

# Right-to-Left Shunt Detection Using Transforaminal Insonation of the Basilar Artery

Nikita Chhabra DO<sup>1</sup>, Gyanendra Kumar MD<sup>1,2</sup>, Jennifer Fruin RVS<sup>2</sup>, Oana M Dumitrascu MD, MSc<sup>1,2</sup>  
 Department of <sup>1</sup>Neurology and <sup>2</sup>Neurovascular Ultrasound Laboratory, at Mayo Clinic College of Medicine and Science, Scottsdale, AZ

## OBJECTIVES

To assess the accuracy of transforaminal insonation of the basilar artery (TIBA) in detecting right-to-left shunt (RLS) in patients with inadequate temporal windows.

## BACKGROUND

Investigation for patent foramen ovale (PFO) screening is warranted in patients with cryptogenic stroke (CS), as PFO closure in select CS patients is recommended for secondary stroke prevention<sup>1</sup>.

Transcranial Doppler (TCD) is non-invasive and has high sensitivity for PFO screening<sup>2</sup>. However, 10% of the population has insufficient temporal bone windows to perform standard TCD monitoring of the middle cerebral arteries (MCAs)<sup>3</sup>.

Prior reports showed similar diagnostic accuracy between the basilar artery and MCAs insonation<sup>4</sup>.

We aimed to determine if TIBA could be used for PFO screening in individuals unable to undergo standard TCD.

## METHODS

We performed a retrospective, single-center, observational study of TIBA in patients with CS and inadequate temporal windows.

We compared the RLS detection accuracy using TIBA versus echocardiogram, either transthoracic (TTE) or transesophageal (TEE).

## RESULTS

16 females and 4 males were included (mean age 63.2 years). All patients underwent TTE, and 10 (50%) underwent gold-standard TEE.

9 patients had positive RLS with both TCD and echocardiogram. 2 patients with negative echocardiogram had TCD-positive RLS.

3 patients had RLS detected on echocardiogram, whereas TCD was negative.

6 patients had absent RLS with both TCD and echocardiogram.

The sensitivity and specificity of TBAI for RLS detection was 75%, positive predictive value 82% and negative predictive value 67%.

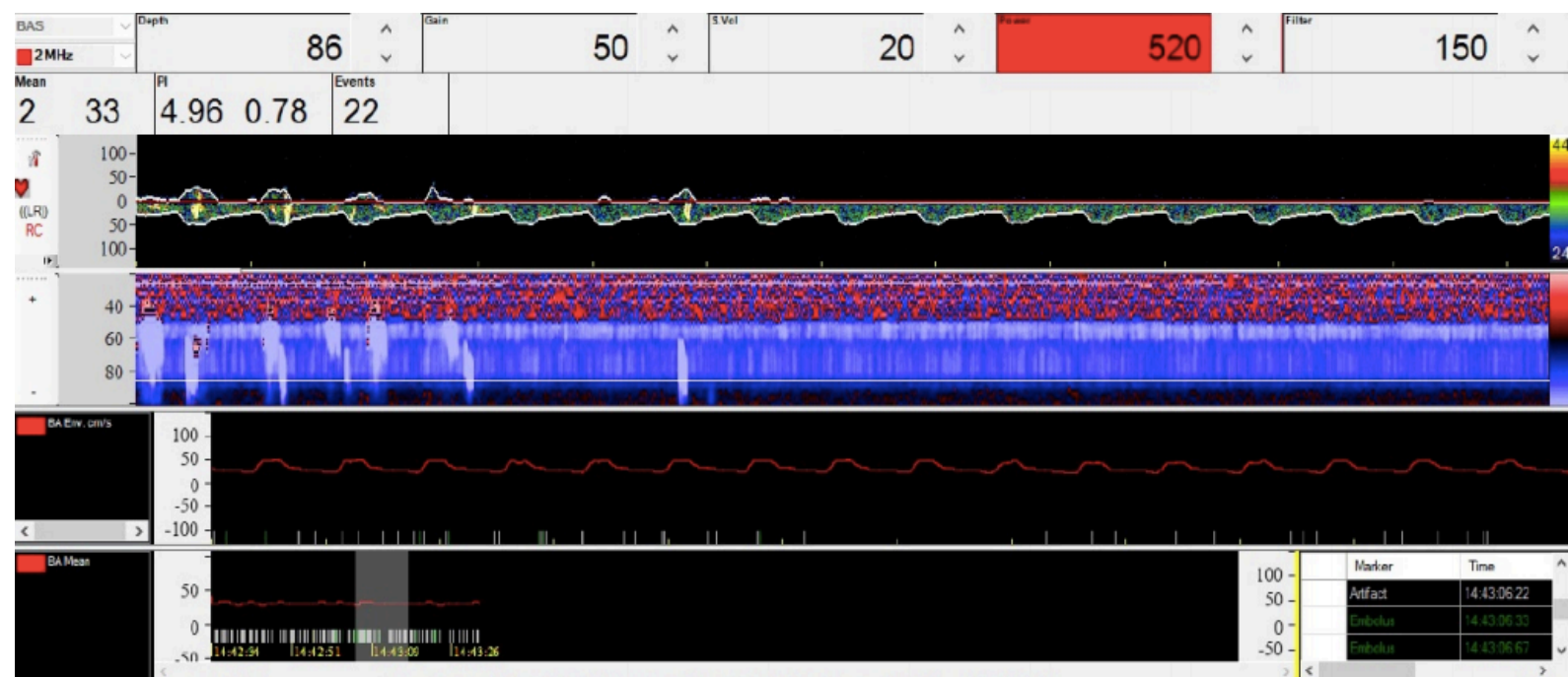
Table 1: Comparison of shunt detection by echocardiogram and TCD

	Shunt on TTE or TEE	No shunt on TTE or TEE
Shunt on TCD	9	2
No shunt on TCD	3	6

Tables 2 and 3: Patient demographics and imaging findings

Age	Gender	Ethnicity	TCD number of MES at rest	TCD number of MES w Valsalva	TCD shunt grade at rest	TCD shunt grade with Valsalva	TTE findings	TEE findings
56	F	caucasian	0	9	Spencer 0, ICS 0	Spencer 1, ICS 1	no shunt	not done
66	F	not hispanic or latino	0	0	Spencer 0, ICS 0	Spencer 0, ICS 0	no shunt	no shunt at rest, 2 bubbles with Valsalva
62	F	not hispanic or latino	39	78	Spencer 3, ICS 3	Spencer 3, ICS 2	small shunt present	not done
31	M	not hispanic or latino	0	0	Spencer 0, ICS 0	Spencer 0, ICS 0	no shunt	not done
83	F	not hispanic or latino	140	123	Spencer 4, ICS 3	Spencer 4, ICS 3	shunt present	not done
55	F	hispanic or latino	0	0	Spencer 0, ICS 0	Spencer 0, ICS 0	no shunt	no shunt
53	F	not hispanic or latino	0	0	Spencer 0, ICS 0	Spencer 0, ICS 0	no shunt	no shunt
86	F	not hispanic or latino	19	48	Spencer 2, ICS 2	Spencer 3, ICS 2	small shunt present	not done
61	M	not hispanic or latino	0	44	Spencer 0, ICS 0	Spencer 3, ICS 2	no shunt	no shunt
81	M	not hispanic or latino	0	0	Spencer 0, ICS 0	Spencer 0, ICS 0	possible shunt (highly mobile fossa ovalis)	no shunt
62	F	not hispanic or latino	0	0	Spencer 0, ICS 0	Spencer 0, ICS 0	no shunt	no shunt
75	F	not hispanic or latino	0	16	Spencer 0, ICS 0	Spencer 2, ICS 2	shunt present	not done
75	F	not hispanic or latino	0	30	Spencer 0, ICS 0	Spencer 2, ICS 2	shunt present	not done
46	F	not hispanic or latino	135	175	Spencer 4, ICS 3	Spencer 4, ICS 3	shunt present	shunt present with ASA
63	M	Not hispanic or latino	5	13	Spencer 1, ICS 1	Spencer 2, ICS 2	shunt present	shunt present
33	M	not hispanic or latino	0	0	Spencer 0, ICS 0	Spencer 0, ICS 0	trivial shunt present	not done
75	F	not hispanic or latino	0	7	Spencer 0, ICS 0	Spencer 1, ICS 1	shunt present	no shunt (limited study due to intolerance)
73	F	not hispanic or latino	0	0	Spencer 0, ICS 0	Spencer 0, ICS 0	no shunt	not done
70	F	not hispanic or latino	0	0	Spencer 0, ICS 0	Spencer 0, ICS 0	shunt present	not done
57	F	Not Hispanic or latino	22	33	Spencer 2, ICS 2	Spencer 3, ICS 3	Trivial shunt present	Shunt present

Image 1: Spectrogram of positive RLS detection by TCD via TBAI



Abbreviations: MES, microembolic signals; TCD, Transcranial Doppler; TTE, Transthoracic Echocardiogram; TEE, Transesophageal Echocardiogram

## DISCUSSION

Our study is the first to compare the utility of TCD using BA insonation and echocardiogram for RLS detection in patients with acoustically insufficient temporal windows. We found that the screening accuracy of TBAI was 75%, somewhat lower compared to prior reports evaluating RLS via MCA insonation<sup>2</sup>.

## CONCLUSIONS

Prospective evaluation of CS patients with TIBA and comparison to the gold-standard TEE<sup>5</sup> should be performed to further guide clinical practice.

## REFERENCES

- Messé S R, Gronseth G., Kent D M, et al. Practice advisory update summary: Patent foramen ovale and secondary stroke prevention: Report of the Guideline Subcommittee of the American Academy of Neurology. *Neurology* 2020, 94(20), 876-885. Duis vestibulum tincidunt felis, at euismod dolor aliquam.
- Komar M, Olszowska M, Przewlocki T, et al. Transcranial Doppler ultrasonography should it be the first choice for persistent foramen ovale screening?. *Cardiovascular Ultrasound* 2014;12(1), 1-6.
- Kollár J, Schulte-Altdorneburg G, Sikula J, et al. Image quality of the temporal bone window examined by transcranial Doppler sonography and correlation with postmortem computed tomography measurements. *Cerebrovascular diseases* 2004; 17(1), 61-65.
- Del Sette M, Dinia L, Rizzi D, Sugo A, Albano B, & Gandolfo C. Diagnosis of right-to-left shunt with transcranial Doppler and vertebral basilar recording. *Stroke* 2007; 38(8), 2254-2256.
- Pearson AC, Labovitz AJ, Tatineni S, et al: Superiority of transesophageal echocardiography in detecting cardiac source of embolism in patients with cerebral ischemia of uncertain etiology. *J Am Coll Cardiol* 1991;17:66-72.