

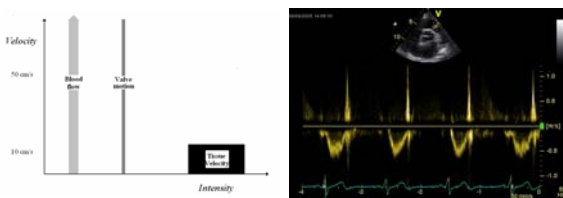
Vevsdoppler:

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DMF,
NTNU
www.ntnu.no/~stoylen/lectures
www.ntnu.no/~stoylen/strainrate

Vevsdoppler

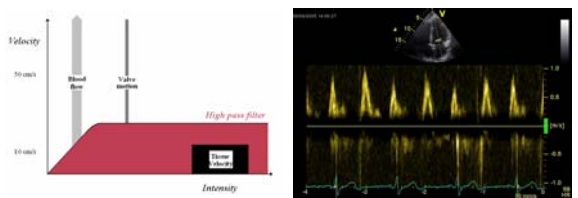
- Samme prinsipp ved vevsdoppler og vanlig Doppler: $f_D \approx 2 f_0 (v/c) \cos(\alpha)$
- Vinkelfeil: $\cos(25^\circ) = 0,95$
- Vinkelkorreksjon?

Vevsdoppler

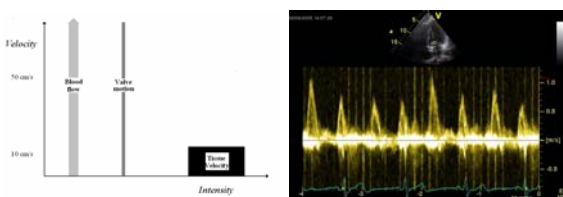


Prinsipielt som Doppler flow:
Blod: Høye hastigheter, lav intensitet (Høypassfilter)
Vev: Lave hastigheter, høy intensitet

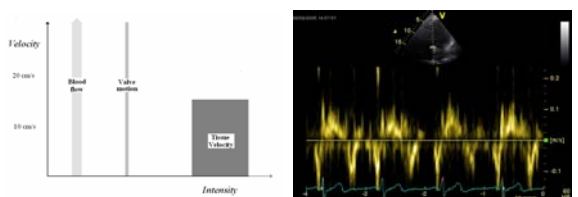
Høypassfiltrering



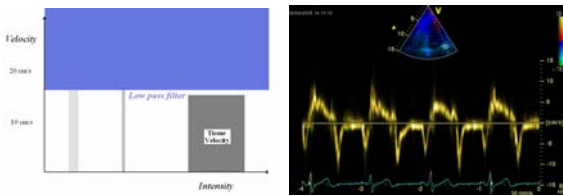
Ingen filtrering



Ingen filtrering, lav gain



Lavpass filtrering



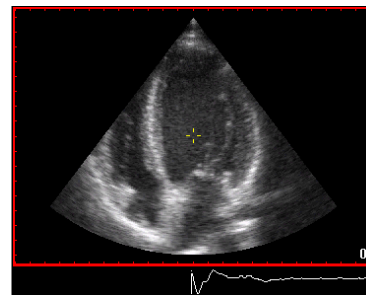
Vevsdoppler:

- Beskrevet teoretisk 1976 (Angelsen)
- Pulset vevsdoppler 1989 (Isaaz)
- Farge vevsdoppler 1992 (McDicken)

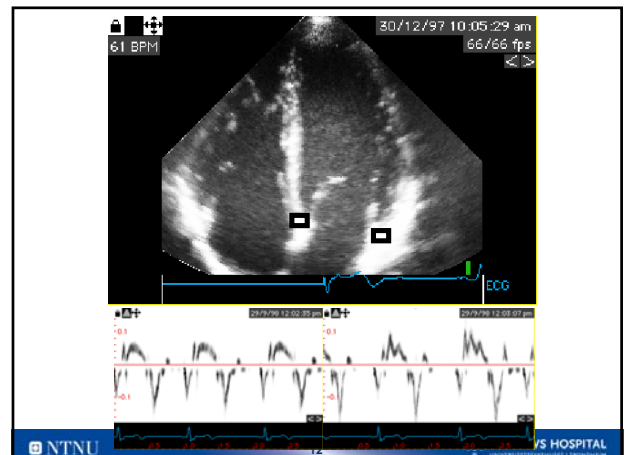
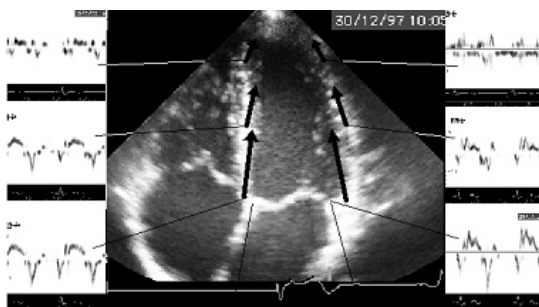
Vevsdoppler:

- Pulset (Global funksjon)
 - Sekvensiell
 - Robust
 - Online (rask)
- Farge
 - Simultan (regional funksjon)
 - Sensitiv for støy
 - Postprosessering

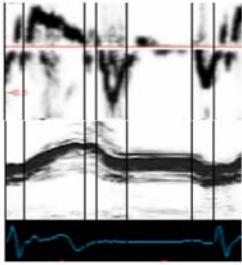
Langaksebevegelsen:



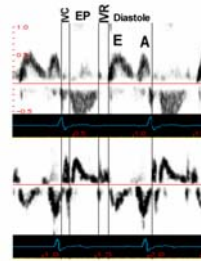
Vevsdoppler:



Pulset vevsdoppler



Vevsdoppler og flow:

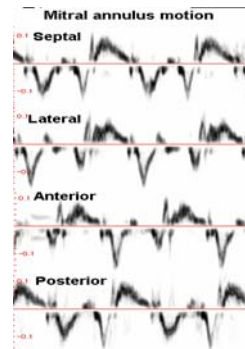


- Flow: Resultat av trykkforskjeller
- Kontraksjon: Årsak til trykkforskjeller

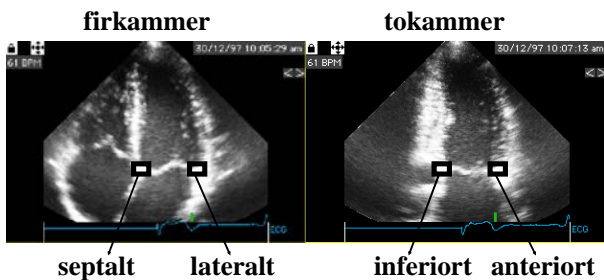
Normalverdier systolisk hastighet:

- **Gulati et al 1996:**
 - Peak velocity korelerer med EF: $R = 0.86$ (Støylen et al 2003: $R = 0.66$)
 - Peak velocity $> 5,4$ cm/s tilsvarer EF $> 50\%$
- **Vinereanu et al 2001:**
 - Peak velocity > 9 differensierer mellom normal og patologisk hypertrofi (men alle med normal EF)
 - Normalverdi > 8

Posisjonsavhengighet :

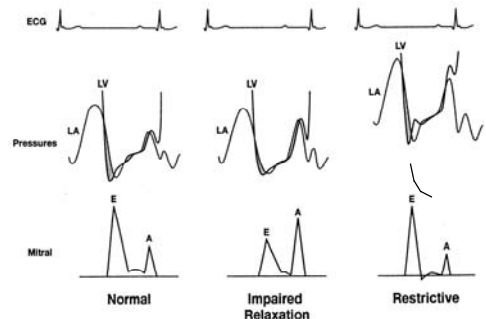


Normalverdiene gjelder gjennomsnitt av 4 punkter:

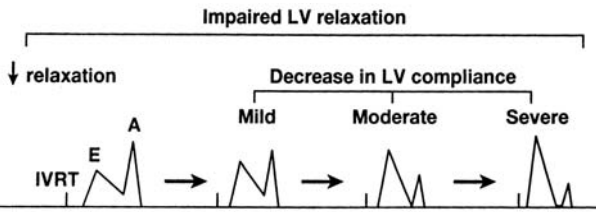


Gjennomsnittet av 4 punkter reduserer også variabiliteten med 25%

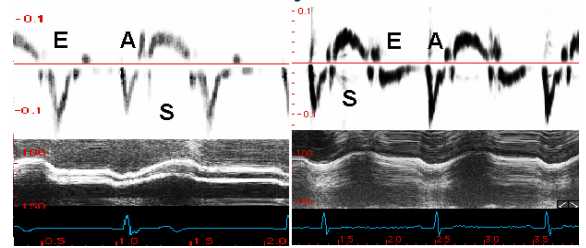
Fylningstrykk og mitralflow



Mitralflow og økande fylningstrykk



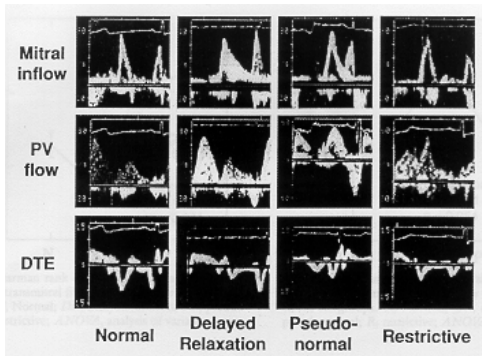
Diastolisk funksjon VV:



Frisk person

Hypertensiv pasient med
forsinket relaksasjon

Diastolisk funksjon:



VevsDoppler, normalverdier

(Middelverdi cm/s ±SD)

Alder	<40 år	40-59 år	≥60 år
Venstre ventrikel:			
Septum	15,5±2,7	12,2±2,3	10,4±2,1
Fremre vegg	17,6±2,9	15±3,3	10,8±2,1
Laterale vegg	19,8±2,9	16,1±2,3	12,9±3,5
Nedre vegg	17,7±2,9	14,2±2,7	10,7±2,1
Middelverdi alle avsn.	17,7±2,4	14,4±2,1	11,3±2,1
Laterale tricuspidalring	17,7±2	15,6±3,7	13,2±2,7

Normalverdier for e-hast.i mitralannulus, forenklet

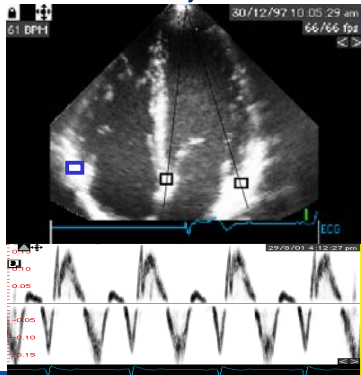
- Yngre voksne:
– >10 cm/s
- Eldre voksne
– >8 cm/s

E/A ratio i mitralflow vs Ea/Aa ratio til mitralannulus

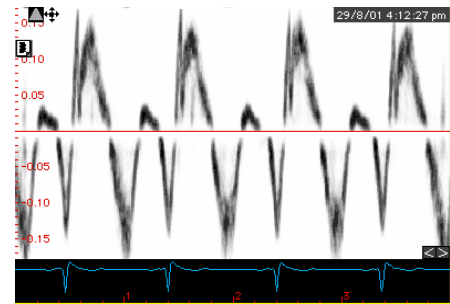
	Normale n=34	Forsinka relaksasjon n=40	Pseudonormale n=51
E/A	1,4±0,3	0,66±0,14	1,7±0,5
Ea/Aa	1,4±0,4	0,62±0,2	0,66±0,2
E/Ea	7,7±3	7,8±3,5	18±4

Nagueh 1997

Høyre ventrikkelfunksjon:



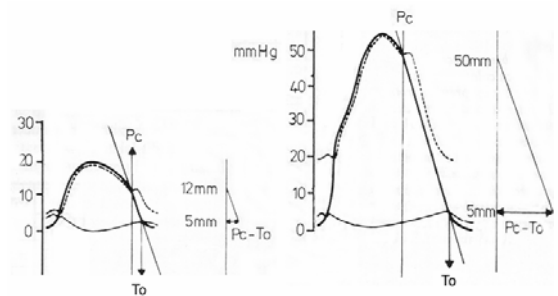
Høyre ventrikkelfunksjon:



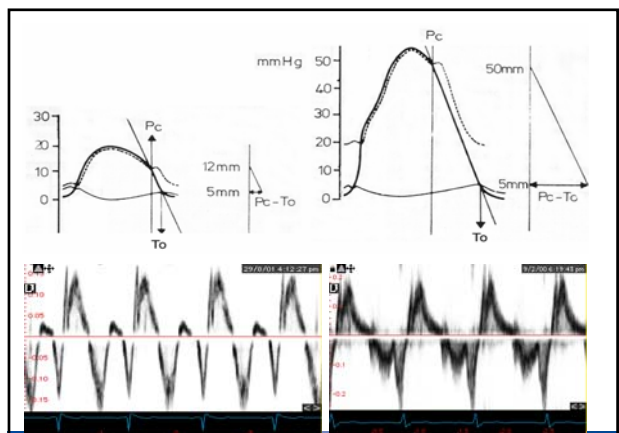
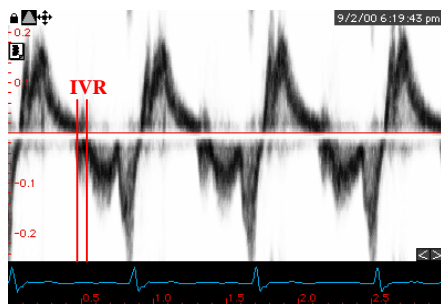
Høyre ventrikkelfunksjon

- Peak systolisk hastighet av tricuspidalringen
- Et målepunkt.
- Normalt 15 cm/s = Normal høyre ventrikkelfunksjon patologisk < 10 cm/s (Alam 2000)
- Hø. Atrietrykk: E/Ea korrelerer dårligere med fyln. Trykk (Nageh 1999) (dessuten finnes bedre metoder som
 - Venestuvning
 - Vena cava)
- Systolisk pulmonalarterietrykk?
 - Påvisbar IVR (cfr Burstin 1967)

Hø. V. isovolumetrisk relaksasjonstid (Pc-To)



RV IVR med vevsdoppler:



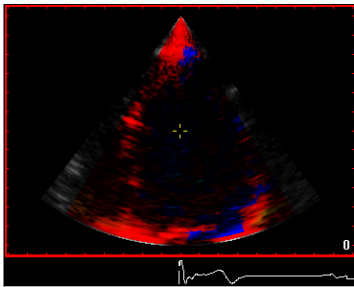
Farge vevsdoppler:

- Handler om regional funksjon
- Foreløpig bare et hjelpemiddel for vurdering av 2D, ikke selvstendig diagnostikum:
- Spesifisitet og sensitivitet ikke kartlagt
- Komplisert å vurdere
 - Hastigheter viser bevegelse, ikke kontraksjon
 - Øvrige metoder har artefaktproblemer

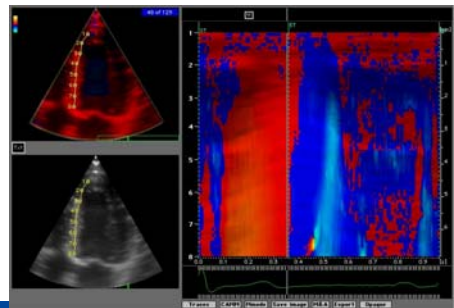
Regional funksjon:

- Hvor er det dysfunksjon
- Hvor utbredt er dysfunksjonen
- Hvor uttalt er dysfunksjonen

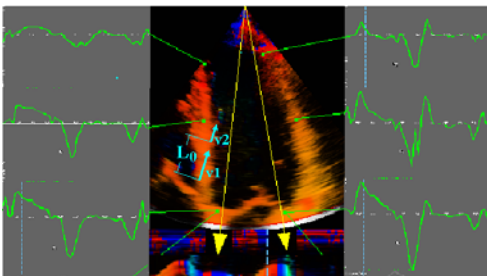
Farge vevsdoppler:



Curved M-mode (CMM):

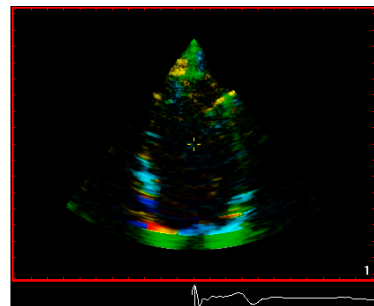


Strain rate:



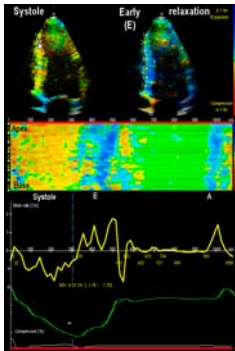
$$SR = \frac{v_1 - v_2}{L_0}$$

Strain rate imaging:

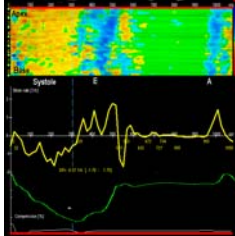


Strain rate Imaging.

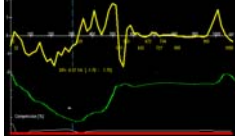
2D:



M-mode:



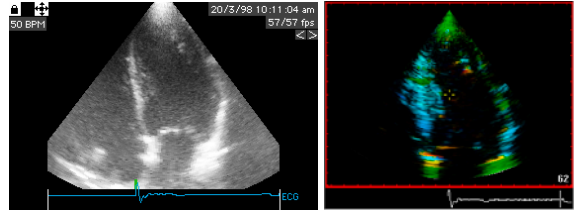
Strain rate:



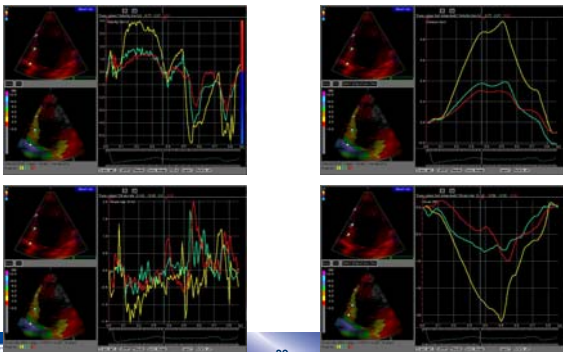
Strain:



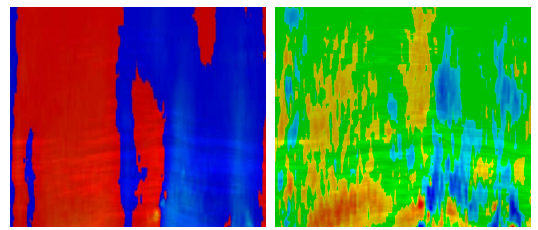
FVI



FVI

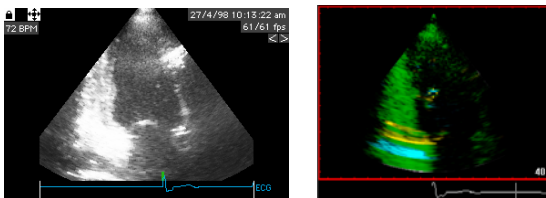


FVI

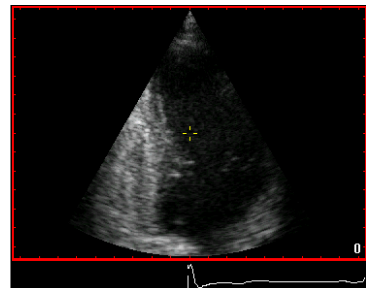


• DTI SRI

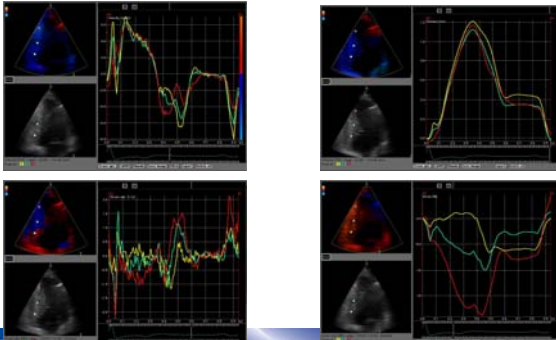
NVI:



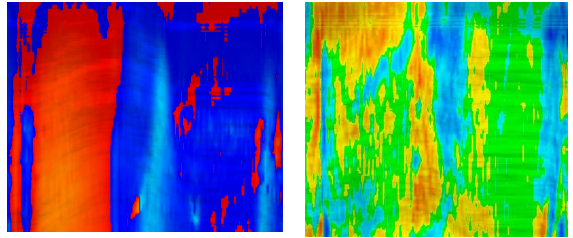
NVI



NVI

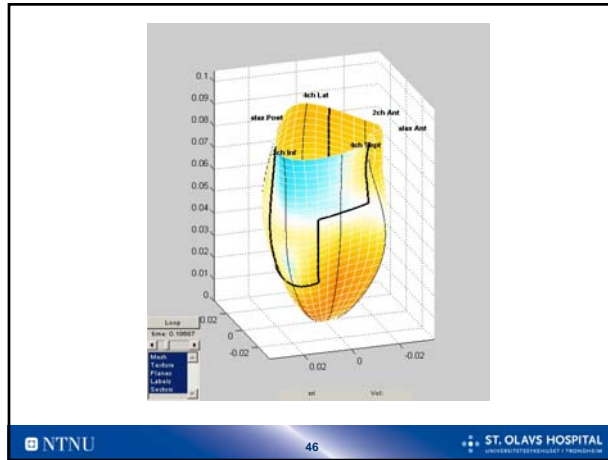
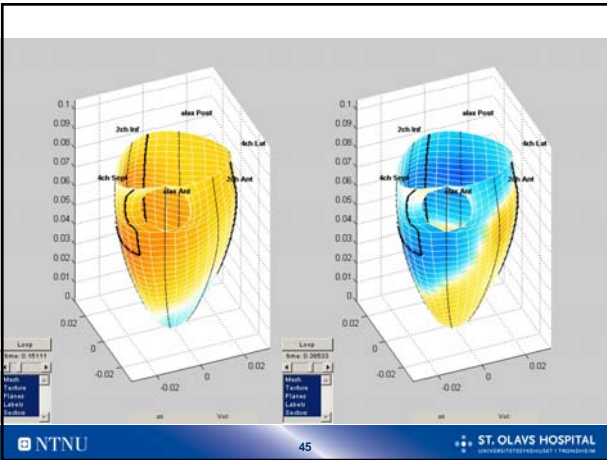


NVI

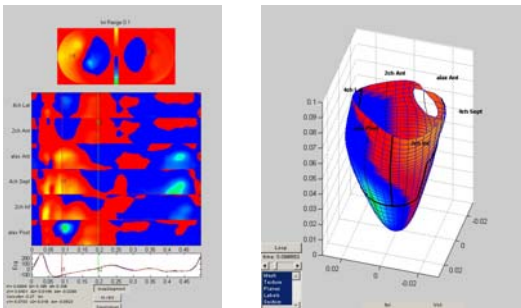


• DTI

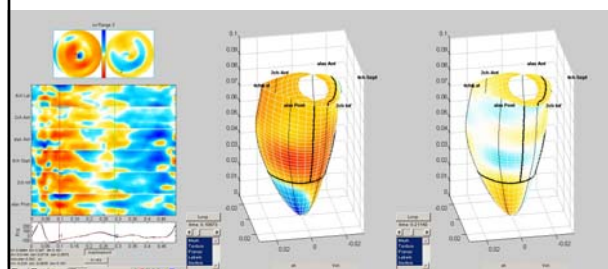
SRI



Asynkroni



Strain rate – peak stress:



Hvordan bruke vevsdoppler?

- **For tilleggsdata og usikkerhet:**
 - TVI. Utelukkelse
 - Verifisering
- **For lokalisasjon av patologi**
 - Strain rate / Strain
 - **MED KRITISK BLIKK**

www.ntnu.no/~stoylen/strainrate