Clinical interpretation of inadequate TCD

Dr Banu Kaya

Barts Health NHS Trust

Risk assessment and inadequate TCD

- TCD scanning required to assign risk status to guide further management
- However inadequate status means risk isn’t easy to determine and can lead to clinician and parental/patient anxiety
- Risk assessment requires consideration of serial TCD results, patient factors and other investigations like MR imaging

Definition of inadequate

National QA SOP definition:

- NON-DIAGNOSTIC – Velocity not measurable due to patient compliance or poor imaging window. Repeat scan if poor compliance.
- INADEQUATE – A study that does not provide readings from right and left MCA/dICA/ACA would be classified as inadequate however, if one vessel is clearly abnormal this scan should be classified as INADEQUATE but ABNORMAL.

2016 TCD standards definition:

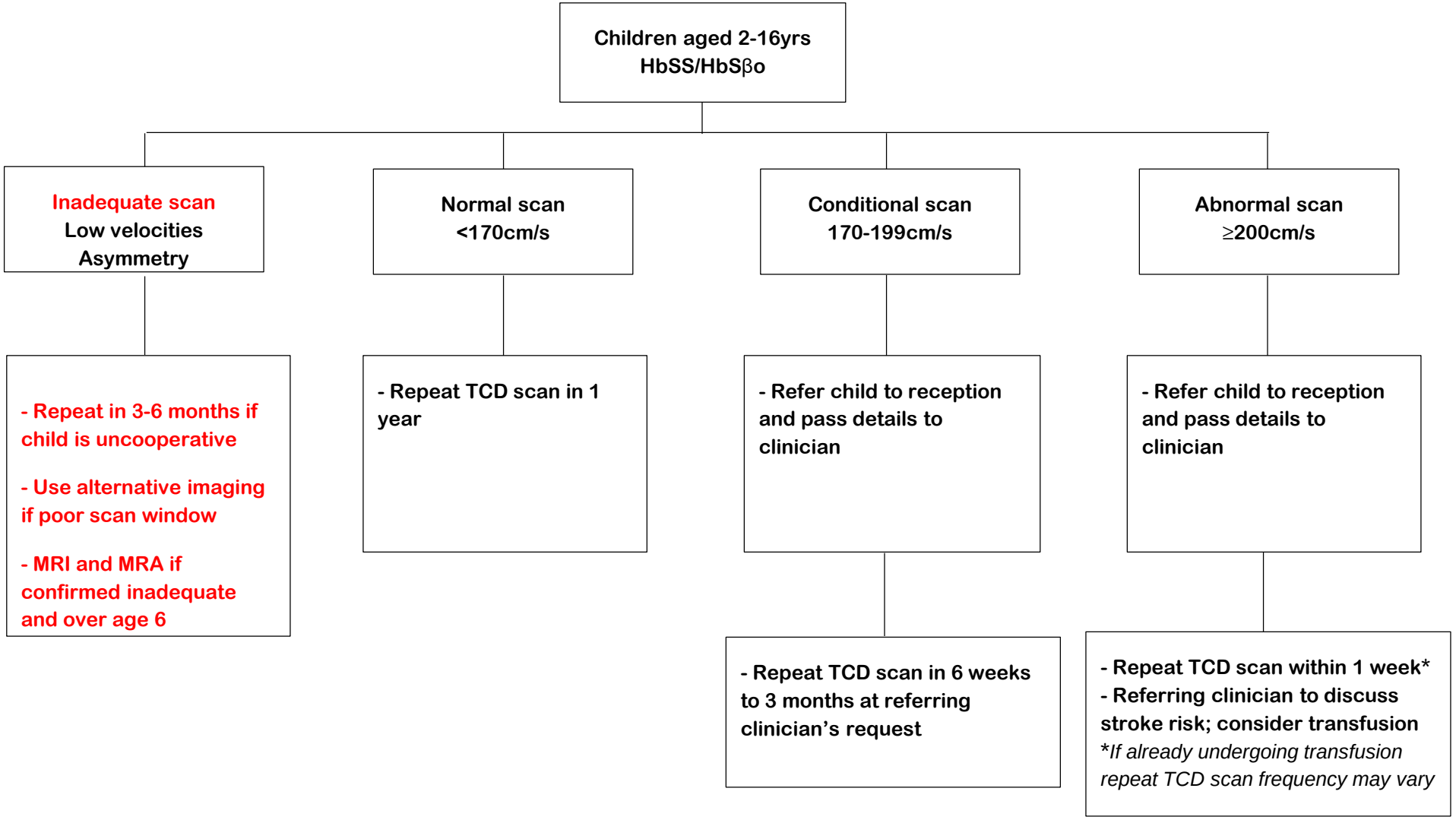
- Incomplete images and measurements from dICA, MCA, ACA or PCA bilaterally

Challenges

- Reduced patient compliance
- Poor temporal window in skull
- Aberrant anatomy of vasculature in circle of Willis
- Rarely severe cerebrovascular disease

- Failure to identify all vessels

Barts Health TCD Scanning Decision Tree



Velocities are the time-averaged maximum mean (TAMMV) measured by non-imaging or imaging TCD. *Velocity thresholds apply to the MCA, distal ICA, bifurcation and ACA.*

Barts Health Data

Year	No of scans	Abnormal	Conditional	Inadequate	Standard Risk
2018	200	6	21	19	152
2019	378	10	47	23	298
2020	314	9	39	8	257
2021	316	4	47	17	248
2022	303	3	28	17	257
2023	94	1	9	8	78
Total	1605	33	191	92	1290

No children with 1 or more inadequate TCD results developed stroke

NHS NUMBER	(All)

Count of CVA risk assessment	Column Labels			
Row Labels	Imaging	Non-Imaging	Grand Total	% of scans
2018		**91**	**248**	**339**
Abnormal		5	5	10
Conditional		13	35	48
Inadequate		10	15	25
Low or asymmetric velocity			3	3
Standard risk		63	190	253
2019		**130**	**235**	**365**
Abnormal		3	7	10
Conditional		6	29	35
Inadequate		6	17	23
Standard risk		115	182	297
2020		**125**	**189**	**314**
Abnormal		2	9	11
Conditional		11	32	43
Inadequate		3	5	8
Low or asymmetric velocity			1	1
Standard risk		109	142	251
2021		**108**	**208**	**316**
Abnormal		1	3	4
Conditional		12	35	47
Inadequate		6	11	17
Standard risk		89	159	248
2022		**113**	**190**	**303**
Abnormal			3	3
Conditional		10	16	26
Inadequate		4	13	17
Standard risk		99	158	257
2023		**31**	**63**	**94**
Abnormal			1	1
Conditional		2	7	9
Inadequate		3	5	8
Standard risk		26	50	76
Grand Total		**598**	**1133**	**1731**

Imaging		Non-Imaging	
Age < 6	Age 6 >	Age <6	Age 6>
4	1	1	4
5	5	8	7
1	2	4	3
2	4	7	10
2	0	7	2
0	4	1	4
1	0	2	1
1	3	5	8
0	0	0	3
1	3	5	8
0	0	0	1
2	1	2	3
19	**23**	**42**	**54**

Barts Health Data (2018-2023)

- Total 1731 scans
- 1133 non imaging, 598 imaging
- 92 non imaging (0.2%)
- Patients < 6 years old
  - Non imaging 2.5%, imaging 1.8%
- Patients > 6 years old
  - Non imaging 3.5%, imaging 3.3%

Case 1 – Inadequate older child

- Standard risk up until age 12 (2020)
- MRI / A head / neck 2019 – no cerebral ischaemia, no vasculopathy
- Annual TCD imaging recommended:
- 2020 non imaging - inadequate
- 2021 non imaging - inadequate
- 2022 Imaging -inadequate
- Surveillance MR imaging 2022 - no cerebral ischaemia, no vasculopathy
- Commenced hydroxycarbamide for recurrent VOC pain 2022

Case 2 – inadequate younger child

- 2020 First scan age 2 – imaging technique- reported non diagnostic – patient unable to comply
- 2nd scan delayed 2022 – reported inadequate:

MCA velocities within standard risk category but dICA / ACA velocities not obtained

- 3rd scan repeated 7 months later –reported inadequate- imaging technique:

R MCA and tICA velocities only (in standard risk category)

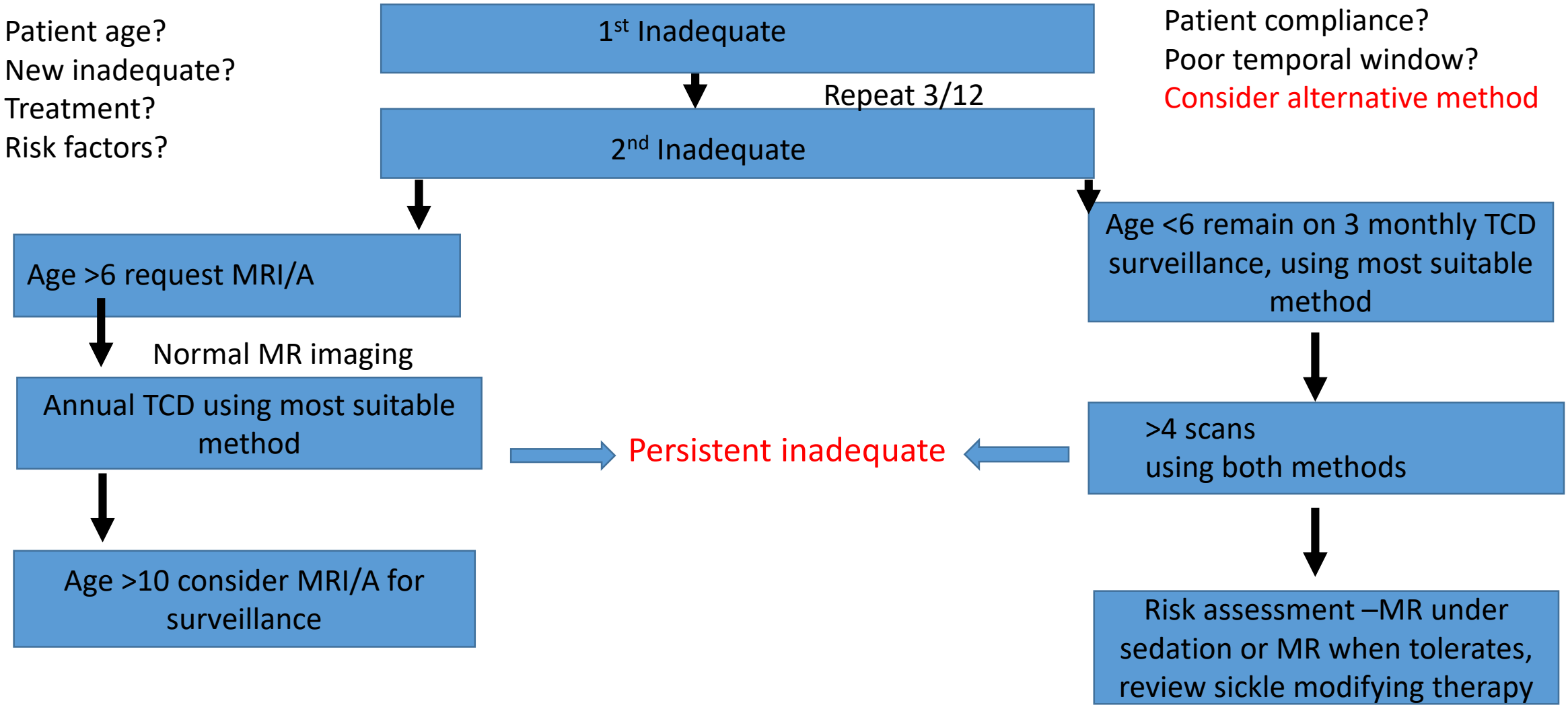
- 4th scan now age 4 –non imaging technique

Good compliance but no velocities obtained – reported inadequate

- Currently not on sickle modifying treatments
- Discussed MR imaging under sedation

Case 3 – young child, ‘non diagnostic’

- 24/05/2017 Inadequate Imaging – patient distressed
- 08/08/2018 Inadequate Imaging – patient distressed
- 08/05/2019 SR on HC Imaging
- 22/09/2020 SR on HC Non-Imaging
- 26/01/2022 SR on HC Imaging


Patient age?
New inadequate?
Treatment?
Risk factors?
1st Inadequate
Repeat 3/12
2nd Inadequate
Patient compliance?
Poor temporal window?
Consider alternative method
Age >6 request MRI/A
Normal MR imaging
Annual TCD using most suitable method
Age >10 consider MRI/A for surveillance
Persistent inadequate
Age <6 remain on 3 monthly TCD surveillance, using most suitable method
>4 scans
using both methods
Risk assessment –MR under sedation or MR when tolerates, review sickle modifying therapy

Comments

- In our practice and reported literature inadequate scans are not associated with an increase risk of stroke
- Prevalence with imaging and non imaging methods similar in children >age 6, imaging lower rates <age 6
- Timeliness and practicalities of repeat scans (3 monthly) can be challenging for services and families
- MR surveillance frequencies undetermined
- Annual TCD scanning in older children with persistent inadequate scans who are on optimised sickle modifying therapies and normal MR imaging may be unnecessary

Discussion points – inadequate scans

- Persistent inadequate in older children adequately treated with sickle modifying therapy with normal MR imaging – what should you use for surveillance if any?
- Young children unable to tolerate TCD scan ‘non diagnostic’ –what are the thresholds for repeat scanning and surveillance with MR imaging?
- NHR reporting and terminology – utility of ‘non diagnostic’ vs inadequate
- Definition of inadequate – should this apply if adequate imaging of MCA bilaterally even if other vessels unmeasured?
- Consider preferential imaging method in young children for 1st scan?