

# ADVANCED ULTRASOUND IMAGING TECHNIQUES FOR MORPHOLOGICAL ASSESSMENT OF POSTERIOR CIRCULATION INTRACRANIAL STENOSIS

N. MERLI<sup>1</sup>, M. CAMPORESE<sup>2</sup>, A. BERNARDONI<sup>3</sup>, C. AZZINI<sup>4</sup>, V. INCHINGOLO<sup>5</sup>, G. MALFERRARI<sup>6</sup>, M. PUGLIATTI<sup>7</sup>

1 PhD Cand., Dept. of Neuroscience and Rehabilitation, University of Ferrara, Ferrara, Italy  
2 University of Ferrara, Faculty of Medicine  
3 Dept. of Neuroscience, Neuroradiology Unit, St. Anna University Hospital, Ferrara, Italy  
4 Dept. of Neuroscience, Neurology Unit, St. Anna University Hospital, Ferrara, Italy

5 Neurology Unit, Fondazione IRCCS Casa Sollievo della Sofferenza, San Giovanni Rotondo, Italy  
6 Neurology and Stroke Unit, IRCCS Istituto delle Scienze Neurologiche di Bologna, Bologna, Italy  
7 Dept. of Neuroscience and Rehabilitation, University of Ferrara; S. Anna University Hospital, Ferrara, Italy

## OBJECTIVES

Transcranial color-coded Doppler (TCCD) assessment of intracranial stenosis (ICAS) has predominantly been focused on haemodynamic criteria. This study aims to evaluate the diagnostic accuracy of high-resolution advanced transcranial Doppler sonography (MicroV) for the morphological characterization of posterior circulation ICAS (PC-ICAS), comparing it with standard ultrasound evaluation (Color and Power Mode) and with Angio-CT assessment, to determine the concordance between these techniques and the clinical advantage of TCCD-MicroV as a non-invasive, repeatable and complementary tool in the diagnosis of PC-ICAS.

## MATERIALS

Esaote MyLab X90 and X9 ultrasound systems were used for TCCD evaluation of PC-ICAS, combining Color, Power Mode and MicroV assessment of the vessels. MicroV features specific technical algorithms, providing elevated sensitivity and high signal/noise ratio.

## METHODS

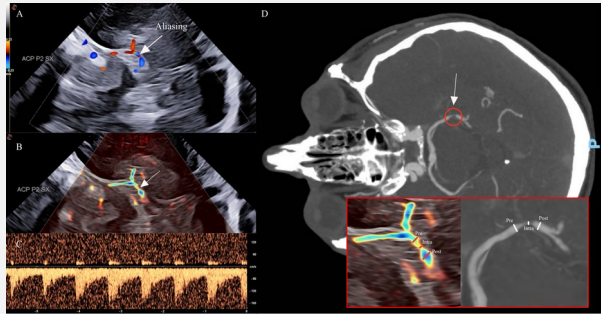
14 patients (8 men and 6 women) were enrolled, for a total of 16 PC-ICAS 2 vertebral artery (VA) V4 hypoplasia analyzed. PC-ICAS were identified with TCCD and Angio-CT. TCCD stenosis identification was guided by Haemodynamic assessment. The length of the stenosis, its mono or multi-focality and the degree of stenosis were collected by application of the NASCET and WASID criteria on both examinations (Fig. 1). The correlation between the different ultrasonographic methods and Angio-CT was sought with bivariate statistical analysis.

## RESULTS

We observed a statistically significant concordance between MicroV and Angio-CT in stenosis grading using the NASCET method ( $p=0.008$ ). Significant correlation was detected on stenosis length between MicroV and Angio-CT ( $p=0.037$ ), and also between both MicroV vs Color ( $p=0.017$ ) and Power ( $p=0.001$ ). Notably, MicroV appeared more sensitive than other ultrasound methods in average stenotic segment measurement and identification of mono and multifocal stenoses, showing concordance with angio-CT (Tab. 1).

## DISCUSSION

Conventional Color and Power Doppler methods present limitations, tending to overestimate vascular diameter due to "overflow" effects.<sup>2</sup> Significant agreement was observed between MicroV and Angio-CT concerning the quantification of PC-ICAS percentage using NASCET criteria, in both moderate and severe stenoses, as well as in identifying stenosis length and focality, showing enhanced accuracy and sensitivity in contrast to other US techniques. Furthermore, MicroV showed significant agreement in stenosis degree quantification between the NASCET and WASID criteria, proving reliability in measuring vessels diameters of pre- and post-stenotic segment.



**Fig.1** Multimodal imaging of severe P2 segment stenosis of the PCA: (A) Color TCCD showing aliasing; (B) Morphological depiction with MicroV technology; (C) Intrastenotic Doppler spectrum with high velocities, turbulence, and high-intensity/low-frequency signals; (D) confirmation by CT angiography. In the smaller box, a detail of the segments' measurement.

		MicroV-WASID	MicroV-NASCET	ANGIOTC-WASID	ANGIOTC-NASCET
MicroV-WASID	Pearson Corr. Sig. (2-tailed) N	1			
MicroV-NASCET	Pearson Corr. Sig. (2-tailed) N	0.749 0.001 15	1		
ANGIOTC-WASID	Pearson Corr. Sig. (2-tailed) N	0.304 0.253 16	0.673 0.008 14	1	
ANGIOTC-NASCET	Pearson Corr. Sig. (2-tailed) N	0.431 0.109 15	0.796 <0.000001 15	0.963 <0.000001 14	1

**Tab.1** Bivariate correlation between MicroV and CT angiography using NASCET and WASID measurement criteria.

## CONCLUSIONS

MicroV overcomes the limitations of traditional TCCD leading to improved morphological evaluation. TCCD-MicroV revealed to be a reliable and accurate US technique for assessing posterior circulation ICAS, providing morphological, structural, and functional insights that support comprehensive stenosis characterization, with potential implication in prognosis and therapeutic strategies of PC-ICAS.

## REFERENCES

- Danyel LA, et al., Classification of Intracranial Stenoses: Discrepancies between Transcranial Duplex Sonography and Computed Tomography Angiography. *Ultrasound Med Biol.* 2020;46(8):1889-1895.
- Malferrari G, et al. Role of Advanced Hemodynamic Ultrasound Evaluation in the Differential Diagnosis of Middle Cerebral Artery Stenosis: Introducing Morphological Criteria. *Ultrasound Med Biol.* 2023;49(11):2428-2435.
- Liu R, et al. Transcranial Color-Coded Sonography Criteria for Moderate and Severe Middle Cerebral Artery Stenosis. *Ultrasound Med Biol.* 2021;47(1):25-32.

## DISCLOSURES & CONTACTS

The authors have nothing to disclose.

[nicola.merli@unife.it](mailto:nicola.merli@unife.it)

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