Sickle Cell Disease Webinar
TCD STOP correlation MR/ MRA

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Objectives

- STOP categories and FU
- STOP velocities and correlation with MR/ MRA
- High velocities extra-cranial ICA and correlation with MR/ MRA
- Interesting case
- Summary

TCD: STOP Categories and FU

STOP: Normal (<170cm/s)

- Annual routine

STOP: Conditional (171-199cm/s)

- Repeat 1 month (age < 10/ 185-199cm/s)
- Repeat 3 months (age >10/ 171-185cm/s)
- MRA if 2 conditional

STOP: Abnormal (>200cm/s)

- Repeat 1-2 weeks
- MRA

STOP velocities
Correlation with MR/ MRA

- Northwest: Royal Manchester Children's Hospital
- TCD Imaging
- Data: April 2020- March 2023

- April 22- March 23: 227 TCDs performed by 2 operators

- Normal 91% (206)
- Conditional 4.4% (10)
- Abnormal 0.88% (2)
- Non-diagnostic 4% (9)

- Low velocity 6% (14)

Conditional TCD correlation MR/ MRA

- Conditional 4.4%
- 10 conditional TCDs in 7 patients

- Repeat TCDs:
- 3 Normal -> Back to routine annual TCD
- 3 Conditional -> MR/ MRA
- 1 Abnormal -> MR/ MRA

Conditional TCD correlation MR/ MRA

Patient 1

- Repeat TCD – Conditional
- MR/ MRA – No abnormality

Patient 2

- Repeat TCD – Conditional
- MR/ MRA – No abnormality

Patient 3

- Repeat TCD – Conditional (Multiple Conditional TCD previously)
- MR - Mild narrowing R TICA and ACA. No infarction.
- FU MR/ MRA in 1 year

Conditional TCD correlation MR/ MRA

Patient 4

- Previous TCD 2021 – STOP Normal
- TCD 2022 – STOP Conditional

- Repeat TCD 1 month – STOP Abnormal
- MR/ MRA Abnormal - ASL Perfusion abnormal + MCA M2 segment stenosis
- NV MDT - Recommend repeat MR 6 months

Conditional TCD: Summary 2020-23

2022-23:

7 Patients Conditional TCD

3 repeat TCD Normal

2 Abnormal MR (28.5%)

2021-22:

4 Patients Conditional TCD

2 Abnormal MR (50%)

2020-21:

3 Patients Conditional TCD

2 repeat TCD Normal

1 patient has MRI: Abnormal MR (33%)

Abnormal TCD correlation MR/MRA

- 2022-23:
- 2 patients (0.88%)
- Both patients (100%) have abnormal MR/ MRA with significant stenosis (COW intracranial)
- NV MDT discussion and FU MR/ MRA

- 2020-22:
- 2 patients TCD STOP Abnormal
- 1 patient abnormality on MR (50%). Repeat TCD Abnormal
- 1 Patient normal MR and CTA (50%). Repeat TCD Normal

Low velocity correlation MR/MRA

April 22- March 23:

- Low velocity < 70cm/s in MCA
- 6% (14 patients)
- 3/14 (21%) abnormality on MR – all silent small infarcts white matter but no vessel stenosis

Low velocity correlation MR/MRA

April 20 - March 22: 2 years

- 35 patients
- 32/35 had MR/ MRA

MR Normal = 23 patients (72%)

MR Abnormality = 9 (28%)

- Silent small infarcts white matter but no stenosis = 5
- Mild stenosis MCA = 2
- Mild stenosis ICA = 1
- Mild stenosis Vertebral A = 1
- However only 2/9 of the abnormality correspond to the same low velocity MCA vascular territory on TCD

Extra-cranial ICA – high velocity

- Linear probe 10 MHz – angle correction
- PSV > 300cm/s

- April 22- March 23: 1 patient – MRA neck and COW normal
- 2021-2022: 0 patient

Case Study: Age 7 girl

2020 TCD: STOP Abnormal (L MCA = 203cm/s)

2020 MR: No infarction. Reduced flow void in L MCA?

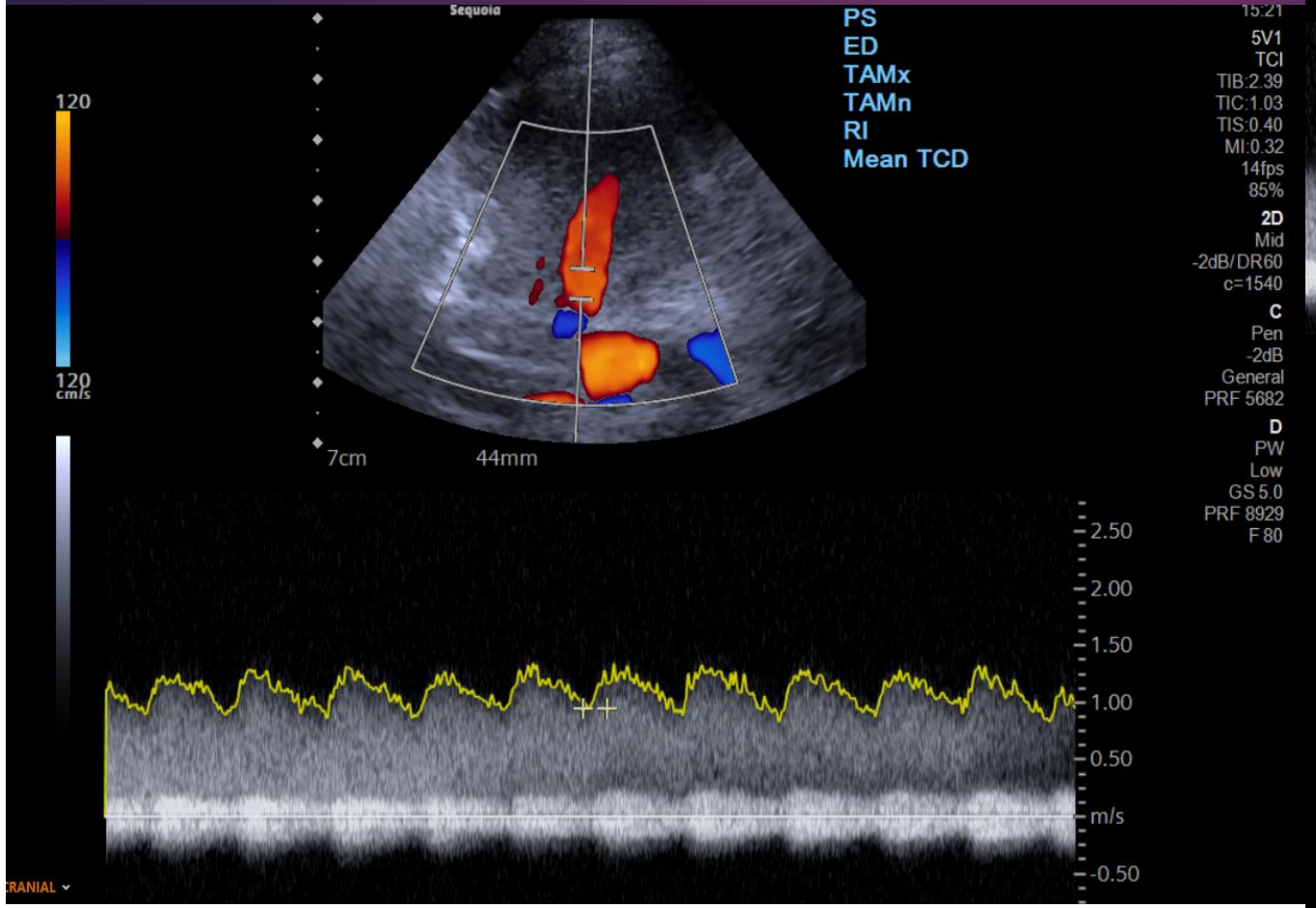
Unable to tolerate MRA/ CTA (Suggested scan under GA)

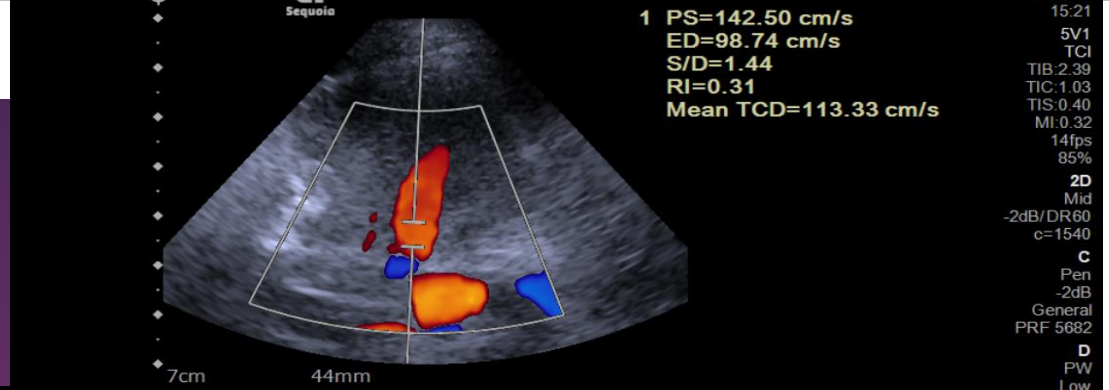
2021 TCD: STOP Normal (L MCA = 120 cm/s)

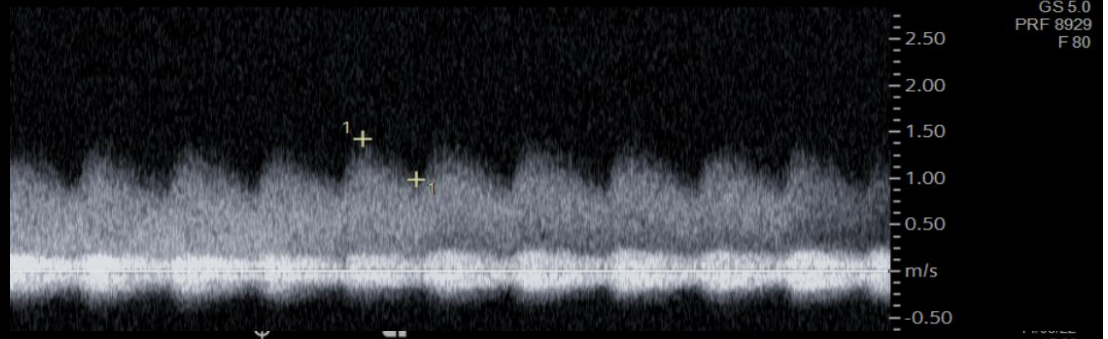
2022 TCD: Routine Out-patient appointment

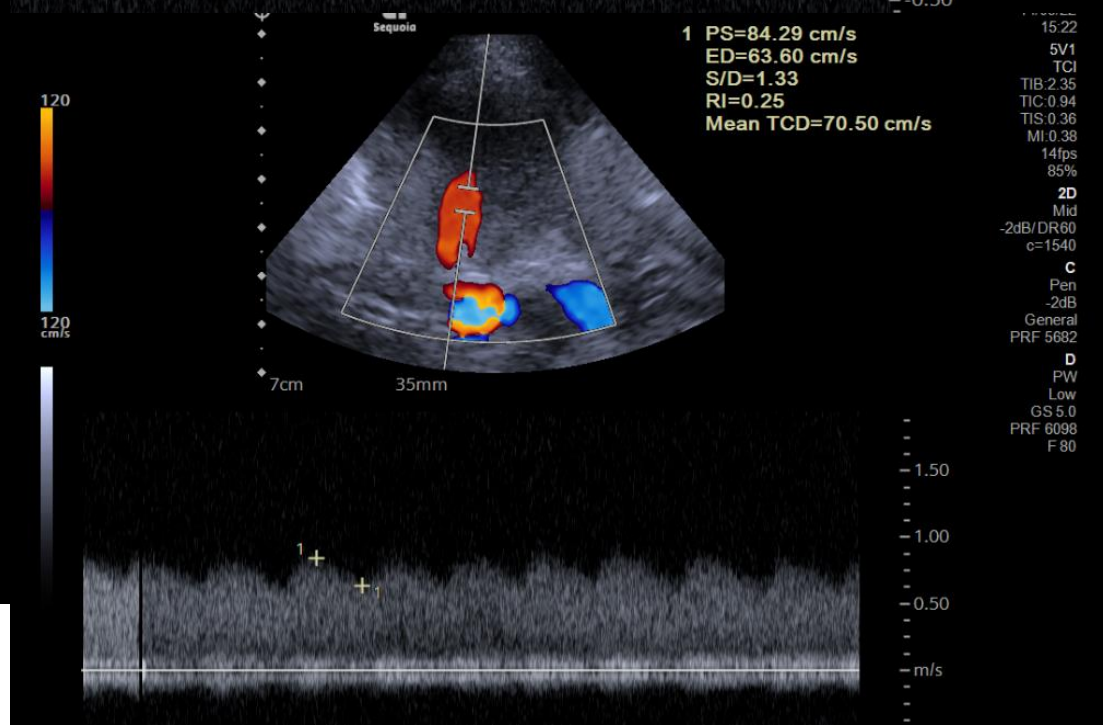
Patient walked into TCD clinic appear well and did not report any symptoms

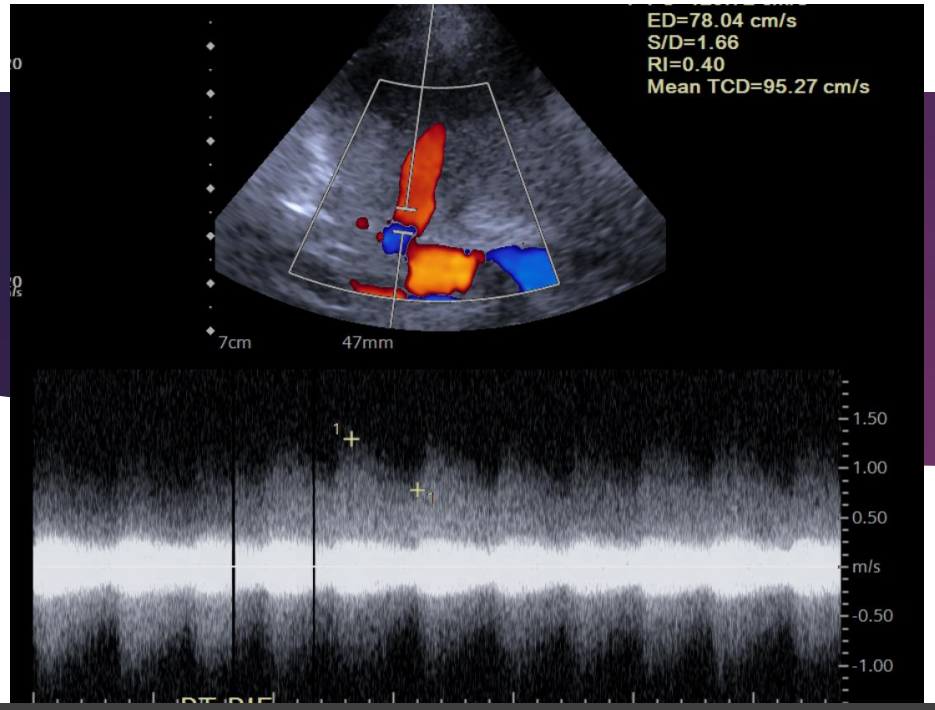
2022 Rt MCA


Sequoia
PS
ED
TAMx
TAMn
RI
Mean TCD
15:21
5V1
TCI
TIB:2.39
TIC:1.03
TIS:0.40
MI:0.32
14fps
85%
2D
Mid
-2dB/DR60
c=1540
C
Pen
-2dB
General
PRF 5682
D
PW
Low
GS 5.0
PRF 8929
F 80
120
120
cm/s
7cm
44mm
2.50
2.00
1.50
1.00
0.50
m/s
-0.50
CRANIAL

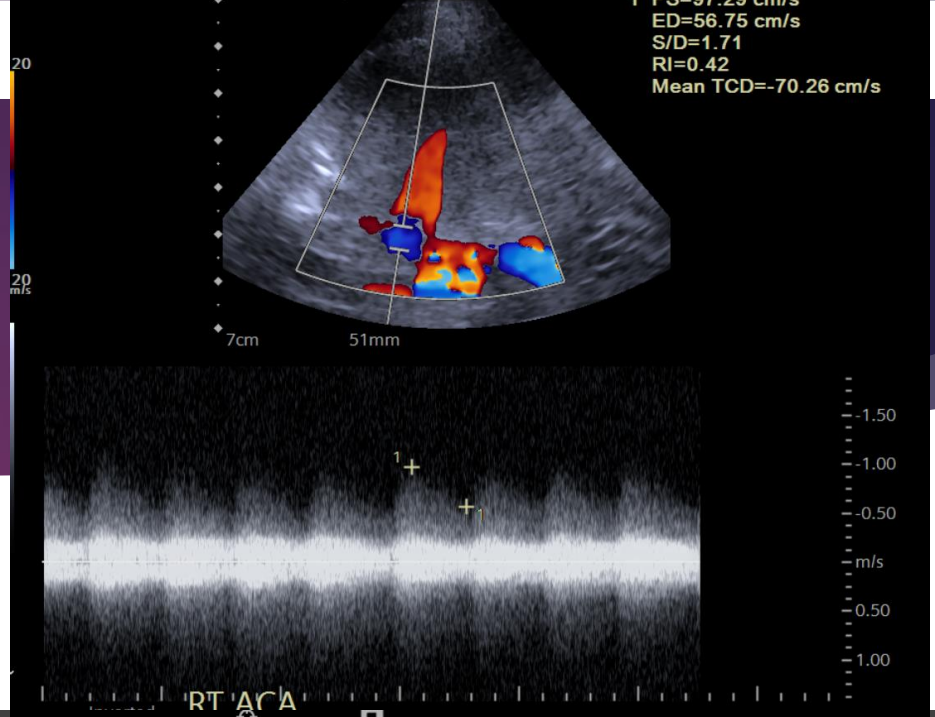

Sequoia
1 PS=142.50 cm/s
ED=98.74 cm/s
S/D=1.44
RI=0.31
Mean TCD=113.33 cm/s
15:21
5V1
TCI
TIB:2.39
TIC:1.03
TIS:0.40
MI:0.32
14fps
85%
2D
Mid
-2dB/DR60
c=1540
C
Pen
-2dB
General
PRF 5682
D
PW
Low
GS 5.0
PRF 8929
F 80
7cm
44mm


2.50
2.00
1.50
1.00
0.50
m/s
-0.50

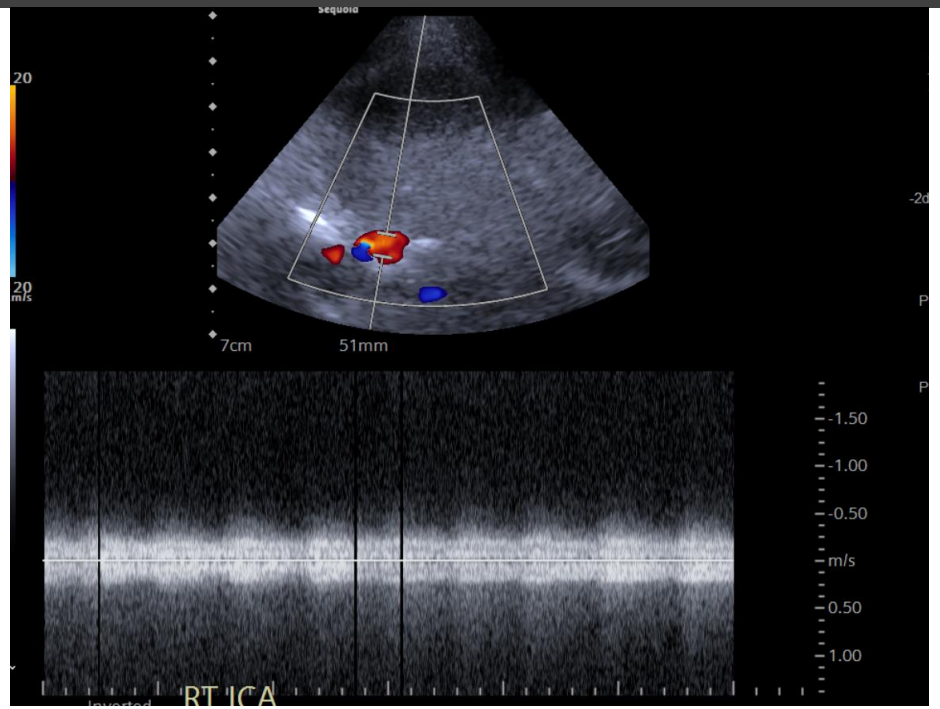

Sequoia
1 PS=84.29 cm/s
ED=63.60 cm/s
S/D=1.33
RI=0.25
Mean TCD=70.50 cm/s
15:22
5V1
TCI
TIB:2.35
TIC:0.94
TIS:0.36
MI:0.38
14fps
85%
2D
Mid
-2dB/DR60
c=1540
C
Pen
-2dB
General
PRF 5682
D
PW
Low
GS 5.0
PRF 6098
F 80
120
120
cm/s
7cm
35mm
1.50
1.00
0.50
m/s



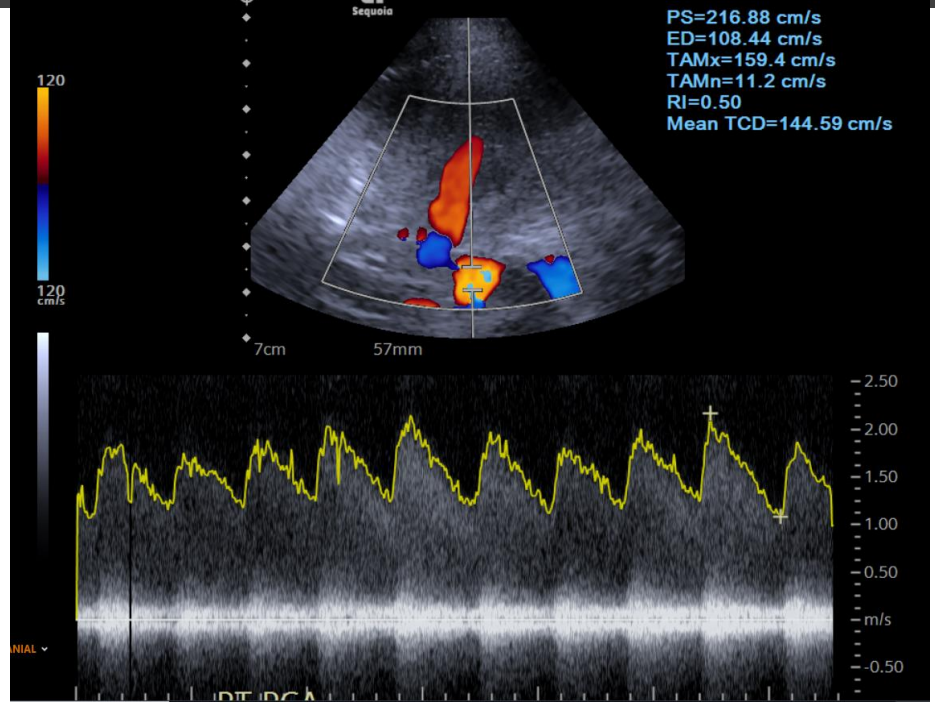
BIF



ACA

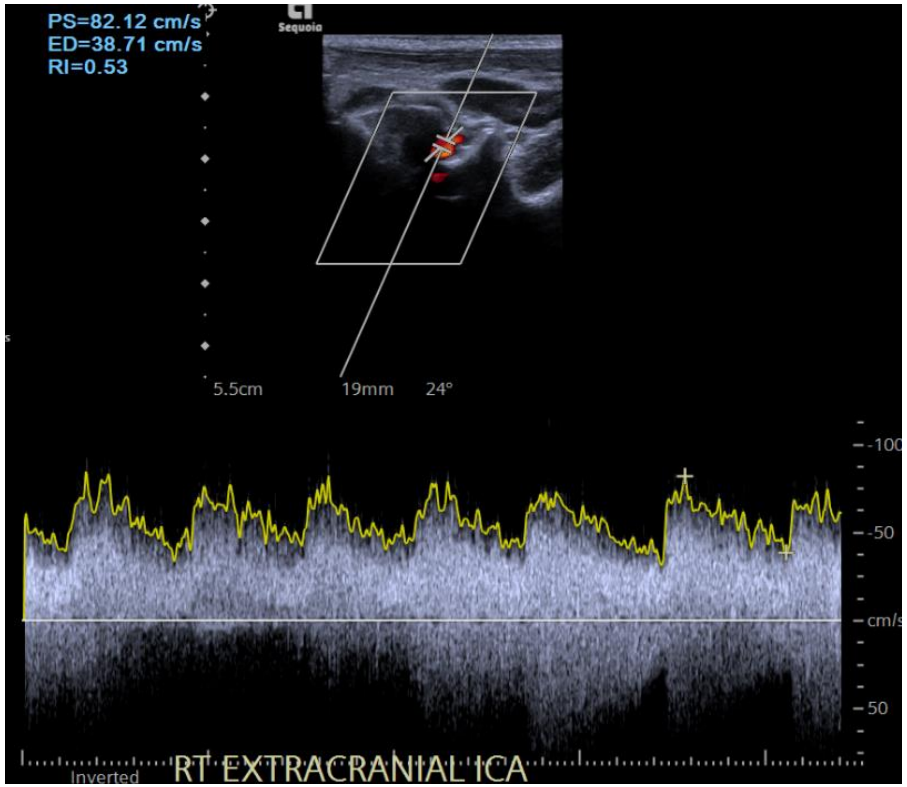


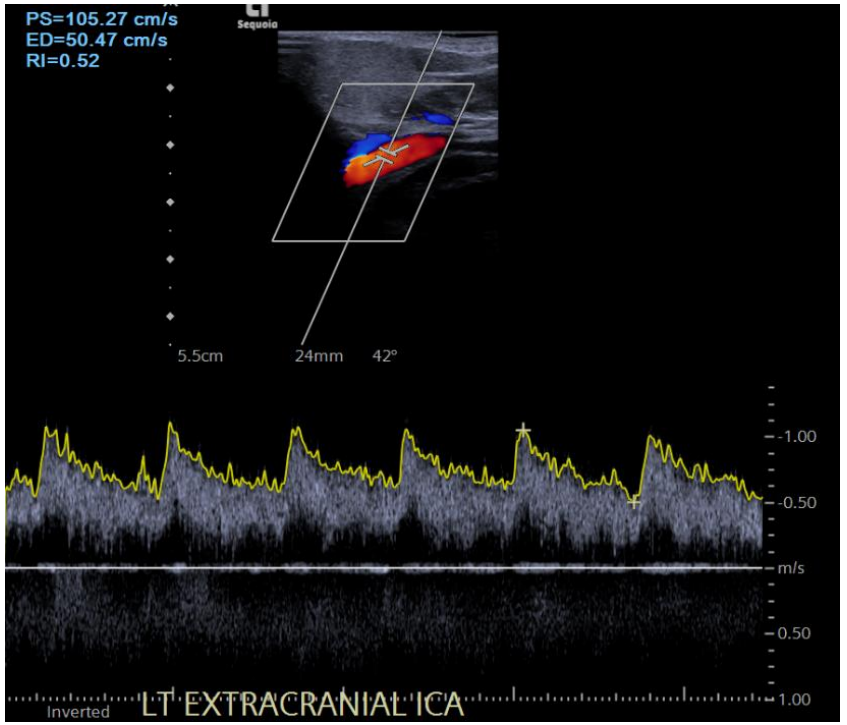
TICA



PCA

2022 Extra-cranial ICA
Rt EC-ICA difficult to see





Lt

2022

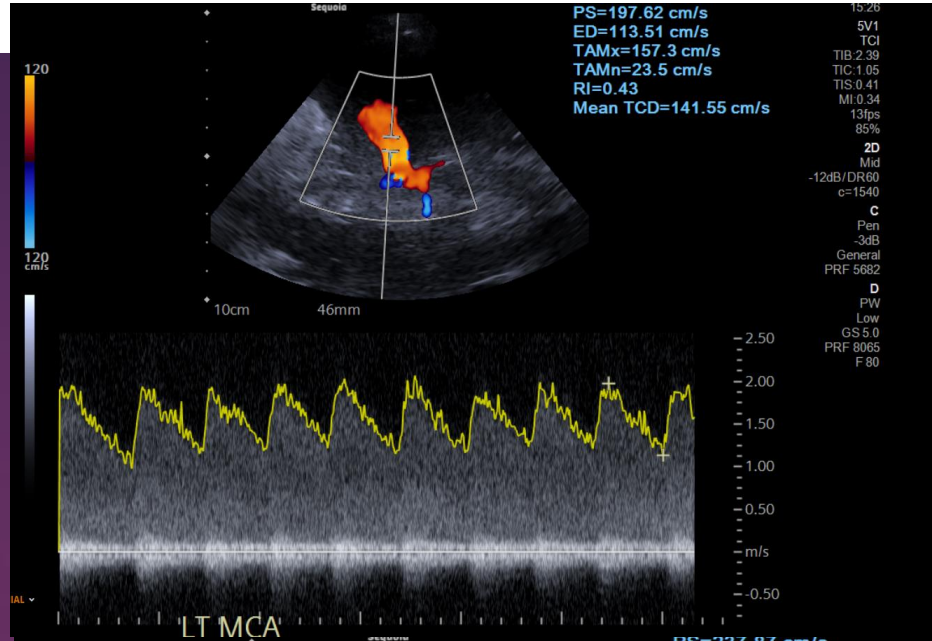
- MCA = 141
- TICA = 76
- **ACA = 191**
- PCA = 101
- **STOP Conditional**

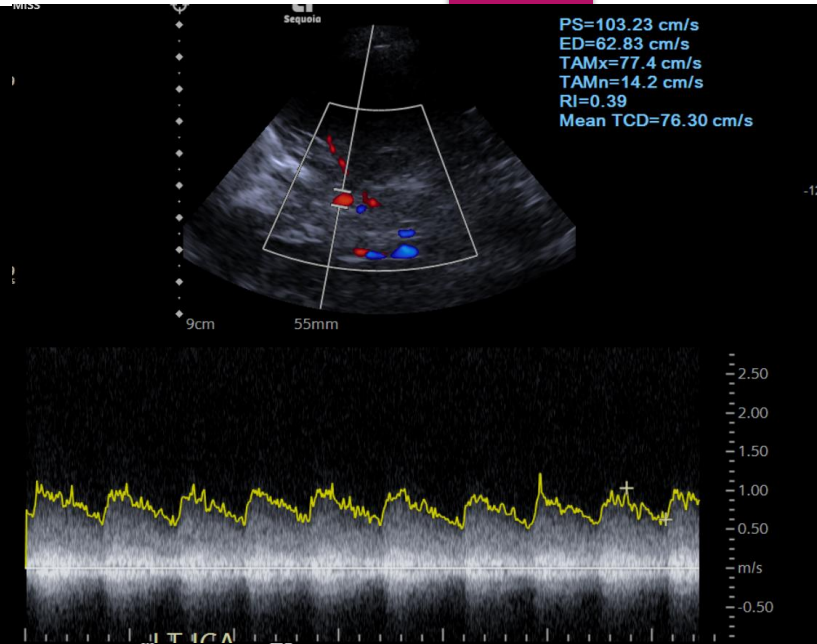
2021

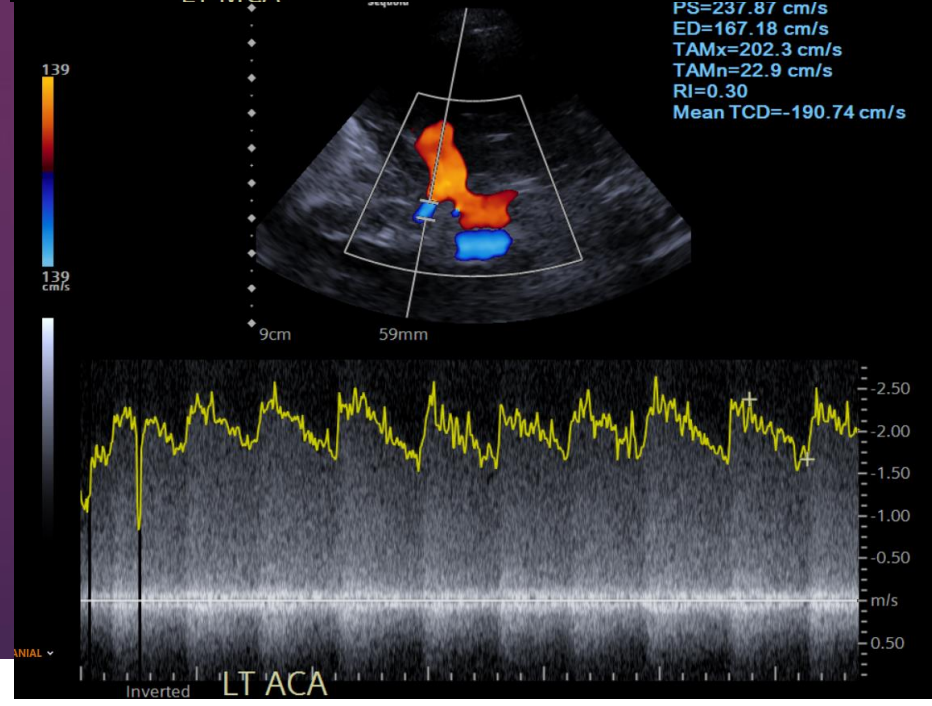
- MCA = 120
- TICA = 101
- ACA = 74
- STOP Normal

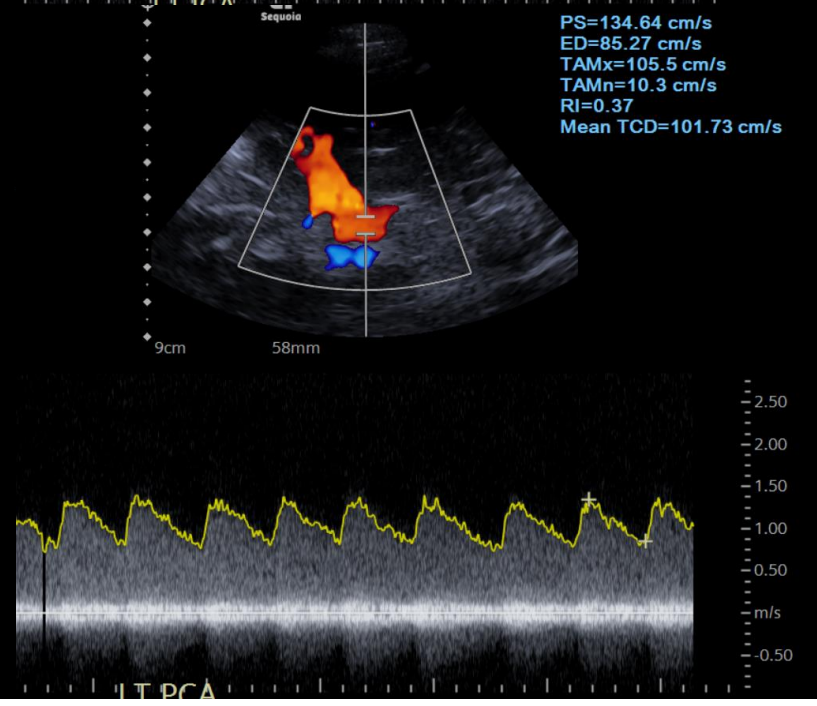
2020

- **MCA = 203**
- **TICA = 112**
- **ACA = 101**
- **STOP Abnormal**



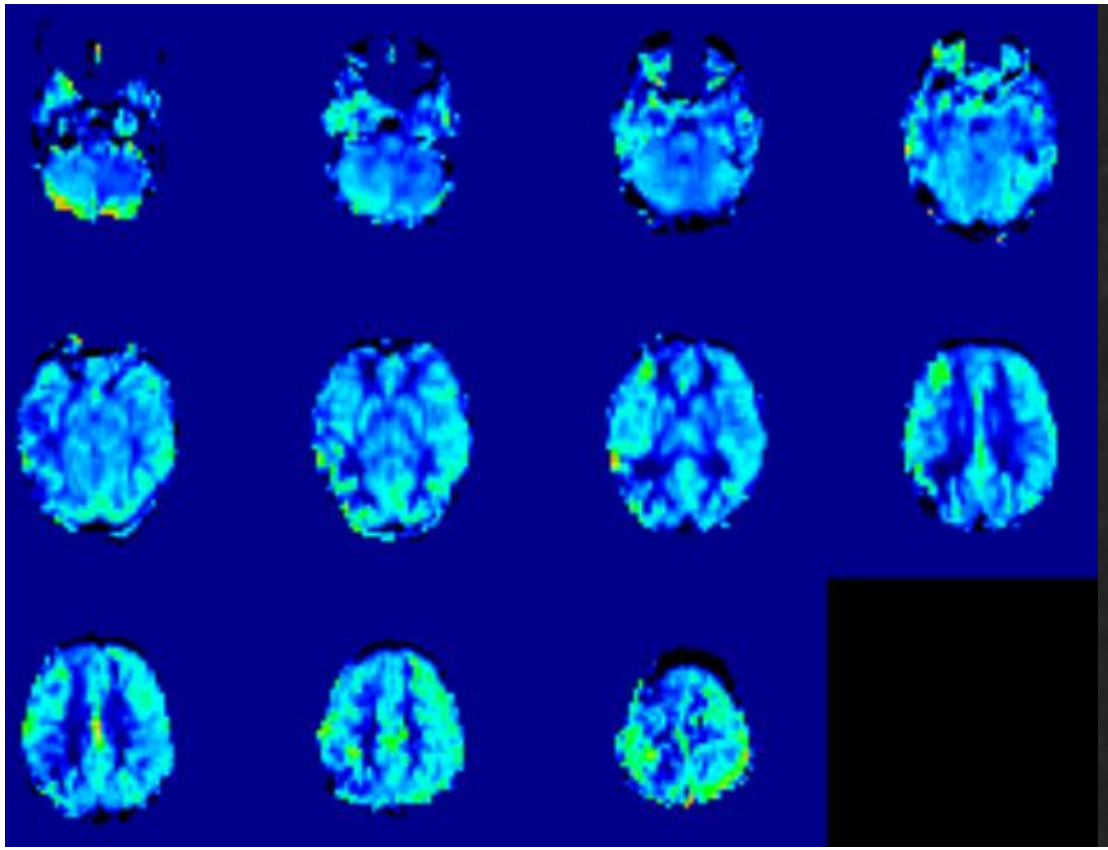


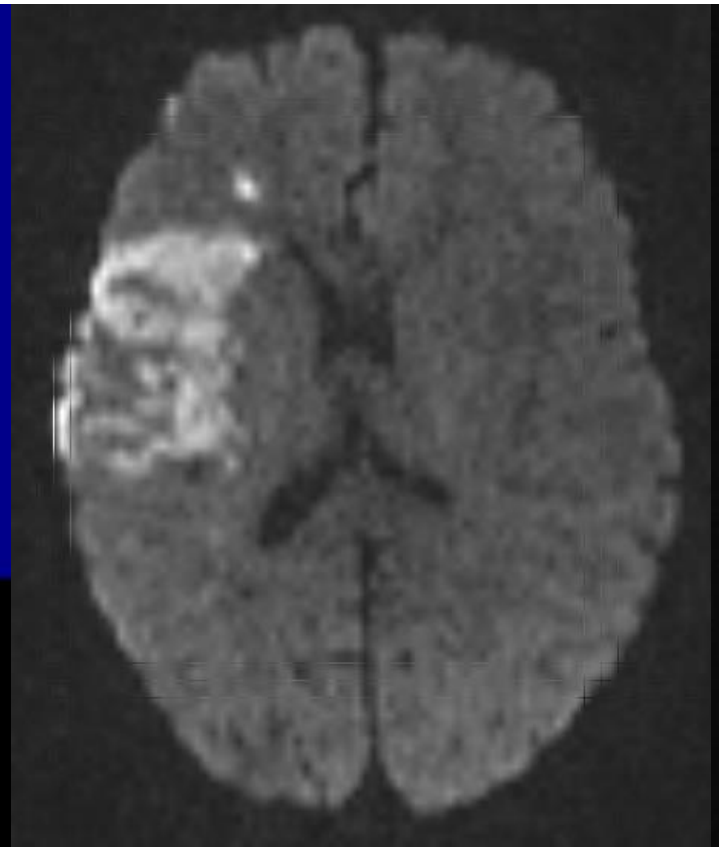


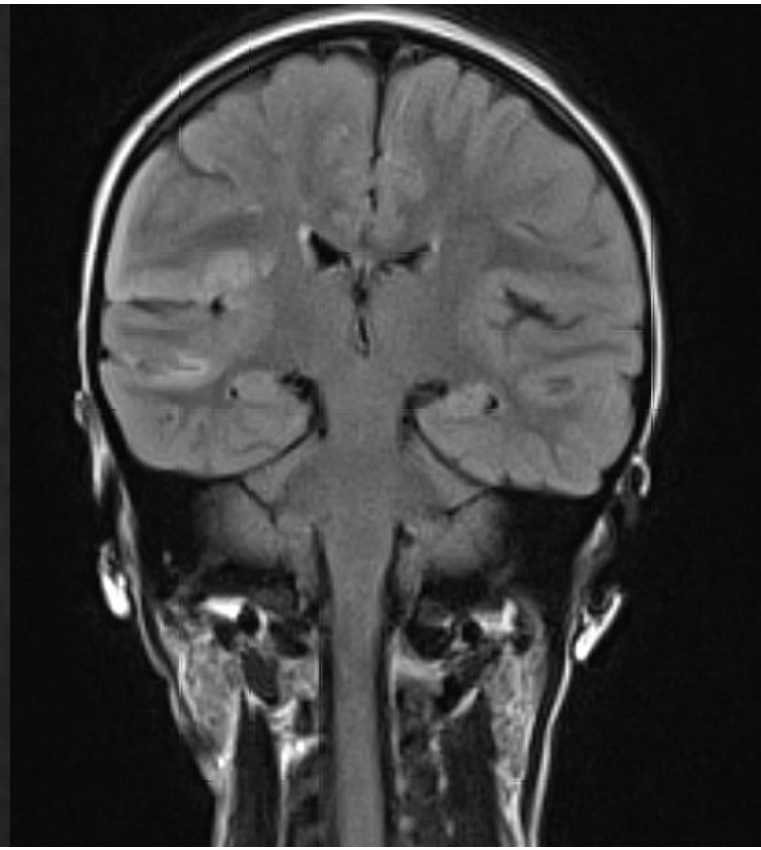


2022
Age 7

MR Same day: Acute infarction R MCA

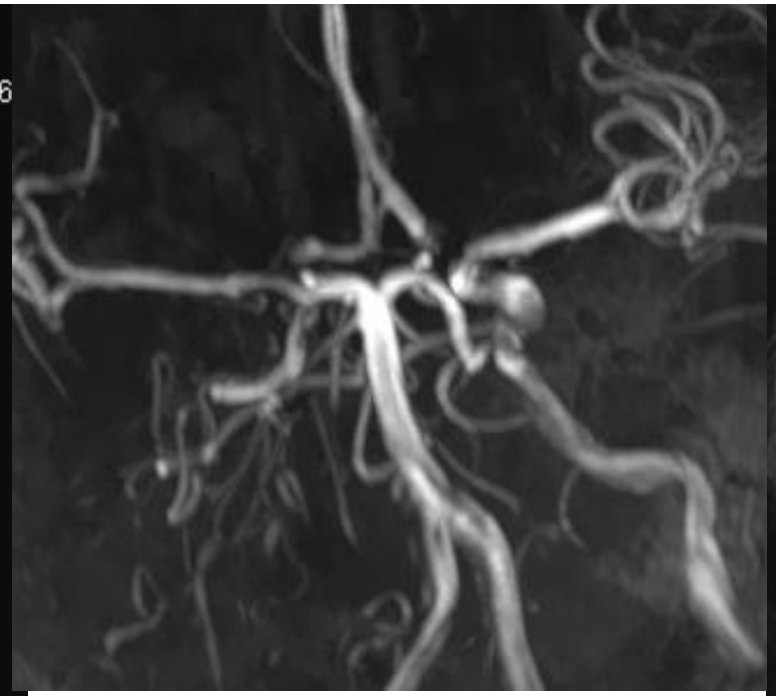


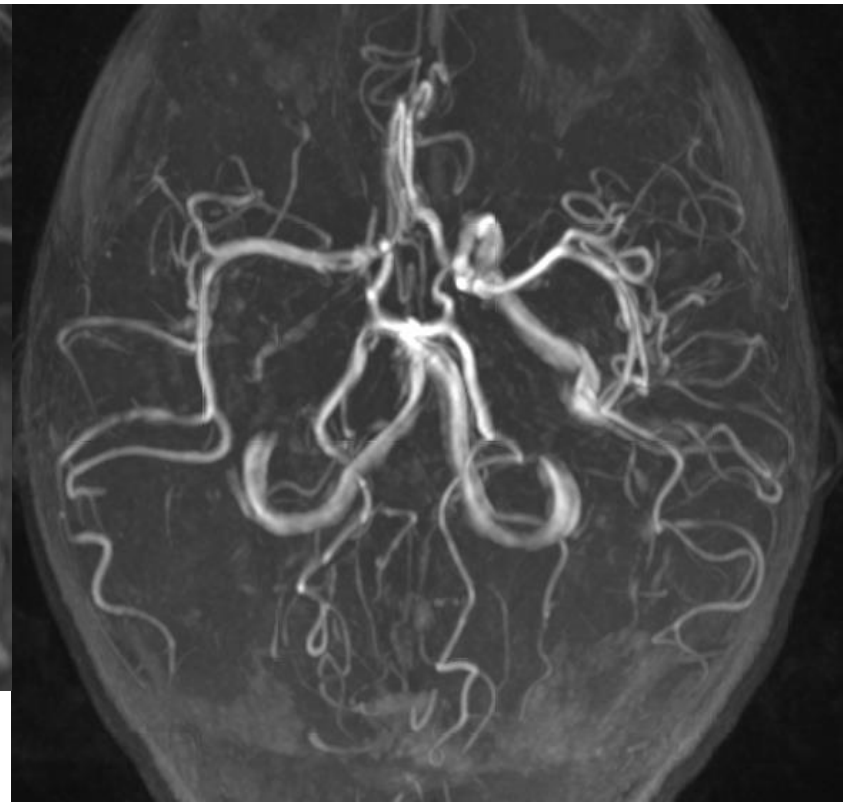


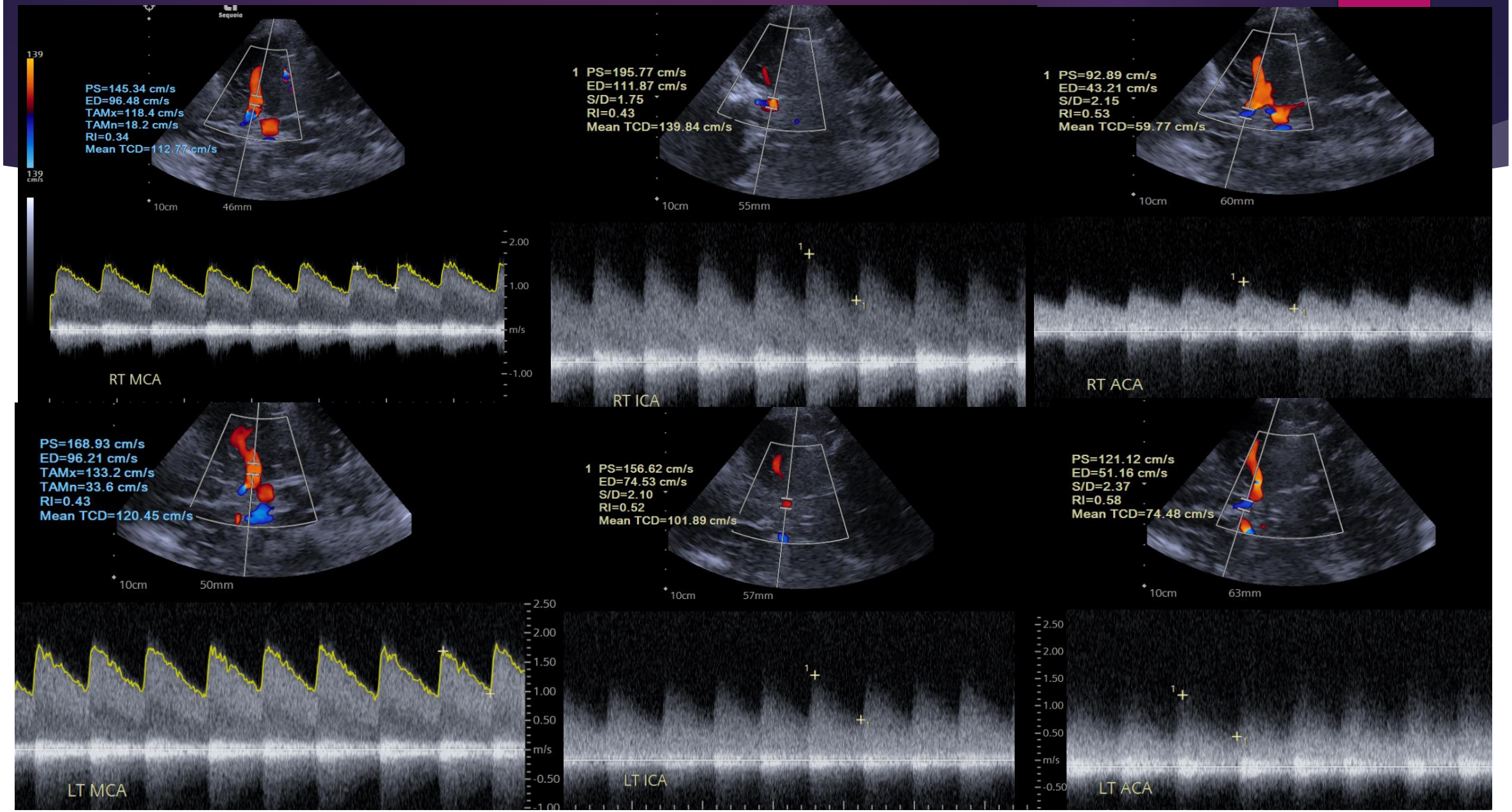


2022
Age 7

MRA: Severe multiple stenosis bilateral
No flow R ICA. R MCA supply by PCA/ pCom






PS=145.34 cm/s
ED=96.48 cm/s
TAMx=118.4 cm/s
TAMn=18.2 cm/s
RI=0.34
Mean TCD=112.77 cm/s
10cm
46mm
RT MCA
1 PS=195.77 cm/s
ED=111.87 cm/s
S/D=1.75
RI=0.43
Mean TCD=139.84 cm/s
10cm
55mm
RT ICA
1 PS=92.89 cm/s
ED=43.21 cm/s
S/D=2.15
RI=0.53
Mean TCD=59.77 cm/s
10cm
60mm
RT ACA
PS=168.93 cm/s
ED=96.21 cm/s
TAMx=133.2 cm/s
TAMn=33.6 cm/s
RI=0.43
Mean TCD=120.45 cm/s
10cm
50mm
LT MCA
1 PS=156.62 cm/s
ED=74.53 cm/s
S/D=2.10
RI=0.52
Mean TCD=101.89 cm/s
10cm
57mm
LT ICA
PS=121.12 cm/s
ED=51.16 cm/s
S/D=2.37
RI=0.58
Mean TCD=74.48 cm/s
10cm
63mm
LT ACA
m/s

Right

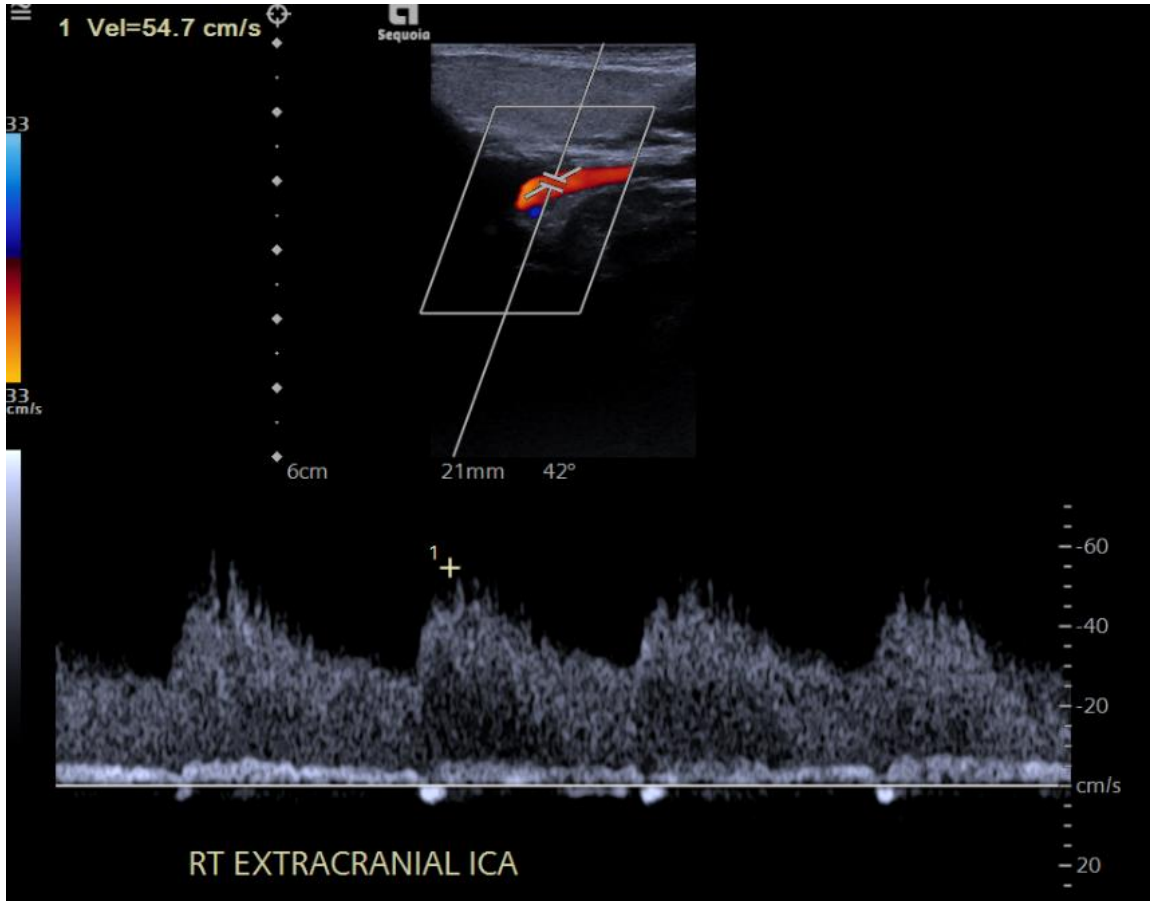
- 2022
- MCA = 113 Abnormal waveform
- TICA = Unmeasurable Abnormal waveform
- ACA = 70

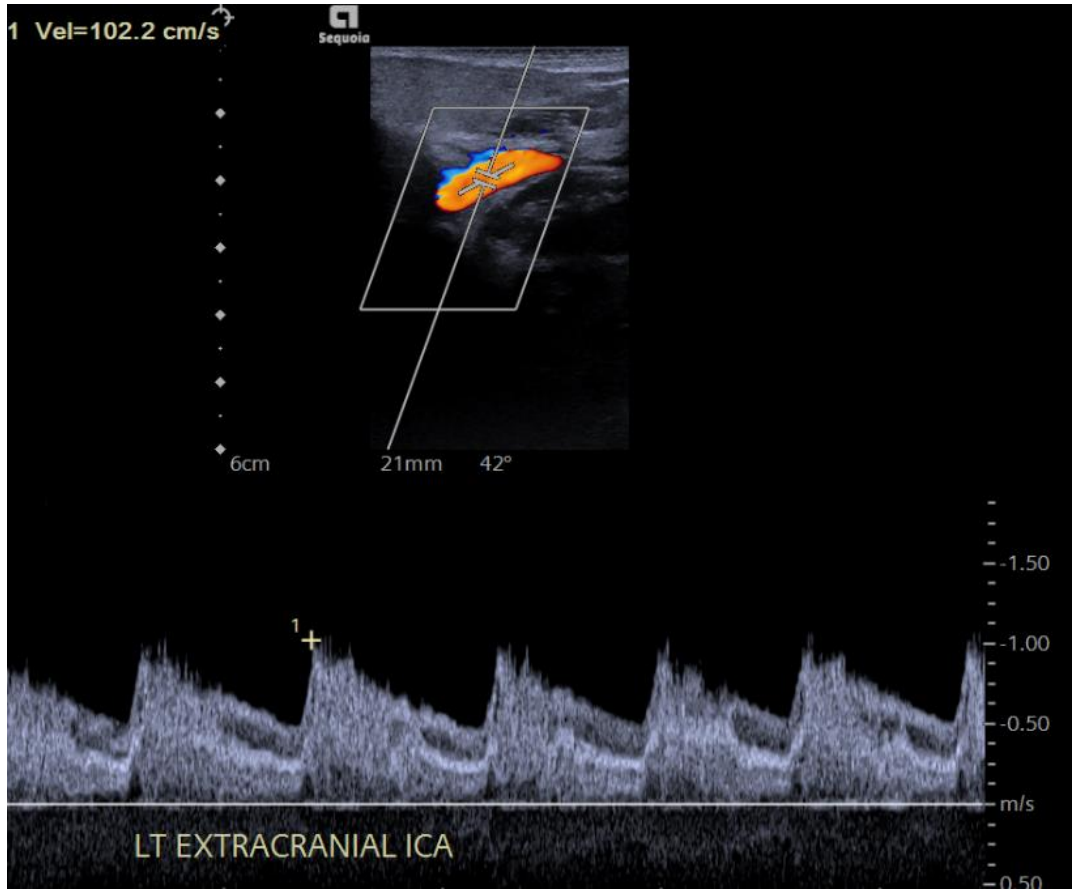
- 2021
- MCA = 112
- TICA = 139
- ACA = 59 *

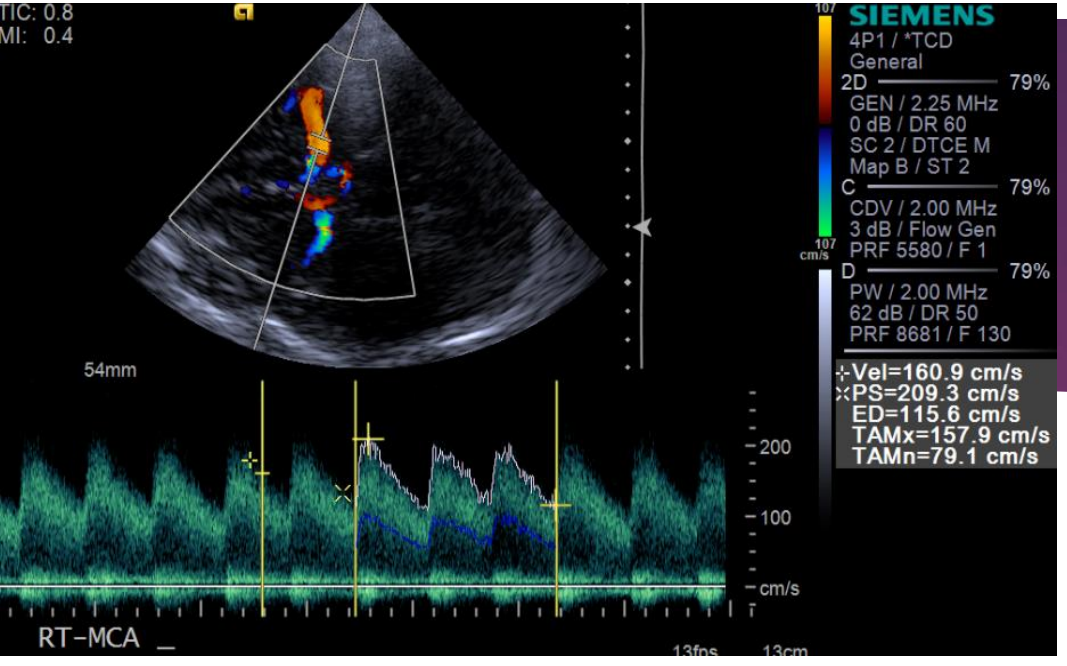
Low velocity and significantly lower than 2020

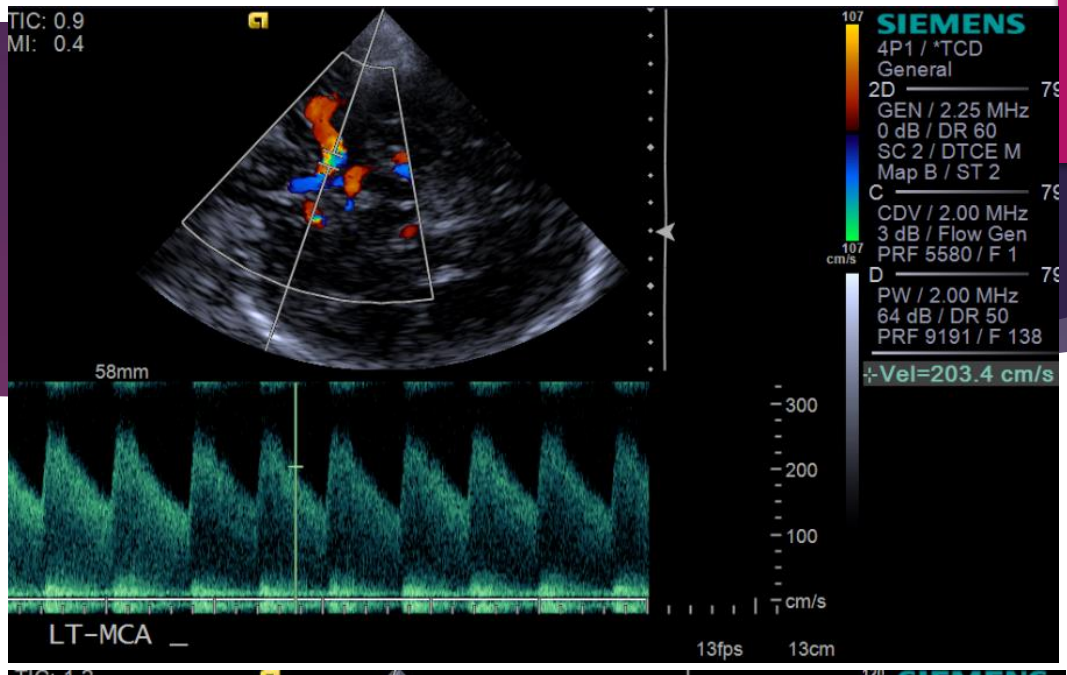
- 2020
- MCA = 157
- TICA= 167
- ACA = 154 *

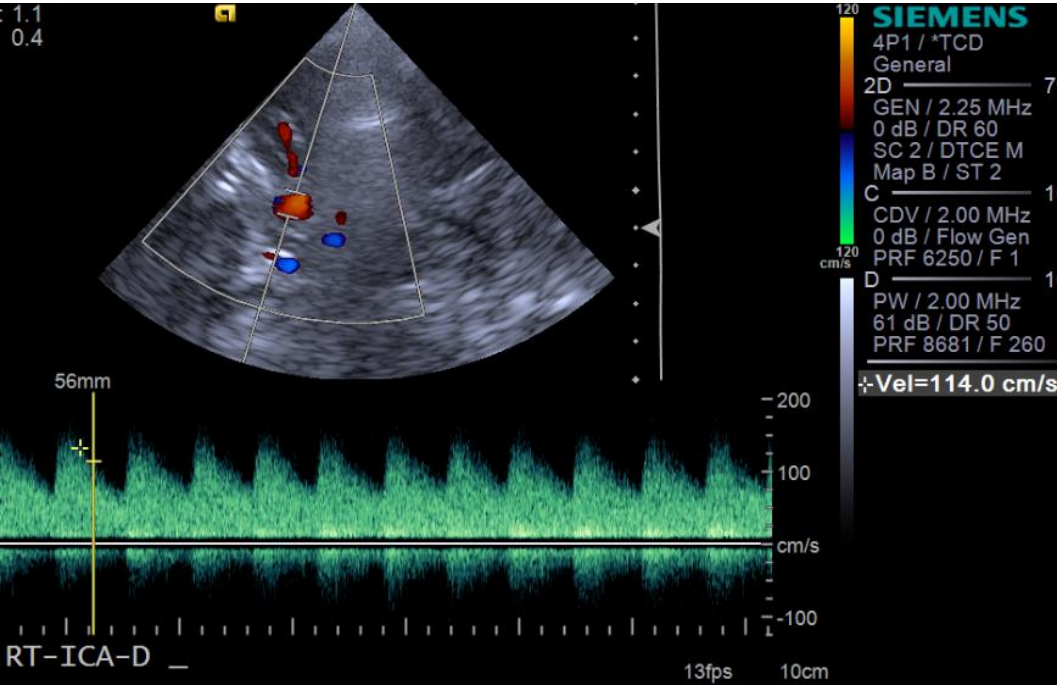
Extra-cranial ICA
Rt asymmetry low velocity

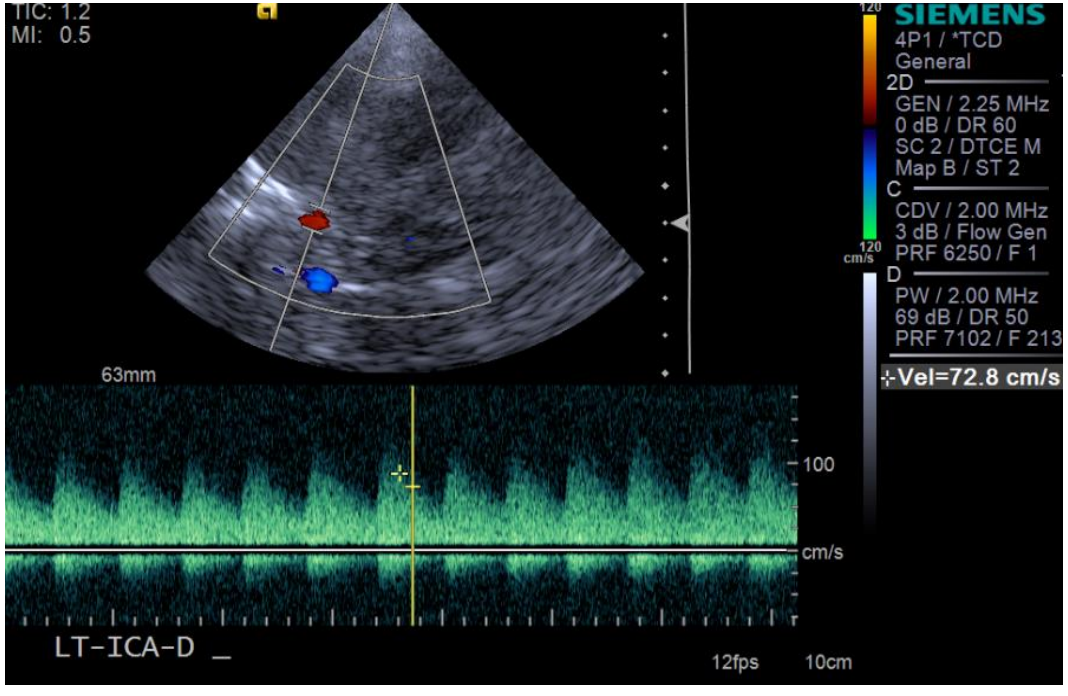





TIC: 0.8
MI: 0.4
SIEMENS
4P1 / *TCD
General
2D 79%
GEN / 2.25 MHz
0 dB / DR 60
SC 2 / DTCE M
Map B / ST 2
C 79%
CDV / 2.00 MHz
3 dB / Flow Gen
PRF 5580 / F 1
D 79%
PW / 2.00 MHz
62 dB / DR 50
PRF 8681 / F 130
Vel=160.9 cm/s
PS=209.3 cm/s
ED=115.6 cm/s
TAMx=157.9 cm/s
TAMn=79.1 cm/s
54mm
200
100
cm/s
RT-MCA
13fps
13cm


TIC: 0.9
MI: 0.4
SIEMENS
4P1 / *TCD
General
2D
GEN / 2.25 MHz
0 dB / DR 60
SC 2 / DTCE M
Map B / ST 2
C
CDV / 2.00 MHz
3 dB / Flow Gen
PRF 5580 / F 1
D
PW / 2.00 MHz
64 dB / DR 50
PRF 9191 / F 138
Vel=203.4 cm/s
58mm
300
200
100
cm/s
LT-MCA
13fps
13cm

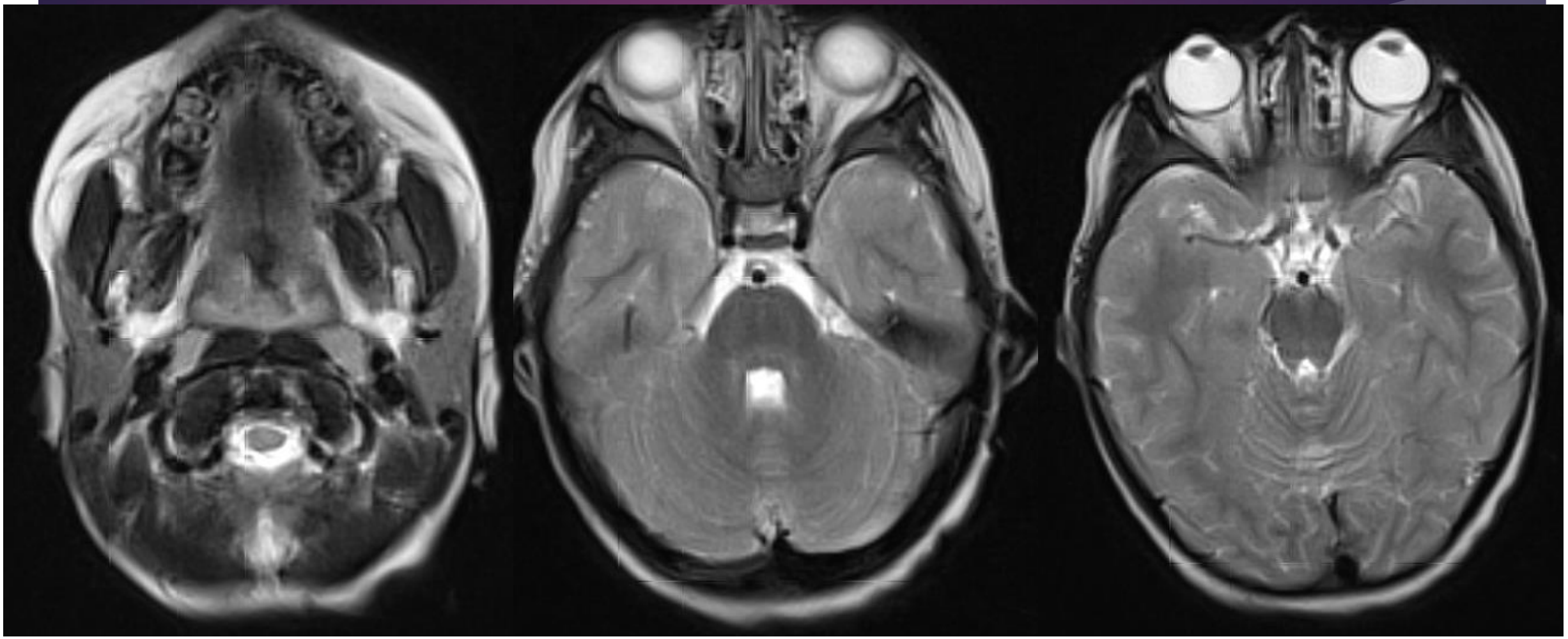

SIEMENS
4P1 / *TCD
General
2D
GEN / 2.25 MHz
0 dB / DR 60
SC 2 / DTCE M
Map B / ST 2
C
CDV / 2.00 MHz
0 dB / Flow Gen
PRF 6250 / F 1
D
PW / 2.00 MHz
61 dB / DR 50
PRF 8681 / F 260
Vel=114.0 cm/s
56mm
200
100
cm/s
-100
RT-ICA-D
13fps
10cm


TIC: 1.2
MI: 0.5
SIEMENS
4P1 / *TCD
General
2D
GEN / 2.25 MHz
0 dB / DR 60
SC 2 / DTCE M
Map B / ST 2
C
CDV / 2.00 MHz
3 dB / Flow Gen
PRF 6250 / F 1
D
PW / 2.00 MHz
69 dB / DR 50
PRF 7102 / F 213
Vel=72.8 cm/s
63mm
100
cm/s
LT-ICA-D
12fps
10cm

2020

Age 5

MR: Not co-operaed for MRA
No definite abnormality
L MCA flow void reduce?



Case Summary: Age 7 girl

2020 TCD: STOP Abnormal (L MCA = 203cm/s)

2020 MR: No infarction. Reduced flow void in L MCA? Unable to tolerate MRA/ CTA (Need GA)

2021 TCD: STOP Normal (L MCA = 120 cm/s)

2022 TCD: Routine Out-patient appointment

R MCA TICA Abnormal waveform, but velocity < 170cm/s

L ACA 190cm/s STOP Conditional

MR immediately - Acute infarct and severe ICA, MCA, ACA stenosis (R > L)

Patient walked into TCD clinic and did not report any symptoms

Very subtle neurological symptoms : slightly more clumsy and very mild weakness on examination

Management

- Urgent Exchange Transfusion
- Aspirin

- Neurovascular opinion:
- Close monitor MR/ MRA: 3 months then 6 months : Stable
- May need pia synangiosis re-vascularisation surgery if progression

Summary: 2020-2023

- STOP Abnormal: 3/4 patients -> significant abnormality and stenosis on MR/ MRA (75%) – Role of MR -> Yes
- STOP Conditional: 5/14 patients -> abnormalities and stenosis on MR/MRA (36%) – Role of MR -> Yes if 2 conditional TCD
- Low Velocity: 12/49 patients -> minor abnormalities on MR/ MRA (24%) – Role of MR -> Possibly Yes
- No Control: We do not know prevalence of silent infarction and mild non-progressive vessel narrowing in STOP Normal patients

- Abnormal/ Conditional/ Low velocity -> if all have MR/ MRA
- Approximately 20 patients/ year (8-10% TCD patients in our HCC)

- EC-ICA: 1 patient - high velocity (PSV > 300cm/s) -> MR/MRA Normal
- EC-ICA: 1 patient - low velocity < 70cm/s asymmetry and difficult to see -> MRA almost no flow in entire ICA
- Very low yield

- Interesting case: learning point: TAMMV < 170cm/s but waveform looks abnormal and unmeasurable by auto-trace

- Not shown here, but we had 4 cases of vasculopathy rapid progression over 12-24 months requiring re-vascularisation surgery

TCD correlation with MR/ MRA Any Questions?

- Single center 3 years experience > 650 TCDs
- Need more data from other centers required to see if results are similar
- NHR Register can be start of data collection and further research