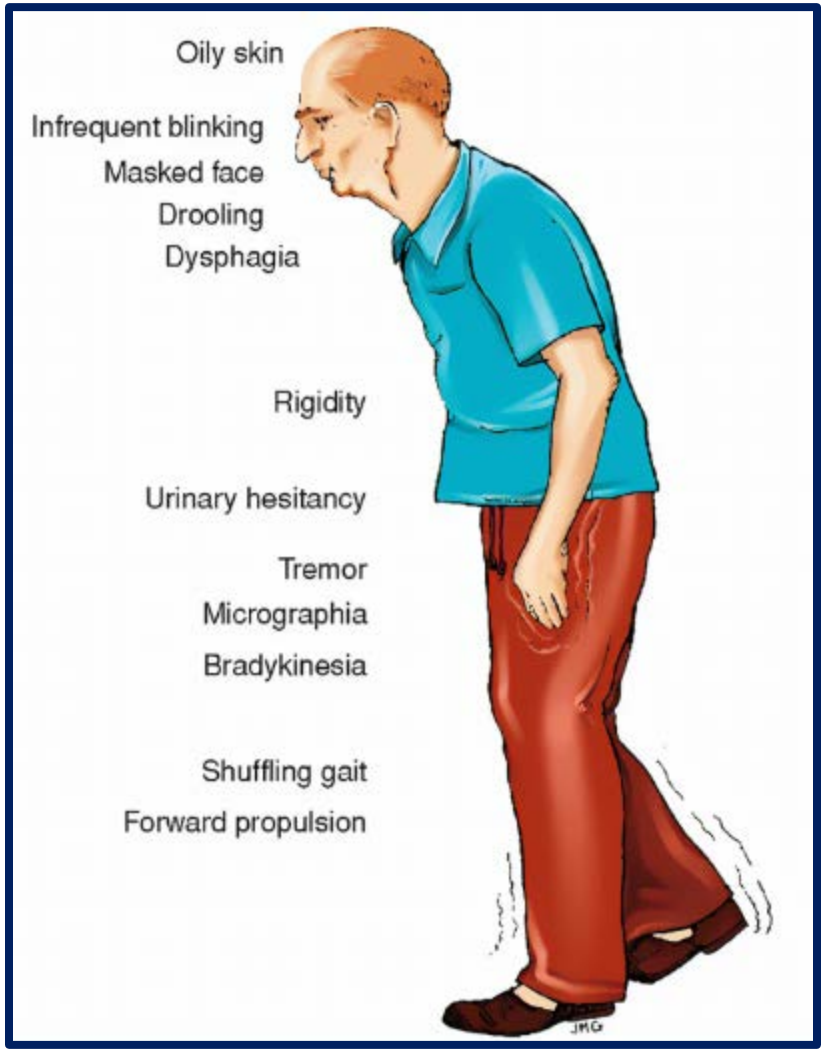
14-16 Novembre 2022

Brain Parenchyma Sonography e malattie degenerative

Enzo Sanzaro
Unità Operativa di Neurologia e Stroke Unit
Ospedale Umberto I Siracusa

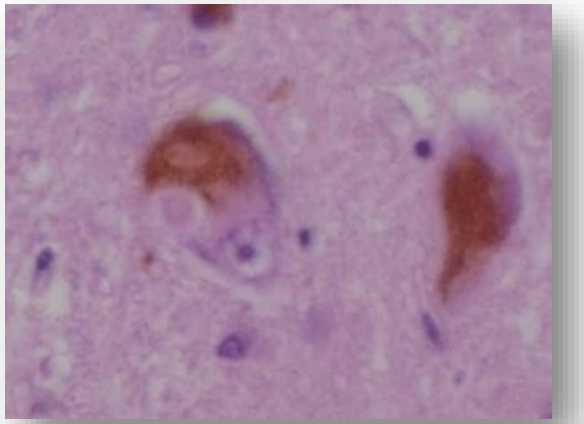

Oily skin
Infrequent blinking
Masked face
Drooling
Dysphagia
Rigidity
Urinary hesitancy
Tremor
Micrographia
Bradykinesia
Shuffling gait
Forward propulsion

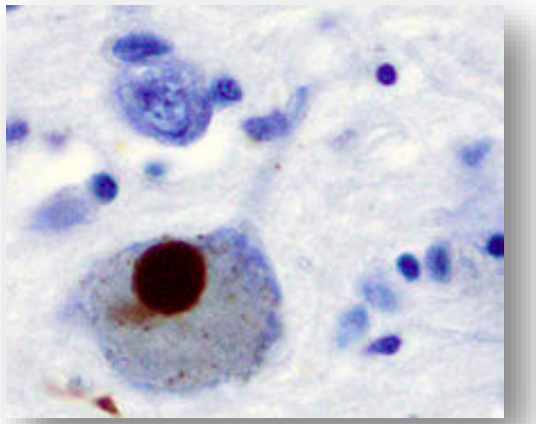
J Neurol Neurosurg Psychiatry. 1992 Mar;55(3):181-4.

Accuracy of clinical diagnosis of idiopathic Parkinson's disease: a clinico-pathological study of 100 cases.

Hughes AJ, Daniel SE, Kilford L, Lees AJ.

Solo **76 pazienti** presentavano le tipiche caratteristiche isto-patologiche



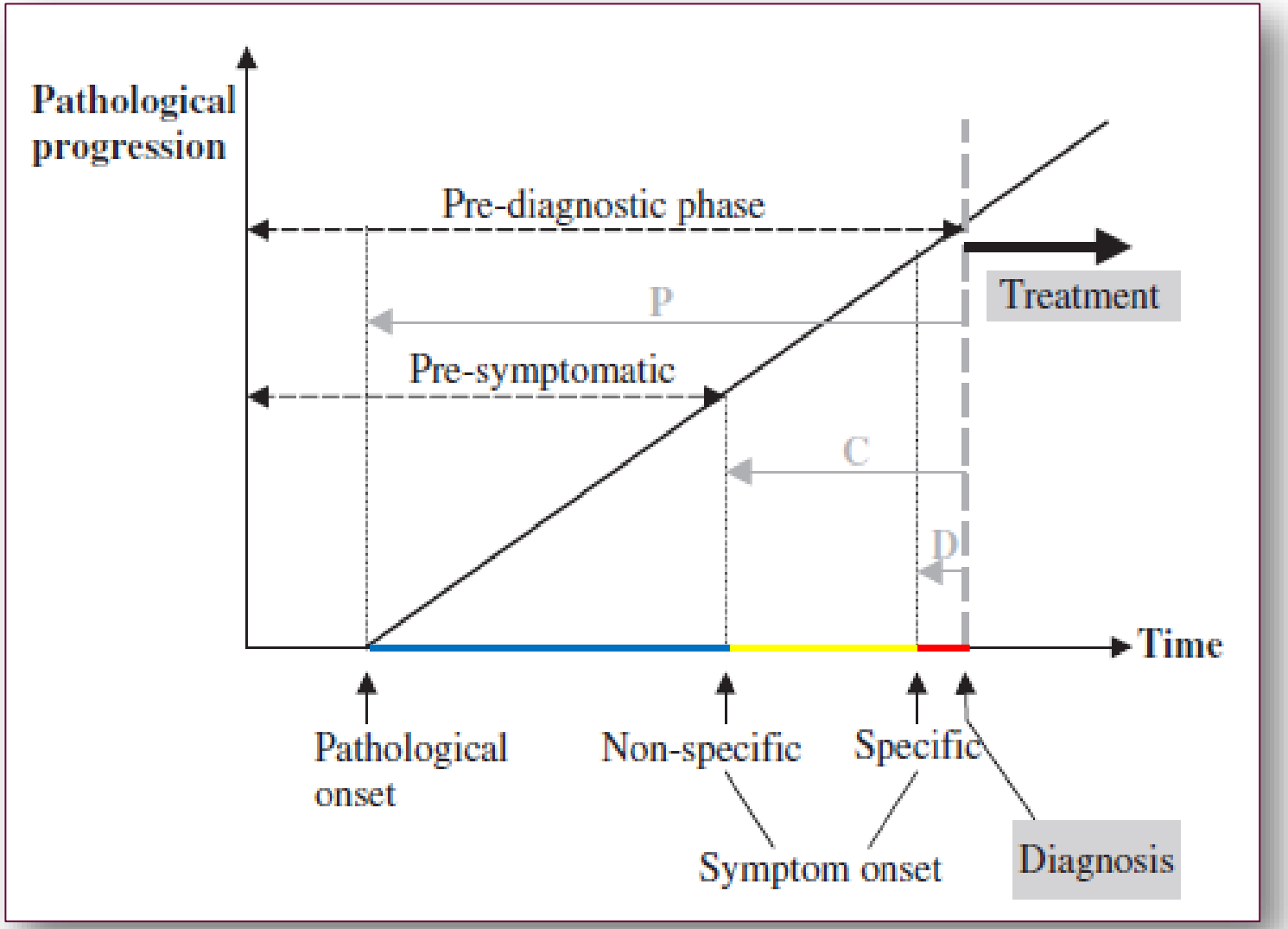


Brain 2002;125:861-70

The accuracy of diagnosis of parkinsonian syndromes in a specialist movement disorder service.

Hughes AJ, Daniel SE, Ben Shlomo Y et al.

Sensitivity 91%


Pathological progression
Pre-diagnostic phase
Treatment
P
Pre-symptomatic
C
D
Time
Pathological onset
Non-specific
Specific
Symptom onset
Diagnosis

DOI: 10.1093/brain/awh198 *Brain* (2004), **127**, 1693–1705

REVIEW ARTICLE

Biomarkers and Parkinson's disease

A. W. Michell, S. J. G. Lewis, T. Foltynie and R. A. Barker

Cambridge Centre for Brain Repair, Cambridge, UK

Correspondence to: Dr A. W. Michell, Cambridge Centre for Brain Repair, Forvie Site, Robinson Way, CB2 2PY, UK
E-mail: awm13@cam.ac.uk

Why do we need a marker for Parkinson's disease?

To improve diagnosis

1. differentiation of susceptible individuals from normals, before symptoms develop (sensitivity)
2. identification of true idiopathic PD from its imitators once symptomatic (specificity)

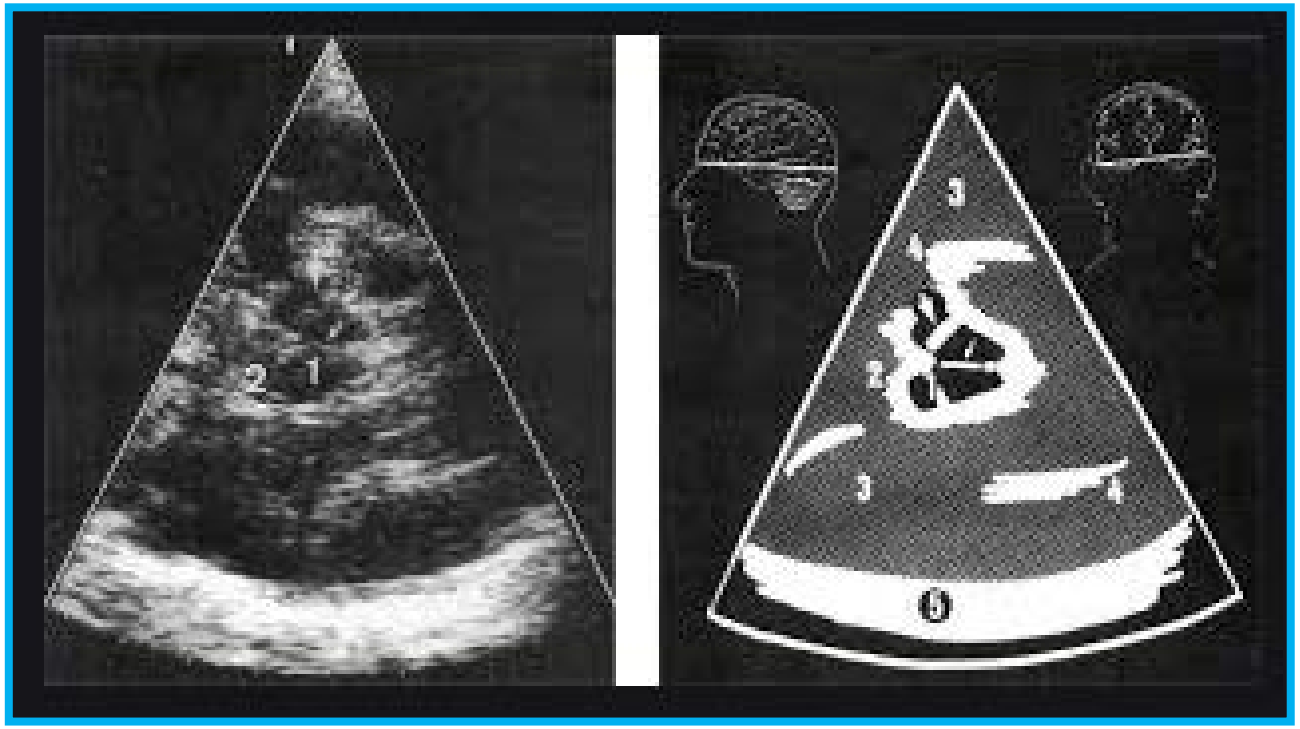
To monitor disease progression and demonstrate treatment efficacy

Neurology®
The most widely read and highly cited peer-reviewed neurology journal
AMERICAN ACADEMY OF NEUROLOGY®

January 01, 1995; 45 (1) BRIEF COMMUNICATIONS

Degeneration of substantia nigra in chronic Parkinson's disease visualized by transcranial color-coded real-time sonography

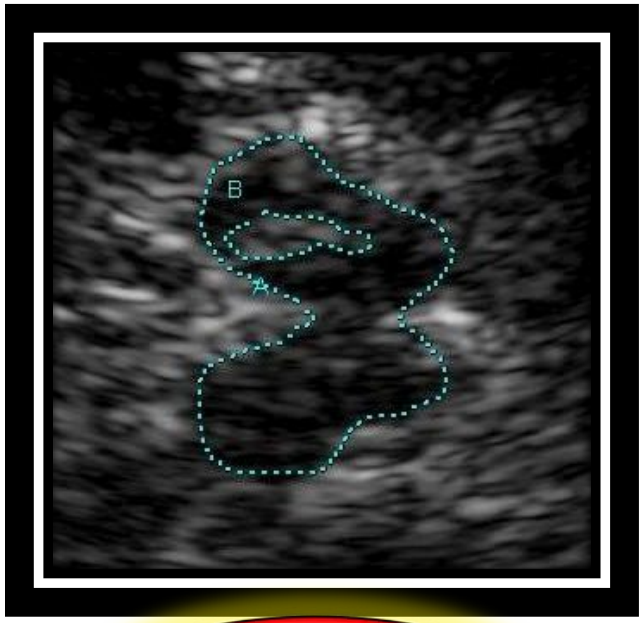
G. Becker, J. Seufert, U. Bogdahn, H. Reichmann, K. Reiners



Berg D, Becker G, Zeiler B et al.
Vulnerability of the nigrostriatal system as detected by transcranial ultrasound.
Neurology 1999; 1026-1031

Adulti sani

8-10%



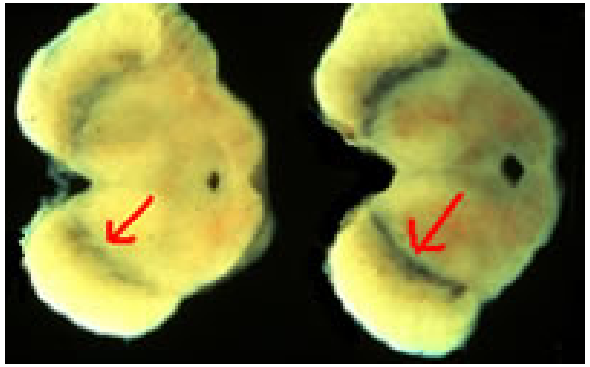
› 0.25 cm^2

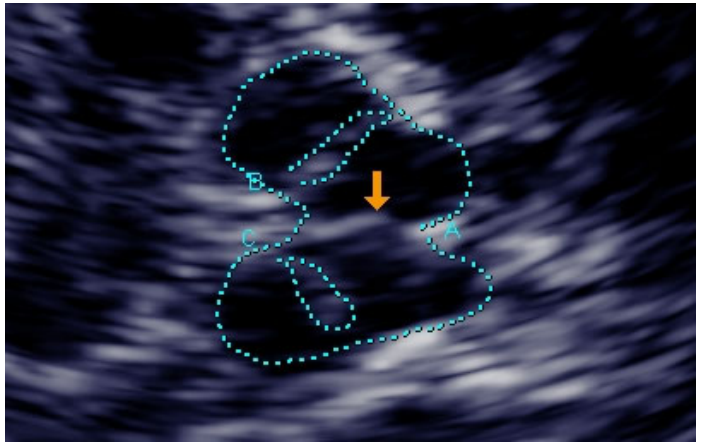
PET

Marked decrease in the accumulation of [^{18}F]-dopa in the caudate nucleus and putamen

> 60%

Perché la Substantia Nigra è iperecogena ?





Mov Disord. 2005 Oct;20(10):1278-85.
In vivo detection of iron and neuromelanin by transcranial sonography: a new approach for early detection of substantia nigra damage.
Zecca L, Berg D, Arzberger T, Ruprecht P, Rausch WD, Musicco M, Tampellini D, Riederer P, Gerlach M, Becker G.

"The hyperechogenic area of substantia nigra correlates significantly with the concentration of H- and L-ferritin in postmortem brains"

Götz M et al.
The relevance of iron in the pathogenesis of PD
Ann N.Y. Acad. Sci. 1012: 193-208 (2004)

Brain (1999), **122**, 667–673

Iron in the basal ganglia in Parkinson's disease
An *in vitro* study using extended X-ray absorption fine structure and cryo-electron microscopy

P. D. Griffiths,[1] B. R. Dobson,[2] G. R. Jones[2] and D. T. Clarke[2]

Hochstrasser H et al.
Sequence variations in genes involved in iron metabolism in PD
Medgen 2003; 15:240

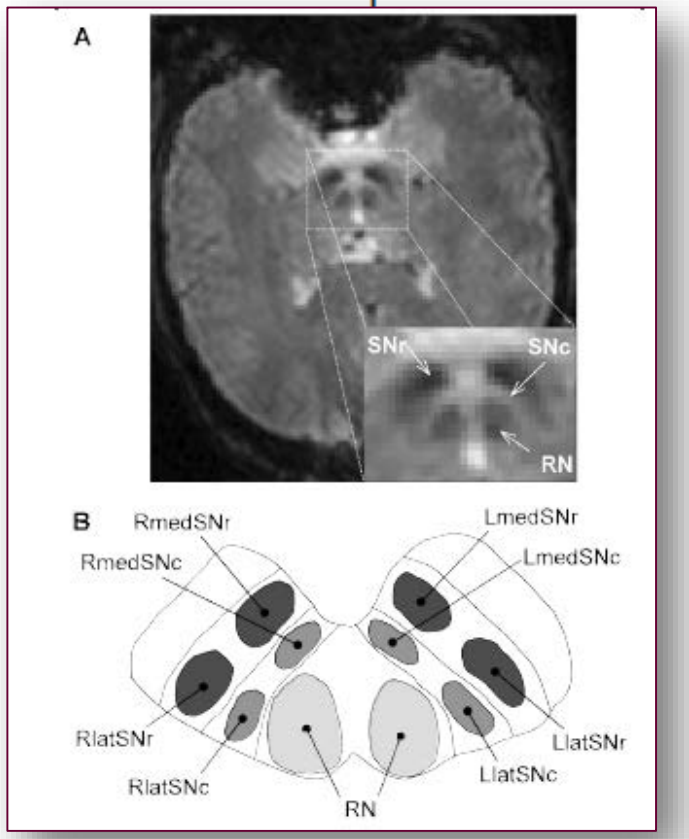
Midbrain iron content in early Parkinson disease

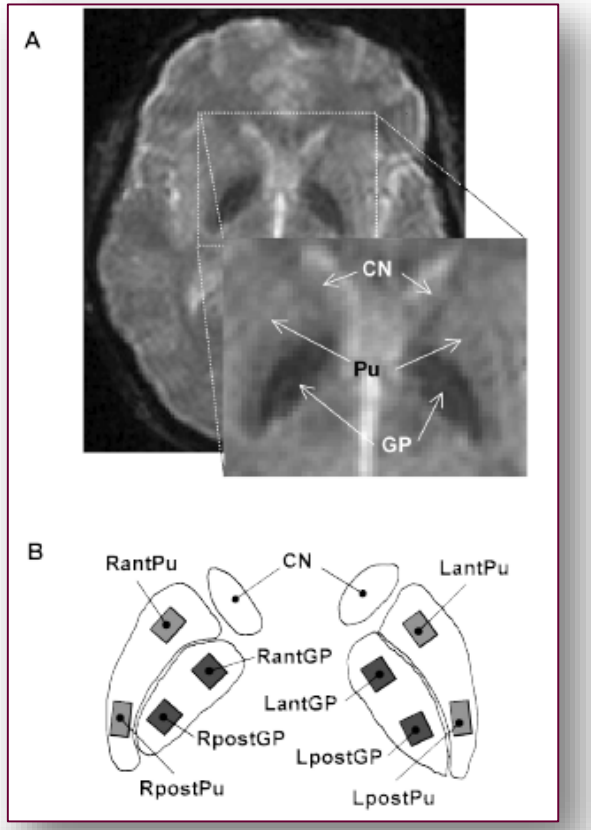
Neurology® 2008;70:1411-1417

Supported by the Canadian Institutes for Health Research.

A potential biomarker of disease status

W.R. Wayne Martin, MD
Marguerite Wieler, MSc
Myrlene Gee, PhD





Conclusions: High field strength MRI demonstrates lateral substantia nigra pars compacta abnormalities in early Parkinson disease (PD) consistent with increased iron content and corresponding to the known distribution of neuronal loss occurring in this disorder. This may ultimately provide an imaging marker for disease progression in PD, although longitudinal studies are required.

Parkinsonism & Related Disorders

March 2017 Volume 36, Pages 76–82

Iron accumulation and microglia activation contribute to substantia nigra hyperechogenicity in the 6-OHDA-induced rat model of Parkinson's disease

Yaqin Zhu, Bao Wang, Kai Tao, Hengli Yang, Yixiao Wang, Tian Zhou, Yilin Yang, Lijun Yuan, Xi Liu, Yunyou Duan

INTRODUCTION: This study aims to explain the mechanisms for the formation of sonographic features of Parkinson's disease (PD) using a 6-hydroxydopamine (6-OHDA) rat model of PD. The iron chelator deferiprone (DFP) was used in the PD model rat to examine the relationship between iron and the echo signal.

METHODS: Rat models were created using stereotactic injections of 6-OHDA. DFP was administered intragastrically. Transcranial sonography (TCS) was performed to observe the substantia nigra (SN) echo signal of the brain. Immunofluorescence and iron staining were performed to observe the histological characteristics of the hyperechogenic area. The imaging findings were compared with the histopathological findings.

RESULTS: The PD model rat presented a large area of hyperechogenicity in the SN. Ferric ion accumulation and microglia proliferation occurred in the hyperechogenic area. DFP inhibited dopaminergic (DA) neuron necrosis, ferric ion accumulation and microglia proliferation and reduced the hyperechogenic area of the SN.

CONCLUSIONS: Both iron aggregation and gliosis contribute to the formation of substantia nigra hyperechogenicity (SNH) in PD. DFP exhibits a neuroprotective effect by inhibiting SNH. Iron deposit and the SNH are correlated with DA neuron necrosis.

NeuroImage: Clinical 26 (2020) 102185

Contents lists available at ScienceDirect

NeuroImage: Clinical

journal homepage: www.elsevier.com/locate/ynicl

Analyzing the co-localization of substantia nigra hyper-echogenicities and iron accumulation in Parkinson's disease: A multi-modal atlas study with transcranial ultrasound and MRI

Seyed-Ahmad Ahmadi[a,b,d], Kai Bötzel[a], Johannes Levin[a], Juliana Maiostre[a], Tassilo Klein[e], Wolfgang Wein[f], Verena Rozanski[g], Olaf Dietrich[c], Birgit Ertl-Wagner[c,h], Nassir Navab[d], Annika Plate[a,*]

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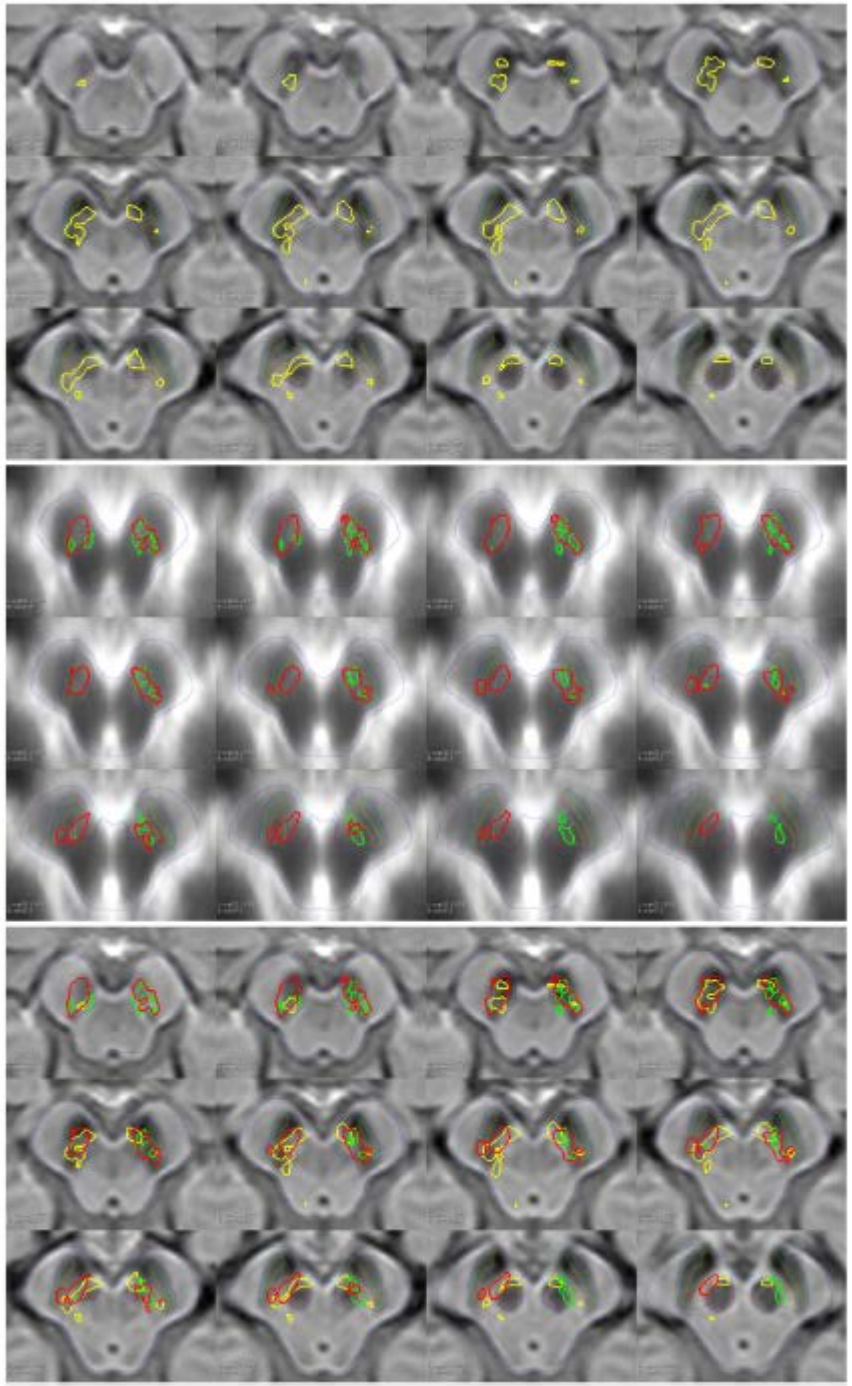
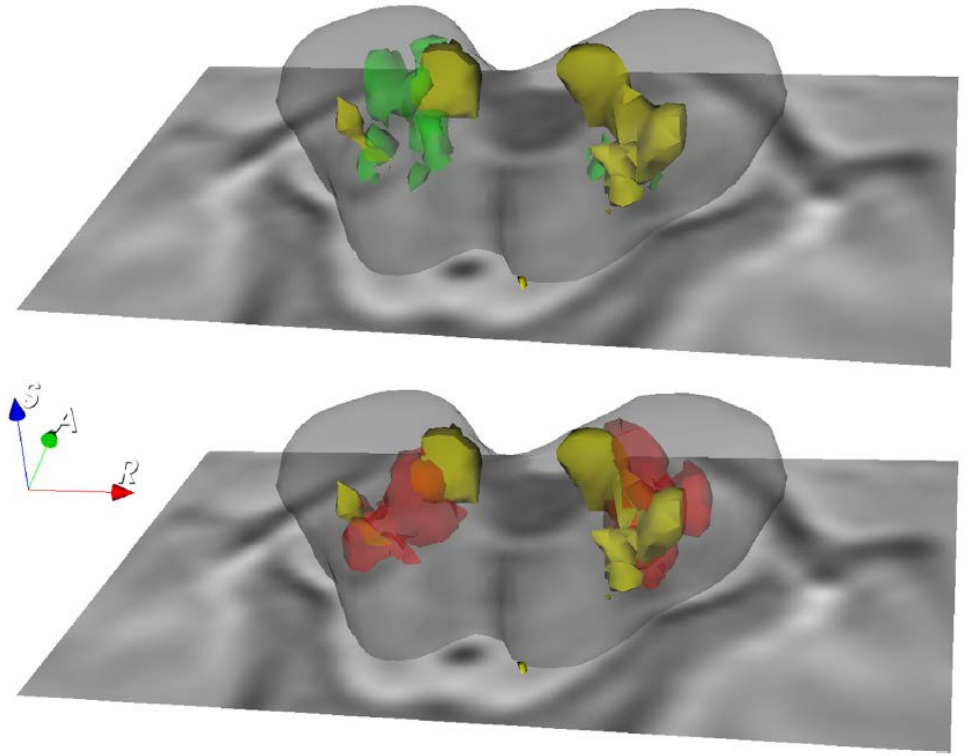
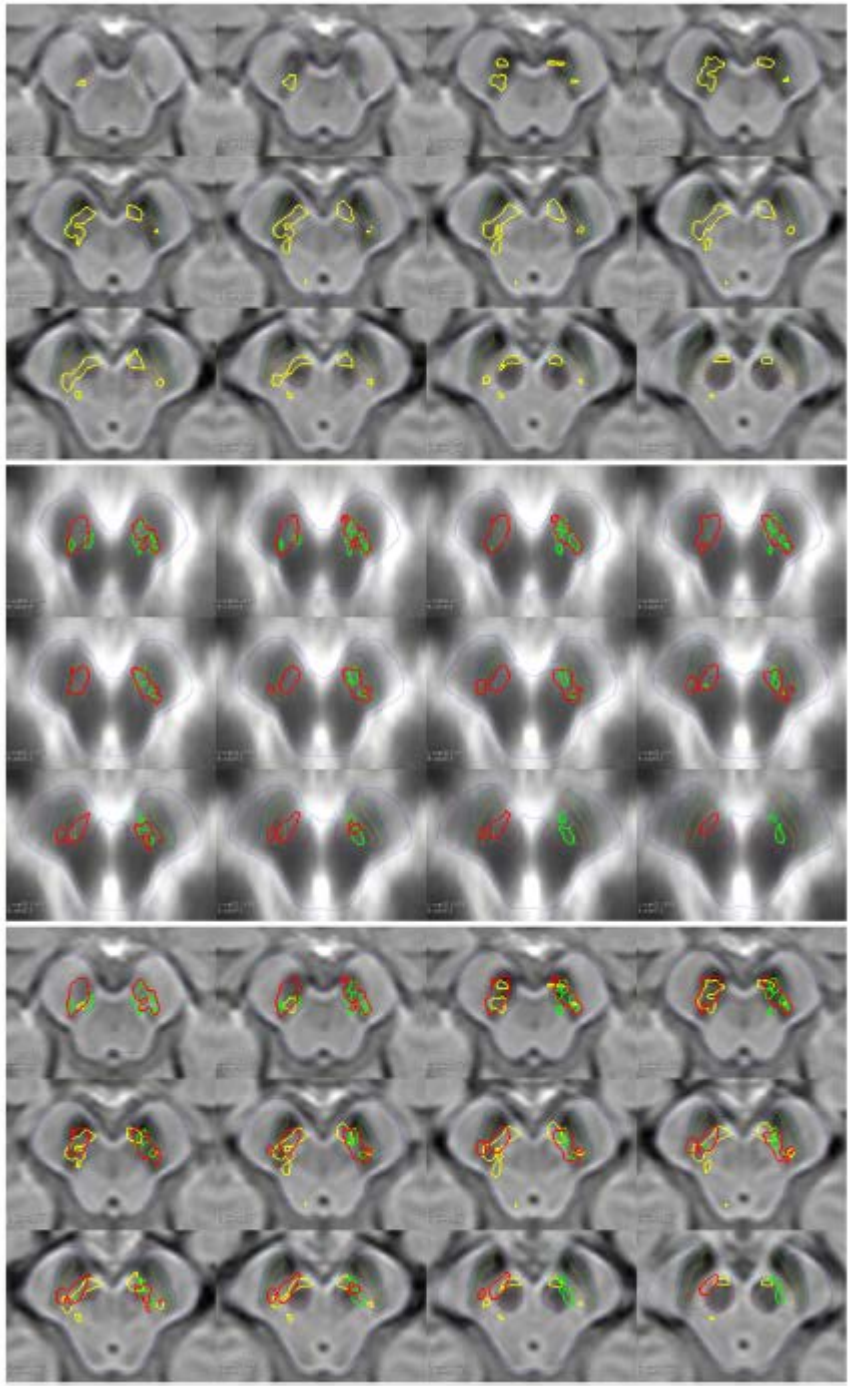
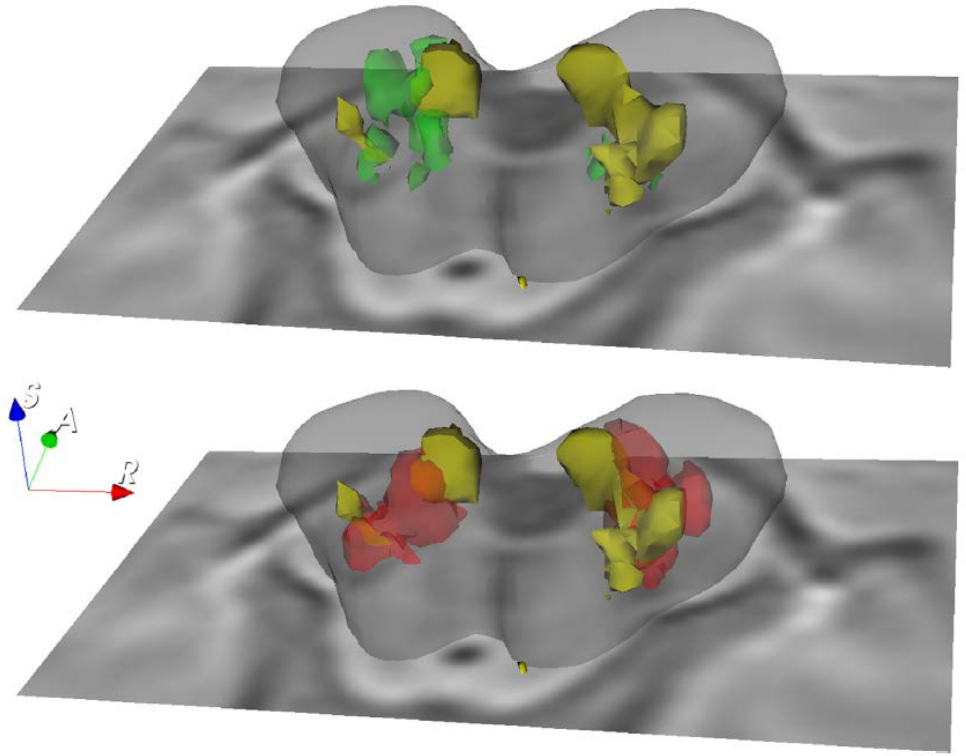
[b] German Center for Vertigo and Balance Disorders (DSGZ), Ludwig-Maximilians University, Marchioninistraße 15, Munich 81377, Germany
[c] Department of Radiology, Ludwig-Maximilians University, Marchioninistr. 15, Munich 81377, Germany
[d] Chair for Computer Aided Medical Procedures (CAMP), Technical University of Munich, Boltzmannstr. 3, Garching 85748, Germany
[e] SAP ML Research, Berlin, Germany
[f] ImFusion GmbH, Agnes-Pockels-Bogen 1, München 80992, Germany
[g] Klinik Haag i. OB, Haag i. OB 83527, Germany
[h] The Hospital for Sick Children, 555 University Avenue, Toronto, Ontario M5G 1 × 8, Canada





A reference technique for precise MRI-based in-vivo localization of iron in the brain is quantitative susceptibility mapping (QSM), which was shown to measure increased iron accumulation (QSM+) in and around the SN, in particular in the pars compacta.





Our study concludes that PD-related increases in TCS and QSM signals demonstrate a high overlap along the entire axial extent of the midbrain. We confirm the established finding of iron accumulation in the substantia nigra pars compacta, and produce evidence that the ventral tegmental area and its sub-nuclei feature comparable alterations as well. Our results imply an earlier functional involvement of the mesolimbic system, rather than an isolated nigrostriatal loss of dopamine neurons.

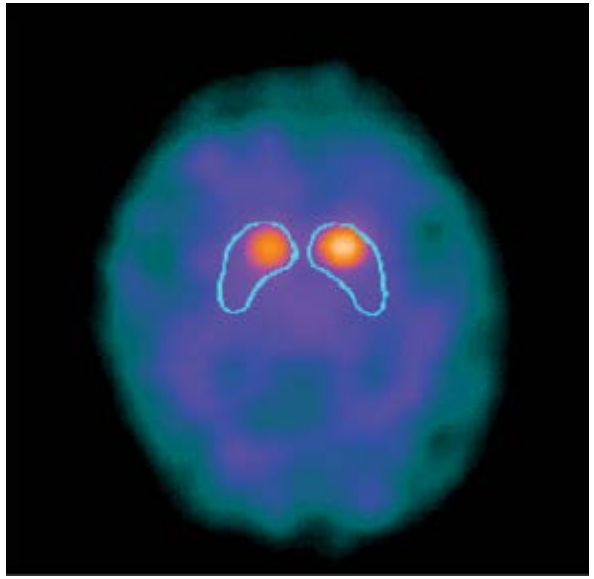
L'iperecogenicità della SN correla con le scale UPDRS, Hoehn and Yahr e la durata di malattia ?

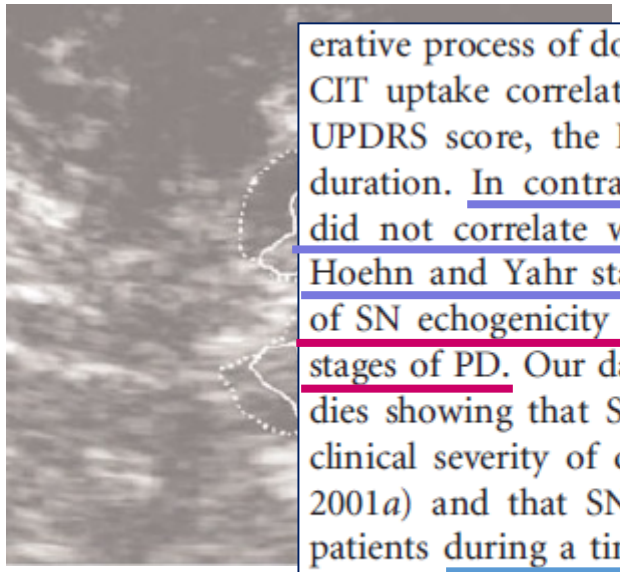
Transcranial sonography and [^{123}I]FP-CIT SPECT disclose complementary aspects of Parkinson's disease

Germany

Brain (2006), **129**, 1188–1193

Jörg Spiegel,[1] Dirk Hellwig,[2] Marc-Oliver Möllers,[2] Stefanie Behnke,[1] Wolfgang Jost,[3] Klaus Fassbender,[1] Samuel Samnick,[2] Ulrich Dillmann,[1] Georg Becker[1] and Carl-Martin Kirsch[2]





erative process of dopaminergic neurons at the SN. The FP-CIT uptake correlated significantly with the motor part of UPDRS score, the Hoehn and Yahr stage and the disease duration. In contrast to FP-CIT uptake, SN echogenicity did not correlate with the motor part of UPDRS score, Hoehn and Yahr stage, or disease duration. The same size of SN echogenicity could be found in early as well as late stages of PD. Our data are in accordance with previous studies showing that SN echogenicity does not correlate with clinical severity of disease or disease duration (Berg *et al.*, 2001*a*) and that SN echogenicity remains constant in PD patients during a time period of 5 years, whereas parkinsonian symptoms clearly progress during this time period (Berg *et al.*, 2005). These previous studies suggest that SN

tice. Applying both methods together we reach a sensitivity of 0.98 concerning the diagnosis of PD. Furthermore, it allows to differentiate between PD and atypical parkinsonian syndromes (Walter *et al.*, 2003; Behnke *et al.*, 2005). Therefore

Correlation Between Substantia Nigra Features Detected by Sonography and Parkinson Disease Symptoms

Ostrava, Czech Republic.

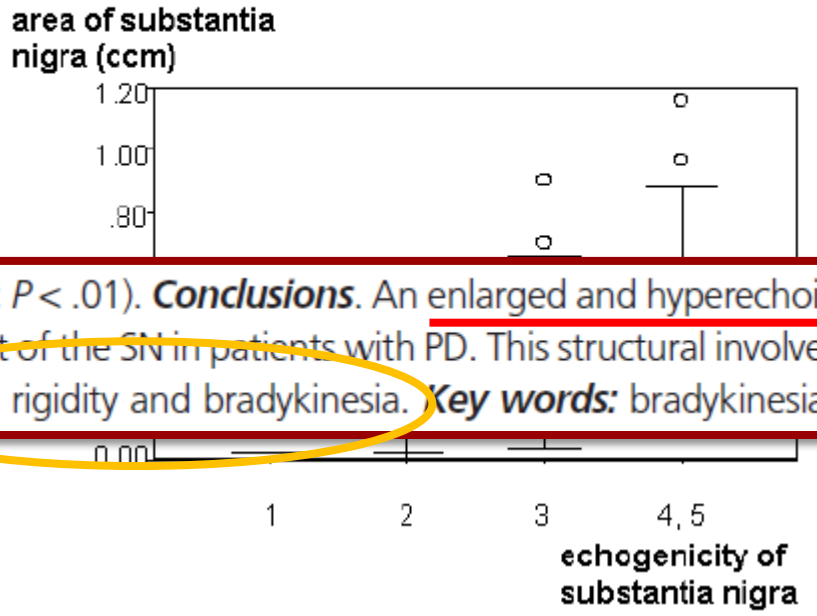
J Ultrasound Med 2010; 29:37–42

Petra Bártová, MD, PhD, David Školoudík, MD, PhD, Pavel Ressner, MD, PhD, Kateřina Langová, Roman Herzig, MD, PhD, Petr Kaňovský, MD, PhD

Table 1. Evaluation of SN Echogenicity

Grade	Echogenicity
1	Same as brain stem
2	Very low but clearly detectable area of SN
3	Medium, lower than perimesencephalic cisterns
4	Same as perimesencephalic cisterns
5	Higher than perimesencephalic cisterns

Figure 2. Correlation between the SN echogenicity and area (ANOVA).



between the SN echogenicity and area ($r = 0.705$; $P < .01$). ***Conclusions***. An enlarged and hyperechoic SN seems to be a marker of structural involvement of the SN in patients with PD. This structural involvement is expressed more in patients with bilateral rigidity and bradykinesia. ***Key words:*** bradykinesia;

A New Assessment Tool for Parkinson Disease

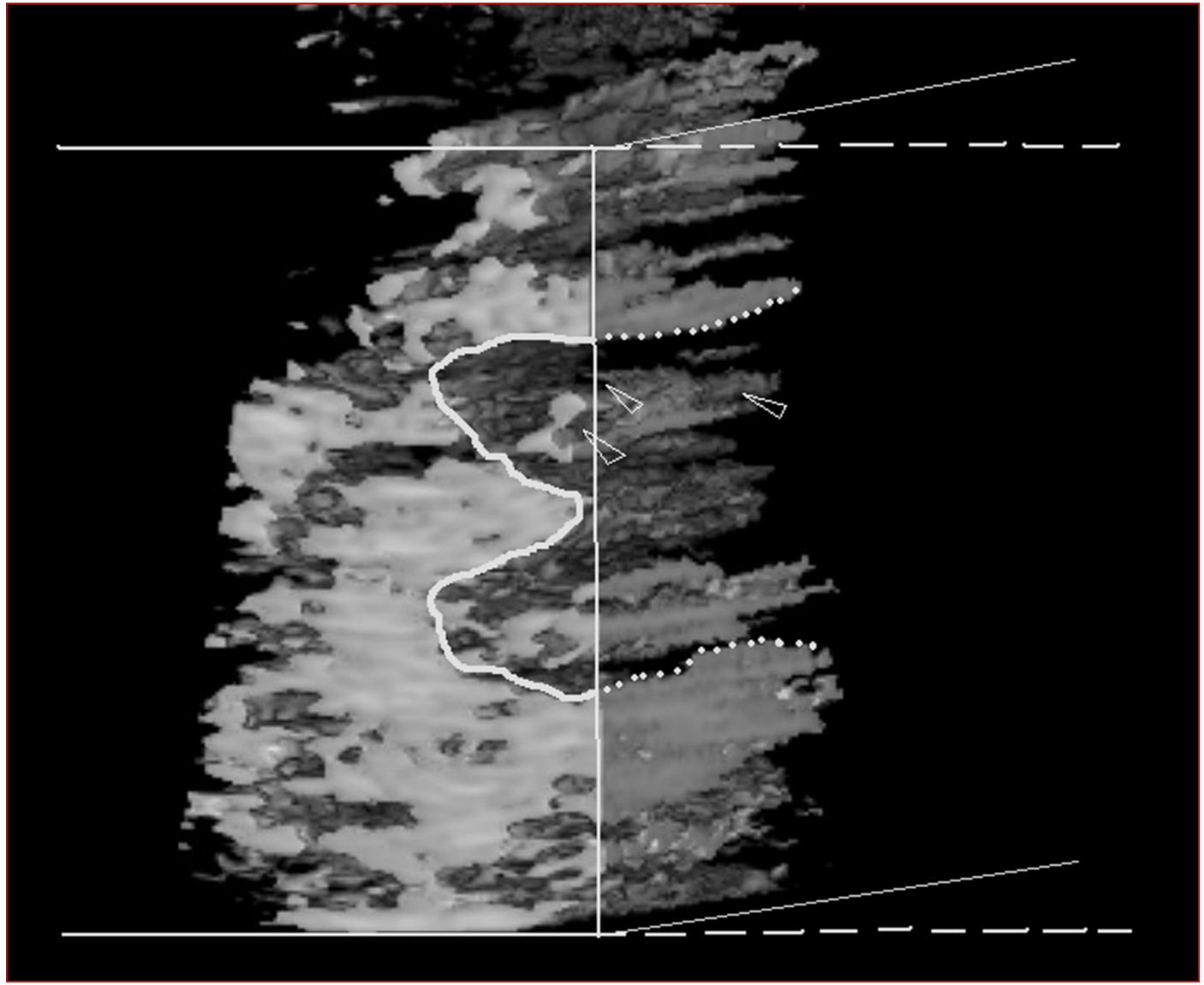
ORIGINAL RESEARCH

The Nigral Lesion Load Obtained by Transcranial Sonography

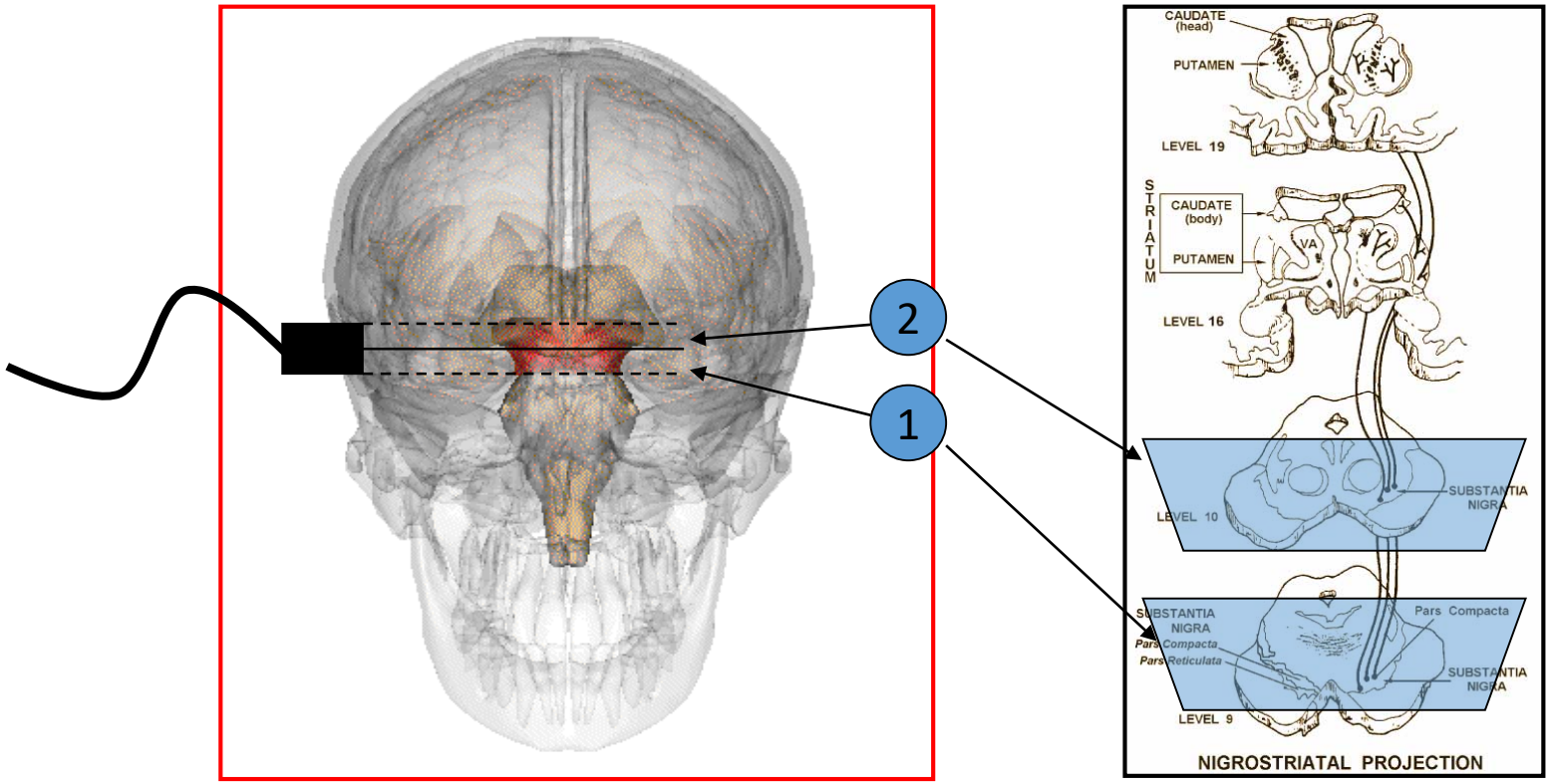
Enzo Sanzaro, MD, Francesco Iemolo, MD, Giovanni Duro, MD, Giovanni Malferrari, MD

 | J Ultrasound Med 2014; 33:1635–1640

Objectives—A sonographic method that provides for the measurement of a single frozen image and ignores the remaining portions of the midbrain has been used recently as a biological marker of Parkinson disease. We propose a new approach to evaluating the midbrain: obtaining the nigral lesion load, with which it is possible to acquire an estimate of the real damage to the substantia nigra.



NIGRAL LESION LOAD (NLL)



A New Assessment Tool for Parkinson Disease

The Nigral Lesion Load Obtained by Transcranial Sonography

Enzo Sanzaro, MD, Francesco Iemolo, MD, Giovanni Duro, MD, Giovanni Malferrari, MD

 | J Ultrasound Med 2014; 33:1635–1640

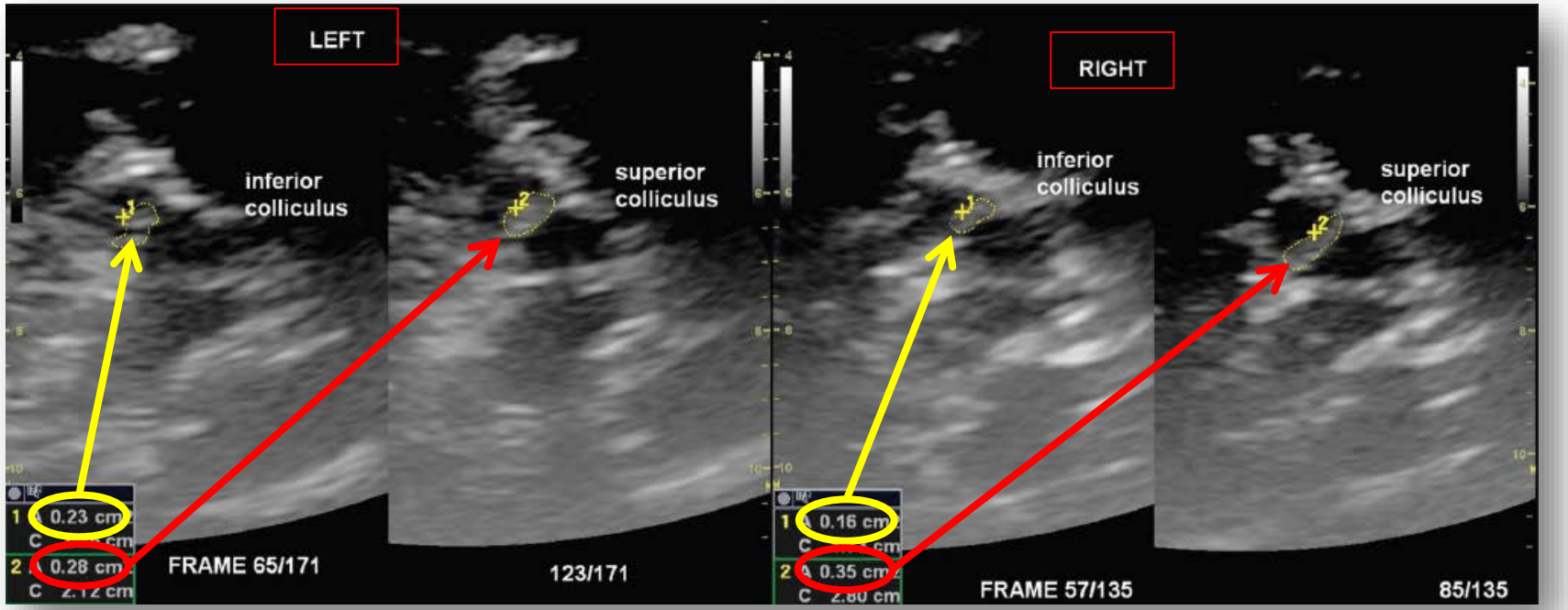


Figure 2. Patient 56 (Hoehn and Yahr stage II; nigral lesion load, 1.02 cm^2).

A New Assessment Tool for Parkinson Disease

The Nigral Lesion Load Obtained by Transcranial Sonography

Enzo Sanzaro, MD, Francesco Iemolo, MD, Giovanni Duro, MD, Giovanni Malferrari, MD

 | J Ultrasound Med 2014; 33:1635–164C

Table 2. Nigral Lesion Loads, Hoehn and Yahr Stages, and SPECT Findings for the 60 Patients

	Patient																			
Parameter	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Stage	II	II	II	I	III	III	III	III	II	II	III	III	II	III	II	II	III	I	III	II
NLL, cm^2	0.91	1.25	1.15	0.52	1.55	1.32	1.58	1.36	1.06	1.38	0.96	1.36	0.89	1.15	0.76	0.77	1.32	0.51	1.22	0.53
SPECT	++	+++	+++	+												++	+++	+	+++	++
Parameter	**21**	**22**	**23**	**24**												**36**	**37**	**38**	**39**	**40**
Stage	II	I	II	II												II	III	II	II	I
NLL, cm^2	0.35	0.47	1.16	1.0												.04	1.50	1.28	0.62	0.83
SPECT	++	+	+++	++												+	+	+++	+	++
Parameter	**41**	**42**	**43**	**44**												**56**	**57**	**58**	**59**	**60**
Stage	II	I	I	II												II	III	II	II	III
NLL, cm^2	1.24	0.95	0.66	1.3												.02	1.57	0.79	1.27	1.66
SPECT	++	+	++	++												+++	+++	++	+++	+++

Pearson correlation showed that the Hoehn and Yahr scale ($r = 0.73$; $r^2 = 0.53$). Regression analysis with correlation. The Spearman rank correlation coefficient (0.74) was gr rrelation between the variables. For SPECT findings, + indicates mild ction.

Figure 4. Nigral lesion load range at each Hoehn and Yahr stage.

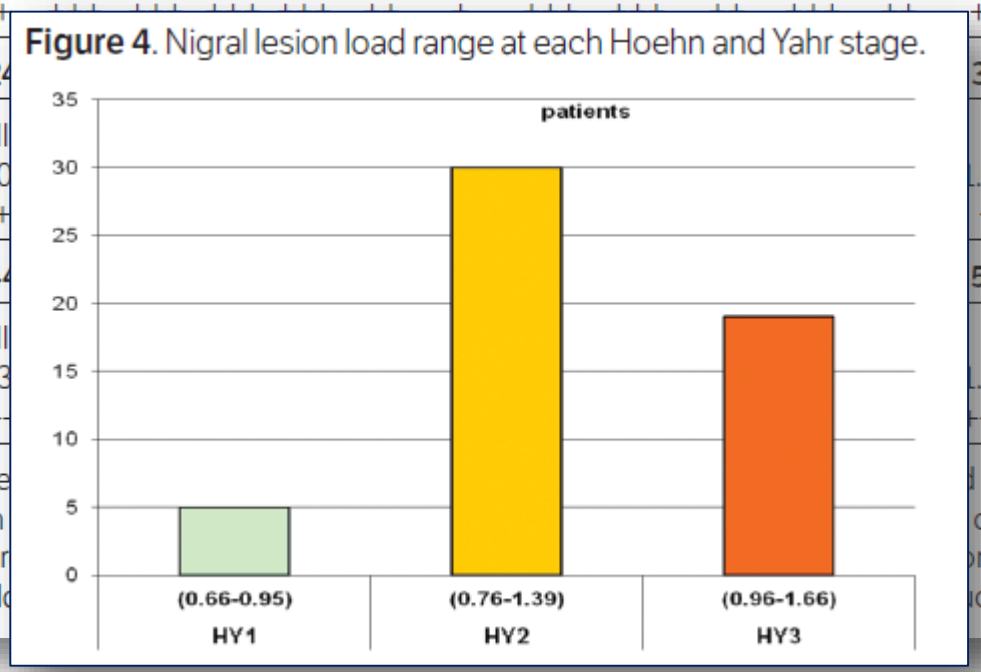


Table 3. Nigral Lesion Load at Each Hoehn and Yahr Stage

Stage	Nigral Lesion Load, cm^2	
	Mean	Range
I	0.88	0.66–0.95
II	1.17	0.76–1.39
III	1.44	0.96–1.66

A New Assessment Tool for Pa
Disease

The Nigral Lesion Load Obtained by Transcranial S

Enzo Sanzaro, MD, Francesco Iemolo, MD, Giovanni Duro, MD, Giovanni Malferr

Ultrasound Med 2014; 33:1635–164C

Neurological Sciences
October 2017, Volume 38, Issue 10, pp 1805–1810 | Cite as

Transcranial sonography image characteristics in different Parkinson's disease subtypes

Authors Authors and affiliations

Ai Yan Sheng, Ying Chun Zhang, Yu Jing Sheng, Cai Shan Wang, Ying Zhang, Hua Hu, Wei Feng Luo, CHun-Feng LIu

Recently, Parkinson's disease (PD) has been classified into three subtypes: postural instability gait difficulty (PIGD), tremor dominate (TD), and indeterminate PD. Transcranial sonography (TCS) is considered to be an important tool to diagnose PD. However, it is uncertain that whether there are differences in TCS image characteristics in different PD subtypes, so 373 idiopathic PD (188 PIGD, 108 TD, 77 indeterminate PD) were registered and received TCS in our investigation; also, the association between clinical characteristics and TCS results in different PD subtypes was analyzed. In accordance with several previous studies, we detected substantia nigra (SN) by TCS in 85.4% of patients with idiopathic PD; we concluded that PIGD patients had more serious disease than TD and indeterminate PD group ($p < 0.05$). They always had larger SN hyperechogenicity areas on TCS ($p < 0.05$), and we found that there was no correlation between SN hyperechogenicity and disease duration or severity ($p > 0.05$). Similarly, abnormal brainstem raphe signal was also more often in PIGD group than in TD and indeterminate PD group ($p < 0.05$), which might imply that PIGD group was vulnerable to suffer from depression in the future.

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DOI: 10.1002/brb3.2252

Brain and Behavior Open Access WILEY

ORIGINAL RESEARCH

Cognition and transcranial sonography in Parkinson's disease patients with or without orthostatic hypotension

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[1] Department of Neurology, The Second Affiliated Hospital of Soochow University, Suzhou, China

[2] Department of Neurology, Suqian First Hospital, Suqian, China

[3] Jiangsu Key Laboratory of Neuropsychiatric Diseases and Institute of Neuroscience, Soochow University, Suzhou, China

- The presence of OH had no influence on cognition
- TCS results were different between the PD-OH and PD-NOH groups
- We found higher values in both groups in our study (PD-OH: 0.34 cm2, PD-NOH: 0.45 cm2)

PD-OH patients showed smaller SNhyperechogenic areas. It may indicate that different clinical subtypes of PD are associated with different SN patterns (Walter, Dressler, et al., 2007)

Qual è il valore diagnostico del TCS negli stadi iniziali, quando spesso i segni clinici non permettono di definire una corretta diagnosi ?

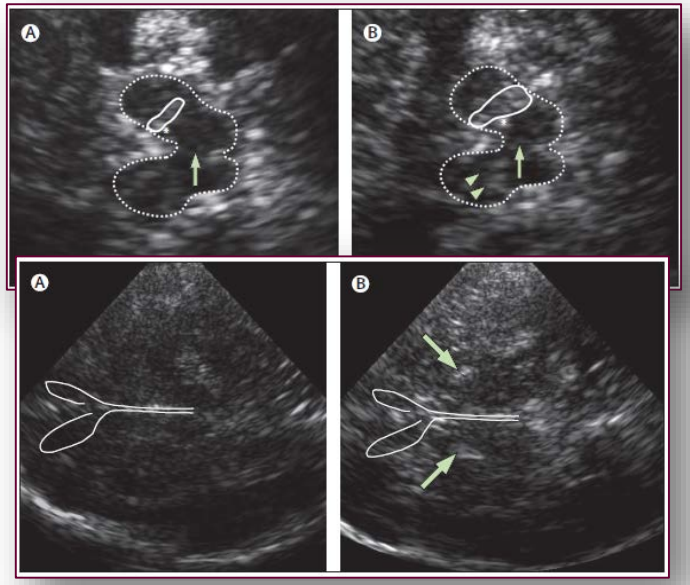
The specificity and sensitivity of transcranial ultrasound in the differential diagnosis of Parkinson's disease: a prospective blinded study

Lancet Neurol 2008; 7: 417–24

Alexandra Gaenslen, Barbara Unmuth, Jana Godau, Inga Liepelt, Adriana Di Santo, Katherine Johanna Schweitzer, Thomas Gasser, Hans-Jürgen Machulla, Matthias Reimold, Kenneth Marek, Daniela Berg

Germany, USA

We aimed to determine the diagnostic value of TCS in the early stages of parkinsonian syndromes, when the clinical symptoms often do not enable a definite diagnosis to be made.



	Substantia nigra		Basal ganglia	
	SN–	SN+	BG–	BG+
iPD	4 (2)	39 (37)	25 (24)	14 (11)
aPS	11 (9)	2 (1)	3 (3)	9 (6)
Other	3	1	2	1

Original ultrasound data. The numbers in brackets are data after exclusion of subjects who had a forced expert diagnosis.

Table 4: **Endpoint diagnosis and transcranial sonography**

39 patients were clinically categorised as having iPD. Compared with endpoint diagnosis, the sensitivity of TCS at baseline was 90·7% and the specificity was 82·4%; the positive predictive value of TCS for iPD was 92·9% and the classification accuracy was 88·3%.

L’iperecogenicità della SN è associata ad un aumentato rischio di PD nella popolazione anziana ?

Enlarged Substantia Nigra Hyperechogenicity and Risk for Parkinson Disease

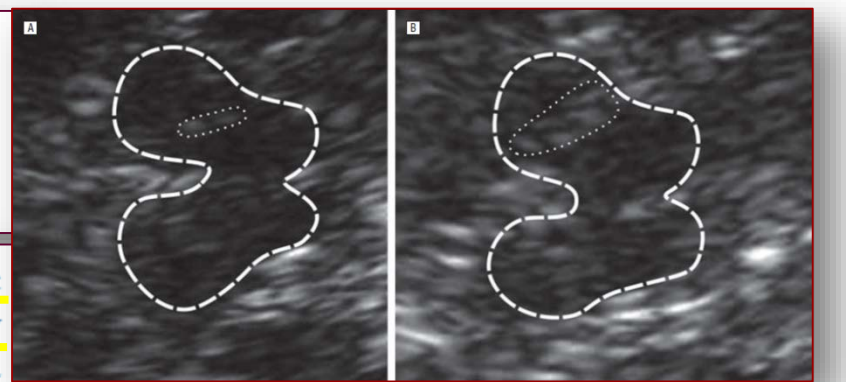
Arch Neurol. 2011;68(7):932-937

A 37-Month 3-Center Study of 1847 Older Persons

Tübingen, Germany
Homburg/Saar, Germany
Innsbruck, Austria

Daniela Berg, MD; Klaus Seppi, MD; Stefanie Behnke, MD; Inga Liepelt, PhD; Katherine Schweitzer, MD; Heike Stockner, MD; Frank Wollenweber, MD; Alexandra Gaenslen, MD; Philipp Mahlknecht, MD; Jörg Spiegel, MD; Jana Godau, MD; Heiko Huber, MD; Karin Srulijes, MD; Stefan Kiechl, MD; Marianna Bentele; Arno Gasperi, MD; Teresa Schubert; Teresa Hiry; Mareike Probst; Vera Schneider; Jochen Klenk, PhD; Martin Sawires, MD; Johann Willeit, MD; Walter Maetzler, MD; Klaus Fassbender, MD; Thomas Gasser, MD; Werner Poewe, MD

Objective: To evaluate whether enlarged substantia nigra hyperechogenicity (SN+) is associated with an increased risk for Parkinson disease (PD) in a healthy elderly population.



Conclusions: In this prospective study, we demonstrate for the first time a highly increased risk for PD in elderly individuals with SN+. Transcranial sonography of the midbrain may therefore be a promising primary screening procedure to define a risk population for imminent PD.

tion period of 37 months, the RR of incident PD was more than 17 times higher in elderly participants with SN+ compared with those with SN–, thus demonstrating an association between SN+ and subsequent development of PD in healthy adults.

Walter U, Niehaus L, Probst T et al.

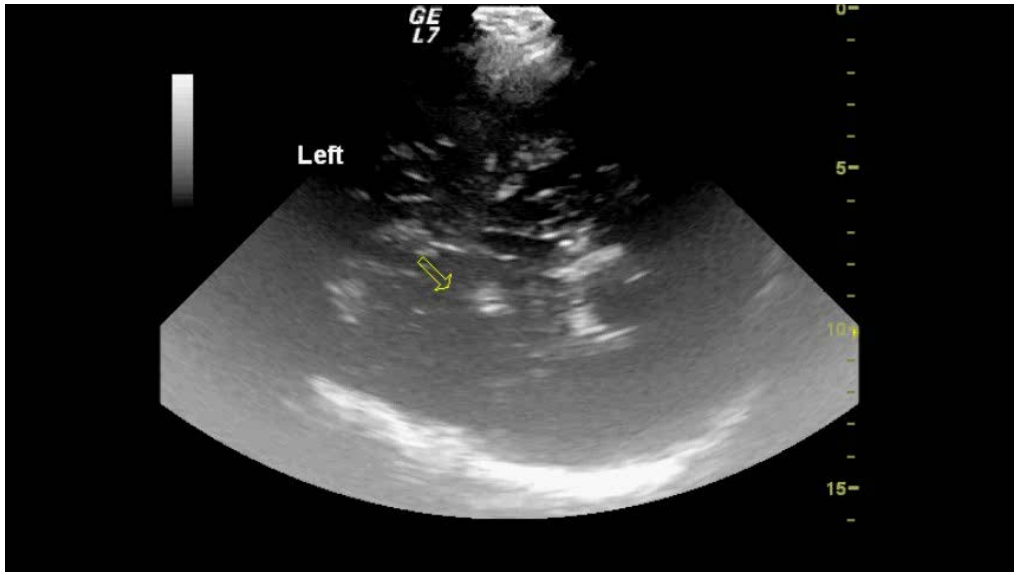
Brain parenchyma sonography discriminates Parkinson's disease and atypical parkinsonian syndromes.

Neurology 2003;60:74-77

Methods: Twenty-five patients with **APS**, 9 with **progressive supranuclear palsy** (PSP) and 16 with **multiple-system atrophy** (MSA), and 25 age-matched patients with **IPD** were prospectively studied with BPS according to a standardized protocol.

Results: Twenty-four of the 25 (96%) IPD patients exhibited hyperechogenicity of the substantia nigra (SN) but only 2 of 23 (9%) APS patients.

Nucleus lentiformis hyperechogenicity was found in 17 of 22 (77%) APS patients but in only 5 of 22 (23%) IPD patients



Walter U, Behnke S, Eyding J et al.

Transcranial brain parenchyma sonography in movement disorders: state of the art.

Ultrasound Med Biol 2007; 33:15-25

The present paper summarizes recommendations on transcranial sonography (TCS) application in Neurodegenerative diseases, resulting from a **consensus meeting** of the **European Society of Neurosonology and Cerebral Hemodynamics**.

Syndrome	SN +	LN +	III Ventr	L Ventr
N>60y	+	+	(+)	+
PD	+++	+	(+)	+
MSA	(+)	+++	-	(+)
PSP	+	+++	+++	++
CBD	+++	+++	-	+

(+) rarely found; + sparsely found; ++ frequent; +++ almost always found

Transcranial sonography in movement disorders

Daniela Berg, Jana Godau, Uwe Walter

Lancet Neurol 2008; 7: 1044–55

TCS finding	Indicated condition	Excluded condition	Sensitivity†	Specificity†	PPV†
Hyperechogenicity of the substantia nigra[41,33,74,75,76]	PD	MSA-P or PSP	82–98 (92‡)	70–100 (80‡)	84–100 (91‡)
Normal substantia nigra[74]	MSA-P or PSP	PD	72	98	91–95
Normal substantia nigra plus hyperechogenicity of the lenticular nucleus[74,75]	MSA-P or PSP	PD	56–59	99–100	96–100
Normal substantia nigra plus hyperechogenicity of the lenticular nucleus[74]	MSA-P	PD	65	100	100
3V (>10 mm) plus hyperechogenicity of the lenticular nucleus[74]	PSP	PD	84	98	94

3V=width of third ventricle (minimally measured width). PPV=positive predictive value. *ie, parkinsonian type of MSA-P and PSP. †percent. ‡result of pooled analysis of all five studies that included 500 patients with adequate assessability on TCS, of whom 353 had definite PD, 86 had probable or possible MSA-P, and 61 had probable or possible PSP.

Table 2: **Sensitivity and specificity of TCS findings to discriminate between idiopathic PD and atypical PS***

Transcranial sonography in movement disorders

Daniela Berg, Jana Godau, Uwe Walter

Lancet Neurol 2008; 7: 1044–55

	Echogenicity of the substantia nigra	Echogenicity of the lenticular nucleus	Echogenicity of the raphe	Ventricle widths	Echogenicity of the red nucleus
Idiopathic Parkinson's disease	↑↑↑↑	↑	↓↓*	↑ to ↑↑	0
Parkinsonian variant of multiple system atrophy and progressive supranuclear palsy	0 or ↑↑	↑↑↑	0	↑ or ↑↑↑↑	0
Corticobasal degeneration and dementia with Lewy bodies	↑↑↑↑	↑↑ to ↑↑↑	0 or ↓	0 or ↑↑↑	0
Vascular parkinsonian syndromes	0	↑↑	0	0	..
Normal pressure hydrocephalus	0	↑↑	0	↑↑↑↑	..
Wilson's disease	↑↑	↑↑↑↑	↓*	↑↑	0
Fahr's disease	0	↑↑↑	0	↑	..
Essential tremor	↑†	0	0	0	..
Depression	↑↑†	0	↓↓↓§	0	0
Primary restless leg syndrome	↓↓↓↓	0	↓↓↓*	0	↑↑↑
Dystonia	0	↑↑ to ↑↑↑	0	0	..
Spinocerebellar ataxia type 3	↑↑	↑↑	0	↑↑↑↑	..
Huntington's disease	0	↑ (caudate nuceus ↑ to ↑↑↑)	0	↑↑↑	..

cells

Cells 2020, 9, 2; doi:10.3390/cells9010002

MDPI

Article

Lentiform Nucleus Hyperechogenicity in Parkinsonian Syndromes: A Systematic Review and Meta-Analysis with Consideration of Molecular Pathology

Daniel Richter [1], Aristeidis H. Katsanos [1,2], Christoph Schroeder [1], Georgios Tsivgoulis [2,3], George P. Paraskevas [4], Thomas Müller [5], Andrei V. Alexandrov [3], Ralf Gold [1,6], Lars Tönges [1,6] and Christos Krogias [1,*]

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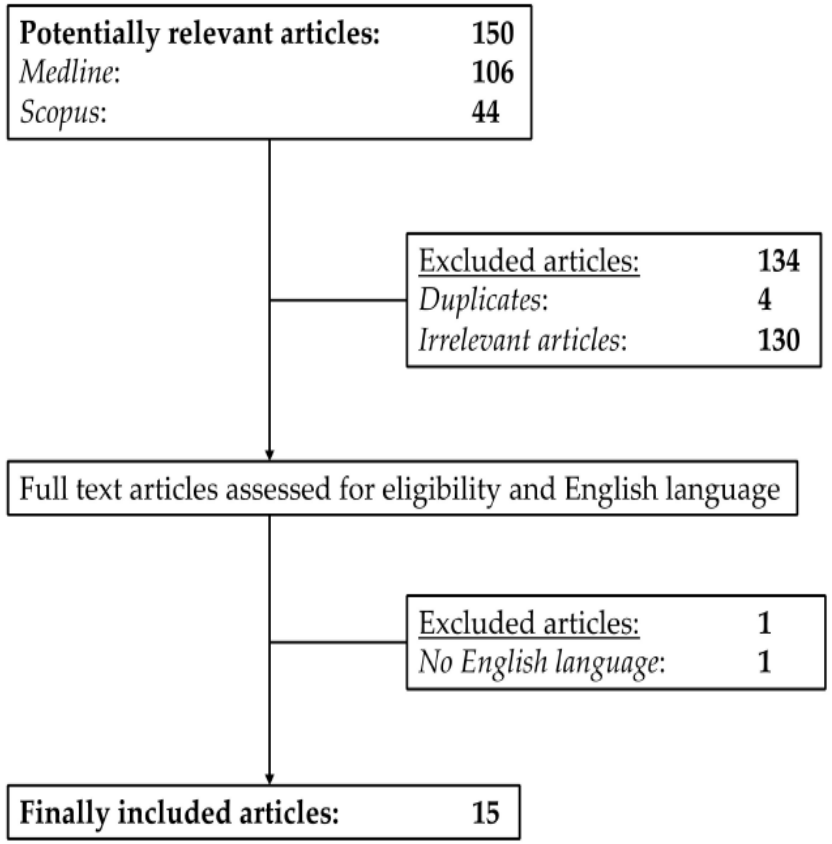

Figure 1. Flow chart of the selection process for the included studies.

From research on MEDLINE and SCOPUS we found 150 potentially relevant articles. Figure 1 shows the selection process visualized as a flow chart. After assessing the abstracts, 135 articles were excluded.

Table 1. Main characteristics of the studies included.

Authors	Year	Country	Center	TCS Device (MHz)	Ultrasound System	PD Cases	aPS Cases (MSA-P/ PSP)	Mean Age (PD/ aPS)
Monaco et al.	2018	Italy	Mono	2–3.5	Sonos 750, Philipps	119	90 (-/-)	66/62
Prati et al.	2017	Italy	Multi	2.5	APLIO 400 Platinum, Toshiba	25	-	-
Sheng et al.	2017	China	Mono	2.5	Sequoia 512, Siemens	356	-	64/-
Smaljovic et al.	2017	Bosnia and Herzegovina	Mono	2.5	EnVisor C HD, Philips	41	-	65/-
Sadowski et al.	2015	Poland	Mono	1–4	Esaote, MyLab 70XVision	-	20 (0/20)	-/60
Sanzaro et al.	2015	Italy	Mono	2.5	General Electric, Logiq 7 Pro	-	5 (2/3)	-/-
Alonso-C. et al.	2014	Spain	Mono	2.5	Xario, Toshiba	78	-	73/-
Laučkaitė et al.	2014	Lithuania	Mono	2-5	Voluson 730, General Electrics Healthcare	141	-	64/-
Laučkaitė et al.	2012	Lithuania	Mono	1, 3–4	Voluson 730, General Electrics Healthcare	-	3 (-/-)	67
Gaenslen et al.	2008	Germany	Mono	2.5	Elegra, Siemens	35	9 (-/-)	-/-
Walter et al.	2007	Germany	Mono	2.5	Elegra, Siemens	134	39 (20/19)	67/68
Walter et al.	2006	Germany	Mono	2.5	Elegra, Siemens	25	-	71/-
Behnke et al.	2005	Germany	Multi	2.5	Elegra, Siemens	88	50 (32/18)	67/66
Walter et al.	2003	Germany	Mono	2.5	Elegra, Siemens	25	23 (-/-)	68/69
Walter et al.	2002	Germany	Mono	2.5	Elegra, Siemens	24	-	69/-

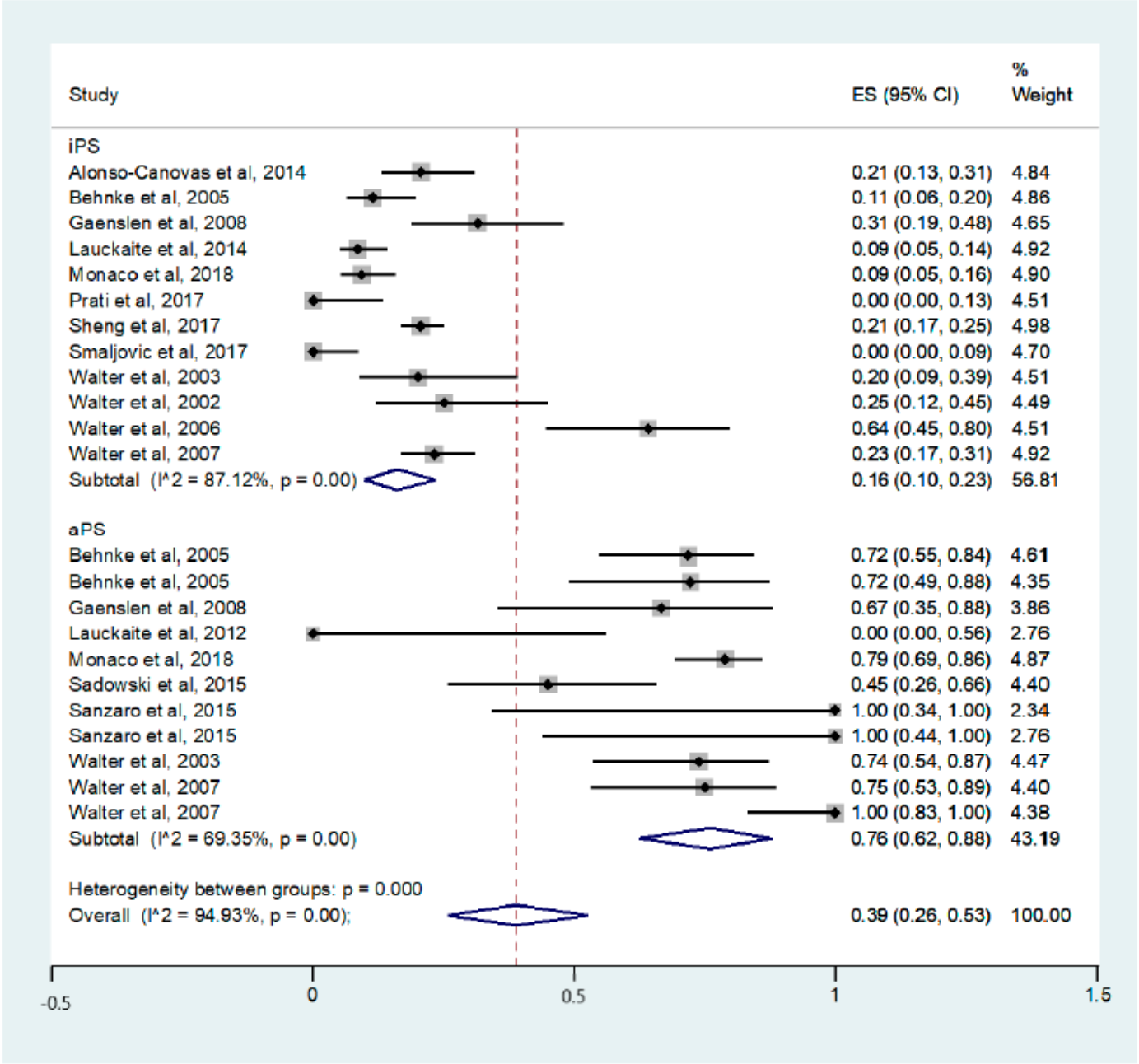

Figure 2. Forest plots of the studies included for the calculation of prevalence of LN hyperechogenicity in PD and aPS. PD = Parkinson's disease; aPS = atypical parkinsonian syndromes.

A hyperechogenic lentiform nucleus frequently occurs in MSA-P and PSP, while it is an uncommon feature in PD.

Additionally, the prevalence of LN hyperechogenicity in the healthy population is assumed to be low.

Whether LN hyperechogenicity could further serve as risk factor or prodromal marker for MSA-P or PSP remains to be evaluated in future studies.

Hindawi
Parkinson's Disease
Volume 2021, Article ID 8891874, 9 pages
https://doi.org/10.1155/2021/8891874

Review Article

Transcranial Sonography of the Substantia Nigra for the Differential Diagnosis of Parkinson's Disease and Other Movement Disorders: A Meta-Analysis

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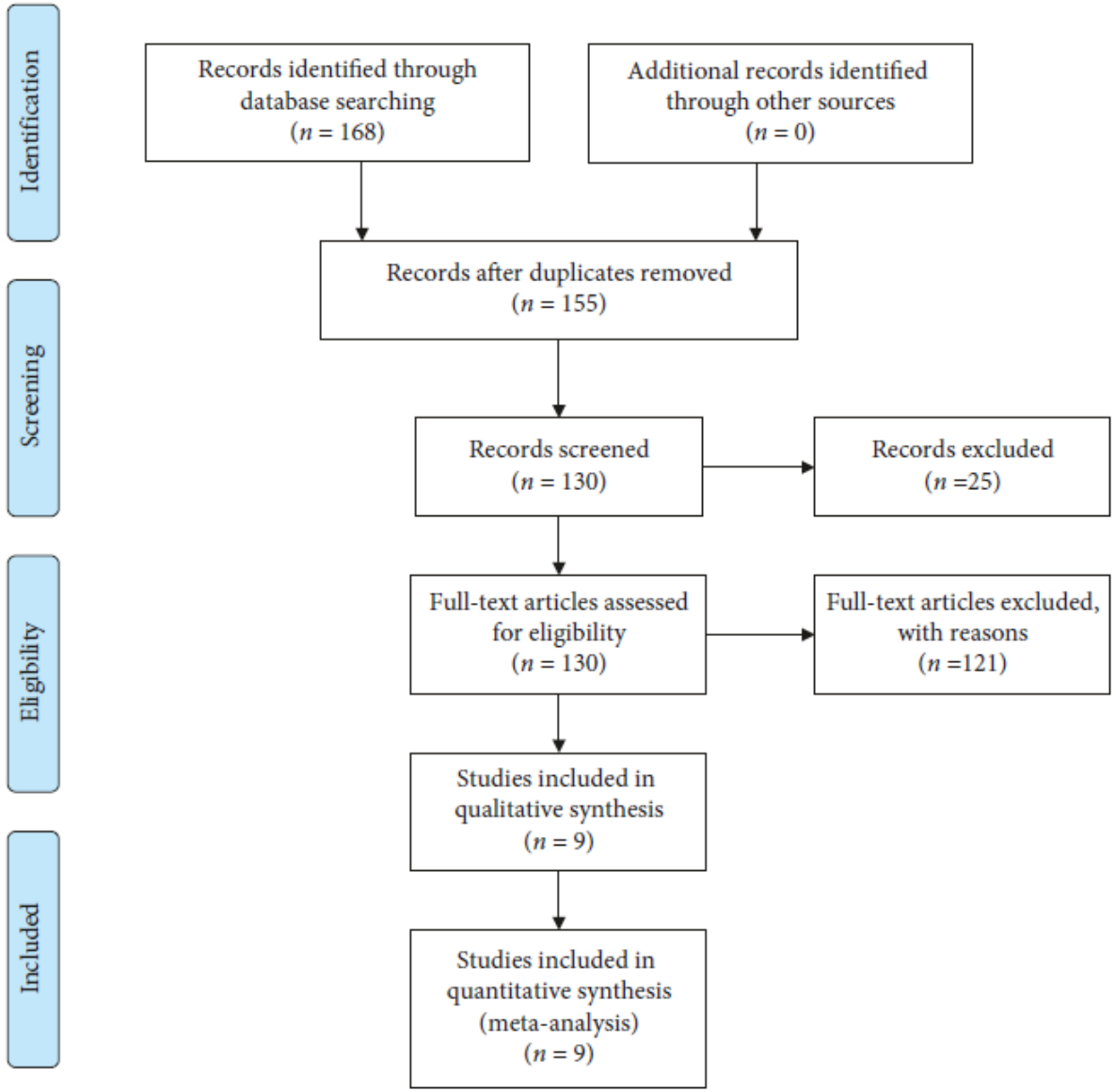


Figure 1: Flow chart of the selection process of the included studies.

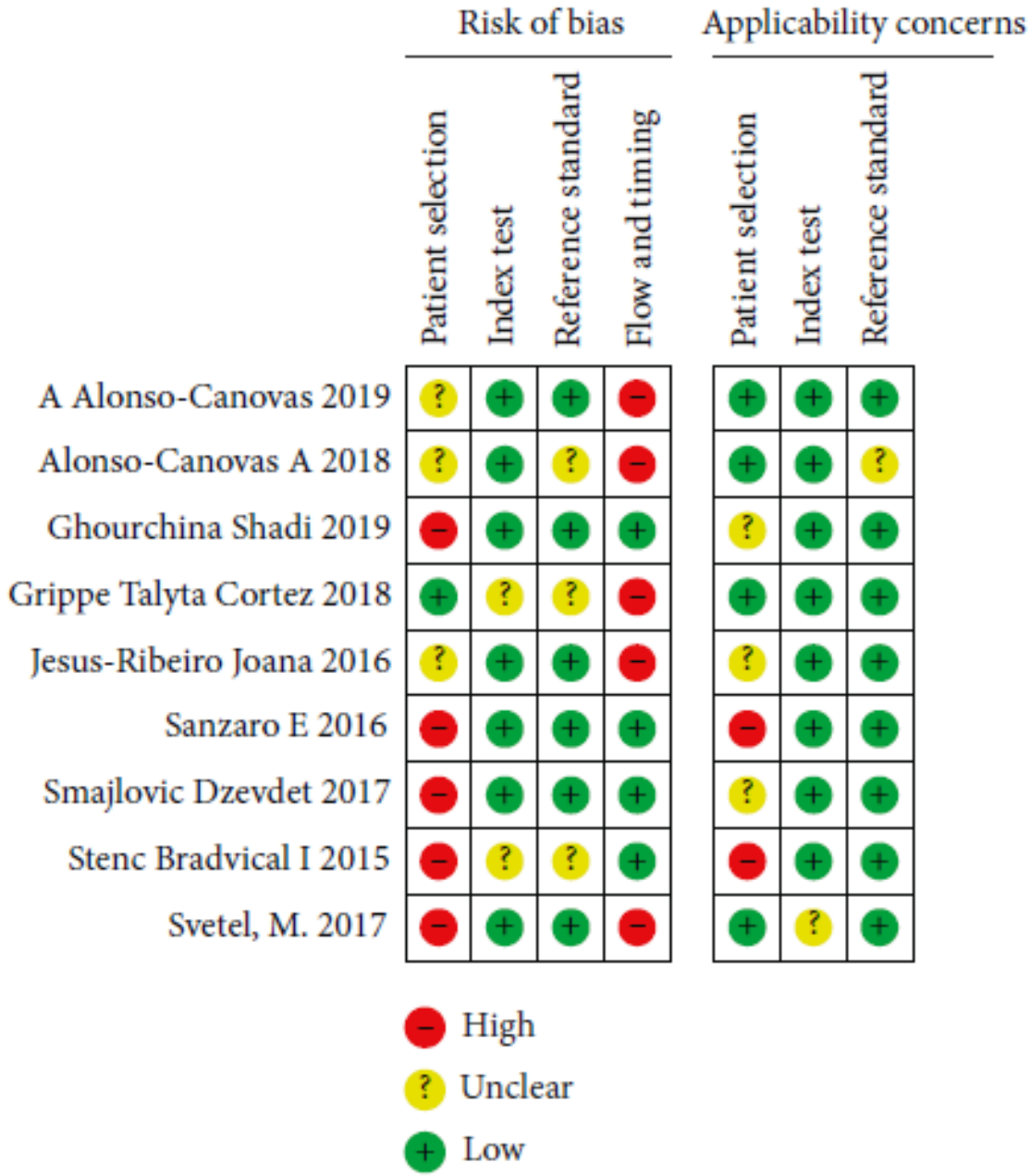
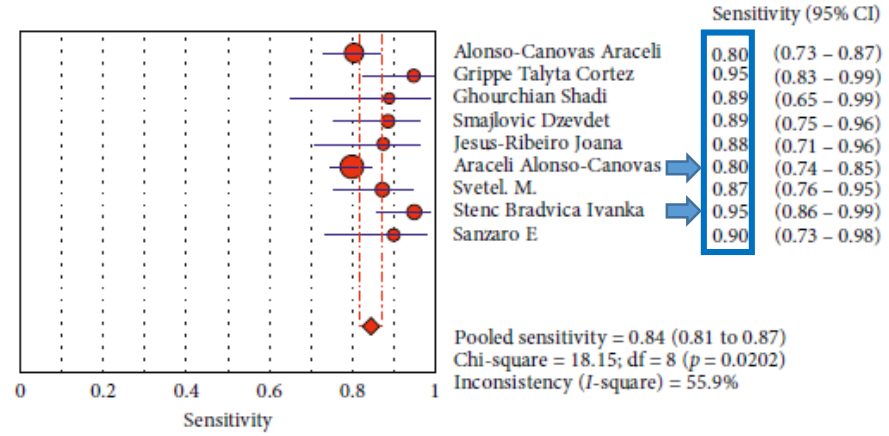

Risk of bias
Applicability concerns
Patient selection
Index test
Reference standard
Flow and timing
Patient selection
Index test
Reference standard
A Alonso-Canovas 2019
Alonso-Canovas A 2018
Ghourchina Shadi 2019
Grippe Talyta Cortez 2018
Jesus-Ribeiro Joana 2016
Sanzaro E 2016
Smajlovic Dzevdet 2017
Stenc Bradvical I 2015
Svetel, M. 2017
High
Unclear
Low

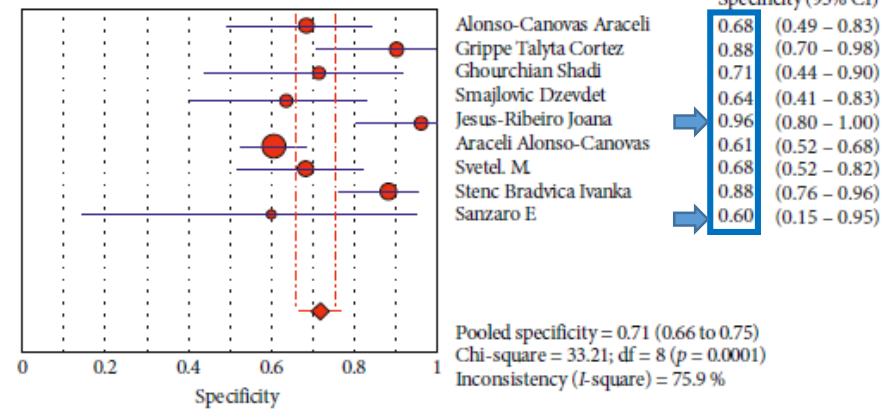
Table 1: Characteristics of the included studies.

Author	Year	PD cases	PD age (years)	Control groups	Cutoff value	TCS device	Diagnostic criteria	TP	FP	FN	TN
Alonso-Canovas A	2018	138	71.0 (25–90)	AP, ET, VP	21 mm or 25 mm	2.5 MHz	UK Brain Bank criteria	111	11	27	23
Grippe TC	2018	39	67.0 (17–88)	AP, ET, EPD	20 mm	2.0–3.5 MHz	UK Brain Bank criteria	37	3	2	23
Ghourchian S	2019	18	65.4 (SD 5.8)	PSP	25 mm	2.0–2.5 MHz	UK Brain Bank criteria	16	5	2	12
Smajlović D	2017	44	64.9 (SD 7.8)	PSP, CBD, MSA, VP	20 mm	2.5 MHz	UK Brain Bank criteria	39	8	5	14
Jesus-Ribeiro J	2016	32	62.0 (IQR 13)	ET	24 mm	3.0 MHz	UK Brain Bank criteria	28	1	4	25
Štenc Bradvica I	2015	59	67.2 (SD 7.6)	ET,HCs	20 mm	2.0–4.0 MHz	Not mentioned	56	6	3	45
Alonso-Canovas A	2019	254	69.0 (SD 11)	PSP, CBD, MSA	21 mm or 25 mm	2.5 MHz	UK Brain Bank criteria	203	61	51	94
Svetel M	2017	55	58.9 (SD 10.9)	DRB, FD, HCs	20 mm	2–4 MHz	UK Brain Bank criteria	48	13	7	28
Sanzaro E	2016	30	45.0–85.0	MSA, PSP	25 mm	2.5 MHz	Not mentioned	27	2	3	3

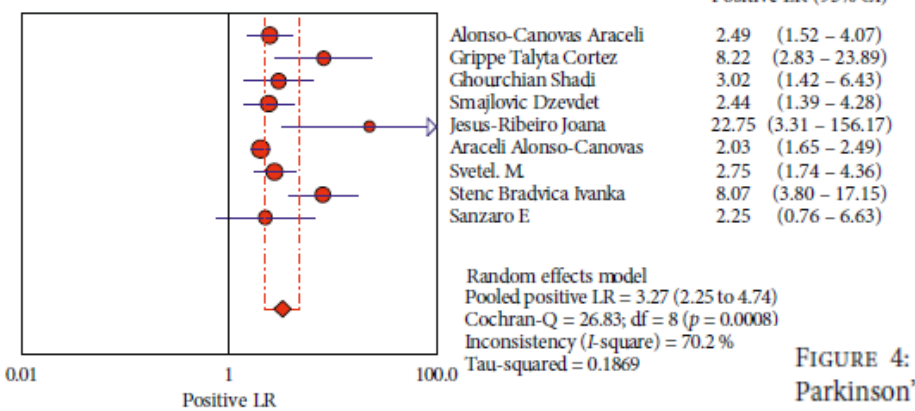
AP: atypical Parkinsonism; ET: essential tremor; VP: vascular Parkinsonism; EPD: excluded PD; PSP: progressive supranuclear palsy; CBD: corticobasal degeneration; MSA: multiple system atrophy; HCs: healthy controls; DRB: dopa-responsive dystonia; FD: isolated adult-onset focal dystonia; TCS: transcranial sonography; TP: true positive; FP: false positive; FN: false negative; PD: Parkinson's disease; TN: true negative; IQR: interquartile range; SD: standard deviation.

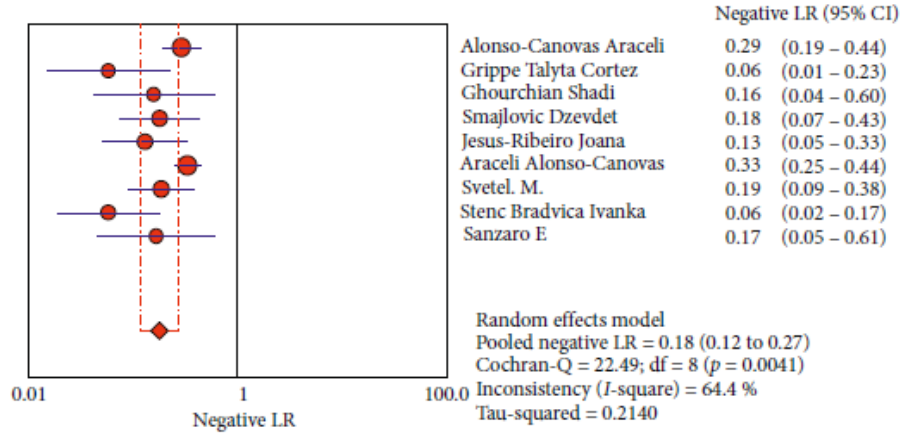


(a)

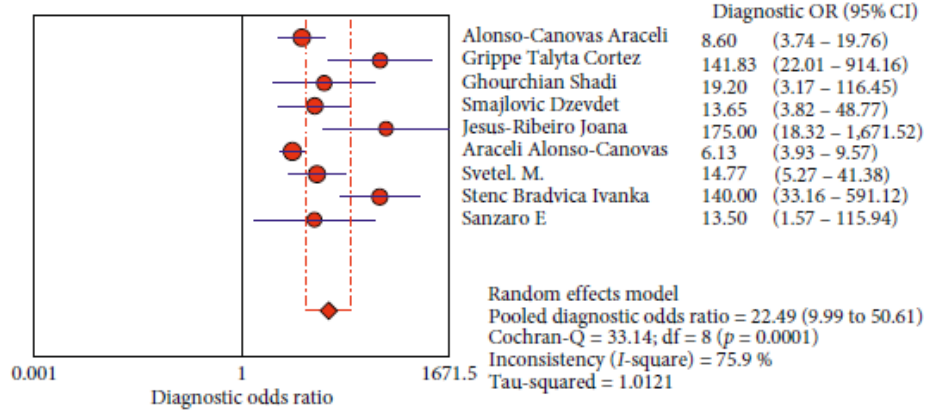


(b)





(d)



(e)

FIGURE 4: Forest plots of the diagnostic accuracy of transcranial sonography of the substantia nigra in the differential diagnosis of Parkinson's disease.

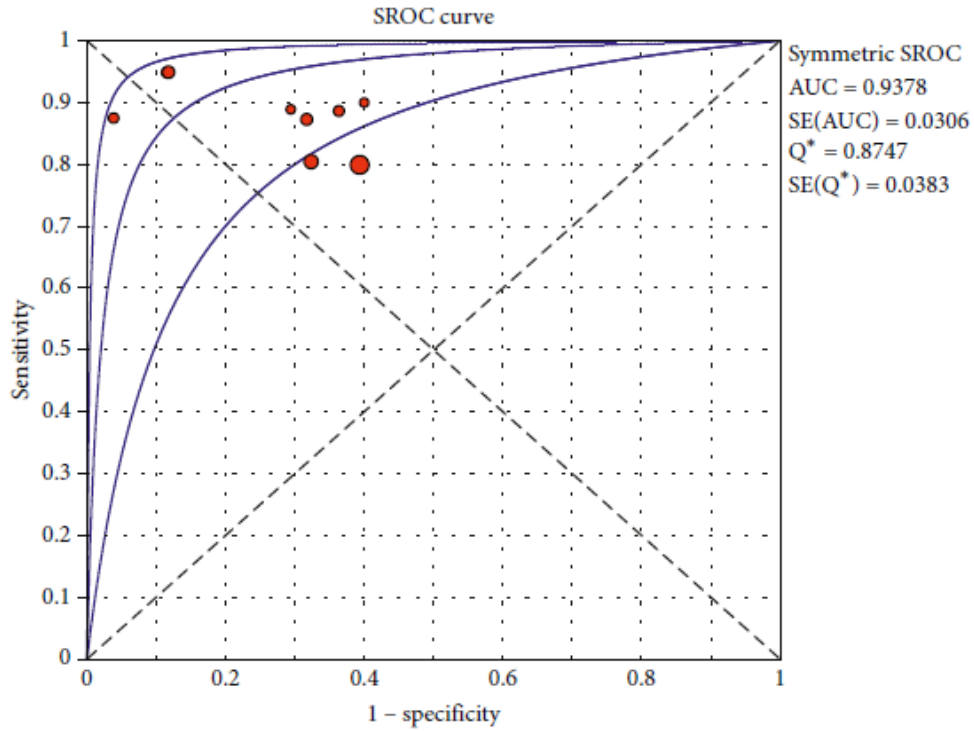
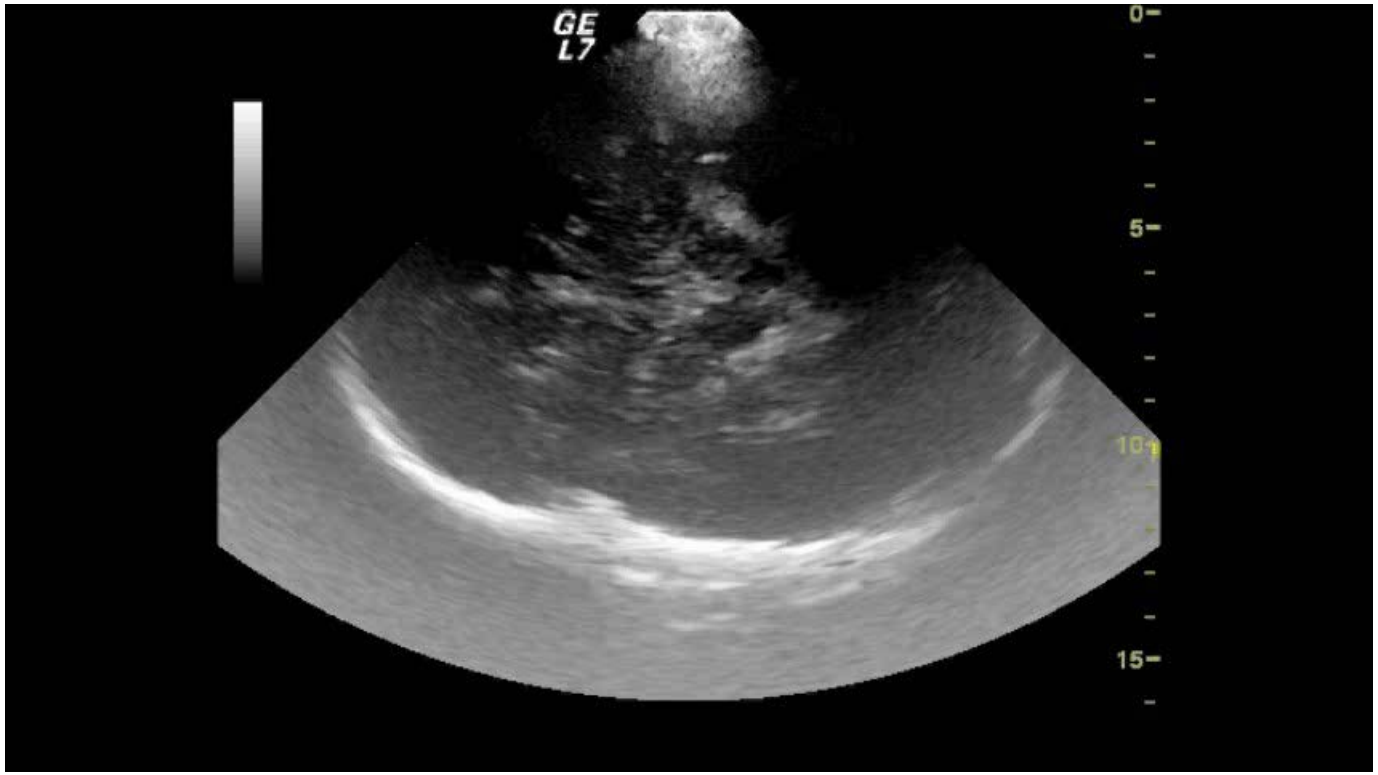


FIGURE 5: Summary receiver operating characteristic (SROC) curve for transcranial sonography for the differentiation of Parkinson's disease from other movement disorders. AUC = area under curve; SE = standard error; Q^* = point at which sensitivity and specificity are equal.

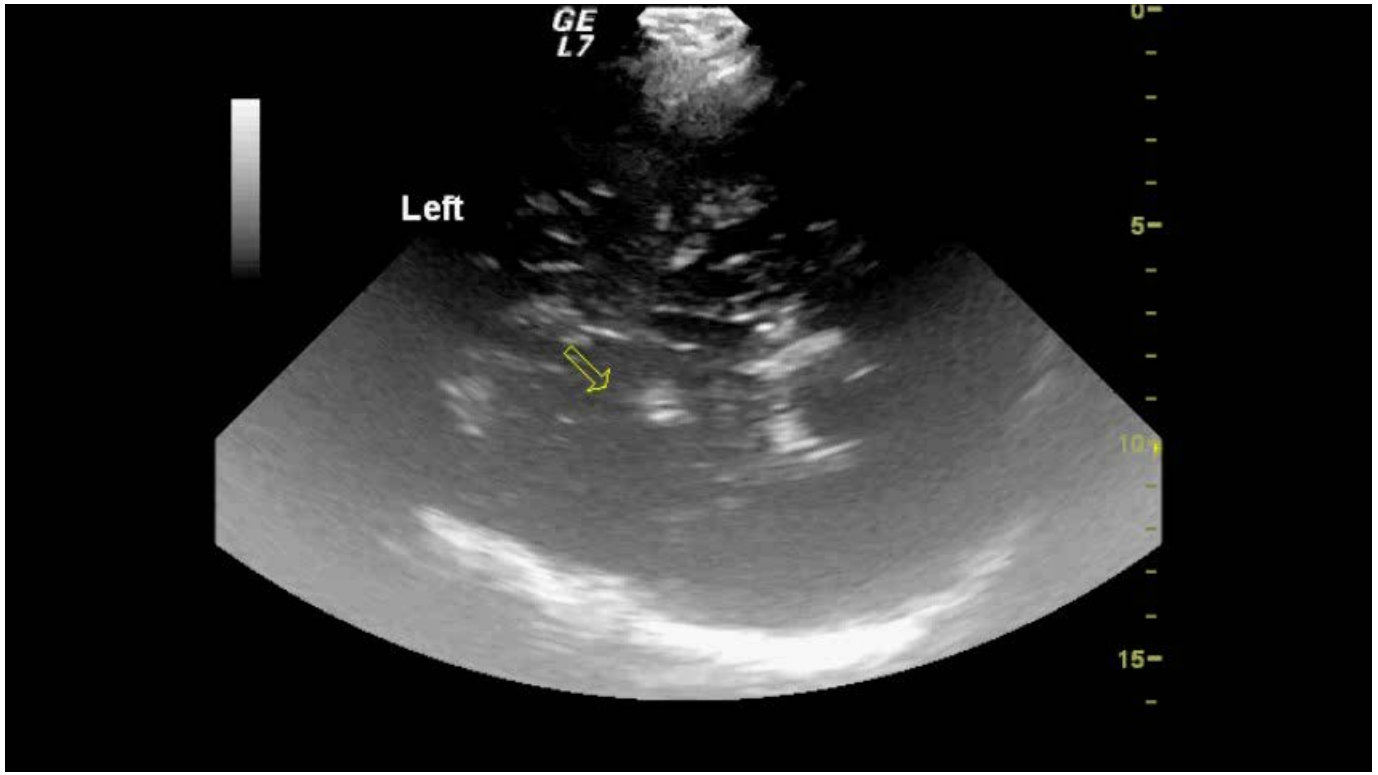
The AUC of this meta-analysis was 0.94, which was indicative of a high diagnostic accuracy

Degenerazione Cortico-Basale (CBD)



SN	n. lent.	Rafe	III vent	n. rosso
↑↑↑↑	↑↑ to ↑↑↑	N or ↓	N to ↑	N

Atrofia Multi-Sistemica (MSA-P)



SN	n. lent.	Rafe	III vent	n. rosso
N or ↑↑	↑↑↑	N	↑ to ↑↑	N

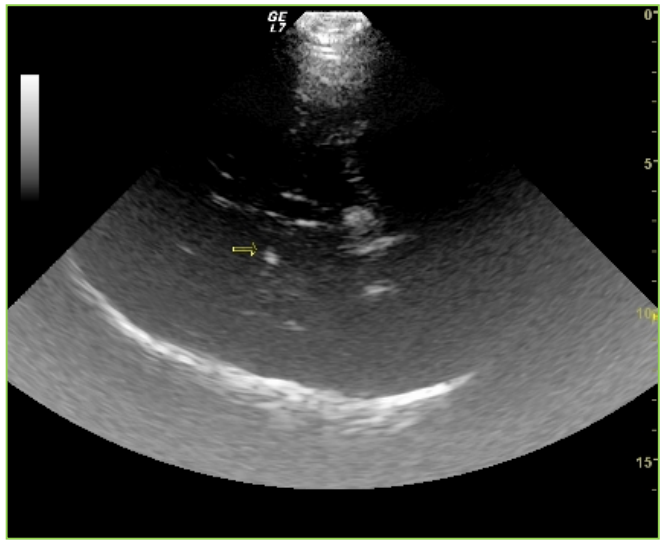
Psychiatry and Clinical Neurosciences 2017; **71**: 238–246 doi:10.1111/pcn.12483

Regular Article

Transcranial sonography in idiopathic REM sleep behavior disorder and multiple system atrophy

Xudong Li, MD, PhD,[1]* Shuang Xue, MD,[1] Shuhong Jia, MD,[1] Zhi Zhou, MD,[2] Yanan Qiao, MD,[1] Chunlei Hou, MB,[1] Kun Wei, MB,[1] Wenjing Zheng, MB,[1] Pei Rong, MB[1] and Jinsong Jiao, MD[1]

Departments of [1]Neurology and [2]Senior Official Ward, China–Japan Friendship Hospital, Beijing, China



Conclusion: Some iRBD patients had basal ganglia hyperechogenicity that was similar to that observed in MSA, which may represent another possible convert direction. The present study further confirmed iRBD as a prodromal stage of synucleinopathy. TCS could detect subclinical changes and thus might provide useful markers for identifying individuals at increased risk for developing a synucleinopathy.

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April 14, 2020; 94 (15) ARTICLE

Left-hemispheric predominance of nigrostriatal deficit in isolated REM sleep behavior disorder

Objective Unilateral onset of parkinsonism due to nigrostriatal damage of the contralateral hemisphere is frequent in Parkinson disease (PD). There is evidence for a left-hemispheric bias of motor asymmetry in right-handed patients with PD indicating a hemispheric dominance. Isolated REM sleep behavior disorder (IRBD) constitutes the prodromal stage of PD and other synucleinopathies. To test the hypothesis that right-handed patients with IRBD exhibit left-hemispheric predominance of subclinical nigrostriatal dysfunction, we evaluated this aspect using neuroimaging instruments.

Methods In 167 right-handed patients with IRBD without parkinsonism, we evaluated in each hemisphere the integrity of the striatal dopaminergic terminals by dopamine transporter (DAT)-SPECT and the substantia nigra echogenicity by transcranial sonography.

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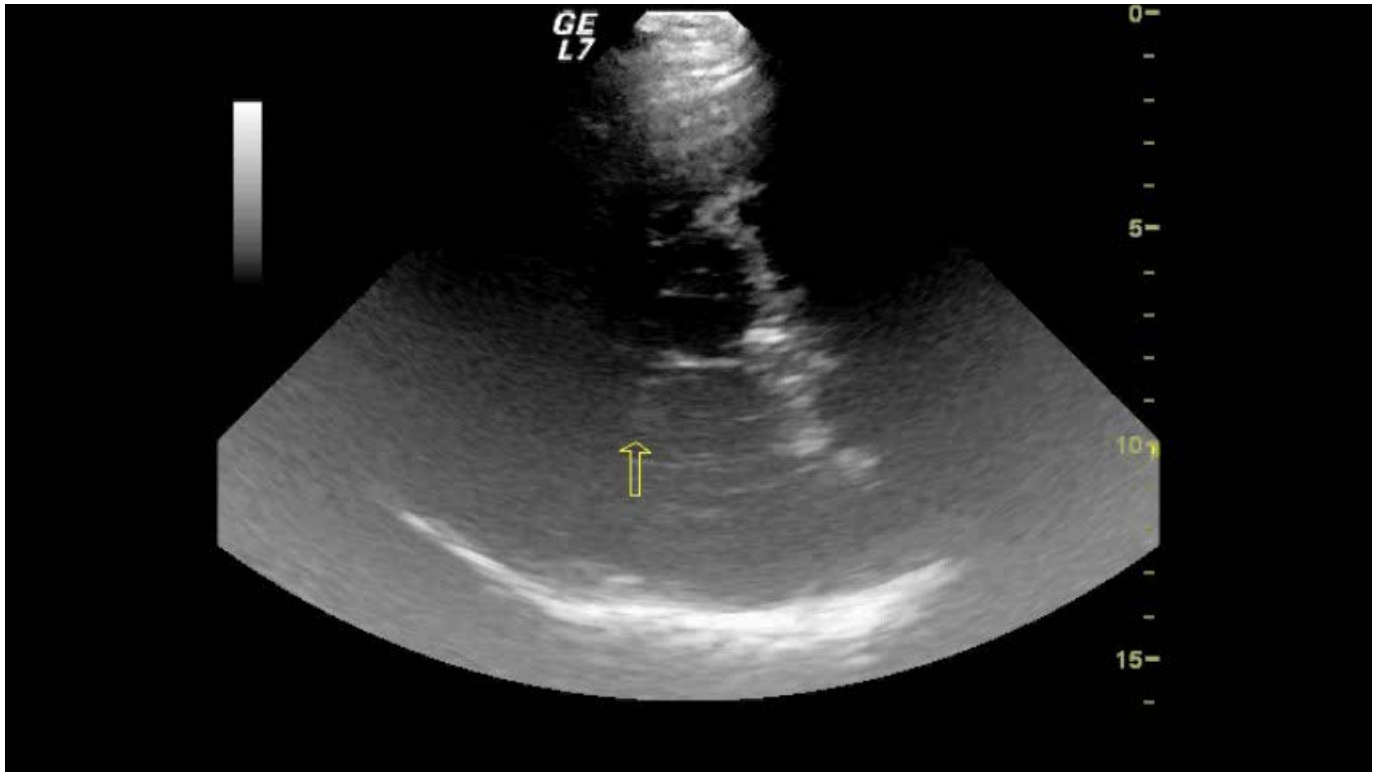
April 14, 2020; 94 (15) ARTICLE

Left-hemispheric predominance of nigrostriatal deficit in isolated REM sleep behavior disorder

Results DAT-SPECT showed lower specific binding ratio (SBR) in the left striatum and left caudate nucleus than in the right striatum and right caudate nucleus. The percentage of patients with lower SBR was greater in the left striatum and left caudate nucleus than in the right striatum and right caudate nucleus. In those who developed a synucleinopathy in <5 years from DAT-SPECT, there was a lower SBR in the left putamen and left caudate nucleus than in the right putamen and right caudate nucleus. Substantia nigra echogenic size was greater in the left than in the right side in patients with hyperechogenicity and among individuals who phenoconverted in <5 years from transcranial sonography.

Conclusion Right-handed patients with IRBD exhibit left-hemispheric predominance of subclinical nigrostriatal dysfunction. In premotor PD, the neurodegenerative process begins asymmetrically, initially impairing the nigrostriatal system of the dominant hemisphere.

Paralisi Sopranucleare Progressiva (PSP)



SN	n. lent.	Rafe	III vent	n. rosso
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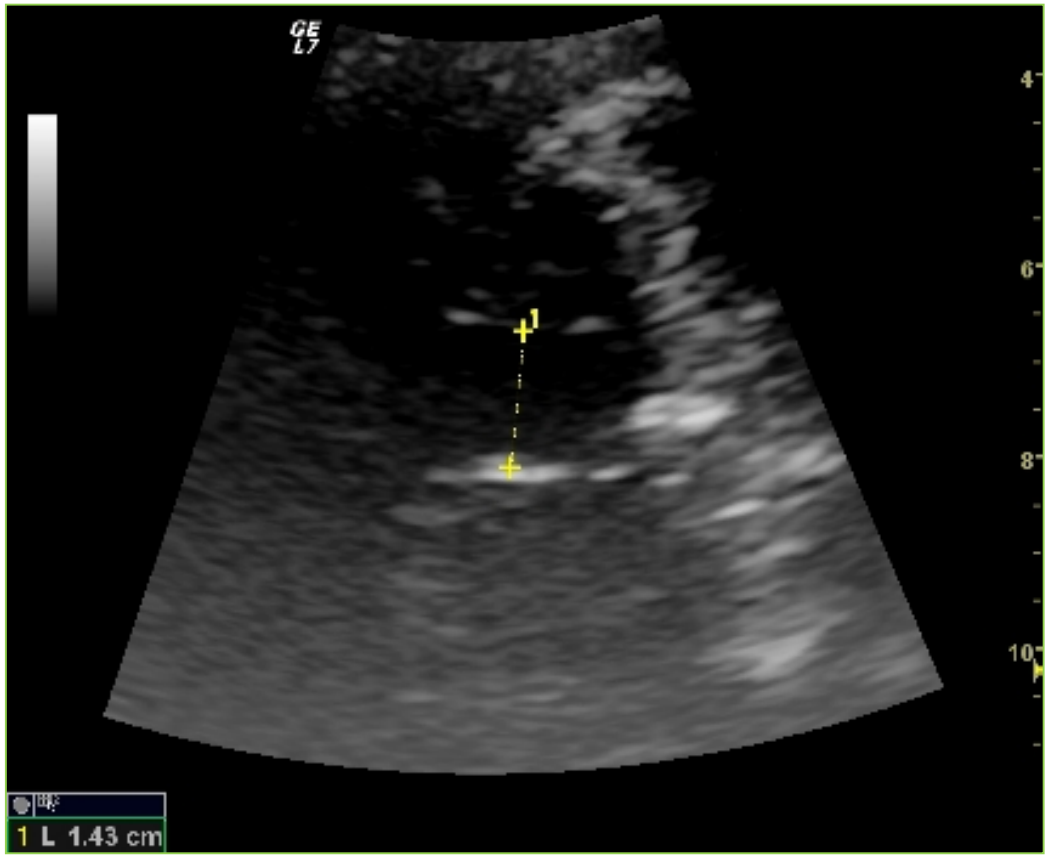
Paralisi Sopranucleare Progressiva (PSP)



SN	n. lent.	Rafe	III vent	n. rosso
N or ↑↑	↑↑↑	N	↑↑↑↑	N

Clin Neurol Neurosurg. 2019 Aug;183:105383. doi: 10.1016/j.clineuro.2019.105383. Epub 2019 Jun 5.

Midbrain area for differentiating Parkinson's disease from progressive supranuclear palsy.

Ghourchian S[1], Mousavi A[2], Zamani B[2], Shahidi G[2], Rohani M[3].

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Abstract

OBJECTIVES: We aimed to investigate the values of midbrain area in diagnosing Parkinson's Disease (PD) and progressive supranuclear palsy (PSP) by using transcranial sonography (TCS). Disease duration effect on brain sonographic findings could decrease the accuracy of TCS in PD and PSP patients. We reduced the disease duration effect on sonographic differences found between PD and PSP patients by using multivariate analysis.

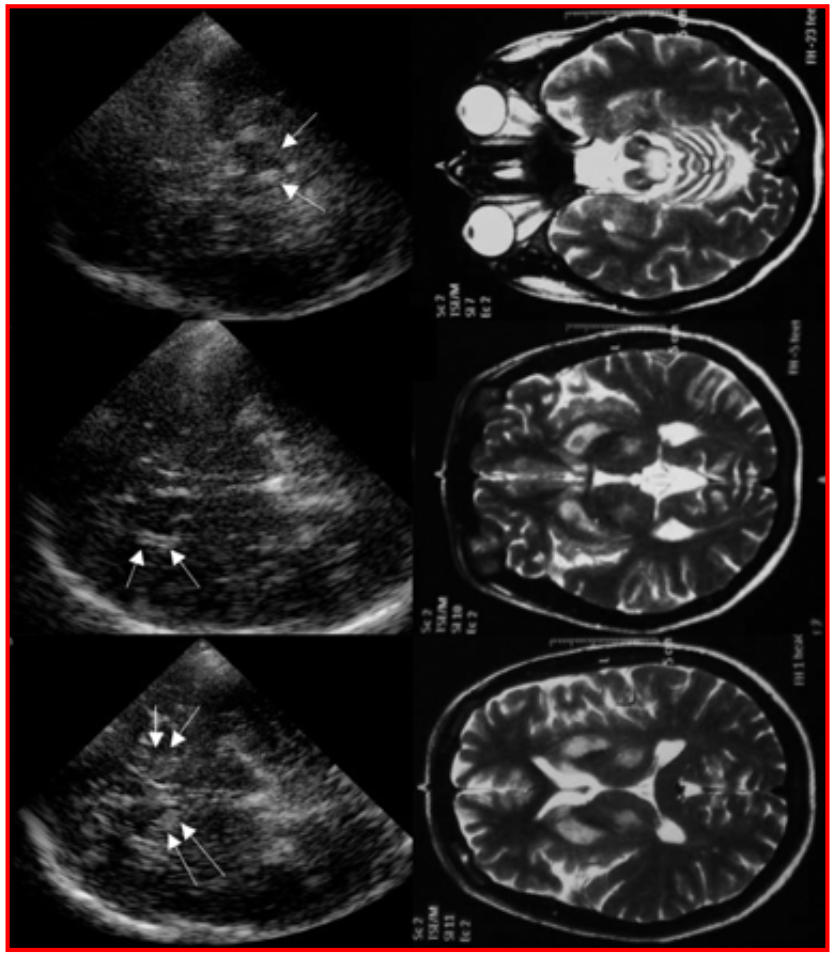
PATIENTS AND METHODS: Patients with clinical diagnosis of PSP and PD were recruited. We used SonoSite Edge II Ultrasound system to measure midbrain area, diameter of third ventricle and substantia nigra echogenicity. Diagnostic value of each measured area in sonography was estimated regarding its power for diagnosing PD or PSP. Independent sample t-test, Regression analysis and receiver operating characteristic (ROC) curve were performed using SPSS software.

RESULTS: Of 35 patients, 18 were PD and 17 PSP cases. The mean midbrain area was $4.86 \pm 0.71 cm^2$ in PD patients and $3.61 \pm 0.85 cm^2$ in those with PSP ($P < 0.005$). Regression for reducing the effect of disease duration on midbrain area variances between patients with PD and PSP revealed a significant P value ($P < 0.005$, Adjusted $R^2 = 0.36$). The sensitivity and specificity of midbrain area in diagnosing PD were 83.3% and 70.6% respectively. The sensitivity of the third ventricle size in diagnosing PSP was 82% although its specificity was 62%.

CONCLUSION: Midbrain area in patients with PD was wider than those with PSP that was not affected by disease duration. Midbrain area was the most accurate index for diagnosing PD by TCS although third ventricle size was the most sensitive one for diagnosing PSP.

Malattia di Wilson

SN	n. lent.	Rafe	III vent	n. rosso
↑↑	↑↑↑↑	↓	↑↑	N



Neurological Sciences (2020) 41:2605–2612
https://doi.org/10.1007/s10072-020-04378-6

ORIGINAL ARTICLE

Transcranial sonography changes in heterozygotic carriers of the *ATP7B* gene

Marta Skowronska[1] · Tomasz Litwin[1] · Iwona Kurkowska-Jastrzębska[1] · Anna Członkowska[1,2]

Heterozygotic carriers of one faulty ATP7B gene should not exhibit symptoms of WD, but one in three heterozygotes has copper metabolism abnormalities. This study examined heterozygote ATP7B mutation carriers using TCS to assess any basal ganglia changes compared with healthy controls.

SN and LN hyperechogenicity were more frequent in heterozygotes than in controls, probably due to copper accumulation, but it remains unknown if this predisposes to brain neurodegeneration.

The study assessed **34 heterozygotes** (21 women), with mean age of 43 years (range of 18 to 74 years) and 18 healthy controls (13 women), with mean age of 47 years (range of 20 to 73 years). **Bilateral lenticular nucleus (LN) hyperechogenicity was found in 25 heterozygotes**, but none of the controls ($p < 0.001$). Bilateral substantia nigra (SN) hyperechogenicity was found in 8 heterozygotes and one control; another 3 heterozygotes had unilateral SN hyperechogenicity ($p = 0.039$ for the right; $p = 0.176$ for the left). Heterozygotes had larger SN area on both sides compared with controls ($p = 0.005$ right; $p = 0.008$ left).

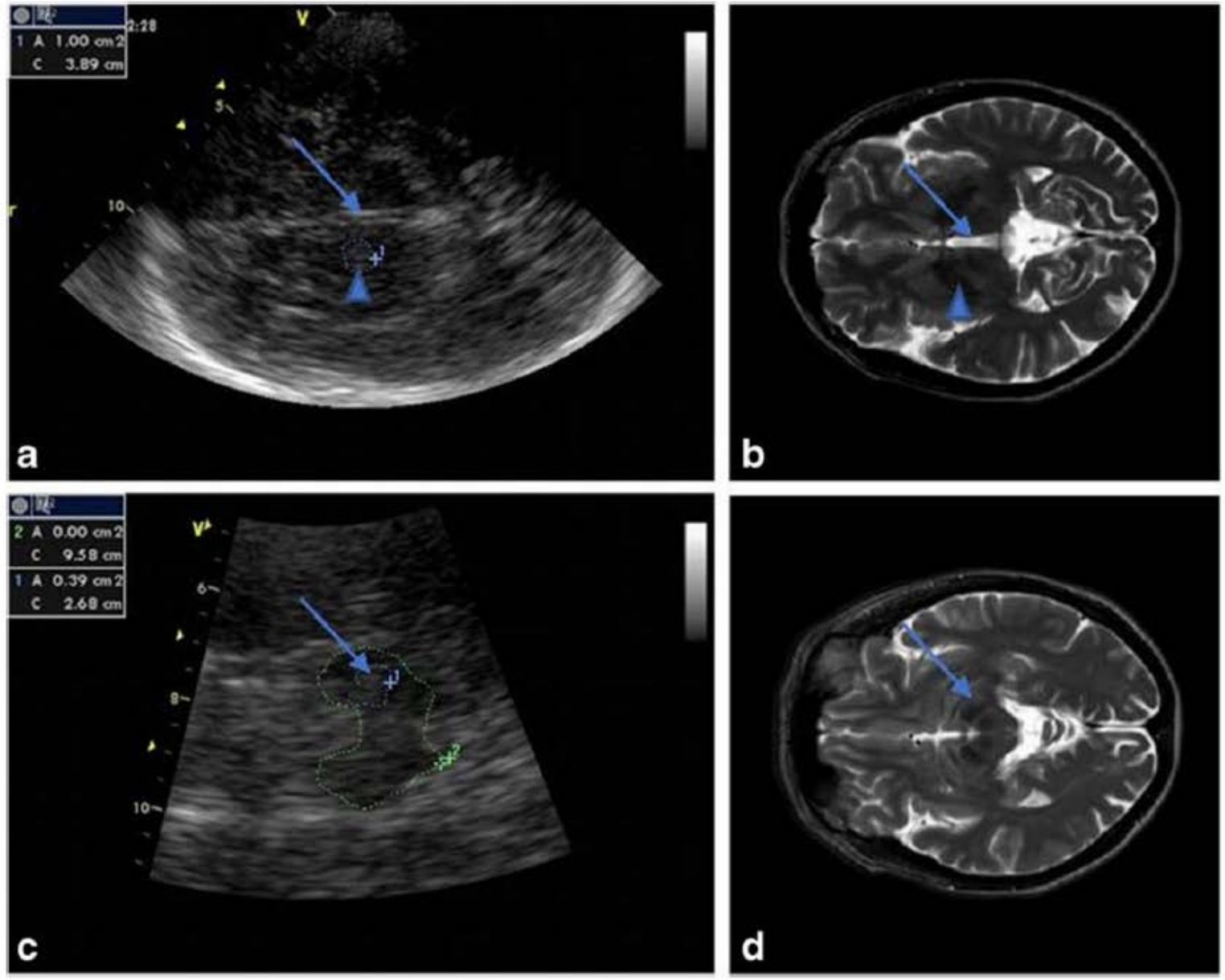
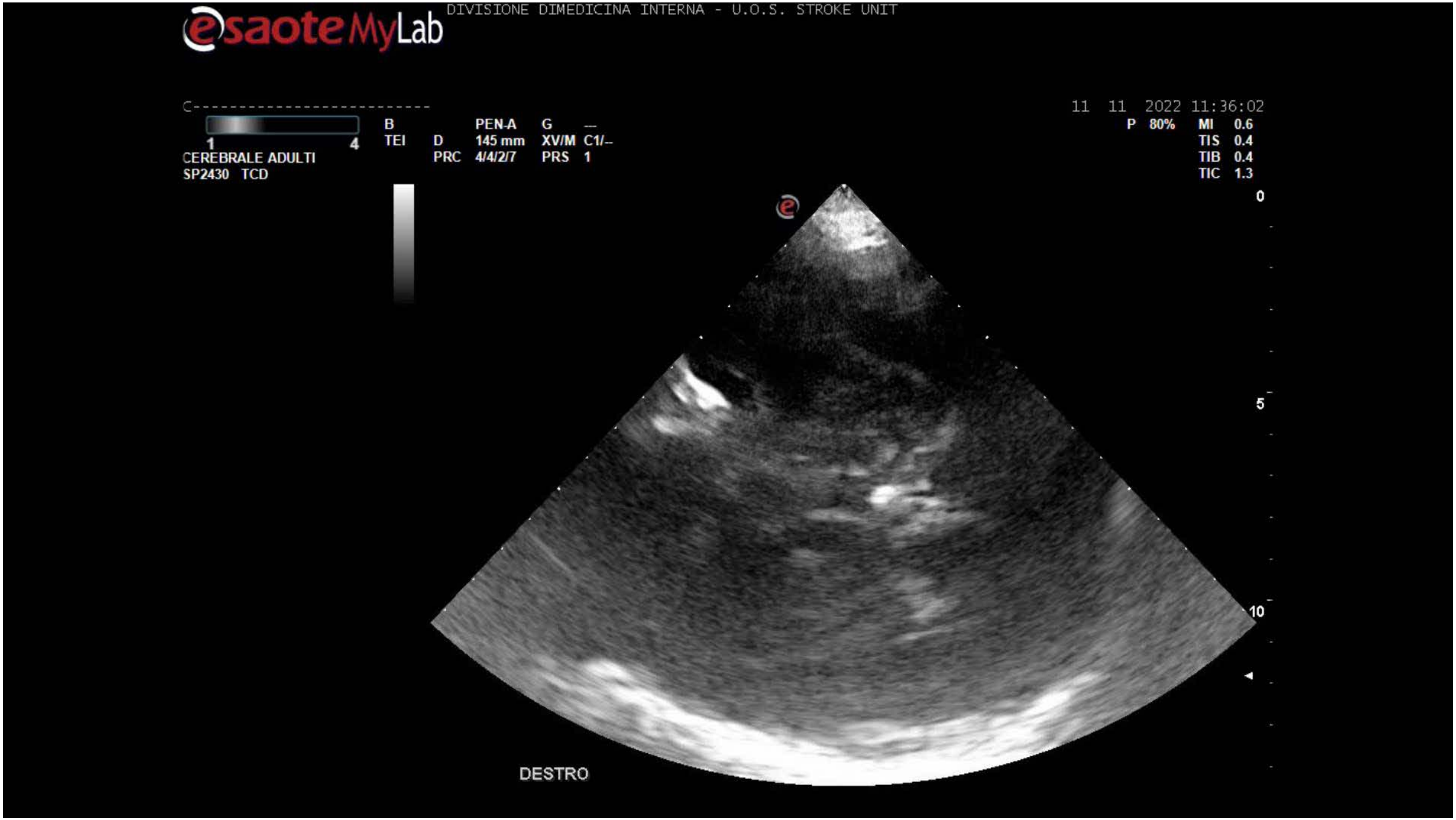


Fig. 1 Midbrain structures in transcranial sonography (TCS) with corresponding magnetic resonance imaging (MRI) T2-weighted images. **a** TCS with the hyperechogenic part of the LN measured (arrowhead). Arrow showing the 3rd ventricle, **b** Corresponding MR results. **c** TCS with substantia nigra measured (arrow). **d**. Corresponding MR results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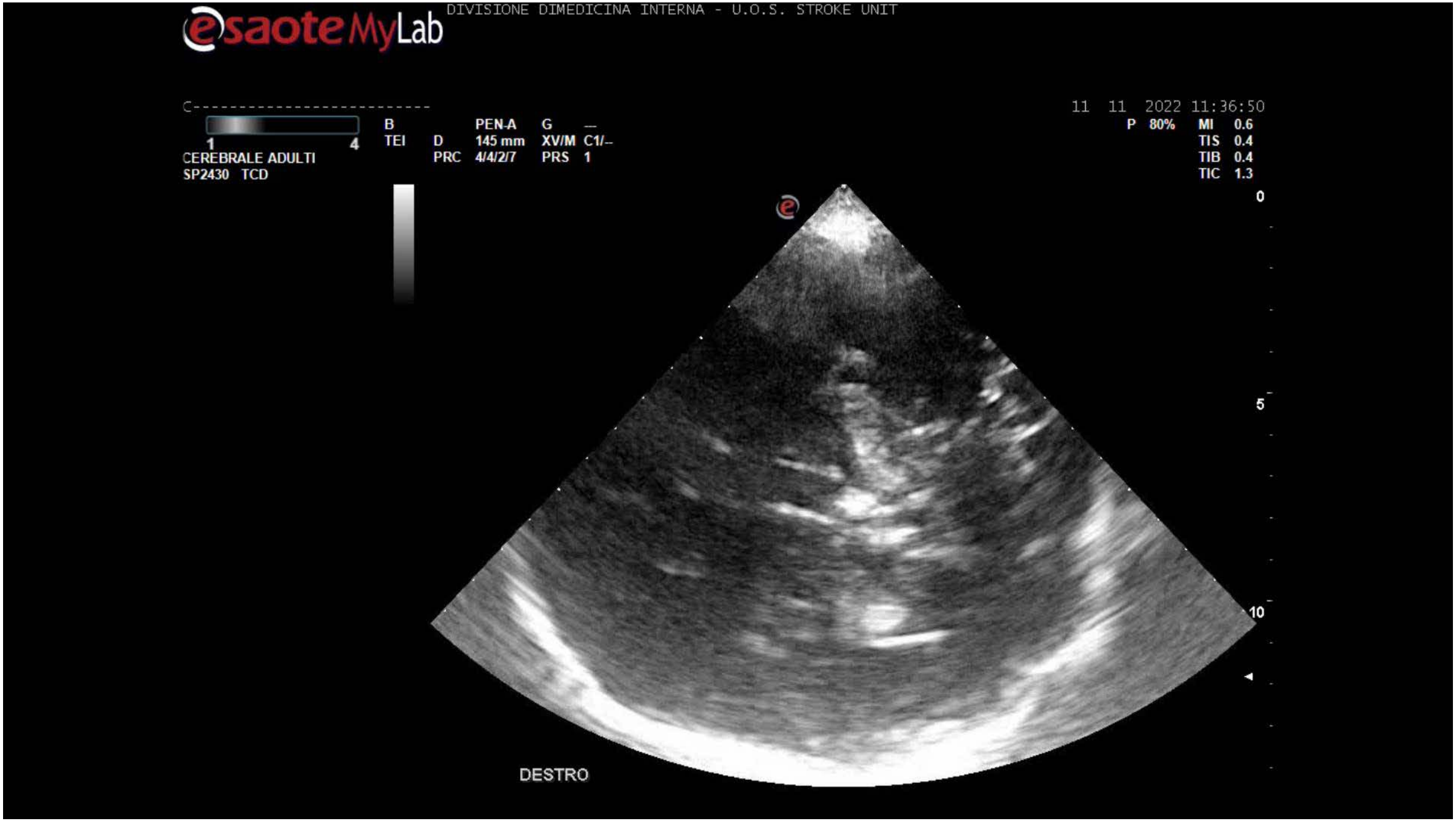
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Malattia di Wilson

SN	n. lent.	Rafe	III vent	n. rosso
↑↑	↑↑↑↑	↓	↑↑	N

Malattia di Fahr

SN	n. lent.	Rafe	III vent	n. rosso
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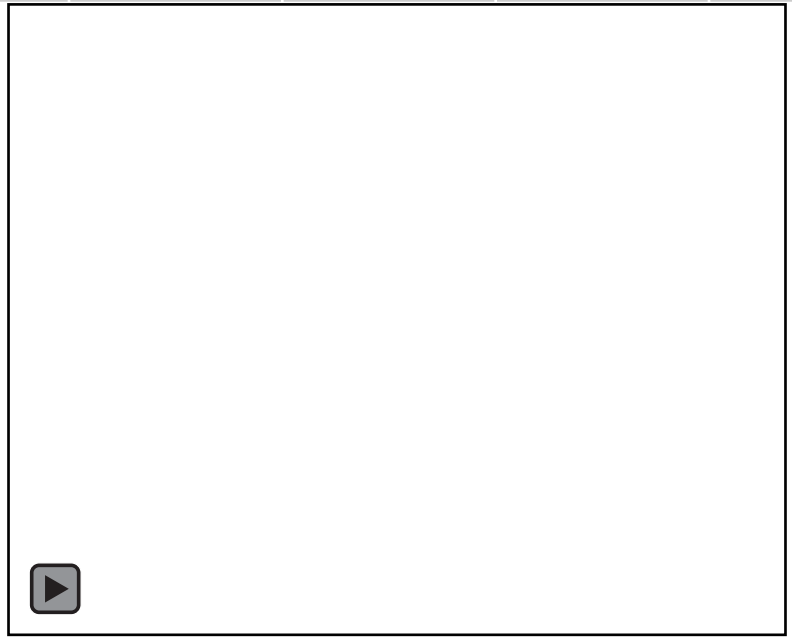

Malattia di Wilson

SN	n. lent.	Rafe	III vent	n. rosso
↑↑	↑↑↑↑	↓	↑↑	N

Malattia di Fahr

SN	n. lent.	Rafe	III vent	n. rosso
N	↑↑↑	N	↑	N

Tremore essenziale

SN	n. lent.	Rafe	III vent	n. rosso
↑	N	N	N	N

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Observational Study

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Essential tremor vs idiopathic Parkinson disease

Utility of transcranial sonography

Anyu Tao, MD, PhD[a], Guangzhi Chen, MD, PhD[b], Zhijuan Mao, MD, PhD[c], Hongling Gao, MD[c], Youbin Deng, MD, PhD[a], Renfan Xu, MD, PhD[a,*]

Abstract

Substantia nigra (SN) hyperechogenicity measured by transcranial sonography (TCS) is a promising biomarker for Parkinson disease (PD). The aim of this study was to explore the diagnostic accuracy of SN hyperechogenicity (SN^+) for differentiating PD from essential tremor (ET). A total of 119 patients with PD, 106 ET patients and 112 healthy controls that underwent TCS from November 2016 to February 2019 were included in this single-center retrospective case–control study. Two reviewers who were blinded to clinical information independently measured the SN^+ by TCS imaging. The diagnostic sensitivity, specificity, and accuracy of TCS imaging were evaluated between the PD and healthy controls and between patients with PD and ET. Interrater agreement was assessed with the Cohen κ statistic. TCS imaging of the SN^+ allowed to differentiate between patients with PD and ET with a sensitivity (91.6% and 90.8%) and specificity (91.5% and 89.6%) for readers 1 and 2, respectively. Interobserver agreement was excellent ($\kappa = 0.87$). In addition, measurement of the SN^+ allowed to differentiate between patients with PD and healthy subjects with a sensitivity (91.6% and 90.8%) and specificity (88.4% and 89.3%) for readers 1 and 2, respectively. Interobserver agreement was excellent ($\kappa = 0.91$). Measurement of SN^+ on TCS images could be a useful tool to distinguishing patients with PD from those with ET.

Abbreviations: APs = atypical parkinsonisms, CIs = confidence intervals, ET = essential tremor, HCs = healthy controls, NPV = negative predictive value, PD = Parkinson disease, PPV = positive predictive value, SN = substantia nigra, SN^+ = SN hyperechogenicity, TCS = transcranial sonography, UPDRS = unified Parkinson disease rating scale.

Keywords: essential tremor, Parkinson disease, substantia nigra hyperechogenicity, transcranial sonography

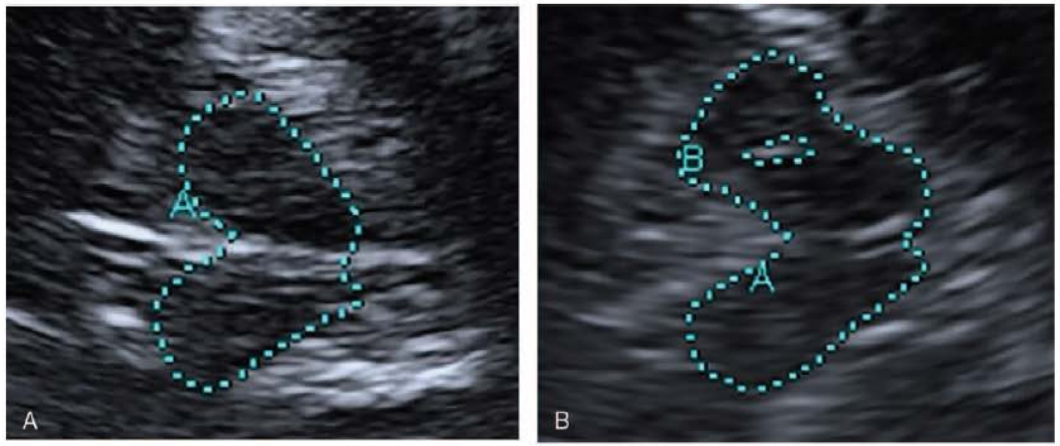

Figure 2. Transcranial sonographic images of the midbrain. (A) Image of normal SN echogenicity in healthy control. (B) Image of substantia nigra (SN) hyperechogenicity in Essential tremor patients. (C) Image of SN hyperechogenicity in Parkinson disease patient. In the graph, A represent midbrain area. The echogenic region of the substantia nigra is encircled with dotted line for better visualization (B and C).

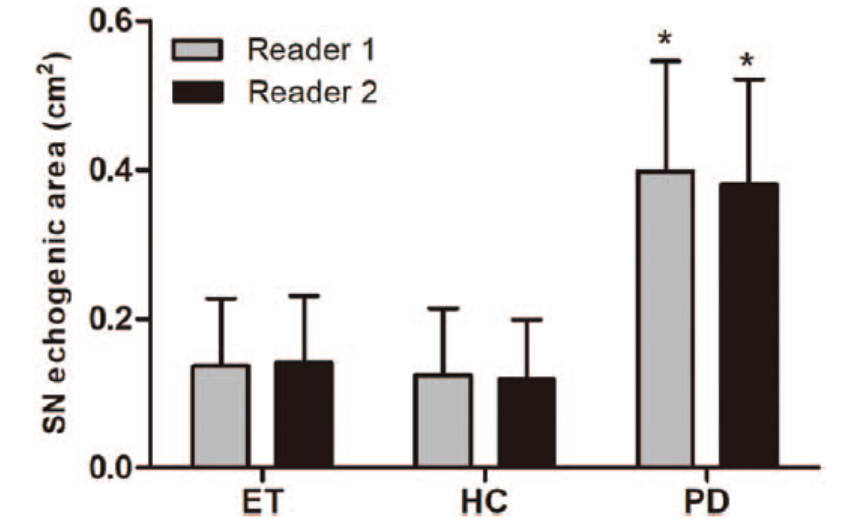

Figure 3. Transcranial sonographic substantia nigra (SN) hyperechogenicity in essential tremor (ET) patients, Parkinson disease (PD) patients, and healthy controls (HC) by reader 1 and reader 2. PD shows significant increased echogenicity than both ET and health control (*$P < .001$). Data are expressed as mean ± standard deviation.

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Original Article

Substantia nigra hyperechogenicity in essential tremor and Parkinson's disease: a longitudinal study

G. Cardaioli, F. Ripandelli, F. Paolini Paoletti, P. Nigro, S. Simoni, E. Brahimi, M. Romoli, M. Filidei, P. Eusebi, P. Calabresi, N. Tambasco

First published: 16 May 2019 | https://doi.org/10.1111/ene.13988 | Citations: 12

Background and purpose

Essential tremor (ET) and Parkinson's disease (PD) sometimes overlap in their clinical expression with ET preceding PD onset, often leading to misdiagnosis. Transcranial sonography (TCS) has been shown to be a valid and non-invasive diagnostic tool to identify early idiopathic PD and to differentiate it from ET. The purpose of this study was to investigate the relevance of substantia nigra hyperechogenicity in patients with ET.

Methods

A total of 138 patients (79 with PD, 59 with ET) and 50 matched controls underwent TCS examination at baseline. All patients were followed in a 3-year longitudinal assessment.

Results

A total of 10 subjects were excluded from the analysis due to the bilateral absence of a temporal acoustic window. During the follow-up period, 11 of the patients with ET developed new-onset parkinsonian features, without fulfilling criteria for PD diagnosis (ET+). Nine patients developed clinical features meeting diagnostic criteria for probable PD (ET-PD). Patients with ET− did not develop parkinsonian features. For each group, the maximum size of the substantia nigra hyperechogenicity was as follows: 5.62 ± 5.40 mm^2 in the control group, 19.02 ± 14.27 mm^2 in patients with PD, 9.15 ± 11.26 mm^2 in patients with ET−, 20.05 ± 13.78 mm^2 in patients with ET+ and 20.13 ± 13.51 mm^2 in patients with ET-PD. ET-PD maximum values were significantly different from controls. Maximum values in patients with ET+ were different from both controls and patients with ET−.

Conclusion

Substantia nigra hyperechogenicity in ET seems to represent a risk marker for developing early parkinsonian symptoms or signs in the 3 years following TCS assessment.

Depressione del tono dell'umore

SN	n. lent.	Rafe	III vent	n. rosso
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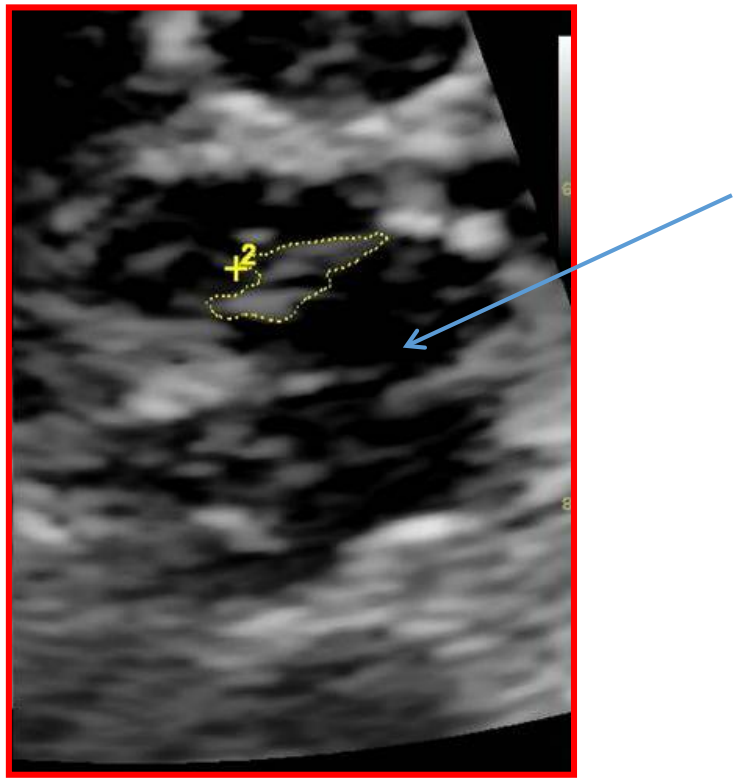

Liu et al. Medicine (2018) 97:50

Clinical Trial/Experimental Study

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Echogenic alteration in the raphe nuclei measured by transcranial sonography in patients with Parkinson disease and depression

Xue Jiao Liu, MD[a], Li Zhang, MD[b], Yong Fang Zhang, Bachelor of Medicine[c], Wen Xu, Bachelor of Medicine[c], Yang Hu, MD[d], Ying Liu, MD[c,*], Jing Bai, PhD[c,*]

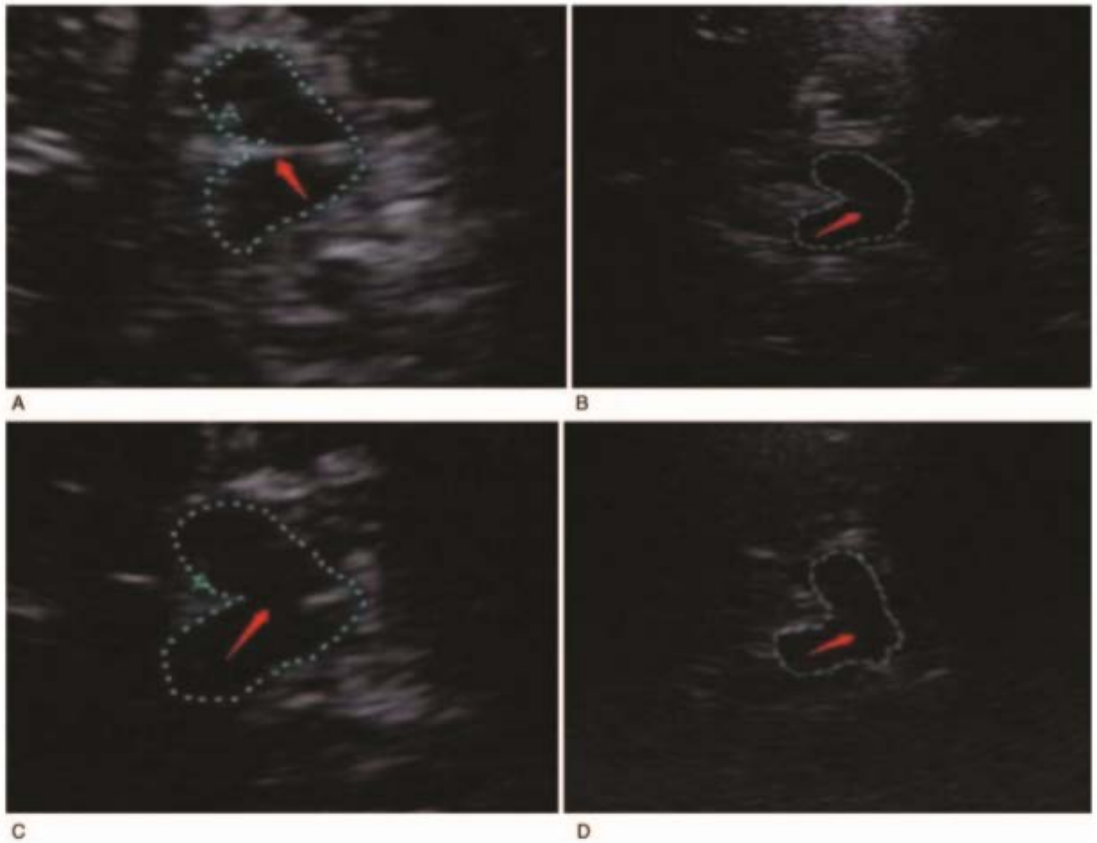

Figure 1. A–D, The echogenicity of the raphe nuclei. A: normal RN; B: slightly echogenic but continuous RN; C: interrupted RN; D: invisible RN.

Journal of Neural Transmission (2020) 127:1047–1055
https://doi.org/10.1007/s00702-020-02187-x

NEUROLOGY AND PRECLINICAL NEUROLOGICAL STUDIES - ORIGINAL ARTICLE

Alterations in transcranial sonography among Huntington's disease patients with psychiatric symptoms

Grzegorz Witkowski[1] · Katarzyna Jachinska[1] · Iwona Stepniak[2] · Karolina Ziora-Jakutowicz[2] · Halina Sienkiewicz-Jarosz[1]

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Transcranial sonography (TCS) is a diagnostic tool in mood and movement disorders. Alterations within the raphe mesencephalic nucleus in the brain have been reported not only in patients with major depression but in patients with depressive symptoms accompanying several neurodegenerative disorders. The aim of the study was to assess the echogenicity of the nucleus raphe and other basal ganglia in patients with Huntington's disease (HD). TCS was performed in 127 HD patients participating in observational studies (Registry/Enroll-HD) in the Institute of Psychiatry and Neurology (Warsaw, Poland). Raphe hypoechogenicity was found in 78% of HD patients with current symptoms of depression (according to DSM-IV criteria), 57% of patients with a previous history of depression, and 56.8% patients who lacked signs or history of depression. Patients with hypoechogenic raphe reported significantly higher depression as measured on the BDI (15.6 ± 1.7) as compared to patients with normal echogenicity (9.5 ± 1.2), ($p = 0.023$). The diameter of the third ventricle was negatively correlated with Mini-Mental State Examination (MMSE) (rho − 0.37) and total functional capacity (TFC) scores (rho − 0.26). Hyperechogenic substantia nigra was visualized in 66,4% patients with HD and the degree of hyperechogenicity was correlated with the total motor score (TMS) (rho − 0.38). Changes in echogenicity of the basal ganglia are related to both depressive and motor symptoms among patients with HD.

Depressione del tono dell'umore

SN	n. lent.	Rafe	III vent	n. rosso
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Distonia idiopatica

SN	n. lent.	Rafe	III vent	n. rosso
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More than 75% of patients with cervical or upper-limb dystonia display LN hyperechogenicity, being most pronounced in the median part representing the globus pallidus internus (Becker 1997, Naumann 1996)

Postmortem examinations yielded significantly increased copper levels in the globus pallidus and putamen (Becker et al. 1999)

Depressione del tono dell'umore

SN	n. lent.	Rafe	III vent	n. rosso
↑↑	N	↓↓↓	N	N

Distonia idiopatica

SN	n. lent.	Rafe	III vent	n. rosso
N	↑↑ to ↑↑↑	N	N	N

SCA 3

SN	n. lent.	Rafe	IV vent	Cervell.
↑↑	↑↑	N	↑↑↑↑	↑↑↑

Malattia di Huntington

SN	n. caud.	Rafe	III vent	n. rosso
↑	↑ to ↑↑↑	↑↑	↑↑↑	N

Neurol Sci. 2021 Jan;42(1):275-283. doi: 10.1007/s10072-020-04566-4. Epub 2020 Jul 8.

The role of transcranial sonography in differentiation of dementia subtypes: an introduction of a new diagnostic method

Mostafa Almasi-Dooghaee [1], Mohammad Rohani [2], Atefeh Imani [3], Shabnam Nadjafi [4], Babak Zamani [5]

Purpose: Transcranial sonography (TCS) is increasingly used for the diagnosis of neurodegenerative disorders. We assessed the role of third ventricle width (TVW), midbrain area (MA), and midbrain circumference (MC) by TCS for diagnosis and differentiation of dementia.

Methods: A cross-sectional study was designed in 59 patients with dementia including 19 patients with Alzheimer's disease (AD), 10 Dementia with Lewy bodies (DLB), 23 Frontotemporal dementia (FTD) and 7 Vascular dementia (VaD), and 22 normal-cognition individuals. Both case and control groups were matched by age, sex, and educational level. The dementia patients were divided into two subgroups: cortical-dominant dementia (CDD) including AD and FTD; and subcortical-dominant dementia (SDD) including DLB and VaD. TCS was performed through a temporal window, in which the size of TVW and midbrain was measured by trans-thalamic and trans-mesencephalic planes, respectively.

Neurol Sci. 2021 Jan;42(1):275-283. doi: 10.1007/s10072-020-04566-4. Epub 2020 Jul 8.

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Results: The mean TVW was 0.85 ± 0.3 cm and 0.66 ± 0.2 cm in dementia patients and the control group, respectively ($p < 0.01$). The MA/MC were smaller in dementia patients compared with the control group ($p < 0.05$ and $p < 0.01$). The TVW in CDD ($p = 0.003$) and SDD ($p = 0.027$), but only MA/MC in SDD ($p < 0.05$), was statistically different compared with the control group.

Conclusion: The measurement of TVW and midbrain size by TCS can be used for diagnosis and differentiation of dementia. Patients with CDD and SDD have larger TVW than the control group, whereas patients with SDD have smaller midbrain sizes.

› Parkinsonism Relat Disord. 2019 Sep;66:68-73. doi: 10.1016/j.parkreldis.2019.07.005.
Epub 2019 Jul 7.

Third ventricular width assessed by transcranial ultrasound correlates with cognitive performance in Parkinson's disease

Stefanie Behnke [1], Andrea Pilotto [2], Inga Liepelt-Scarfone [3], Rezzak Yilmaz [4], Christoph Pausch [5], Svea Dieterich [6], Jan Bürmann [5], Jörg Spiegel [5], Ulrich Dillmann [5], Marcus Unger [5], Ina Posner [7], Daniela Berg [8]

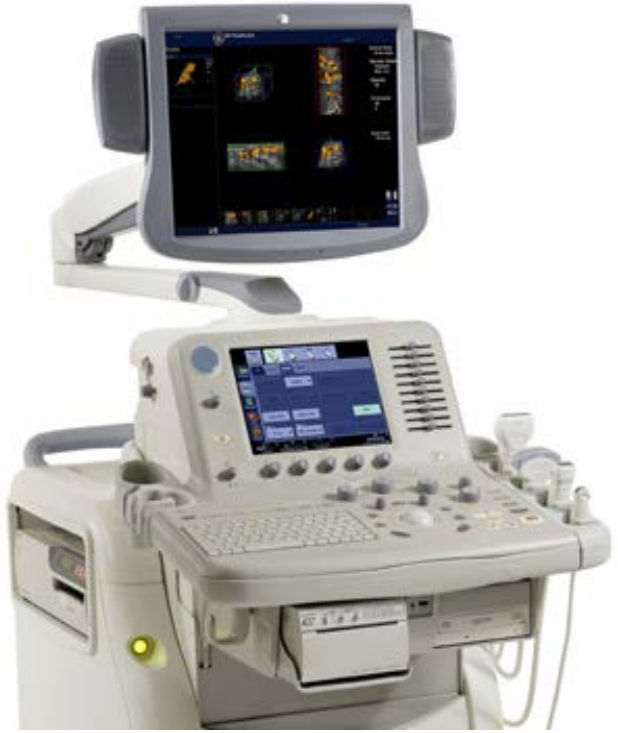
Introduction: Cognitive impairment and dementia are common in PD; however, no stable marker of cognitive dysfunction is available. Transcranial sonography can evaluate global and focal brain atrophy and has been widely used in the differential diagnosis of parkinsonism.

Methods: 225 consecutive PD patients were recruited in a two-center cross sectional study and underwent a standardized sonographic protocol assessing the third ventricle's width and substantia nigra hyperechogenicity. All subjects were evaluated with an extensive motor and cognitive battery.

Results: 222 PD patients were included and classified as PD with normal cognition (PDNC; n = 130), mild cognitive impairment (PD-MCI; n = 61) and dementia (PDD; n = 31). Ventricular width correlated strongly with cognitive performance in all cognitive domains ($p < 0.001$) while SN size did not. PDD patients had significantly wider ventricles than PD patients without dementia ($p < 0.001$) while differences between PD-MCI and PDNC or PDD were less strong ($p < 0.05$). There were no group differences in SN size. ROC analyses resulted in age-related cut-offs of third ventricular diameter for the prediction of PDD (6.0 and 7.5 mm for subjects < and ≥70 years of age, respectively). These cut-offs significantly differentiated PDD from PDNC ($p < 0.001$) and from all patients without dementia (PDNC + PD-MCI; $p < 0.001$).

Conclusions: The third ventricular diameter correlated with cognitive performance in all domains and was able to differentiate PDD patients from those without dementia. Longitudinal studies are warranted to evaluate whether transcranial sonography could identify PD patients at risk for a rapid cognitive decline.

- Commercial ultrasound devices
- 2-4 MHz phased-array transducer
- Softwares



Preauricular temporal acoustic bone windows

Standardized axial scanning planes

Penetration depth of 15-16 cm

Dynamic range of 45-52 dB

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Image brightness and time gain compensation are adapted as needed

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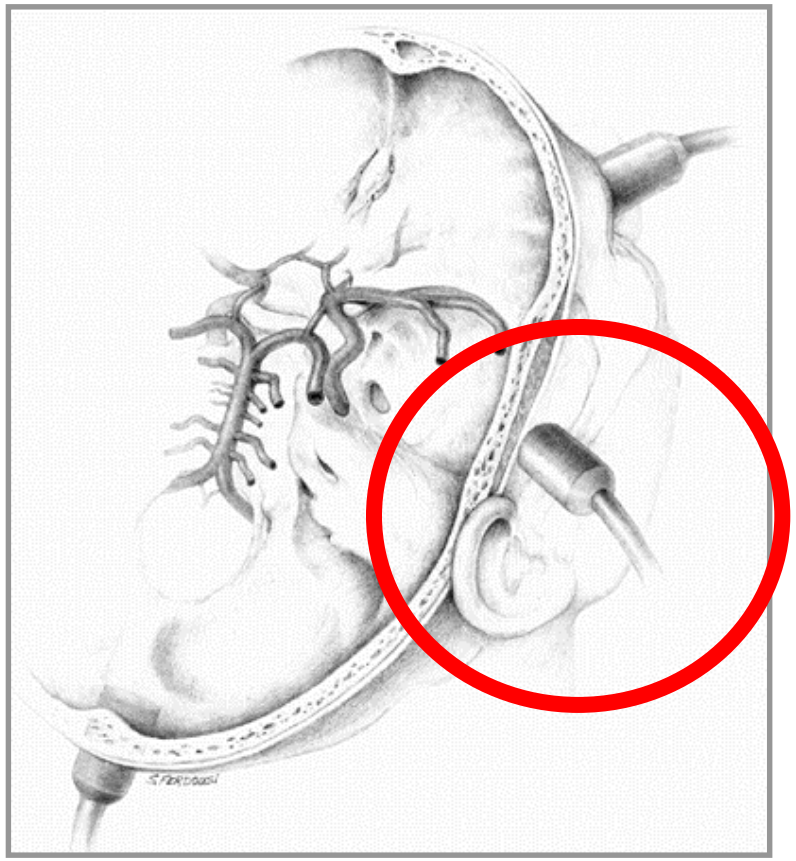
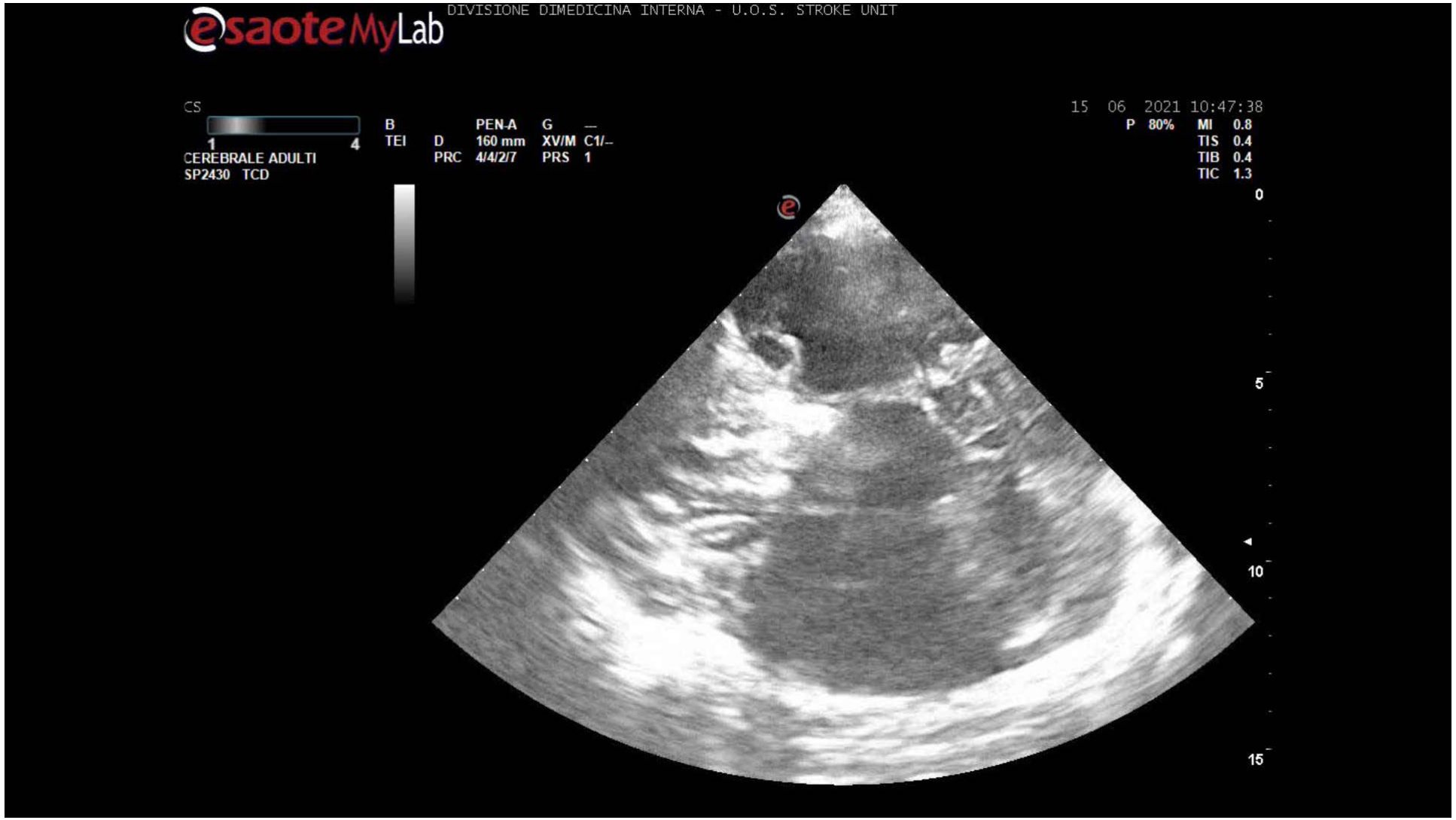
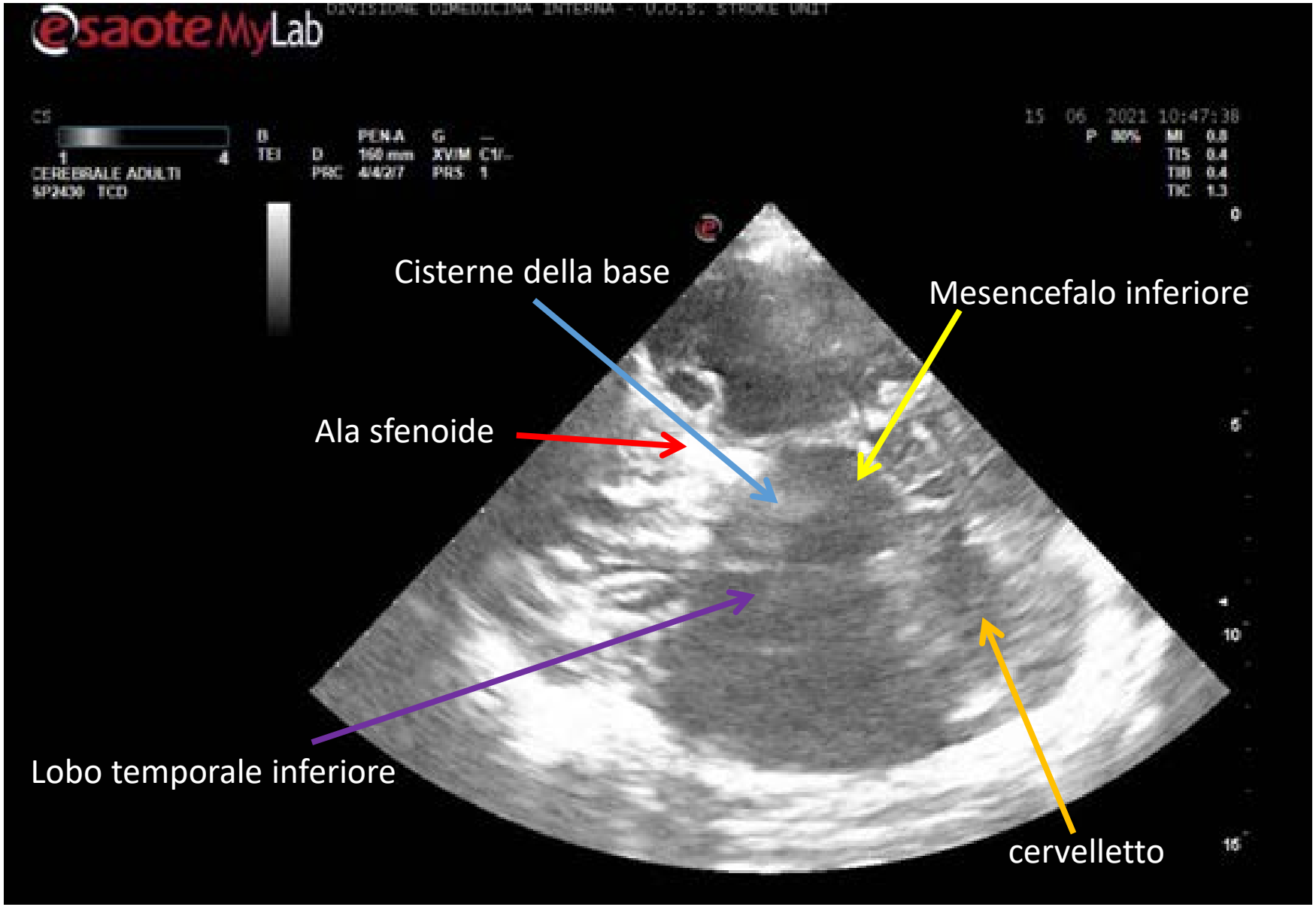




Piano mesencefalico inferiore



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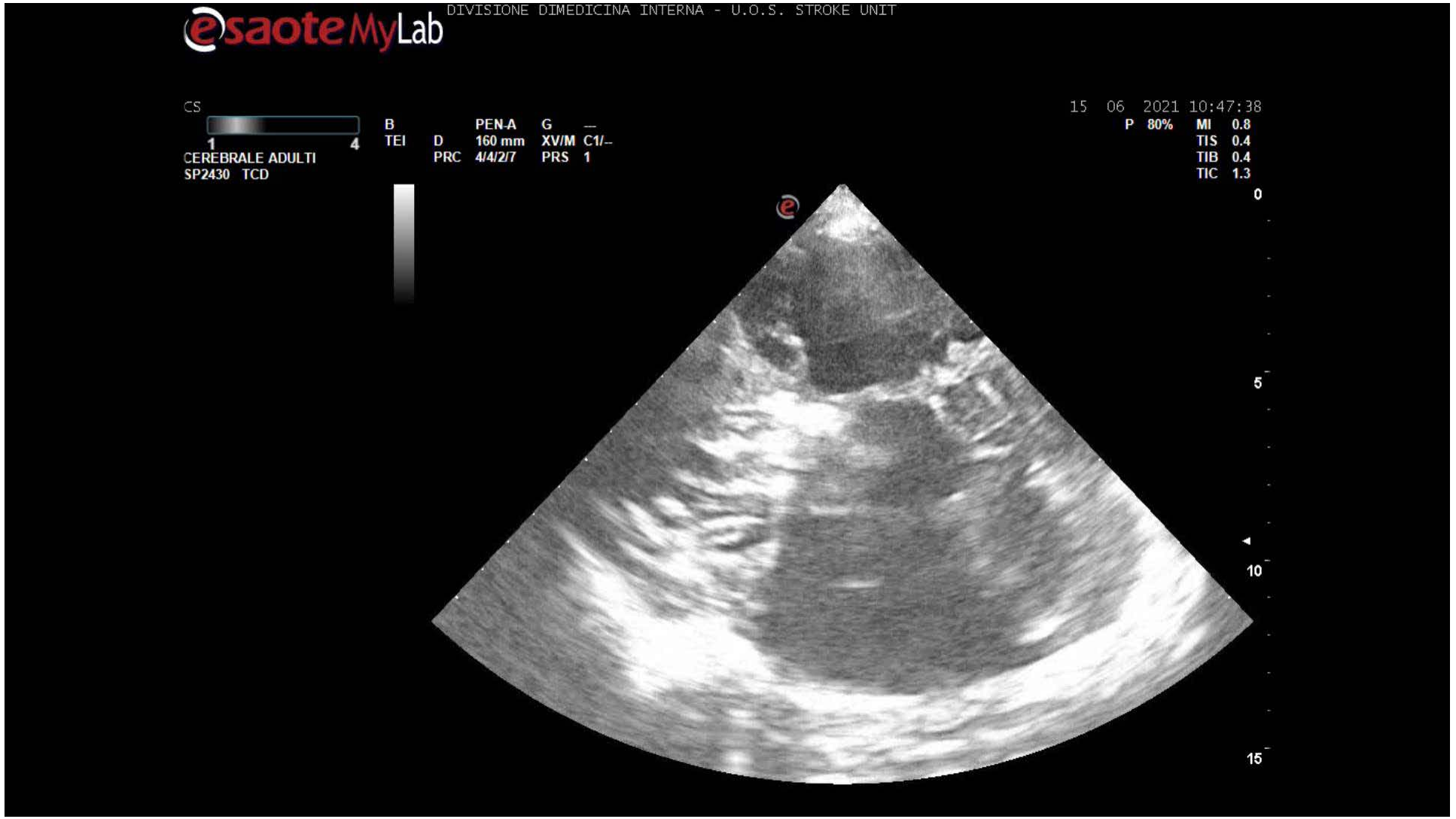
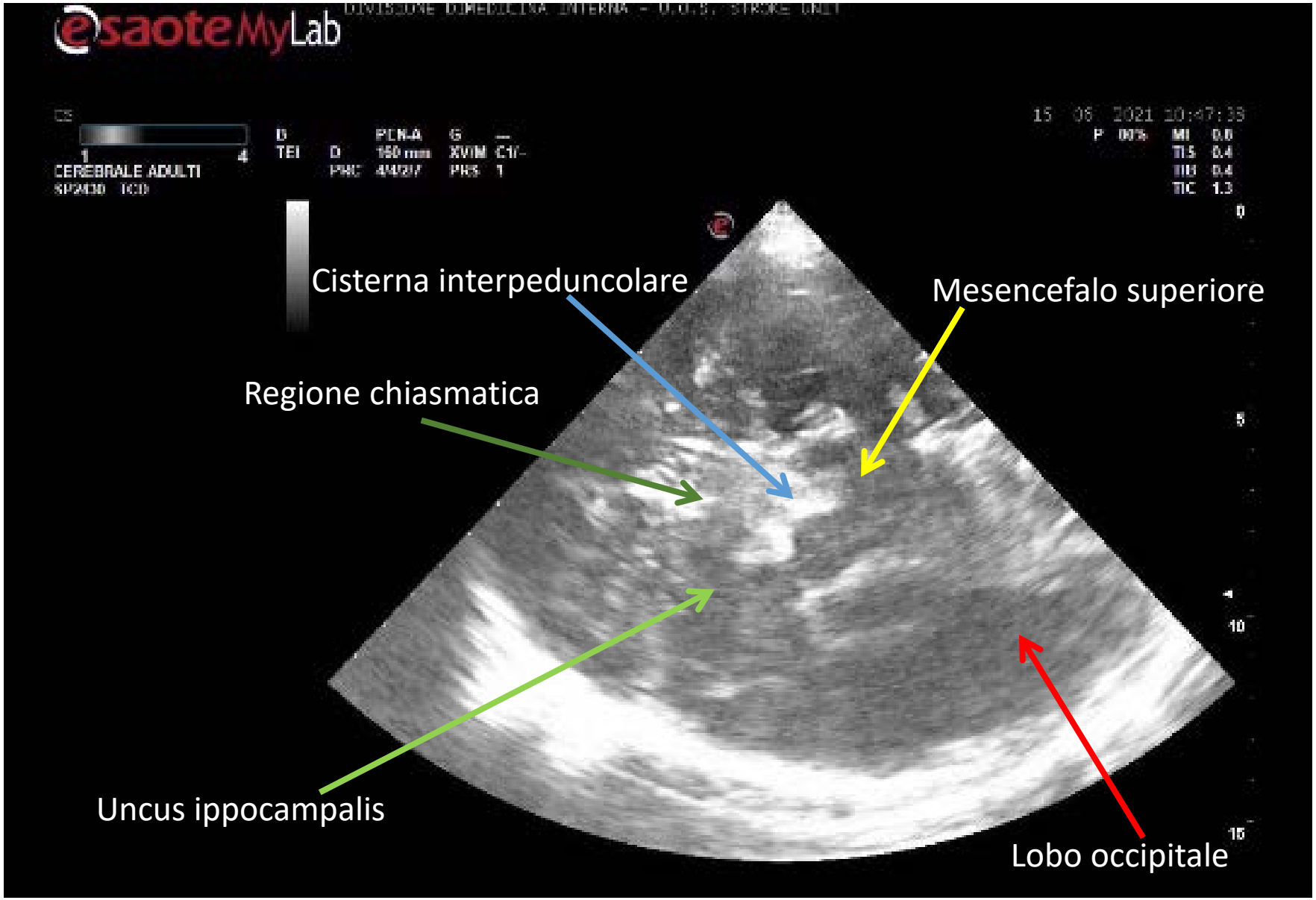


Piano mesencefalico medio-superiore



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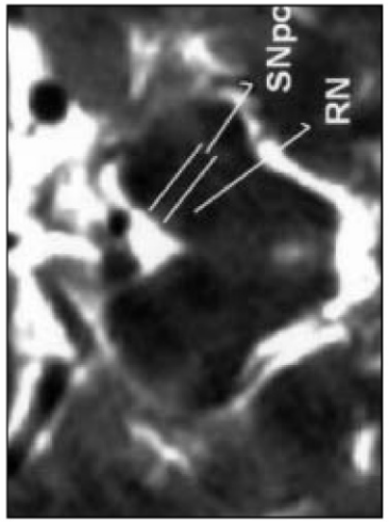
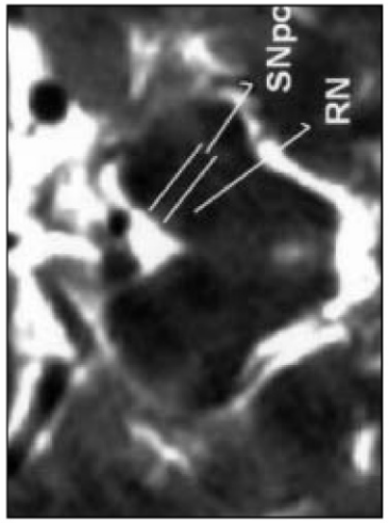


MRI

Quantificazione planimetrica



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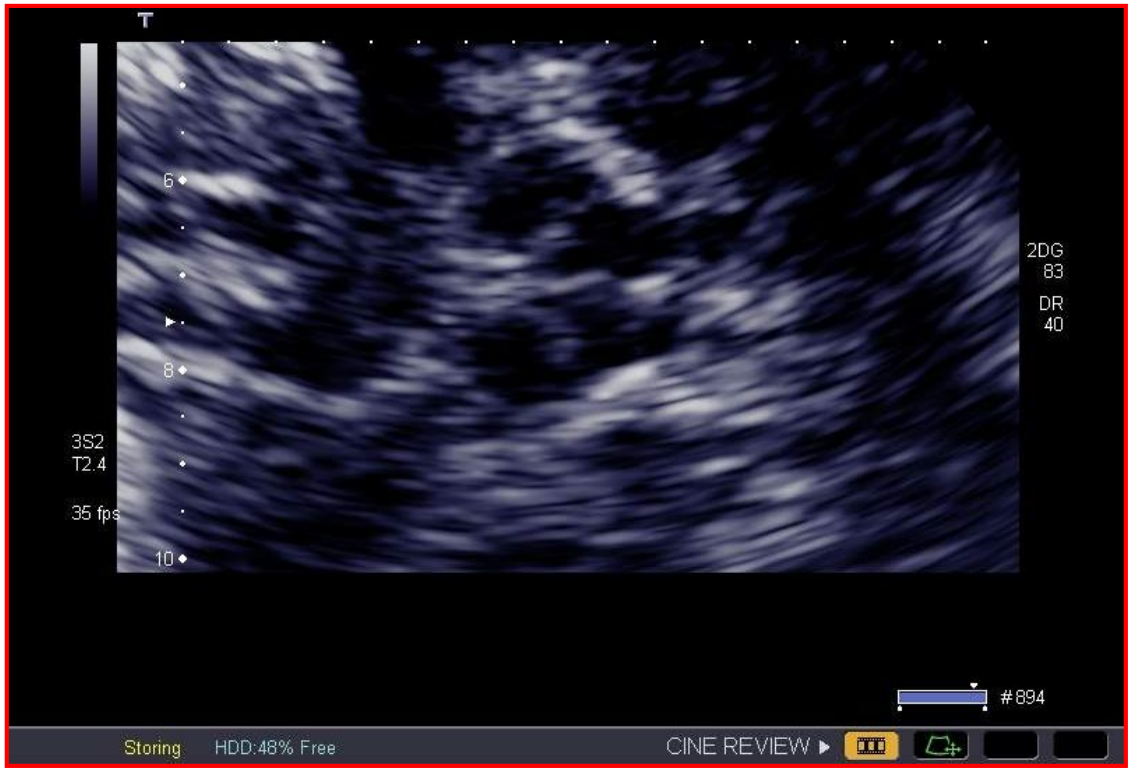
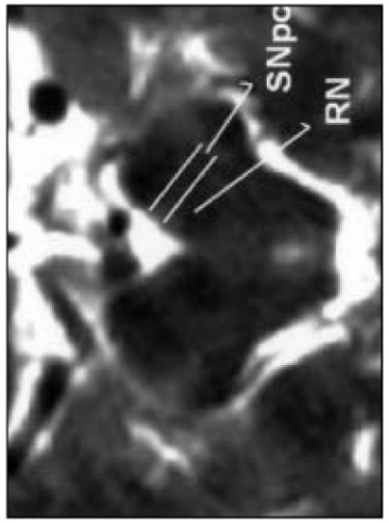
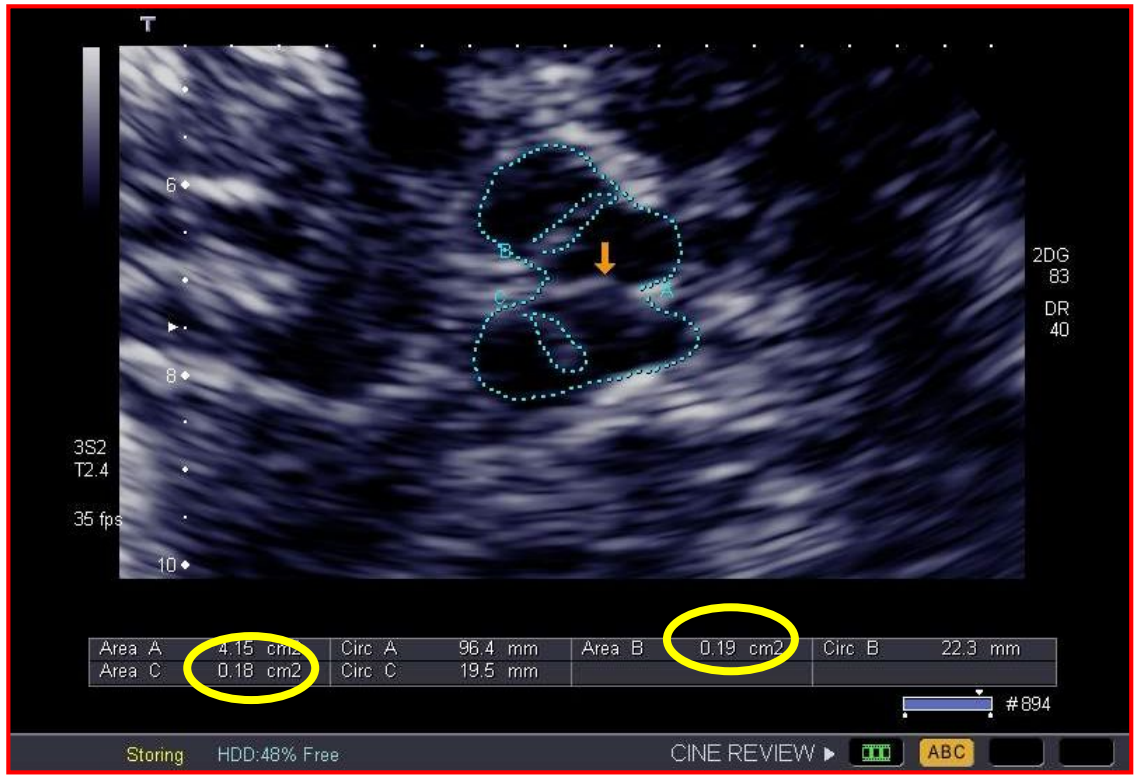
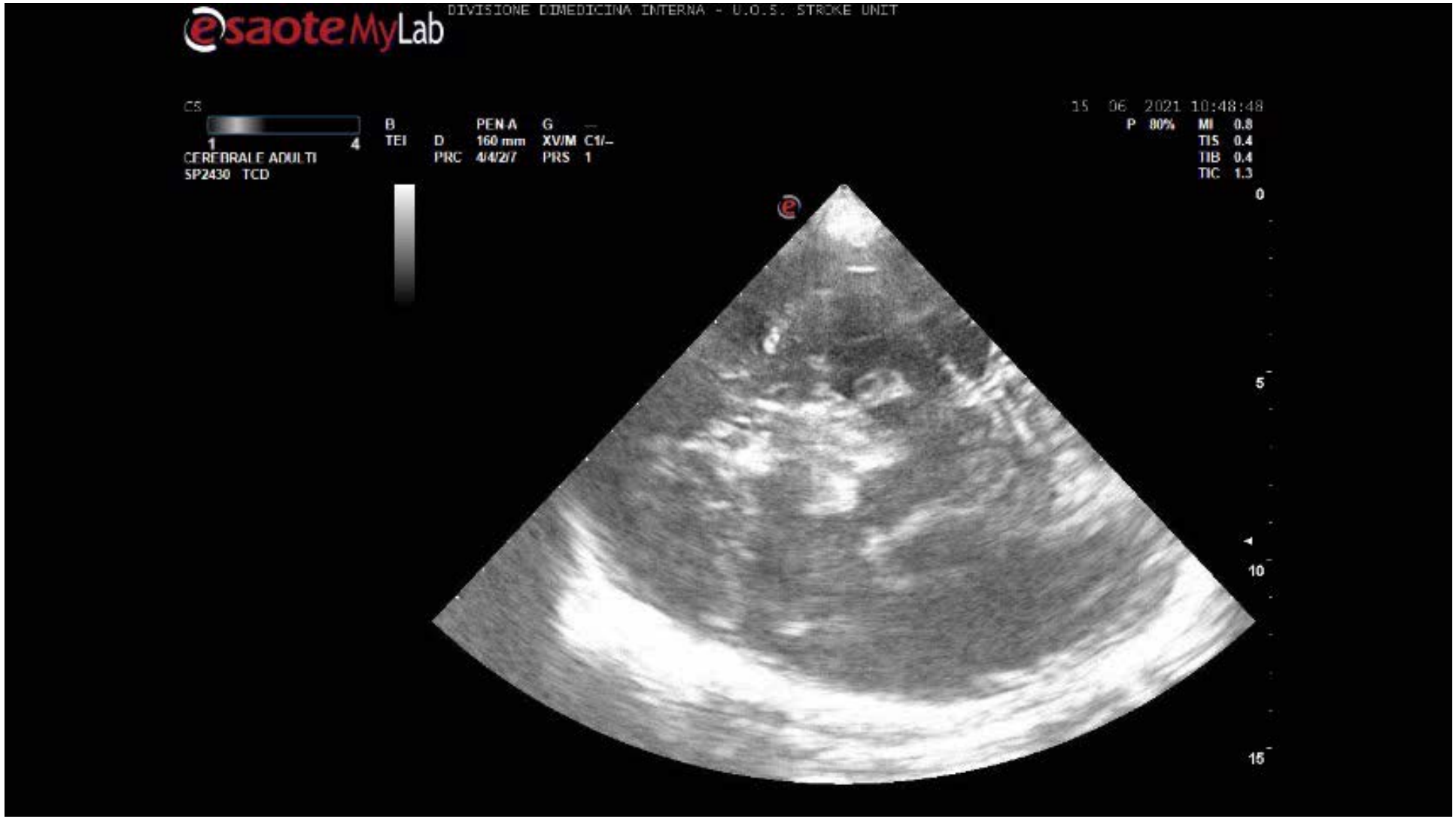


Quantificazione planimetrica

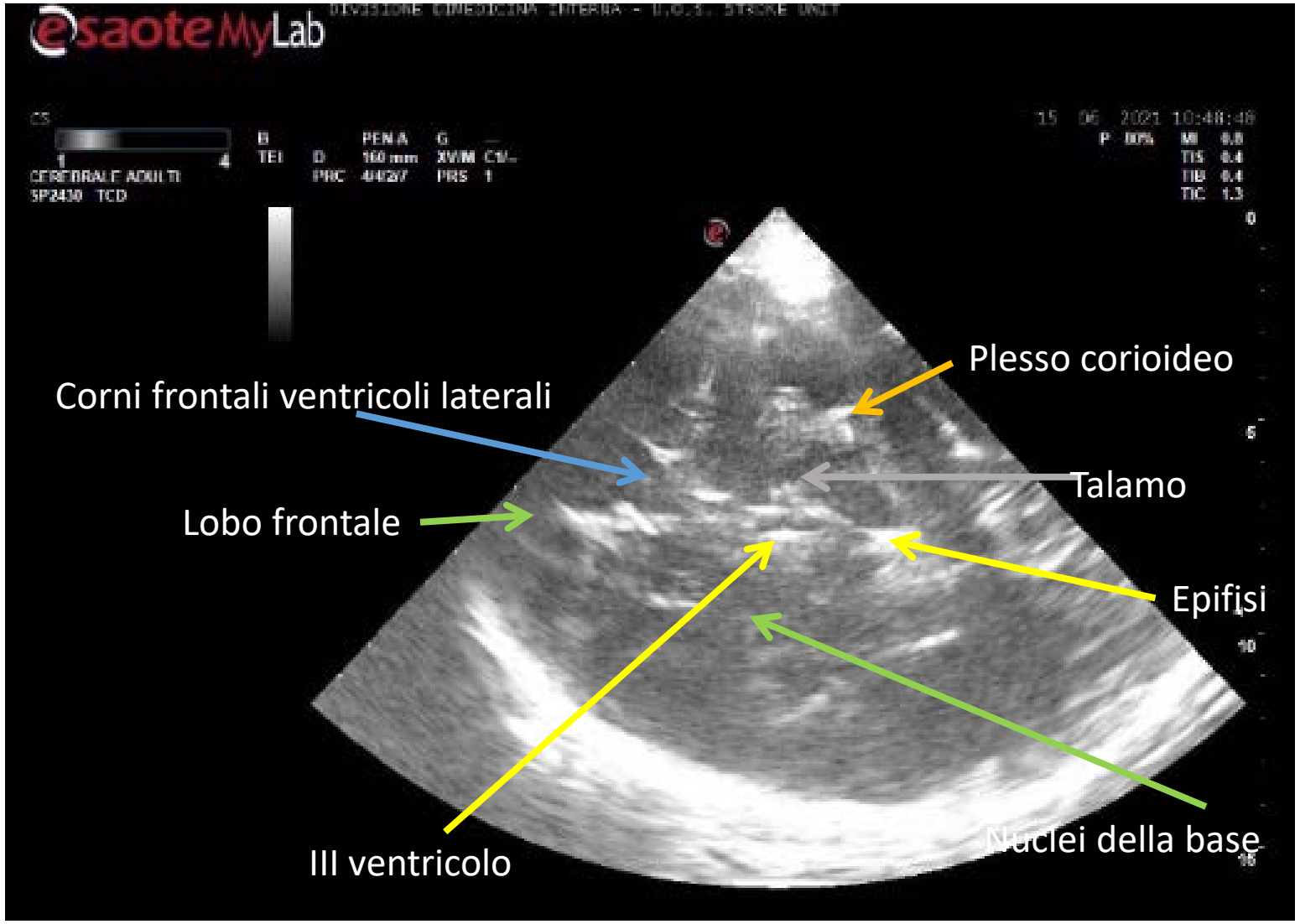


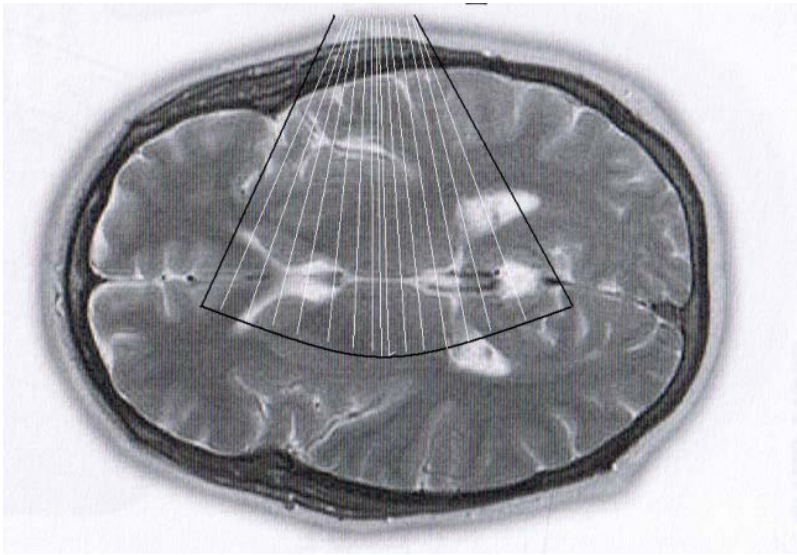
MRI



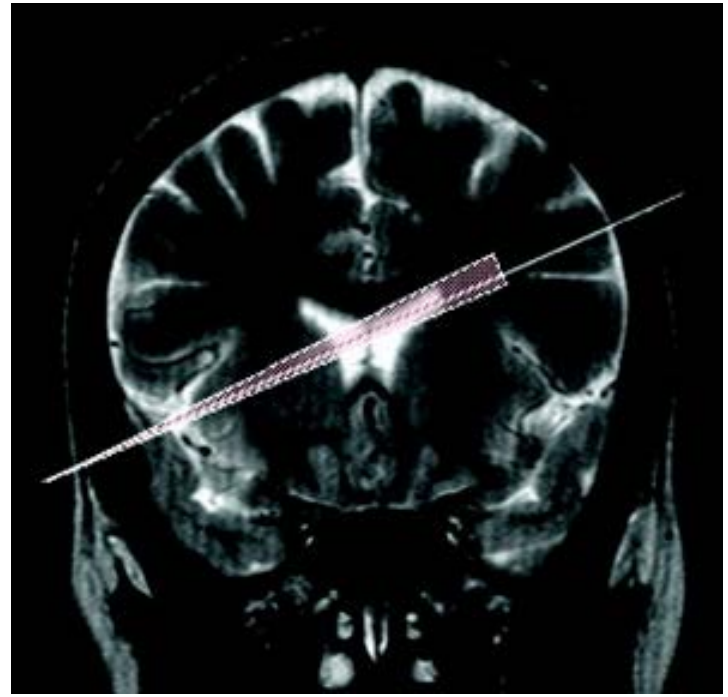


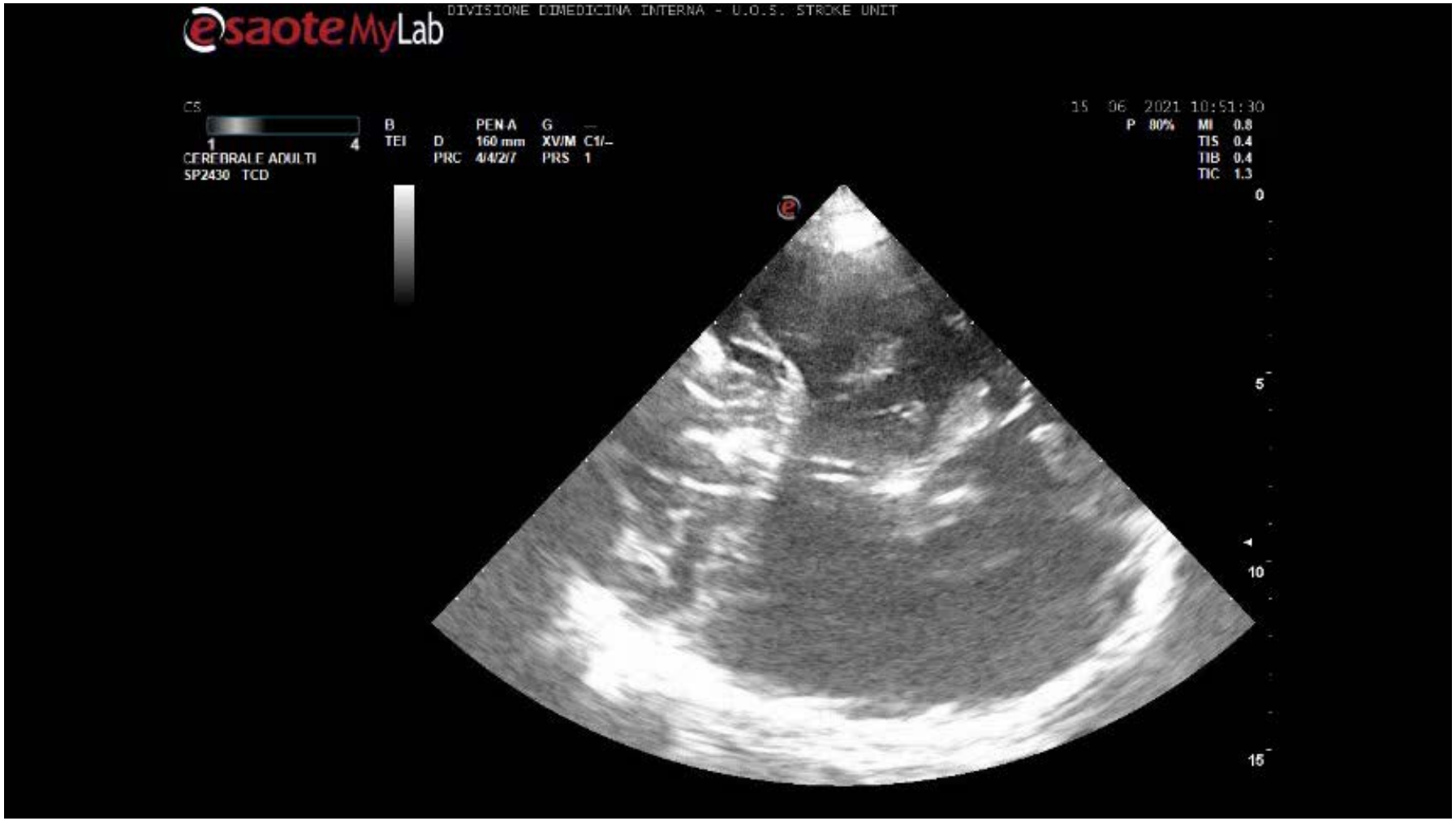
Piano diencefalico



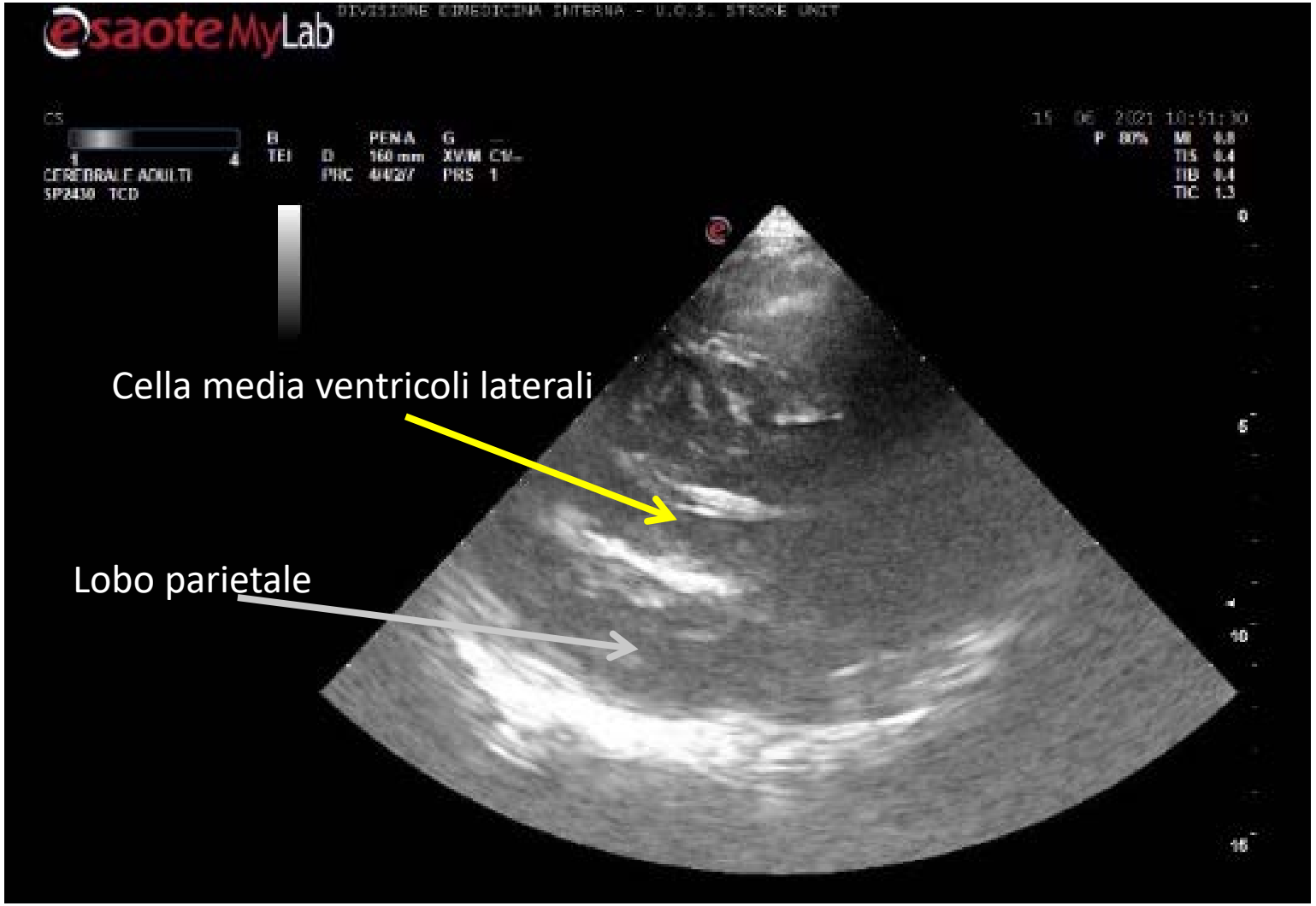


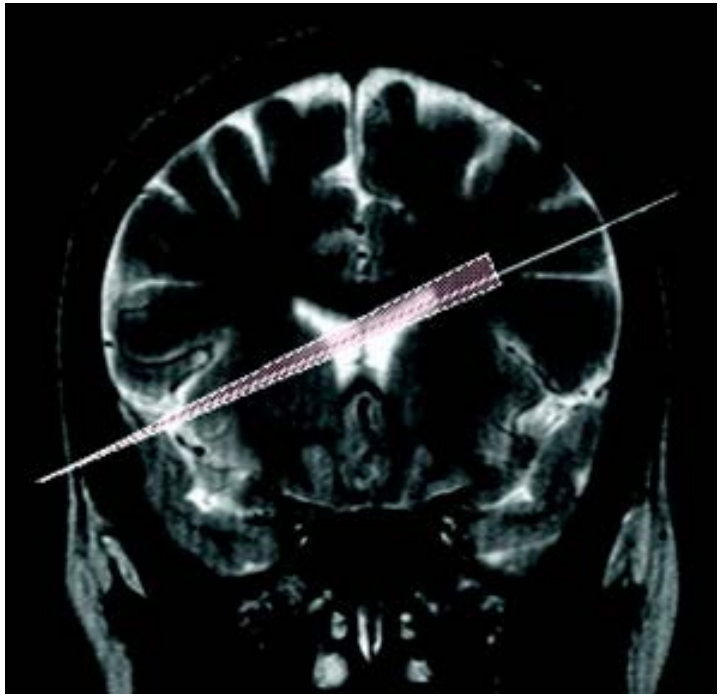
Piano diencefalico





Piano sovra-diencefalico





Piano sovra-diencefalico


Grazie per l’attenzione