

Echographie cérébrale en réanimation

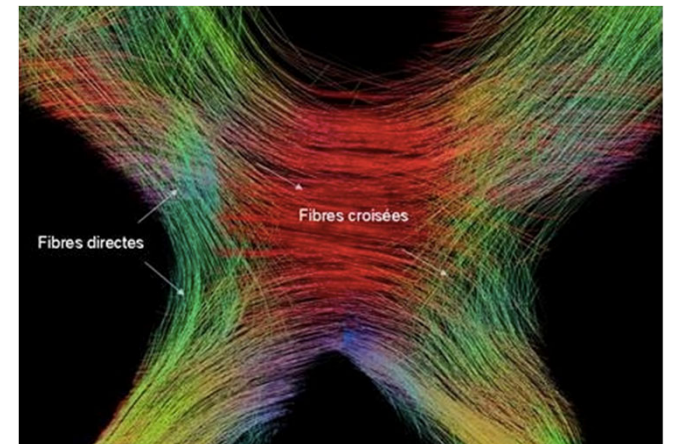
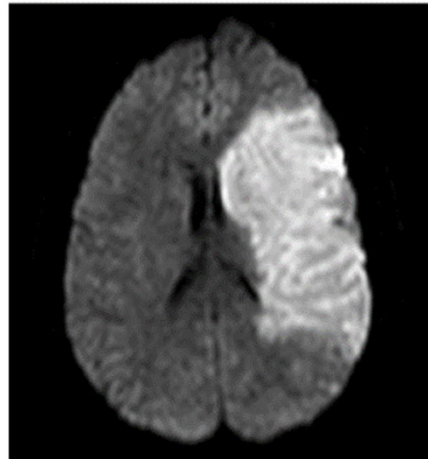
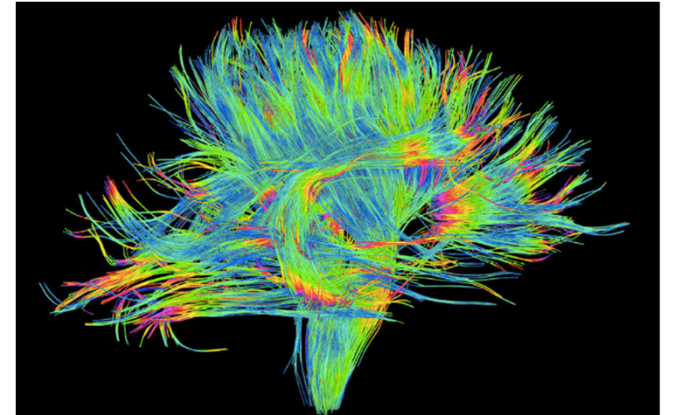
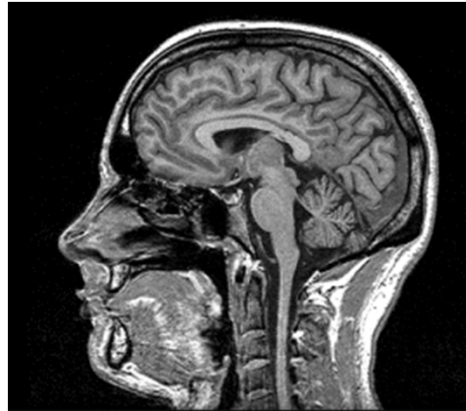
Pr Thomas GEERAERTS

*Anesthésie – Réanimation - Médecine Péri-opératoire
CHU de Toulouse*





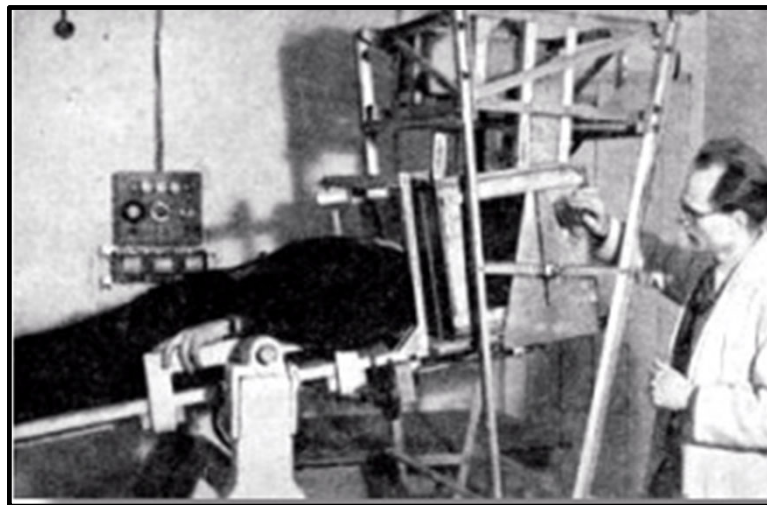
Les références



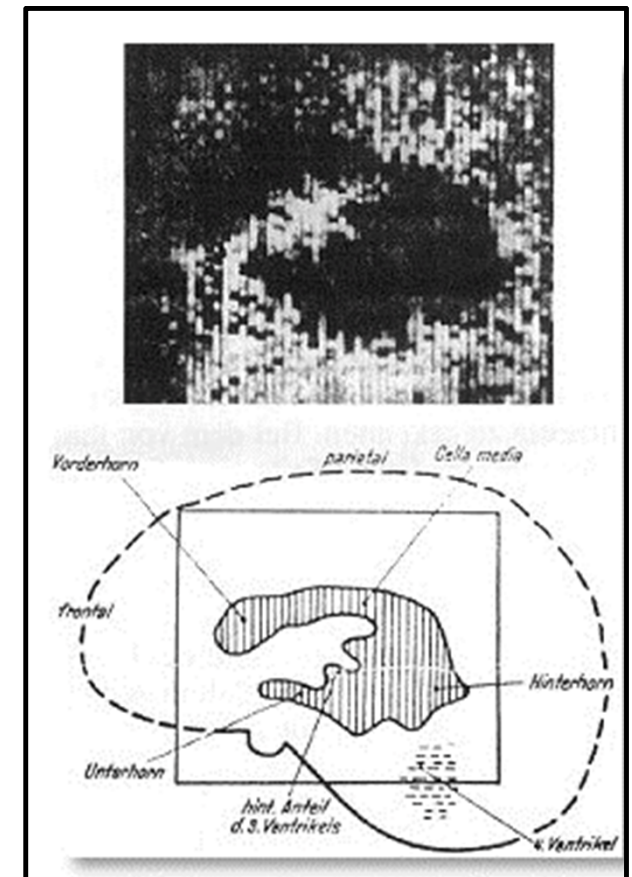
Echographie cérébrale



Karl Dussik
1908-1968



<http://www.ob-ultrasound.net/dussikbio.html>



Everyone's a radiologist now

Are ultrasound machines truly the stethoscope of the 21st century? Should all doctors keep one in their back pocket? **Jacqui Wise** reports on the battle over ultrasound imaging



Wise J, *BMJ*, 2008

Brain ultrasonography: methodology, basic and advanced principles and clinical applications. A narrative review

Chiara Robba^{1*} , Alberto Goffi² , Thomas Geeraerts³, Danilo Cardim⁴, Gabriele Via⁵, Marek Czosnyka⁶, Soojin Park⁷, Aarti Sarwal⁸, Llewellyn Padayachy⁹, Frank Rasulo¹⁰  and Giuseppe Citerio¹¹ 

Brain ultrasonography enables assessment of the main structures of the brain, including the parenchyma and major cerebral vessels.

Brain ultrasonography: methodology, basic and advanced principles and clinical applications. A narrative review

Chiara Robba^{1*} , Alberto Goffi² , Thomas Geeraerts³, Danilo Cardim⁴, Gabriele Via⁵, Marek Czosnyka⁶, Soojin Park⁷, Aarti Sarwal⁸, Llewellyn Padayachy⁹, Frank Rasulo¹⁰ , and Giuseppe Citerio¹¹ 

Brain ultrasonography can be used for rapid bedside assessment of pathological changes in neurocritically ill patients, allowing, for example, evaluation of intracerebral haematomas, estimation of raised intracranial pressure, and detection of midline shift and intracranial masses.

Brain ultrasonography: methodology, basic and advanced principles and clinical applications. A narrative review

Chiara Robba^{1*} , Alberto Goffi² , Thomas Geeraerts³, Danilo Cardim⁴, Gabriele Via⁵, Marek Czosnyka⁶, Soojin Park⁷, Aarti Sarwal⁸, Llewellyn Padayachy⁹, Frank Rasulo¹⁰  and Giuseppe Citerio¹¹ 

Brain ultrasonography is not used exclusively in neurocritical care; clinical applications have been described in different settings, including general intensive care and the emergency department.

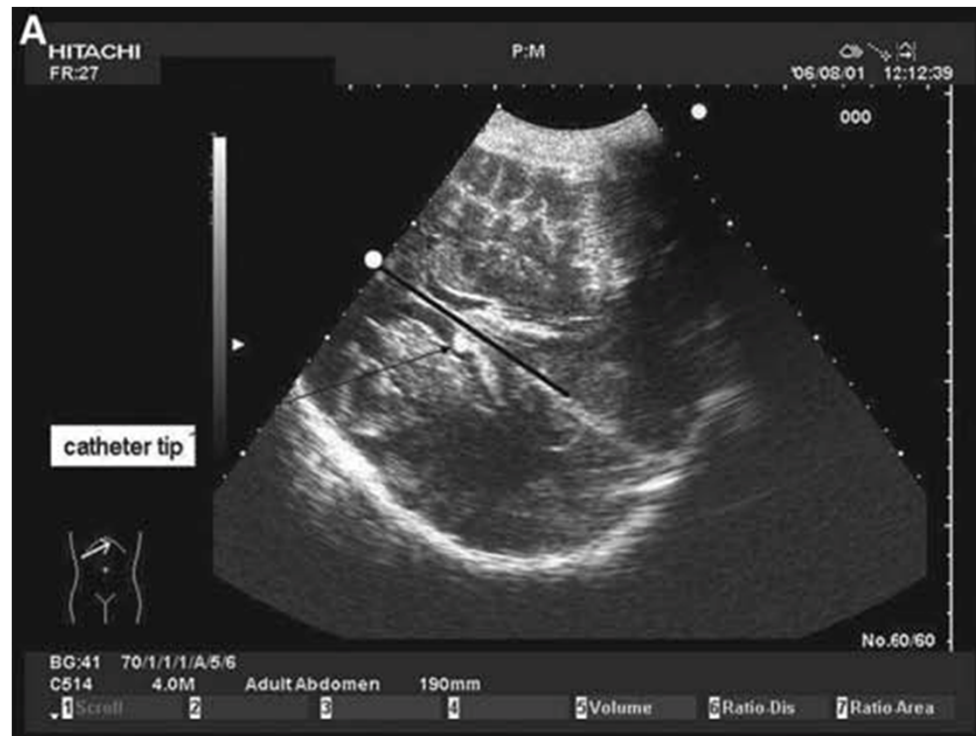
Parfois la fenêtre est ouverte



Pierre Bonnard, Fenêtre ouverte sur la Seine, 1911

Usefulness of transcranial echography in patients with decompressive craniectomy: A comparison with computed tomography scan*

Anselmo Caricato, MD; Vittorio Mignani, MD; Maria Grazia Bocci; Mariano Alberto Pennisi, MD; Claudio Sandroni, MD; Alessandra Tersali, MD; Alessandra Antonaci, MD; Chiara de Waure, MD; Massimo Antonelli, MD



Crit Care Med 2012; 40:1745–1752

Usefulness of transcranial echography in patients with decompressive craniectomy: A comparison with computed tomography scan*

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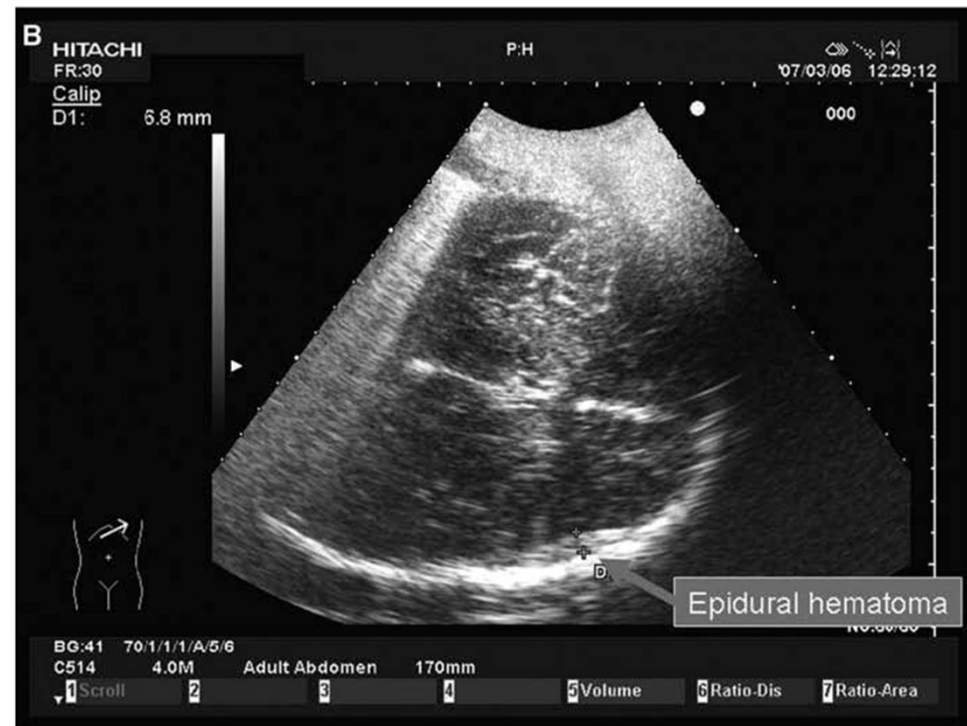
Table 2. Diameters of mass lesions

	Mean Difference (95% confidence interval)	Intraclass Correlation Coefficient (95% confidence interval)
Hyperdense lesions		
Axial diameter	-1.30 (3.18-0.58)	0.984 (0.967-0.992) ^a
Sagittal diameter	-0.13 (-1.77 to 1.51)	0.979 (0.957-0.990) ^a
Coronal diameter	-1.10 (-2.58 to 0.38)	0.982 (0.961-0.991) ^a
Hypodense lesions		
Axial diameter	-12.55 (-21.05 to -4.05)	0.490 (-0.897 to 0.863)
Sagittal diameter	-11.82 (-21.00 to -2.63)	0.161 (-2.117 to 0.774)
Coronal diameter	-8.00 (-13.81 to -2.19)	0.134 (-2.219 to 0.767)

^aStatistically significant correlation.

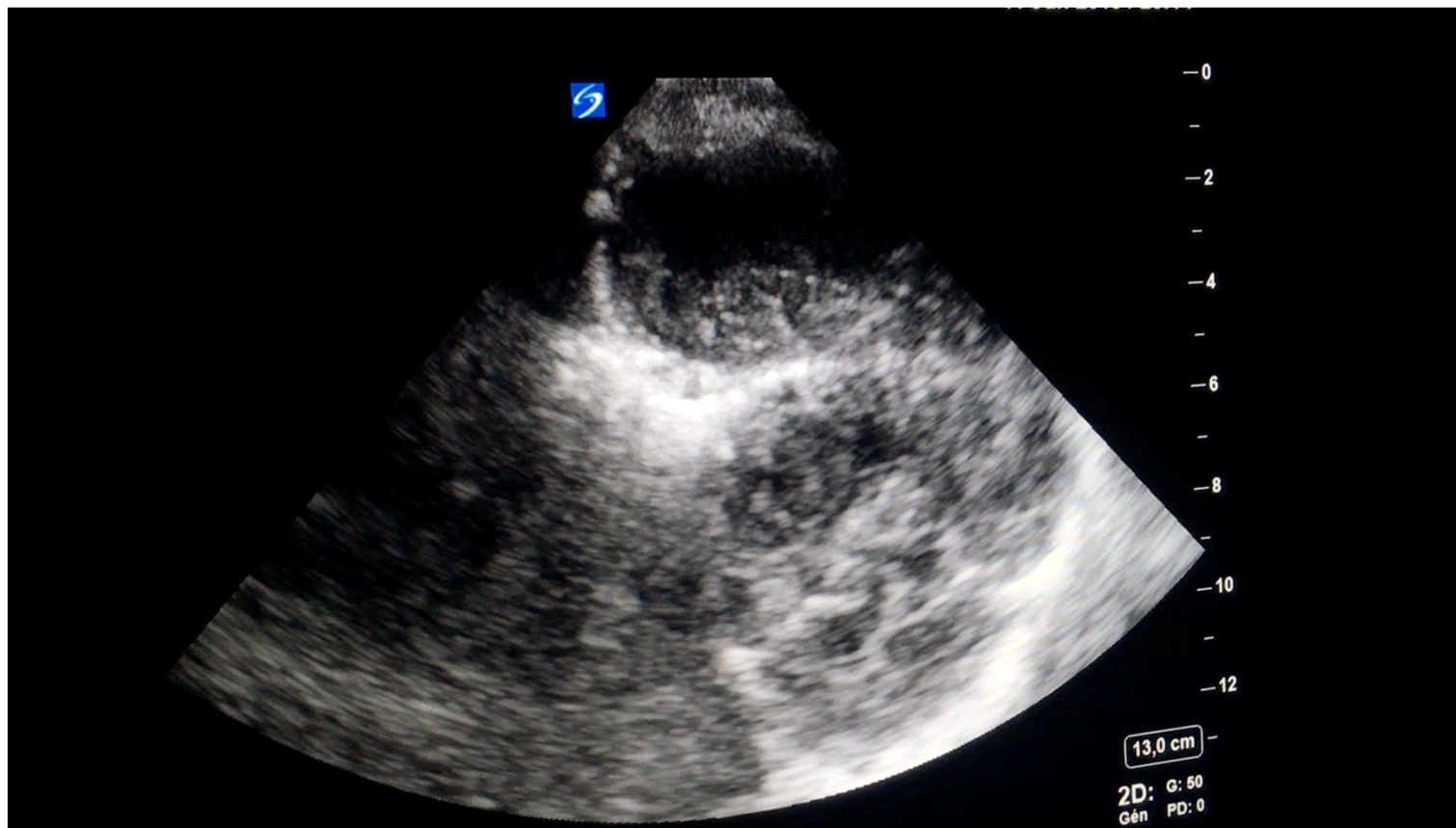
Usefulness of transcranial echography in patients with decompressive craniectomy: A comparison with computed tomography scan*

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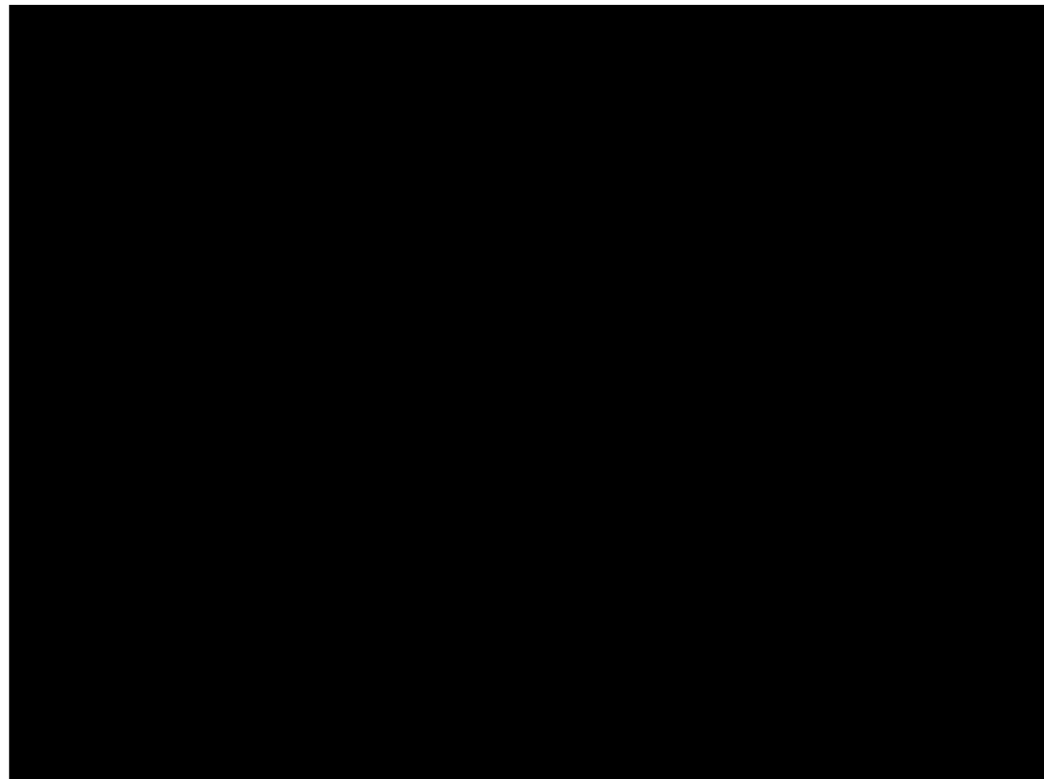


Crit Care Med 2012; 40: 1745–1752

Ventricules



Dérivation ventriculaire



Usefulness of transcranial echography in patients with decompressive craniectomy: A comparison with computed tomography scan*

Anselmo Caricato, MD; Vittorio Mignani, MD; Maria Grazia Bocci; Mariano Alberto Pennisi, MD; Claudio Sandroni, MD; Alessandra Tersali, MD; Alessandra Antonaci, MD; Chiara de Waure, MD; Massimo Antonelli, MD

Echographie cérébrale utile pour

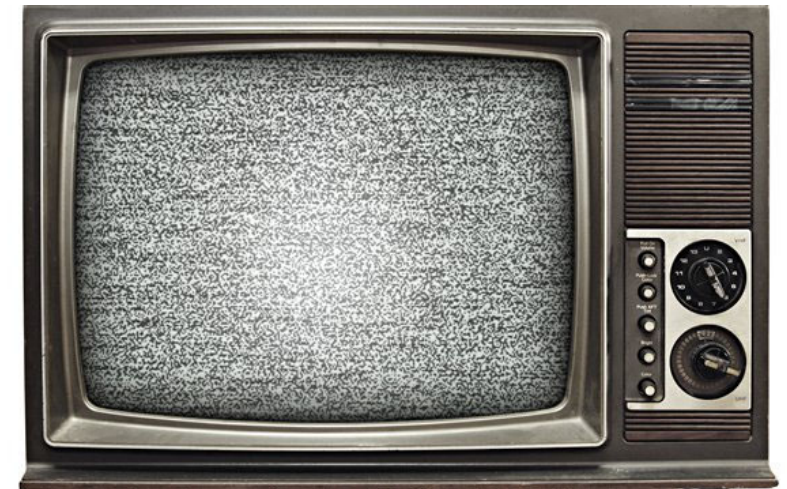
- Volume des hématomes
- Taille des ventricules

Echographie cérébrale **PAS utile pour**

- Volume ischémique

Parfois la fenêtre est fermée

- Jusqu'à 18% dans les études d'AVC
- Femme
- Age
- Ethnie « non-blanche »



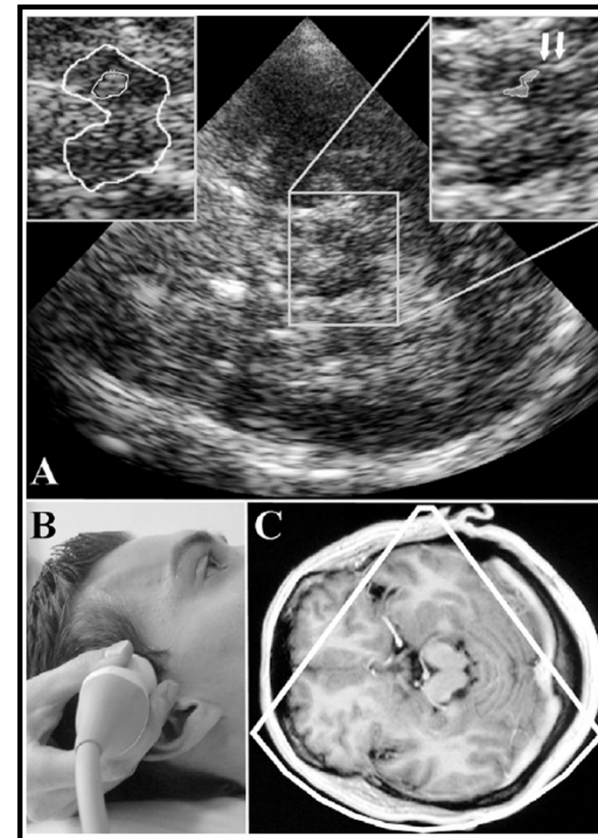
Grolimund P. Transmission of ultrasound through the temporal bone.
In: Aaslid R, ed. Transcranial Doppler sonography. Wien/New
York: Springer Verlag, 1985:10–18.

Transcranial sonography of the cerebral parenchyma: Update on clinically relevant applications

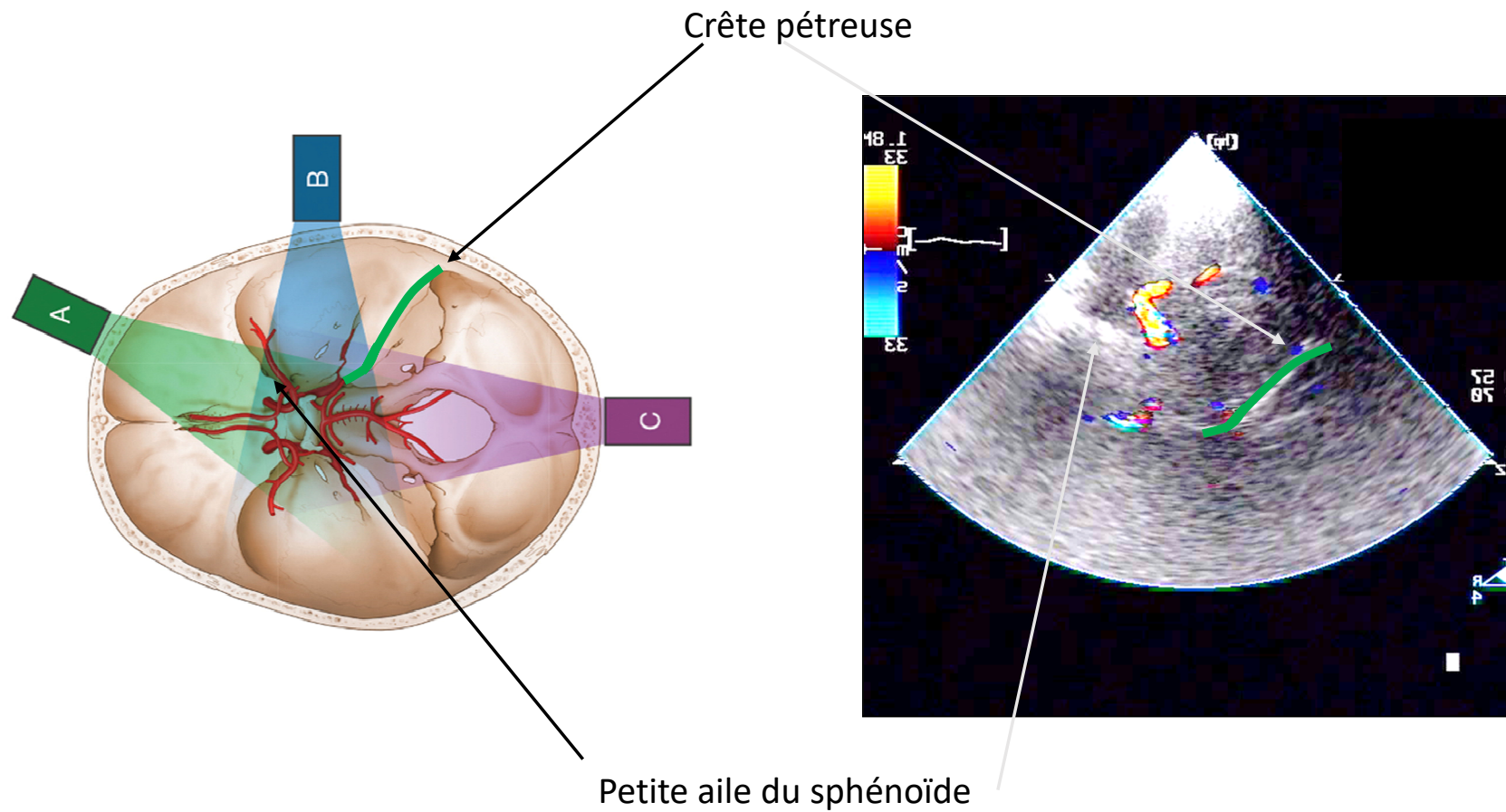
Uwe Walter*

Table 1 Ultrasound system settings for transcranial sonography.

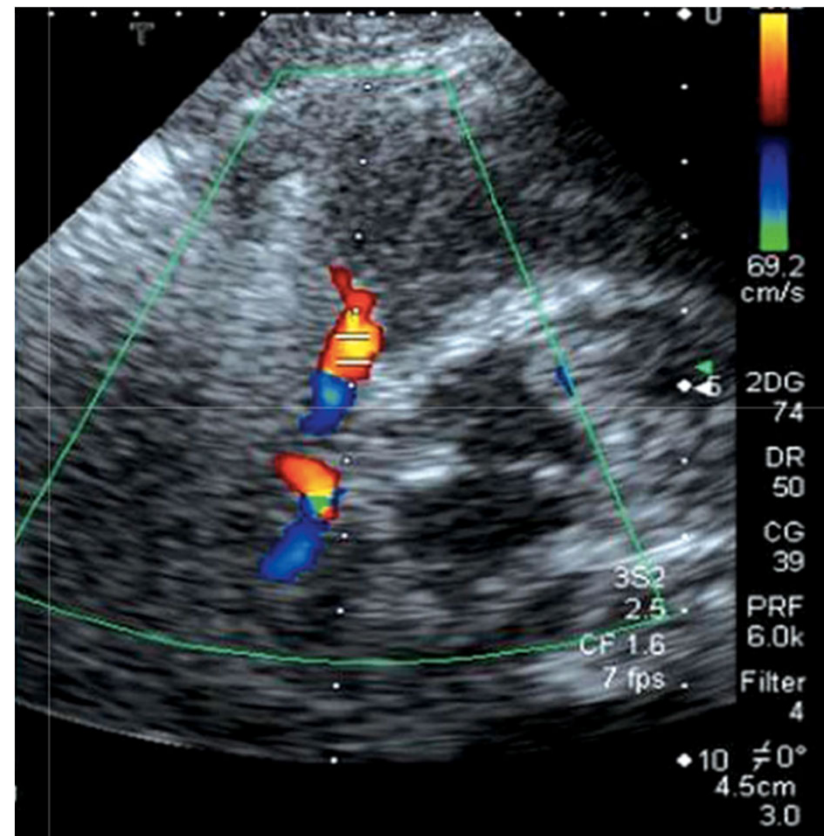
Parameter	Settings
Ultrasound system	
Penetration depth	Start with 14–16 cm, reduce if needed
Dynamic range	45–55 dB
Postprocessing function	Moderate suppression of low echo signals
Time gain compensation	Adjust manually as needed, or use the 'tissue optimization' function if available
Image brightness	Adjust manually, not too high, or use the 'tissue optimization' function if available
Ultrasound transducer	
Crystal/channel	As high as possible, ideally: 'matrix' probe
Insonation frequency (center frequency)	2.0–3.5 MHz, preferably 2.5 MHz



Repères osseux

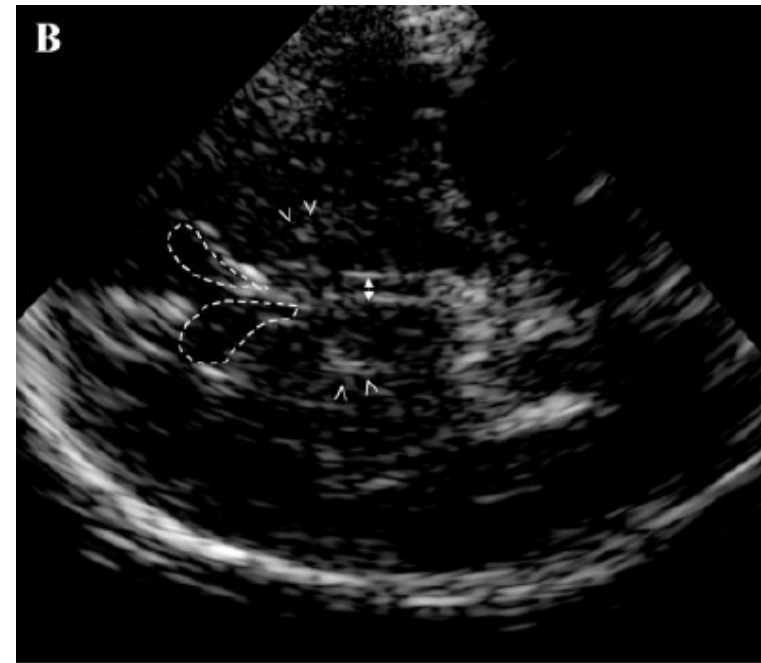
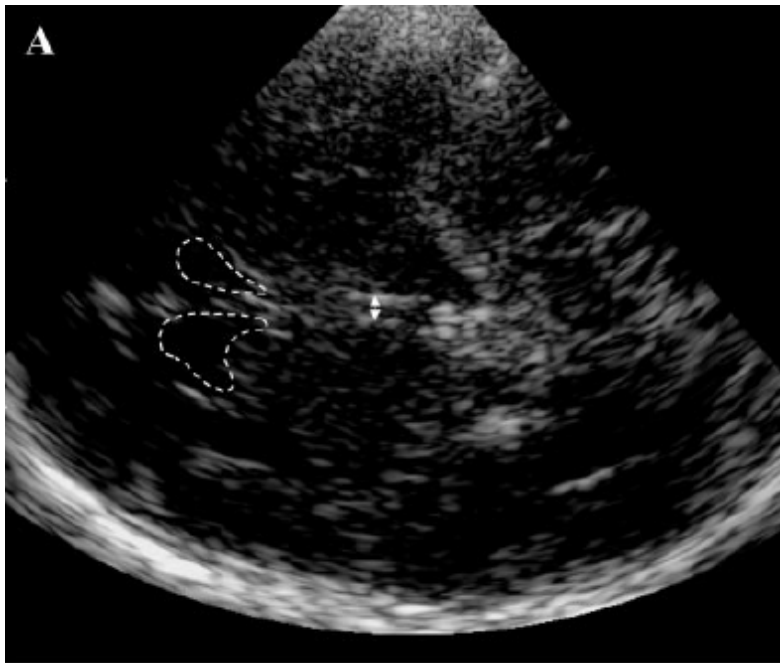


Visualiser le mesencéphale



Perspectives of B-Mode Transcranial Ultrasound

Daniela Berg and Georg Becker*

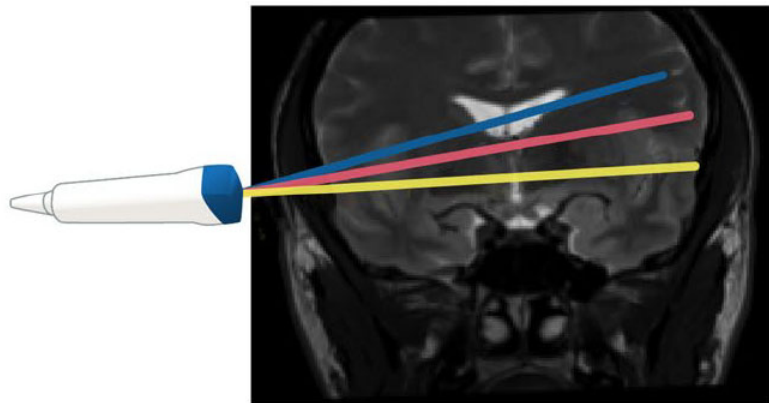


NeuroImage 15, 463–473 (2002)

CT

Non-decompressed brain

DC



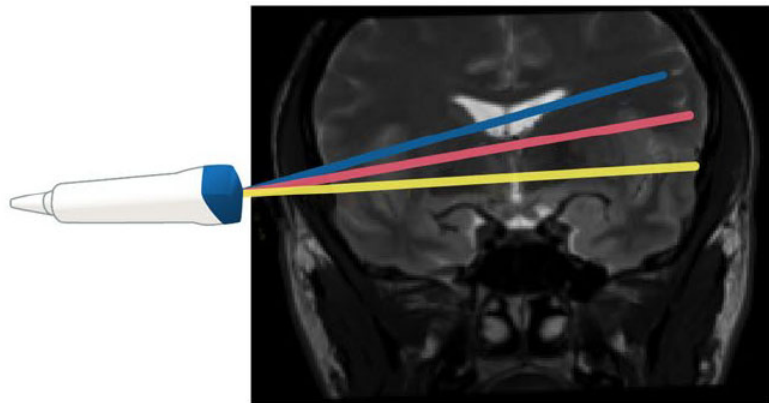
Mesencephalic plane



CT

Non-decompressed brain

DC

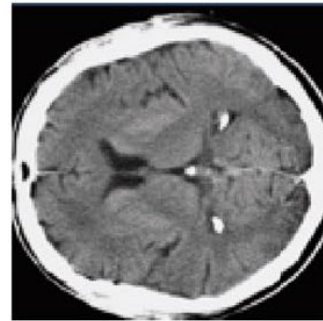
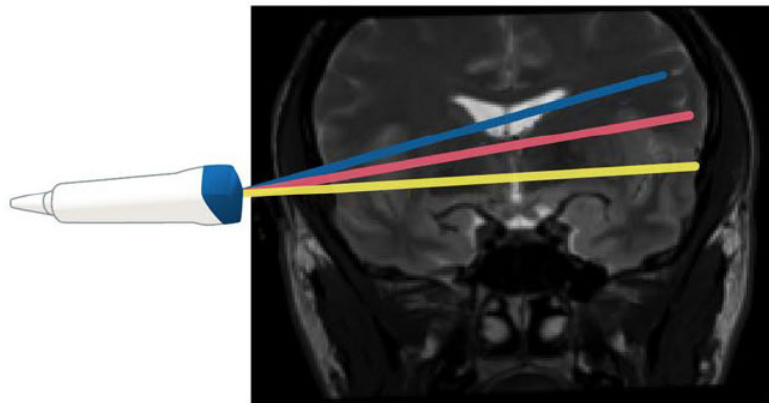


Diencephalic or III ventricle plane

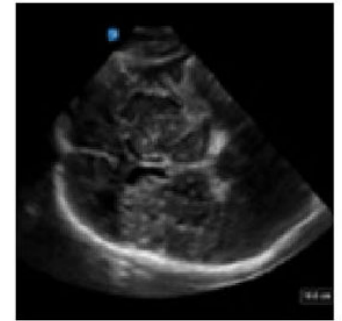
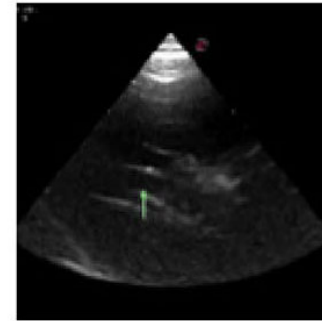
CT

Non-decompressed brain

DC



Ventricular plane



Comparison of the accuracy of ventricular catheter placement using freehand placement, ultrasonic guidance, and stereotactic neuronavigation

Clinical article

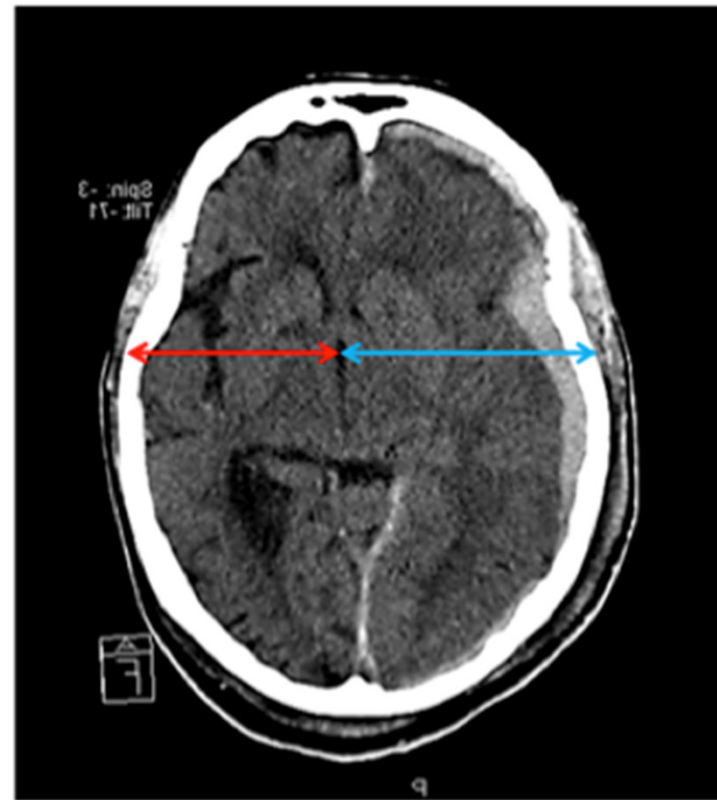
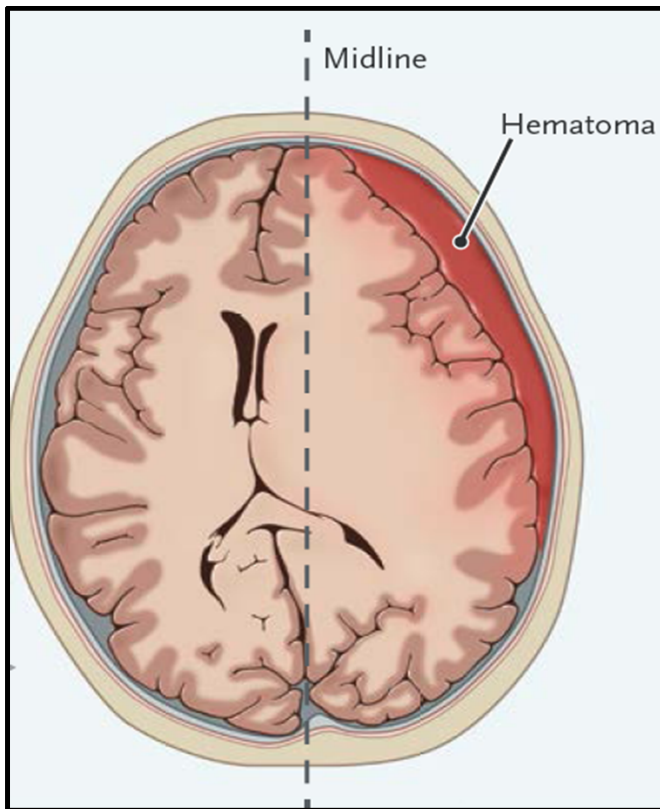
THOMAS J. WILSON, M.D., WILLIAM R. STETLER JR., M.D., WAJD N. AL-HOLOU, M.D.,
AND STEPHEN E. SULLIVAN, M.D.

- Etude rétrospective
- N=249

DVE	Sans aide	Guidée par Scanner	Guidée par échographie
Placement correct	55%	88%	89%

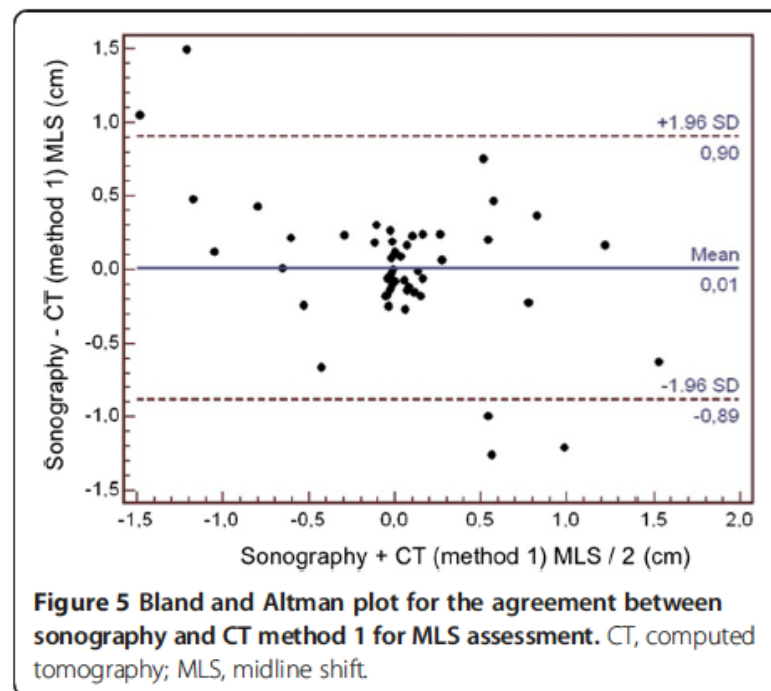
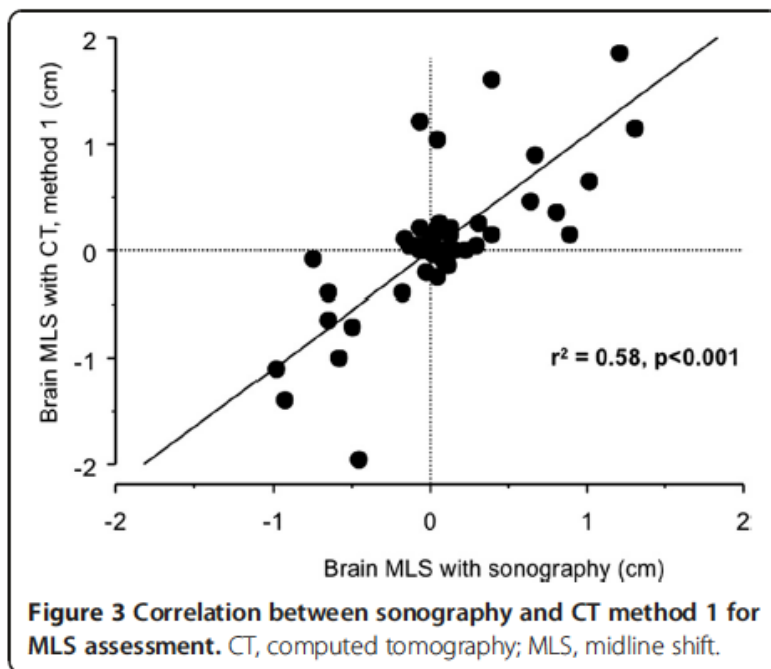
- DVE sans aide = facteur de risque de mauvais placement

Déviations de ligne médiane

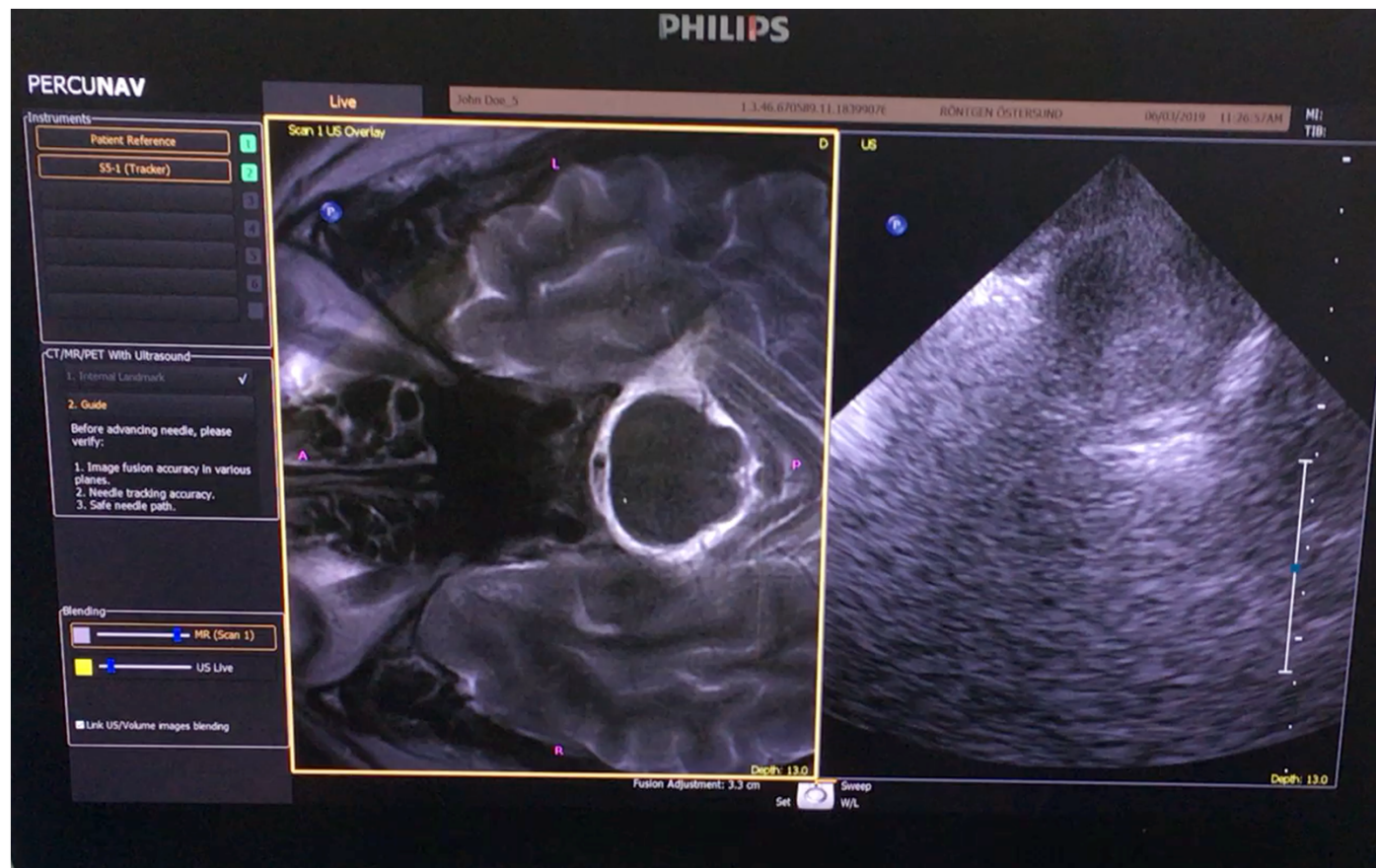


Assessment of brain midline shift using sonography in neurosurgical ICU patients

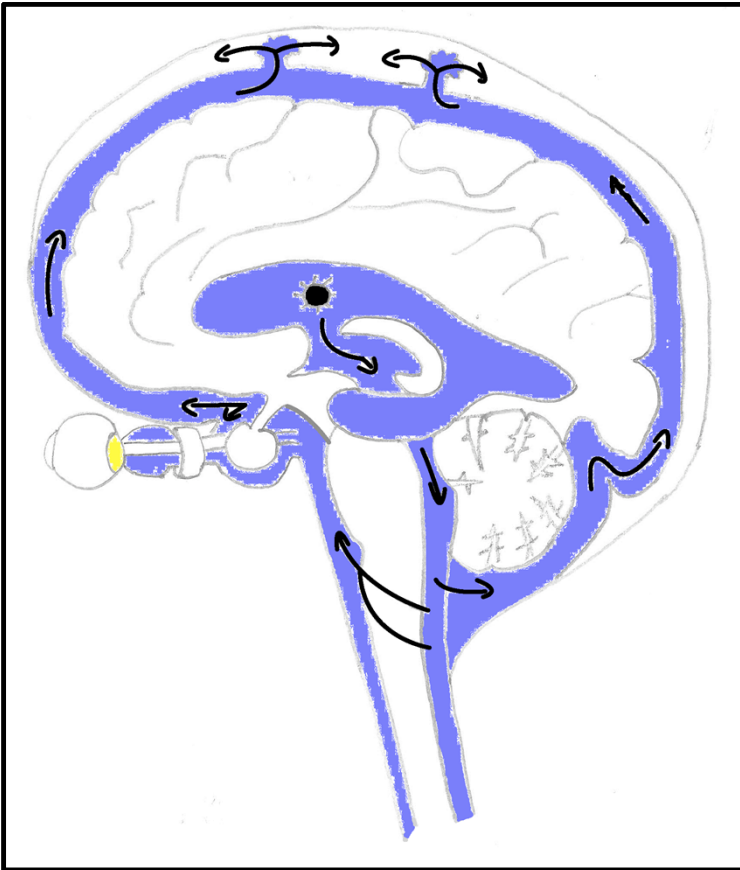
Julie Motuel¹, Isaure Biette², Mohamed Srairi¹, Ségolène Mrozek¹, Matt M Kurrek³, Patrick Chaynes⁴, Christophe Cognard², Olivier Fourcade¹ and Thomas Geeraerts^{1*}



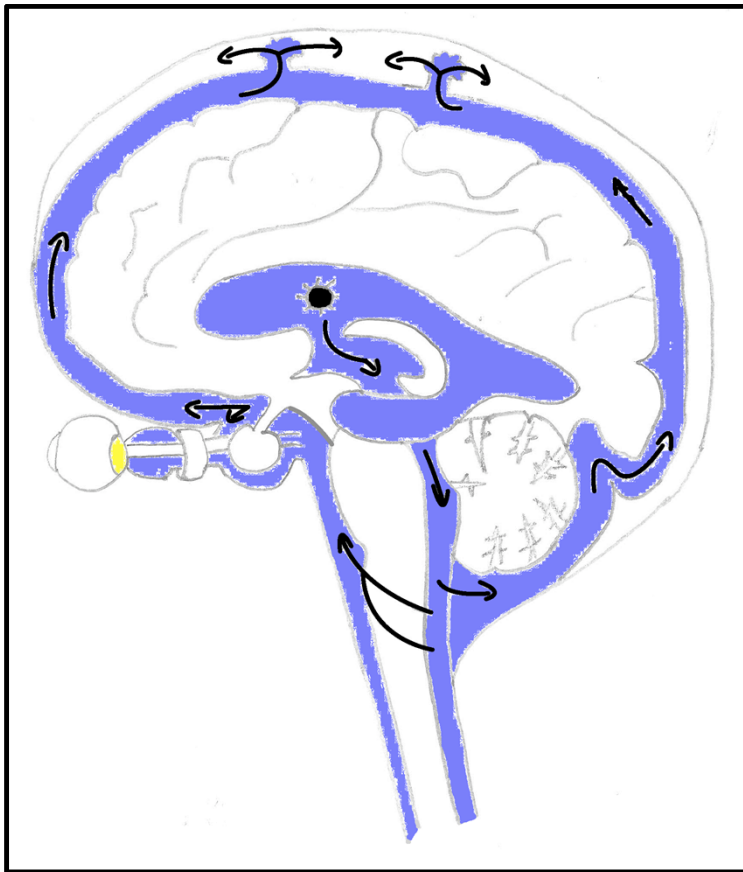
Echographie combinée



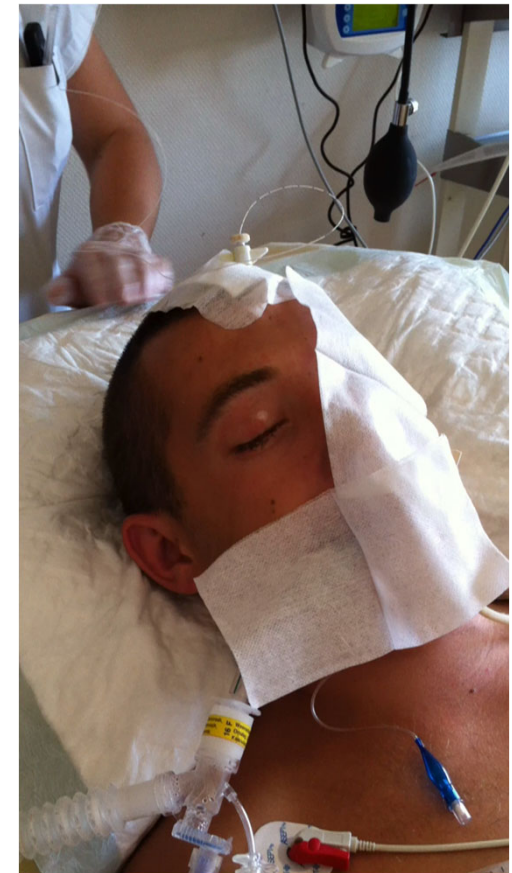
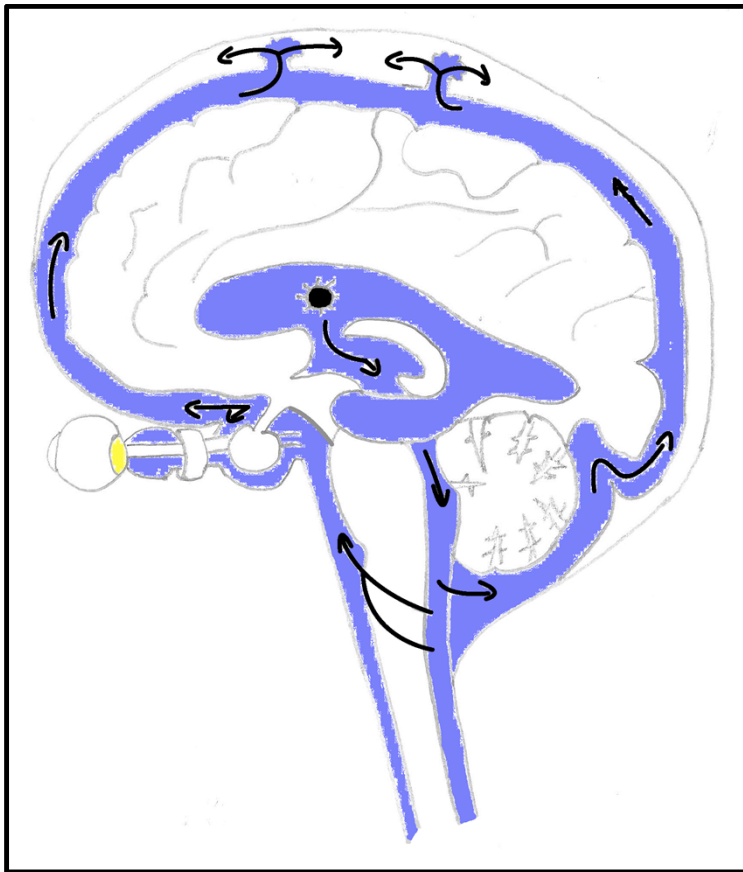
Enveloppes du nerf optique



Enveloppes du nerf optique

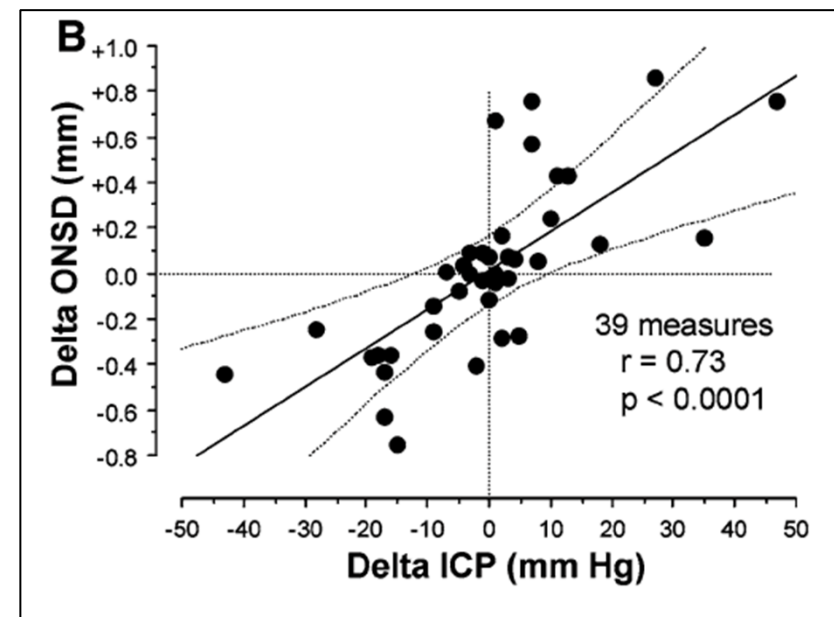
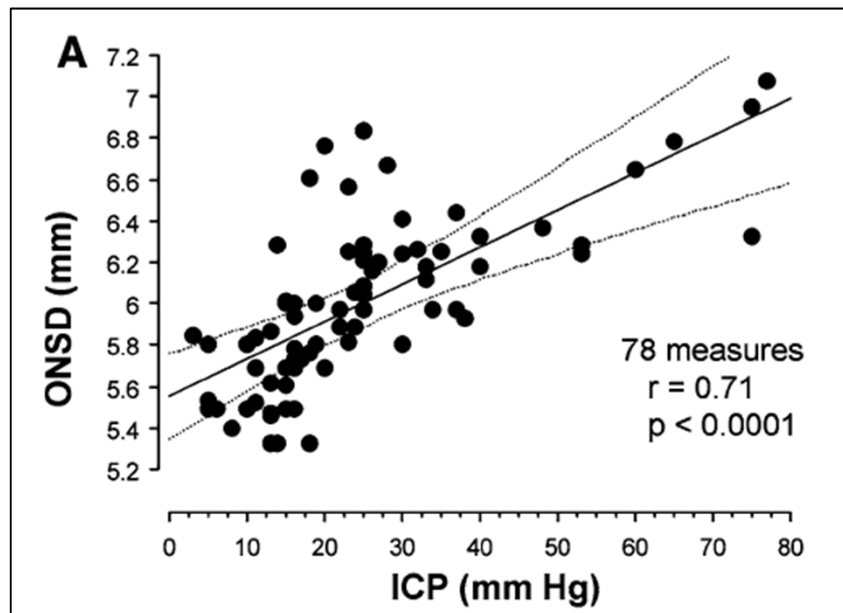


Enveloppes du nerf optique

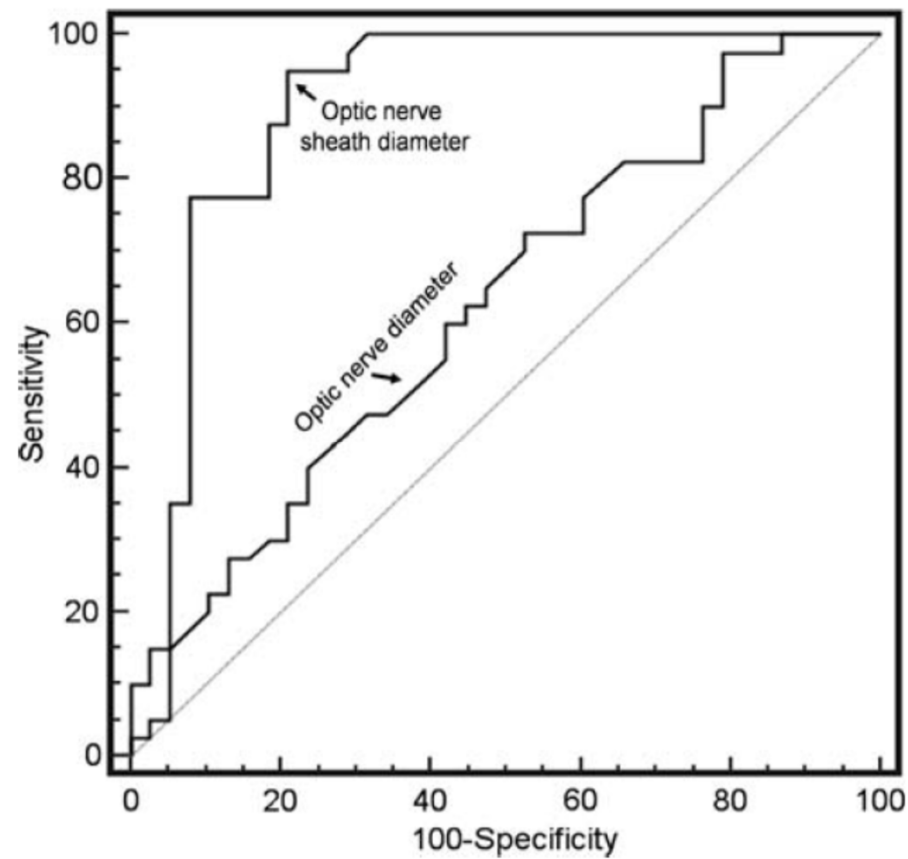


Thomas Geeraerts
Sybille Merceron
Dan Benhamou
Bernard Vigué
Jacques Duranteau

Non-invasive assessment of intracranial pressure using ocular sonography in neurocritical care patients

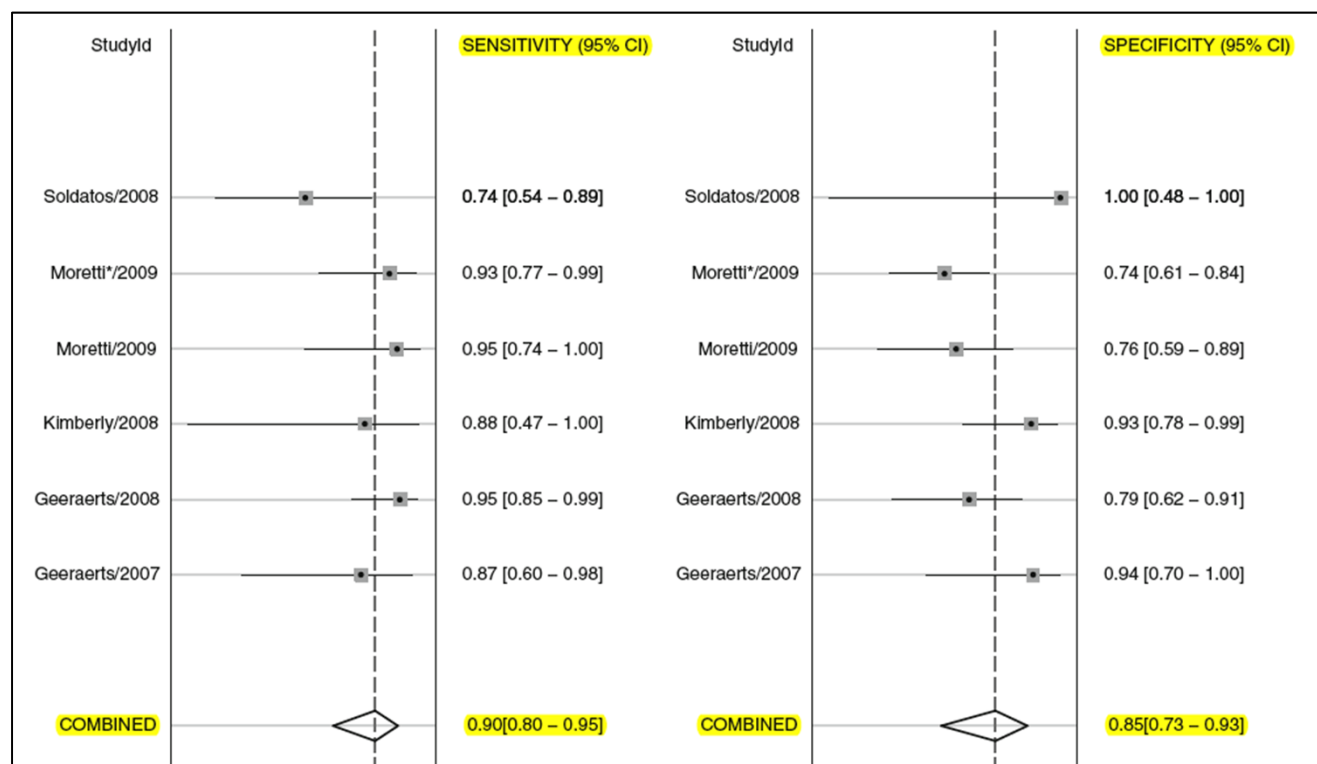


Prédiction PIC > 20 mmHg



Julie Dubourg
Etienne Javouhey
Thomas Geeraerts
Mahmoud Messerer
Behrouz Kassai

Ultrasonography of optic nerve sheath diameter for detection of raised intracranial pressure: a systematic review and meta-analysis



Effect of Osmotherapy on Optic Nerve Sheath Diameter in Patients With Increased Intracranial Pressure

Yoann Launey,¹⁻³ Nicolas Nessler,¹⁻³ Pascale Le Maguet,¹ Yannick Mallédant,¹⁻³ and Philippe Seguin¹⁻³

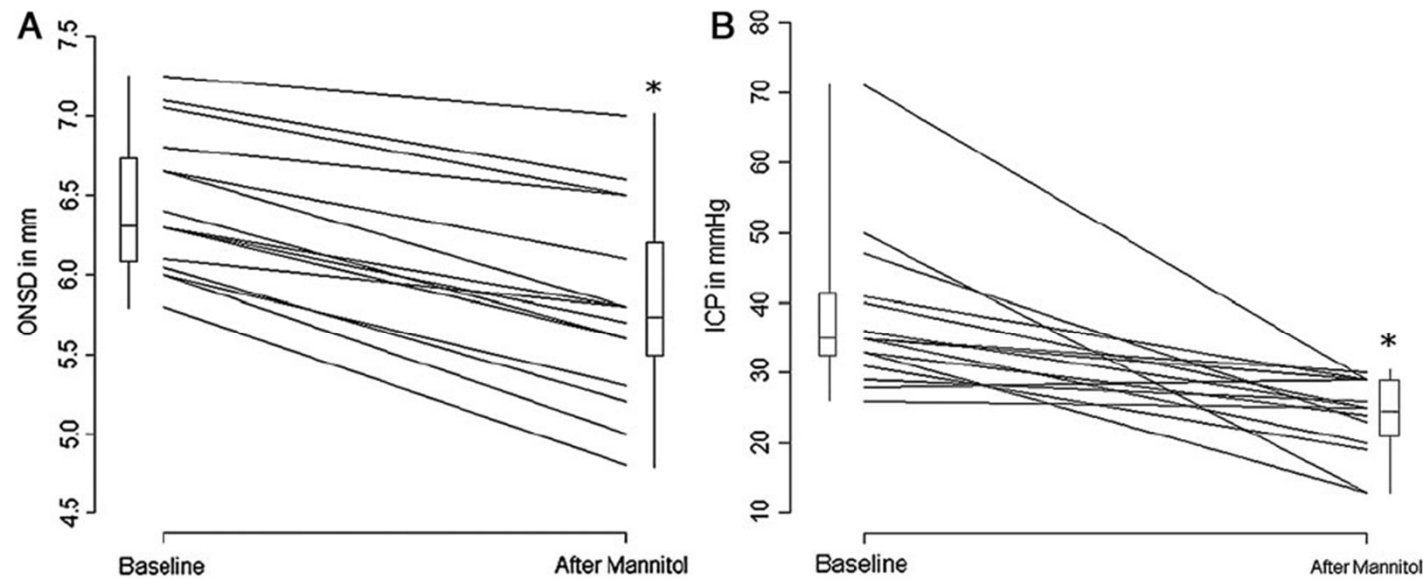


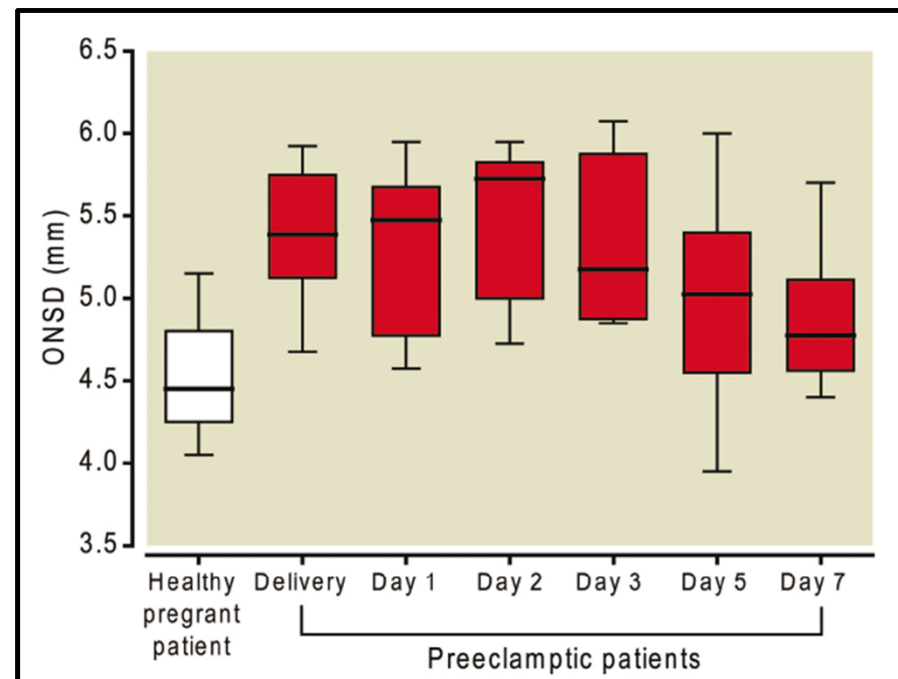
FIG. 2. Individual variations and box plots of (A) optic nerve sheath diameter (ONSD) and (B) intracranial pressure (ICP) before and after mannitol infusion. * $p < 0.05$ versus baseline value.

Optic Nerve Sheath Diameter Used as Ultrasonographic Assessment of the Incidence of Raised Intracranial Pressure in Preeclampsia

A Pilot Study

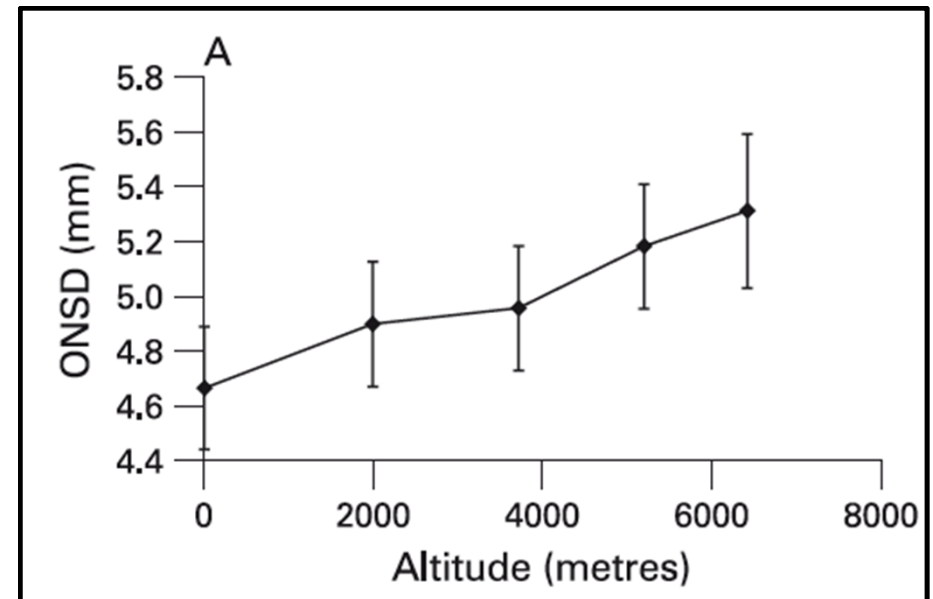
Clément Dubost, M.D.,* Agnès Le Gouez, M.D.,† Viridiana Jouffroy, M.D.,*
Sandrine Roger-Christoph, M.D.,† Dan Benhamou, M.D.,‡ Frédéric J. Mercier, M.D., Ph.D.,§
Thomas Geeraerts, M.D., Ph.D.#

	Preeclamptic Patients (n = 26)	Healthy Pregnant (n = 25)	P Value
ONSD (mm)	5.4 (5.2–5.8)	4.5 (4.3–4.8)	<0.0001
Systolic BP (mmHg)	143 (138–153)	111 (102–119)	<0.0001
Diastolic BP (mmHg)	84 (79–88)	70 (66–75)	<0.0001
Mean BP (mmHg)	105 (98–109)	84 (80–92)	<0.0001



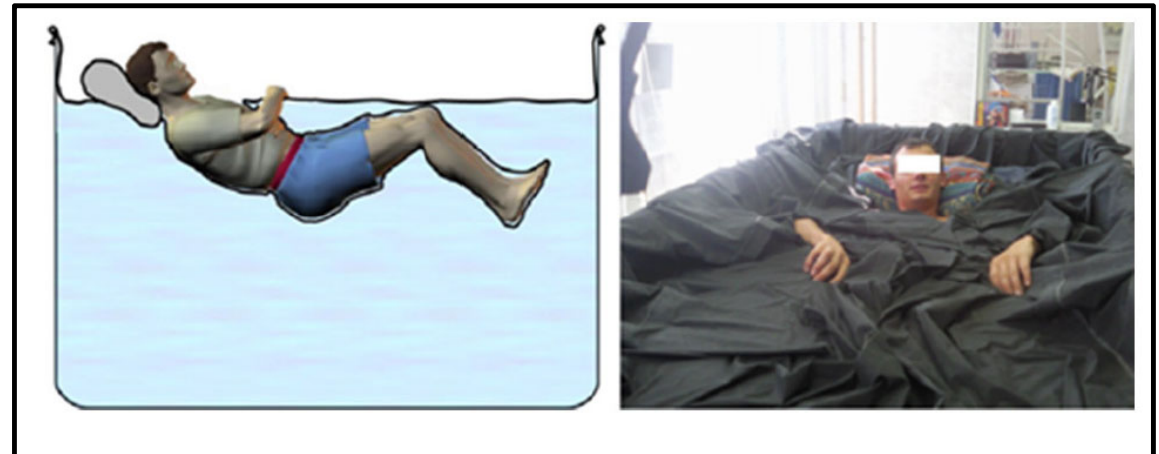
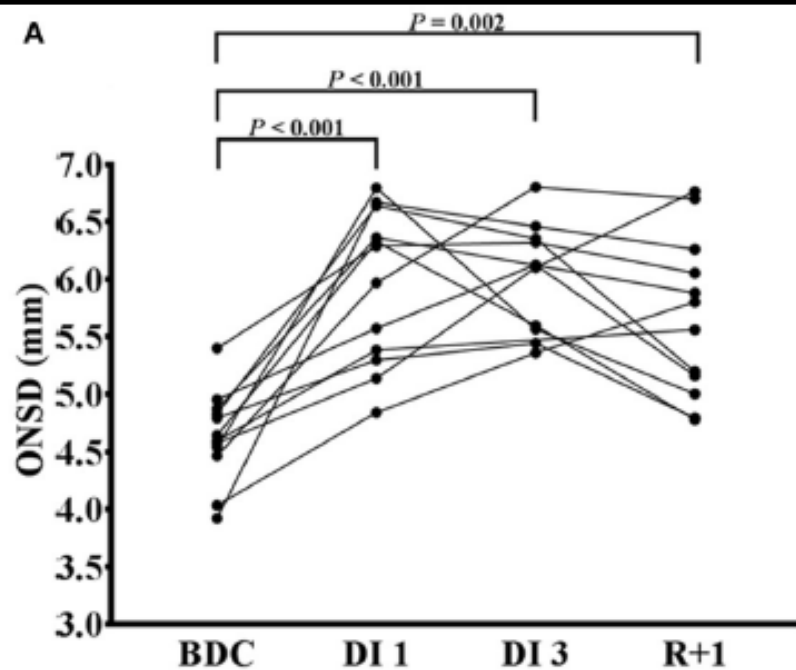
Optic nerve sheath diameter, intracranial pressure and acute mountain sickness on Mount Everest: a longitudinal cohort study

A I Sutherland,¹ D S Morris,² C G Owen,³ A J Bron,⁴ R C Roach⁵



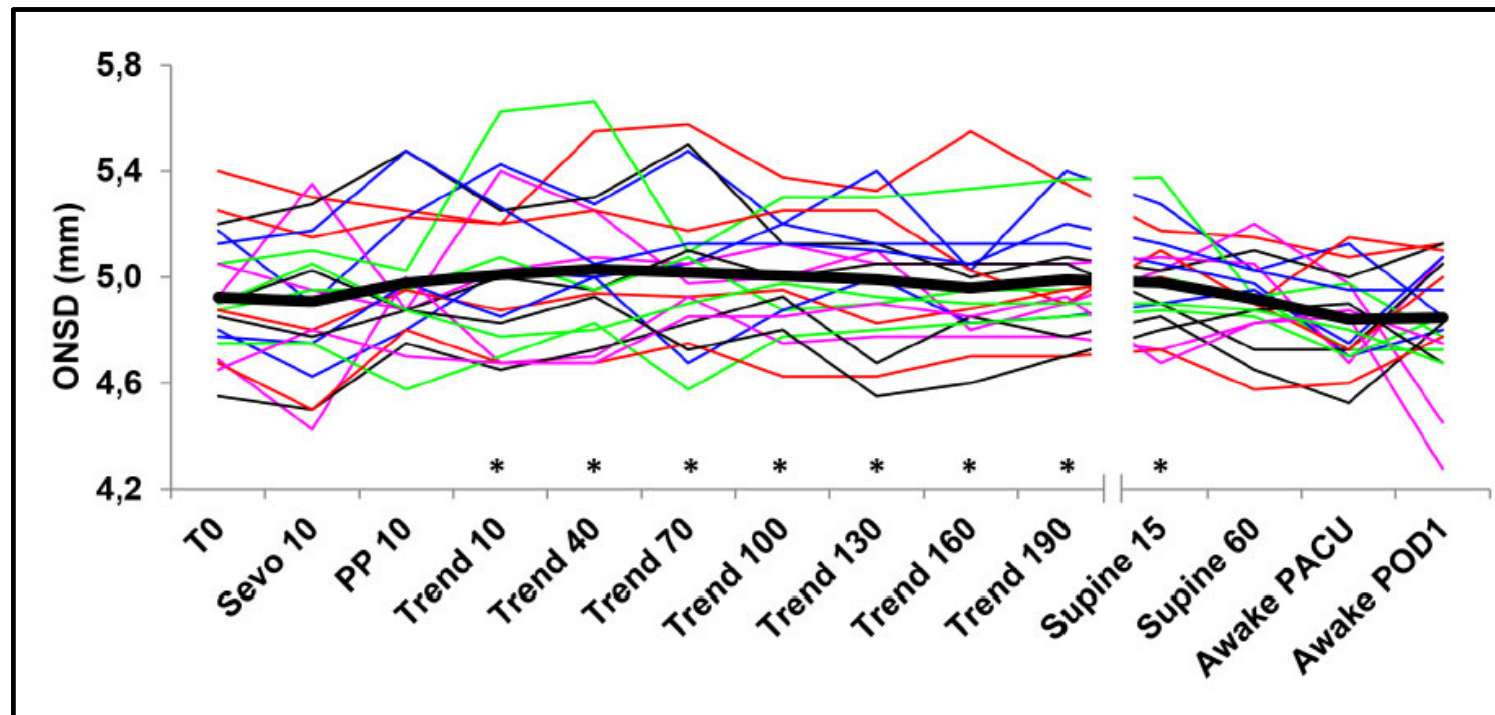
Impacts of Simulated Weightlessness by Dry Immersion on Optic Nerve Sheath Diameter and Cerebral Autoregulation

Marc Kermorgant¹, Florian Leca², Nathalie Nasr^{1,3}, Marc-Antoine Custaud⁴, Thomas Geeraerts^{2,5}, Marek Czosnyka^{6,7}, Dina N. Arvanitis¹, Jean-Michel Senard^{1,3} and Anne Pavy-Le Traon^{1,3*}



Optic Nerve Sheath Diameter Remains Constant during Robot Assisted Laparoscopic Radical Prostatectomy

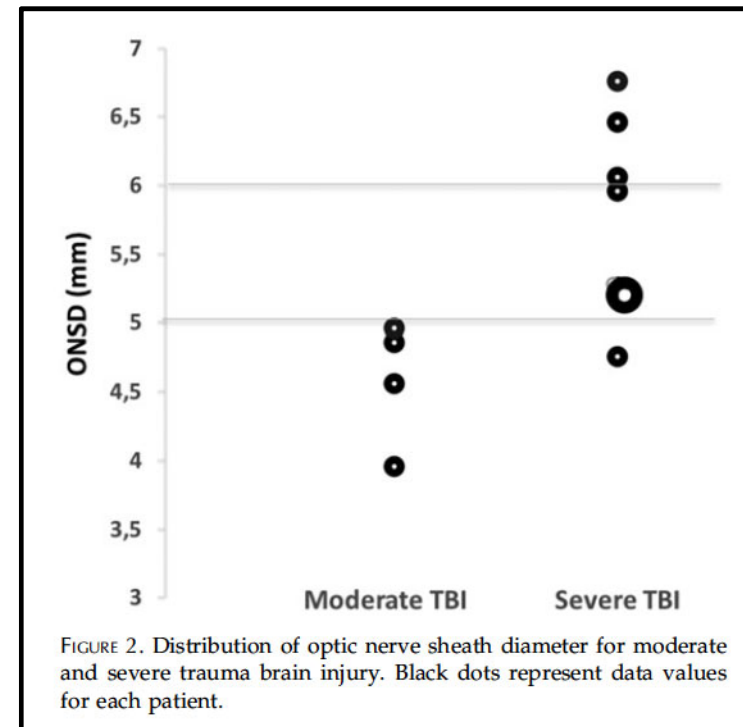
Philip Verdonck¹, Alain F. Kalmar^{2*}, Koen Suy³, Thomas Geeraerts⁴, Marcel Vercauteren¹, Alex Mottrie^{5,7}, Andre M. De Wolf⁶, Jan F. A. Hendrickx³

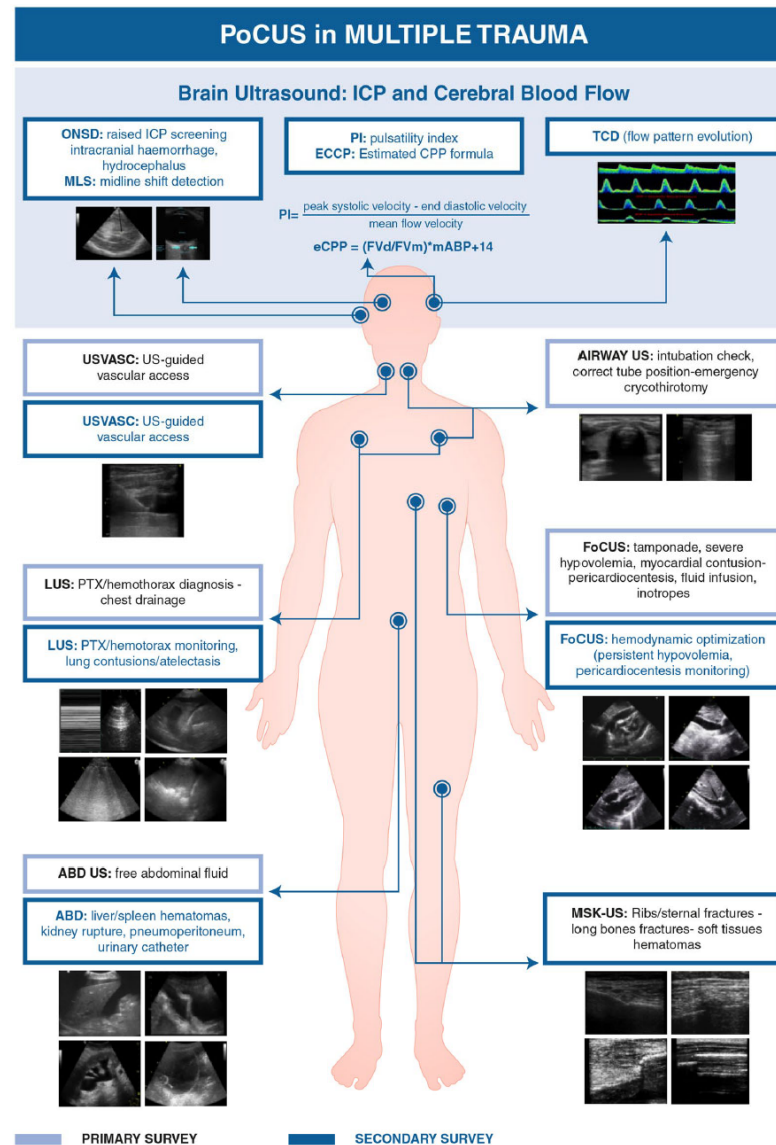


QUALITY AND FEASIBILITY OF SONOGRAPHIC MEASUREMENT OF THE OPTIC NERVE SHEATH DIAMETER TO ESTIMATE THE RISK OF RAISED INTRACRANIAL PRESSURE AFTER TRAUMATIC BRAIN INJURY IN PREHOSPITAL SETTING

Charles-Henri Houzé-Cerfon, MD, Vincent Bounes, PhD, Johanna Guemon, MD, Thibault Le Gourrierec, MD, Thomas Geeraerts, PhD

- Echographie oculaire
- En pré-hospitalier
- Traumatisme crânien
- 20% non fait, manque de temps
- Si fait, 80% de mesures valides





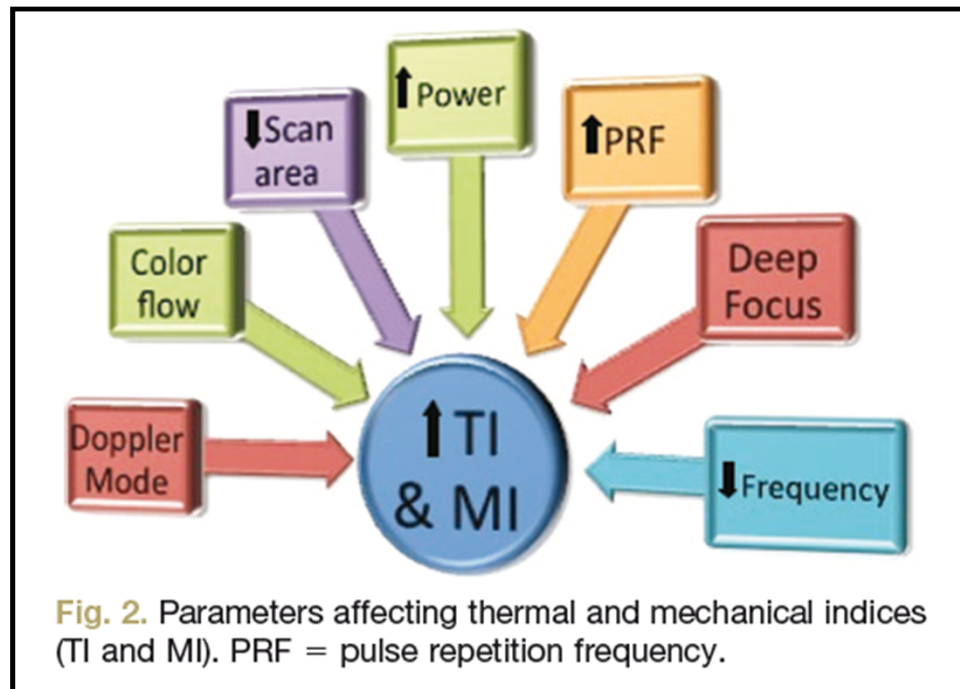
Effets biologiques des ultrasons

- **Effets thermiques** (Thermal Index = TI)
 - 1 à 3° C
 - Dépend du temps d'exposition aux ultrasons
 - Toxique pour le SNC
- **Effets mécaniques** (Mechanical Index = MI)
 - Présence de gaz, cavitations
 - Hémorragie pétéchiiale
 - Nécrose / apoptose endothéliale

Potential Adverse Ultrasound-related Biological Effects

A Critical Review

Hariharan Shankar, M.B.B.S.,* Paul S. Pagel, M.D., Ph.D.†



The British Medical Ultrasound Society.

Guidelines for the safe use of diagnostic ultrasound equipment

Prepared by the Safety Group of the British Medical Ultrasound Society.

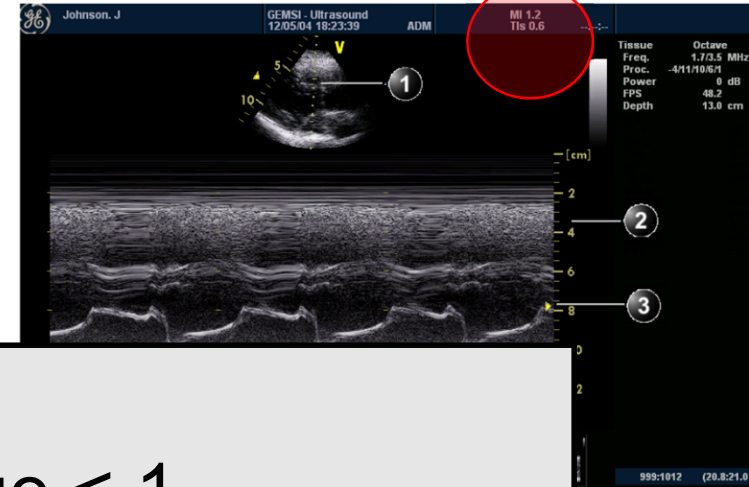
Application	Values to monitor (A)	Thermal Index value		Mechanical Index value	
		0 – 1.0	> 1.0	0 - 0.3	> 0.7
General abdominal Peripheral vascular Unlisted applications	Usually TIB and MI. [use TIC and MI if bone closer than 1 cm; TIS and MI only if bone does not come into the image]	✓	(B) restrict time to 1.0<TIB≤1.5 : 120 min 1.5<TIB≤2.0 : 60 min 2.0<TIB≤2.5 : 15 min 2.5<TIB≤3.0 : 4 min 3.0<TIB≤4.0 : 1 min 4.0<TIB≤5.0 : 15 sec 5.0<TIB≤6.0 : 5 sec TIB>6: not recommended	✓	(C) risk of cavitation with contrast agents
Eye	TIS and MI recommended	✓	Scanning of the eye is not recommended	✓	(C) risk of cavitation with contrast agents
Adult transcranial (imaging and stand-alone) (D)	TIC and MI	✓	(B) restrict time to 0.7<TIC≤1.0 : 60 min 1.0<TIC≤1.5 : 30 min 1.5<TIC≤2.0 : 15 min 2.0<TIC≤2.5 : 4 min 2.5<TIC≤3.0 : 1 min TIC>3: not recommended	✓	(C) risk of cavitation with contrast agents

Web site: <http://www.bmus.org/policies-guides/pg-safety03.asp>.

Sonosite, Edge

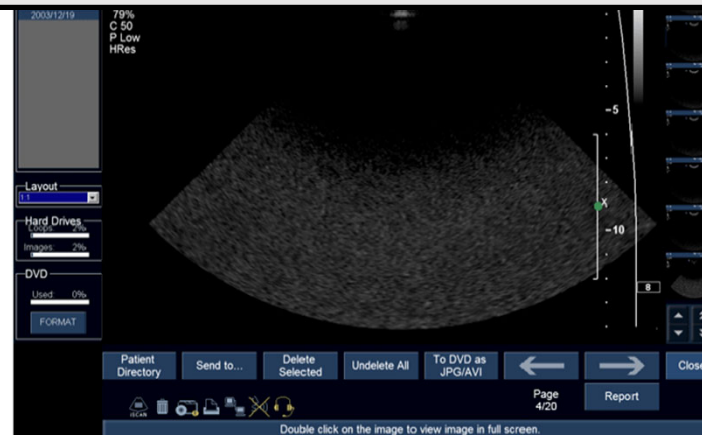


General Electric, Vivid-i



Pour le cerveau

- Index thermique < 1
- Index mécanique $< 0,3$



Phillips, IU-22

Je vous remercie de votre attention

geeraerts.t@chu-toulouse.fr

