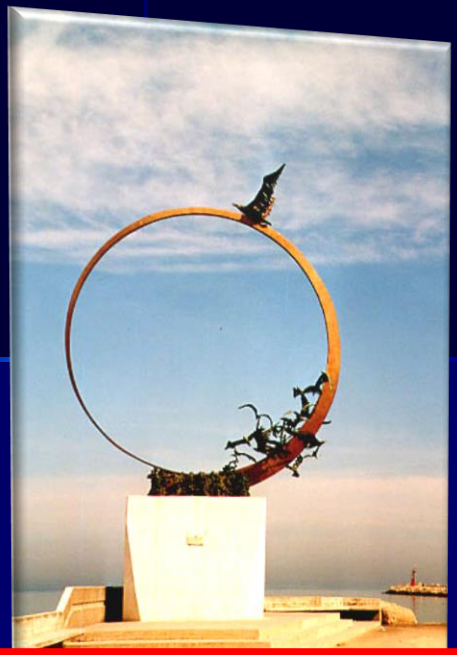


Unità Operativa di Neurologia
Ospedale "Madonna del Soccorso"
San Benedetto del Tronto (AP)
Direttore M.Ragno

NEUROSONOLOGIA ED ECOGRAFIA CEREBRALE: Brain Parenchyma Sonography e malattie extrapiramidali

Perché il TCCD è diventato un esame insostituibile nella gestione del paz con patologia cerebrale?

Dr. Sandro Sanguigni

Neurosonologia
Stroke-Unit

San Benedetto del Tronto

6-8 Novembre 2017

Società Italiana Interdisciplinare Neurovascolare

STUDI ARTERIOSI

STUDI VENOSI

STUDI PARENCHIMALI

NEUROSONOLOGIA

STUDIO ECOGRAFICO PARENCHIMALE

Indicazioni cliniche

BRAIN PARENCHYMA SONOGRAPHY

Anatomia e metodologia

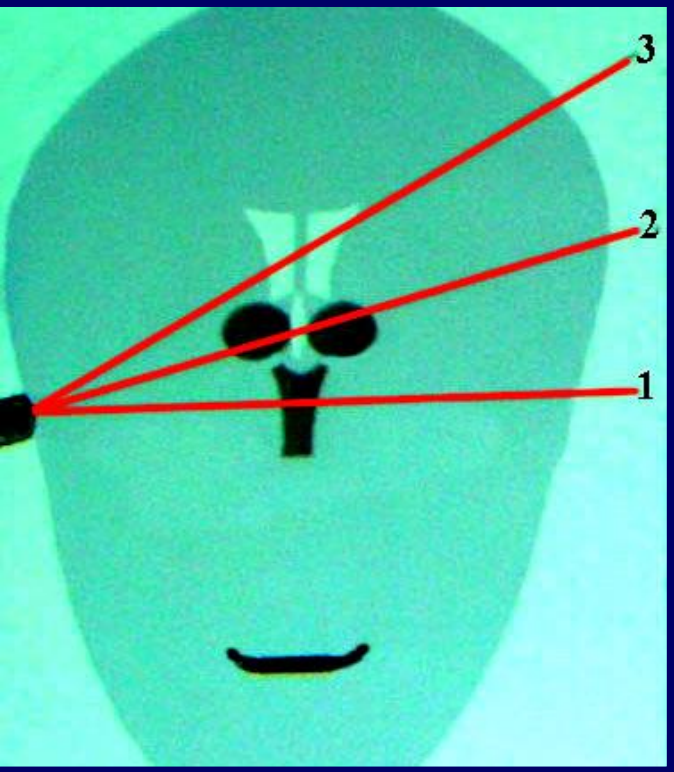
Why ultrasound parenchymal study ?:

- Mastery of anatomy: Where are we? What are we seeing ??

DOVE SIAMO??
COSA STIAMO INSONANDO??

axial Plane:

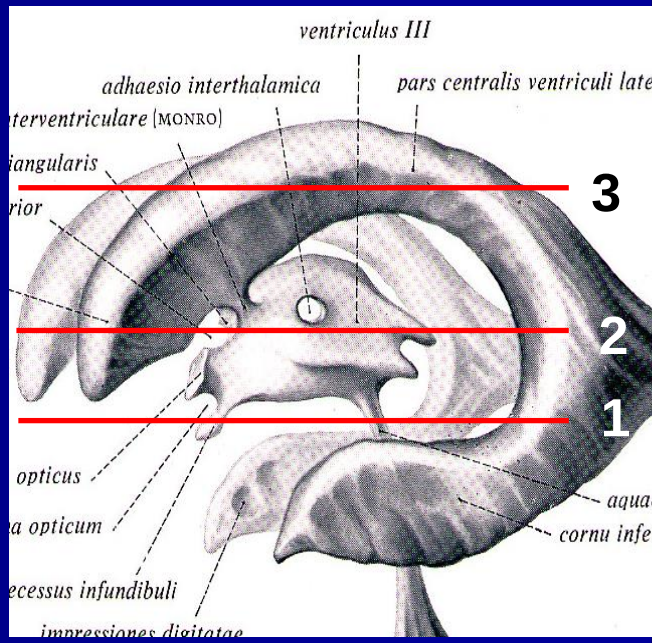
(orbito-meatal line)



Sovradiencephalic (3)

Diencephalic plane(2)

Mesencephalic (1)

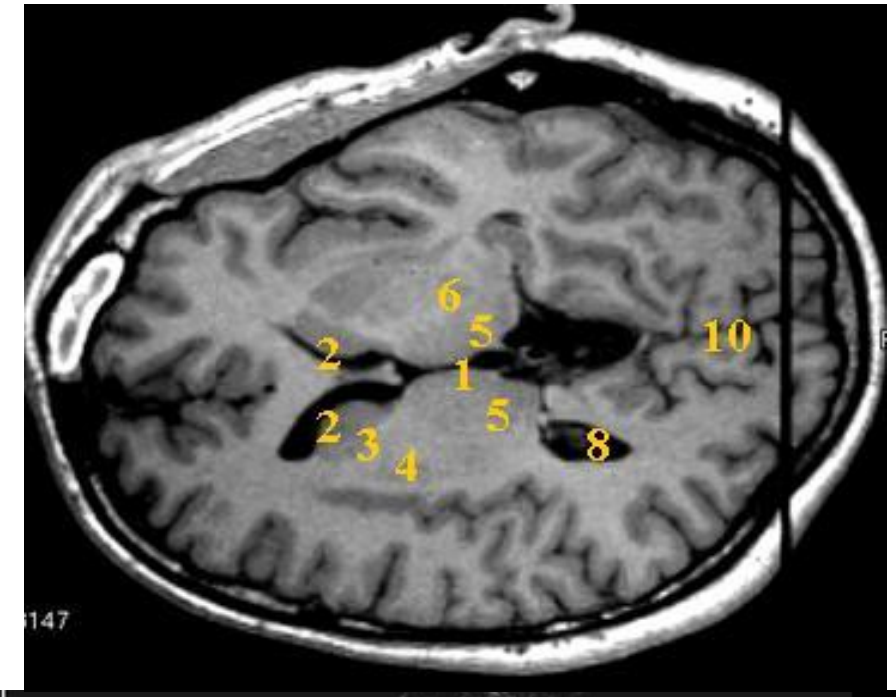


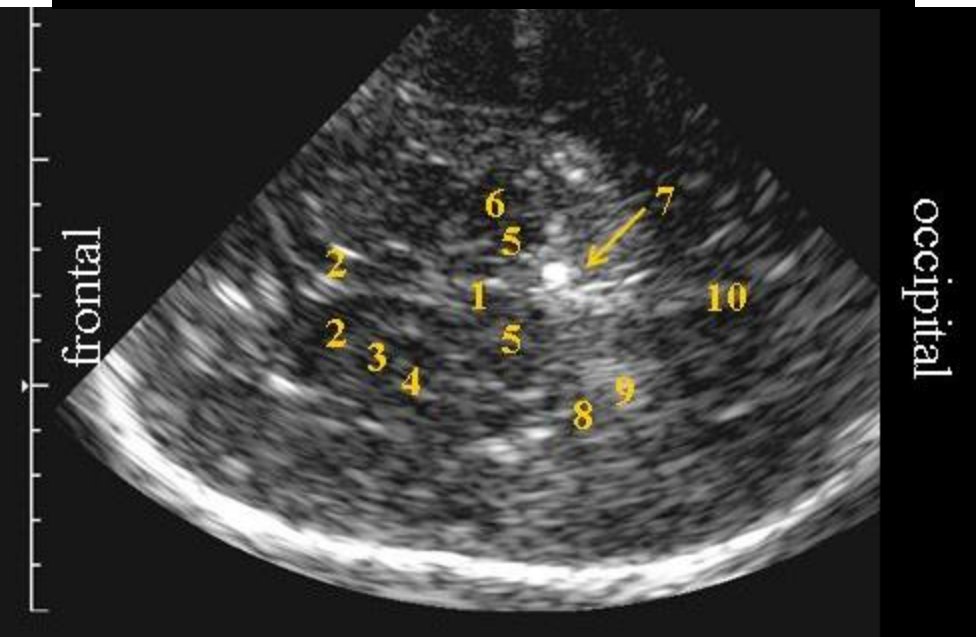
IL CONCETTO DI «FUSION» STA CAMBIANDO TALI PIANI !!

Il piano lo stabilisco io ma lo valido con TAC/RMN !

Non ho più bisogno di punti di repere ecografici !

Anatomia e imaging ultrasonoro

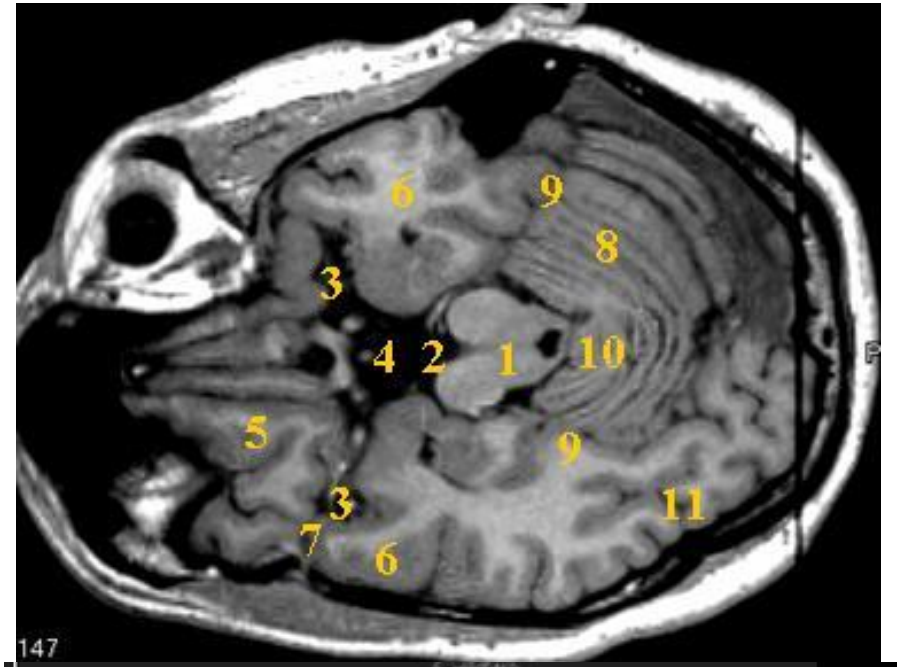


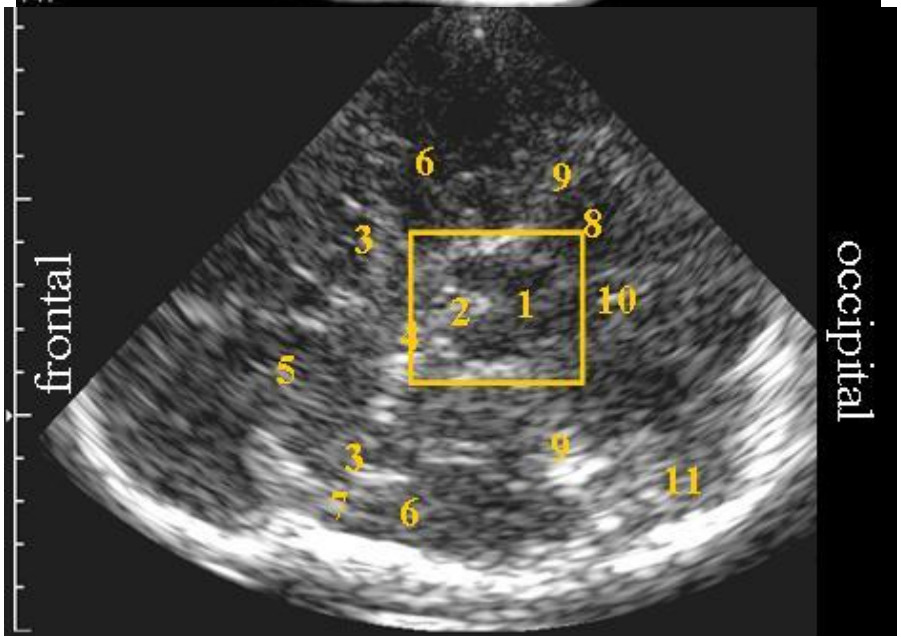


1. 3.ventricle
2. anterior horn
3. nucleus caudatus
4. nucleus lentiformis
5. thalamus
6. capsula interna
7. glandula pinealis
8. posterior horn
9. plexus choroideus
10. falx cerebri

Berg et al

Anatomia e imaging ultrasonoro

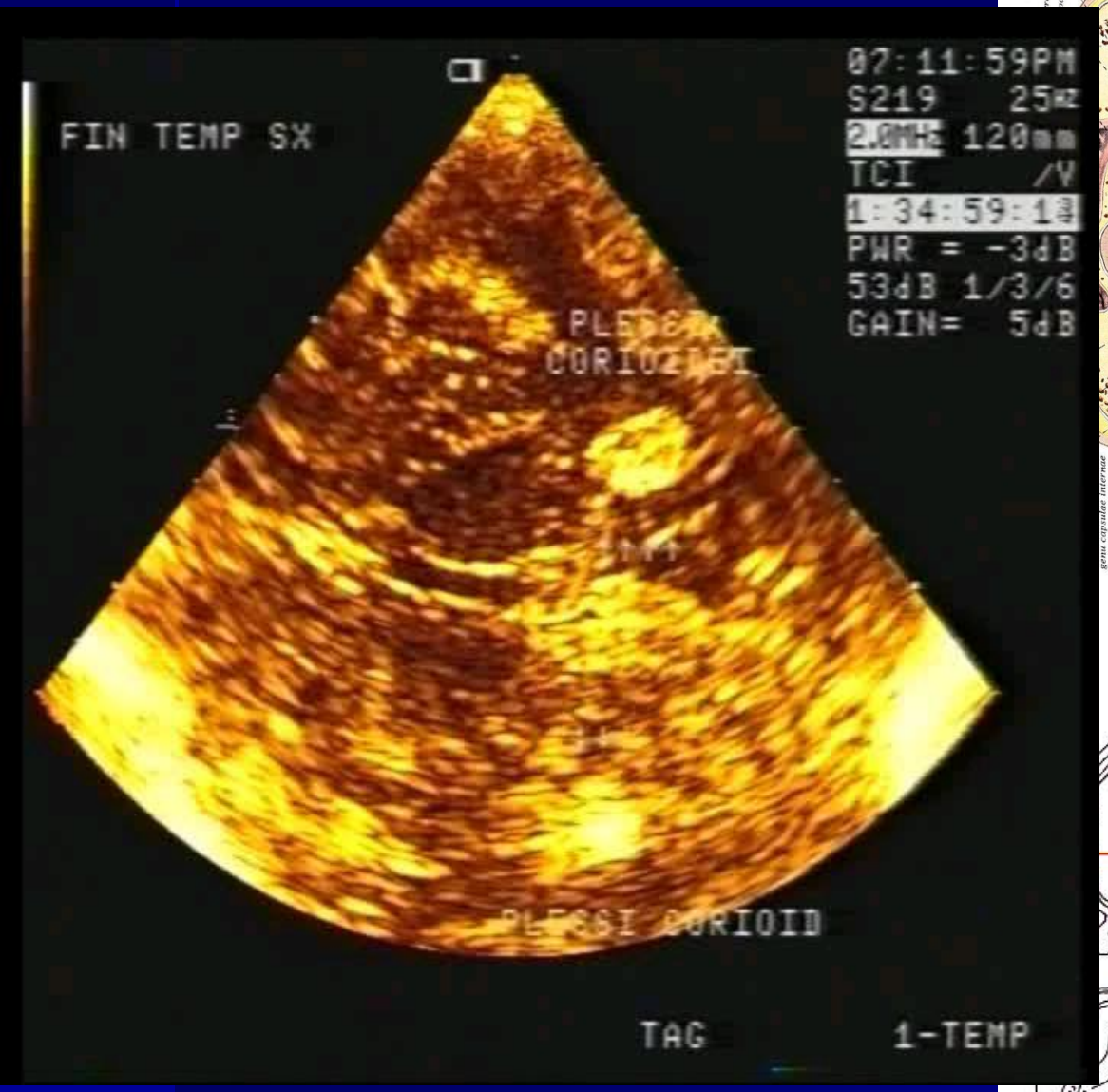




1. mesencephalic brainstem
2. basal cistern
3. mca
4. chiasma opticum
5. basal frontal lobe
6. temporal lobe
7. sylvic fissure
8. cerebellum
9. tentorium cerebelli
10. superior cerebellar vermis
11. occipital lobe

Berg et al

BRAIN PARENCHYMA



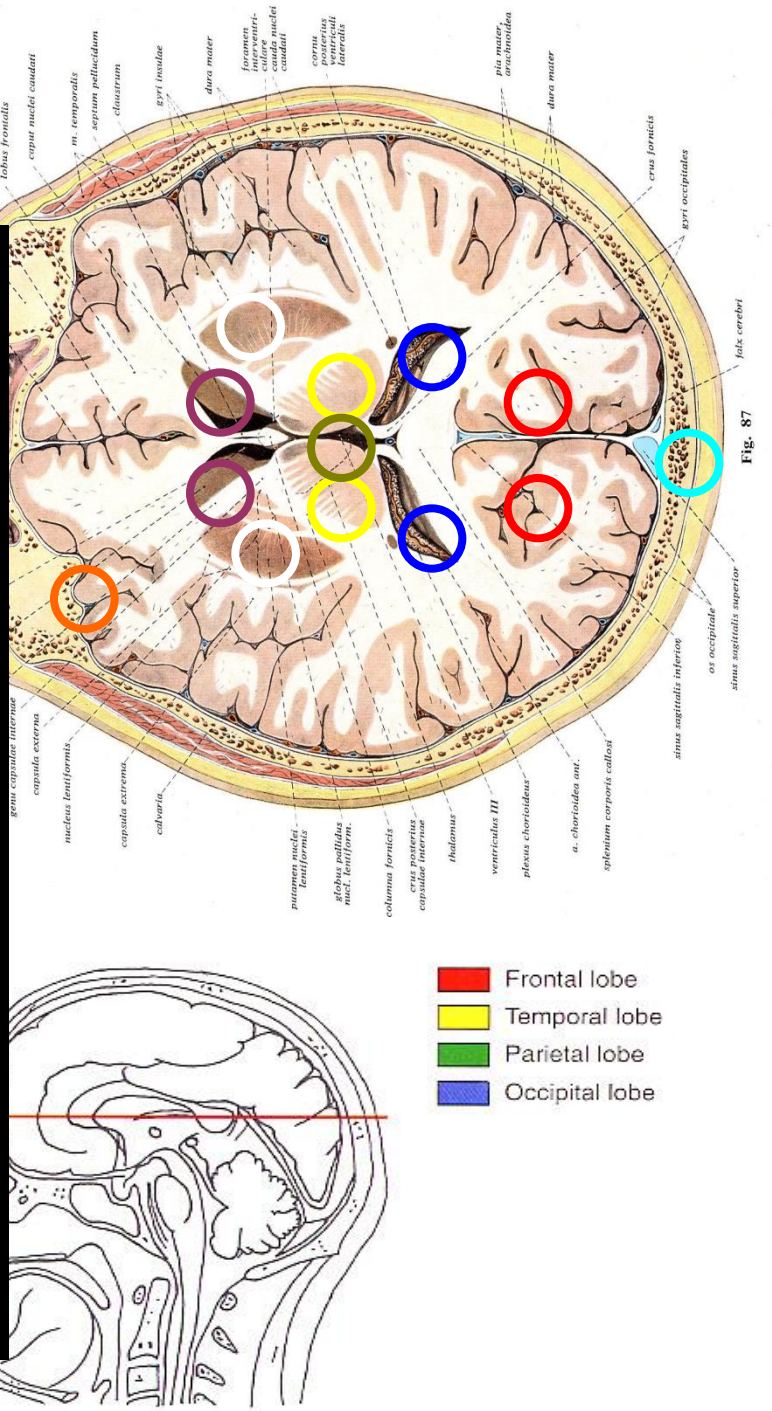


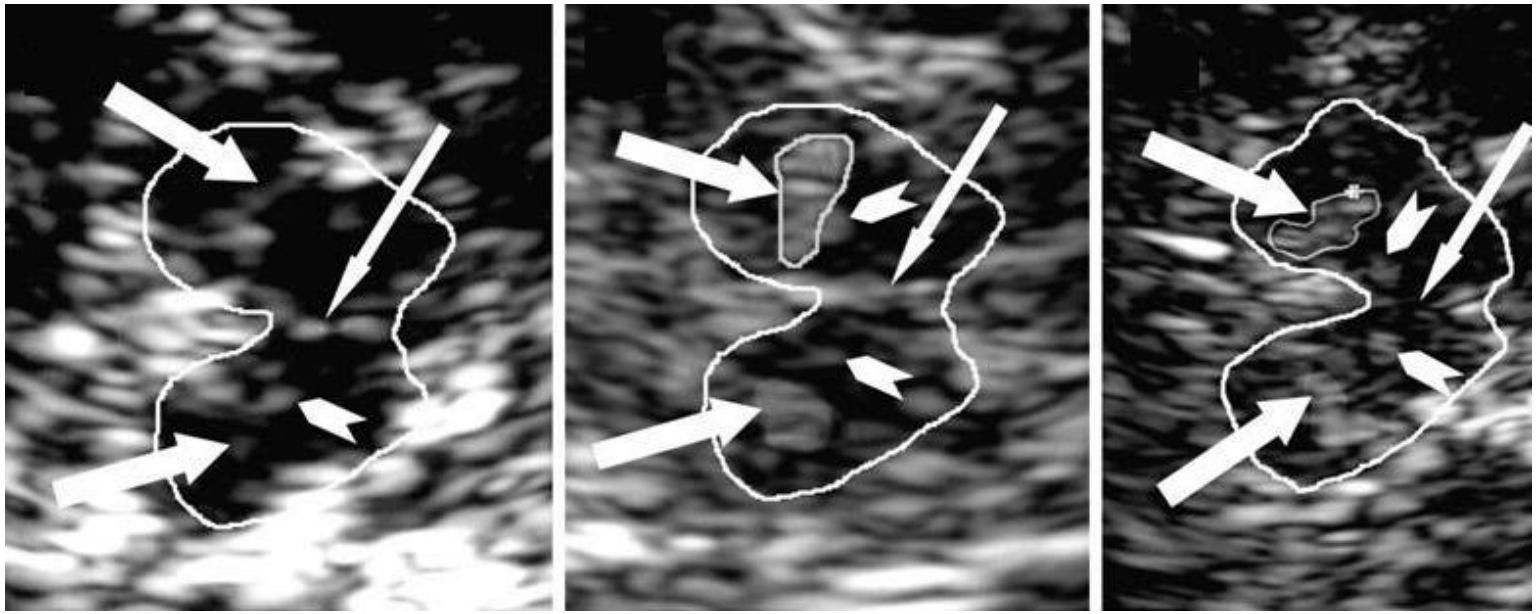
Fig. 87

Alterata ecogenicità del rafe mediano mesencefalico

Presente nel:

•10 % della popolazione normale,

•50 – 70 % dei paz con disturbi depressivi.



Walter et al.. Brain 2007

Role of Transcranial Ultrasound in the Diagnosis of Movement Disorders

Neuroimaging Clin N Am. (2010)

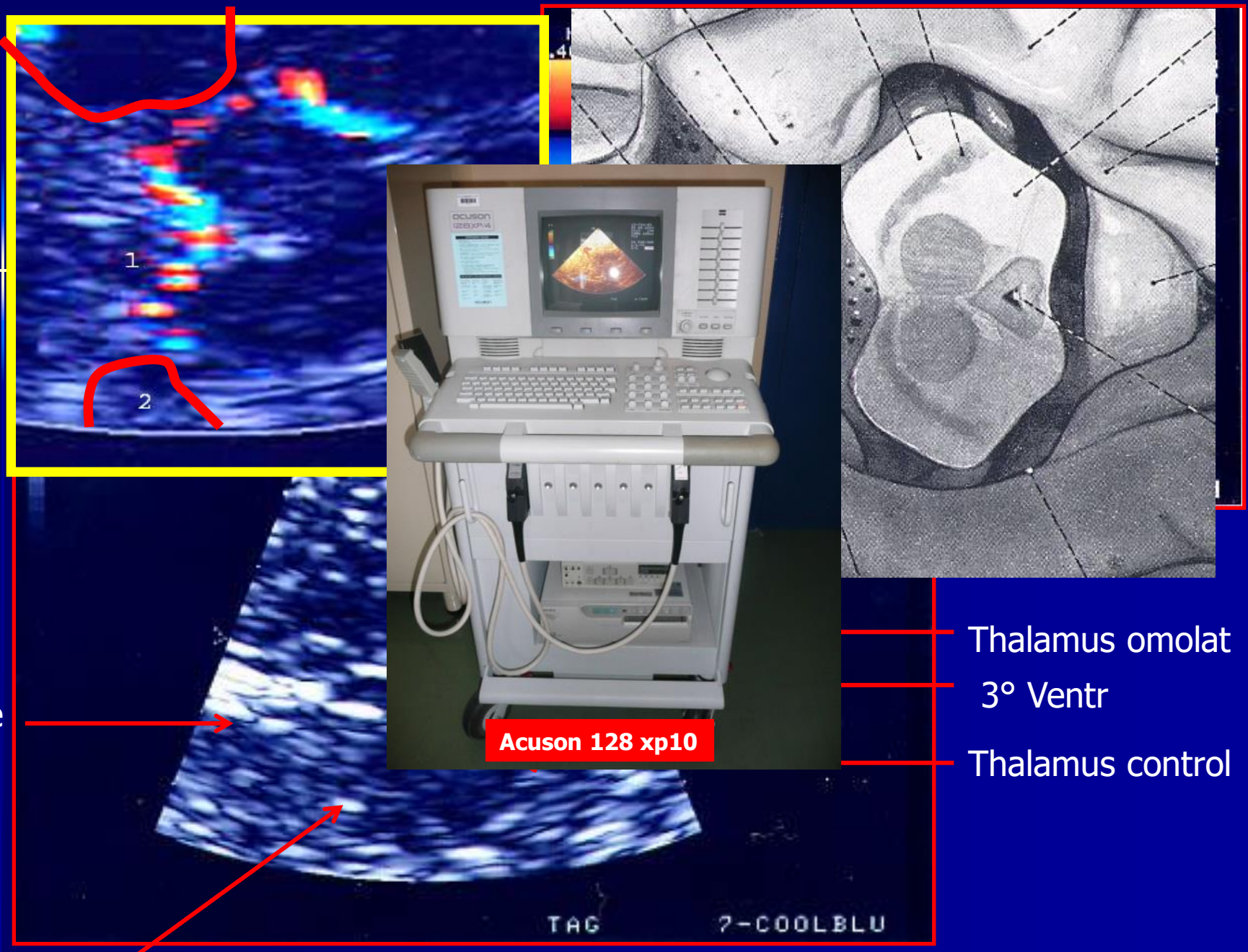
Jana Godau, MD*, Daniela Berg, MD

Table 2
System settings

Ultrasound transducer	1.8–3.5 MHz
Penetration depth	14–16 cm
Dynamic range	45–55 dB
Contour amplification	Medium–high
Postprocessing parameters	Moderate suppresion of low echo signals
Time gain compensation	Adjust as needed
Image brightness	Adjust as needed

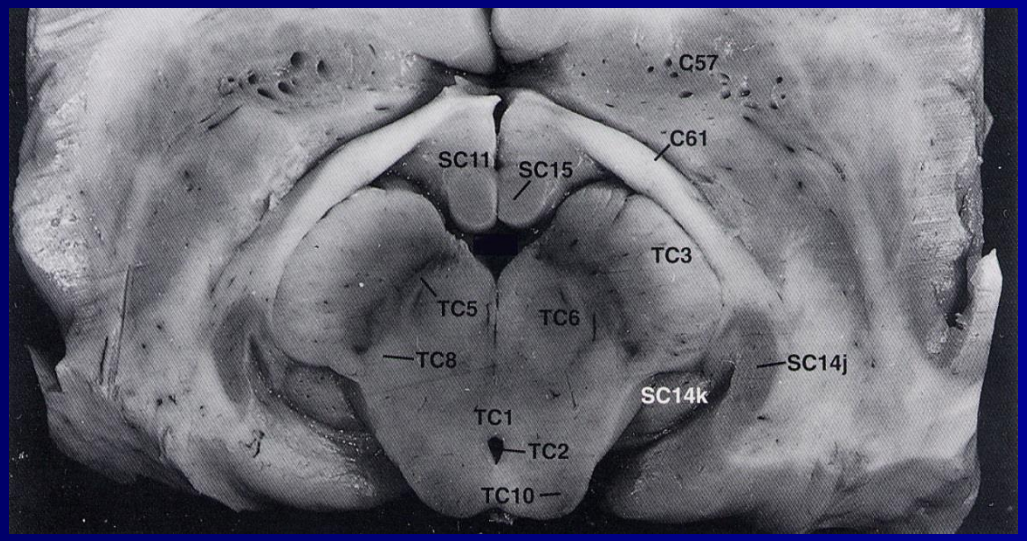
Axial resolution : 0.3-0.7 mm

Lateral resolution :1.1 mm

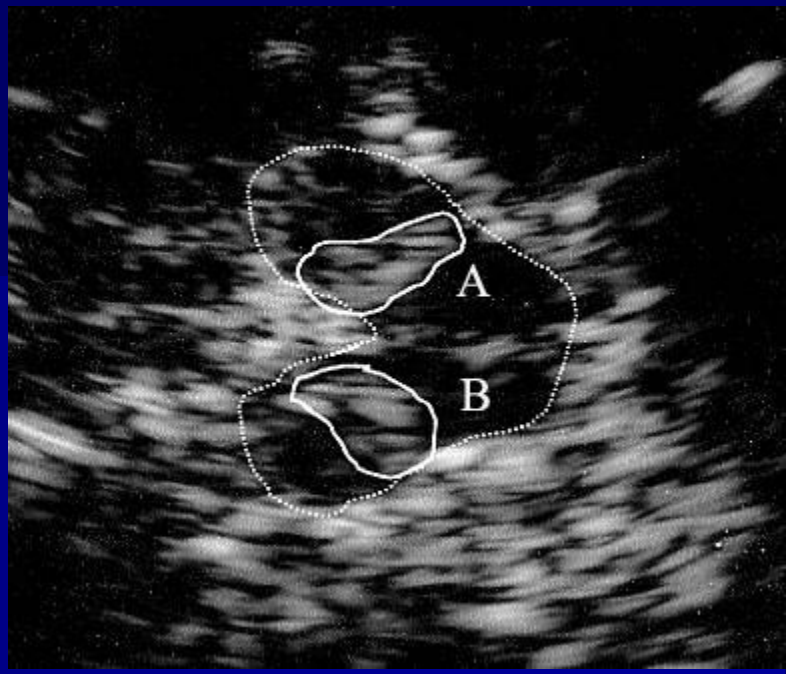

1
2
Acuson 128 xp10
TAG
7-COOLBLU
Caudate
Lenticular Nucleus
Thalamus omolat
3° Ventr
Thalamus control

TCCD e Morbo di Parkinson

STUDI :
ECOGRAFICI
FLUSSIMETRICI
MED. NUCLEARE



STUDI ECOGRAFICI



A=0,25 cm^2

B=0,27 cm^2

Changes in cerebral blood flow detected in the middlle cerebral artery, in patients affected by Idipoatic Parkinson Disease, during ON-OFF fenomena. A transcranial color doppler study.

Curatola.Sanguigni.Malferrari,Carboni,Gobbato,Paci.
Journal of Neurology 2002;249-251

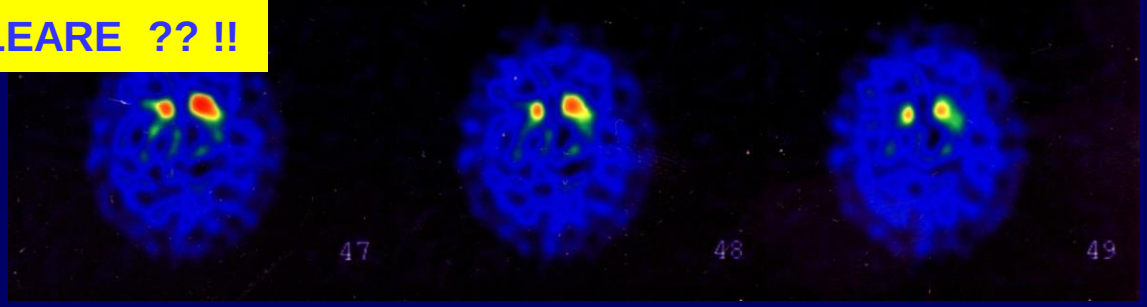
Esame eseguito:

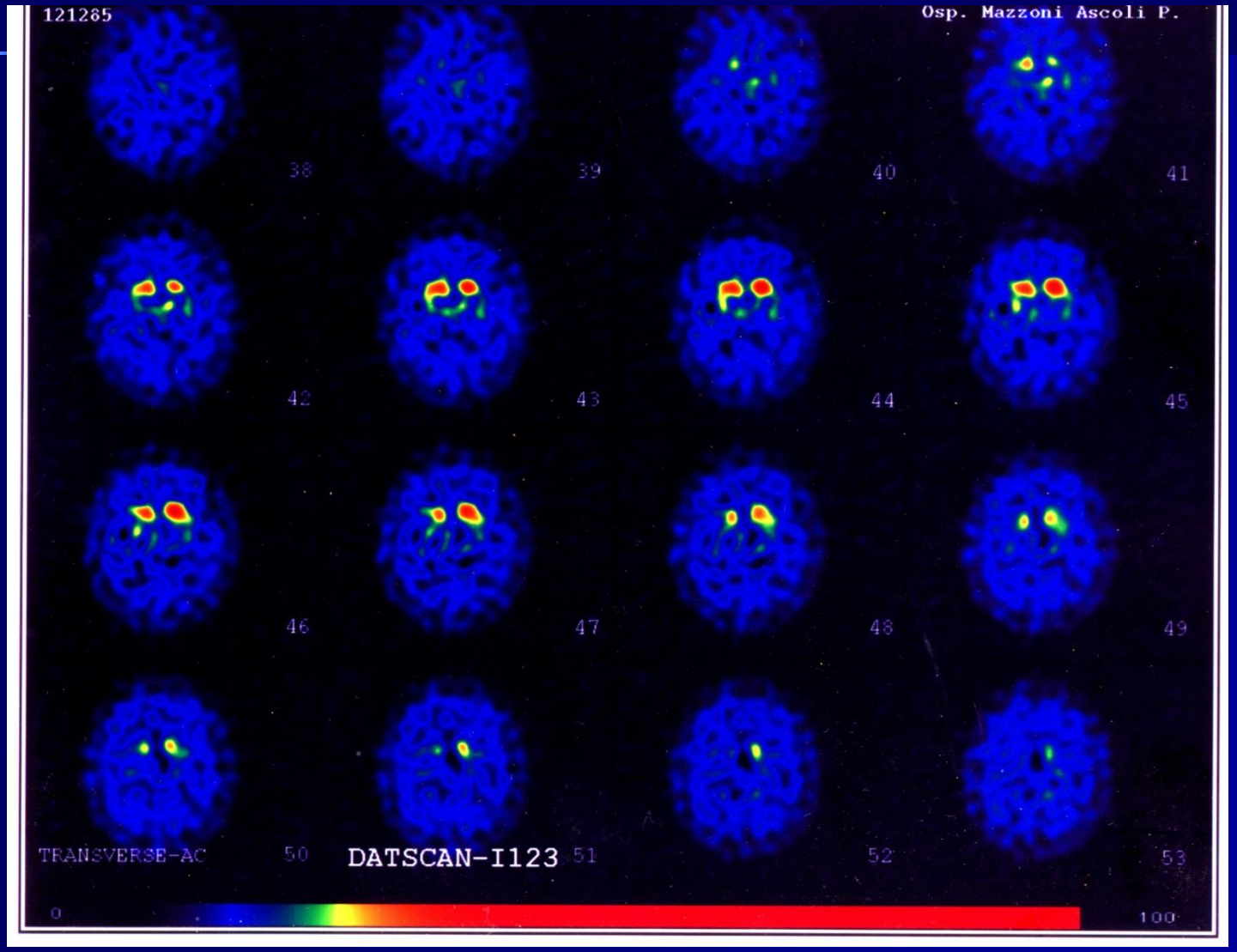
- Precedentemente esclusi disturbi autonomici (Shy-Drager,Ipot.Posturale ecc.)
- Riposo psicosensoriale-occhi chiusi
- Stanza buia
- Controllo dei valori di P.Arteriosa
- Controllo dei valori di saturazione della $_{P}O2$

STUDI FLUSSIMETRICI

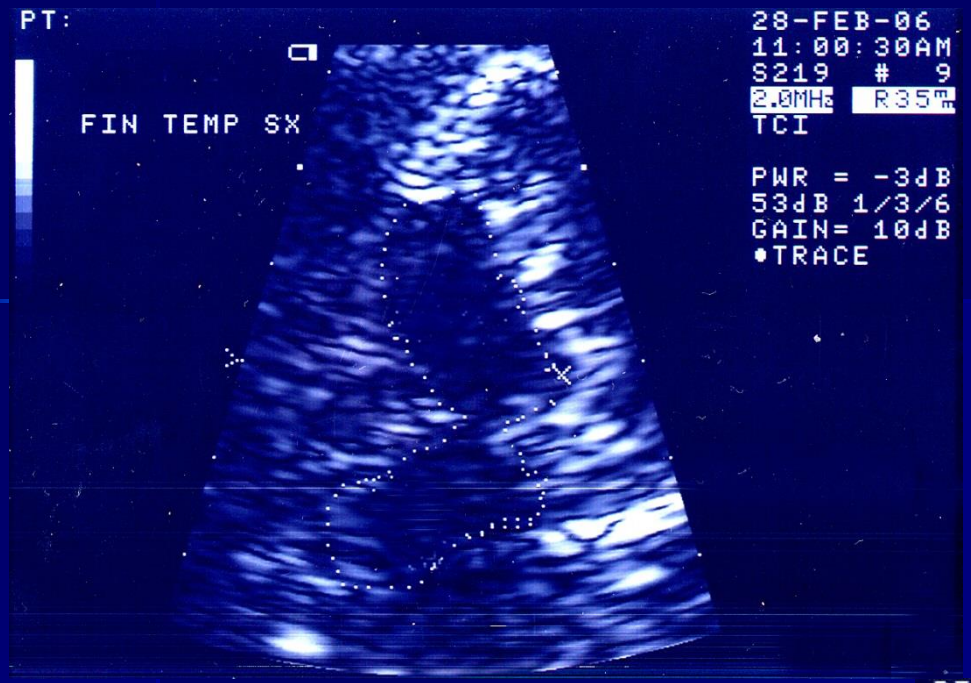
Pazienti	Arteria Cerebrale Media Destra				Arteria Cerebrale Media Sinistra			
	PSV m/sec		PEDV m/sec		PSV m/sec		PEDV m/sec	
	ON	OFF	ON	OFF	ON	OFF	ON	OFF
Pz 1	1.23	0.87	0.60	0.46	1.46	0.96	0.69	0.49
Pz 2	0.87	0.70	0.43	0.34	0.94	0.67	0.47	0.31
Pz 3	1.33	0.96	0.64	0.42	1.32	0.96	0.67	0.42
Pz 4	1.30	1.03	0.47	0.33	1.30	1.03	0.50	0.33
Pz 5	1.10	0.75	0.37	0.24	1.10	0.79	0.38	0.26
Pz 6	1.01	0.80	0.48	0.35	1.08	0.90	0.50	0.36
Pz 7	1.07	0.78	0.55	0.40	1.15	0.75	0.53	0.38
Pz 8	1.05	0.75	0.48	0.35	1.03	0.68	0.47	0.31
Pz 9	1.15	0.83	0.38	0.25	1.20	0.87	0.41	0.29
Pz 10	1.06	0.80	0.40	0.28	1.01	0.77	0.37	0.26
Pz 11	1.17	0.90	0.39	0.25	1.25	0.96	0.40	0.25
Pz 12	1.13	0.79	0.50	0.29	1.10	0.80	0.52	0.30
Media	1.12± 0.13	0.83± 0.09	0.47± 0.09	0.33± 0.07	1.16± 0.15	0.84± 0.12	0.49± 0.10	0.33± 0.07
P	P<0.001		P<0.001		P<0.001		P<0.001	

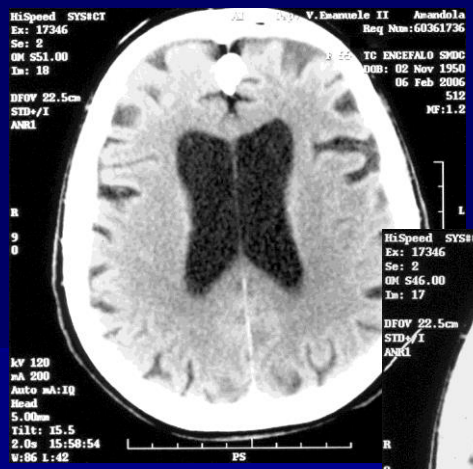
STUDI DI MED. NUCLEARE ?? !!

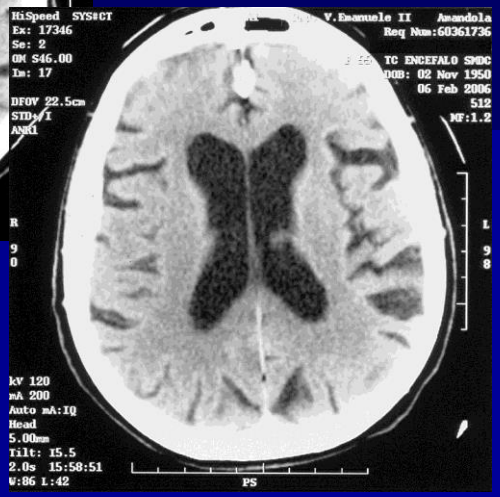




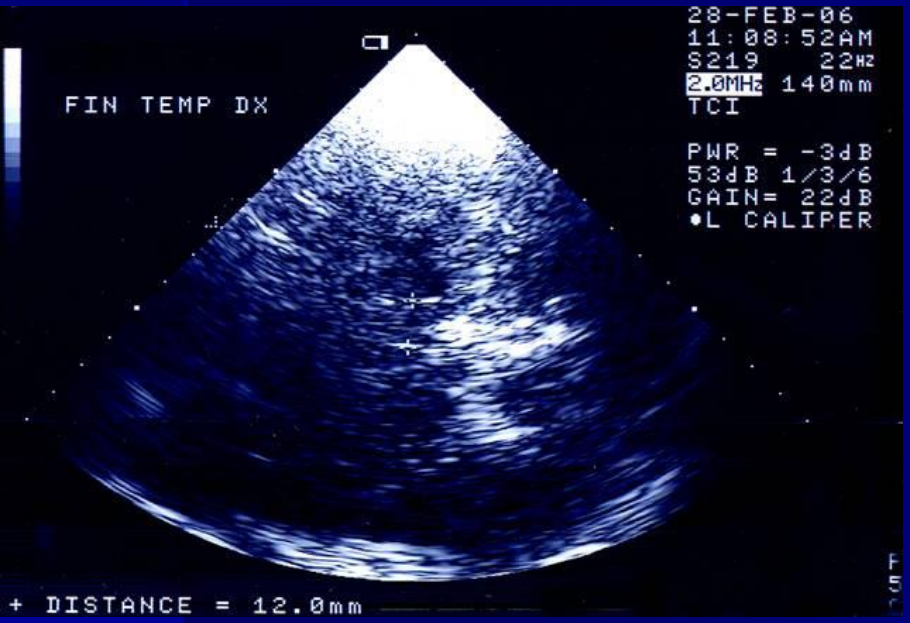
STUDI ECOGRAFICI 2006



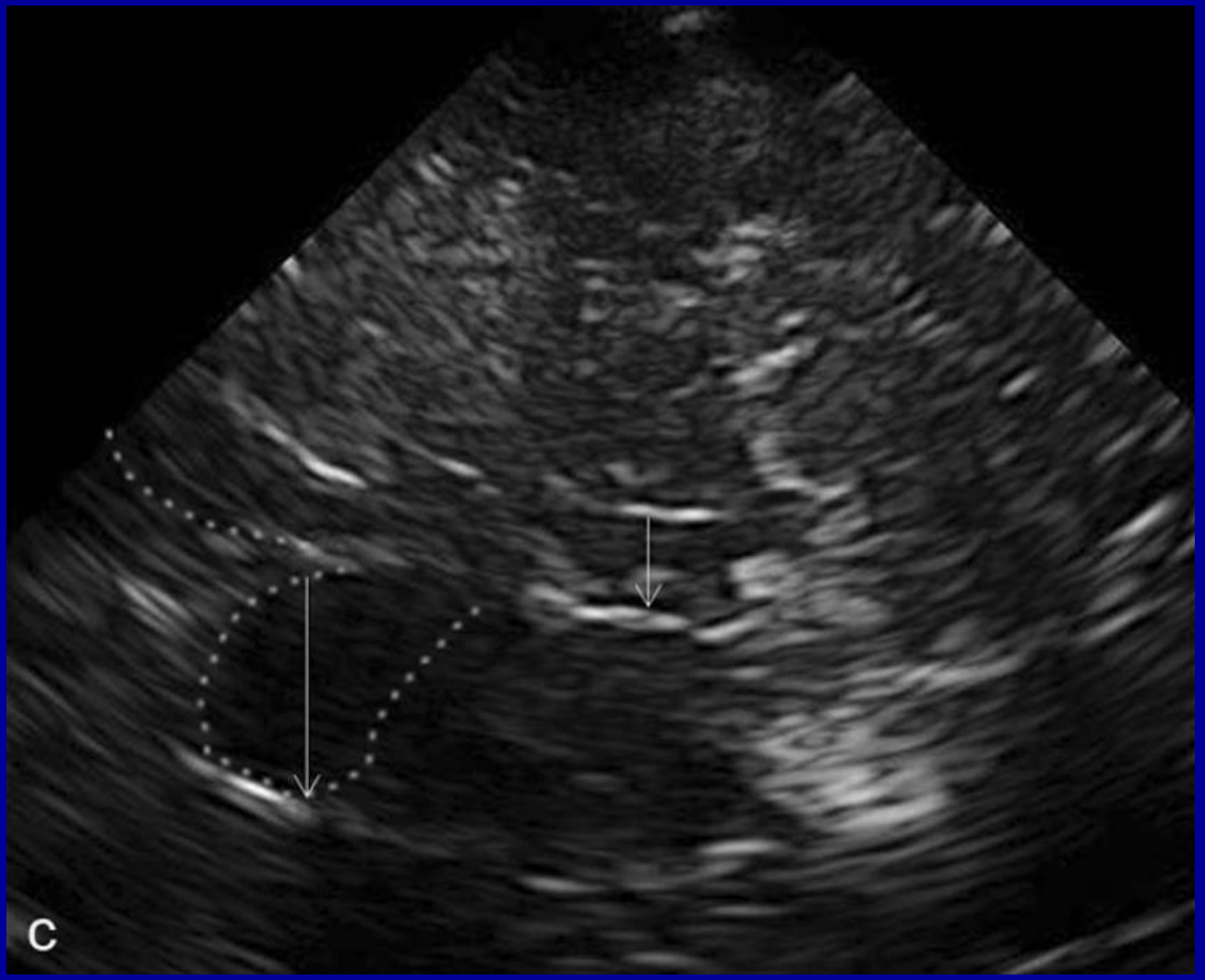




PSP



Atypical parkinsonism



PSP

Berg et al

EFNS/MDS-ES recommendations for the diagnosis of Parkinson's disease

A. Berardelli, G. K. Wenning, A. Antonini, D. Berg, B. R. Bloem, V. Bonifati, D. Brooks, D. J. Burn, C. Colosimo, A. Fanciulli, J. Ferreira,T. Gasser, F. Grandas, P. Kanovsky V. Kostic, J. Kulisevsky, W. Oertel, W. Poewe, J.-P. Reese, M. Relja, E. Ruzicka, A. Schrag, K. Seppi, P. Tabat, M. Vidailhet

European Journal of Neurology 2012 EFNS

The current evidence suggests that TCS is useful in the diagnosis of parkinsonian syndromes, especially with regard to:

- Differentiation of atypical parkinsonian syndromes (APS; class I evidence, Level A)
- Differentiation of secondary parkinsonian syndromes (class I and II evidence, Level A – for sensitivity, specificity and predictive value of parameters)
- Early diagnosis of PD, in clinically unclear cases (class II evidence)
- Detection of subjects at risk for PD (class I) including asymptomatic mutation carriers for monogenic forms of PD.

Enlarged substantia nigra hyperechogenicity and risk for Parkinson disease: a 37-month 3-center study of 1847 older persons.

Berg D., Seppi K., Behnke S., Liepelt I., et al

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

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 (17.4-fold) for PD in elderly individuals with SN+.

Enlarged hyperechogenic substantia nigra as a risk marker for Parkinson's disease.

Berg D., Behnke S., Seppi K., Godau J., et al

Mov Disord.2013 Feb;28(2):216-9

Recently, we reported a 17.4-fold increased risk for PD in individuals with SN+ older than 50 years within 3 years.

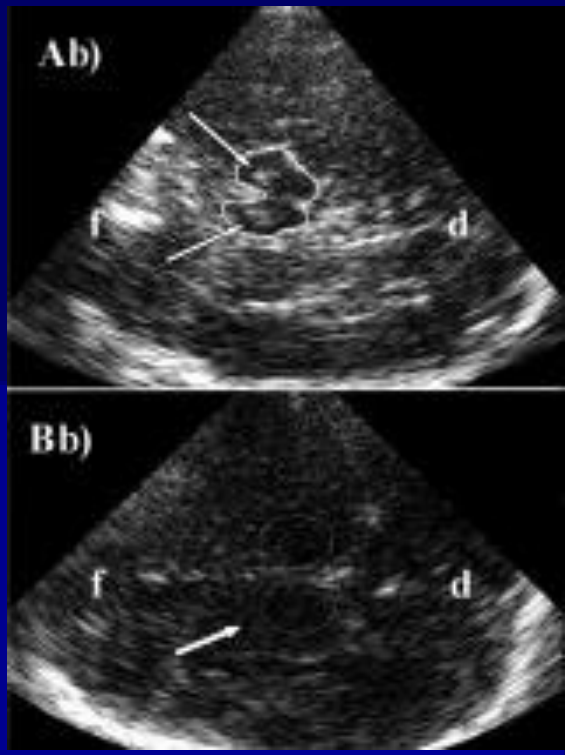
Of the initial 1,847 at baseline PD-free participants 50 years or older, 1,271 underwent the 5-year reassessment.

Participants with SN+ at baseline had a more than 20.6 times increased risk to develop PD in this time span than those without this echo feature.

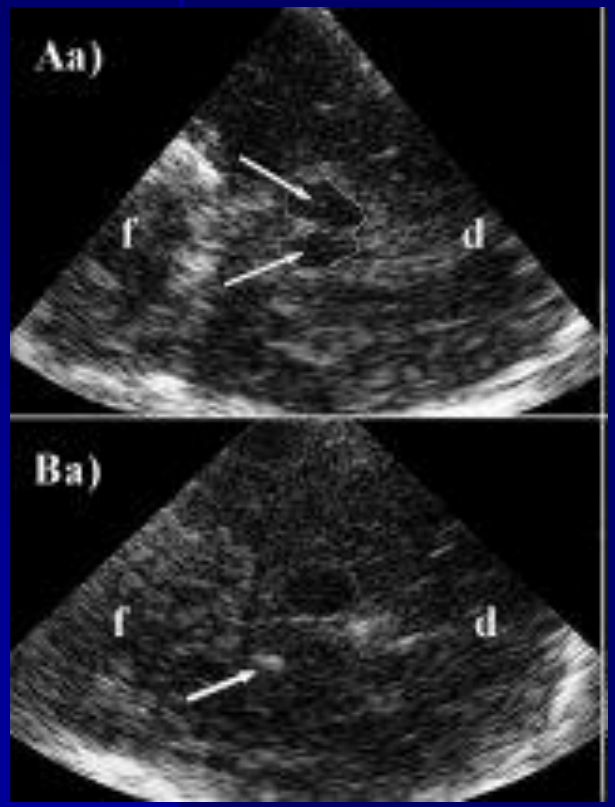
Conclusions: We suggest SN+ as an important risk marker for PD.

Transcranial Sonography Findings in Welding-Related Parkinsonism(WRP) in Comparison to Parkinson's Disease

Uwe Walter,Dirk Dressler, Christian Lindemann,
Andrea Slachevsky, and Marcelo Miranda,
Movement disorders 2008



Idiopathic Parkinson's disease :
-marked hyperechogenicity of SN lenticular nucleus with normal echogenicity.



Welding-related Parkinsonism:
-Normal SN echogenicity
-lenticular nucleus with marked hyperechogenicity

Paz with WR-P developed a L-dopa-resistant akinetic-rigid parkinsonian syndrome at age <50 years

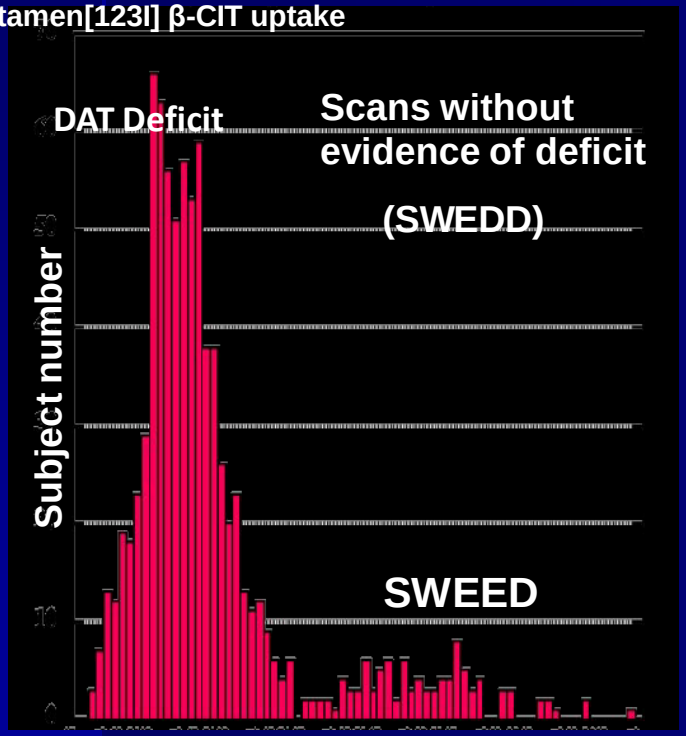
Is Transcranial Sonography Useful to Distinguish Scans Without Evidence of Dopaminergic Deficit Patients From Parkinson's Disease?

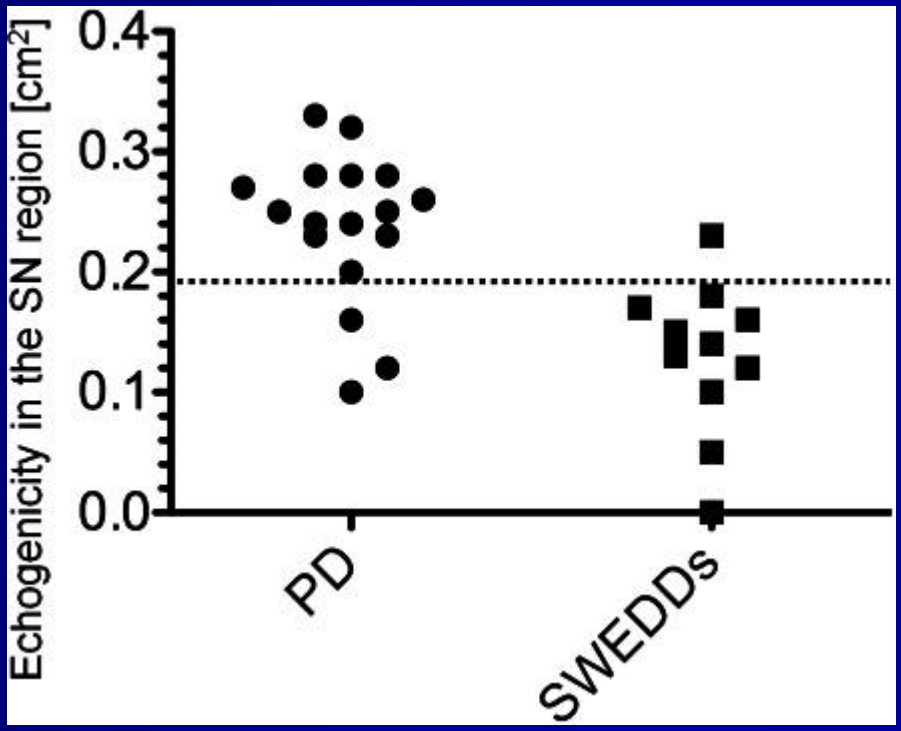
Heike Stockner, Petra Schwingenschuh, Atbin Djamshidian, Laura Silveira-Moriyama, Petra Katschnig, Klaus Seppi, John Dickson, Mark J. Edwards, Andrew J. Lees, Werner Poewe, Kailash P. Bhatia,

Movement Disorders 2012

Baseline PRECEPT- % Age expected

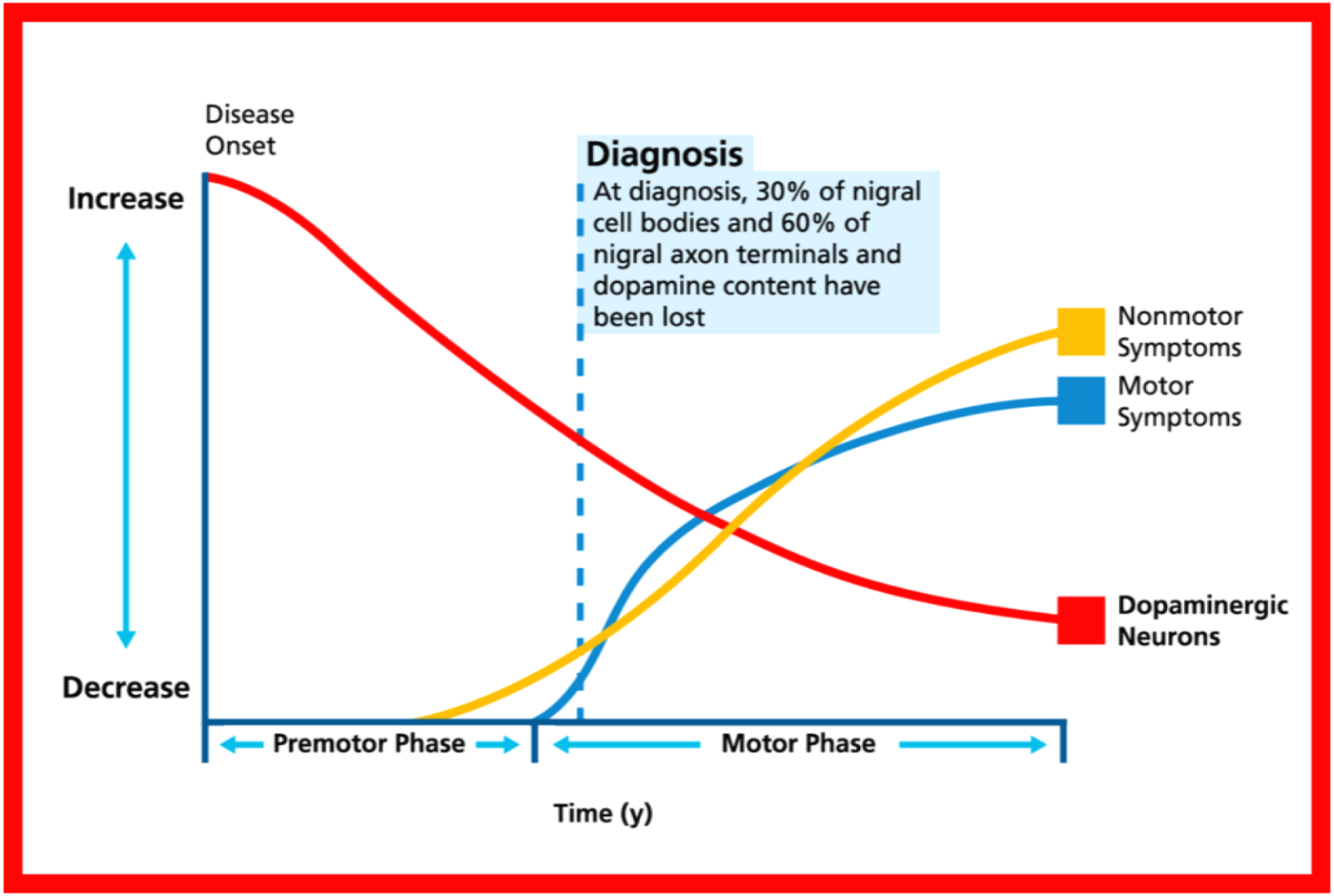
Putamen[123I] β-CIT uptake



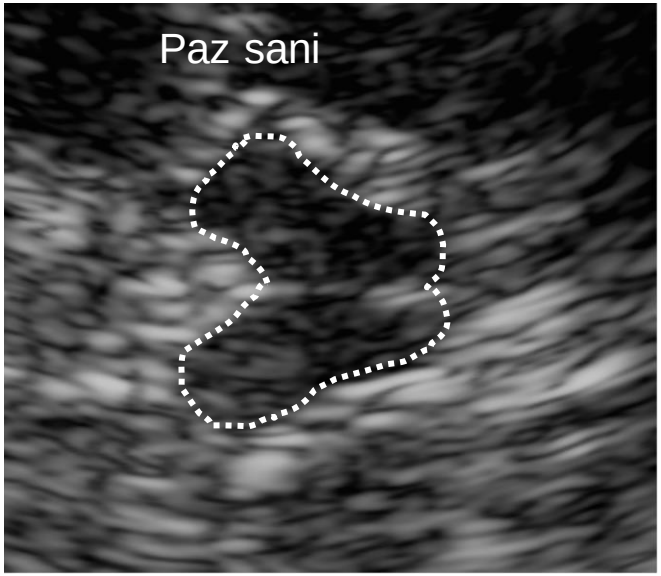


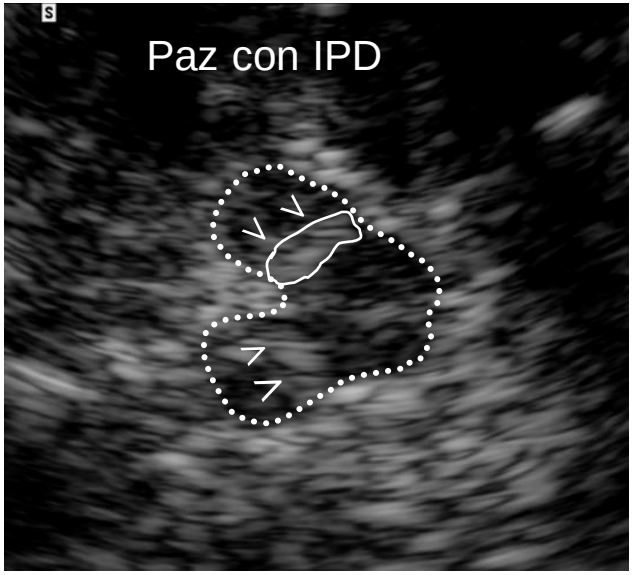
Significantly increased area of midbrain echogenicity in the IPD group compared with the SWEDD group (P < 0.001)

Storia naturale del Morbo di Parkinson



Echogenicity of the Substantia nigra





La iperecogenicità della SN è presente in oltre il 90% dei paz con Idiopatic Parkinson Disease(IPD):

(Berg et al., 2001; Walter et al., 2002)

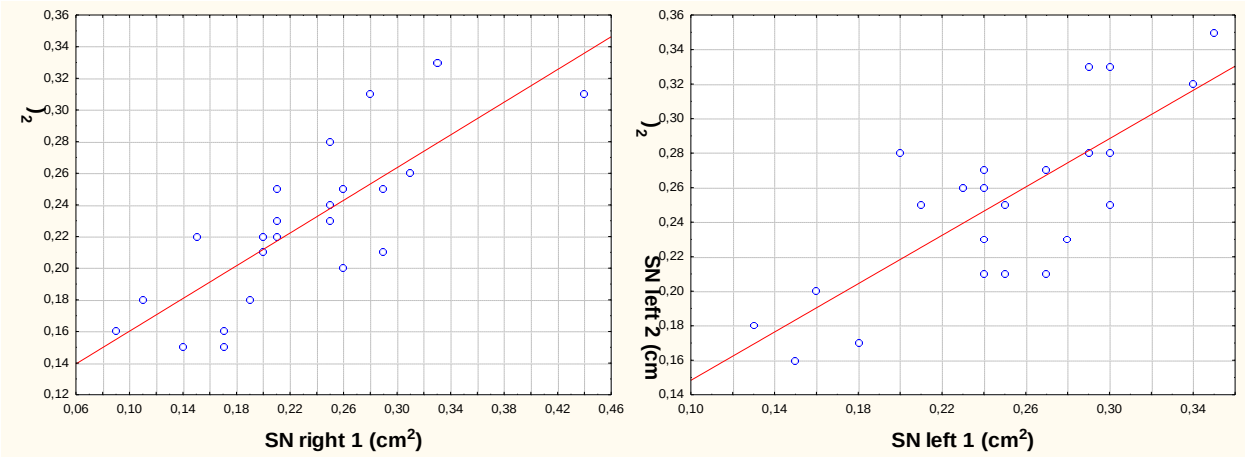
Iron in the basal ganglia in the Parkinson disease
Griffiths P.D. et al
Brain 1999

The relevance of iron in the pathogenesis of PD
Gotz ML et
ann NY Acad. Sci. 2004

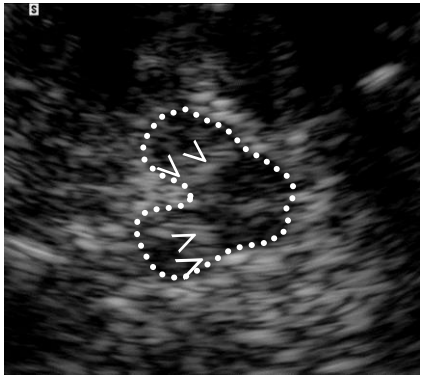
Sequence variations in genes involved in iron metabolism in PD
Hochstrasser H. et al
Medgen 2003

In vivo detection of iron and neuromelanin by transcranial sonography--a new approach for early detection of substantia nigra damage
Berg D.
J Neural Transm.2006
«However, it is not clear yet, whether iron accumulation is a primary cause or a secondary phenomenon in the disease process"

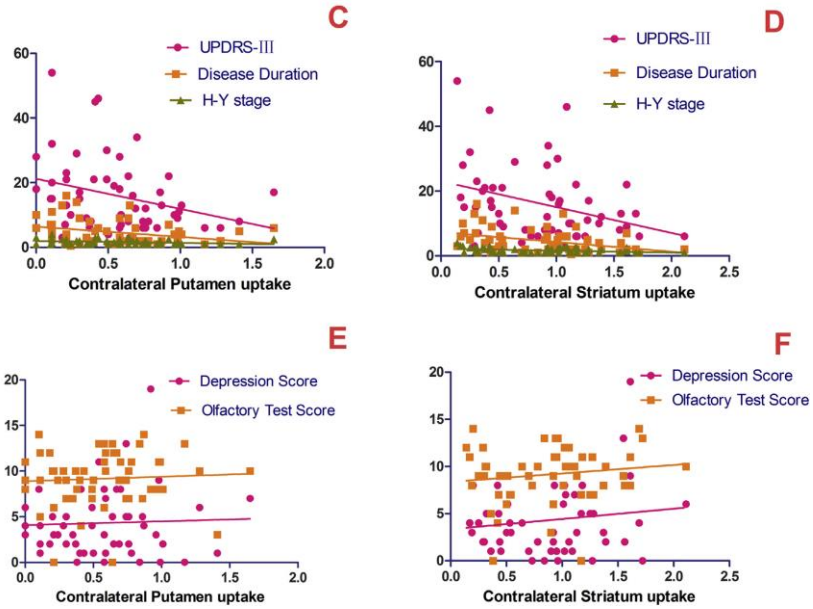
L‘area della SN varia con l‘età e il decorso del MDP?



Berg et al. Mov Disord 2005



L‘estensione dell‘area della SN <u>non</u> è correlata con lo stadio della malattia

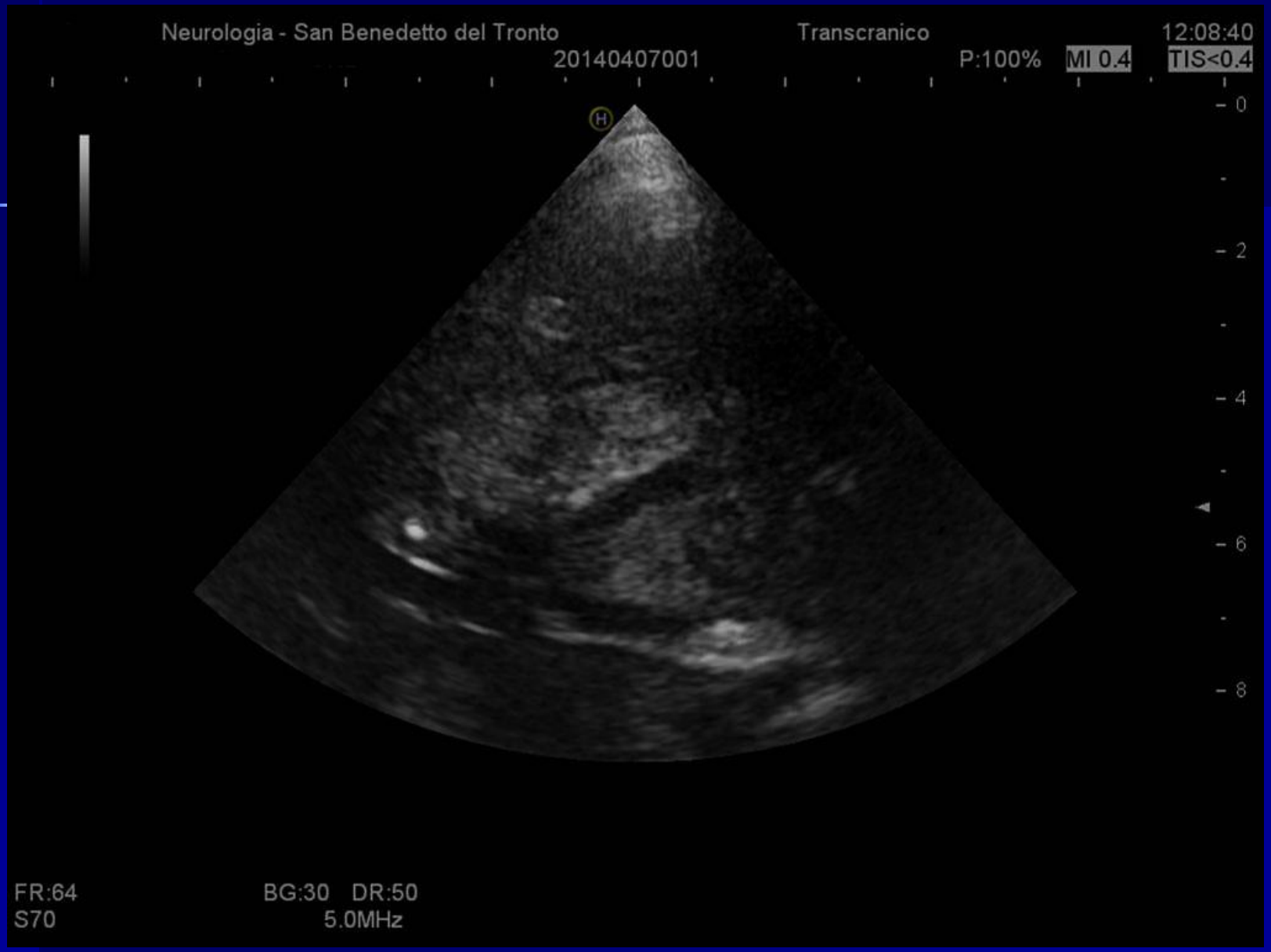


Li Park and related disorders 2015

Summary:neurosonologic patterns for differential diagnosis

Malattia	Substanzia Nigra	Raphe Mesenc	Ventricoli	Gangli Basali
MDP Sporadico	↑↑	↓	-	-
Parkinsonismi Atipici	↑	-	↑↑ 3. Ventricolo	↑↑
Metabolico		-	-	↑↑
Idrocefalo	-	-	↑↑	-
Tremore Essenziale	(↑)	-	-	-
Depressione	(↑)	↓↓	-	-

Wilson Disease



Sonographic detection of basal ganglia lesions in asymptomatic and symptomatic Wilson disease

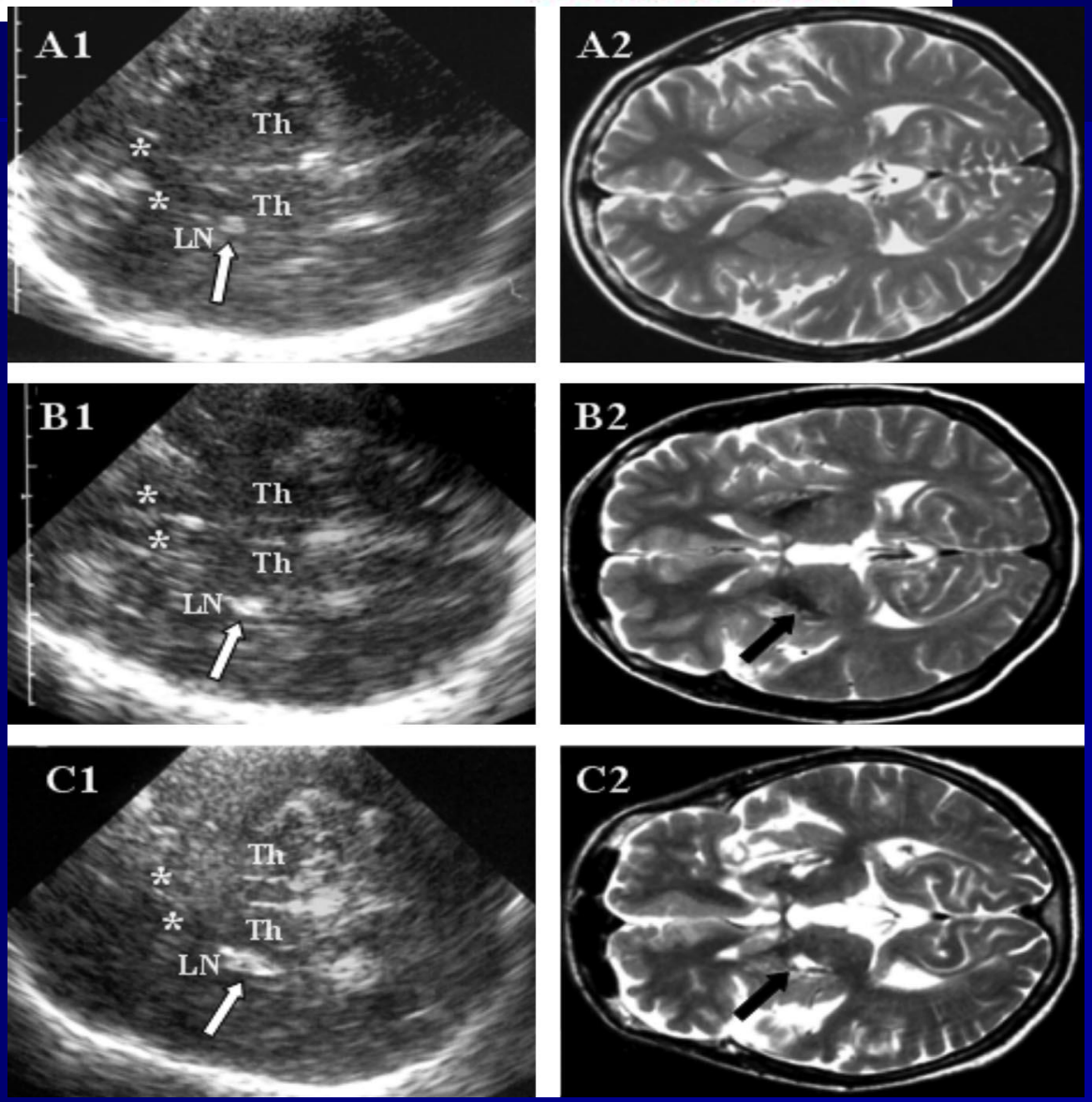
U. WALTER et al.

NEUROLOGY 2005

(A) Neurologically asymptomatic patient with WD. Whereas MRI (A2) shows normalLN, TCS (A1) depicts abnormal,dot-like hyperechogenicity of the lenticular nucleus (arrow).

(B) Neurologically moderately affected patient with WD. TCS (B1) shows abnormal hyperechogenicity (arrow) of the LN, corresponding to hypointense MRI lesion (B2, arrow).

(C) Neurologically severely affected patient with WD.TCS (C1) displays abnormal LN hyperechogenicity (arrow), corresponding to hyperintense and hypointense lesions on MRI (C2,arrow).



Pitfalls !!

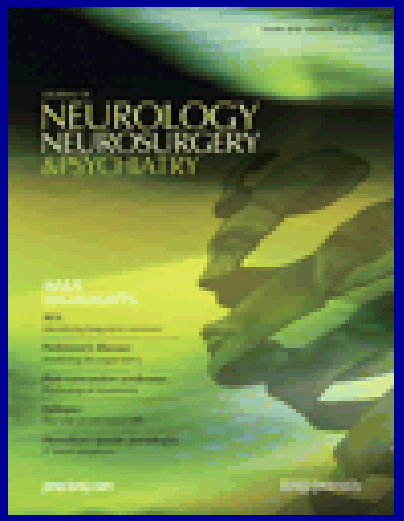
JNNP

Reproducibility and diagnostic accuracy of substantia nigra sonography for the diagnosis of Parkinson's disease

van de Loo S., Walter U., Behnke S., Hagenah J., Lorenz M., Sitzer M., Hilker R., Berg D.

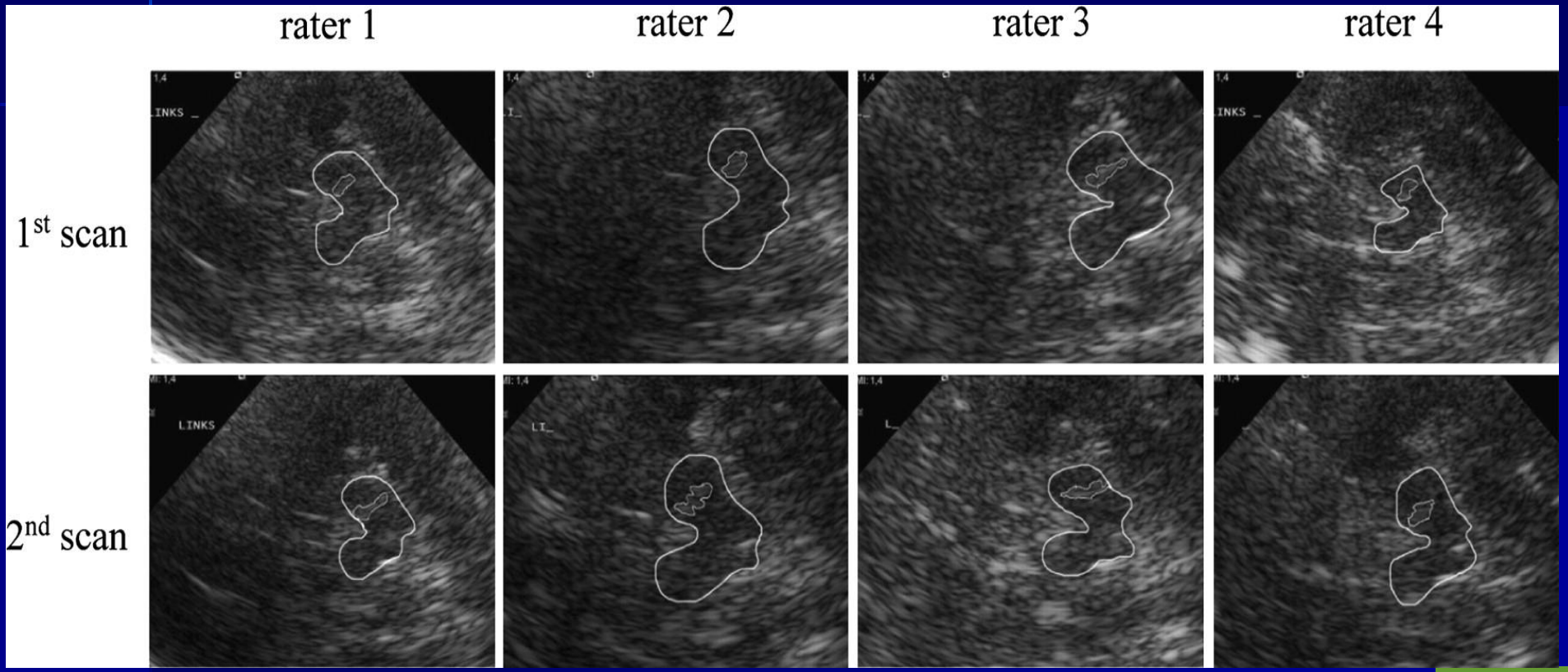
J Neurol Neurosurg Psychiatry.2010 Oct;81(10):1087-92

a hyperechogenic area of 0.24 cm^2 as the optimum cut-off value for the differentiation between PD and controls (sensitivity 79%, specificity 81%).



Transaxial midbrain B-mode sonography of the substantia nigra (SN) measured twice by four raters in the same Parkinson's disease patient with good transtemporal bone window quality (first scan: upper row; second scan: lower row).

van de Loo S et al. J Neurol Neurosurg Psychiatry 2010;81:1087-1092

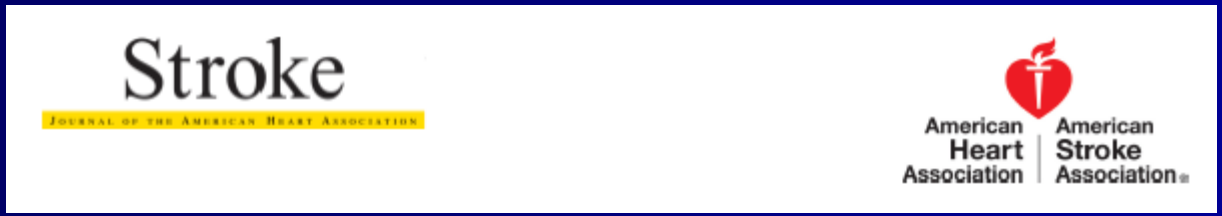


Reliable SN TCS data on PD can be achieved in clinical routine and multicentre trials when standardised analysis protocols and certain quality criteria of brain parenchyma sonography are met.

JNNP

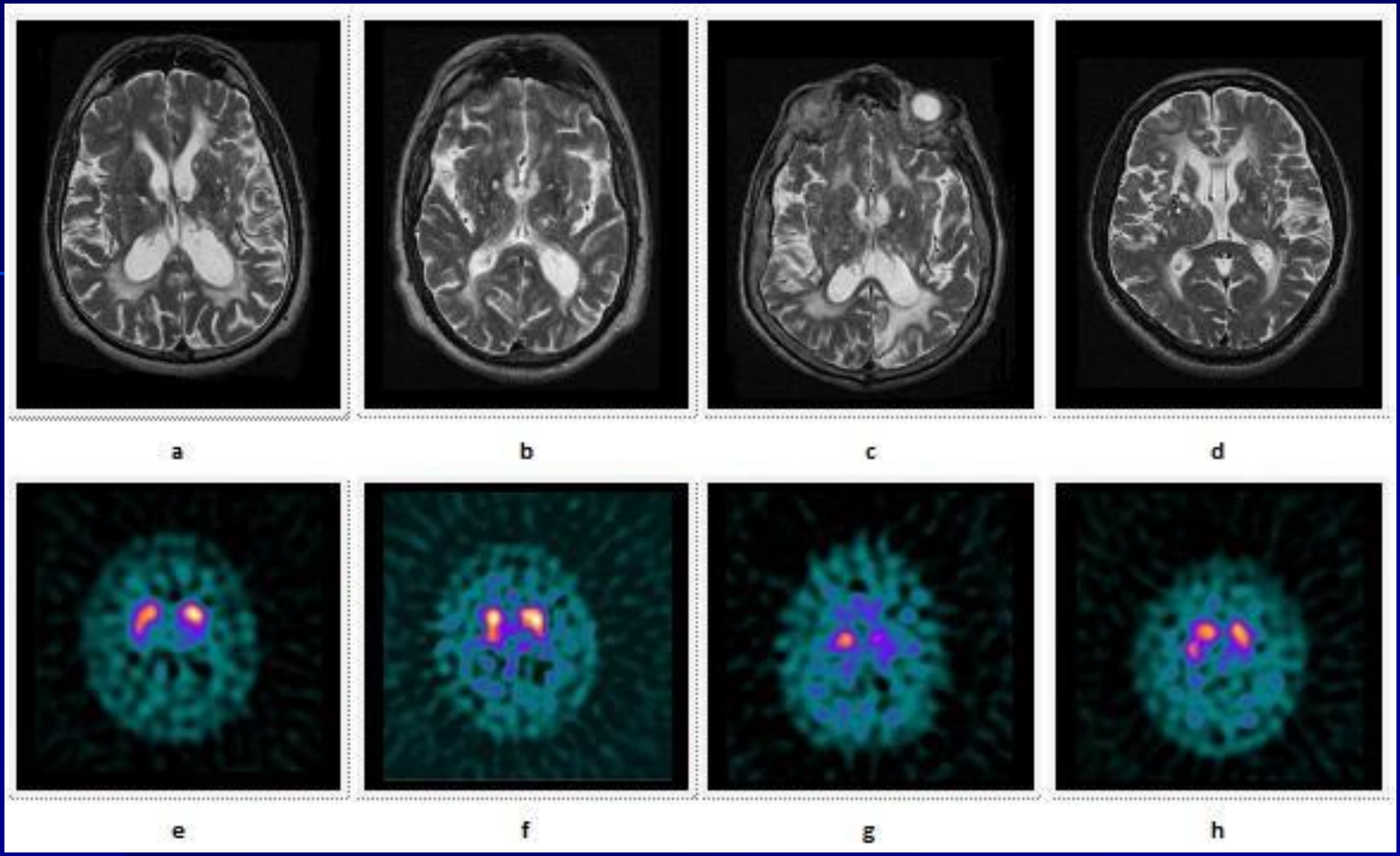
Conclusions: "The data demonstrate that the observer variability of SN planimetry is low only in the hands of <u>experienced</u> investigators".

Cerebral Autosomal Dominant Arteriopathy With Subcortical Infarcts and Leukoencephalopathy (**CADASIL**)



Parkinsonism is a late, not rare,feature of CADASIL: a study on Italian patients carrying the R 1006 C mutation.
Ragno M. et al
Stroke Apr;44(4):1147-9. 2013

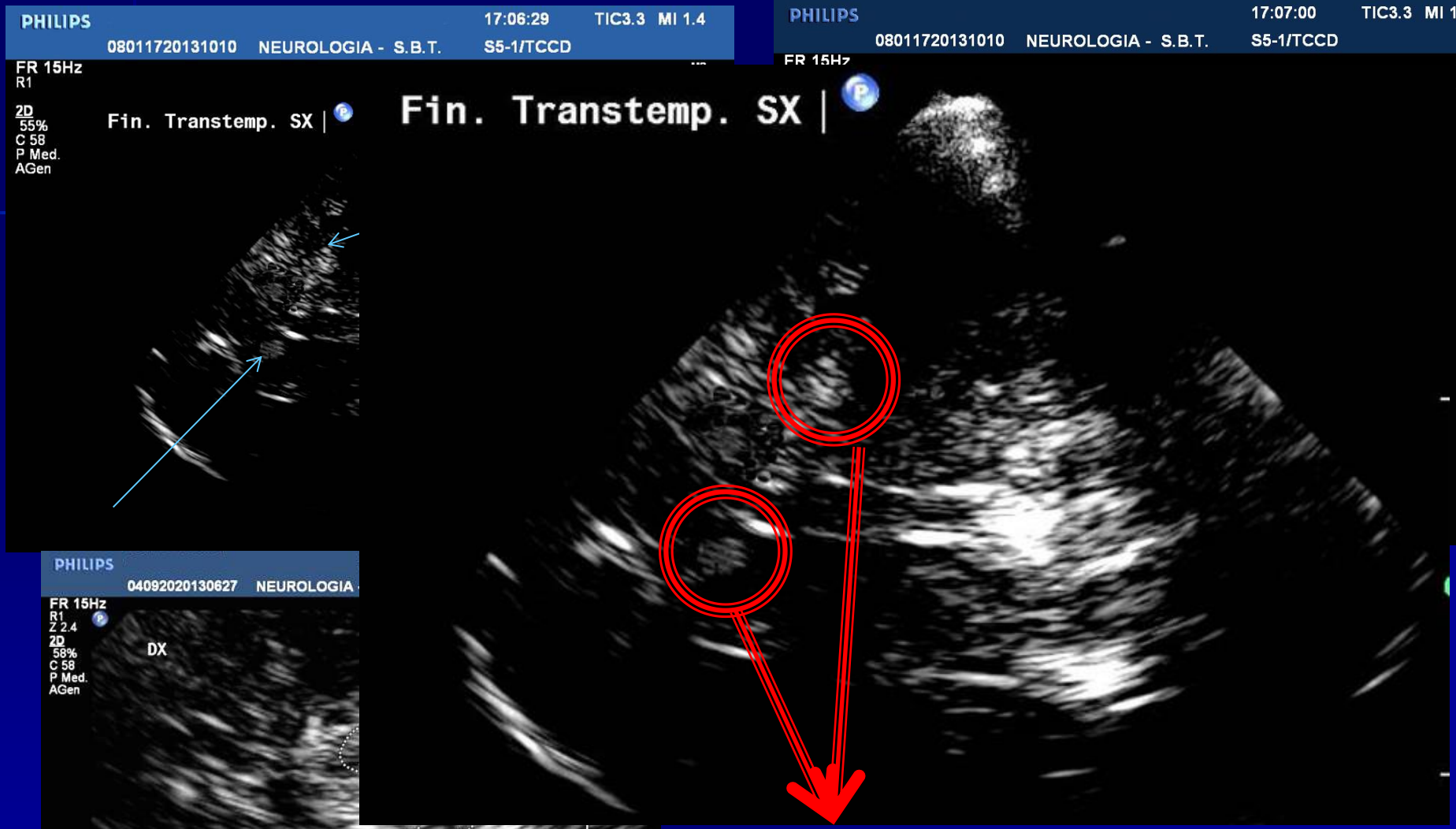
Stroke Apr;44(4):1147-9. 2013



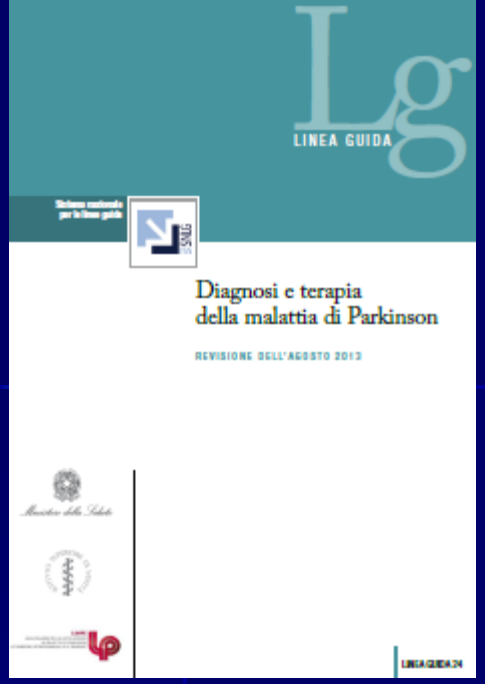
Axial brain MRI showing: (a) multiple lacunae of the basal ganglia, more evident on the right pallidus and left caudate head on T2-weighted images ; (b) small basal ganglia lacunae and ischemic lesions of the left ventral thalamus and right globus pallidus on T2-weighted spin echo image ; (c) cortical infarct in the left temporo-occipital region and lacunae in the left pallidus and right thalamus on T2-weighted images ; (d) ischemic infarction of the right lentiform nucleus on T2-weighted spin echo images . [123I]-FP-CIT showing: (e) slight reduction of left putamen uptake; (f) bilateral low putaminal uptake; (g) bilaterally reduced uptake in the caudate and putamen ; (h) moderate low uptake at the right caudate and bilaterally reduced putaminal uptake.

Brain Parenchyma Sonography(BPS) in pat. with Cadasil

Our ongoing experience



-Bilateral ipercogenicity of LN



task force sottolinea che questa tecnica non è universalmente utilizzata e richiede una particolare esperienza. Inoltre a causa della bassa specificità dell'ecografia transcranica nella diagnosi di malattia di Parkinson, questa tecnica dovrebbe essere utilizzata insieme ad altri test.

Considerando le finalità delle raccomandazioni redatte in questa linea guida, orientate verso la pratica clinica corrente e la sanità pubblica, e le difficoltà nell'esecuzione del test (con la necessità di un operatore esperto e la limitazione imposta all'esecuzione dell'esame subordinata alla qualità della finestra trans temporale) si ritiene di non dover raccomandare l'uso dell'ecografia transcranica nella malattia di Parkinson.

Raccomandazioni

C L'ecografia transcranica parenchimale non dovrebbe essere utilizzata per la diagnosi differenziale tra malattia di Parkinson idiopatica e altre condizioni associate, se non all'interno di specifici protocolli di ricerca.

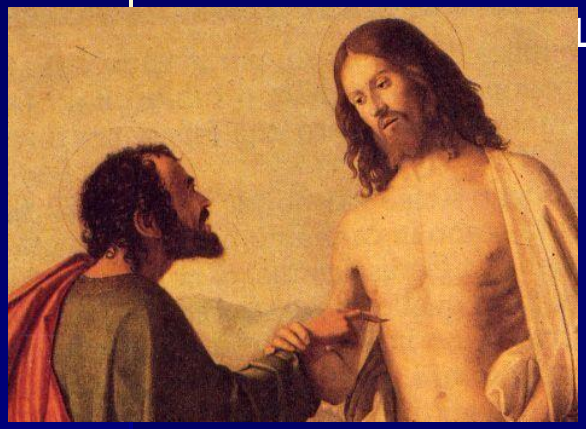
Raccomandazione per la ricerca

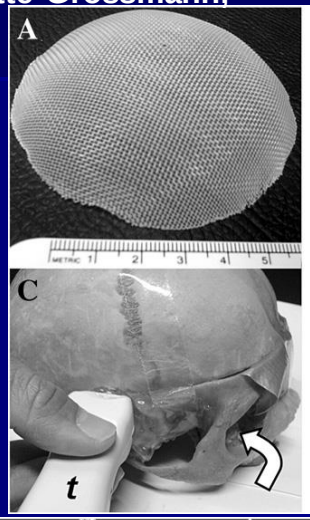
In considerazione dei risultati raggiunti sono sollecitati ulteriori studi relativi all'impiego dell'*imaging* strutturale cerebrale (TC, RM, ecografia transcranica parenchimale) per la diagnosi differenziale tra malattia di Parkinson e altri parkinsonismi degenerativi.

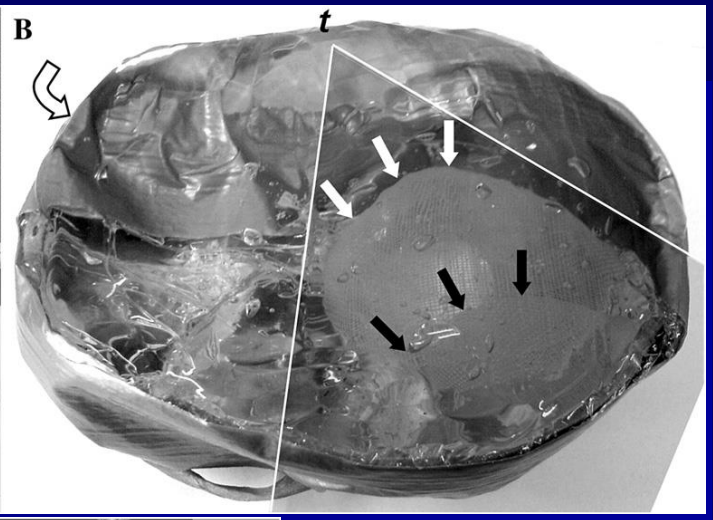
Contemporary ultrasound systems allow high-resolution transcranial imaging of small echogenic deep intracranial structures similarly as MRI: A phantom study

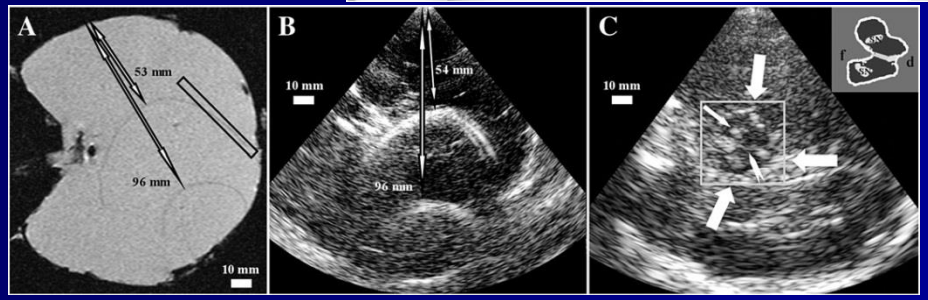
Uwe Walter, Martin Kanowski,Jörn Kaufmann, Annette Grossmann, Reiner Benecke, and Ludwig Niehaus

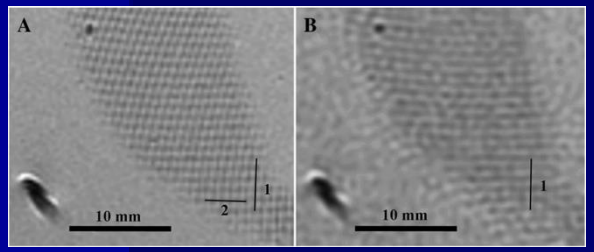
–558

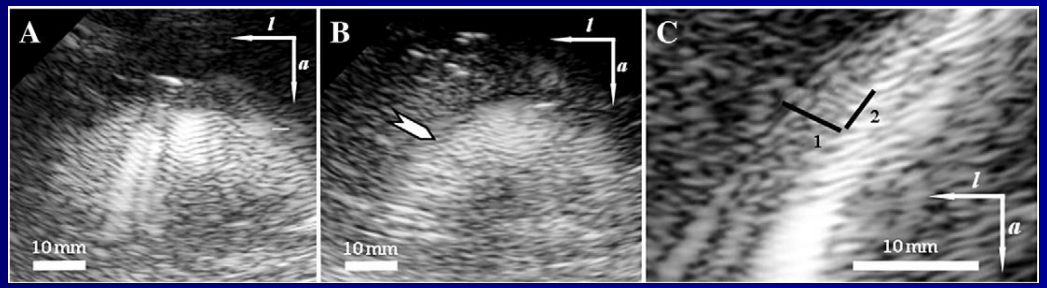




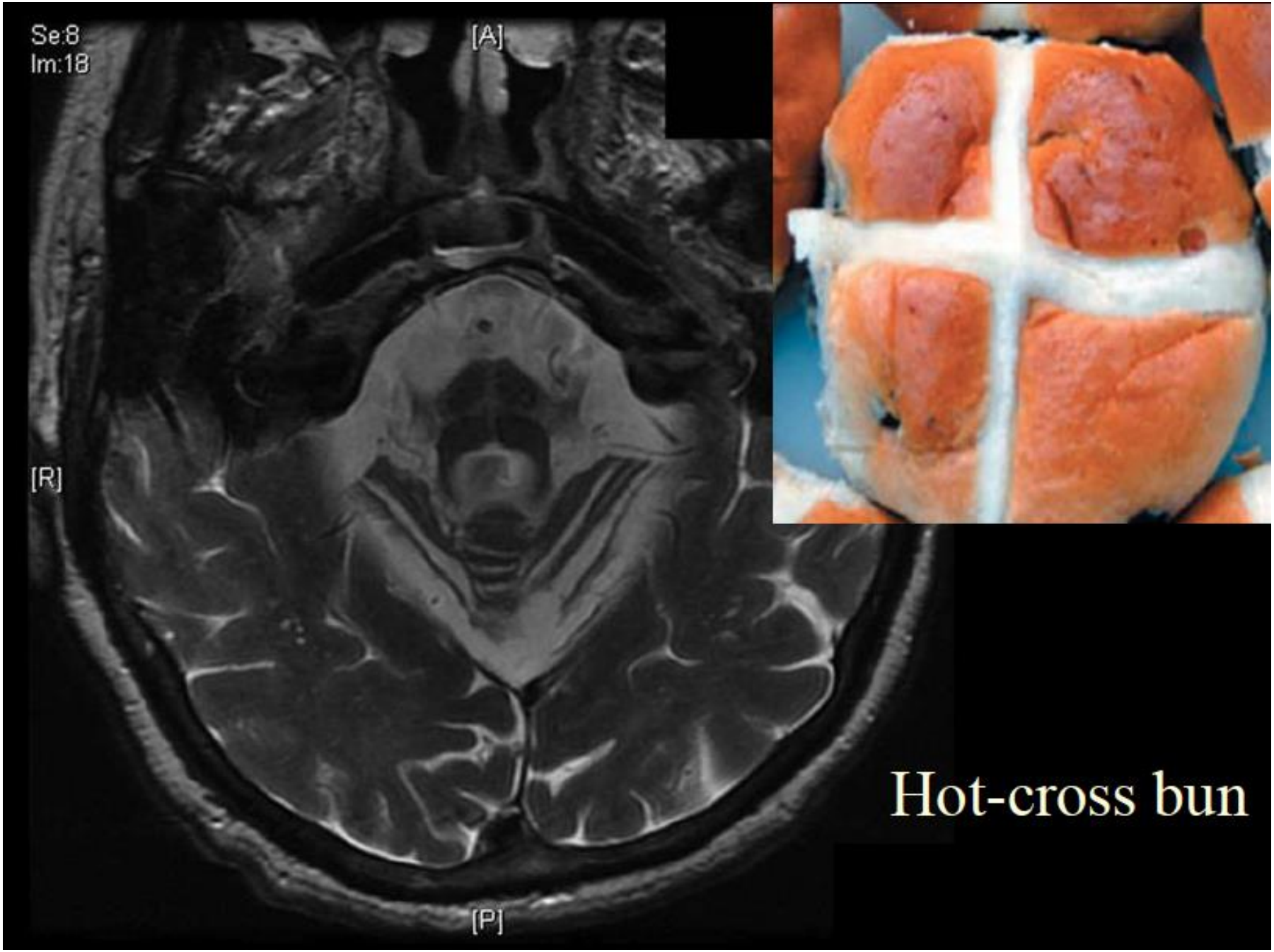








Future applicazioni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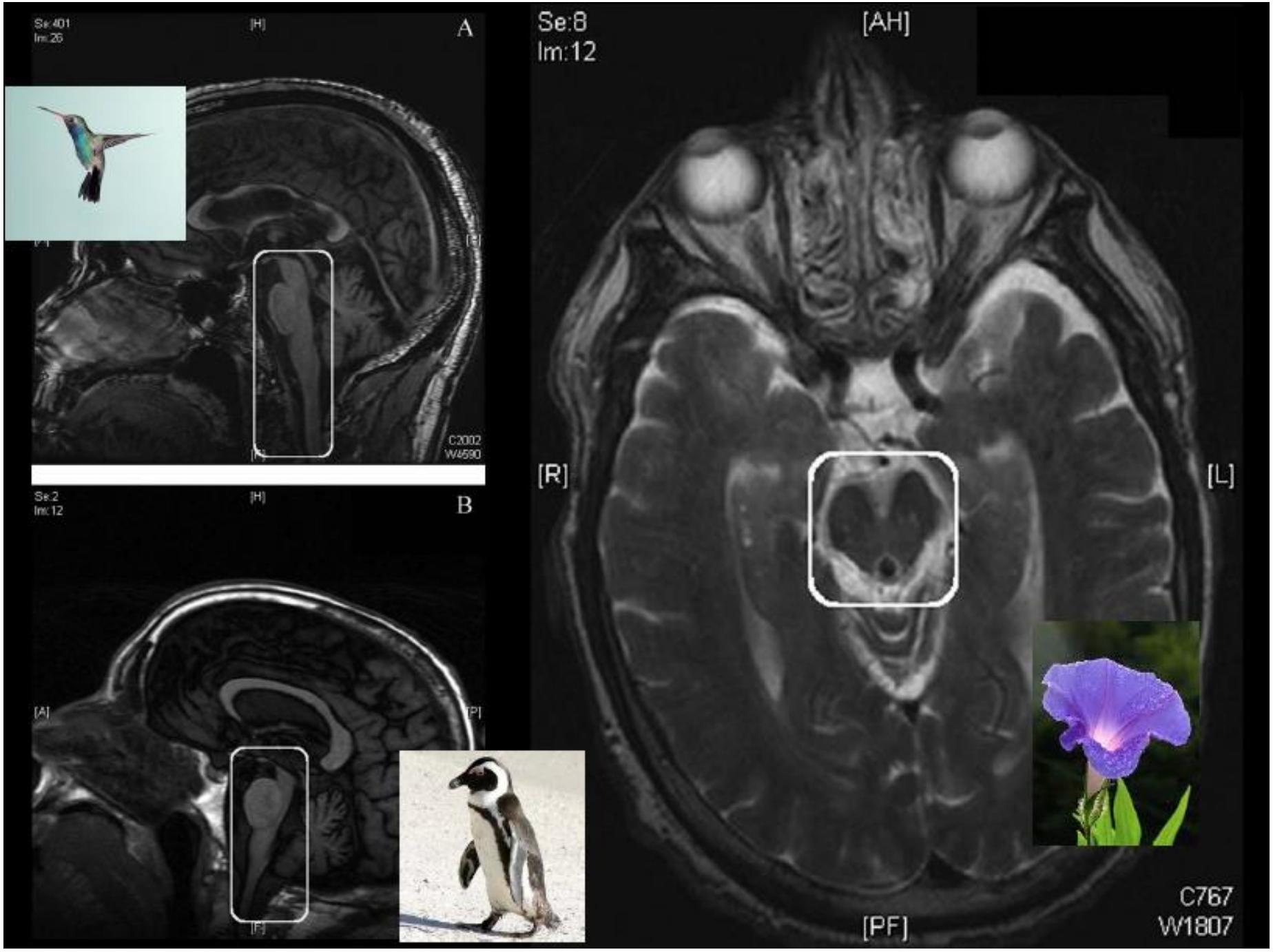
Hot-cross bun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W1807

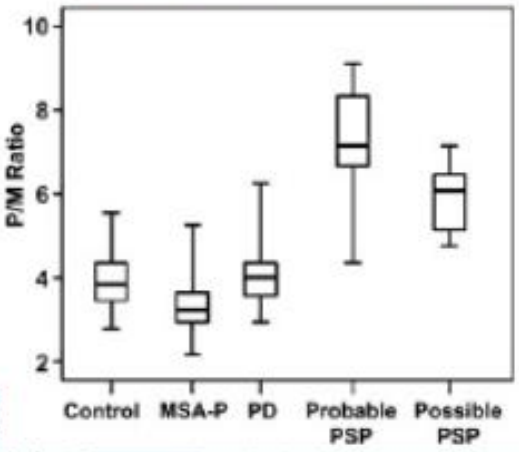
MR Imaging Index for Differentiation of Progressive Supranuclear Palsy from Parkinson Disease and the Parkinson Variant of Multiple System Atrophy[1]

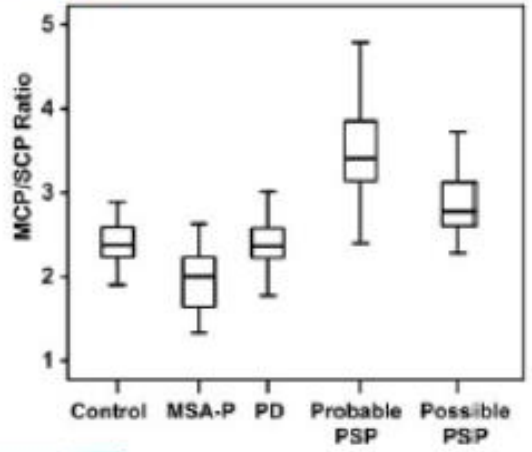
Aldo Quattrone, MD
Giuseppe Nicoletti, MD
Donatella Messina, MD
Francesca Fera, MD
Francesca Condelire, PhD
Pierfrancesco Puglisea, MD
Pierluigi Lanza, MD
Paolo Barone, MD
Letterio Morgante, MD
Mario Zappia, MD
Umberto Aguglia, MD
Olivier Gallo, STc

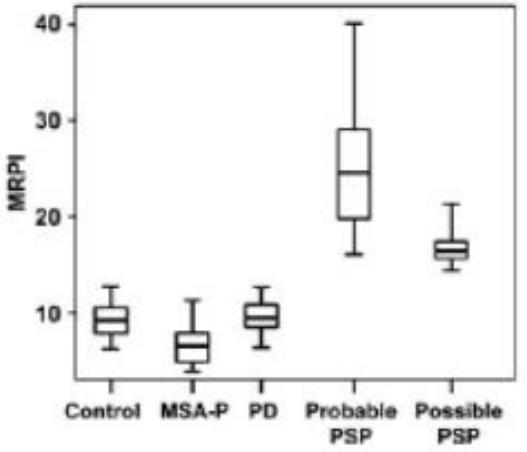
Radiology

Radiology: Volume 246: Number 1—January 2008

Purpose: To prospectively assess sensitivity and specificity of mag







[1] From the Institute of Neurology (A.Q., ... Neurosciences, Psychiatry and Anesthesiology, Magna Graecia University, Catanzaro, Calabria, Italy; Institute ... Sciences, National Research Council, ... Milagros, Cosenza, Calabria, Italy (A.Q., ... O.G.); Department of Neurological Scien... Naples Federico II, Naples, Italy (F.B.); ... Neuroscience, Psychiatry and Anesthesi... of Messina, Messina, Sicily (L.M.); Insti... Department of Neurosciences, Universi... Ionia, Sicily (M.Z.); and Regional Epilep... Ospedaliero Bianchi-Melacrino-Morelli, ... Calabria, Italy (U.A.). Received October ... requested December 12; revision recei... 2007; accepted February 28; final versi... 16. **Address correspondence to** A.Q. ... logna, Policlinico Mater Domini, Campu... Germaneto, 88100 Catanzaro, Italy (e-m... @libero.it).

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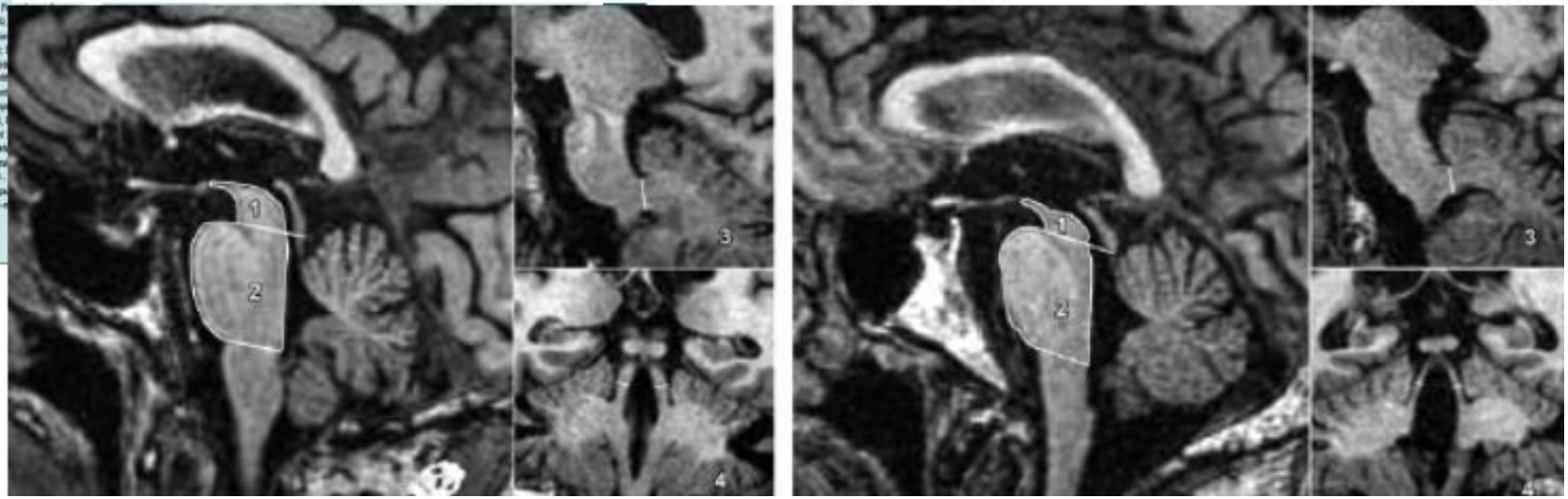

RESEARCH ARTICLE

Magnetic Resonance-Transcranial Ultrasound Fusion Imaging: A Novel Tool for Brain Electrode Location

Uwe Walter, MD,[1*] Jan-Uwe Müller, MD,[2] Johannes Rösche, MD,[1] Michael Kirsch, MD,[3] Annette Grossmann, MD,[4] Reiner Benecke, MD,[1] Matthias Wittstock, MD,[1†] and Alexander Wolters, MD[1†]

[1]*Department of Neurology, University of Rostock, Rostock, Germany*
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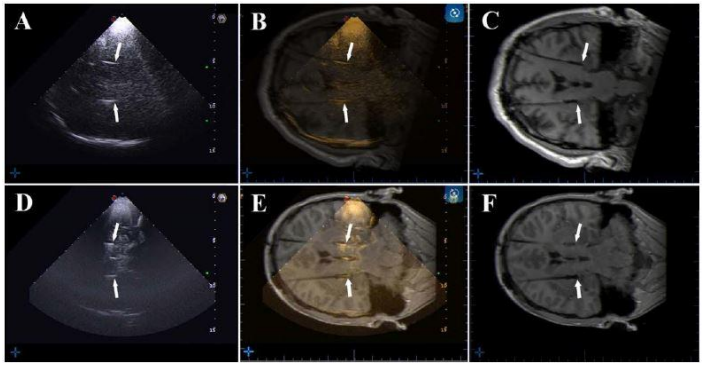
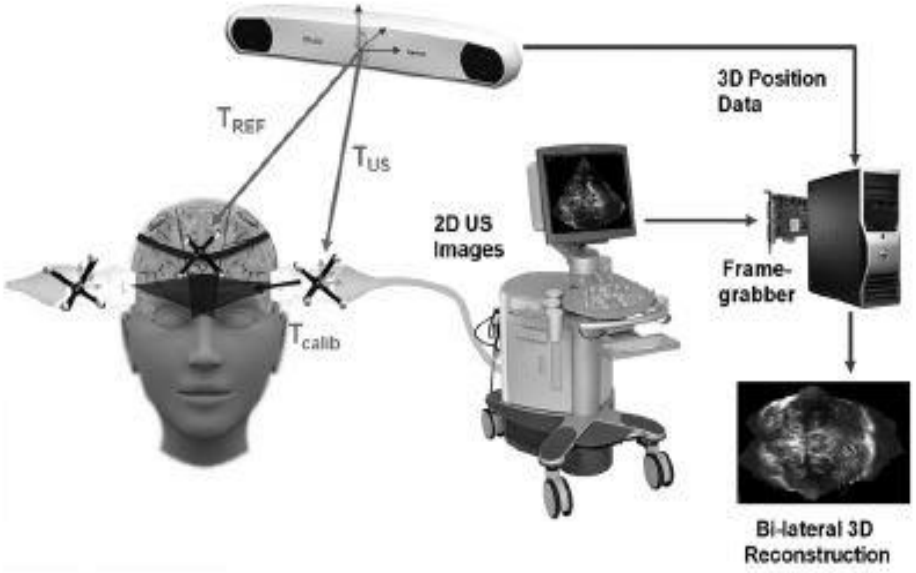
[4]*Institute of Diagnostic and Interventional Radiology, University of Rostock, Rostock, Germany*

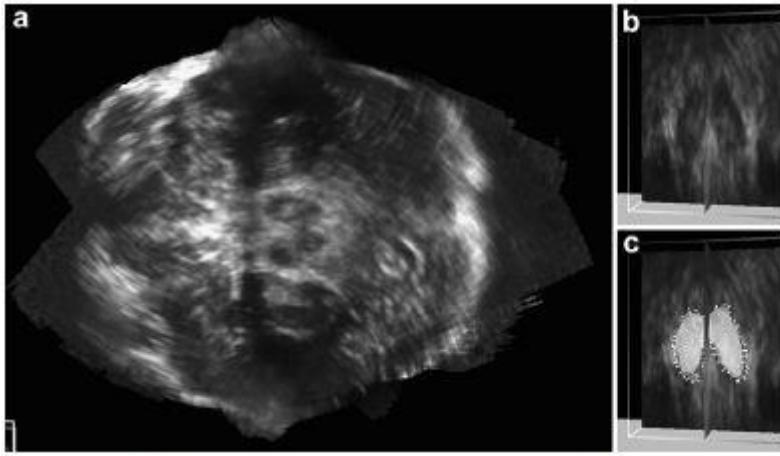


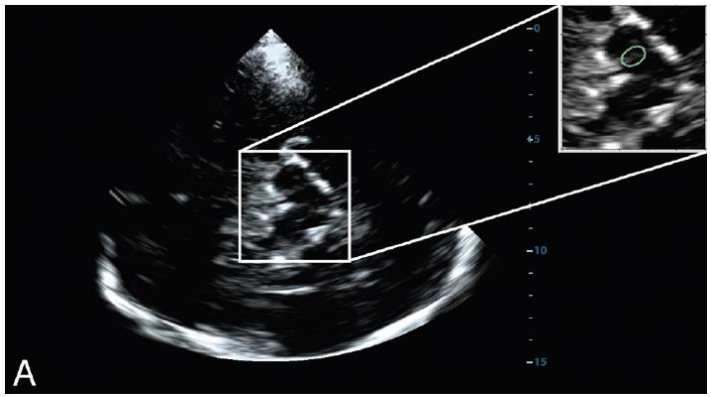
THREE-DIMENSIONAL SONOGRAPHIC EXAMINATION OF THE MIDBRAIN FOR COMPUTER-AIDED DIAGNOSIS OF MOVEMENT DISORDERS

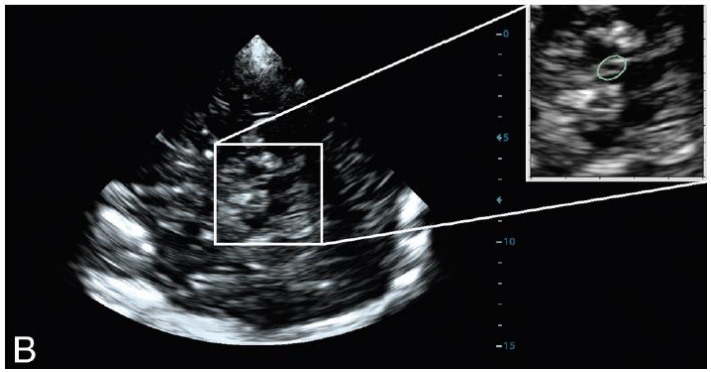
ANNIKA PLATE,* SEYED-AHMAD AHMADI,† OLIVIER PAULY,†‡ TASSILO KLEIN,† NASSIR NAVAB,† and KAI BÖTZEL*

*Department of Neurology, Ludwig-Maximilians-Universität München, Munich, Germany; †Computer Aided Medical Procedures (CAMP), Technische Universität München (TUM), Garching at Munich, Germany; and ‡Institute of Biomathematics and Biometry, HelmholtzZentrum München, Germany







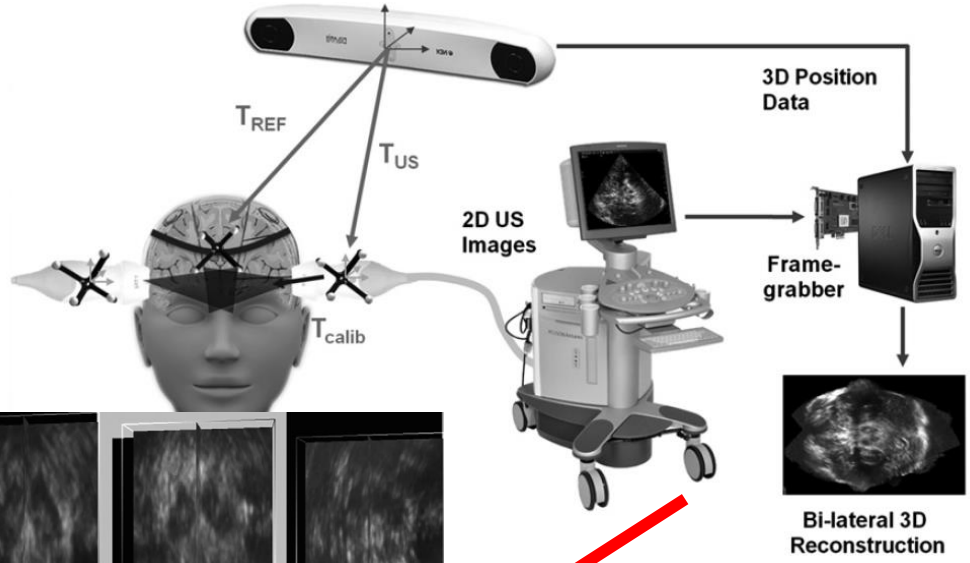


Skoloudik 2014 AJNR

- active contour algorithms
- 3D SN detection based

(random forests vs principal component analyses of artificial neural networks)

still dependent on the image's quality and on operator's skills).



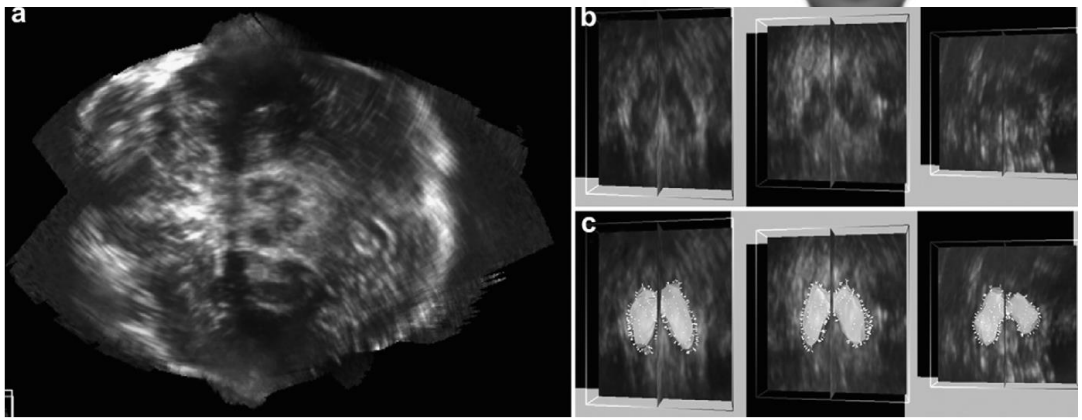
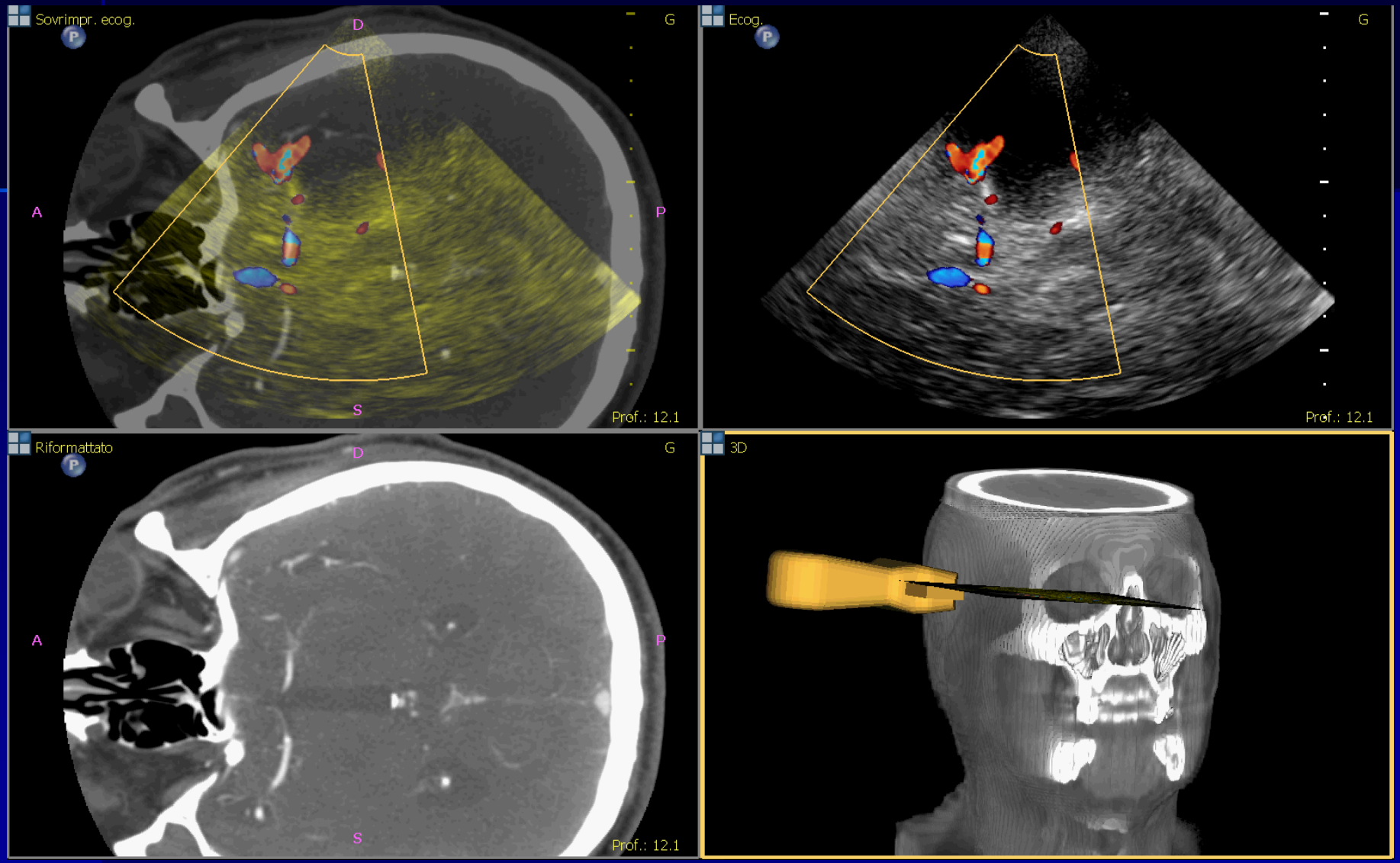


Plate et al. Ultras Med 2012

IL CONCETTO DI «FUSION» IN NEUROLOSONOLOGIA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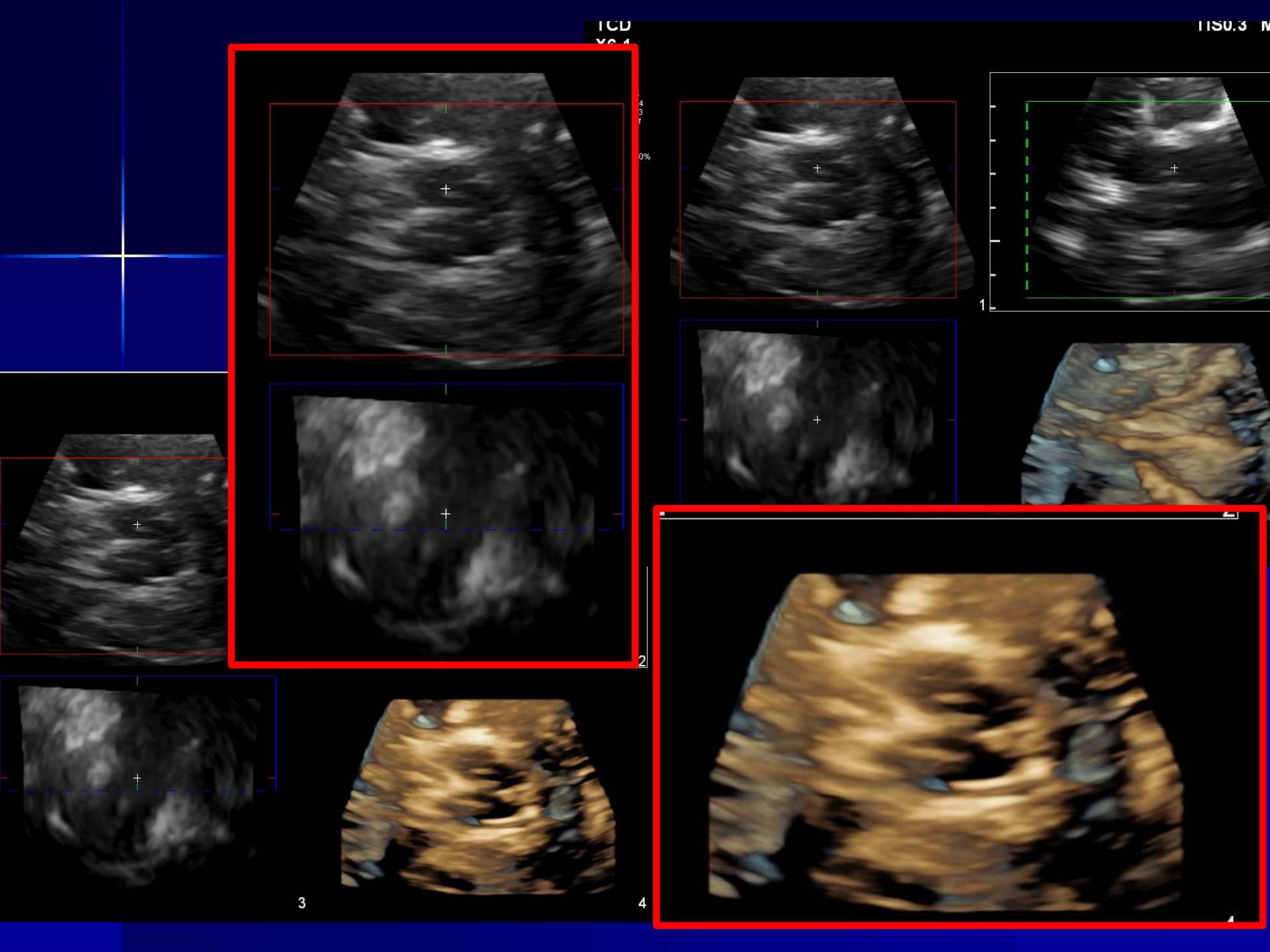
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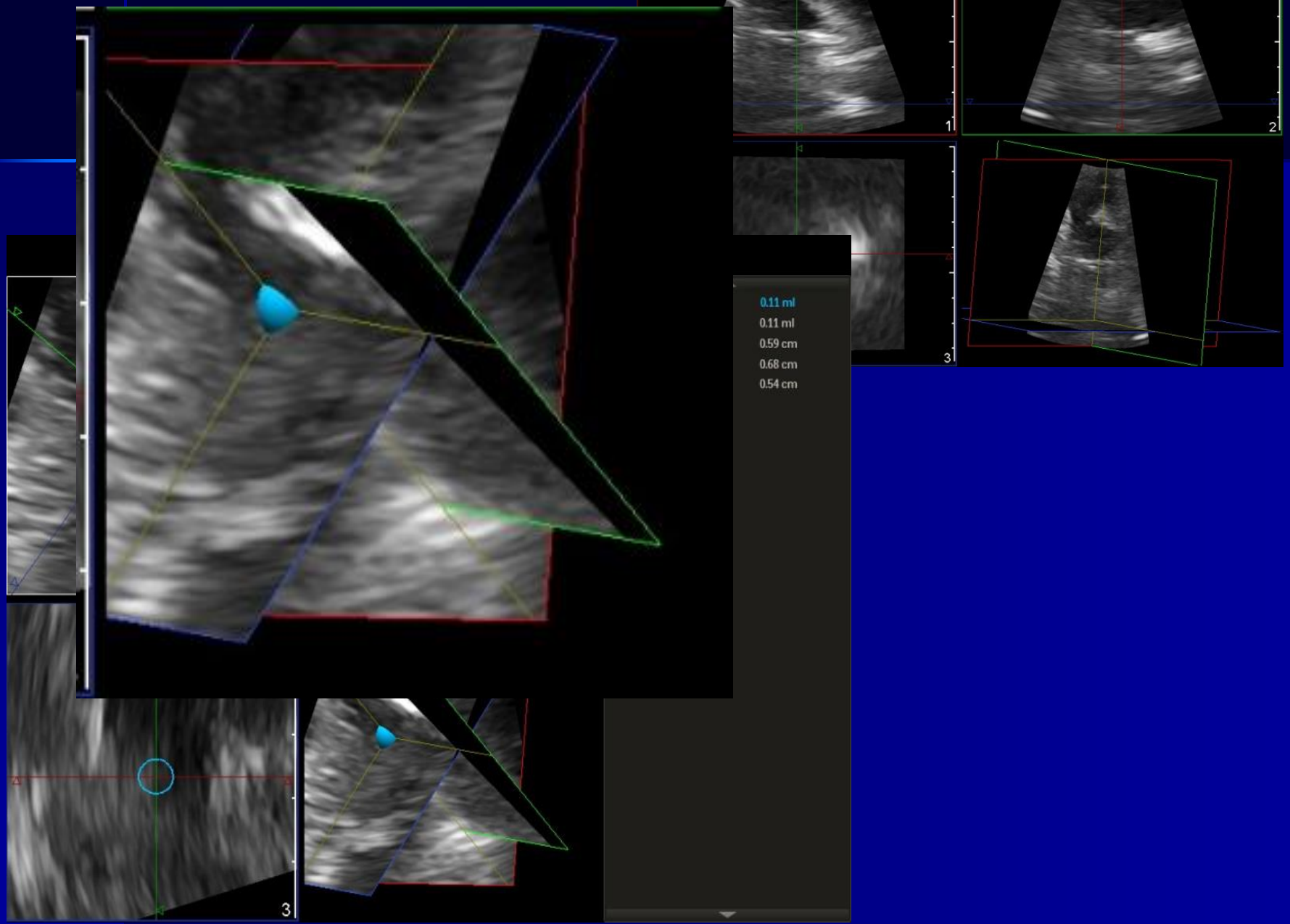
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0.11 ml
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0.68 cm
0.54 cm
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ARTERIAL STUDY

VENOUS STUDY

PARENCHYMAL STUDY

Dr.Ragno M.

C.Sala Sig.ra Rossi M.

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S. M. SUCCURRE MISERIS

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Tnfp:

S.Sobrini

V.Urbano

A.Brandimarti

L.Iannelli

San Benedetto del Tronto

GRAZIE PER L'ATTENZIONE