac{v(x) - v(x + \Delta x)}{\Delta x} = \frac{\Delta v}{\Delta x}$$

Heimdal et al 1998, www.ntnu.no/~stoylen/strainrate

