

Carotid Duplex
TCD Examinations
“How one affects the other!”

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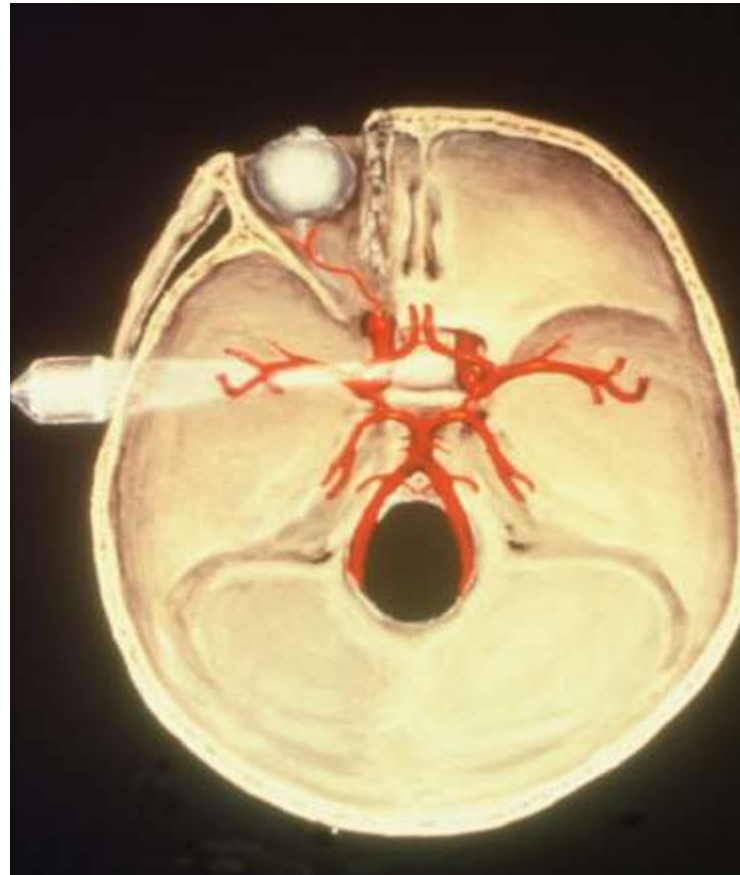


Definition: ---- Collateral Circulation

“Circulation of blood through a network of minor vessels that become enlarged and joined with adjacent vessels when a major vein or artery is impaired, as by obstruction”

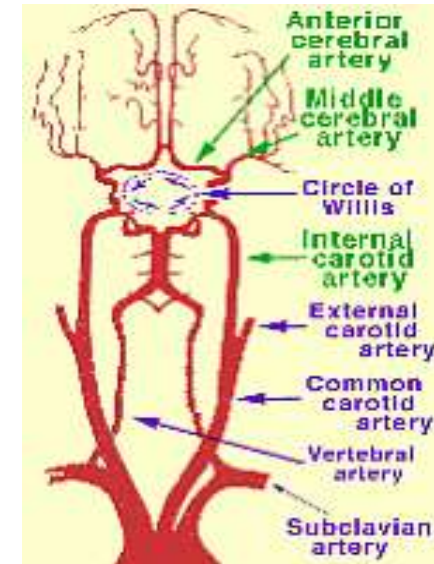
CIRCLE OF WILLIS

Collateral Circulation for the Brain



CIRCLE OF WILLIS

- RECEIVES BLOOD FROM INTERNAL CAROTID ARTERIES
- RECEIVES BLOOD FROM THE BASILAR ARTERY
- COMMUNICATES THE ANTERIOR AND POSTERIOR CIRCULATION- RIGHT AND LEFT HEMISPHERE

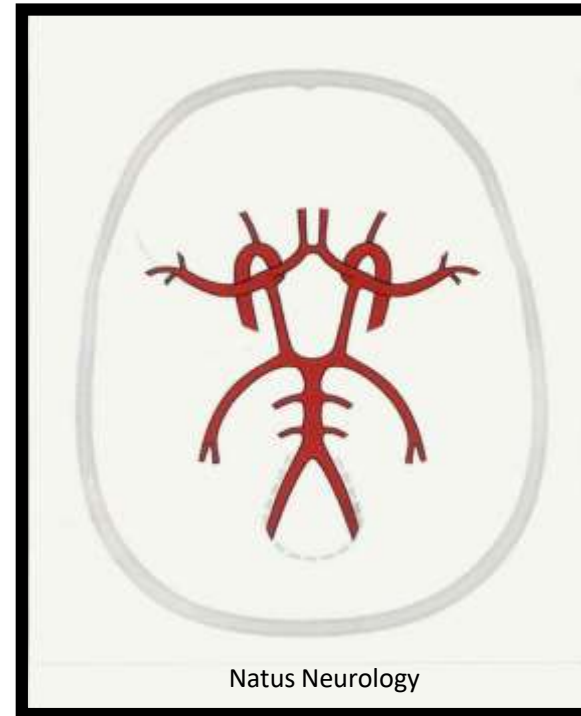


CIRCLE OF WILLIS

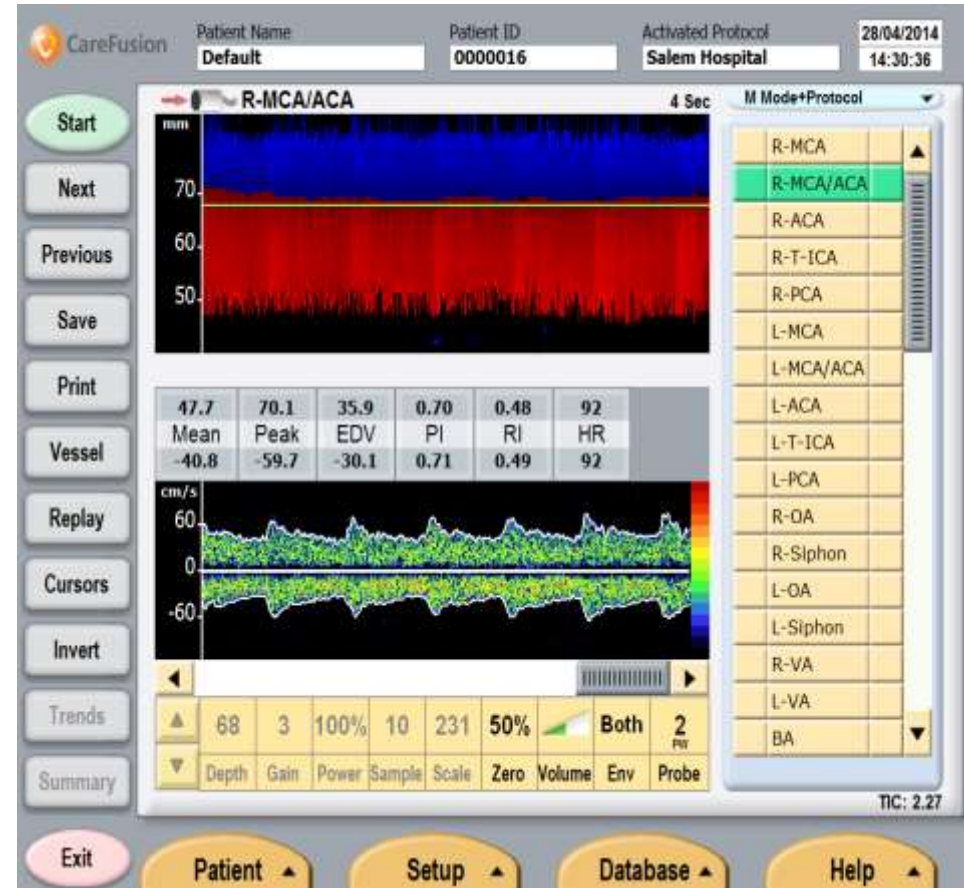
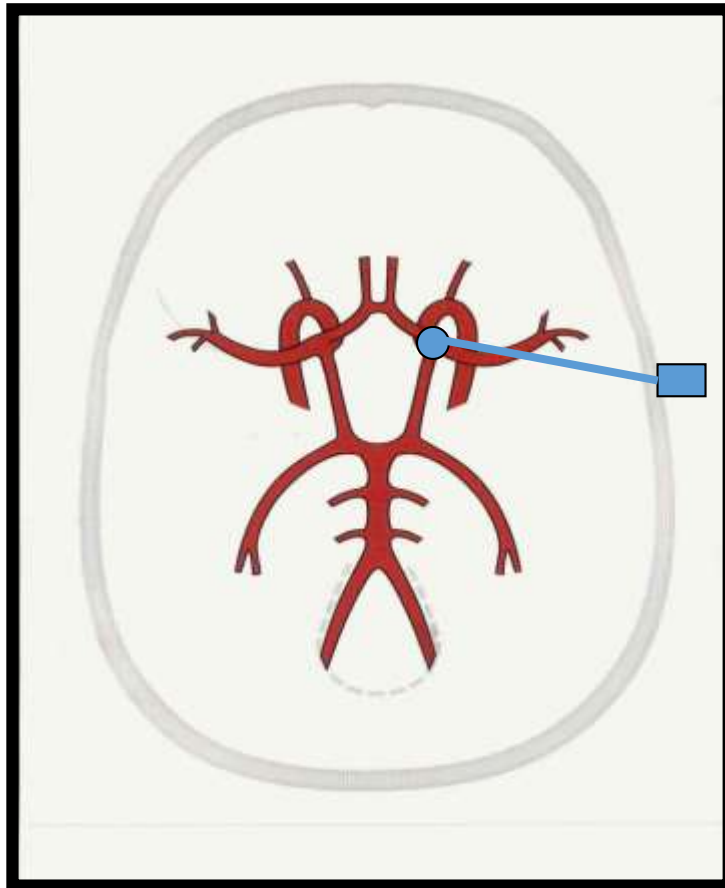
- PROTECTS THE BRAIN BY SHUNTING BLOOD BETWEEN THE TWO SYSTEMS
- OCCURS FOLLOWING OBSTRUCTION

CIRCLE OF WILLIS

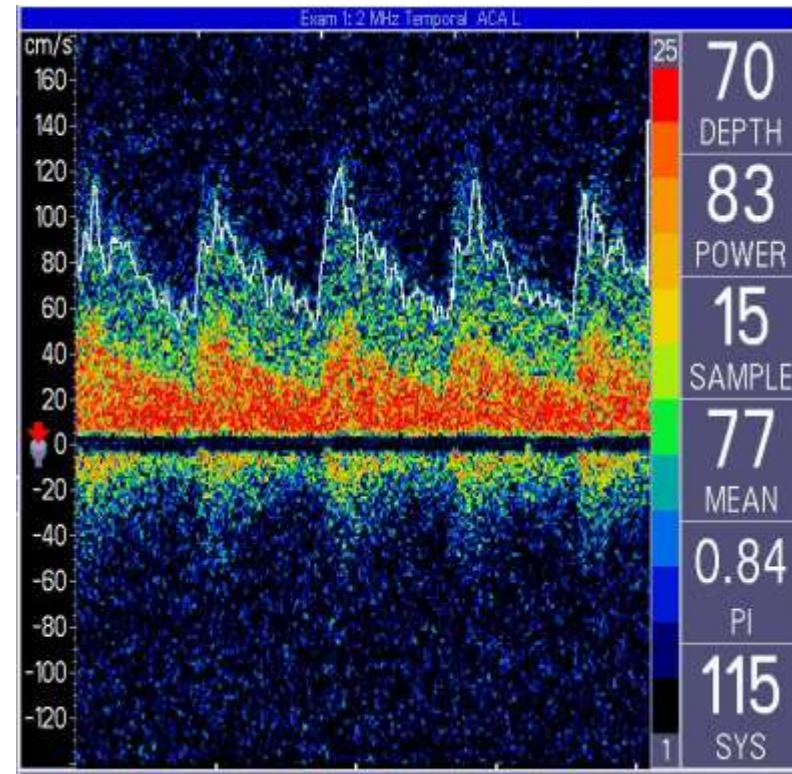
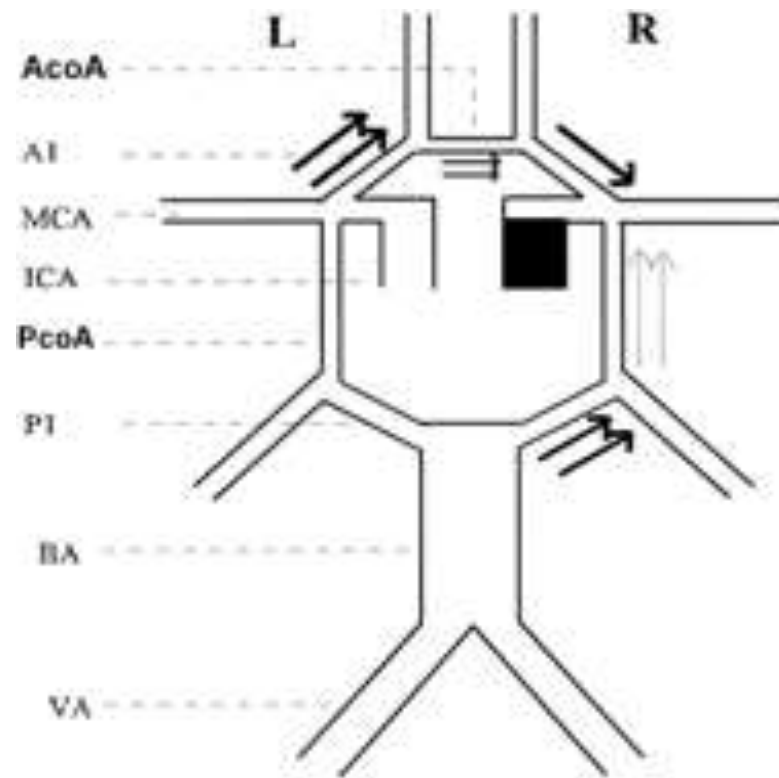
- ANTERIOR CIRCULATION VIA ANTERIOR COMMUNICATING ARTERY (ACOM)
- POSTERIOR CIRCULATION VIA POSTERIOR COMMUNICATING ARTERY (PCOM)



MCA / ACA Bifurcation

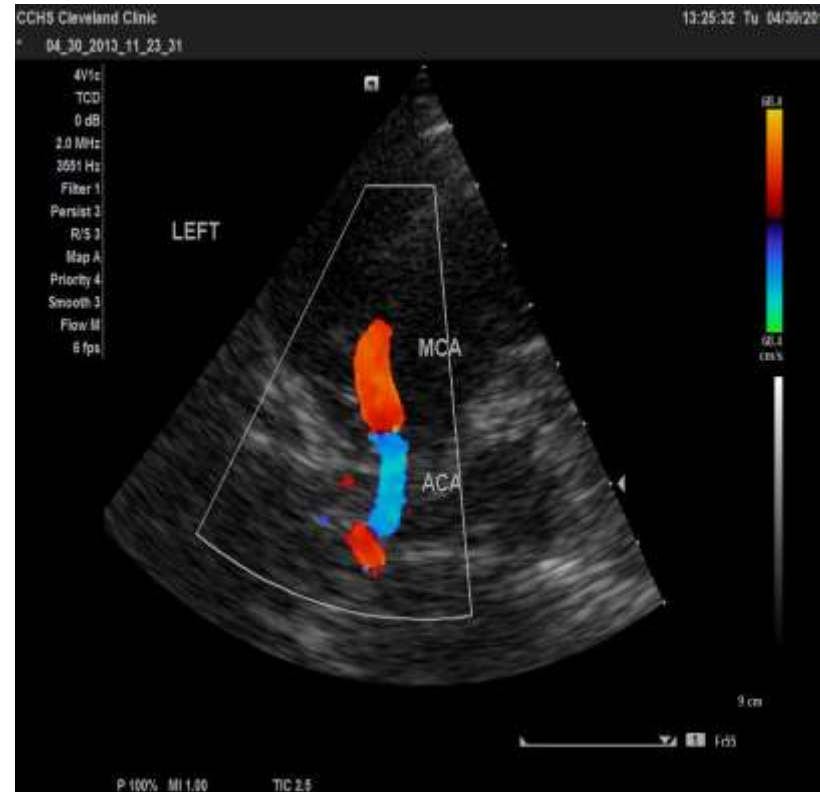


Natus Neurology



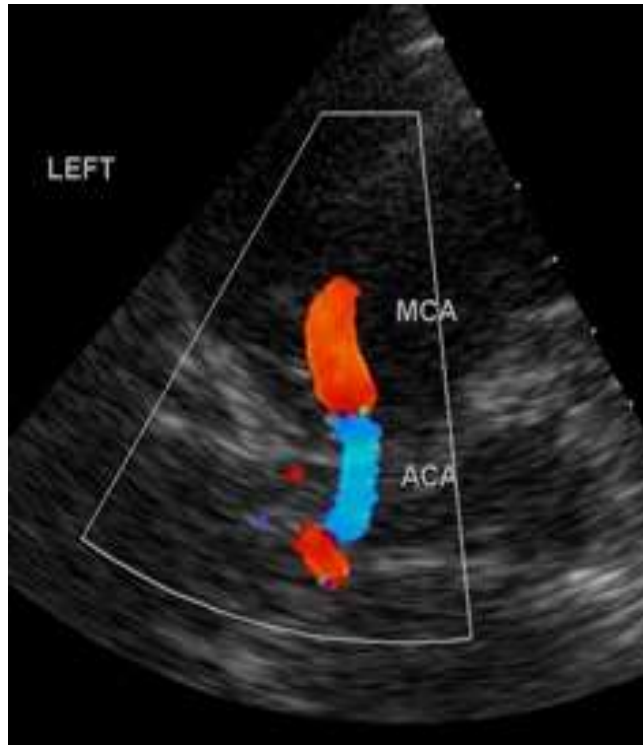
stroke, 2000;31;1656.)
 2000 American Heart Association, Inc

TCI – MCA/ACA







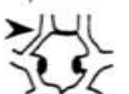








COLLATERAL FLOW

TCI



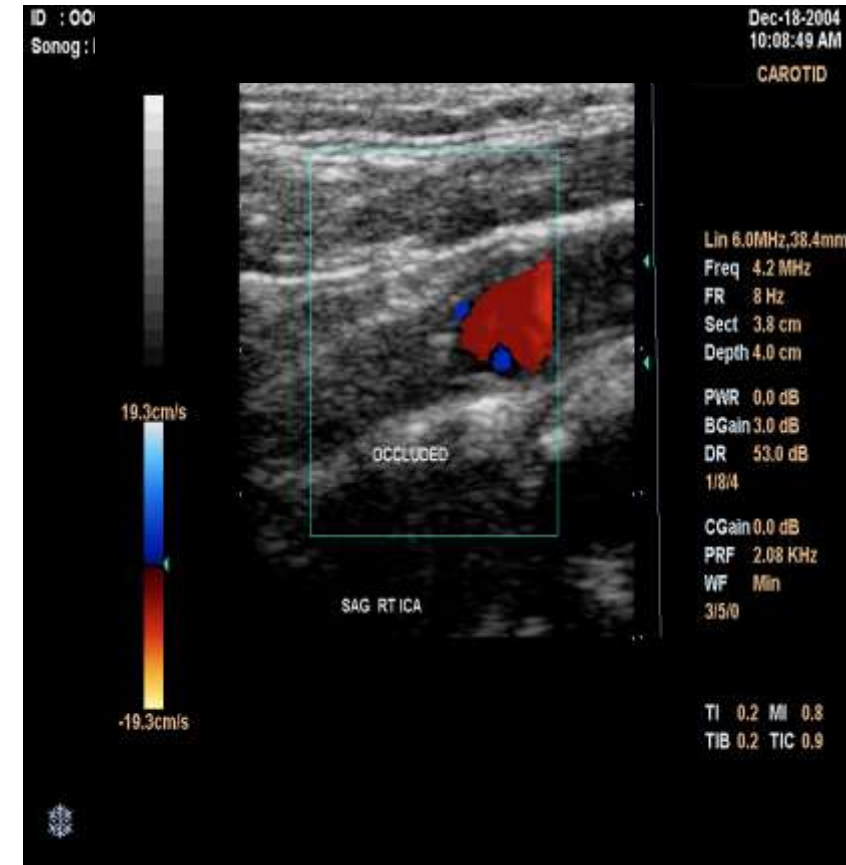
ANATOMIC VARIANTS

Variant	Incidence (%)	Illustration	Variant	Incidence (%)	Illustration
Classic circle of Willis	18-20		Duplicate A1	1	
Hypoplasia of one or both PComAs	22-53		Absent A1	1	
Hypoplasia of P1	15-40		Absent PComA	1	
Hypoplasia of AComA	13		Absent AComA	0.3-1	
Duplicate or triplicate AComA	9-40		Absent MCA	0.3	
Hypoplasia of A1	2-12		Persistent trigeminal artery	0.1-0.2	
Third ACA arising from AComA	1.5-10				

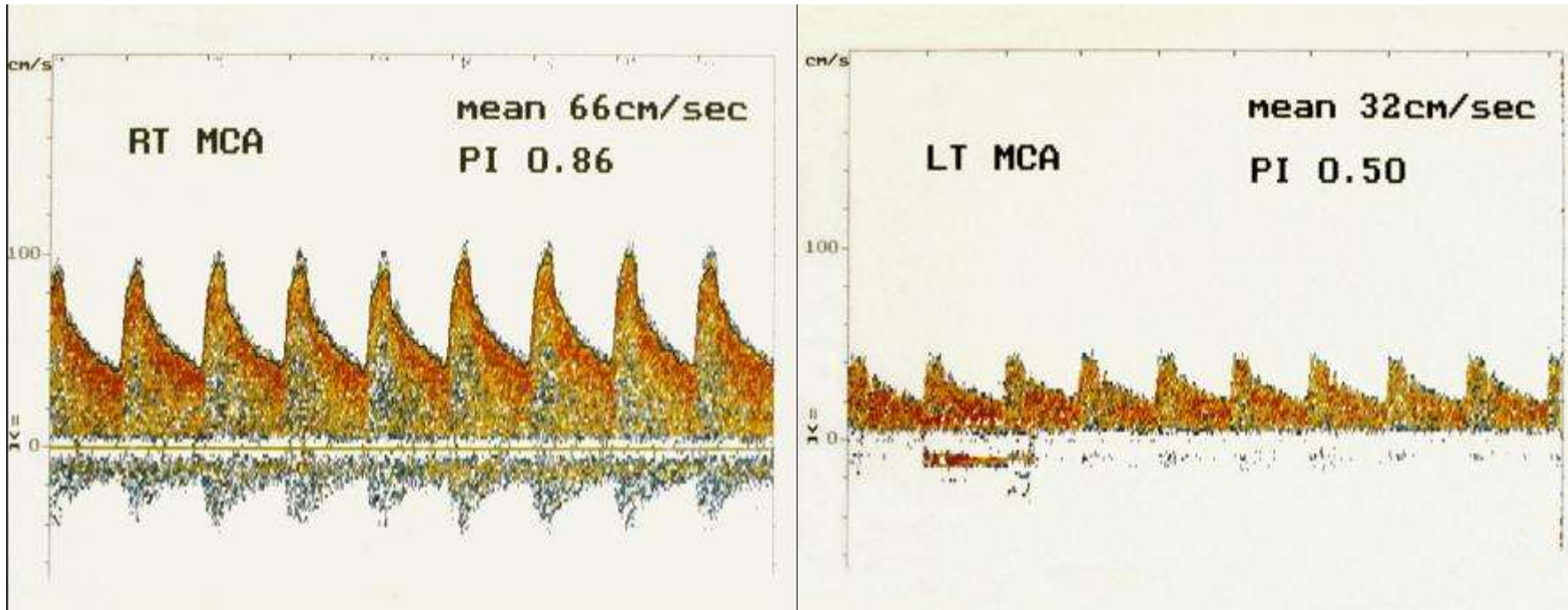


EXTRACRANIAL DISEASE

Left ICA



LT EXTRACRANIAL ICA OCCLUSION

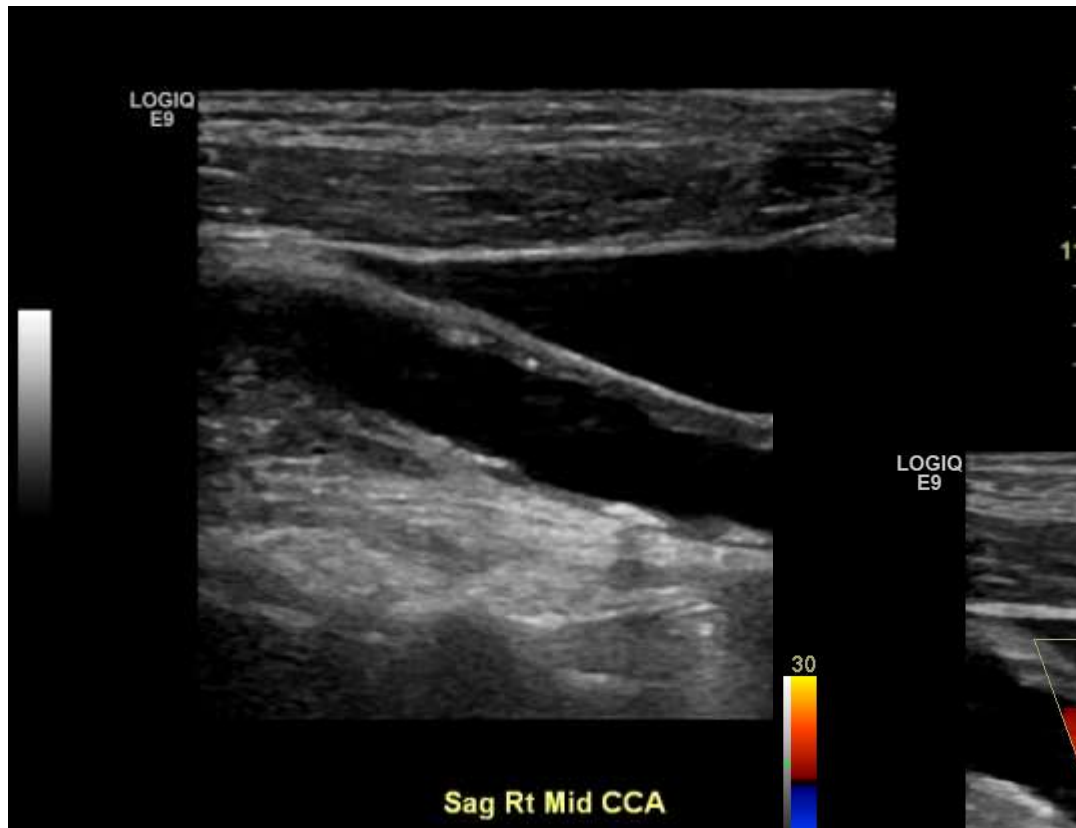


Interesting Carotid Cases

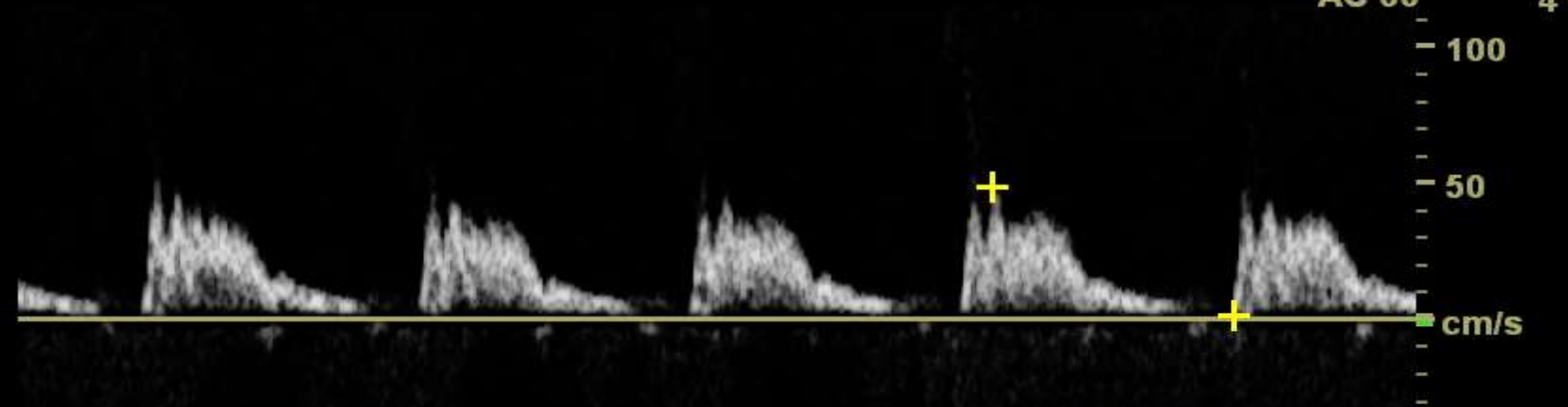
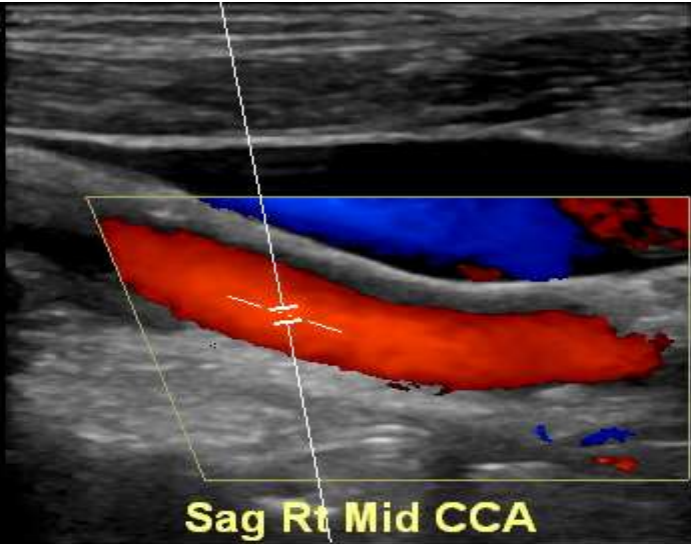
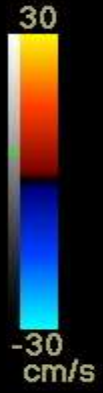
#1

- 68 yo Male
- Head hyperextended for 1 hr. during dental procedure
- Multiple episodes of syncope since
- Resident in access clinic questioned right carotid bruit
- Carotid Duplex ordered

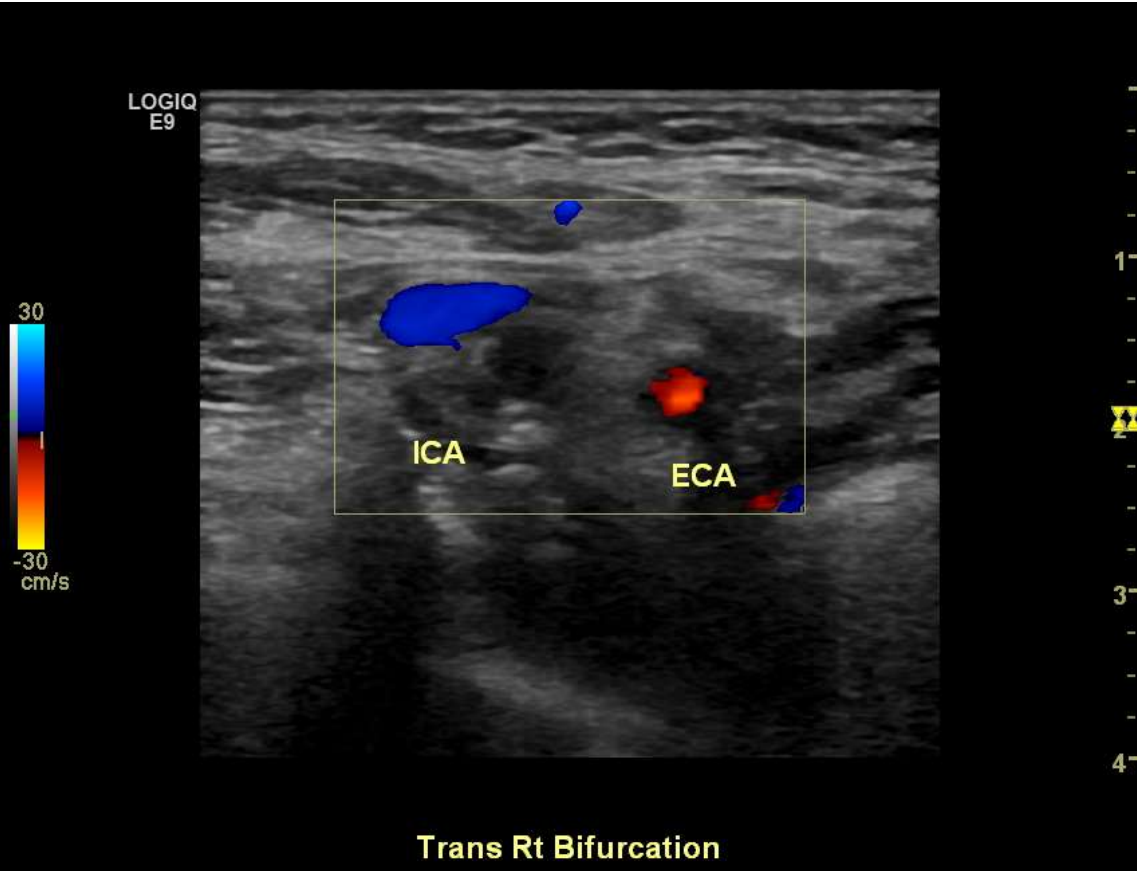


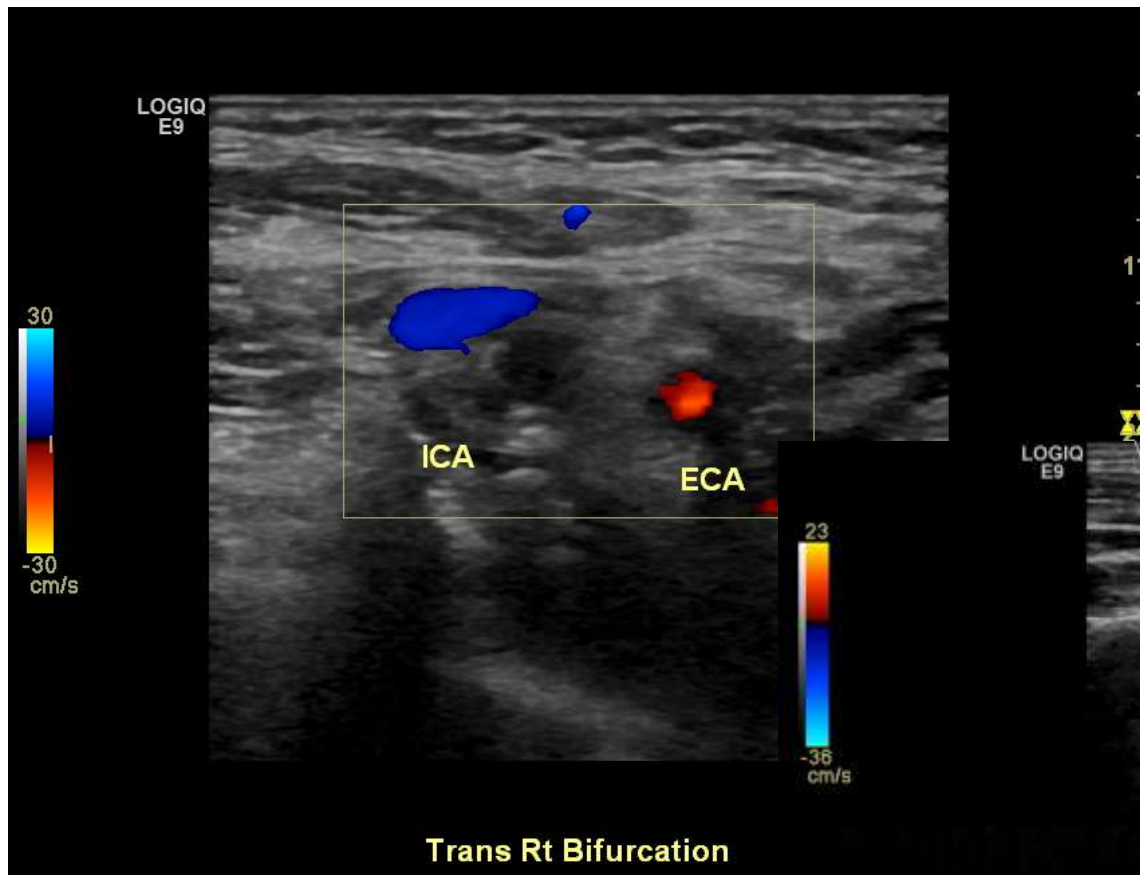


LOGIQ
E9

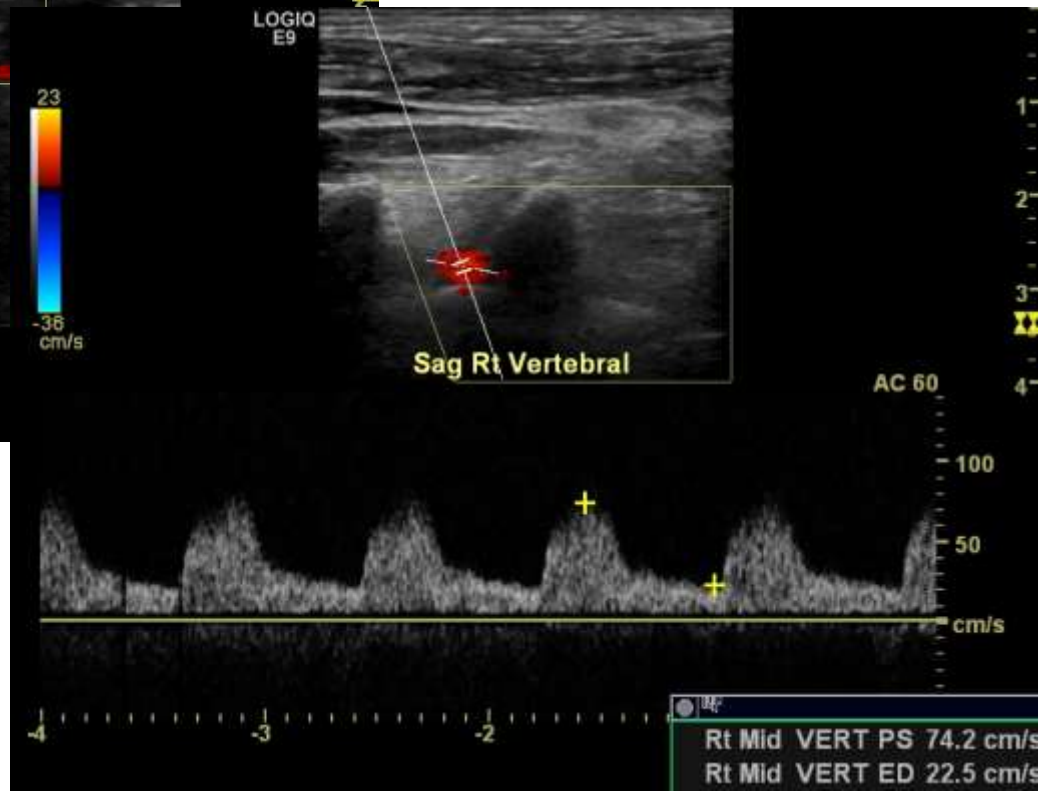


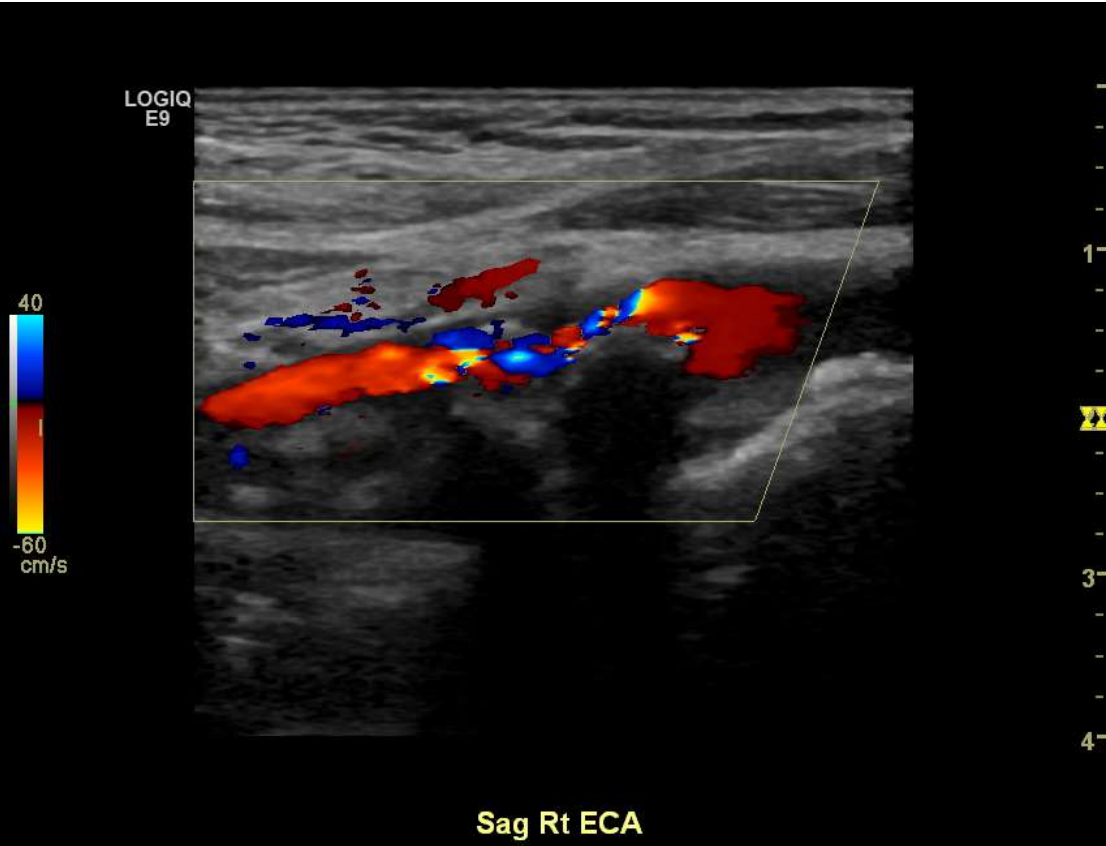
Rt Mid CCA PS 49.0 cm/s
Rt Mid CCA ED 0.0 cm/s

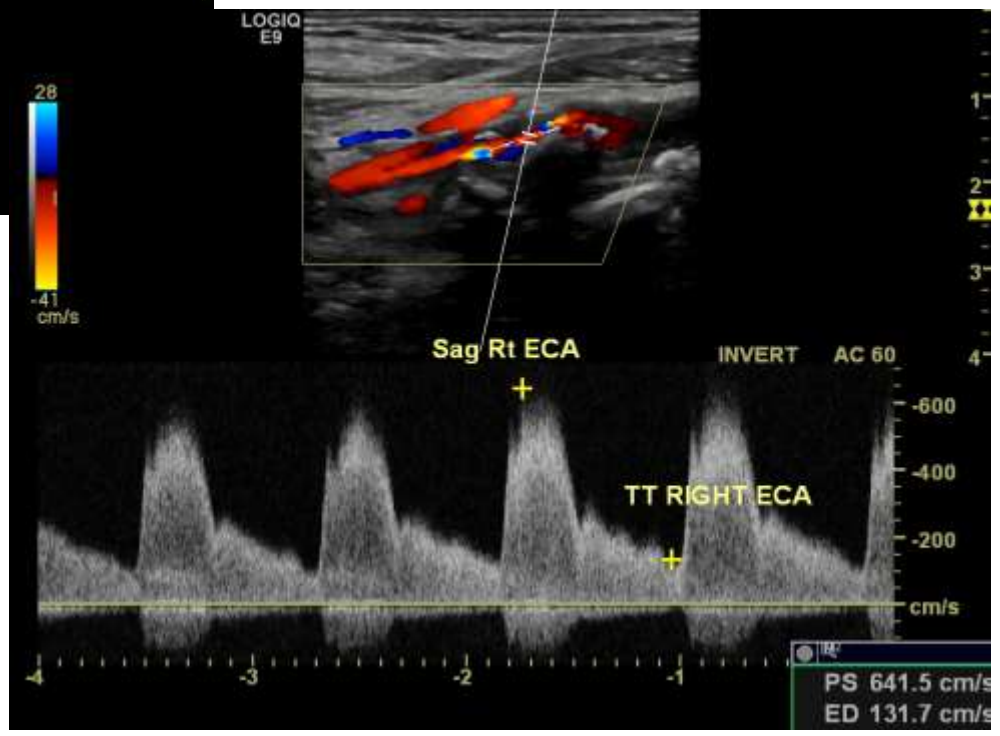
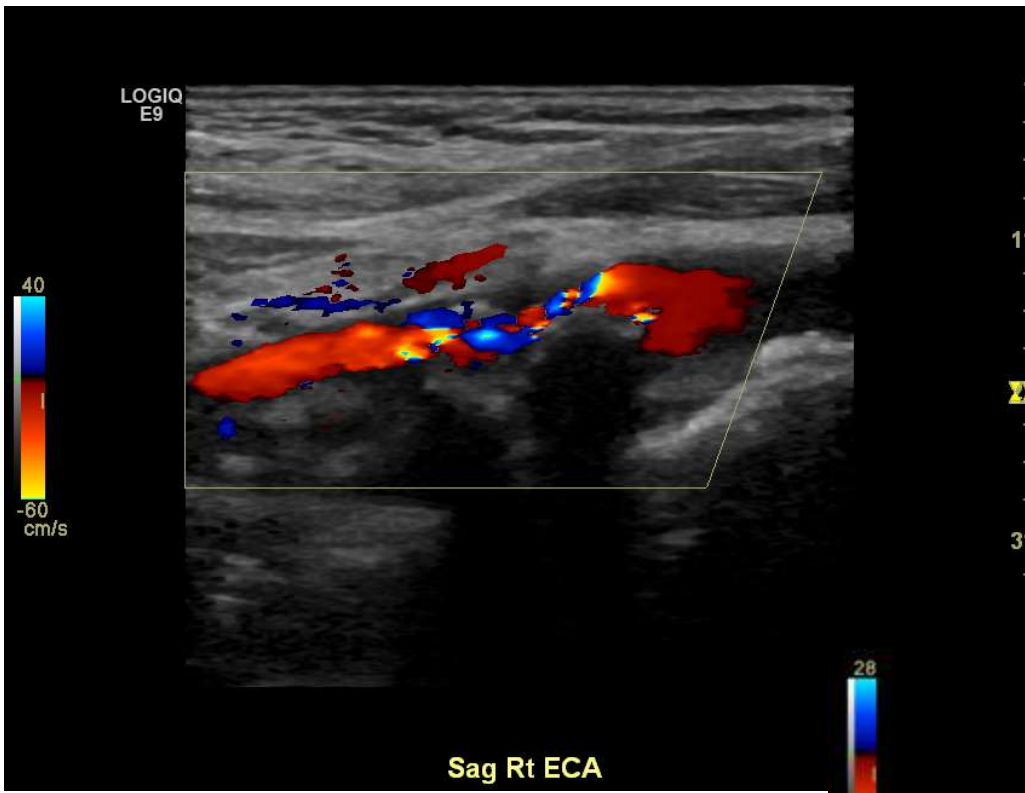


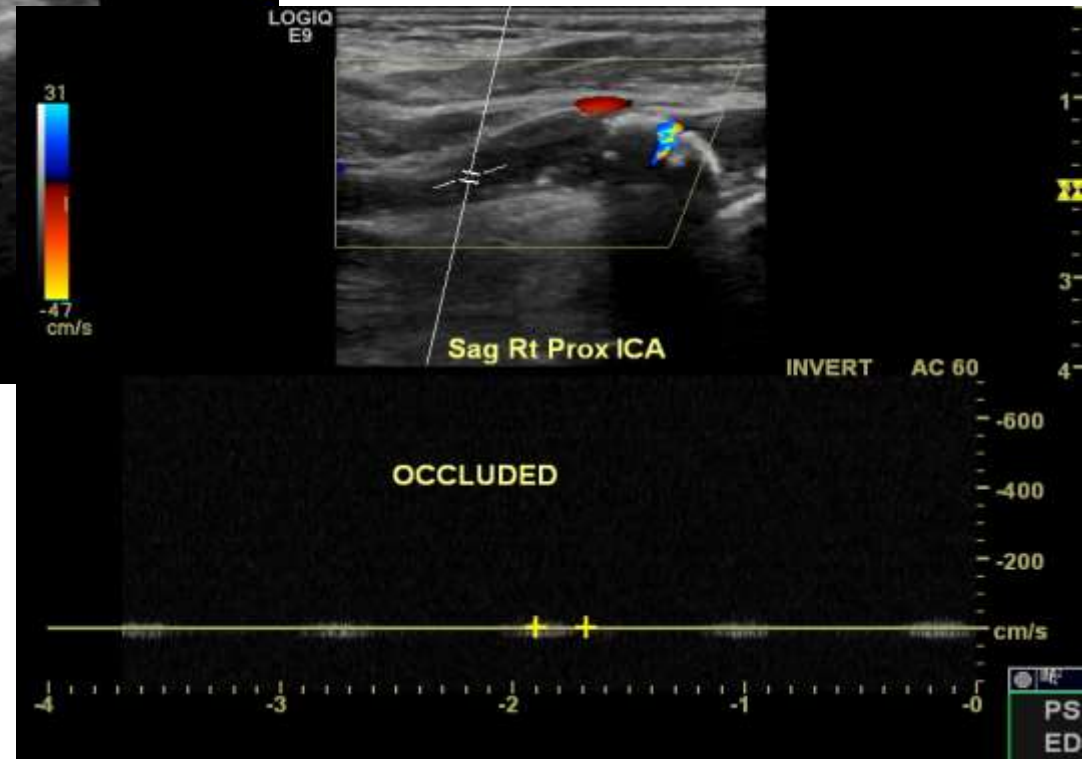
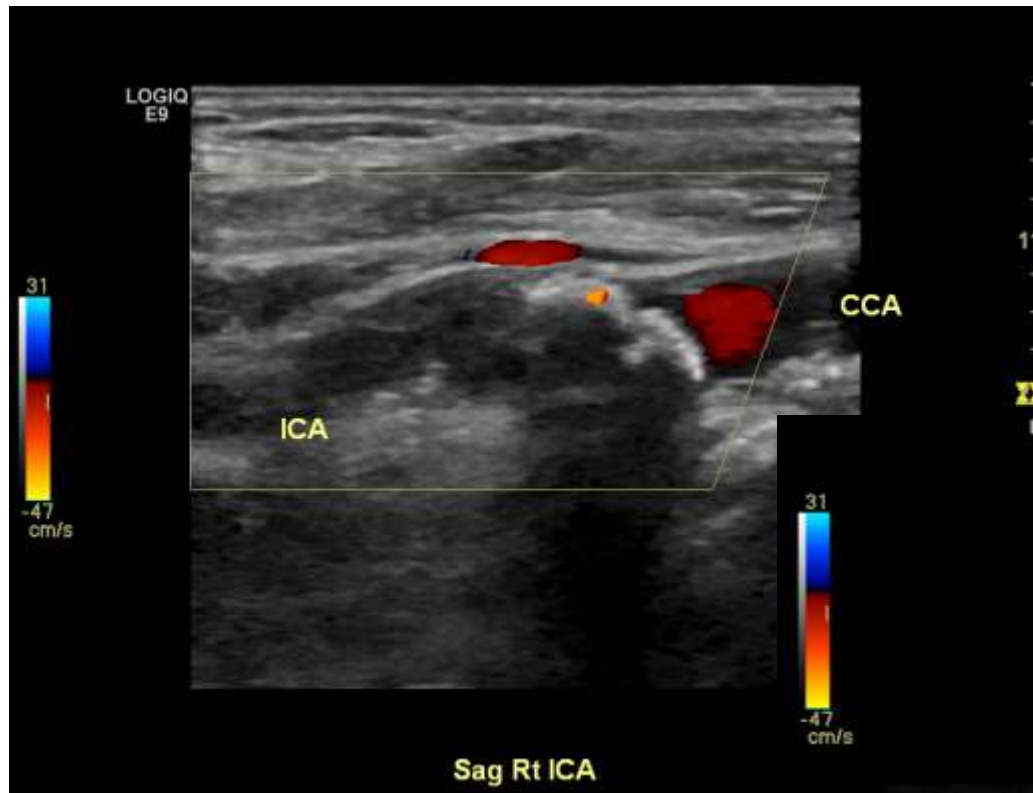


Trans Rt Bifurcation











Trans Lt Mid CCA



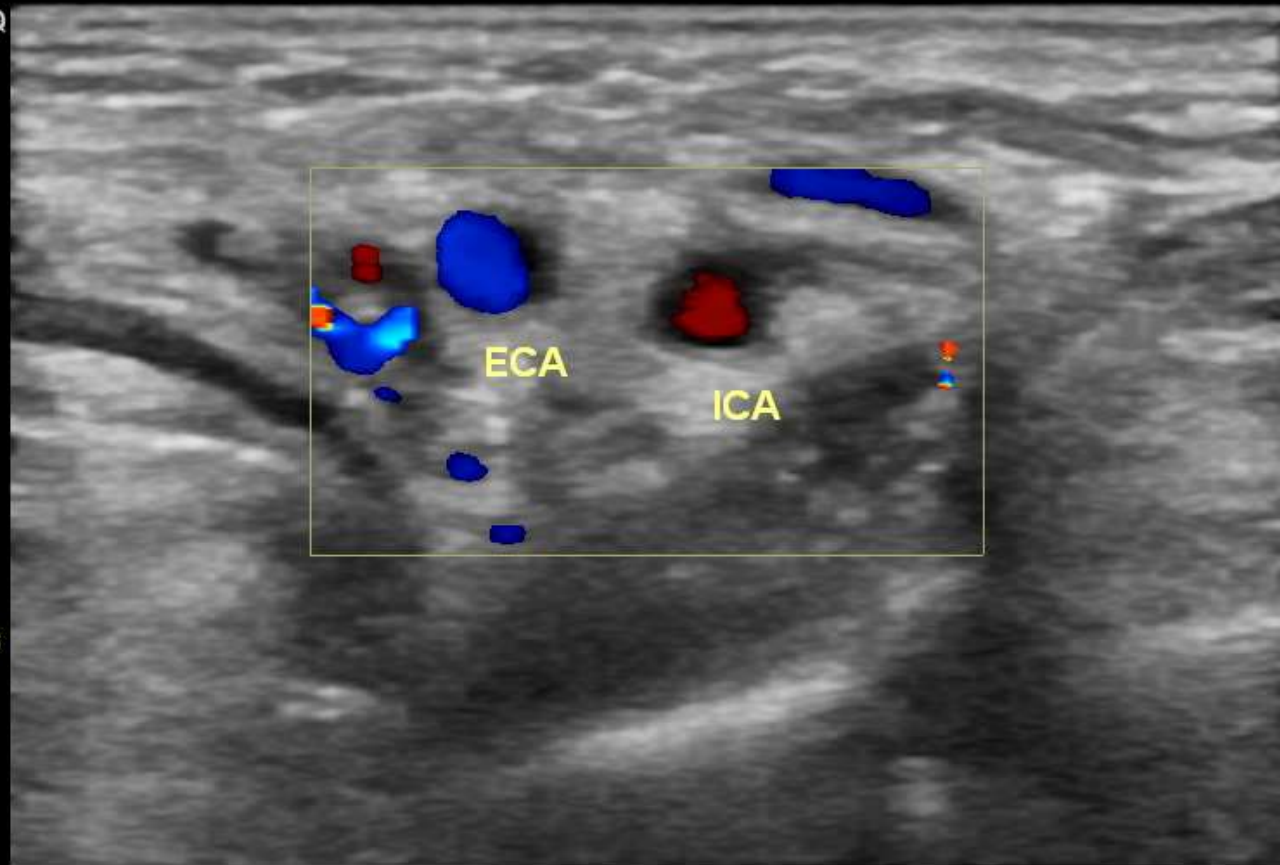
Trans Lt Dist CCA



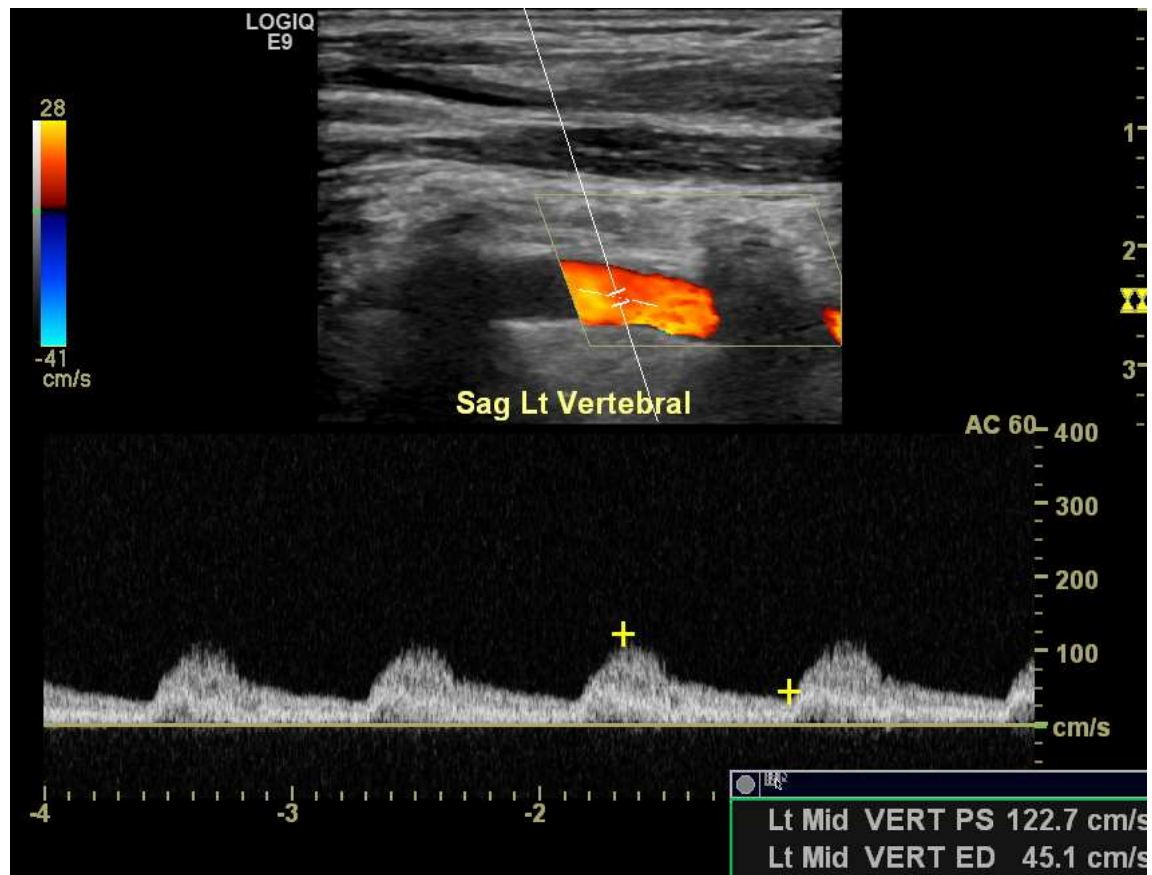


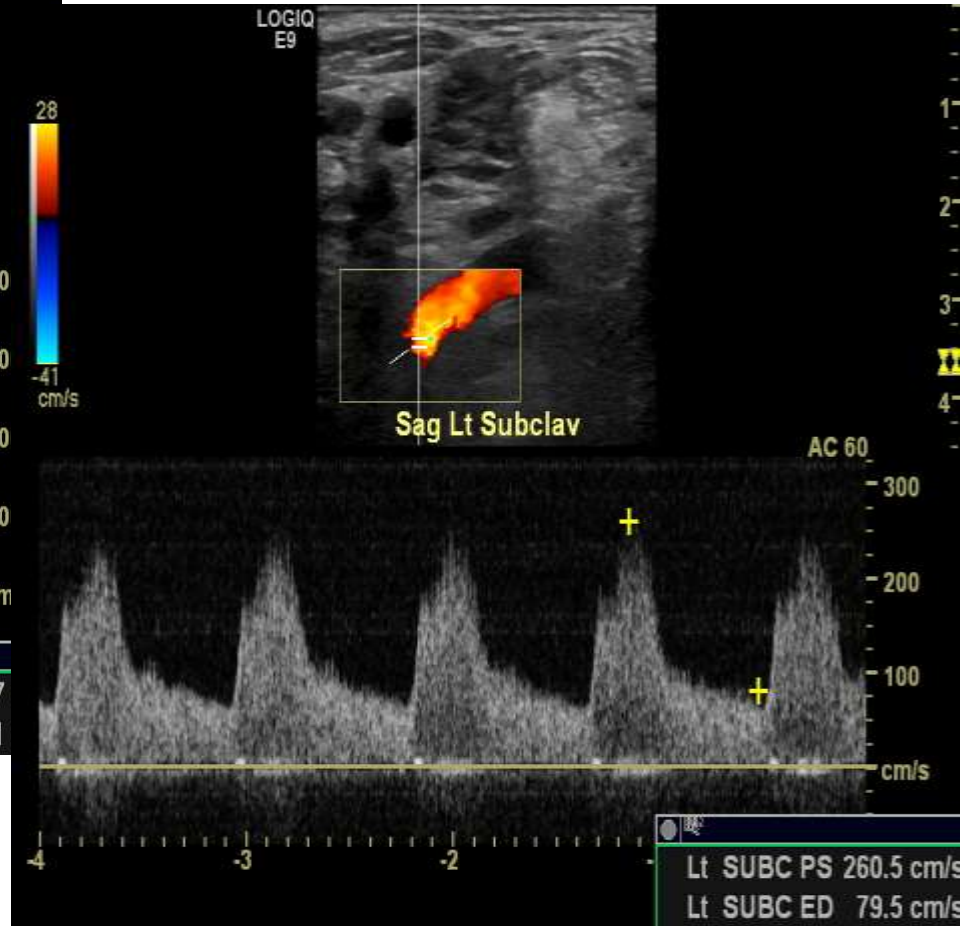
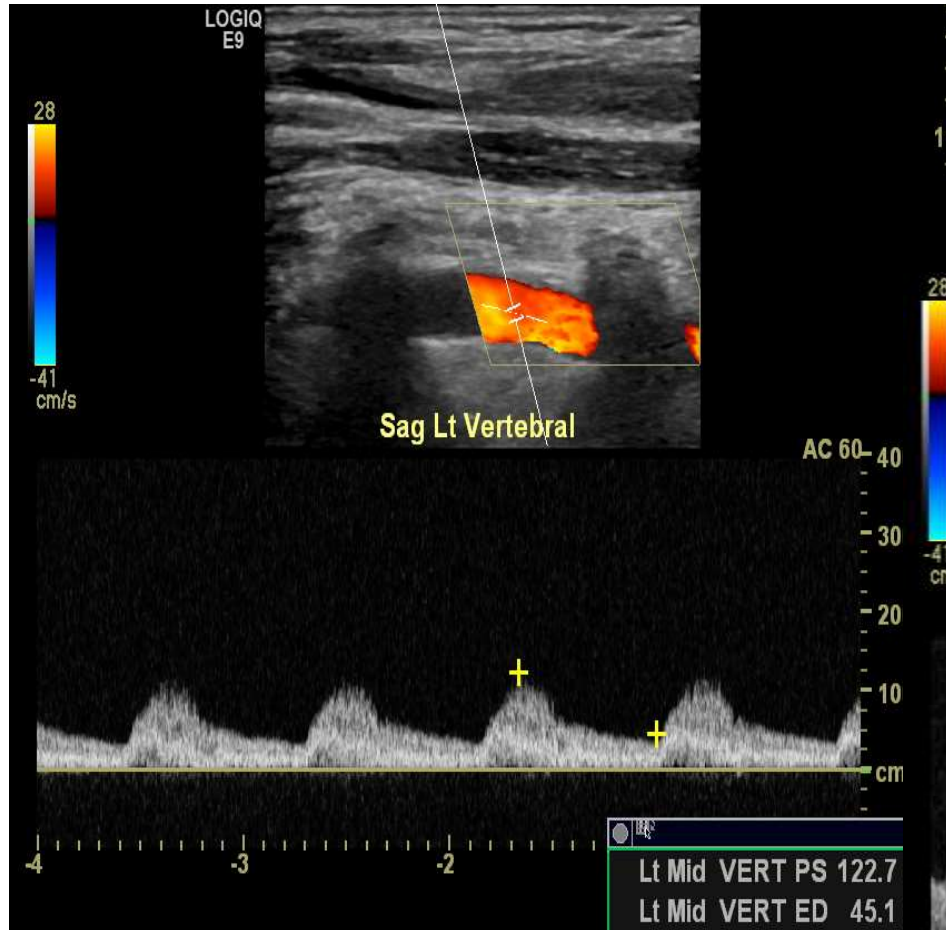
LOGIQ
E9

28
-41
cm/s

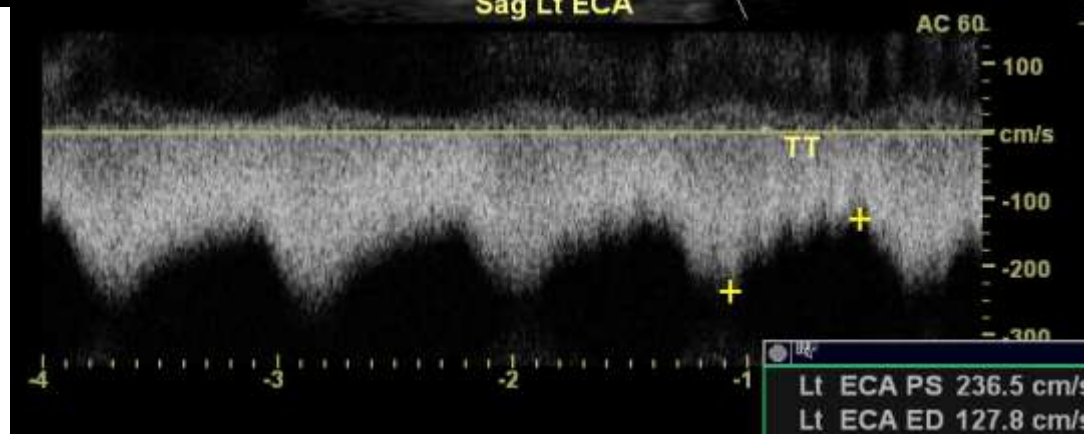
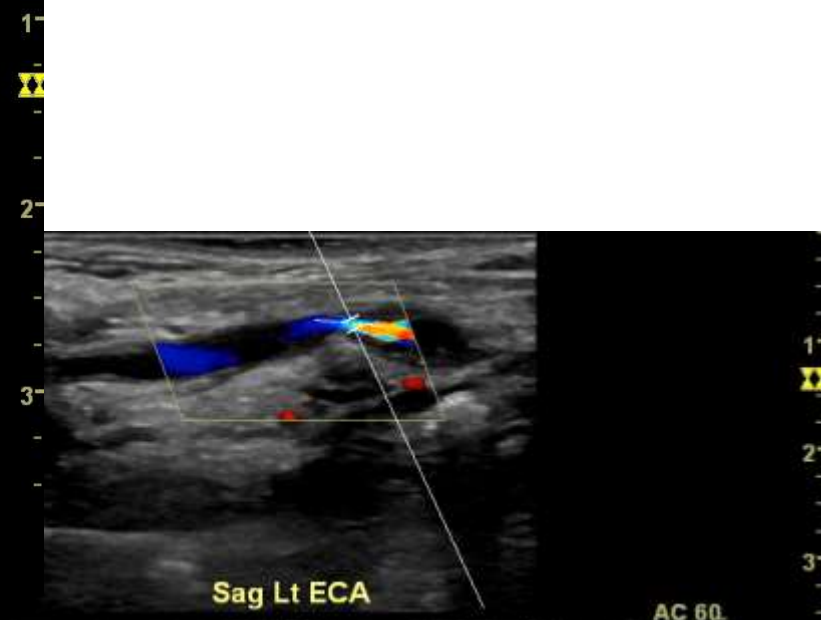


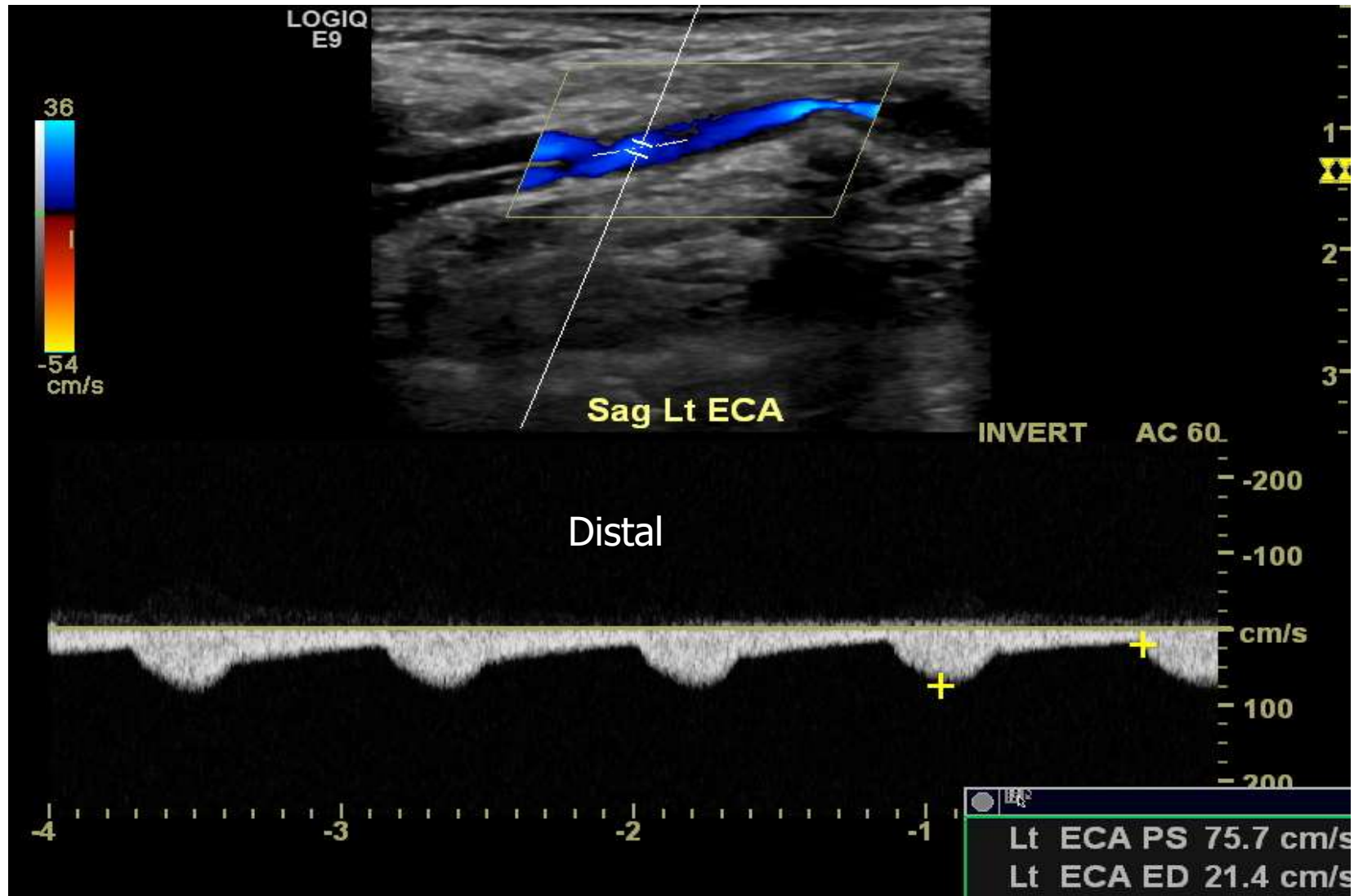
Trans Lt Bifurcation



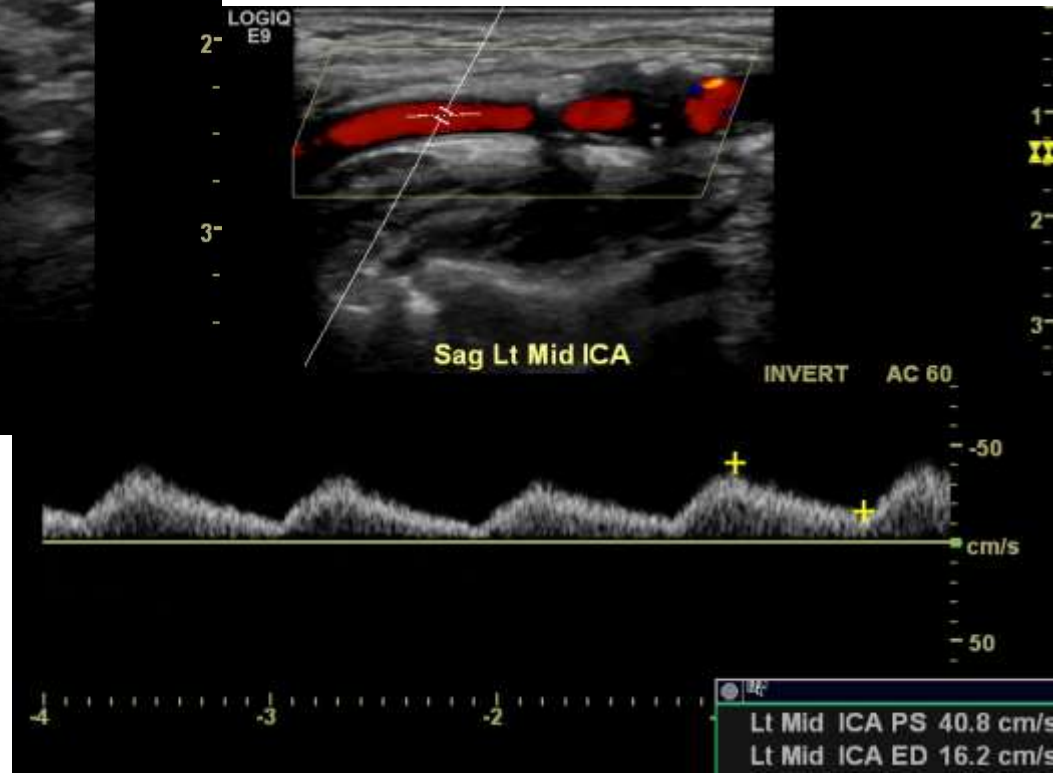
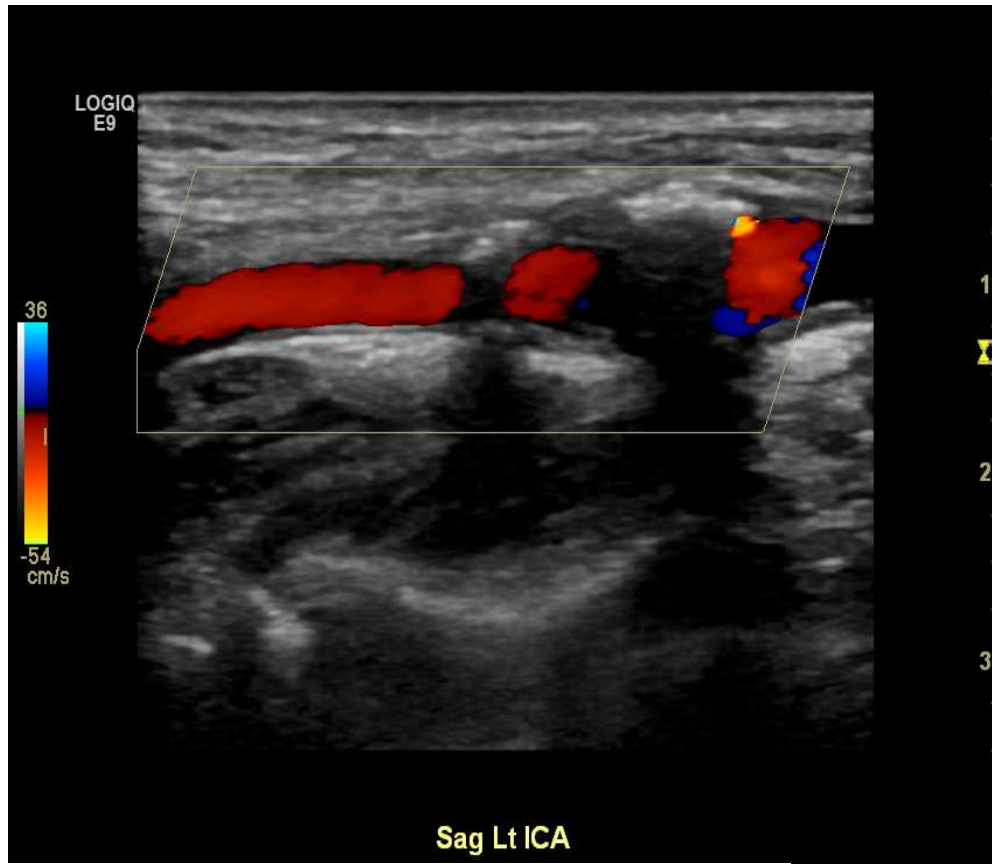












Breath holding TCD

Due to the bilateral carotid disease there was concern that the patient did not have adequate cerebrovascular reserve.

A TCD with Breath Holding was ordered

Breath holding TCD

Head band is used to monitor the bilateral MCAs continuously.



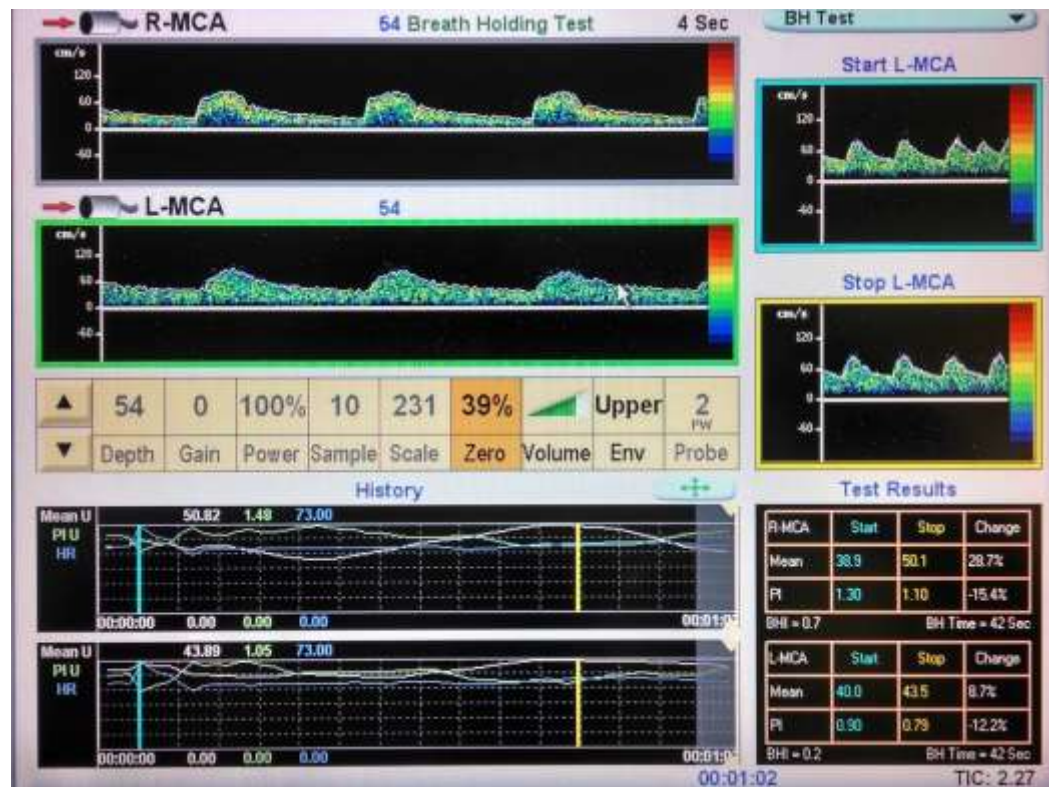
The patient is asked to take in a breath, let it out, and take in another breath and hold as long as they can, 30sec is optimal.

If adequate cerebrovascular reserve is present the MFVs will increase 20% over baseline and the Breath holding index (BHI) will be $>.70$.

BHI $<.69$ is Abnormal

BHI $\leq .30$ is Severely abnormal

Breath holding TCD / Results



Right MCA:

MFV Increased 28.7%-Normal

Right MCA BHI .70 – Normal (just!)

Left MCA:

MFV Increased 8.7% - Abnormal

Left MCA BHI .2 –Severely Abnormal

Interesting Carotid Case #1 Duplex Results

- Occluded right ICA
- Severe right ECA stenosis
- Occluded left CCA
- Retrograde flow left ECA
- Severe left ECA stenosis
- Left Subclavian stenosis

Interesting Carotid Cases

#1

- Patient admitted directly to Clinic
- Started on Plavix
- Heparin 5,000 units injection every 12 hours
- 81 mg ASA
- Schedule for Angiogram

Interesting Carotid Cases

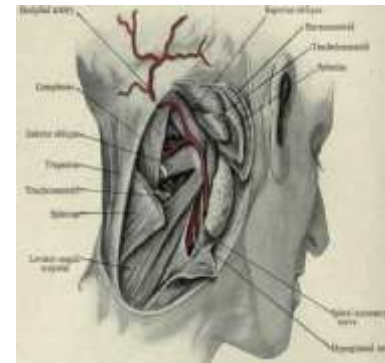
#1 Angio results

- Right ICA occluded
- Right ECA stenosis
- Flow to right MCA from PCOM
- Small Superficial Temporal Artery
- ECA-ICA Collateral – Retrograde flow right OA

Interesting Carotid Cases

#1 Angio results

- Left CCA occluded
- Collateral flow via: Vertebral artery branches to occipital artery to ECA retrograde with antegrade flow into Left ICA
- Severe proximal
Left Subclavian stenosis



Interesting Carotid Cases

#1

- Potential revascularization options
- Stenting of proximal right ECA (?? Improve flow to right hemisphere)
- ?? Stenting of left subclavian stenosis and then perform left subclavian bypass to distal left CCA.
- Continue Plavix and ASA

Interesting Carotid / TCD Case #2

- 53 yo female
- History of Type A aortic dissection, repaired with graft at OSH
- Began having abdominal pain, vomiting and nausea.
- Felt “clammy”, bilateral upper extremity weakness
- Went to OSH where CTA questioned new aortic dissection.
- Airlifted to Cleveland Clinic

Interesting Carotid / TCD Case #2

- History of Tobacco use:
- ***5 packs/day***
- Admitted to Cardiothoracic ICU
- Carotid Duplex
- Transcranial Monitoring ordered



MI 1.2 TIs 0.4 9L

Carotid

FR 33

CHI

- Frq 9.0

- Gn 37

- S/A 2/1

Map H/0

- D 4.0

1-DR 69

AO% 100

2-

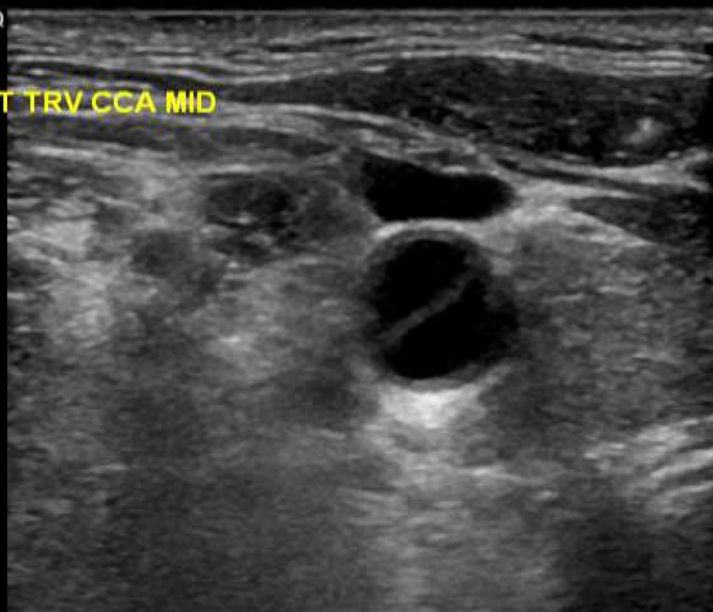
Σ

3-

4-

LOGIQ
E9

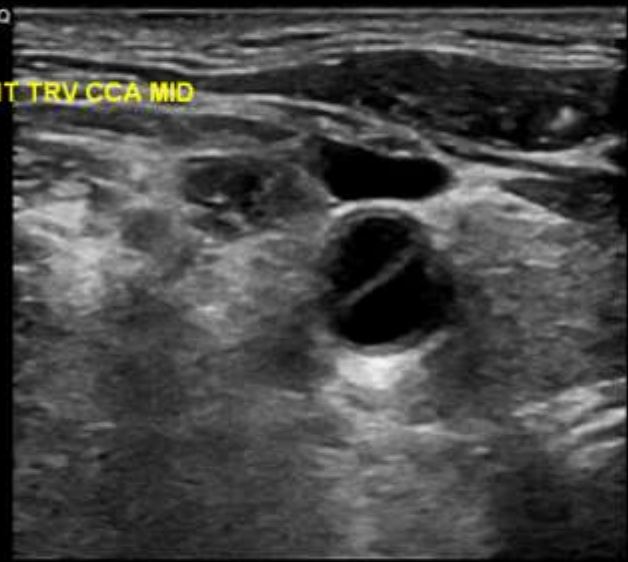
RIGHT TRV CCA MID



FR 33
CHI
- Frq 9.0
- Gn 36
- S/A 4/1
- Map H/0
- D 4.0
1- DR 63
- AO% 100
-
-
2-

LOGIQ
E9

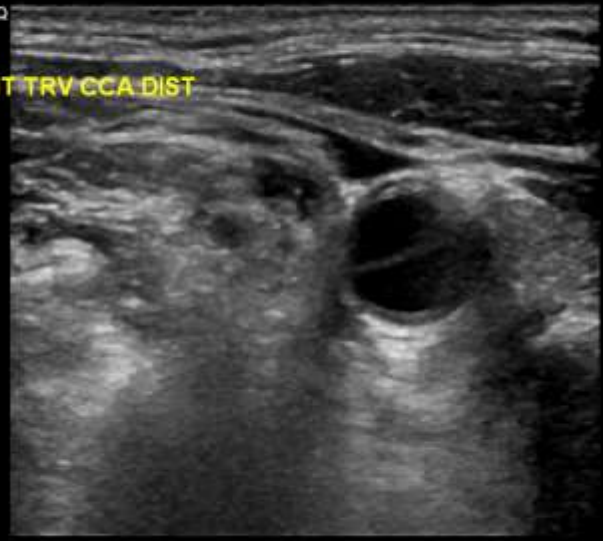
RIGHT TRV CCA MID



FR 33
CHI
- Frq 9.0
- Gn 37
- S/A 2/1
- Map H/0
- D 4.0
1- DR 69
- AO% 100
-
-
2-

LOGIQ
E9

RIGHT TRV CCA DIST



II

3-

4-



MI 1.2 TIs 0.4 9L

Carotid

FR 33

CHI

- Frq 9.0

- Gn 30

- S/A 2/1

Map H/0

- D 4.0

1- DR 69

AO% 100

LOGIQ
E9

RIGHT SAG CCA PROX



2-

XX

3-

4-



MI 1.2 TIs 0.6 9L

Carotid

FR 15

CHI

- Frq 9.0

- Gn 33

- D 3.5

- AO% 100

CF

1- Frq 3.6

- Gn 18.0

- L/A 0/7

- PRF 7.3

- WF 533

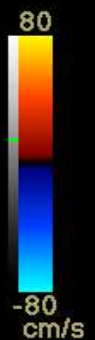
- S/P 5/12

2- AO% 100

Σ

3-

LOGIQ
E9



RIGHT SAG CCA PROX



MI 1.2 TIs 0.9 9L

Carotid

FR 17

CHI

- Frq 9.0

- Gn 30

- D 4.0

- AO% 100

1- CF

- Frq 3.6

- Gn 18.0

- L/A 0/7

- PRF 9.2

- WF 666

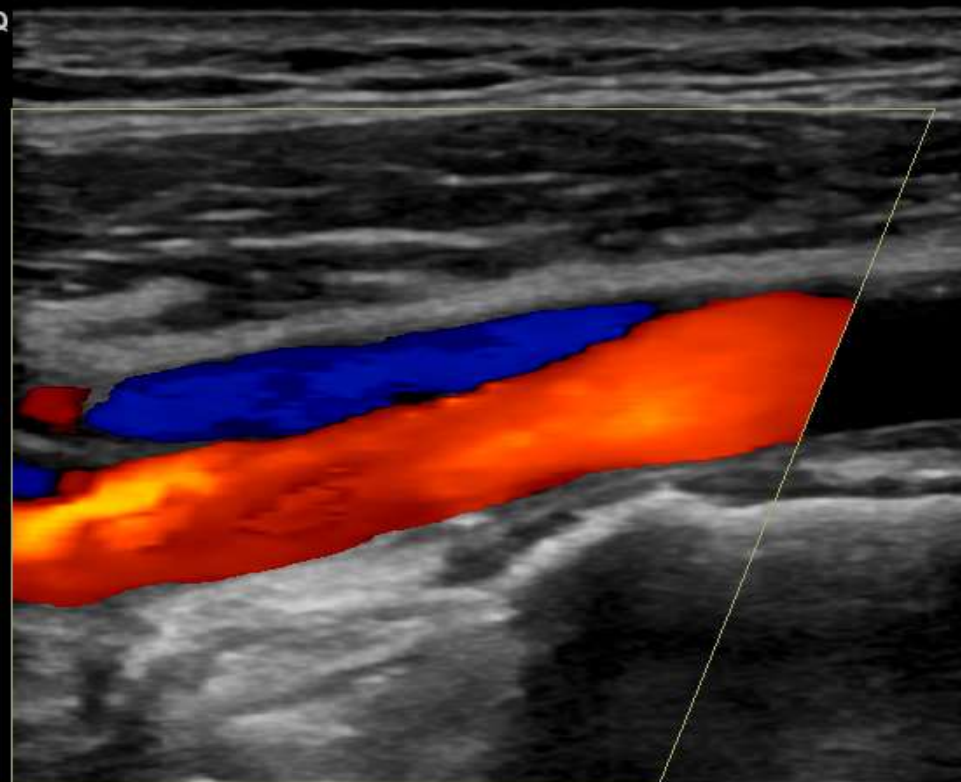
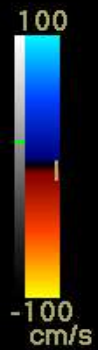
2- S/P 5/12

- AO% 100

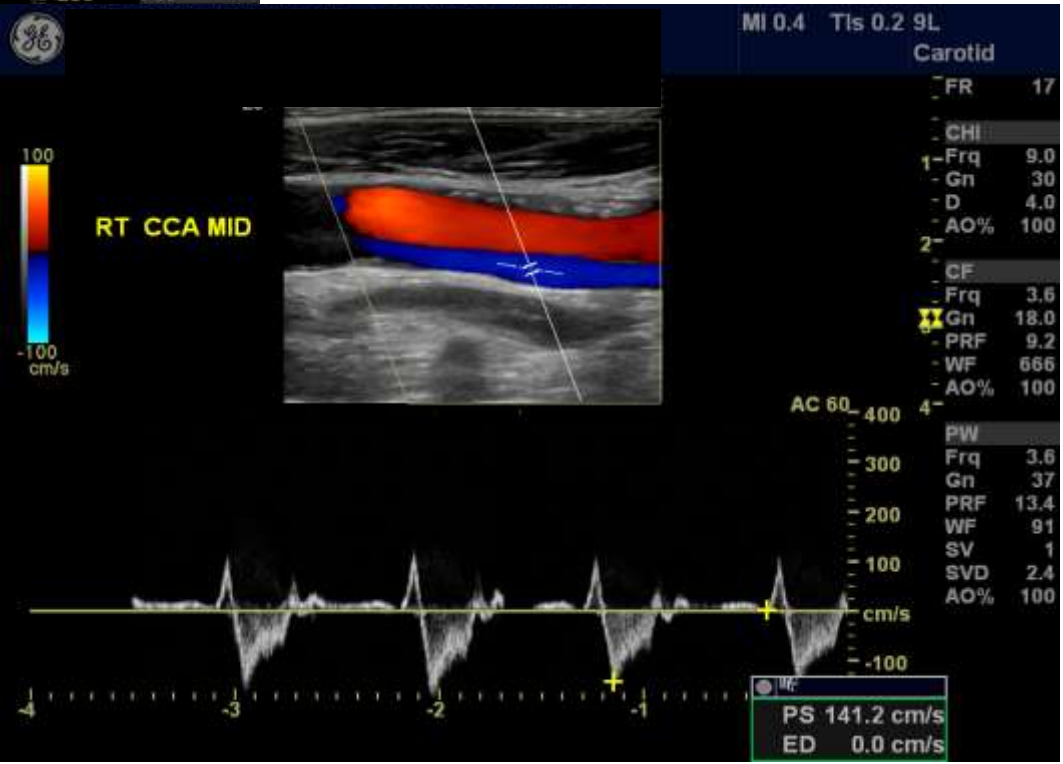
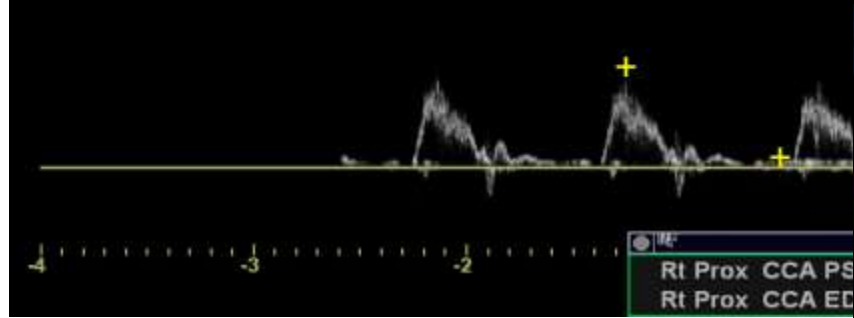
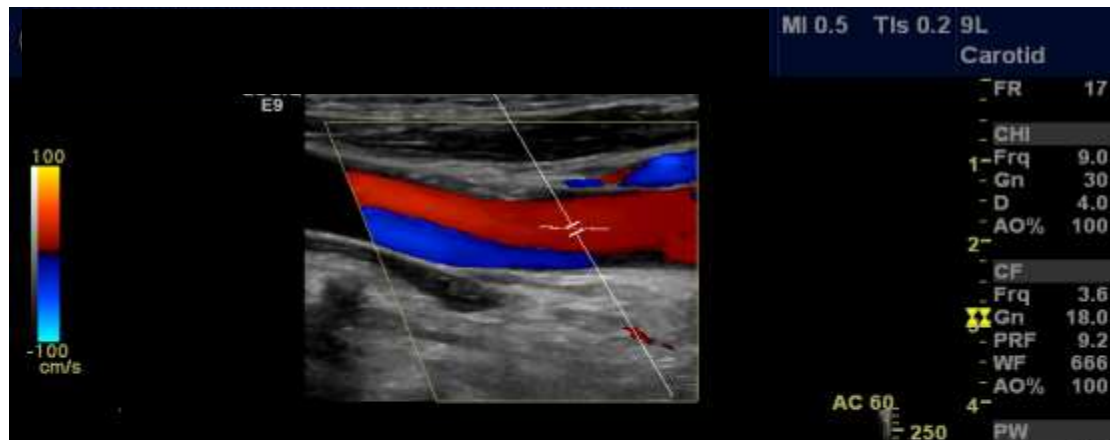
3

4

LOGIQ
E9



RIGHT SAG CCA DIST





MI 1.2 TIs 0.4 9L

Carotid

FR 33

CHI

Frq 9.0

- Gn 38

- S/A 4/1

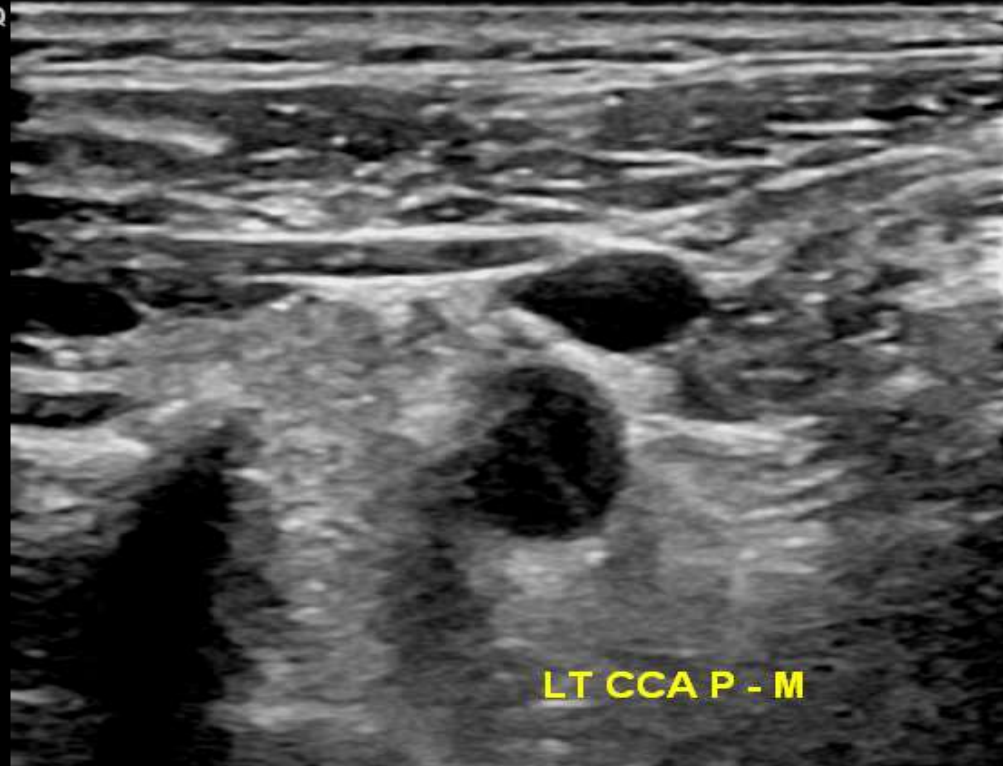
Map J/1

- D 4.0

1- DR 51

AO% 100

LOGIQ
E9



LT CCA P - M

2-

XX

3-

4-



MI 1.2 TIs 0.4 9L

Carotid

FR 33

CHI

- Frq 9.0
- Gn 36
- S/A 2/1
- Map H/0
D 4.5
1- DR 69
- AO% 100

LOGIQ
E9

LEFT SAG CCA PROX



3-
▲▲

4-



MI 1.2 TIs 0.8 9L

Carotid

FR 24

CHI

- Frq 9.0

- Gn 36

- D 4.5

- AO% 100

1- CF

- Frq 3.6

- Gn 19.5

- L/A 0/7

- PRF 11.6

2- WF 847

S/P 5/12

- AO% 100

-

3-

-

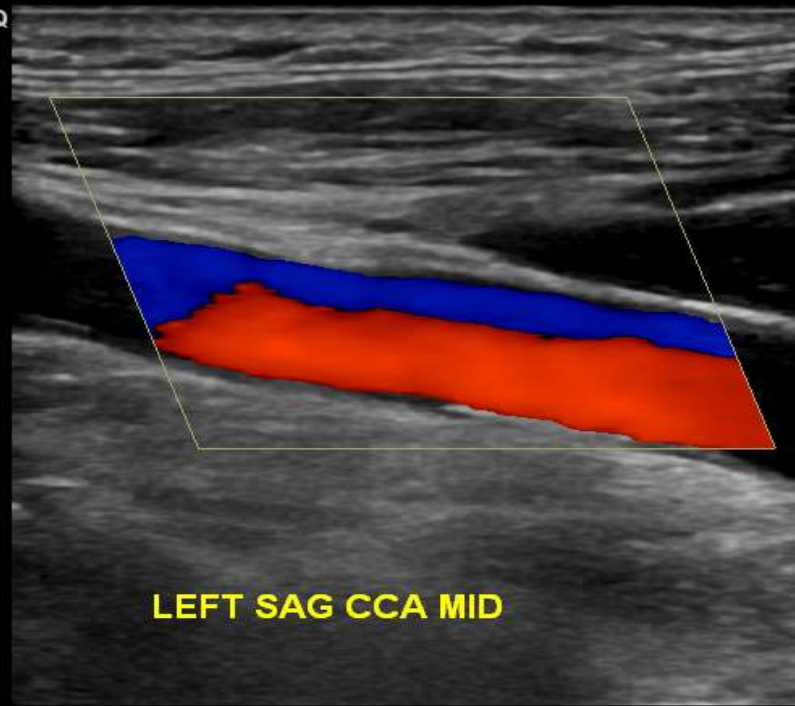
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4-

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LOGIQ
E9



LEFT SAG CCA MID