

TCD

What is Power M-mode Trans-Cranial Doppler?

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DISCLOSURE

NOTHING TO DISCLOSE

A stylized silhouette of a mountain range in a darker shade of teal, located in the bottom right corner of the slide.

Right-to-left shunt increase adverse outcome in a large and varied set of conditions

MACRO-EMBOLIZATION

- ◆ CVA /TIA
- ◆ LIVER TRANSPLANTATION
- ◆ SURGERY
- ◆ CV SURGERY
- ◆ PREGNANCY
- ◆ AIR TRAVEL
- ◆ CENTRAL LINES
- ◆ HYPER-COAGULABILITY
- ◆ SLEEP APNEA
- ◆ DVT / PULMONARY EMBOLI
- ◆ PULMONARY HYPERTENSION

MICRO-EMBOLIZATION / "HUMOURS" / O2

- ◆ HYPOXEMIA
- ◆ +PRESSURE VENT
- ◆ SLEEP APNEA
- ◆ COGNITIVE DYSFUNCTION
- ◆ ORTHODEOXIA / PLATYPNEA
- ◆ DIVERS BRAIN / ++MRI
- ◆ DECOMPRESSION ILLNESS
- ◆ MIGRAINE HEADACHE
 - MIGRAINE STROKE
 - MIGRAINE WMH LOAD



RIGHT-TO-LEFT SHUNT DIAGNOSIS

The “Ideal” test

- ◆ Non-invasive and low risk
- ◆ Quantitative to discern different levels of severity and risk
- ◆ Reproducible to permit serial evaluation of disease and treatments
- ◆ Low cost to permit use as a screening test

Remember: shunt is not lesion specific

ASD, PFO, AVM all cause events

Remember: Catheterization is a poor technique for measuring right-to-left shunt

Specific anatomy (type of ASD, PFO, AVM) is more important as a treatment issue

HOW DO WE DIAGNOSE RLS?

Trans-Esophageal Echocardiography (TEE)

- ◆ PROS

 - Best for anatomy

 - ICE: Close to TEE

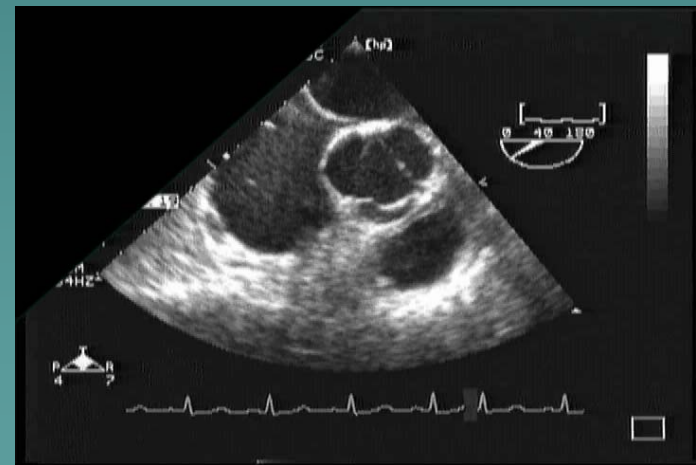
- ◆ CONS

 - Sedation

 - Discomfort

 - Some Risk

 - Worst for shunt



PFO BY TEE

HOW DO WE DIAGNOSE RLS?

Contrast Enhanced Trans-Thoracic Echocardiography (Bubble Echo)

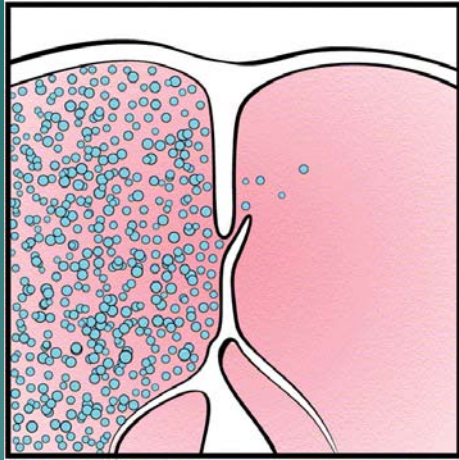
- ◆ PROS
 - Convenient, comfortable
 - Readily Available
 - Not good for Anatomy (i.e., ASD/PFO not seen)
 - Pretty good for shunt
- ◆ CONS
 - Not quantitative (shunt)
 - Therefore, not as reproducible
 - Not cheap



THE PROBLEM: SHUNT VARIABILITY

THE PROBLEM: FALSE POSITIVES

DIFFERENT DEFECT TYPE, SIZE, PHYSIOLOGY



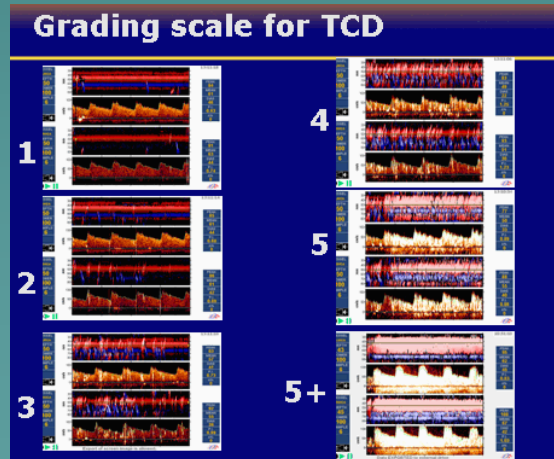
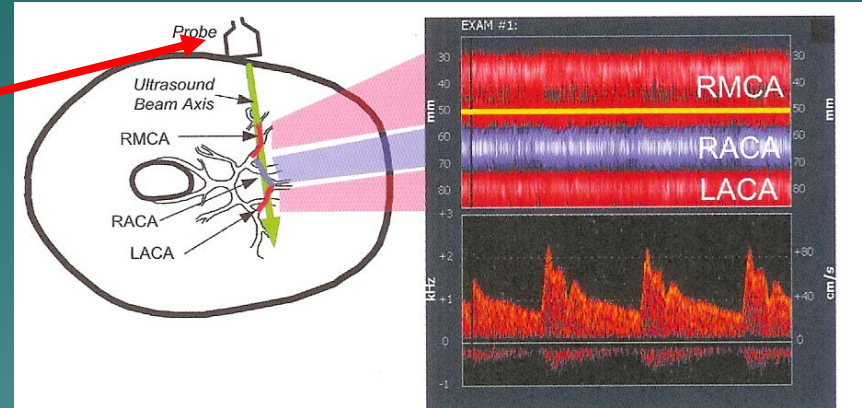
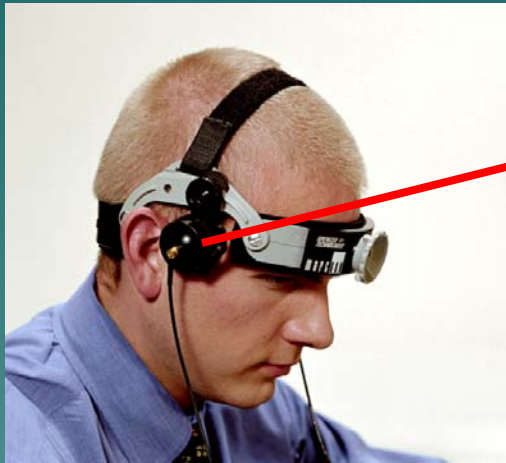
- ◆ MIST
7%: No PFO in lab
- ◆ ICC (Lao et al)
24%: No PFO by TEE
(1-20, >20 =shower
- ◆ PICSS
59% Had <9 Bubbles
Conclusion: PFO do
not cause stroke(?)

TCD EQUIPMENT

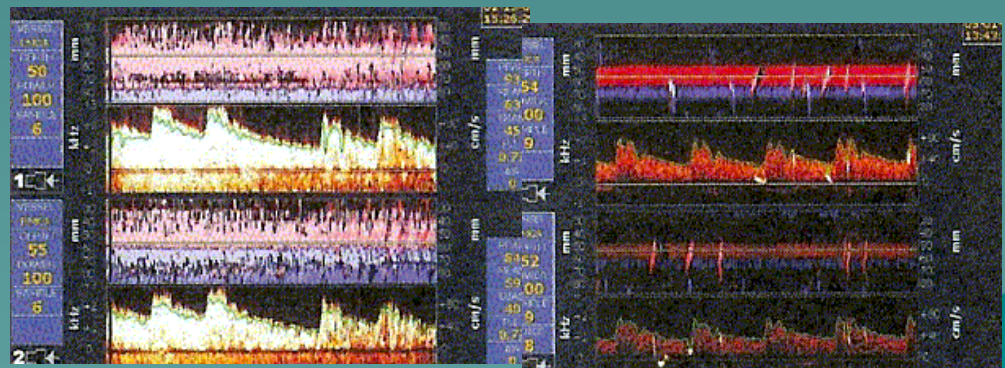
What is Trans-Cranial Doppler?



CAN WE QUANTIFY RIGHT-TO-LEFT SHUNT? TCD for RLS detection and quantification



SPENCER GRADING



BEFORE CLOSURE

3 MONTHS POST

TCD

Reliability and Reproducibility

- ◆ Spencer M et al (**J NEUROIMAGING 2004;14:342-349**)
100 catheter proven PFO

	sensitivity	Dx accuracy
TTE	64%	63
TEE	89%	86
TCD	100%	95
- ◆ Sastry S et al (**CEREBROVASC DISEASE 2007; 23: 424-429**)
Intra-observer variability $r=.89$
Inter-observer variability $r=.87$
- ◆ Lao et (**J NEUROIMAGING 2007; 22: 348-352**)
ICC vs Spencer Grade TEE diagnosed PFO
ICC false + 24% Spencer 7%
Both 100% for large defects

TCD PROCEEDURE

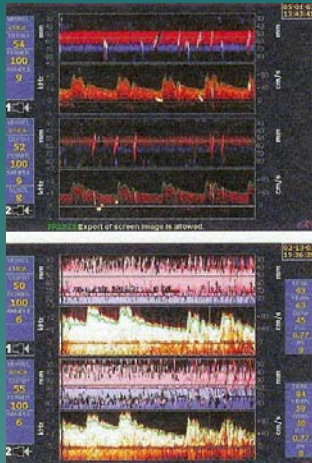


TCD ANIMATION



HOW WE USE TCD

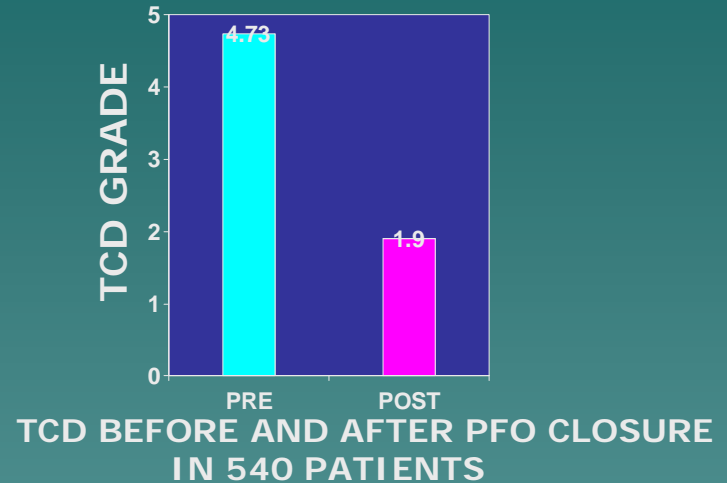
DIAGNOSIS OF SIGNIFICANT SHUNT



REST

RESP
STRAIN

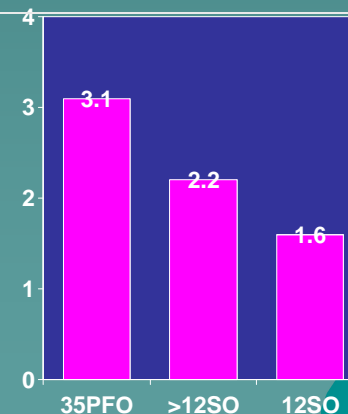
PROCEDURE RESULTS



IN CONJUNCTION WITH CE-TTE
REDUCES THE NEED FOR TEE



DIFFERENT DEVICE RESULTS



90 DAY VALSALVA GRADE
FOR 3 DIFFERENT DEVICES

CONCLUSIONS

- ◆ Transcranial Doppler is a low cost reproducible procedure which is sensitive and quantitative for RLS evaluation
- ◆ Transcranial Doppler is non specific and cannot distinguish between RLS occurring due to ASD, ASD variants, PFO, or AVM
- ◆ Transcranial Doppler when combined with CE-TTE provides anatomic and shunt information which is adequate for management of shunt patients without TEE