

Praktisk bruk av vevsdoppler

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NTNU

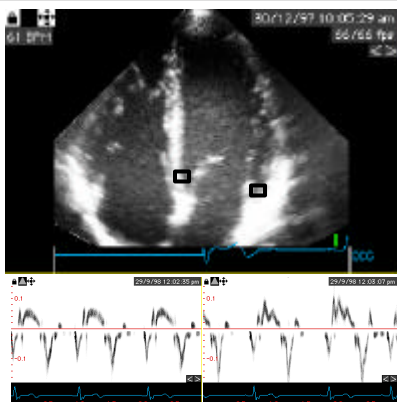
Vevsdoppler:

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

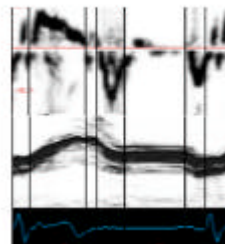
Langaksebevegelsen:



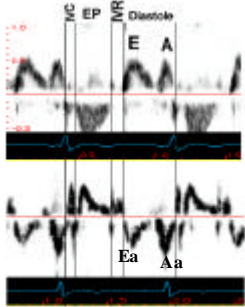
Vevsdoppler:



Vevsdoppler



Vevsdoppler og flow:



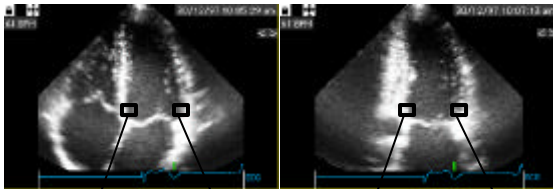
Normalverdier systolisk hastighet:

- 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

Normalverdiene gjelder gjennomsnitt av 4 punkter:

firkammer

tokammer



septalt

lateralt

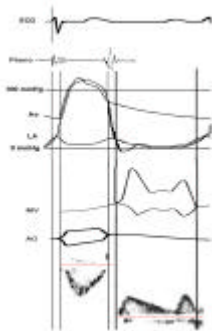
inferiort antèriort

Gjennomsnittet av 4 punkter reduserer også variabiliteten med 25%

Støylen et al 2003

Klaffeplan vevsdoppler:

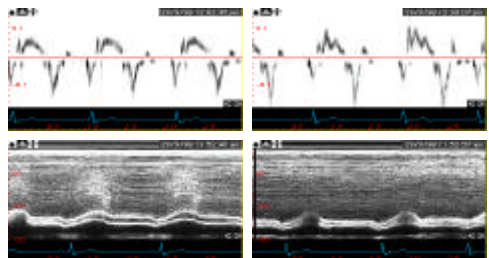
- Fordeler:
 - Enkel i bruk
 - Robust – gir data på de fleste
 - Reproduserbar
 - Sensitiv
 - Nærmeste korrelat til kontraktilitet
- Ulemper:
 - Gain-avhengig
 - Fortsatt noe usikkerhet om normalgrense
 - Langaksebevegelse er nedsatt ved
 - Hypertrofi: OBS hypertensjon HCM, AS!
 - Alder



Vevsdoppler:

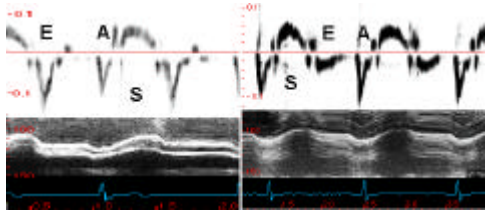
septalt

lateralt



Ea måler relaksasjonshastigheten, men ETTER IVR

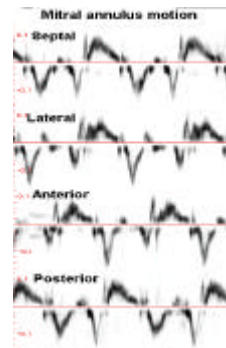
Diastolisk funksjon VV:



Frisk person

Hypertensiv pasient med forsinket relaksasjon

Posisjonsavhengighet :



VevsDoppler, normalverdier

(Middelverdi cm/s \pm SD)

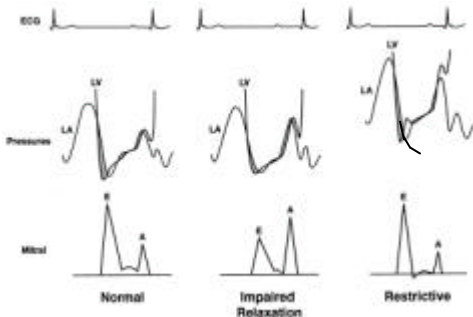
Alder	<40 år	40-59 år	≥ 60 år
Venstre ventrikel:			
Septum	15,5 \pm 2,7	12,2 \pm 2,3	10,4 \pm 2,1
Fremre vegg	17,6 \pm 2,9	15,1 \pm 3,3	10,8 \pm 2,1
Laterale vegg	19,8 \pm 2,9	16,1 \pm 2,3	12,9 \pm 3,5
Nedre vegg	17,7 \pm 2,9	14,2 \pm 2,7	10,7 \pm 2,1
Middelverdi alle avsn.	17,7 \pm 2,4	14,4 \pm 2,1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

Alam et al.

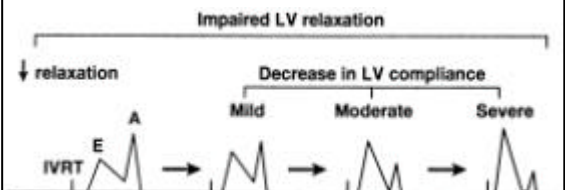
Normalverdier for e-hast.i mitralannulus, forenkla

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

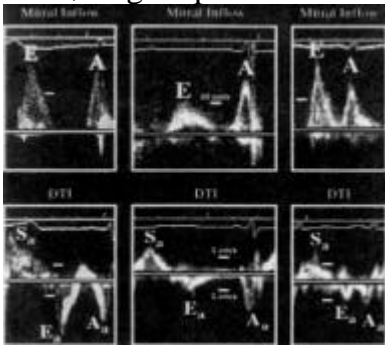
Fyllingstrykk og mitralflow



Mitralflow og økande fylningstrykk

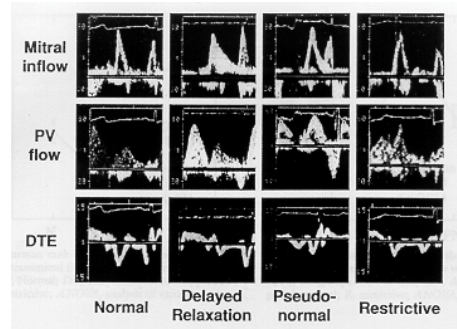


Avsløring av pseudonormalisering



Nagueh -97

Diastolisk funksjon:



Farias et al. JASE 1999

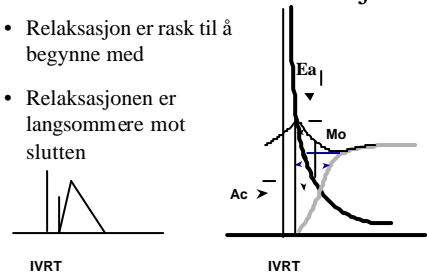
E/A ratio i mitralflow vs Ea/Aa ratio til mitralannulus

	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

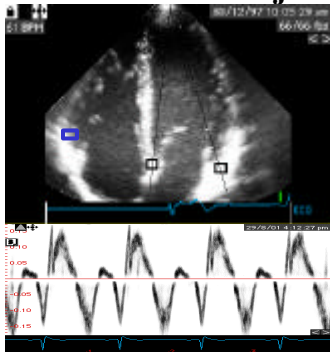
Venstre ventrikkel relaksasjon

- Relaksasjon er rask til å begynne med
- Relaksasjonen er langsommere mot slutten

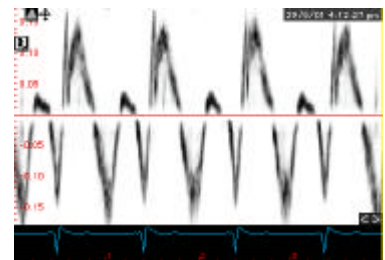


Tau: Tidskonstanten for trykkfallet under IVRT

Høyre ventrikkelfunksjon:



Høyre ventrikkelfunksjon:



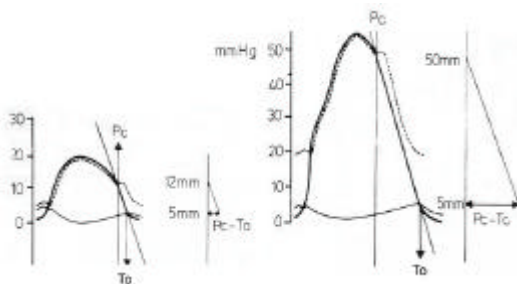
Systolisk høyre ventrikkelfunksjon

- Peak systolisk hastighet av tricuspidalringen
- Et målepunkt.
- Normalt 15 cm/s = Normal høyre ventrikkelfunksjon patologisk < 10 cm/s (Alam 2000)
- Systolisk pulmonalarterietrykk?
 - Påvisbar IVR (cfr Burstin 1967)

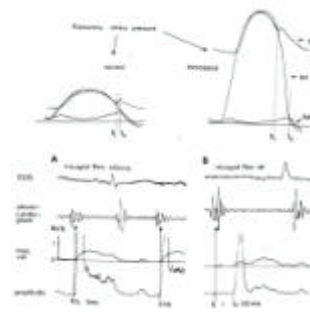
Diastolisk høyre ventrikkelfunksjon:

- Hø. Atrietrykk: E/Ea korrelerer dårligere med fyln. Trykk (Nageh 1999) (dessuten finnes bedre metoder som
 - Venestuvning
 - Vena cava)

Hø. V. isovolumetrisk relaksasjonstid (Pc-To)

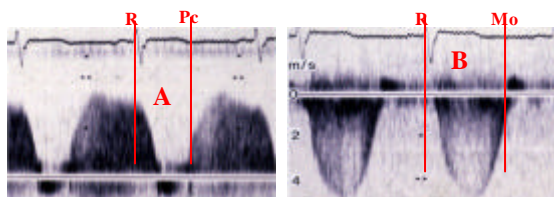


Høyre ventrikkel IVR:



Burstin 61, Hatle-85

RV IVR (Pc - Mo) med Doppler:



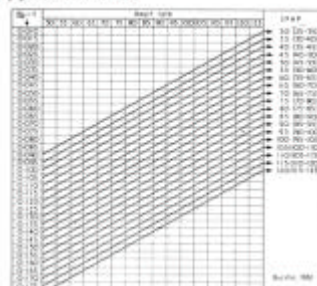
A = R til Pc

B = R til Mo

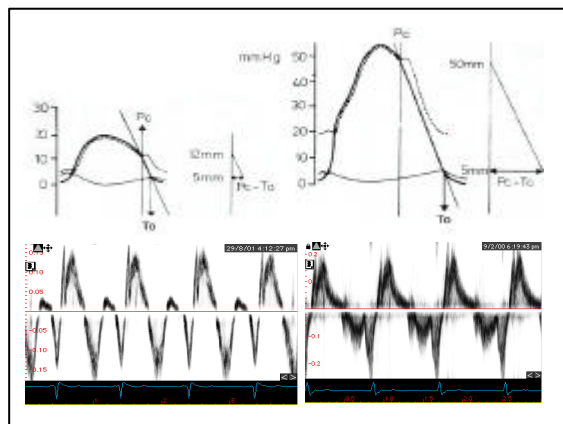
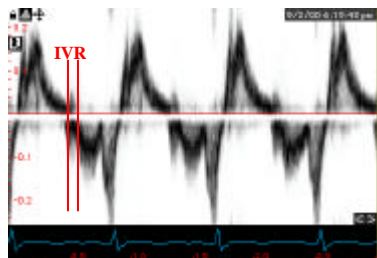
IVR = B - A

Burstin's nomogram:

Table 23. Determination of peak pulmonary arterial pressure from P_c , T_c , interval and heart rate¹¹

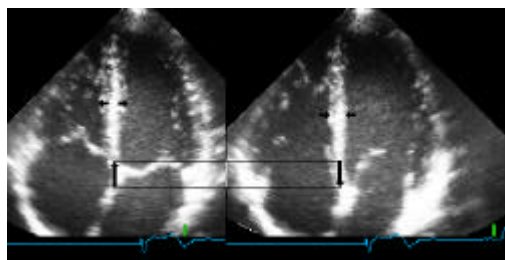
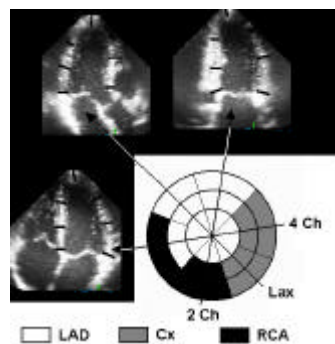


RV IVR med vevsdoppler:



Klaffeplan vevsdoppler:

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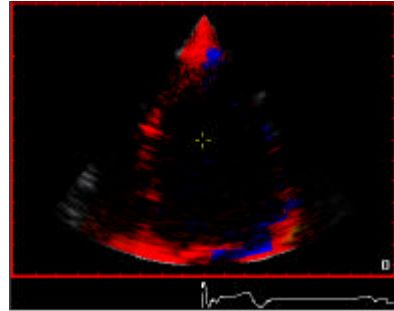
Regional funksjon:

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

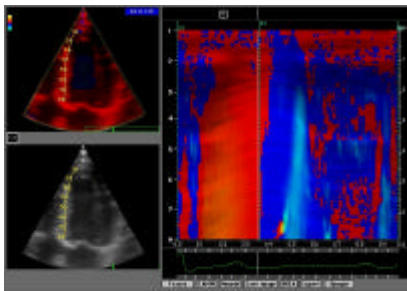
Farge vevsdoppler:

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

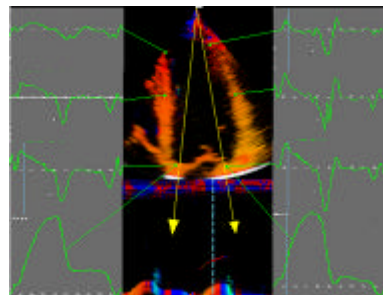
Farge vevsdoppler:



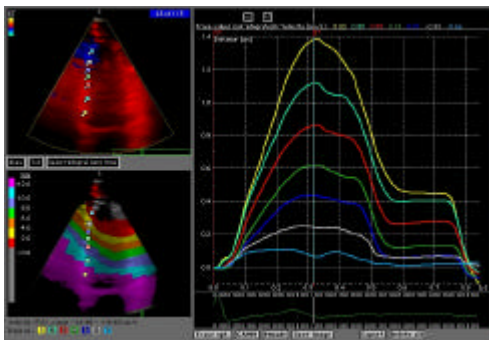
Curved M-mode (Camm):



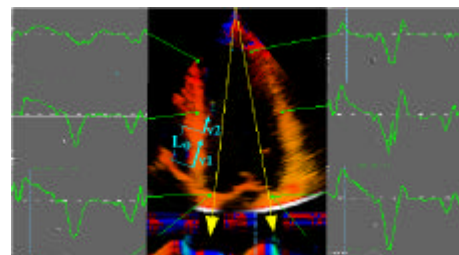
Farge vevsdoppler:



Tissue tracking:

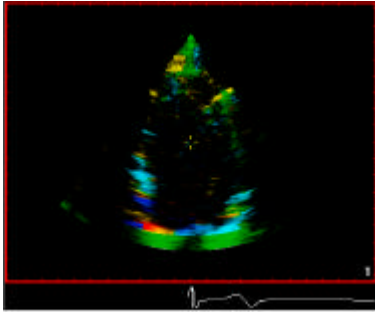


Strain rate:



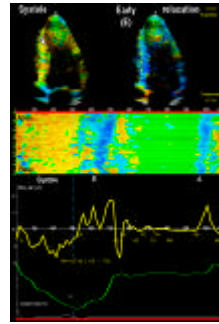
$$SR = v_1 - v_2 / L_0$$

Strain rate imaging:



Strain rate Imaging.

2D:

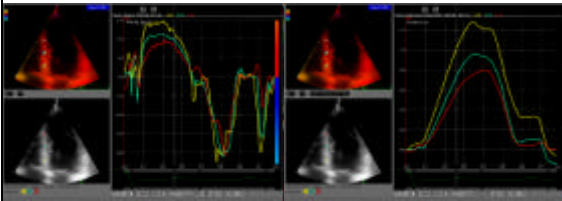


M-mode:

Strain rate:

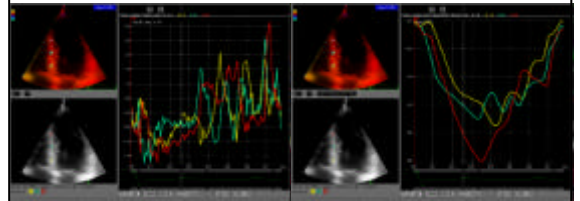
Strain:

Støylen et al 2000



• Tissue velocity

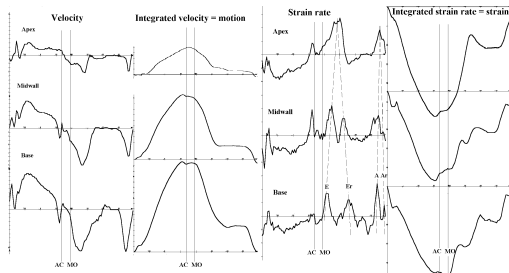
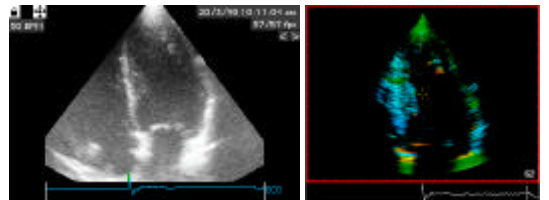
Motion



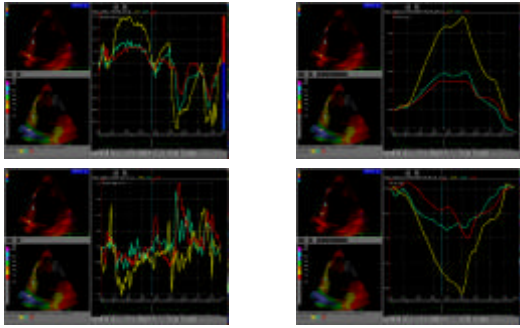
• Strain rate

Strain

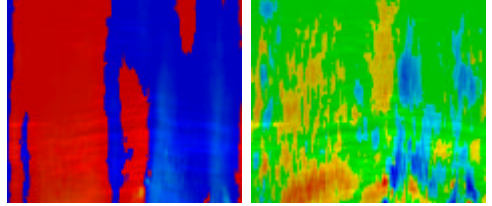
FVI



FVI



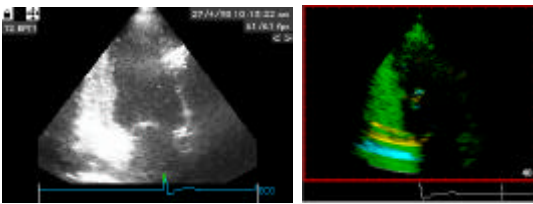
FVI



• DTI

SRI

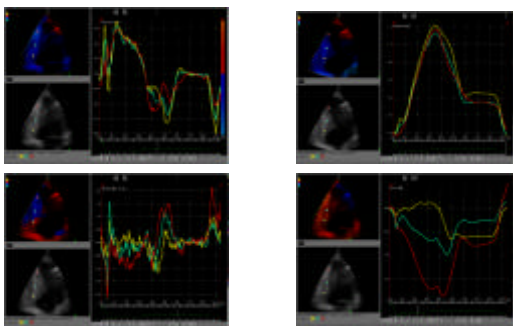
NVI:



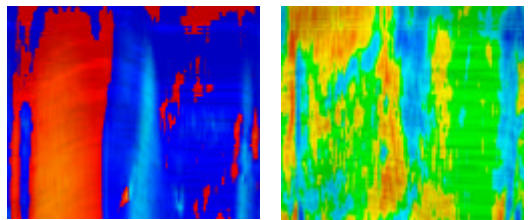
NVI



NVI

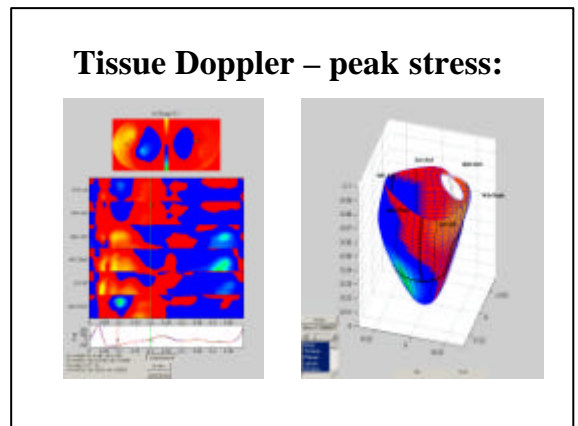
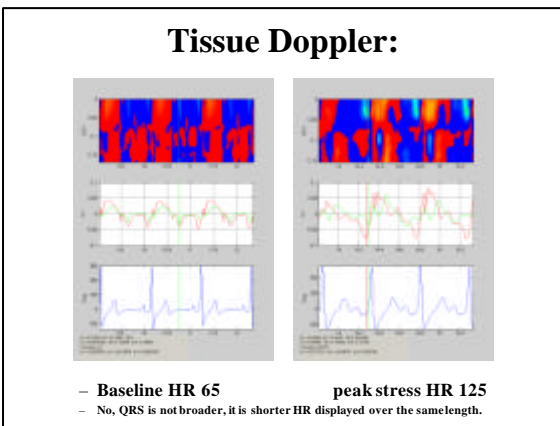
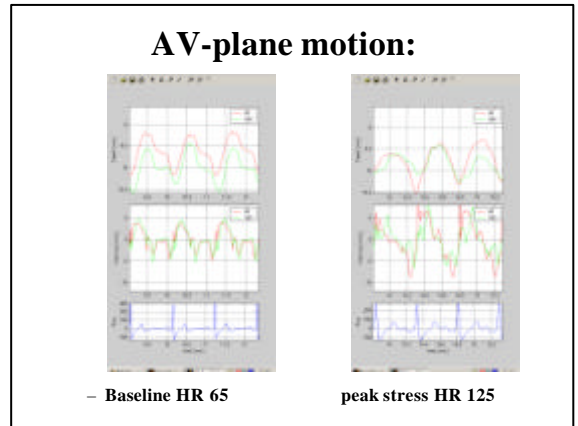
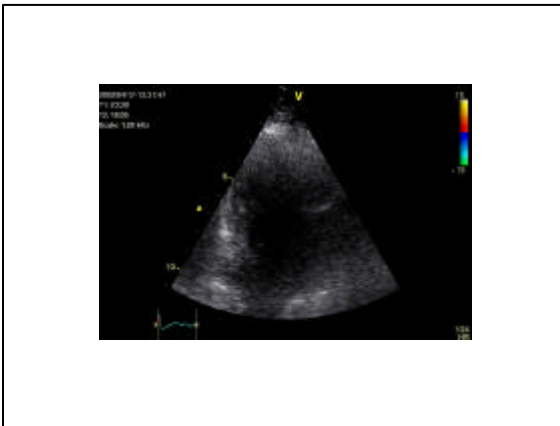
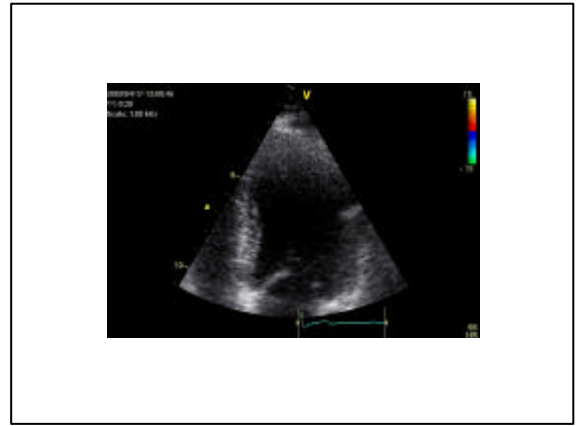
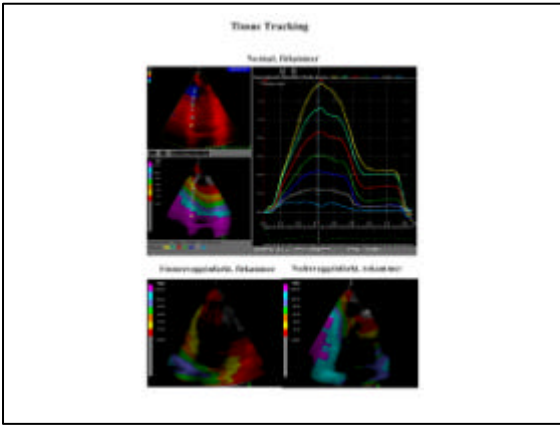


NVI

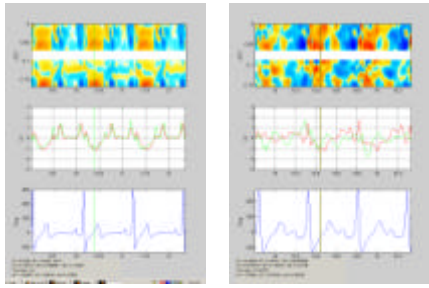


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SRI



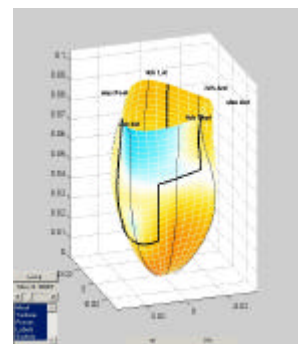
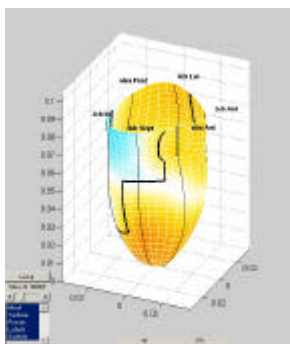
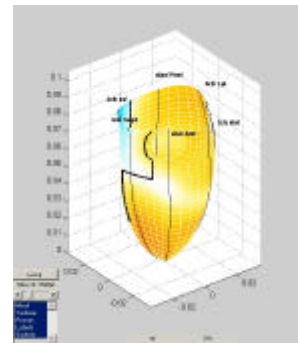
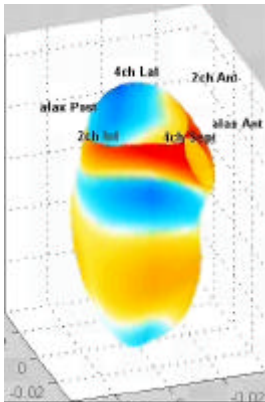
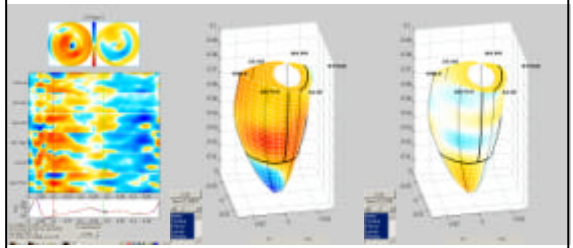
Strain rate imaging:



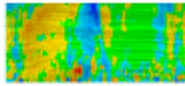
- Baseline HR 65

peak stress HR 125

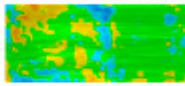
Strain rate – peak stress:



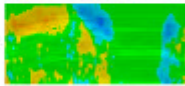
1: Normal:



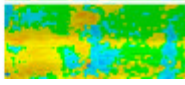
2: Hypokinetic:
(two basal segs.)



3: Akinetic:
(two basal segs.)

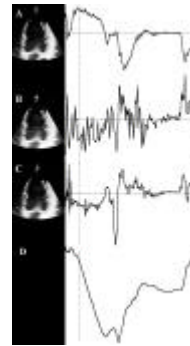


4: Dyskinetic:
(apical segm.)



Stoylen et al 2000

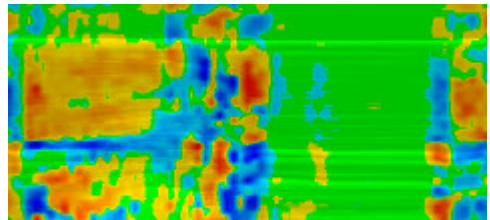
Støy:



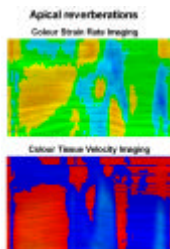
Hvordan redusere støy?

- Strain lengde
- Romlig midling (ROI)
- Tidsmidling
- Cine compound
- Oktav strain

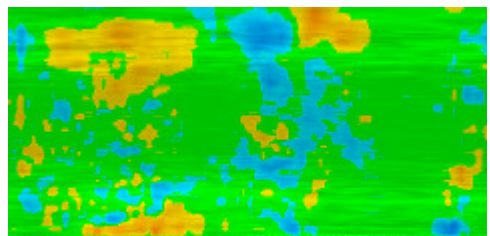
Reverberasjoner



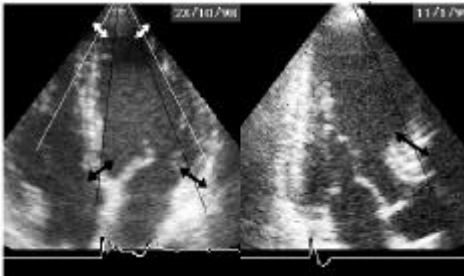
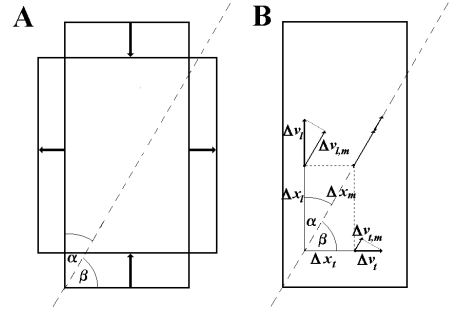
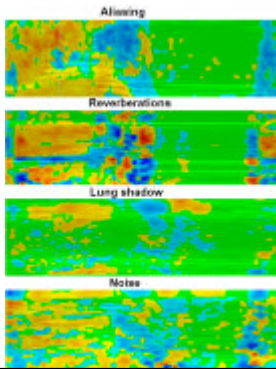
Reverberasjoner



Dropout



Artefakter:



Hvordan bruke vevsdoppler?

- 2D viser sannheten
- For tilleggsdata og usikkerhet:
 - TVI. Utelukkelse
 - Verifisering
- For lokalisasjon av patologi
 - Strain rate / Strain
 - MED KRITISK BLIKK