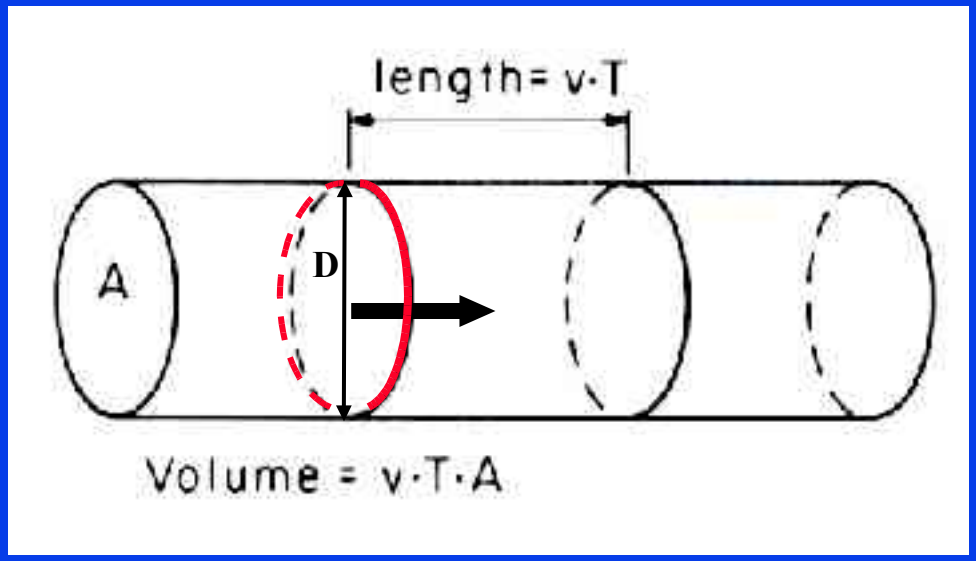
MESURE DU DEBIT CARDIAQUE

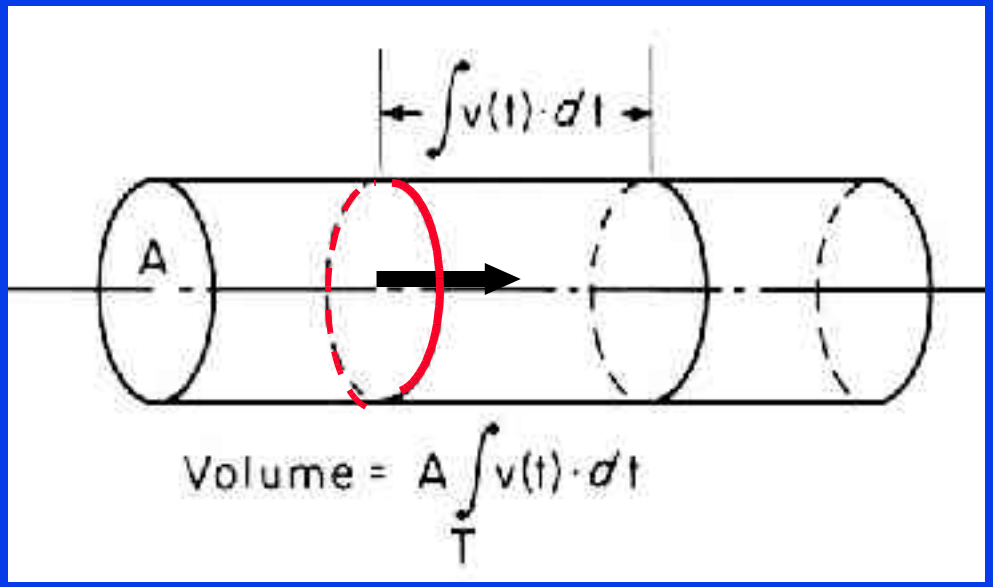
Antoine Vieillard-Baron, Boulogne

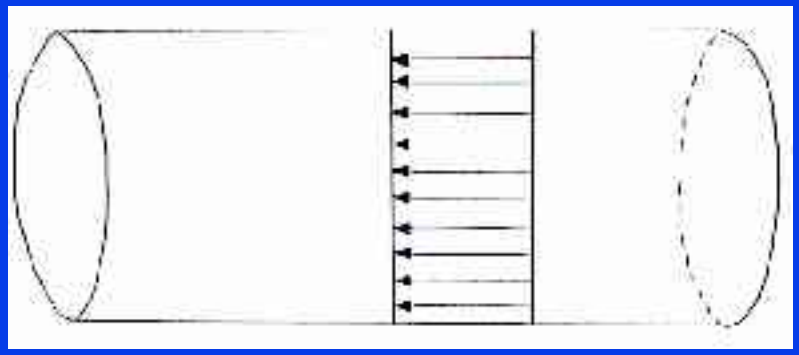
I

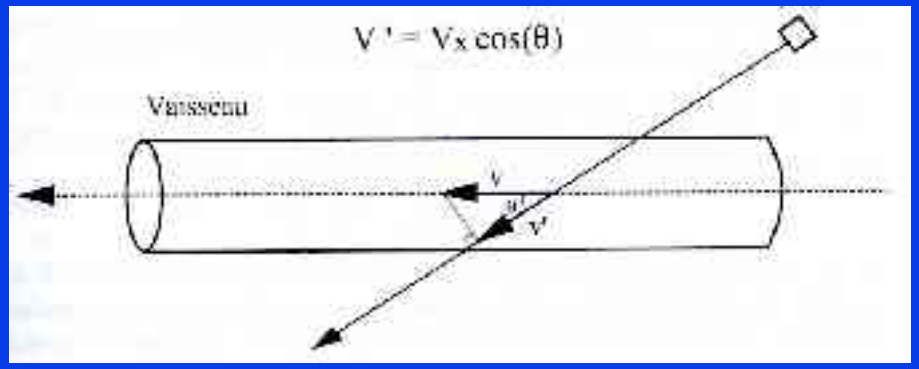
METHODE DOPPLER



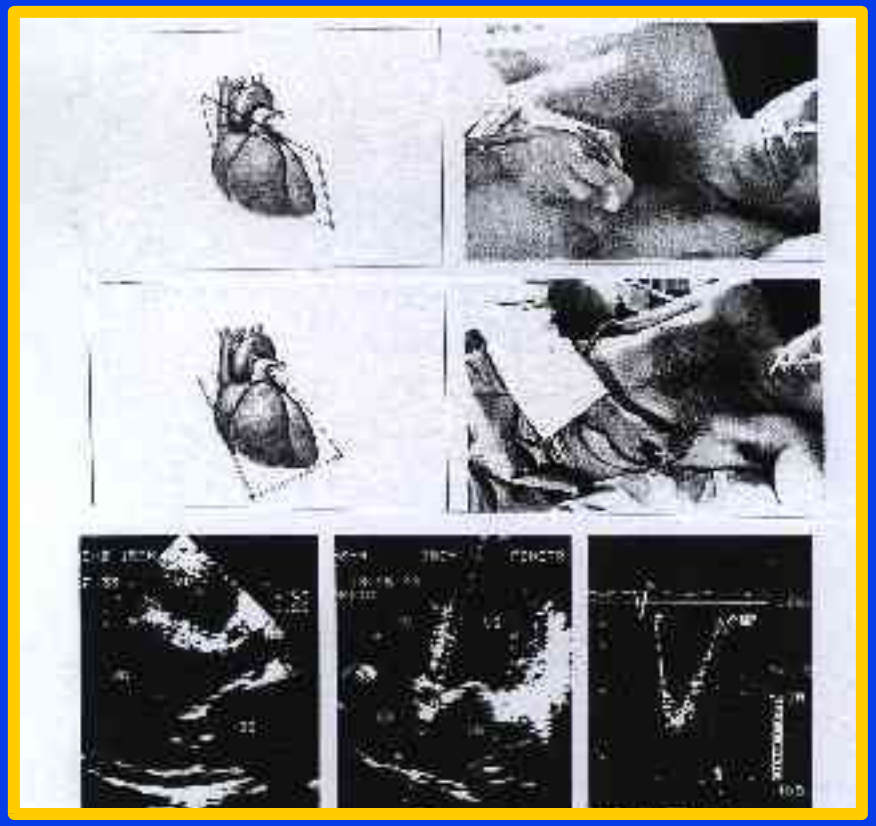
$A = \Pi\ D^2/4$

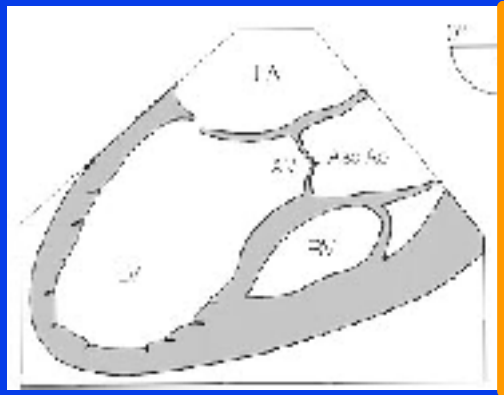


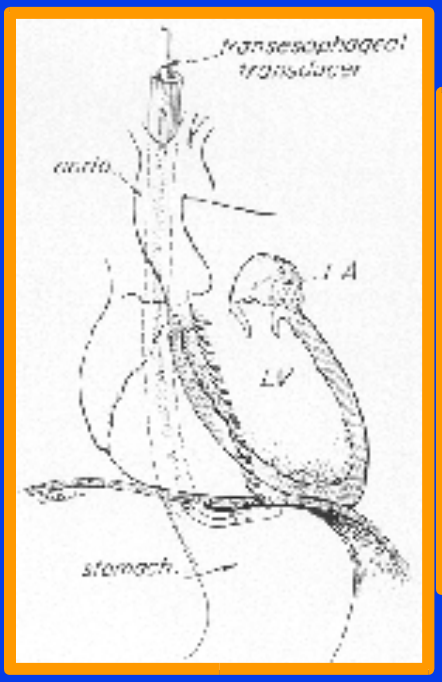


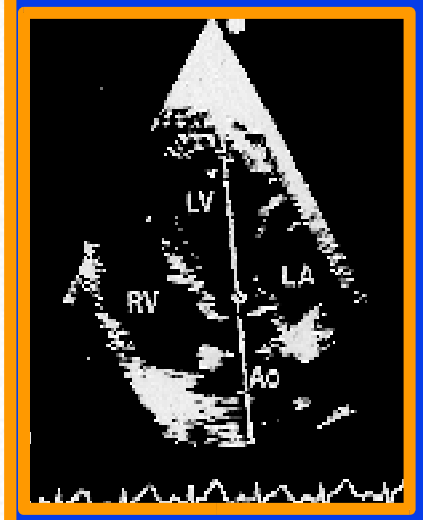

V ' = Vx cos(θ)
Vaisseau
v
v'

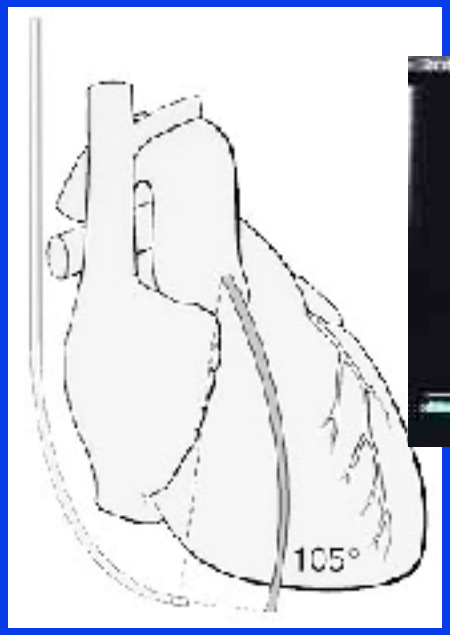
CHAMBRE CHASSE VG



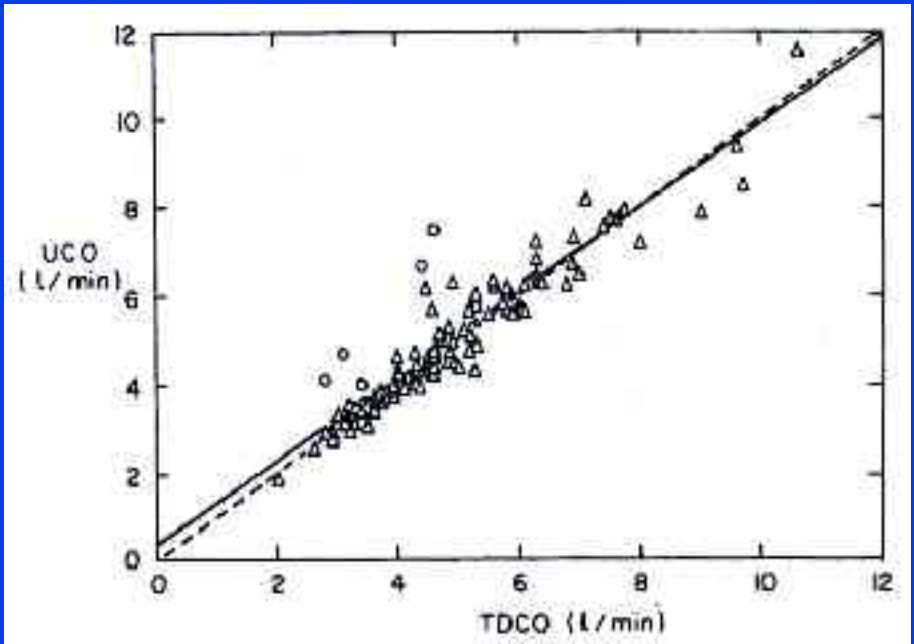

LA
RV
LV


transesophageal transducer
aorta
LA
LV
stomach


LV
RV
LA
Ao

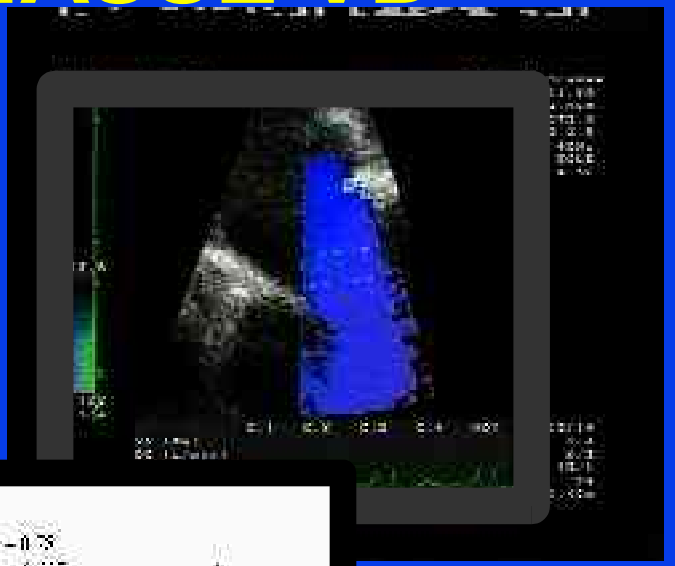

105°

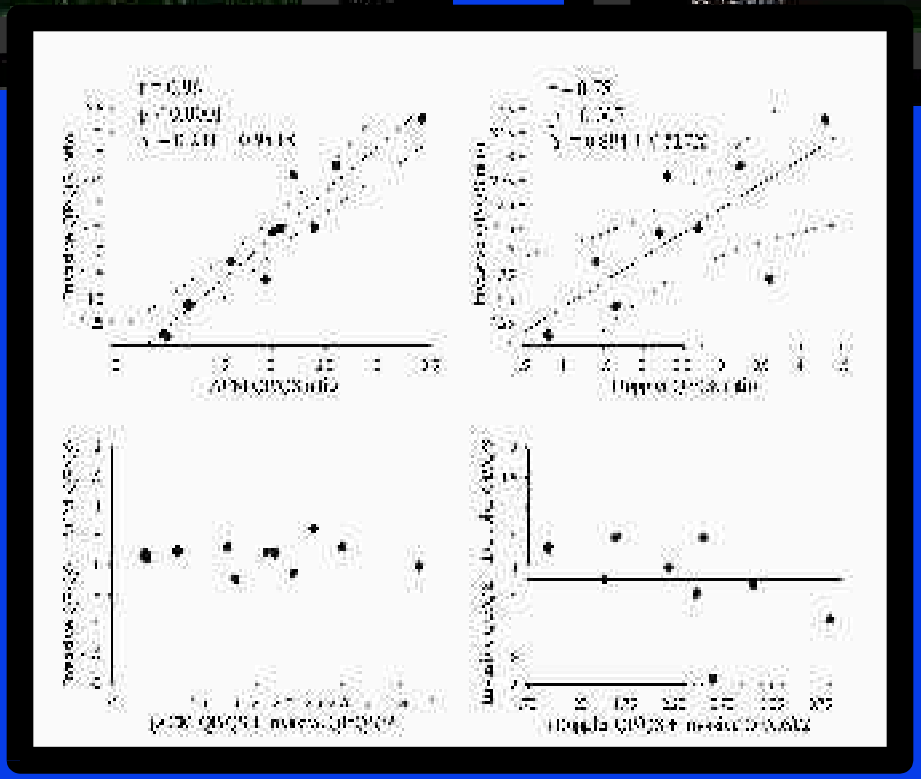

LV
Ao



Huntsman et al. Circulation 1983

CHAMBRE CHASSE VD





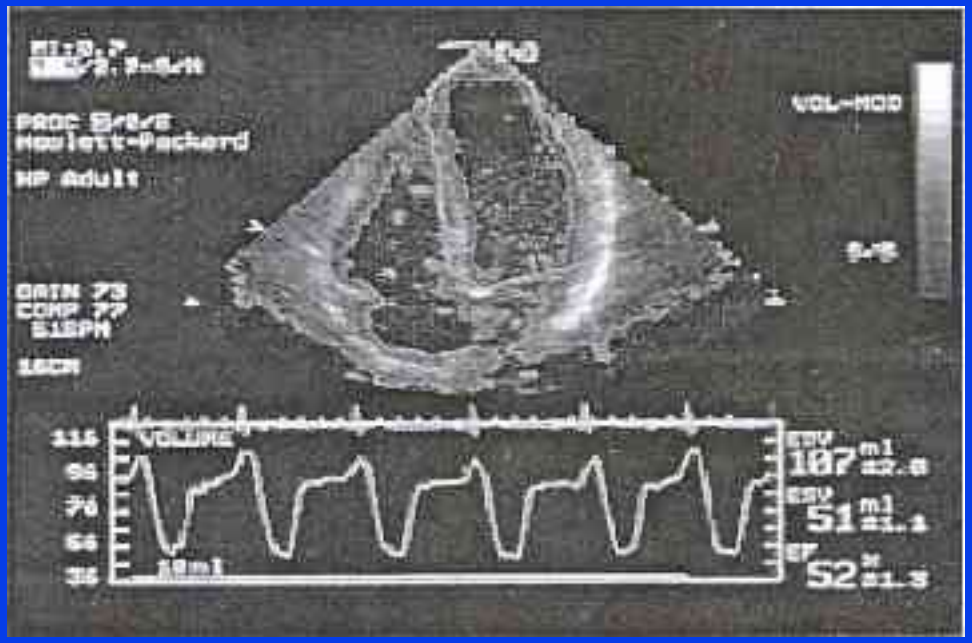
Mansencal ACC 2003

Débit pulmonaire Doppler

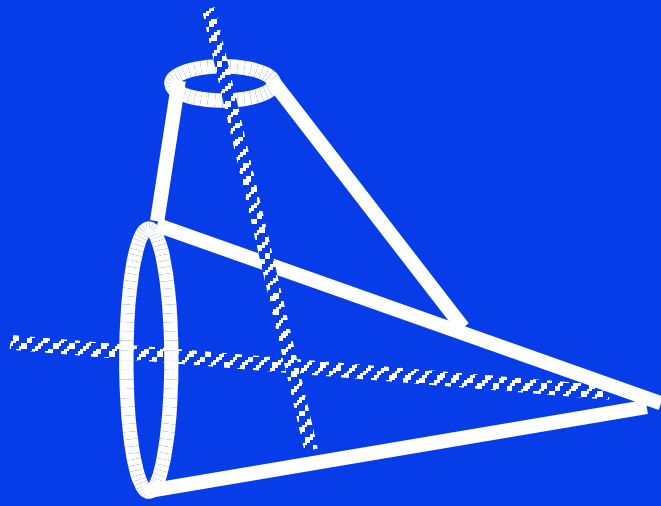
	date	n	r	SEE	F^{aise}	Age
Goldberg	1982	14	0.72	1.1	78%	enfts
Sanders	1983	20	0.88	0.24	80%	9M
Labowitz	1985	12	0.81	0.82	21%	50
Graettinger	1987	9	0.95	0.81	53%	62
Notre étude	1988	23	0.64	0.99	55%	59

II

METHODE DES VOLUMES


PROC Sieve
Hewlett-Packard
HP Adult
VOL-MOD
GAIN 73
COMP 77
SIEPH
VOLUME
115
95
75
55
35
10ml
ESV
107 ml
ESV
51 ml
EF
52 %

EVALUATION DE LA FONCTION VD

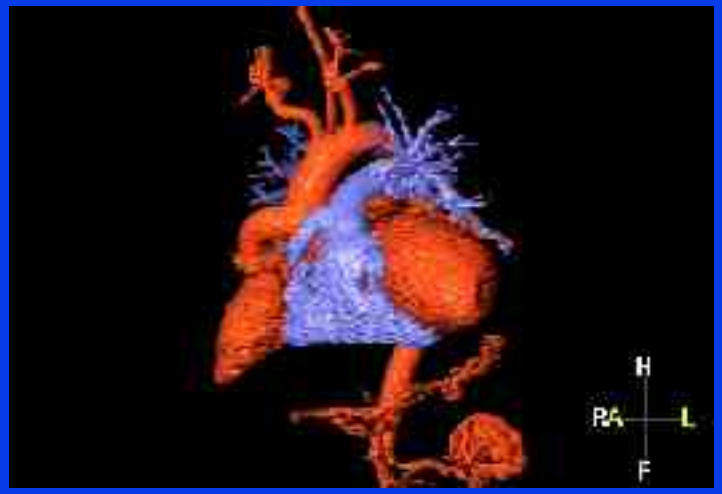


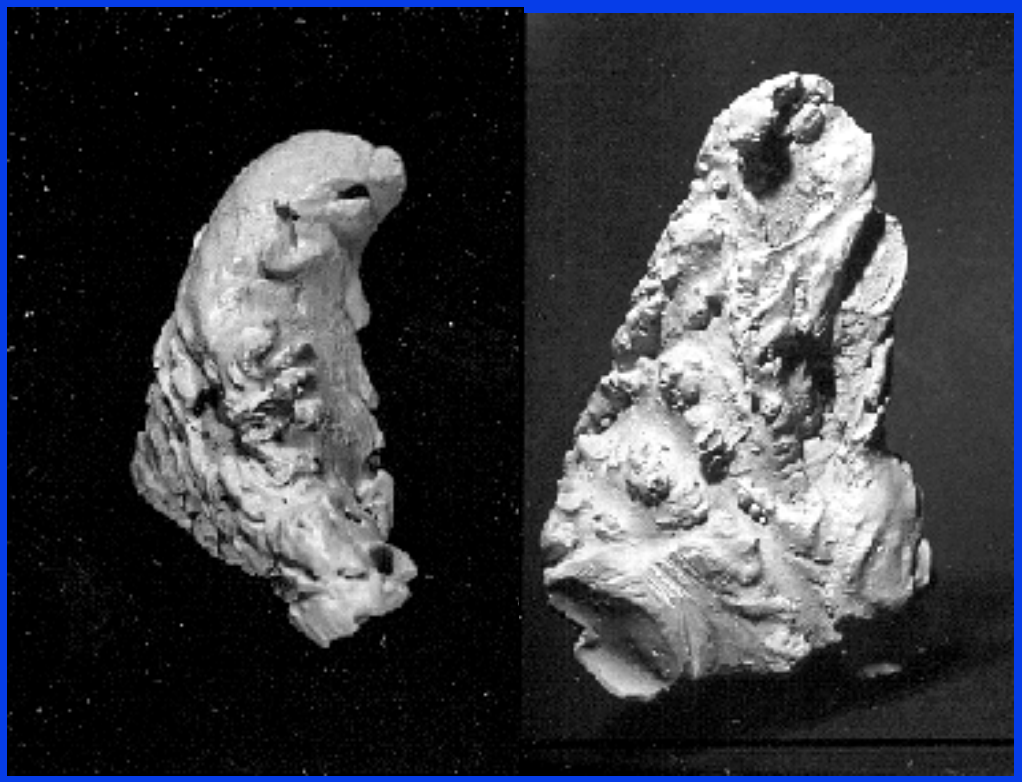
- Forme du VD complexe
  - chambre remplissage plan postéro-ant.
  - chambre chasse inféro-sup.

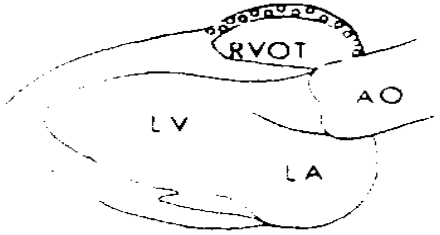
- Position thoracique (résolution proximale...)
  - en amont circulation pulmonaire
  - paroi commune avec VG

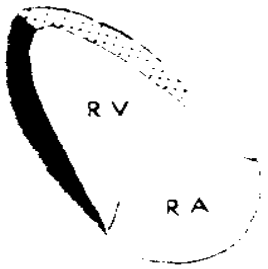
- Taille variable
  - Si surcharge aiguë de P modification instantanée de forme pour s'adapter et avoir une configuration plus efficace

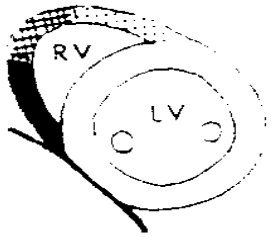
- Contraction différente du VG
  - Soufflet à surface large alors que l'espace entre les parois est faible
  - permet d'éjecter un large volume de sang avec un raccourcissement minimal du VD

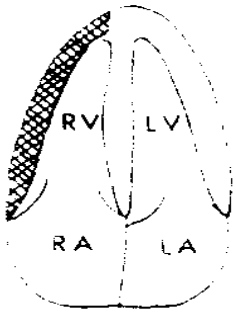

H
PA
L
F









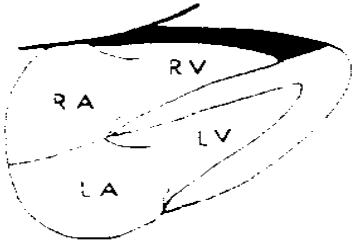


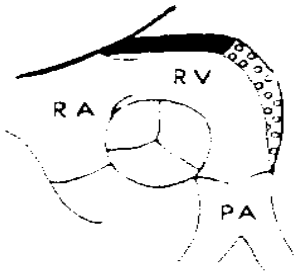
anterior wall of the RVOT

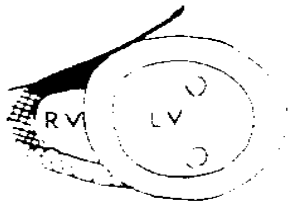
anterior wall of the RV

lateral wall of the RV

inferior wall of the RV





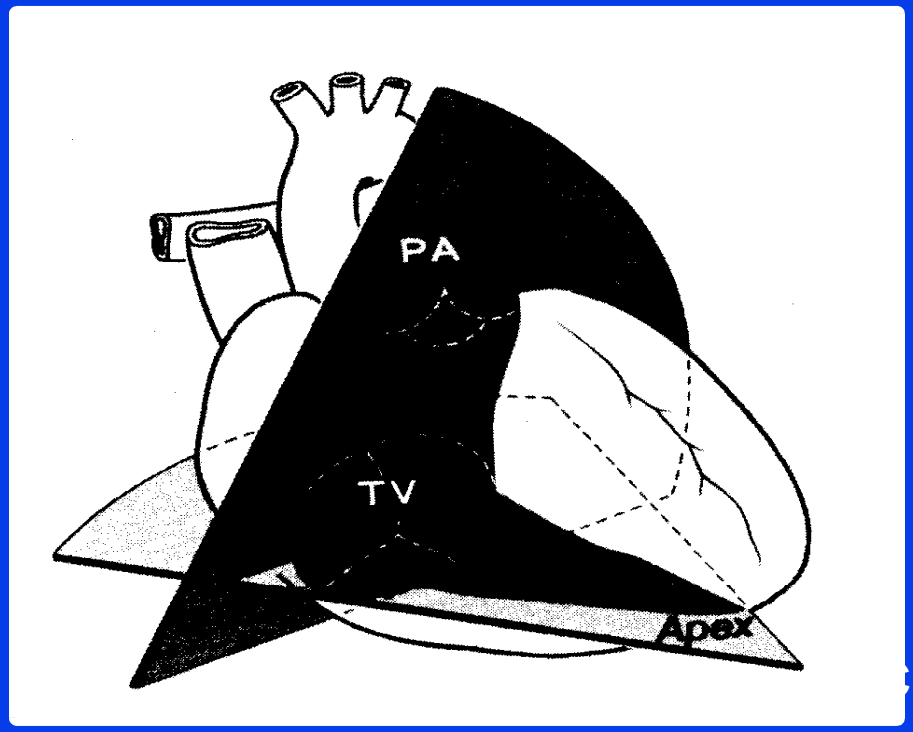


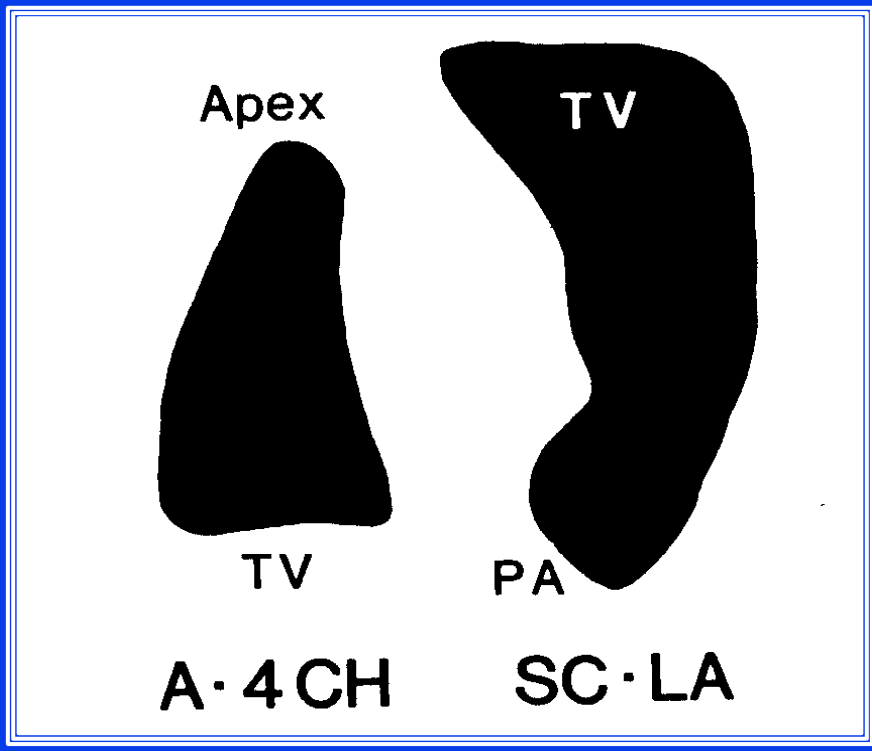
I

EVALUATION FONCTION SYSTOLIQUE VD

- Calcul des surfaces => FRS
- Calcul des volumes => FE
- VES (ITVp)
- Excursion systolique anneau tricuspide
- Nouveaux indices

VOLUMES VD
MÉTHODE DE GIBSON





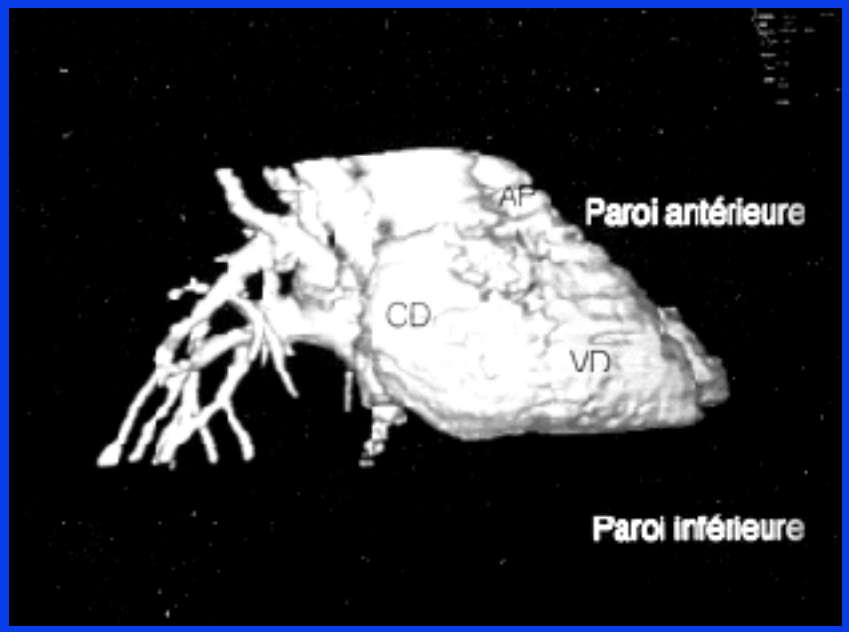
Méthode surface longueur 2 vues A4C et sous-costale

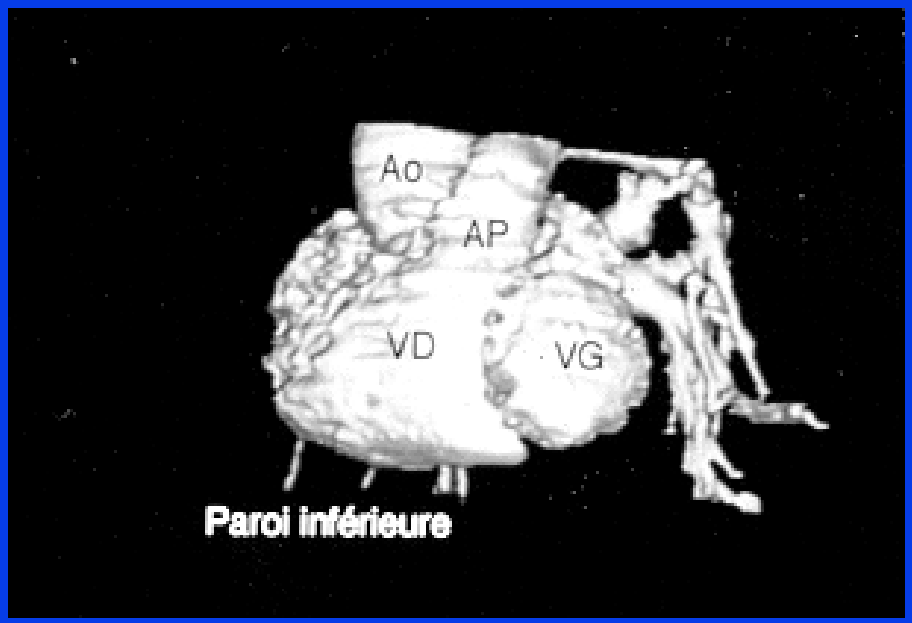
V = 2/3 (SA4CxL SC) corrélation 0.92 avec méthode angiographique

Gibson Am J Cardiol 85

SURFACES VD
INCIDENCES ECHO

- Différentes coupes apicales
  - A4C elle permet une mesure de surface qui est comparable à angio en OAG
    - » mais n'est pas ds le même plan
  - A2C
- Sous-costale grand axe permet de mesurer le grand axe et la surface du VD
  - comparable à un OAD mais là encore..


AP
Paroi antérieure
CD
VD
Paroi inférieure


Ao
AP
VD
VG
Paroi inférieure

CORRÉLATIONS ANGIO ET ECHO

Hiraishi Am J Cardiol 1982; 50:1368

Vues angiographiques VD **(22 ENFANTS)**

Vue frontale(OAD)

Vue latérale(OAG)

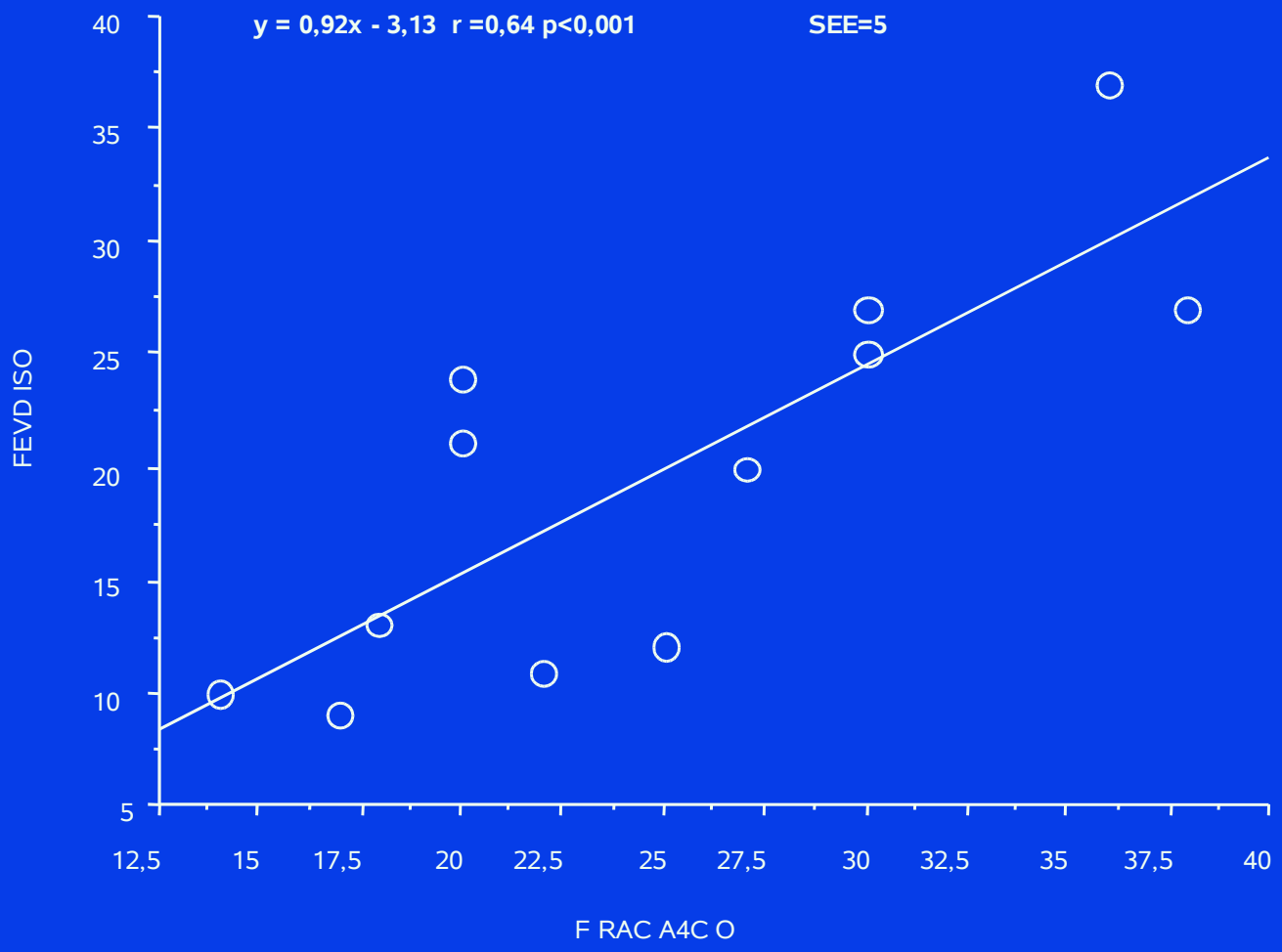
$SDVD_F$ 0.86 & **$LDVD_F$** 0.84

$SSVD_F$ 0.79 & **$LSVD_F$** 0.80

$SDVD_L$ 0.92 & **$LDVD_L$** 0.89

$SSVD_L$ 0.85 & **$LSVD_L$** 0.86

F RAC VD A4C / FE VD ISO.



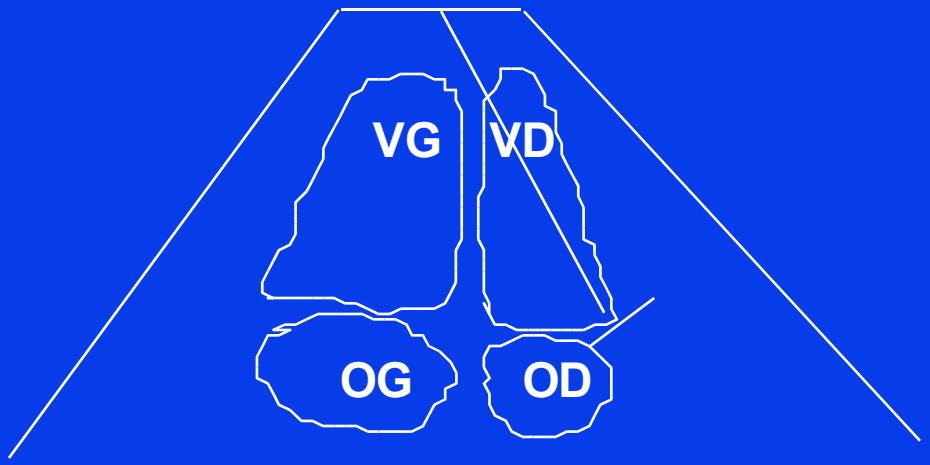
N = 12

VALEURS ÉCHOCARDIOGRAPHIQUES NORMALES

n = 27	Moyenne ± DS
DTD VD para petit axe	14 ± 2 cm / m^2
STD VD A4C	9 ± 3 cm^2 / m^2
STS VD A4C	4 ± 2 cm^2 / m^2
Fracc VD	52 ± 11 %

L'excursion systolique du plan de l'anneau tricuspidien

Kaul et al Am Heart J 1984

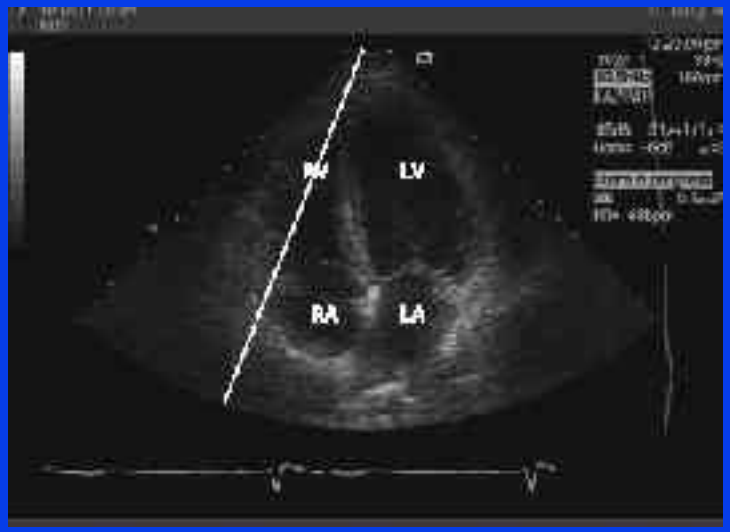


20 pts et FEVD isotopique

r = 0.92

Grp 1: 16.3± 2 mm

Grp 2: 9 ± 0.3 mm



Patients à fonction systolique VD normale

24 ± 4 mm

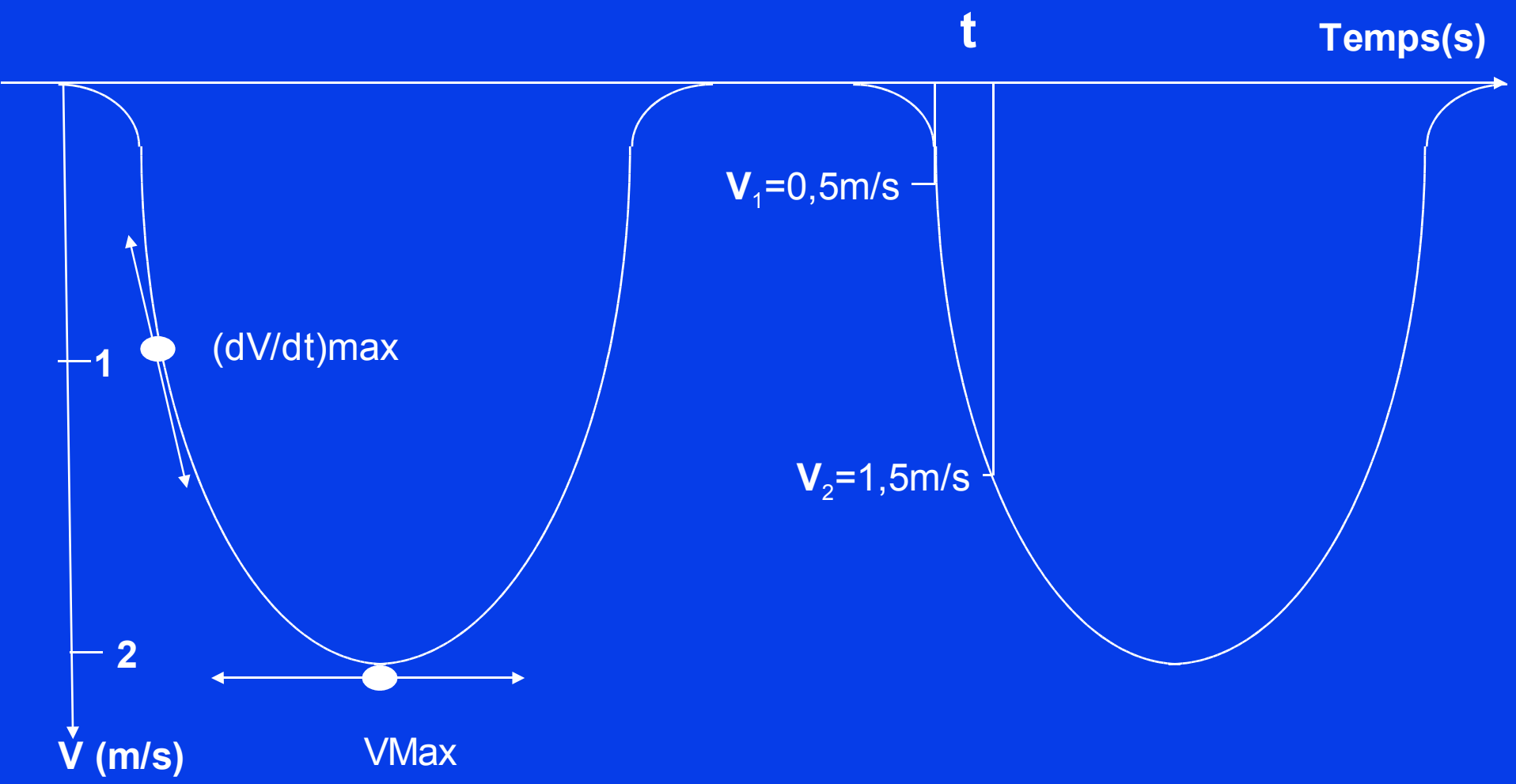
Lindqvist et al., Eur J Echocardiography 2003

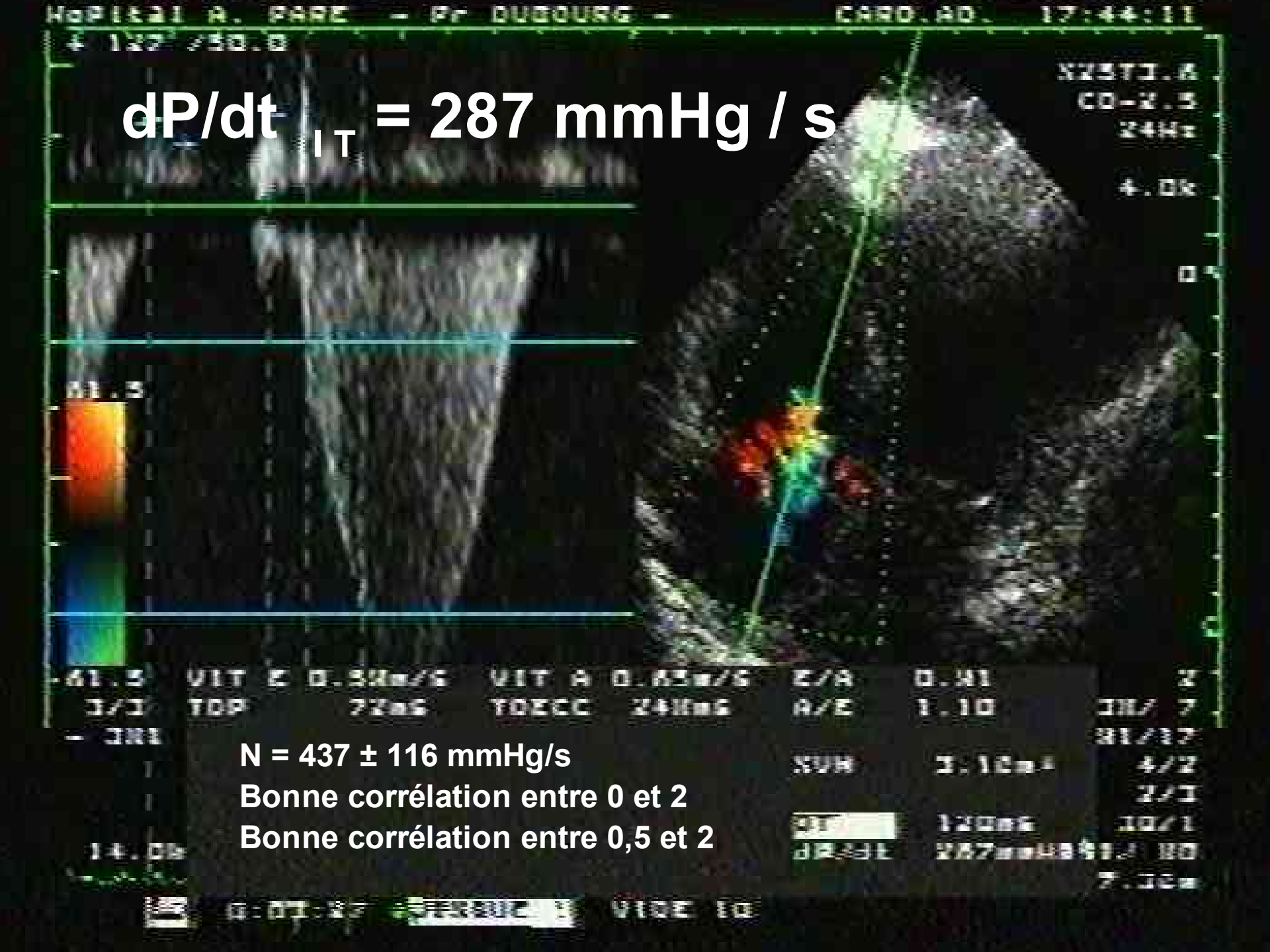
Autres indices de fonction pompe VD

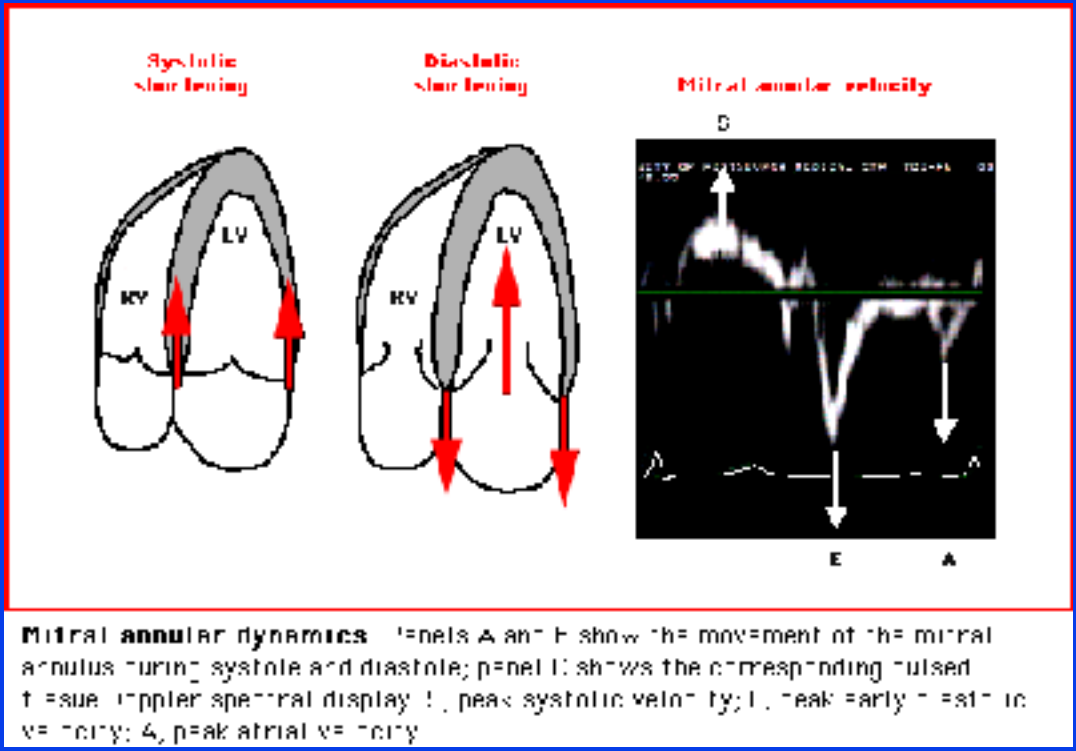
- A partir de l'IT
  - dV/dt max
  - dP/dt max
- A partir du DTI anneau tricuspide
- A partir du flux systolique dans l'AP
  - Acc max
  - Acc moyenne

dV/dt max,dP/dt max et Taux d'accroissement moyen de la Pression (Vaur L et al Arch M C V 1991,84:89)

(Anconina J et al Arch M C V 1992,85:1317)




dP/dt IT = 287 mmHg / s
N = 437 ± 116 mmHg/s
Bonne corrélation entre 0 et 2
Bonne corrélation entre 0,5 et 2



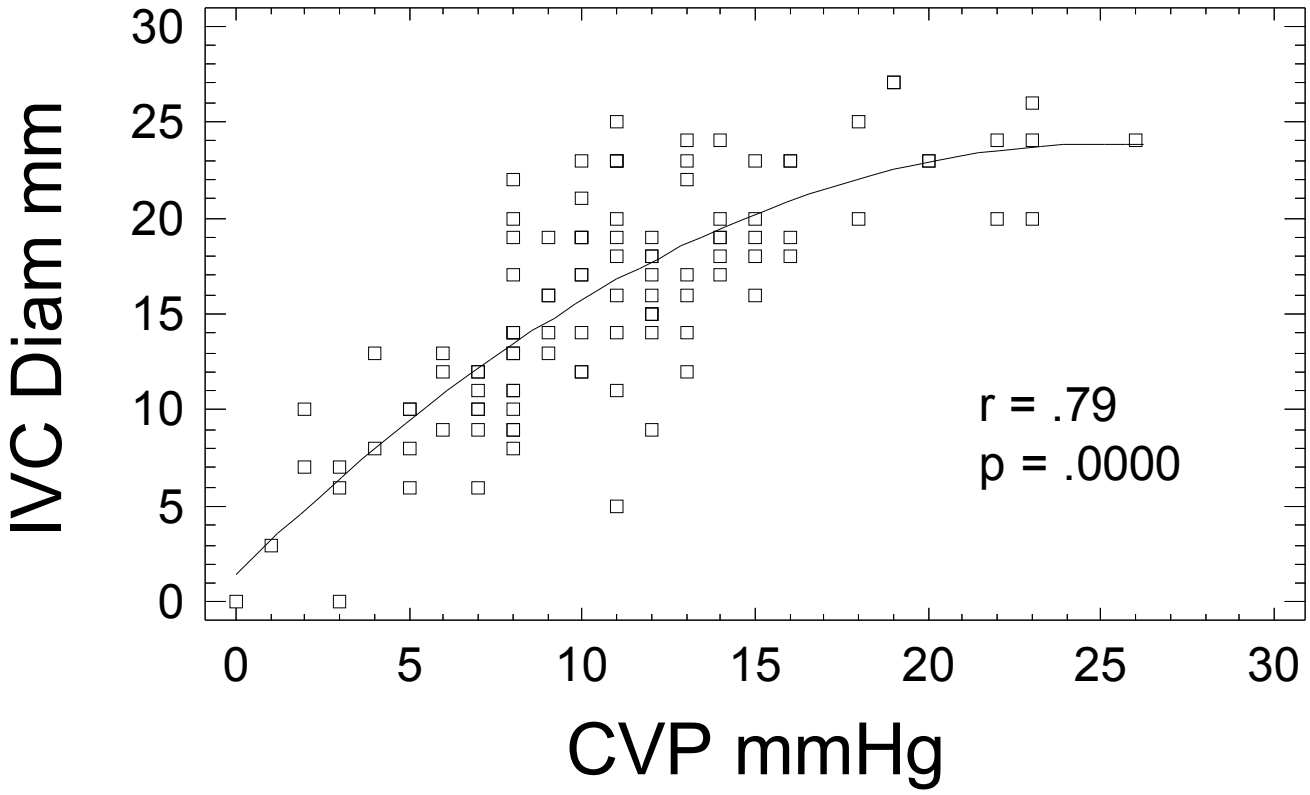
Mitral annular dynamics Panels A and B show the movement of the mitral annulus during systole and diastole; panel C shows the corresponding pulsed tissue Doppler spectral display. S, peak systolic velocity; E, peak early diastolic velocity; A, peak atrial velocity.

Onde S_{anneau} < 11,5 cm/s <=> FEVD < 45%

II

EVALUATION PRESSIONS DE REMPLISSAGE VD

VCI et POD

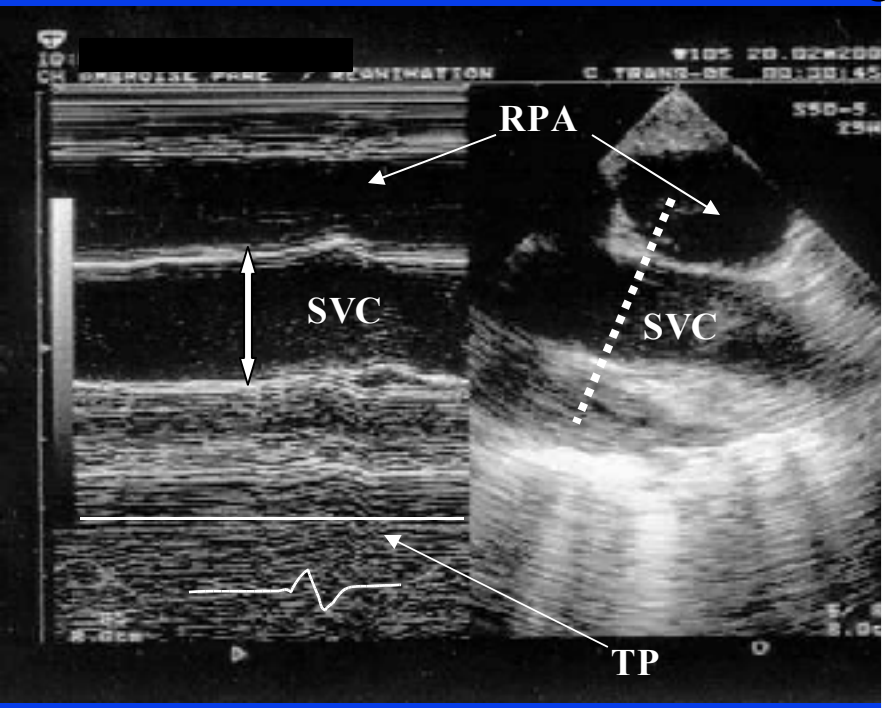


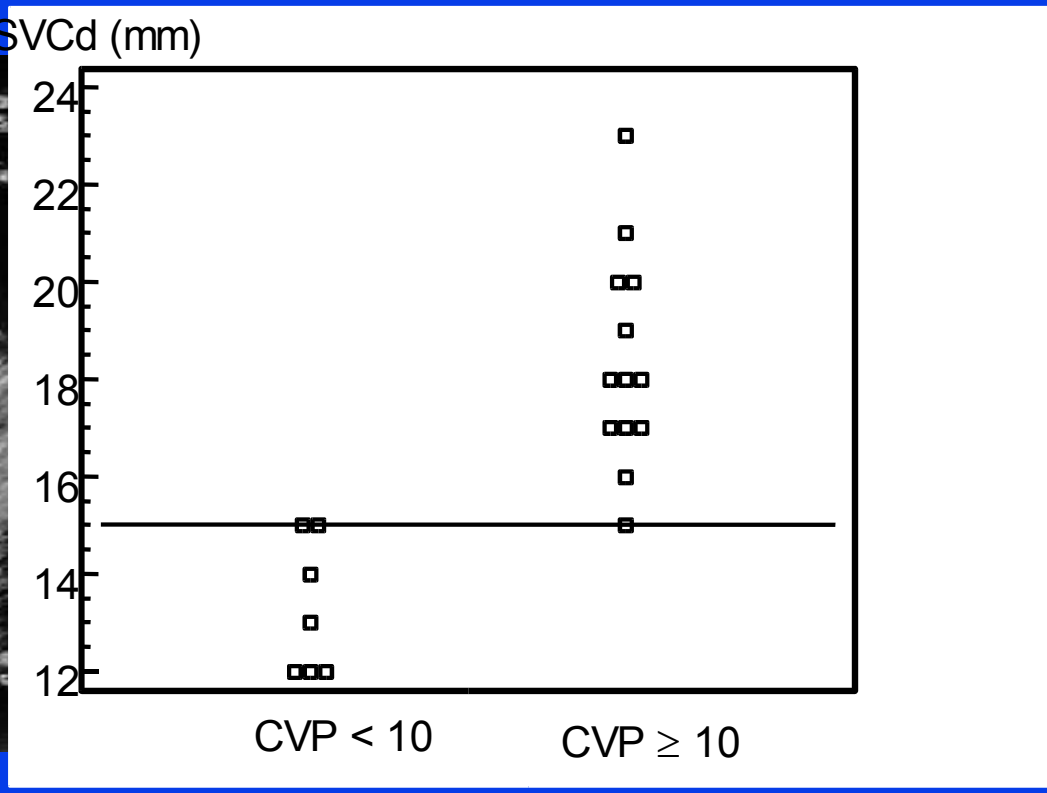
- IVCCI (inferior vena cava collapsibilityindex)

  Pepi et al, JAmSocEcho1994;7:20

- IVCCI
  - diminution inspi de VCI calculée :
    - » diametre max expi en TM en dessous VSH -diametre min isnpi/diametre max expi)x100
  - trois éventualités
    - » IVCCI >45% et POD 6 mmHg
    - » 35<IVCCI<45% et POD 9mmHg
    - » IVCCI <35% et POD 16 mmHg
- Chez 110 pts les auteurs trouvent que leur méthode est fiable et utile pour les POD basses et élevées

VCS et CVP



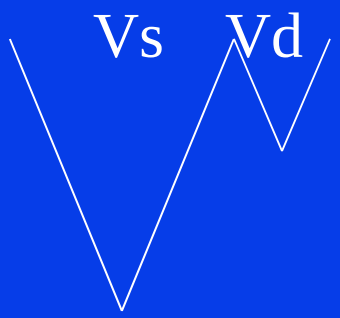


Systolic Filling Fraction de Fv SH et POD

Nagueh Circulation 96

SFF = VTIs / (VTIs+VTI d)

Et r = 0,86 POD et SFF SEE 2,5mmHg



Ou SFF = Vs / (Vs+Vd)

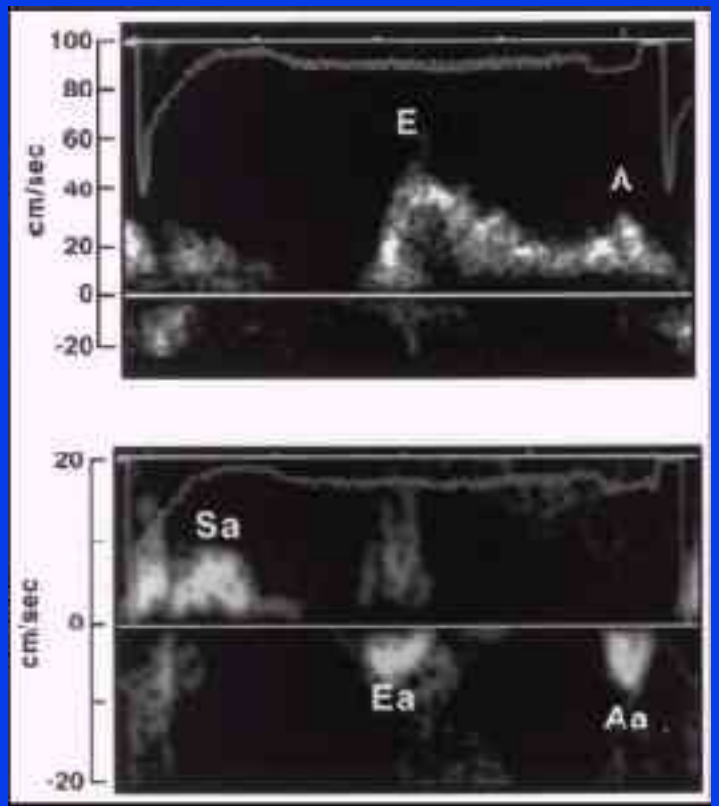
Et r = 0,85 POD et SFF SEE 3 mmHg

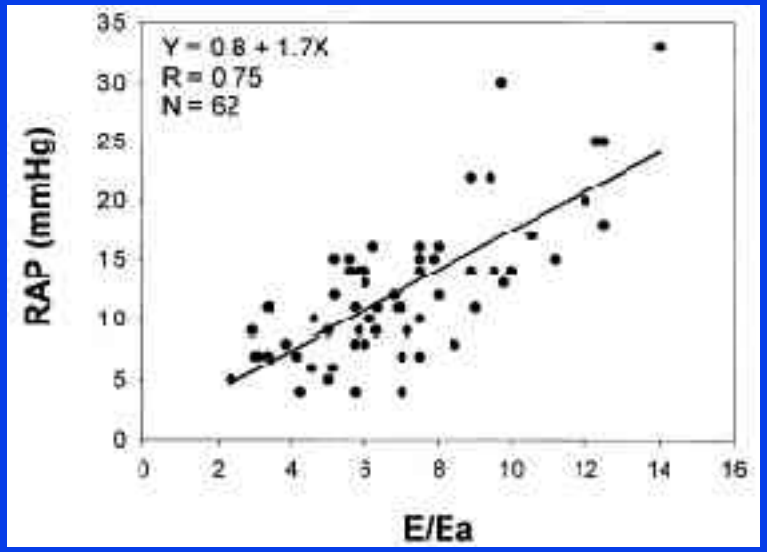
RAP ≤ 8 mmHg avec S FF 52 ±11%

Et RAP > 8 mmHg avec SFF 39 ±15%

TDI / RAP

N = 62 KT vs DTI
(Sens 79 %, Spe 73 %)
E/Ea > 6
RAP > 10 mm Hg



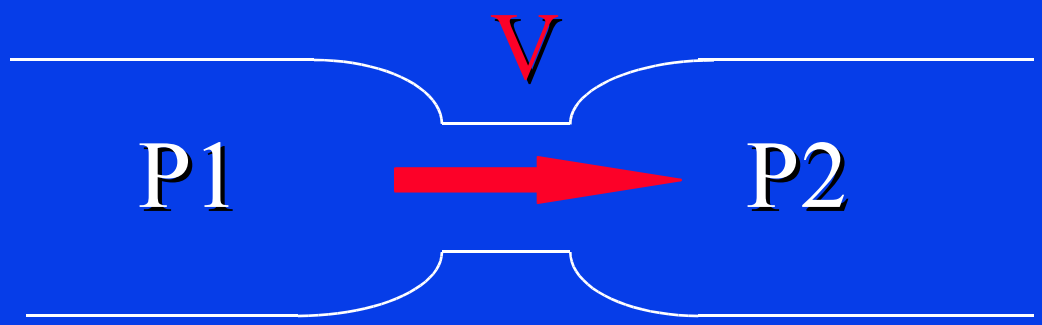


Nagueh et al. Am J Cardiol 1999

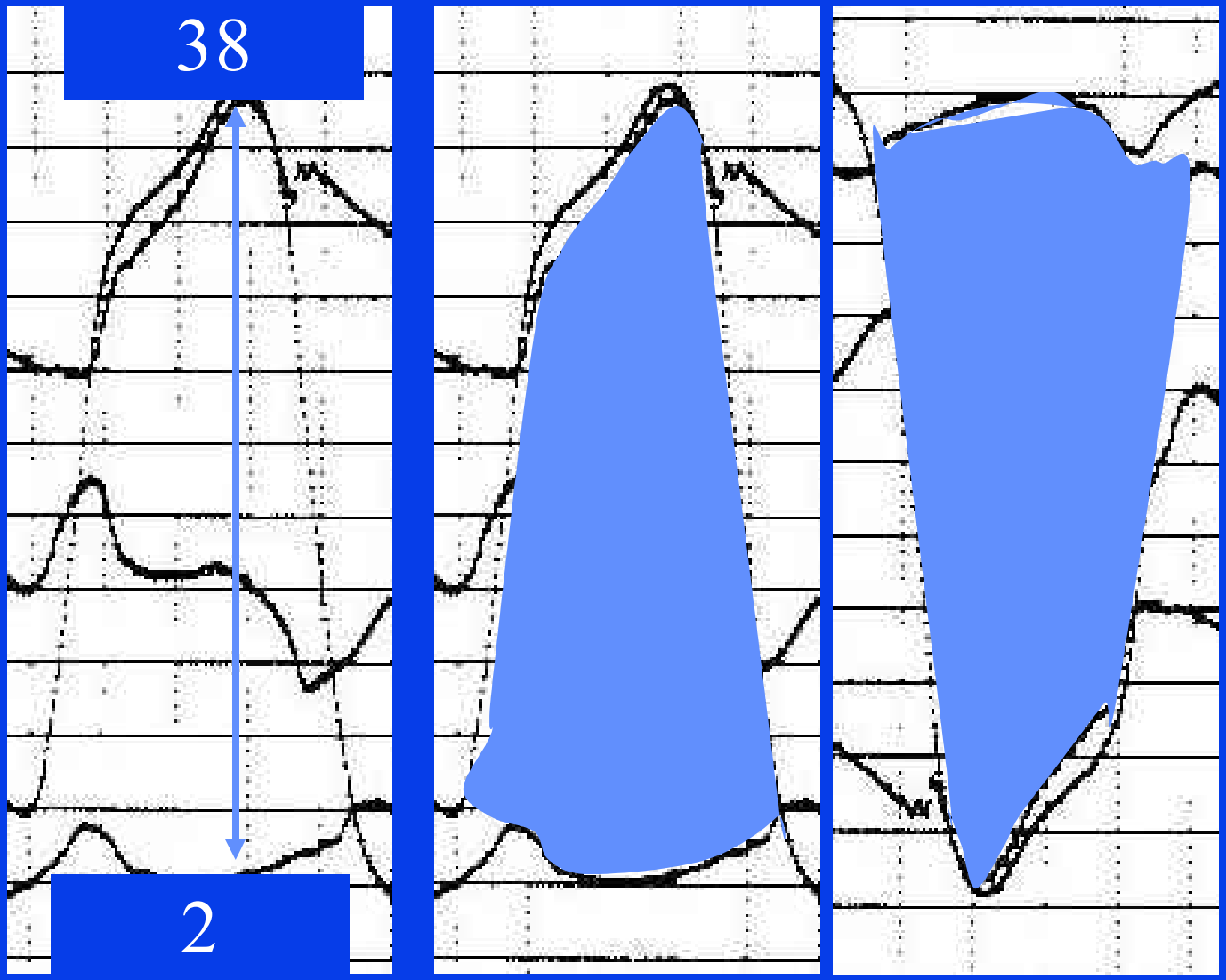
III

MESURE DES PRESSIONS PULMONAIRES

Doppler : non-invasive "Swan-Ganz"



$$P2 - P1 = 4 \times V^2$$



Gradient = 36 mmHg

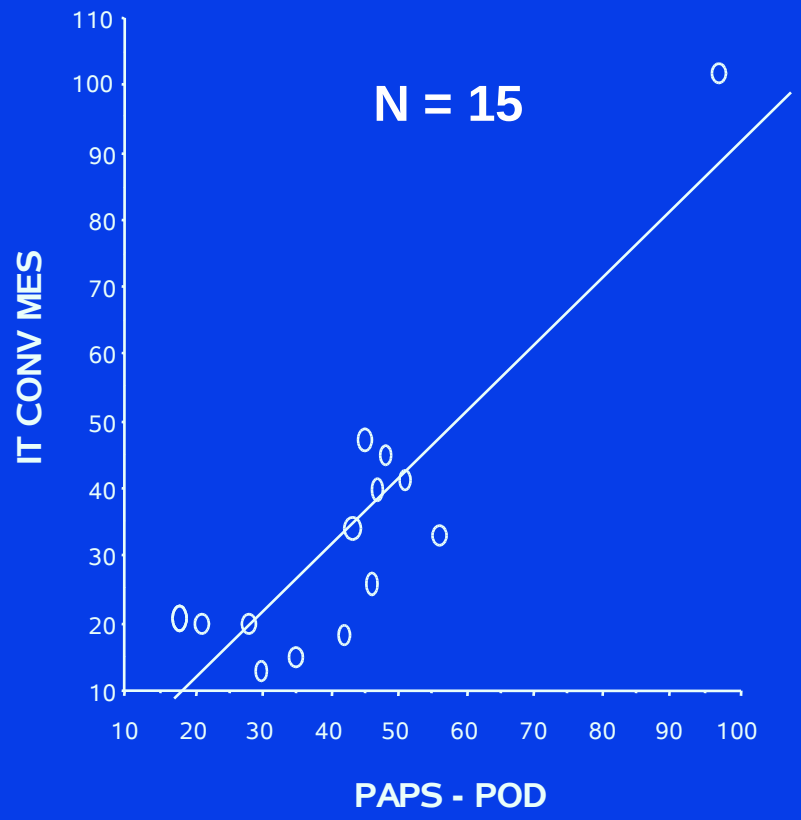
Velocity = 3 m/s

DP = PVDs - POD = 36

PAPS - POD = 36

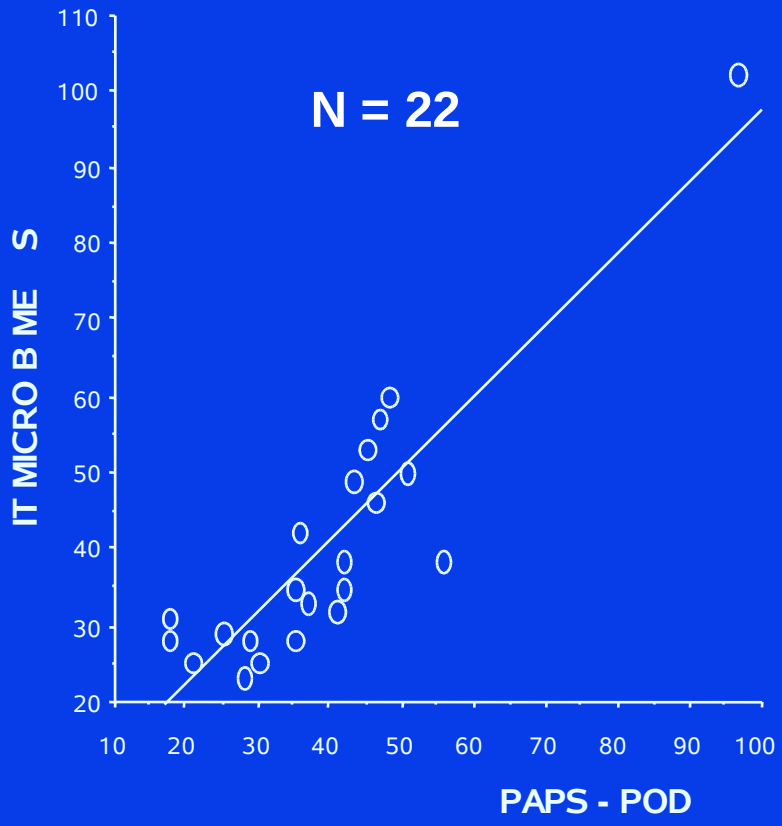
PAP SYSTOLIQUE >35 mmHg HEMOD / DOPPLER

y = 1x - 8,73 r = 0,89 p<0,001 SE E=10

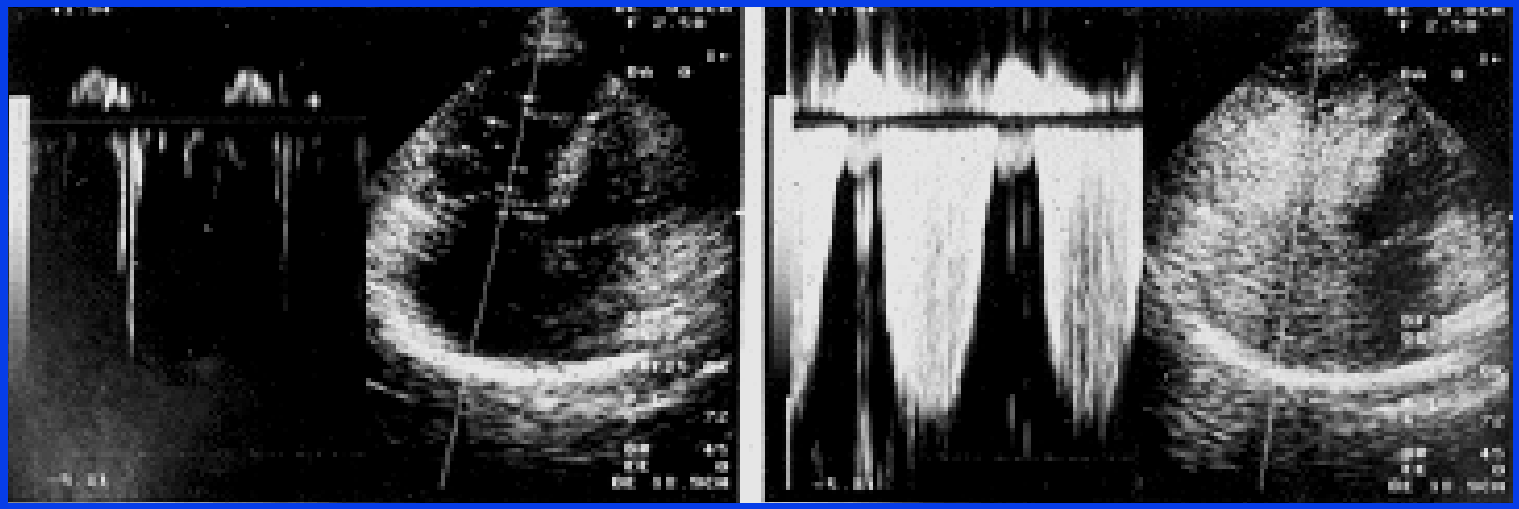


CONTROLE

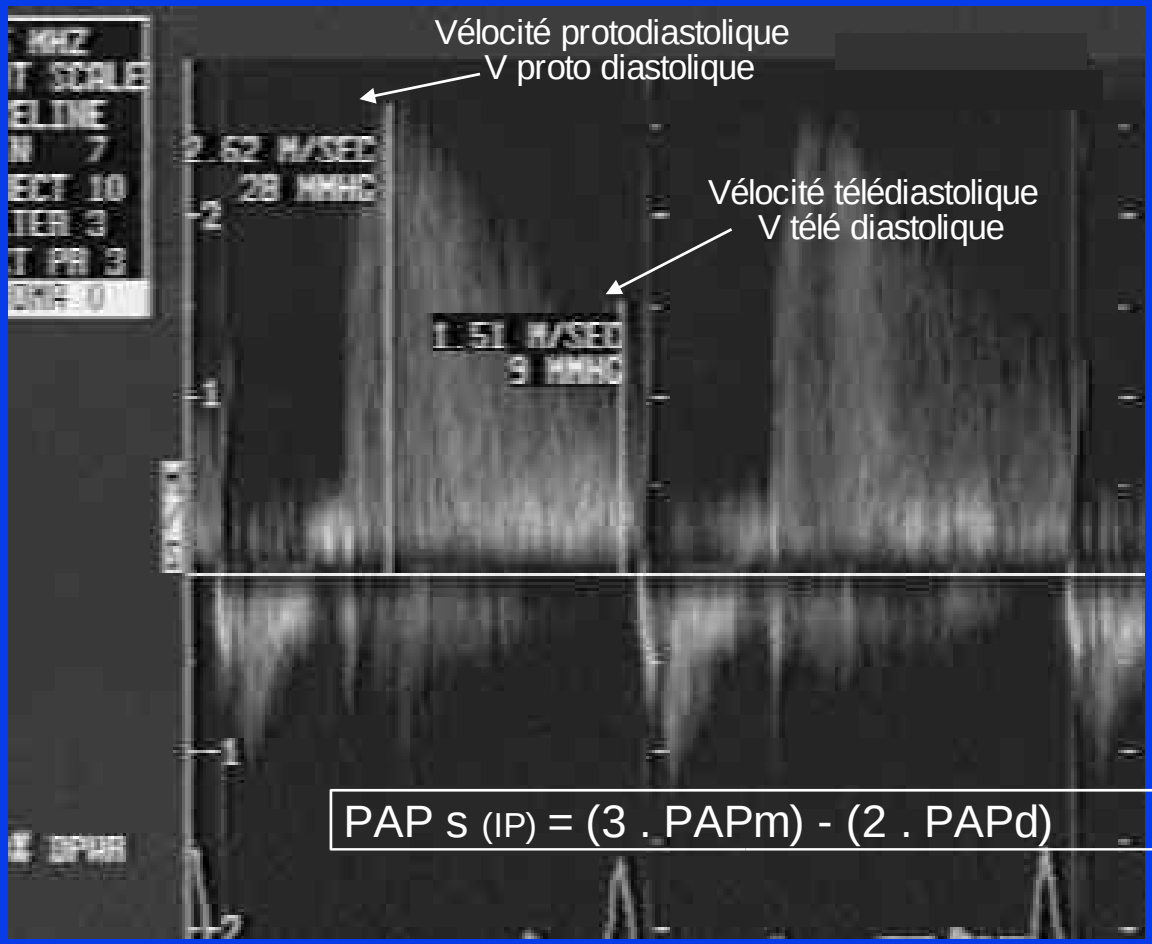
y = 0,95x + 2,89 r =0 ,9 p<0,001 S EE=7,9



CONTRASTE



REGURGITATION ARTERIELLE PULMONAIRE ETUDIEE EN DOPPLER CONTINU



$PAPd = (4 . V\ télé\ d)^2 + 10$

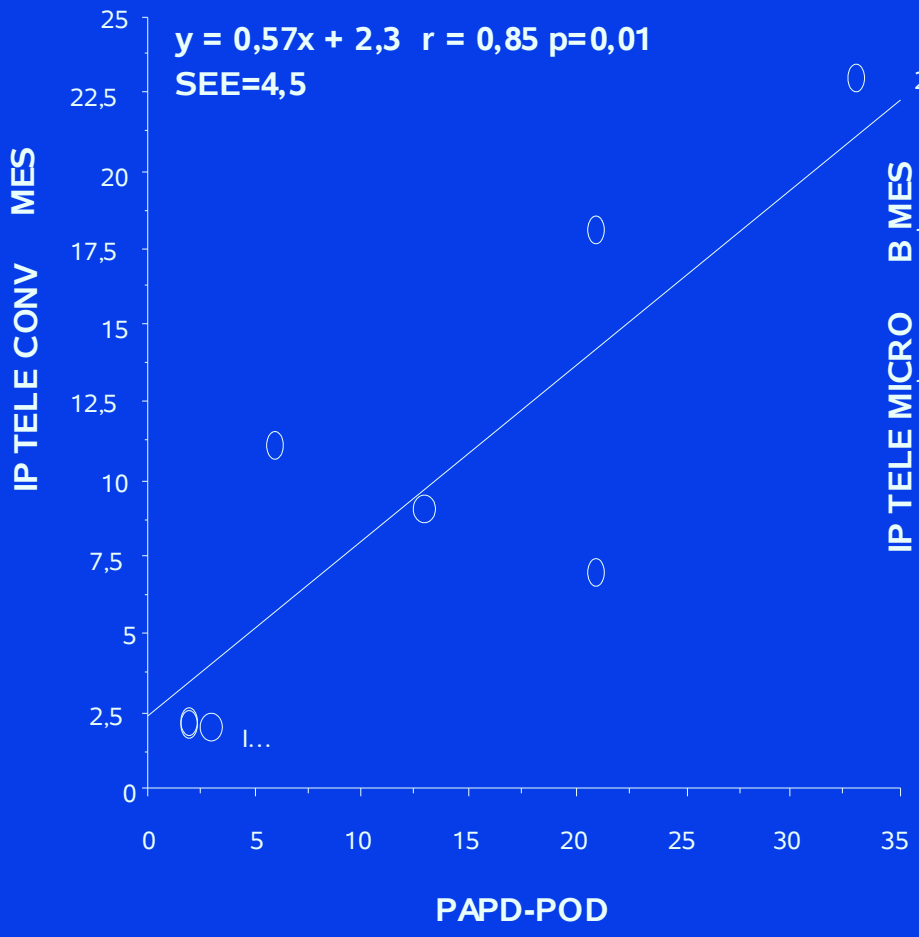
$PAP\ m = (4 . V\ proto\ d)^2 + 10$

$PAPm = (PAPs + 2PAPd) / 3$

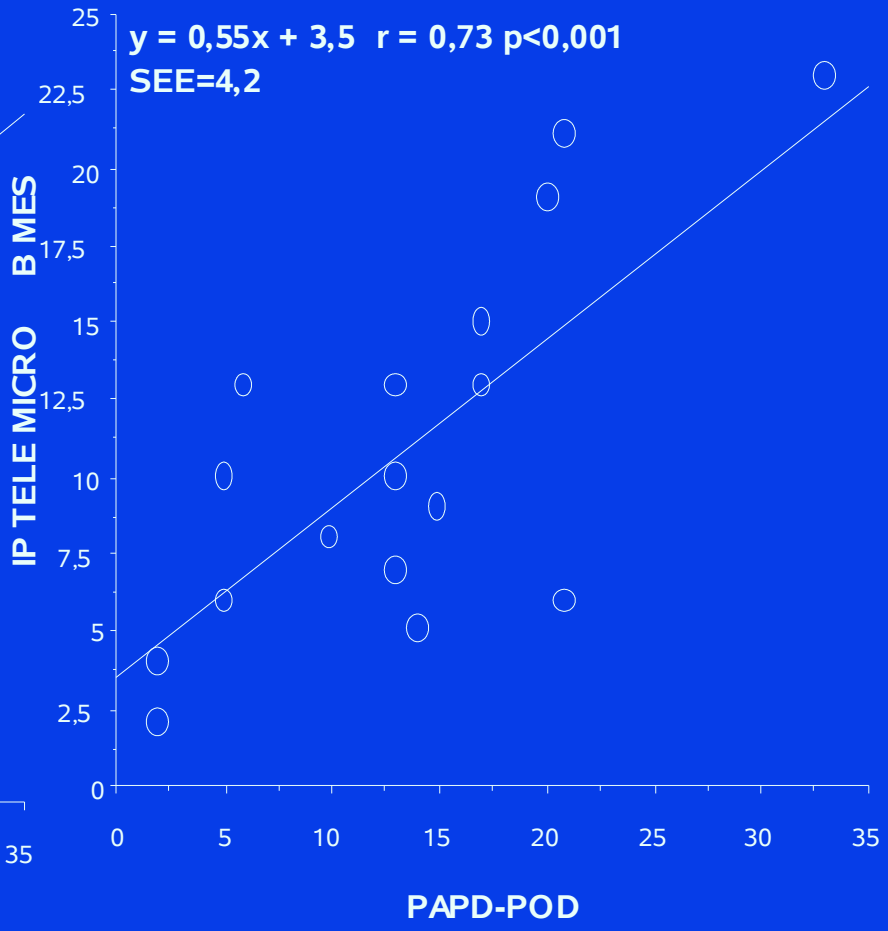
H. Raffoul, P. Gueret, B. Diebold et al Arch Mal Coeur 1990 ; 83 : 1703

PAP DIASTOLIQUE HEMOD / DOPPLER

GROUPE PAPS >35mmHg



CONTROLE
(n= 7)



CONTRASTE
(n= 17)