Predictive Value of MCA Doppler– A Lifetime of Clinical Utility

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Community Regional Medical Center

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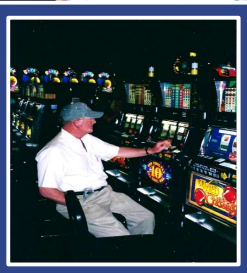
Stephen (Steve) McLaughlin



THANK YOU TO DR. KEVIN EVANS FOR PROVIDING IMAGES AND CONTENT

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Stephen (Steve) McLaughlin

- Steve McLaughlin, BS, RT(R), RDMS, FSDMS
- SDMS President (1999-2001)
- Lead with focus on listening, empathy, persuasion, forward thinking, and especially growth of people
- When Steve was President he was diagnosed with brain cancer

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Stephen (Steve) McLaughlin

- Steve lead with both humor and strength
- Kevin Evans described Steve's dislike for email and told Kevin that he was trying to read one of his lengthy emails and his wife found him blacked out
- He said "can you shorten those up a bit ?" It was clearly due to Kevin's emails and NOT his cancer

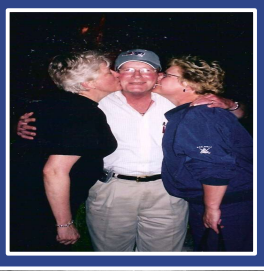
8

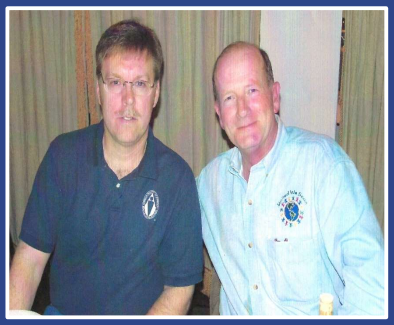
Major Accomplishments

- Steve persuaded the US Bureau of Labor Statistics to reclassify sonographers and upgrade our Labor outlook handbook
- Steve felt that sonographers should have a unified voice and believed in sonographers meeting in person at the annual conference to learn from each other and network. He came up with the slogan “United We Scan”

9

Thank you Steve – “Forever in our Hearts”





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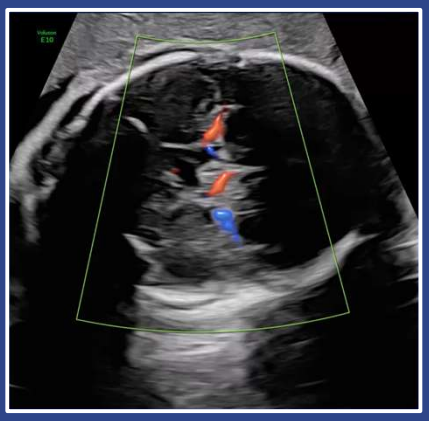
OBJECTIVES

- Describe clinical utility of MCA Doppler from Fetus to Adult
- Provide examples of versatility of MCA Doppler across multiple diseases
- Provide case examples utilizing MCA Doppler assessment



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FETAL ASSESSMENT

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FETAL ANEMIA

- Fetal anemia is a serious condition that occurs when a fetus has an inadequate number or quality of red blood cells
- Red blood cells carry oxygen to the body's organs and cells, so fetal anemia can have serious consequences for the fetus and pregnancy

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FETAL ANEMIA ETIOLOGY

- Alloimmunisation (antibodies) occurs when the mother creates antibodies against the blood of the fetus
- Non-immune anemia can be caused by infections, transfusion between twins, heart problems, or other causes

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IFT- INTRAUTERINE FETAL TRANSFUSION

- Ultrasound guided procedure to draw blood from the fetal umbilical vein to determine type of anemia, blood type, and HCT
- If serious fetal anemia is found, Intrauterine fetal transfusion will be performed.

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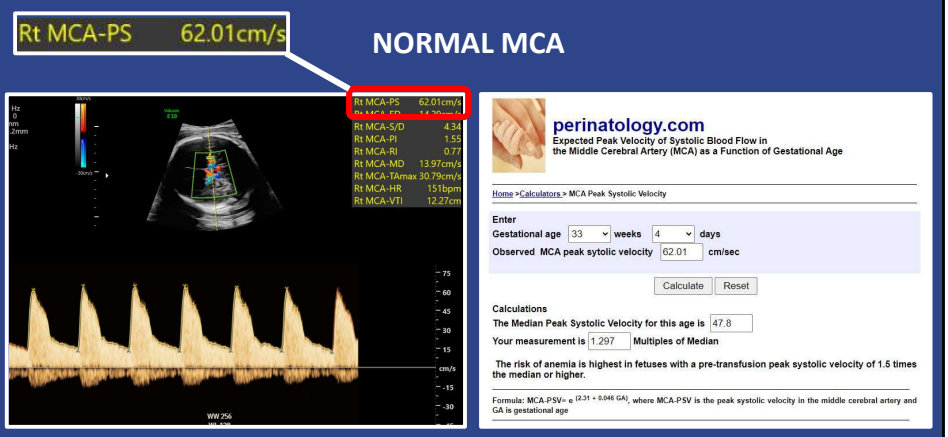
FETAL ANEMIA



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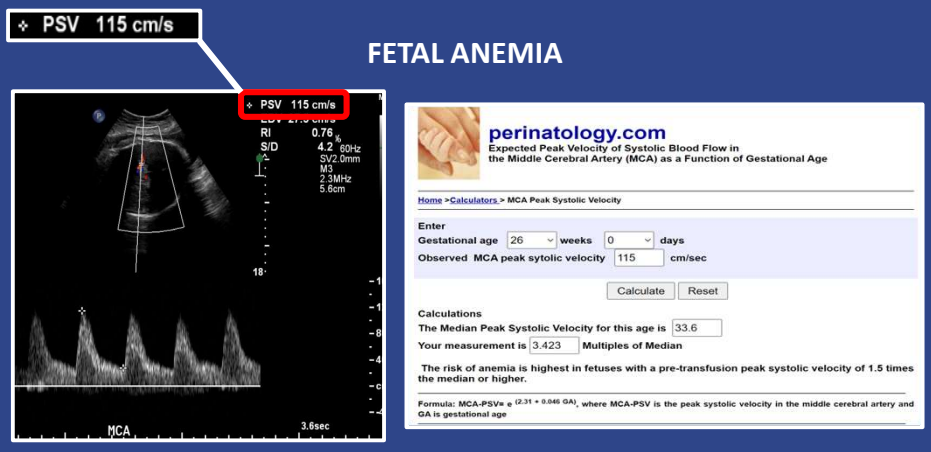
HOW TO RECORD RESULTS FOR FETAL ANEMIA



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ASSESSMENT OF INTRAUTERINE GROWTH RESTRICTION

- Intrauterine growth restriction (IUGR), is a condition that occurs when a fetus doesn't grow at a normal rate during pregnancy
- The fetus may not be getting enough nutrients and oxygen for growth and development. This can be due to a problem with the placenta, or an infection
- Early-onset IUGR can also be caused by chromosomal abnormalities

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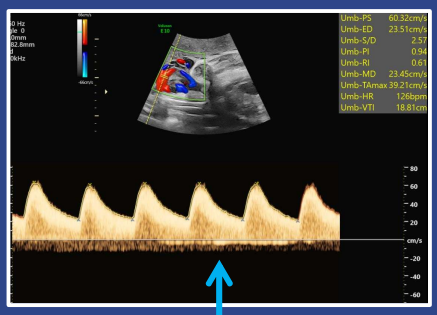
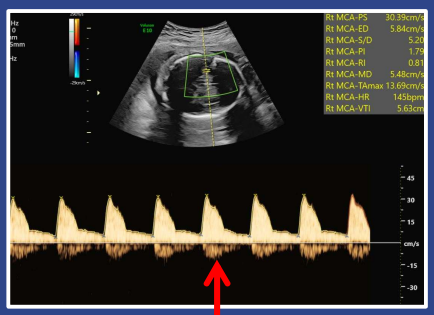
UMBILICAL ARTERY PI/MCA PI RATIO

Normal umbilical artery PI/MCA PI ratio is < 1



NORMAL LOW RESISTIVE FLOW IN UMBILICAL ARTERY



NORMAL HIGH RESISTIVE FLOW IN FETAL MCA

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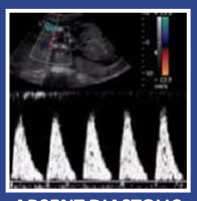
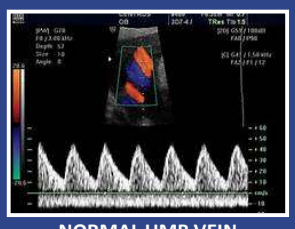
VASCULAR ASSESSMENT

NORMAL UMB ART

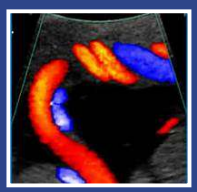


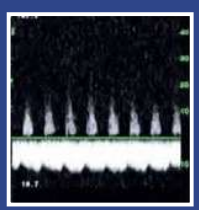
ABSENT DIASTOLIC FLOW

REVERSED D FLOW



NORMAL UMB VEIN





PULSATILE UMB VEIN

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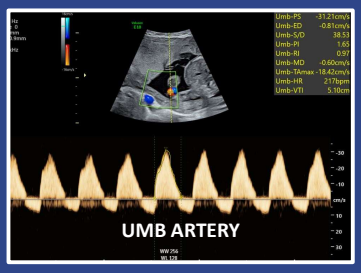
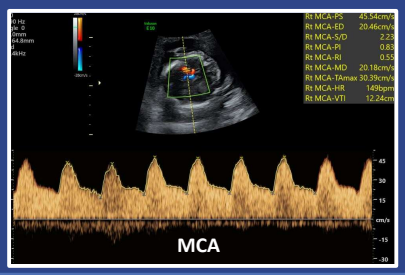
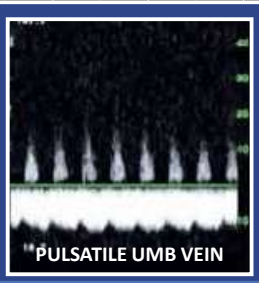
ASSESSMENT OF INTRAUTERINE GROWTH RESTRICTION







BRAIN SPARING IUGR (ASYMMETRICAL)

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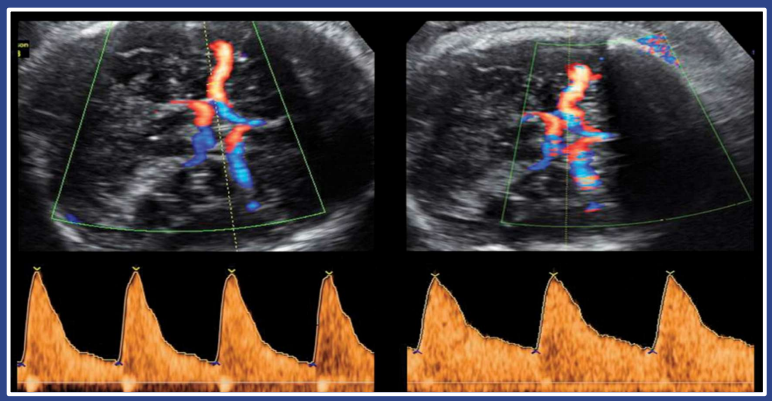
ASSESSMENT OF INTRAUTERINE GROWTH RESTRICTION



FETAL MCA - BRAIN SPARING IUGR

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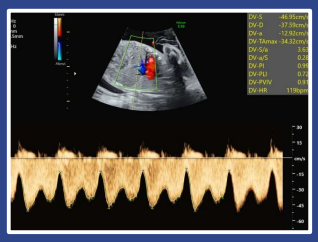
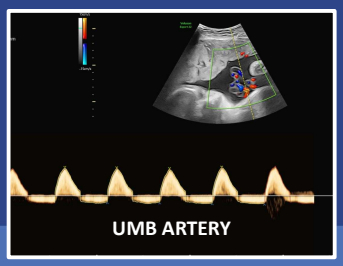
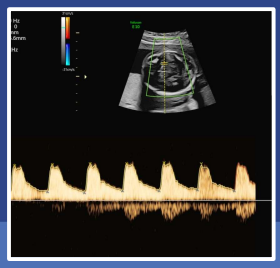
ASSESSMENT OF INTRAUTERINE GROWTH RESTRICTION

PLACENTAL INSUFFICIENCY/ HYPERCOILED CORD







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COMPLICATIONS OF MONO-DI TWINS

- Monochorionic/ Diamniotic Twins
- TTTS (Twin to Twin Transfusion Syndrome)
- Twin Anemia/Polycythemia Syndrome
- Donor Twin (Anemia) Increased PSV Fetal MCA
- Recipient Twin (Polycythemia) Decreased PSV

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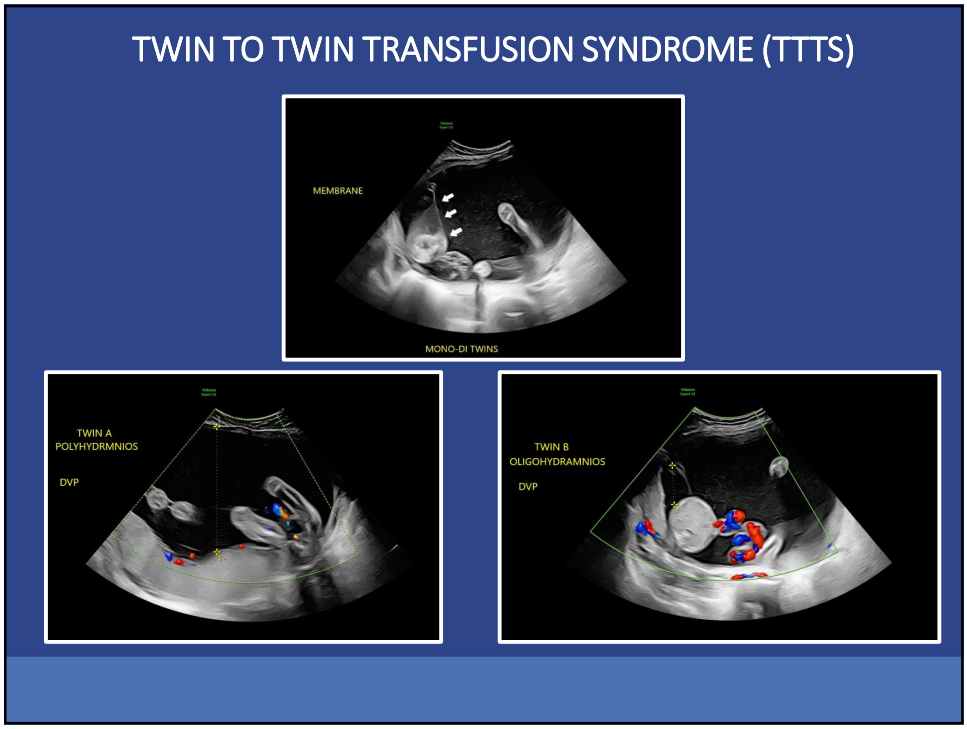

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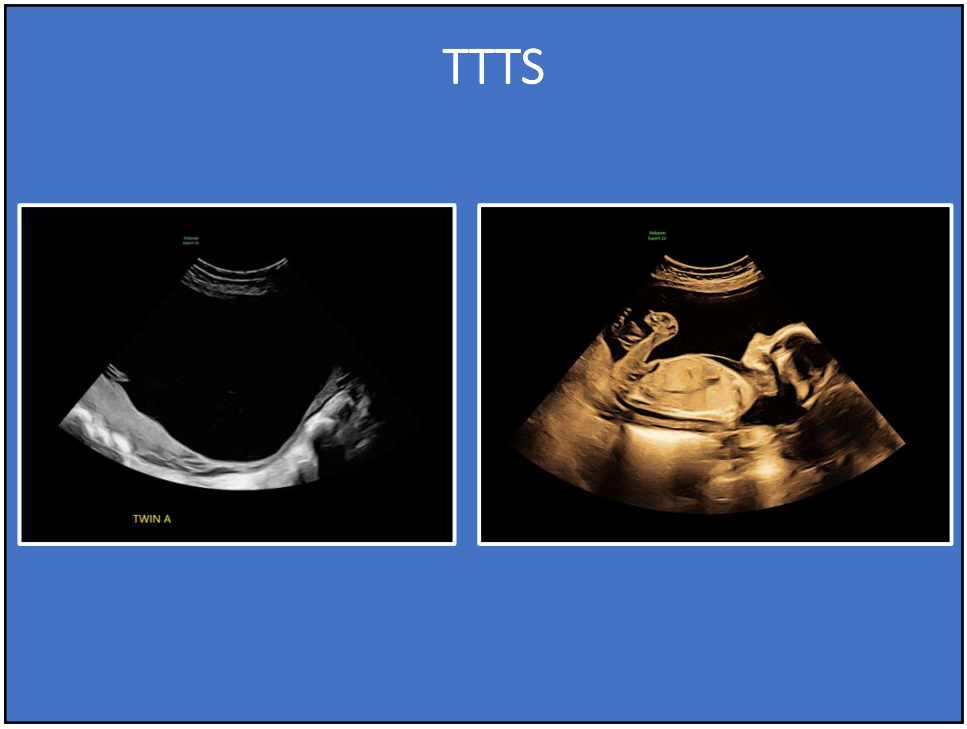

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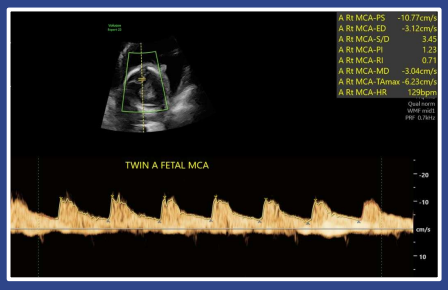
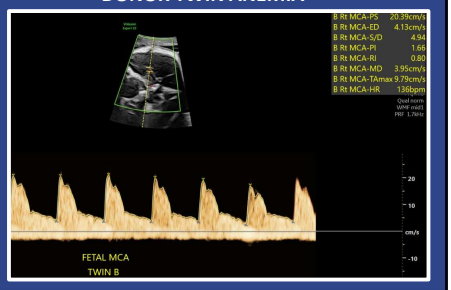
Twin Anemia/Polycythemia Syndrome
TAPS

RECIPIENT TWIN POLYCYTHEMIA



DONOR TWIN ANEMIA



Fetal Therapy *Scientific Basis and Critical Appraisal of Clinical Benefits*, pp. 367 - 372
DOI: https://doi.org/10.1017/9781108564434.035(Opens in a new window)
Publisher: Cambridge University Press
Print publication year: 2020

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NEONATAL

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HYPOXIC ISCHEMIC ENCEPHALOPATHY

Hypoxic ischemic encephalopathy (HIE) is an umbrella term for a brain injury that happens before, during, or shortly after birth when oxygen or blood flow to the brain is reduced or stopped.

HYPOXIA= Lack of Oxygen ISCHEMIA = Lack of perfusion ENCEPHALOPATHY= Decreased brain function

Placental abruption

Uterine Rupture

Fetal bradycardia

Cord knot or prolapse

Birth trauma

Maternal Hypoxia or demise

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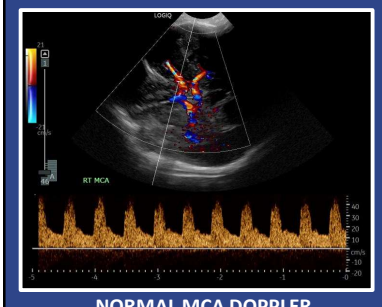
HIE DOPPLER ANALYSIS

Photo courtesy of Thermakid



NORMAL MCA DOPPLER

Birth to 6 hours

Cooling Therapy

- Decrease body temp to < 91.0 degrees F
- Start before 6 hours after birth
- Lasts 72 hours only
- Decreases metabolic rate
- Preserves brain function

ACUTE HYPOXIA:
INCREASE IN DIASTOLIC FLOW

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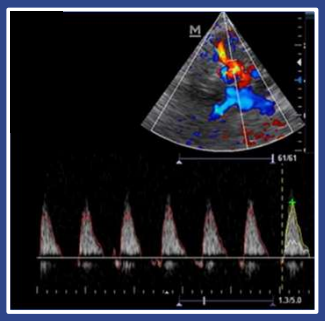
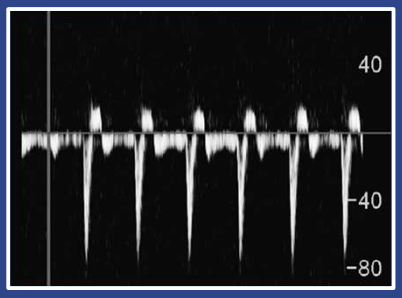
HYPOXIC ISCHEMIC ENCEPHALOPATHY

SUSTAINED HYPOXIA
48-72 HOURS:



SUGGESTIVE OF DECREASE IN CEREBRAL FUNCTION



BRAIN DEATH

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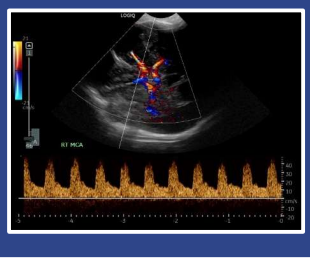
HYPOXIC ISCHEMIC ENCEPHALOPATHY

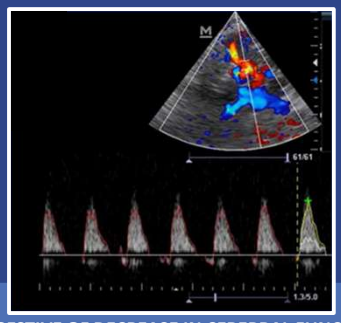


COOL THERAPY
48-72 HOURS:

Normalized MCA

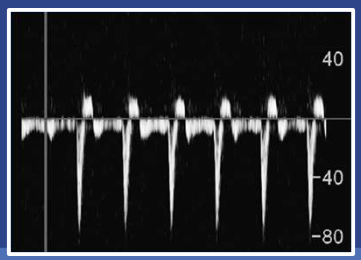
ACUTE HYPOXIA: INCREASE IN DIASTOLIC FLOW

Sustained Hypoxia



SUGGESTIVE OF DECREASE IN CEREBRAL FUNCTION

Prolonged Hypoxia



BRAIN DEATH

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PEDIATRICS

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SICKLE CELL ANEMIA

- Sickle cell anemia is a blood disorder that affects the shape of red blood cells, which carry oxygen throughout the body
- It's caused by an inherited gene that produces an abnormal form of hemoglobin
- Transcranial Doppler (TCD) monitors the risk of stroke in children with sickle cell disease

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SICKLE CELL ANEMIA

- SCD causes red blood cells to become rigid and irregularly shaped (sickle) which can block blood vessels and increase the risk of stroke
- TCD is utilized to determine if there in increased velocities within the intracranial vessels

https://theconversation.com/theres-no-cure-for-sickle-cell-disease-but-spotting-it-early-can-improve-treatment-185784?utm_source=clipboard&utm_medium=bylinecopy_url_button

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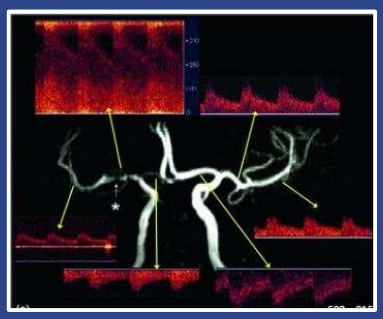
SICKLE CELL ANEMIA

- Typically the children are screened annually unless increased velocities are noted
- If elevated velocities are detected, the child will require further monitoring or transfusion intervention



Topcuoglu, Mehmet. (2012). Transcranial Doppler ultrasound in neurovascular diseases: Diagnostic and therapeutic aspects. Journal of neurochemistry. 123 Suppl 2. 39-51. 10.1111/j.1471-4159.2012.07942.x.

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ADULTS

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TCD ASSESSMENT FOR VASOSPASM SECONDARY TO SUBARACHNOID HEMORRHAGE

- Transcranial Doppler (TCD) ultrasound is a non-invasive test that can be used to detect and monitor cerebral vasospasm

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VASOSPASM

- Serious complication after subarachnoid hemorrhage (SAH)
- Significant cause of morbidity and mortality
- Most common cause of SAH is leakage from intracranial cerebral aneurysms into subarachnoid space
- Common sites for aneurysms are the ACoA, MCA, and PCoA

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VASOSPASM AFTER SAH

- Increased blood flow velocity and pressure drop distal to the narrowed segment
- Unusual in the first 2-3 days after SAH
- Do early baseline study
- TCD should be performed daily or every other day for two weeks, and the highest velocity obtained from each artery should be recorded
- Complete exam not always possible

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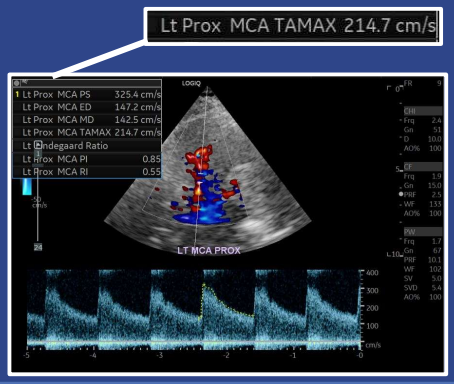
VASOSPASM AFTER SAH

- MCA/ICA ratio should be obtained (Lindegaard ratio)
- PCO2, Hct, and BP should also be recorded
- Time and date of exam should be documented
- Velocity increases begin to occur about day 3
- Reaches maximum between days 7-12
- Generally resolve at 2-3 weeks



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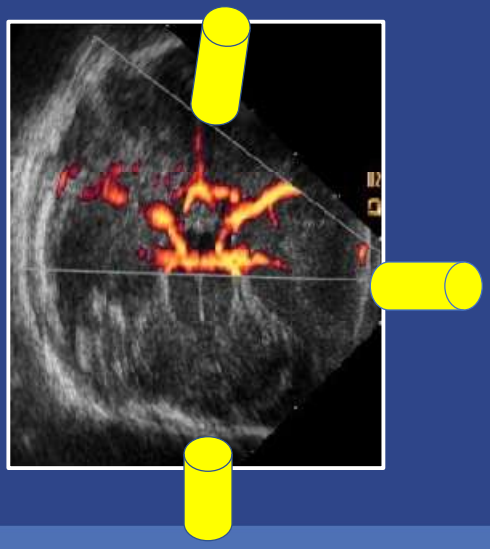
TECHNIQUE (IMAGING WINDOWS)

- Transtemporal
- Transoccipital
- Transorbital
- Submandibular



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INTRACRANIAL ARTERIAL ANATOMY

- Internal carotid artery
- Ophthalmic artery
- Middle cerebral artery
- Anterior cerebral artery
- Vertebral artery
- Posterior cerebral artery
- Basilar artery
- Circle of Willis

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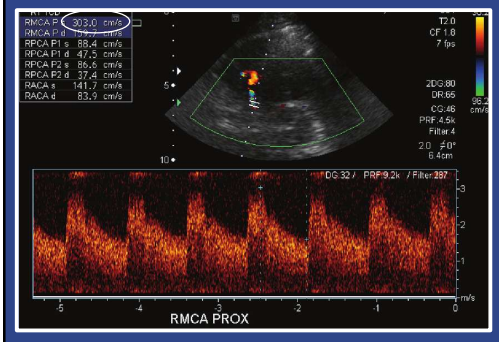
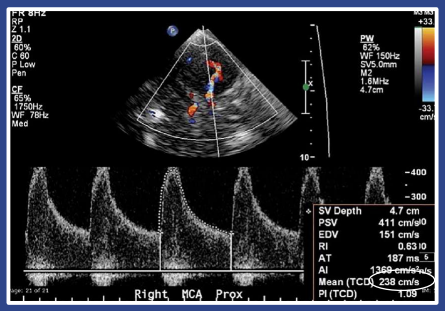
TCD ASSESSMENT FOR VASOSPASM SECONDARY TO SUBARACHNOID HEMORRHAGE





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LIMITED TCD

- TCD with bubble to evaluate for right to left shunt at foramen ovale
- Determine possible cause of Cryptogenic stroke

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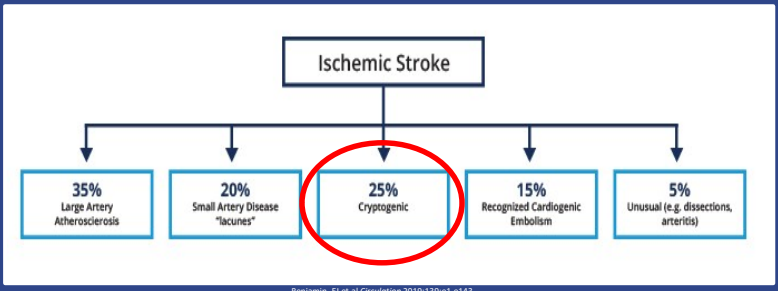
SUBCLASSIFICATION OF ISCHEMIC STROKE



Benjamin, EJ.et al *Circulation* 2019:139:e1-e143

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WHAT IS CRYPTOGENIC STROKE?

- Despite extensive investigation, a brain infarction is NOT clearly attributable to typical types of ischemic stroke

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MICROEMBOLI IN PATIENTS WITH CRYPTOGENIC STROKE

- Microemboli can be a cause of cryptogenic stroke
- Cryptogenic stoke may be caused by venous thromboembolism in patients with a patent foramen ovale

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WHO IS AT RISK?

- 25-40% of all ischemic strokes are cryptogenic
- PFO, pulmonary arterial AVMs, unstable carotid plaque, atrial fibrillation.
- All ages
- Less common in HTN
- Smoking not associated

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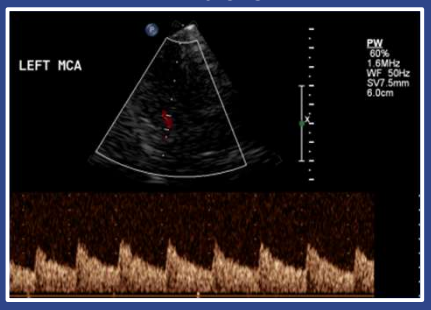
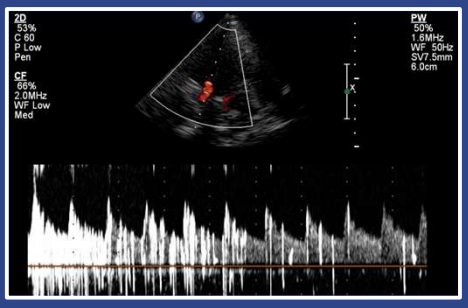
POSITIVE BUBBLE STUDY

PRE-INJECTION



POST-INJECTION WITH BUBBLE



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TCD INTERPRETATION

- GRADE 0: No micro emboli detected
- GRADE I: 1-10 micro emboli
- GRADE II: 11-30 micro emboli
- GRADE III: 31-100 micro emboli
- GRADE IV: 101-300 micro emboli
- GRADE V: > 300 micro emboli

Spencer, MP et al. *Journal of Neuroimaging 2004;14:342-349*

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CASE STUDY

- 56 y.o. male with recent cryptogenic stroke
- Fit, athletic, no prior neurologic symptoms
- Recent bronchitis x1 week
- Multiple coughing spells

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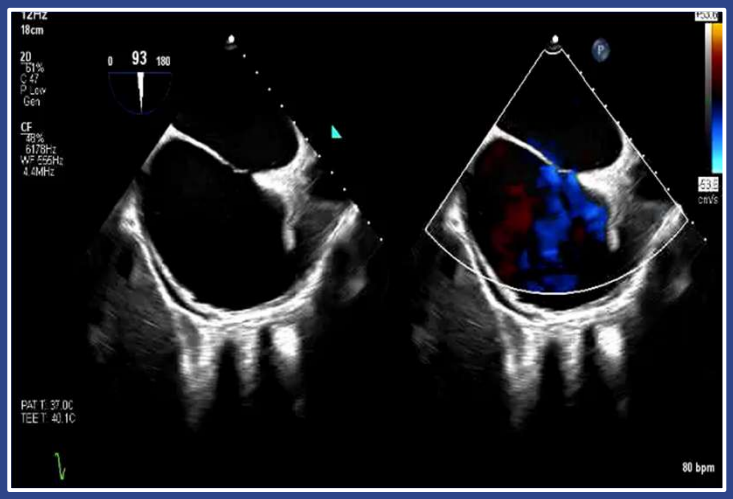
CASE STUDY - IMAGES



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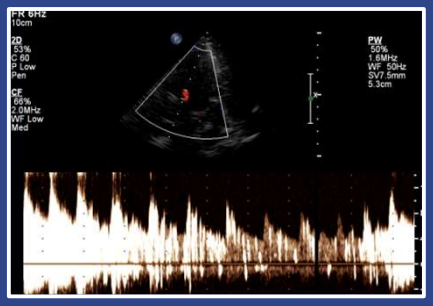
TCD



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CASE STUDY #2

- 23 y/o female with h/o frequent migraines and visual disturbances
- Seen and followed at another regional hospital for past three years. Treated medically for migraines
- Previous TTE, Carotid US and CT head was negative
- Presented to our ER with migraine and partial blindness in right eye
- Echo with bubble was ordered

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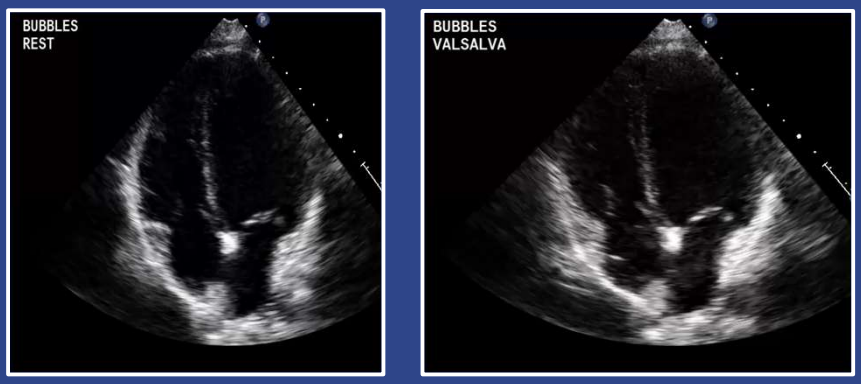
ECHO PERFORMED WITH BUBBLE STUDY



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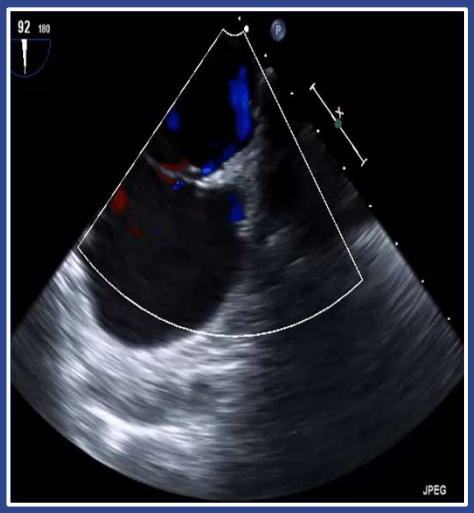
TEE - PFO



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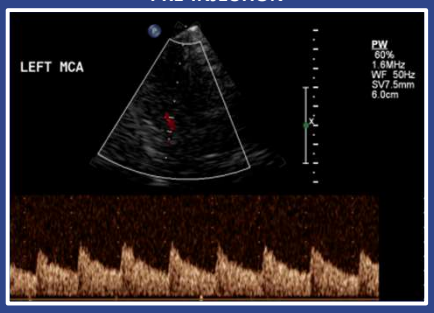
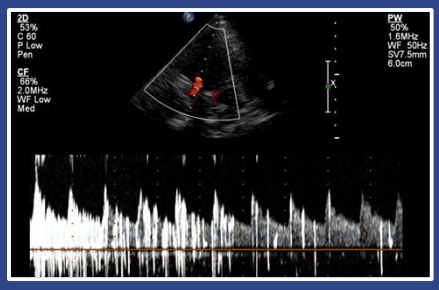
POSITIVE BUBBLE STUDY

PRE-INJECTION



POST-INJECTION WITH BUBBLE



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CASE STUDY #3

- 35-year-old female presented to ER for shortness of breath, leg swelling, palpitations and right sided weakness
- No prior studies or records were available at time of the echocardiogram other than a chest x-ray reporting cardiomegaly

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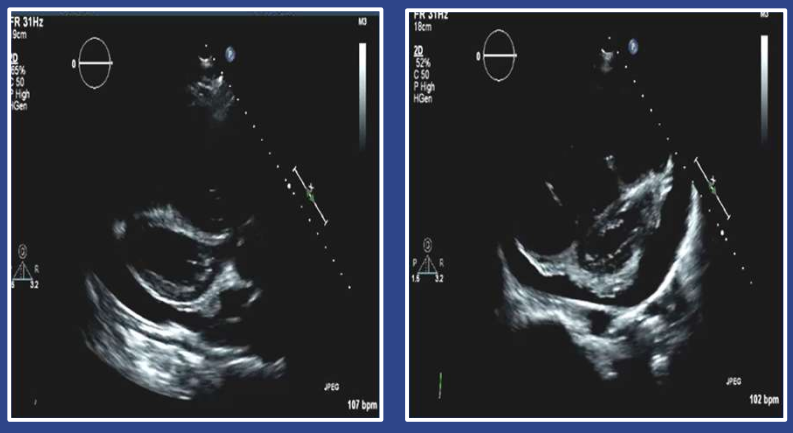
CASE STUDY #3



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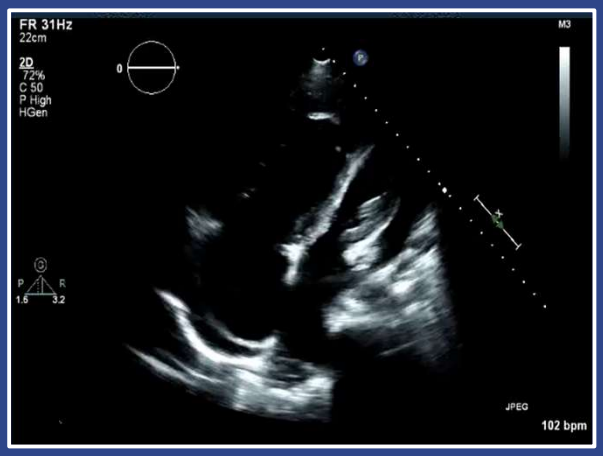
CASE STUDY #3



APICAL 4 CHAMBER

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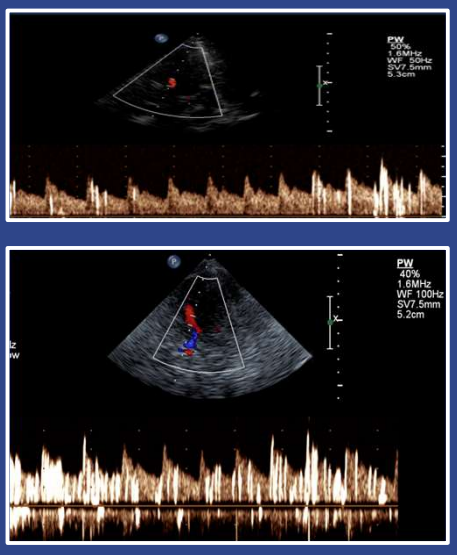

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CONCLUSION

- Described clinical utility of MCA Doppler from Fetus to Adult
- Provided examples of versatility of MCA Doppler across multiple diseases
- Provided case examples utilizing MCA Doppler assessment

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