

**22. BRNĚNSKÉ DNY  
URGENTNÍ MEDICÍNY**

# POCUS u pacienta v bezvědomí

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# Cíl

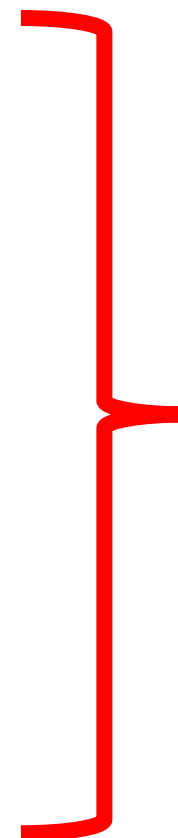
„Čísla“

+

Teorie

Aplikace

Perličky



**Přehled  
Motivace**

# Přehled

Poruchu vědomí má **4 – 10 %** pacientů ošetřených na urgentním příjmu/ZZS

příčina	četnost
neurologická	28 %
intoxikace	21 %
trauma	14 %
psychogenní	14 %
infekce	10 %
endokrinní/metabolická	5 %
plicní	3 %
onkologická	3 %
kardiovaskulární	1 %
gastrointestinální	1 %
renální	1 %

Altered mental status: evaluation and etiology in the ED

William Kanich <sup>1</sup>, William J Brady, J Stephen Huff, Andrew D Perron, Christopher Holstege, George Lindbeck, C Thomas Carter

# Proč POCUS?

POCUS was found to be potentially beneficial in 27.0% of all patients. High triage score, known cardiac disease, hypertension, pulmonary diseases, a clinical presentation with abdominal pain, dyspnea, or syncope are predictors of this. Future research should focus on patient-important outcomes when applying POCUS on these patients.

Point-of-care ultrasound induced changes in management of unselected patients in the emergency department - a prospective single-blinded observational trial

Jesper Weile,<sup>1,2</sup> Christian A. Frederiksen,<sup>3</sup> Christian B. Laursen,<sup>4</sup> Ole Graumann,<sup>5,6</sup> Erik Sloth,<sup>7</sup> and Hans Kirkegaard<sup>2,8</sup>

**Recommendation:** ACP suggests that clinicians may use point-of-care ultrasonography in addition to the standard diagnostic pathway when there is diagnostic uncertainty in patients with acute dyspnea in emergency department or inpatient settings (conditional recommendation; low-certainty evidence).

Intensive Care Med (2021) 47:1347–1367  
https://doi.org/10.1007/s00134-021-06486-z

## CONSENSUS AND EXPERT RECOMMENDATION

Basic ultrasound head-to-toe skills for intensivists in the general and neuro intensive care unit population: consensus and expert recommendations of the European Society of Intensive Care Medicine

Chiara Robba<sup>1,2\*</sup>, Adrian Wong<sup>3</sup>, Daniele Poole<sup>4</sup>, Ashraf Al Tayar<sup>5</sup>, Robert T. Arntfield<sup>6</sup>, Michelle S. Francesco Corrad<sup>8,9</sup>, Ghislaine Doufle<sup>10</sup>, Alberto Goffi<sup>11</sup>, Massimo Lamperti<sup>12</sup>, Paul Mayo<sup>13</sup>, Antonio Messina<sup>14</sup>, Silvia Mongodi<sup>15</sup>, Mangala Narasimhan<sup>16</sup>, Corina Puppo<sup>17</sup>, Aarti Sarwal<sup>18</sup>, Michel Slama<sup>19</sup>, Fabio S. Taccone<sup>20</sup>, Philippe Vignon<sup>21</sup>, Antoine Vieillard-Baron<sup>22,23</sup> and The European Society of Intensive Care Medicine task force for critical care ultrasonography<sup>24\*</sup>

### Item 1. Triage or clinical suspicion for intracranial hypertension (ESM 2, Video S1, Figure S1)

- We **recommend** B-mode Transcranial color-coded duplex (TCCD) insonation of the middle cerebral artery as basic skill for the qualitative waveforms analysis and to measure pulsatility index to rule out intracranial hypertension impairing cerebral perfusion (*weak recommendation*).
- We are **unable to provide recommendation** regarding the use of optic nerve sheath diameter (ONSD) as a basic skill for intensivists to rule out intracranial hypertension (*no recommendation*).

► **Table 2** Recommended methodology for creation of Neuro-POCUS clinical questions with examples.

(P)opulation		(I)ntervention		(C)omparator		(O)utcome
Symptoms/disease	Location	Neuro-POCUS protocol	Timing	Other diagnostic method(s)	Considerations	Role
Stroke	Ambulance/ ED/SD unit/ ICU/ward	TCD/TCCS +/- Carotid/ vertebral US	Urgent	CT/CTA MRI/MRA	Radiation exposure, absolute/relative contraindications, cost, availability	Establish diagnosis & guide treatment
Headache	Ambulance/ ED/ward	TCD/TCCS Carotid/vertebral/ superficial temporal artery US	Urgent	CT/CTA MRI/MRA	Radiation exposure, absolute/relative contraindications, cost, availability	Rule out vascular abnormalities (e. g., dissection, RCVS) & cerebral edema, diagnosis of giant cell arteritis
Impaired consciousness	Ambulance/ ED/SD unit/ ICU/ward	TCD/TCCS	Urgent	CT/CTA MRI/ MRA	Radiation exposure, absolute/relative contraindications, cost, availability	Rule out vascular abnormalities (e. g., occlusion, vasospasm) & cerebral edema
		TCD/ carotid ver- tebral US or TCCS/ carotid vertebral US	Semi-urgent	CT/CTA Perfusion scintigraphy/ SPECT	Exposure to contrast agents, need of transportation of mechanically respiration patients, cost, availability	Proof of cerebral circulatory arrest
Other neurological symptoms	ICU	Transorbital sonography	Semi-urgent	Fundoscopy	Technical challenges, use of mydriatics	Monitoring/follow-up of intracranial pressure
Subacute Sensory/ motor symptoms in extremities	ED/SD unit/ ICU/ward	Peripheral nerve US	Semi-urgent	EMG	Availability	Diagnosis of neuropathies/plexopathies & prognostication
		Muscle US	Semi-urgent or Elective	CT, EMG	Availability	Intramuscular botulinum toxin injection in painful nerve compression syndromes (e. g., thoracic outlet syndrome, piriformis syndrome)
Dysphagia with hypersalivation	ED/SD unit/ ICU/ward	US of parotid and submandi-bular gland	Semi-urgent or Elective	Injection without US guidance	Availability	Intramuscular botulinum toxin injection in relative hypersalivation due to dysphagia with imminent aspiration

CT – computed tomography; CTA – computed tomography angiography; DSA – digital subtraction angiography; ED – emergency department; EMG – electromyography ICU – intensive care unit; MRI – magnetic resonance imaging; MRA – magnetic resonance angiography; POCUS – point-of-care ultrasound; RCVS – reversible cerebral vasoconstriction syndrome; SD – step-down unit; SPECT – single photon emission computed tomography; TCCS – transcranial color-coded duplex sonography; TCD – transcranial Doppler; US – ultrasound.

# POCUS + bezvědomí

## Kraniocerebrální POCUS (= neurosonologie)

- Vyšetření orbity
- Průtok krve hlavních mozkových tepen (TCD, TCCD)
- Vyšetření krčních cév

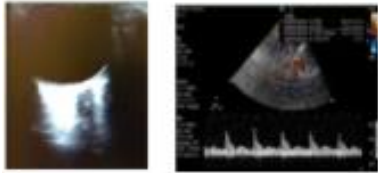
## Extrakraniální POCUS

- Srdce
- Onemocnění pleury a plic
- HŽT
- Šok
- Aorta
- Zdroj infekce

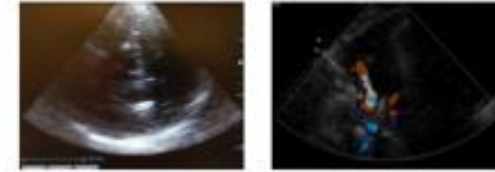


# Kraniocerebrální POCUS - akustické okno

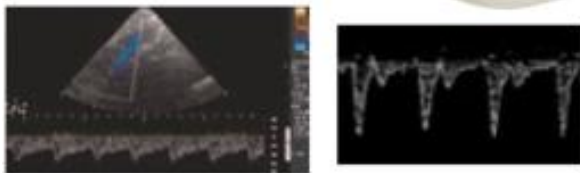
Transorbital



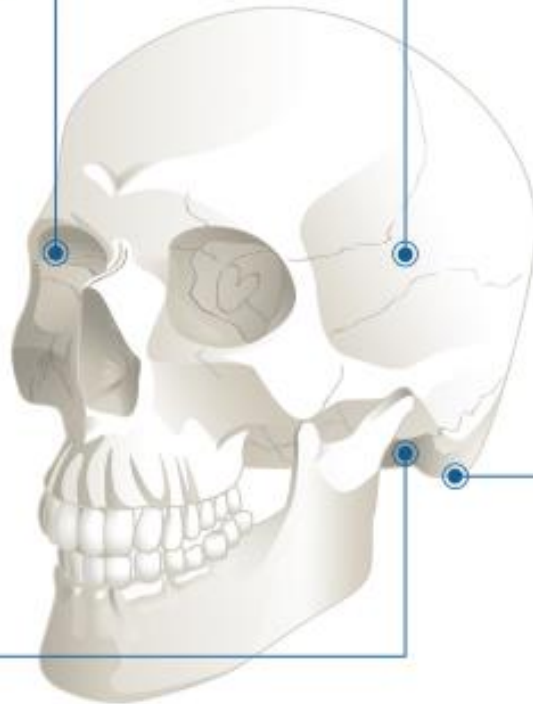
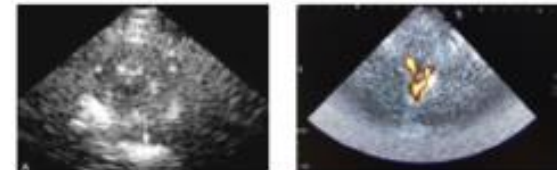
Transtemporal



Submandibular



Occipital



# Transorbitální přístup

Lineární sonda

Horizontální /vertikální poloha přes víčko

Optimalizace polohy sondy (a. centralis retinae)

Známky elevace ICP:

1) ONSD – optic nerve sheath diameter

- Měření 3 mm od zadní části očního bulbu
- <5mm norma
- 5-6 mm šedá zona
- >6 mm abnormální

2) Elevace optického disku



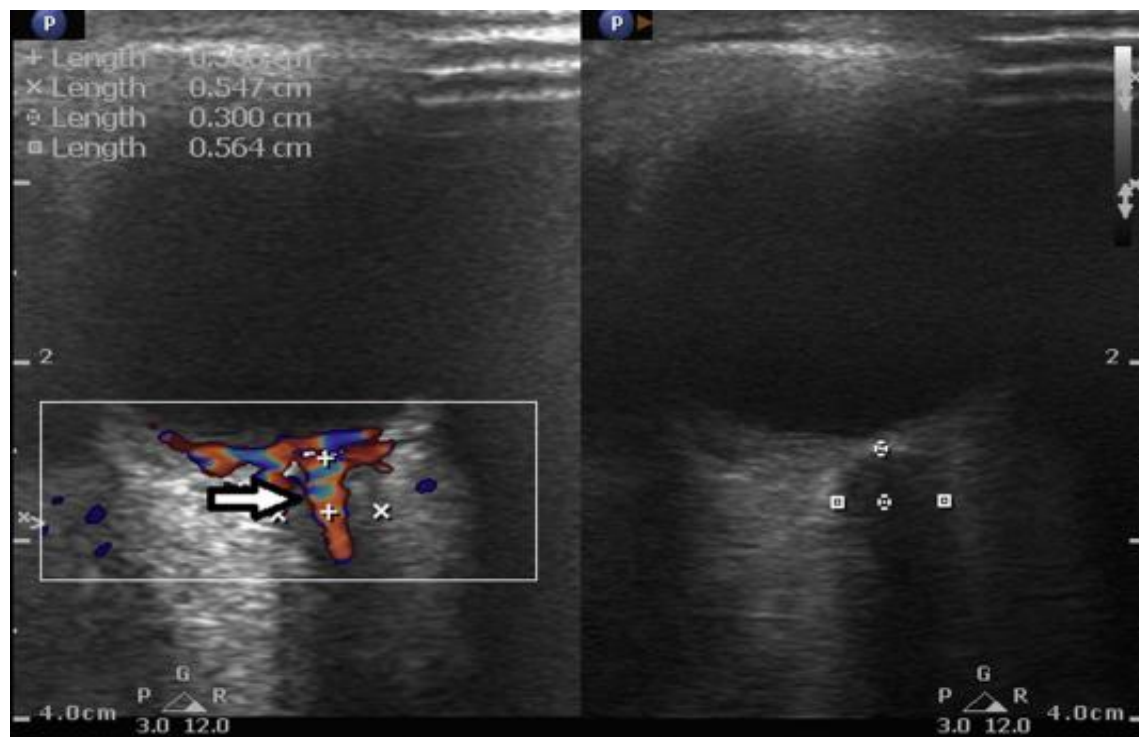
(a)

(b)



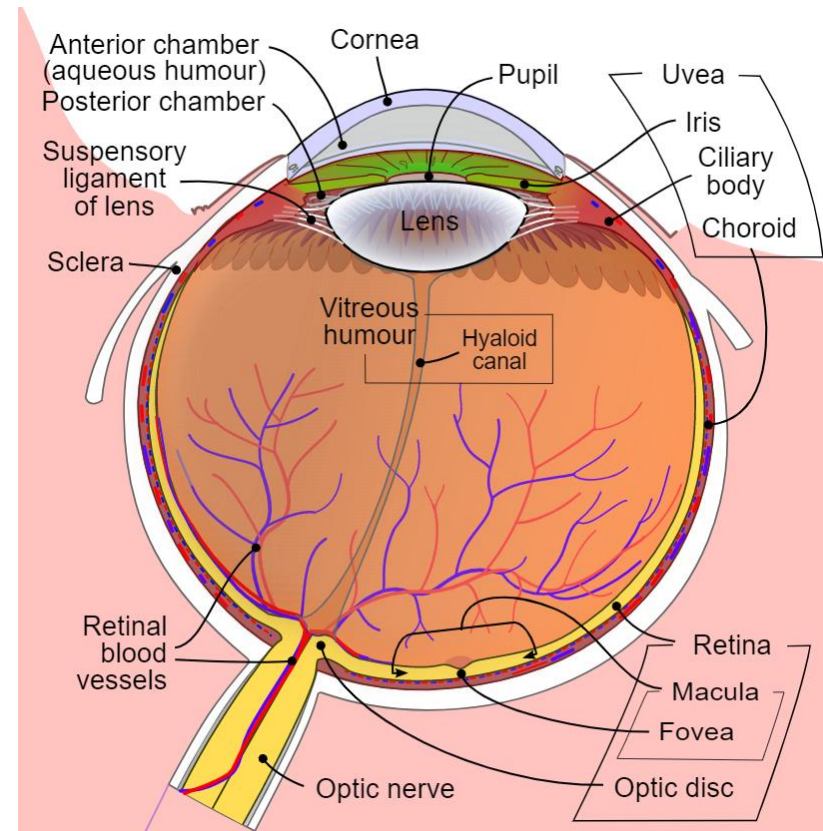
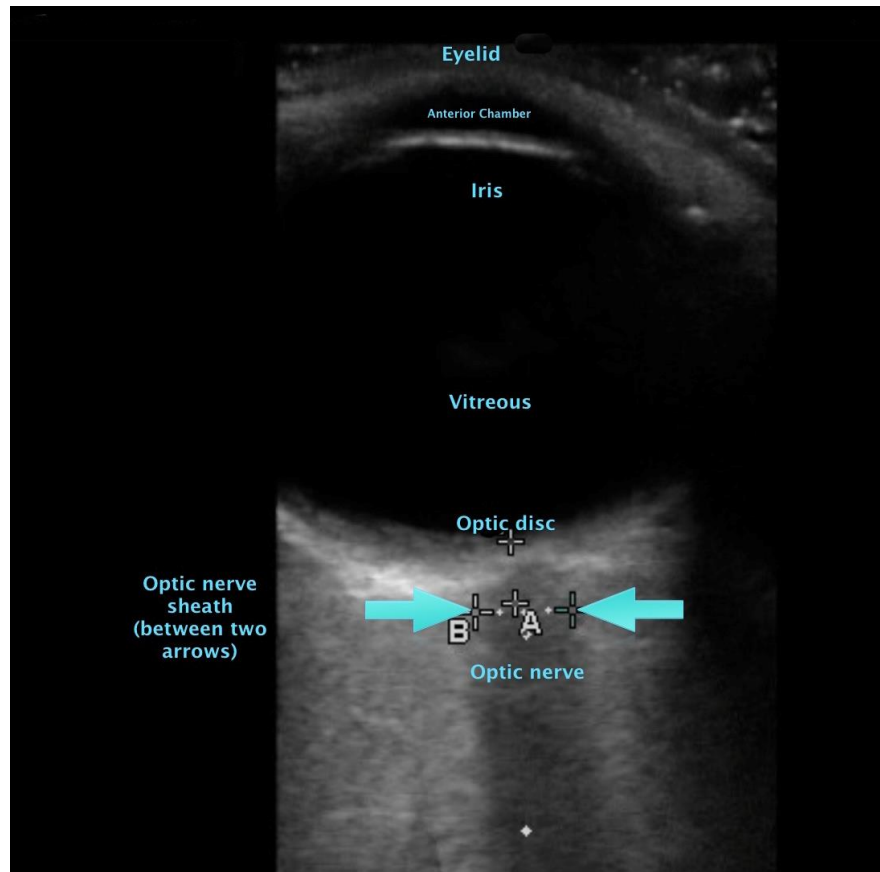


# Optimalizace polohy

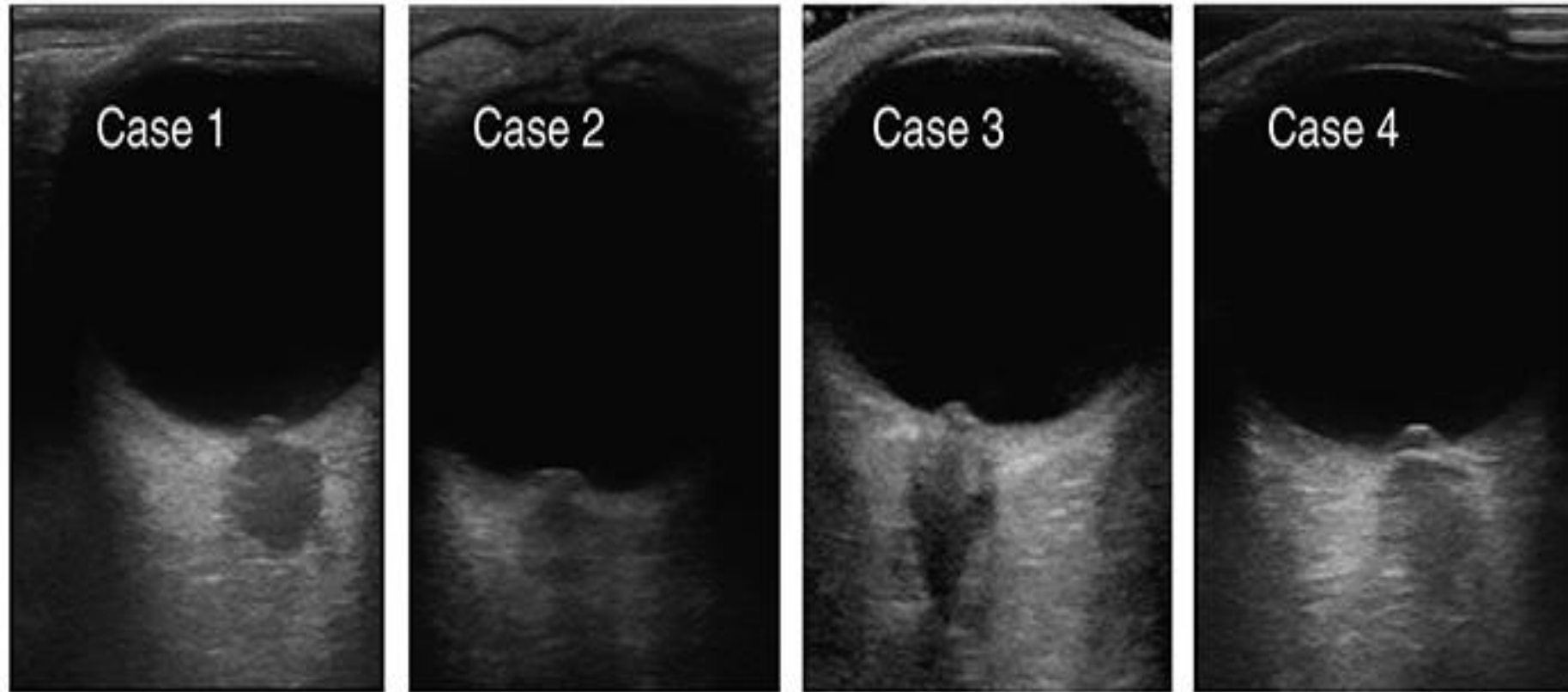


<https://emcrit.org/pulmcrit/pulmcrit-algorithm-diagnosing-icp-elevation-ocular-sonography/>

# Měření 3 mm od zadní části bulbu

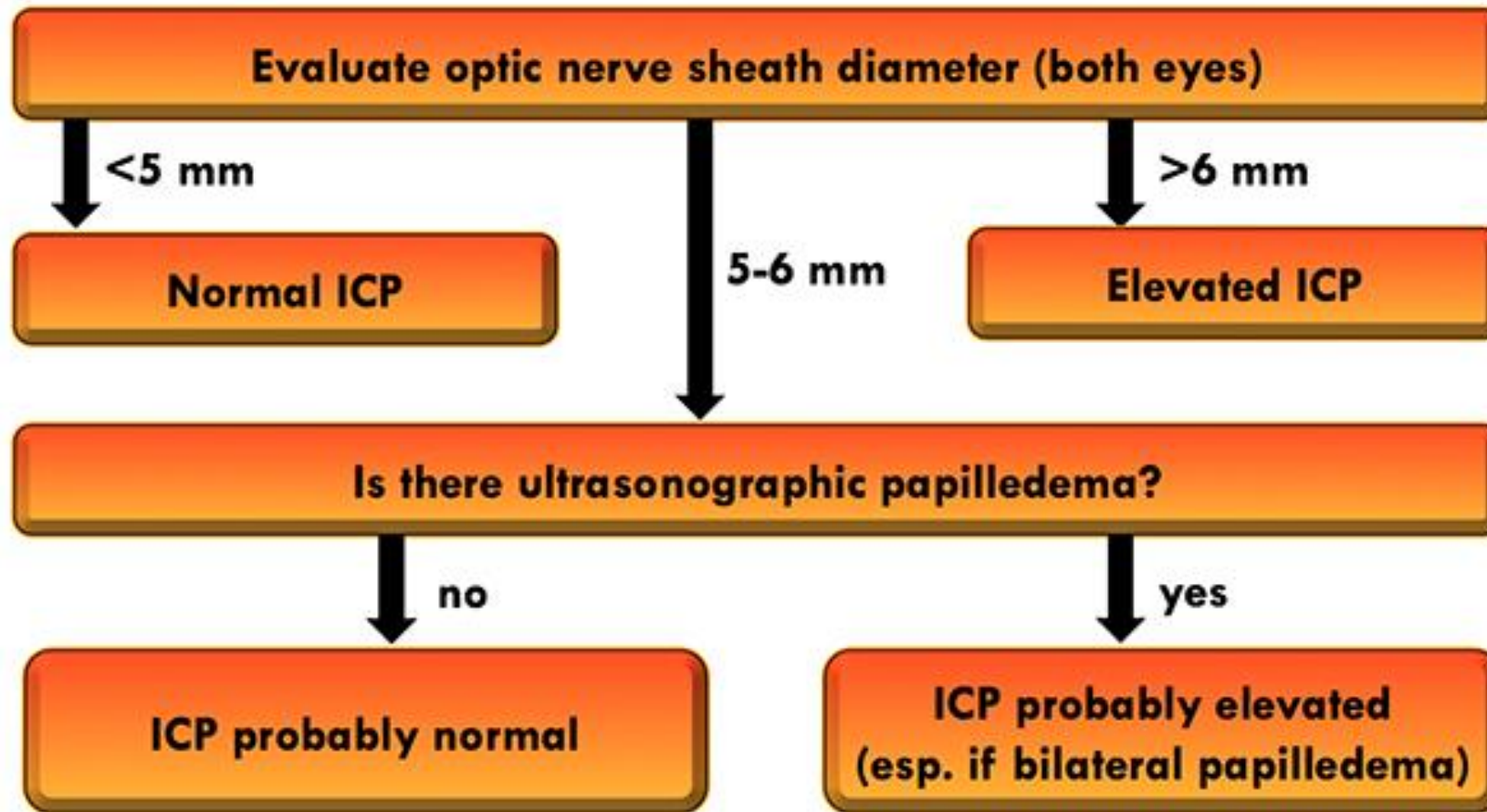


# Elevace optického disku



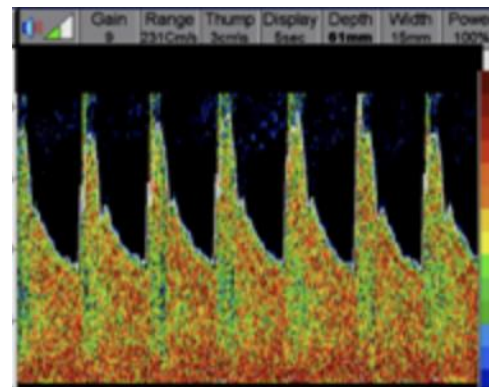
**FIGURE 1.** Point-of-care ocular ultrasound images demonstrating papilledema. Each image above demonstrates papilledema as evidenced by both increased ONSD and optic disc elevation.

## Algorithm to evaluate for ICP elevation using ocular ultrasonography



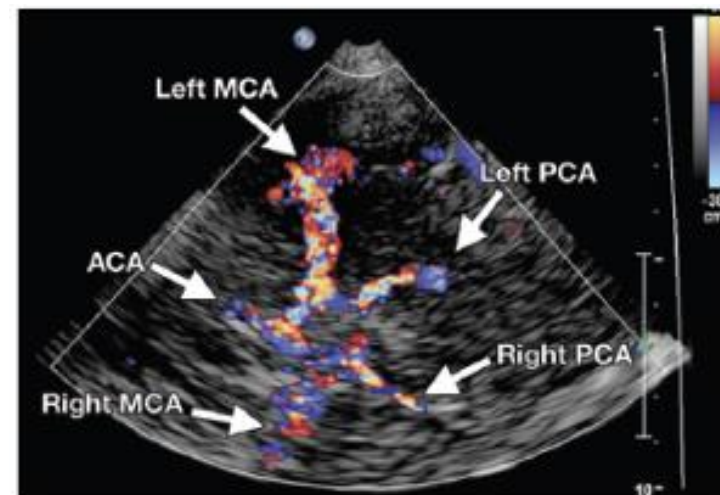
# Průtok krve v mozkových tepnách

TCD (Transcranial Doppler Ultrasonography)

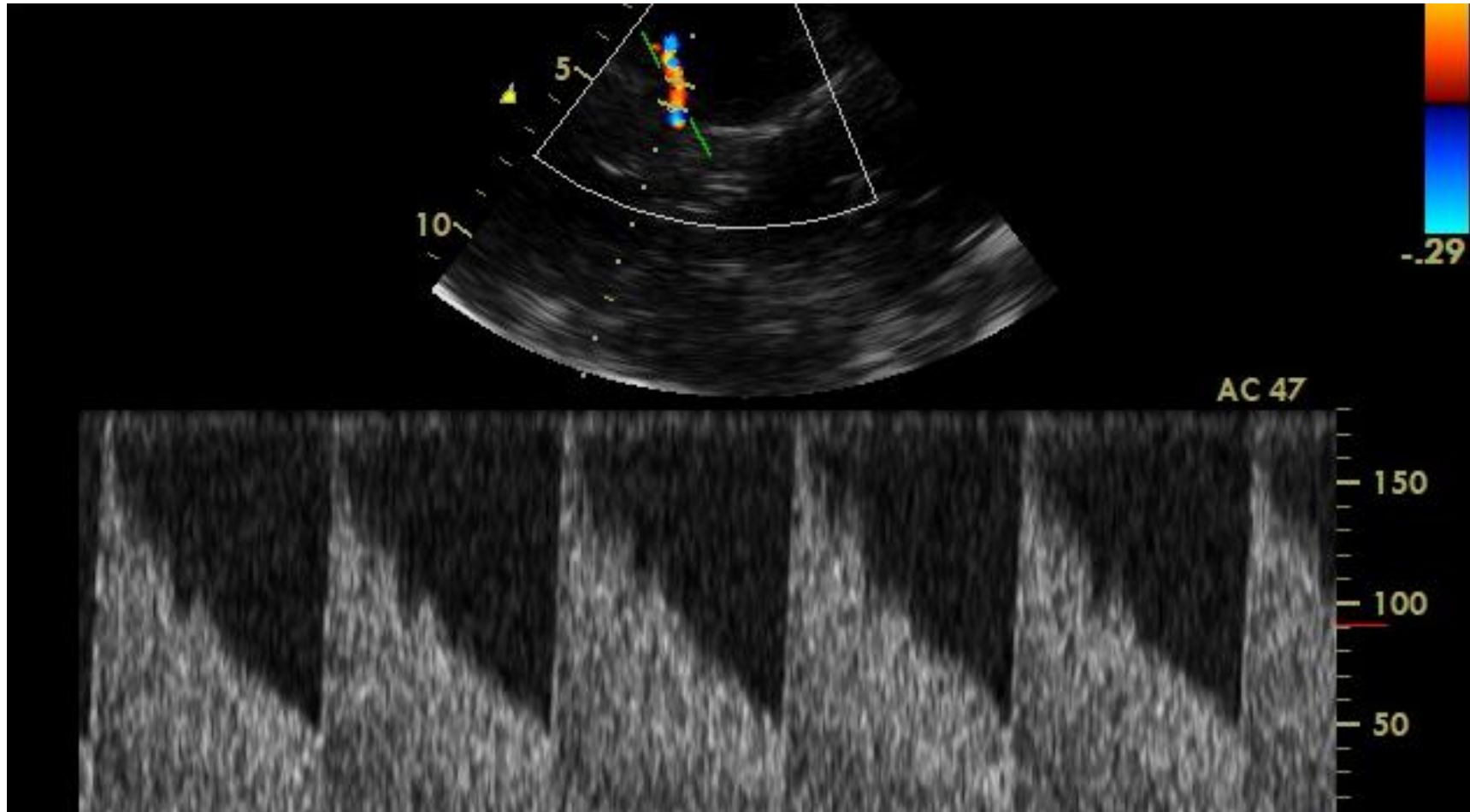


TCCD (Transcranial Colour-Coded Duplex ultrasonography )

- kombinace TCD+B mode+ barevný mode + parenchym



# TCD TCCD



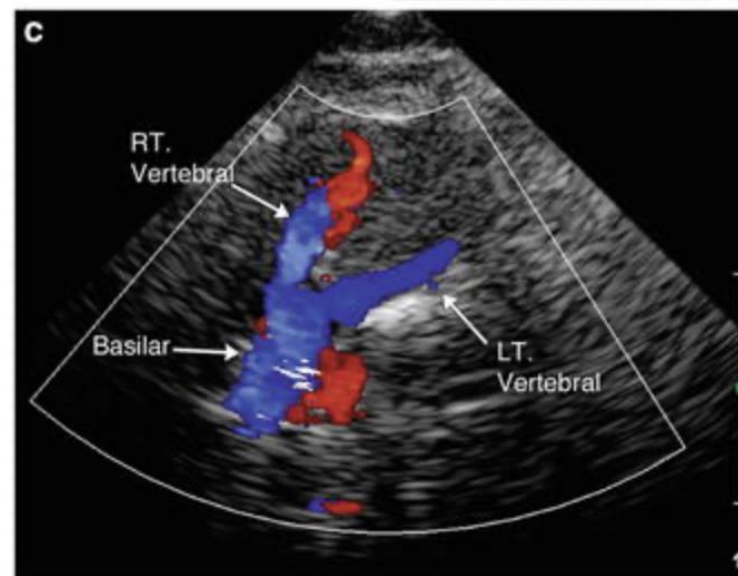
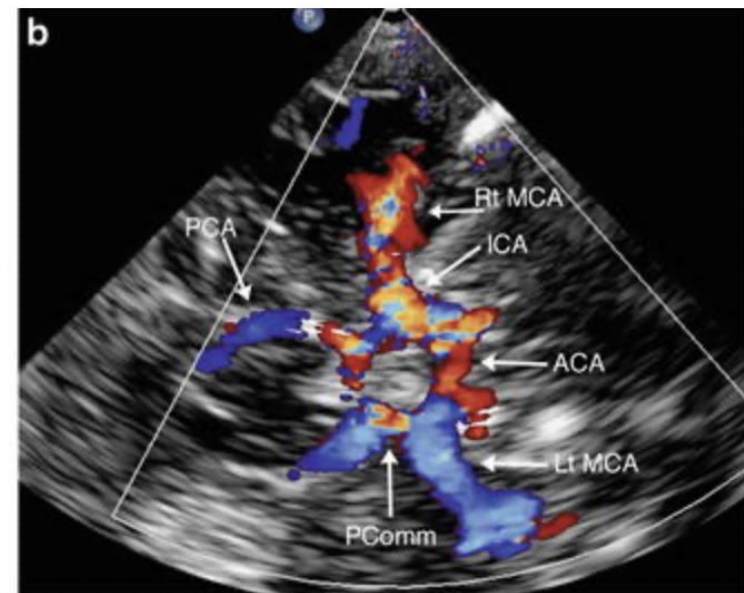
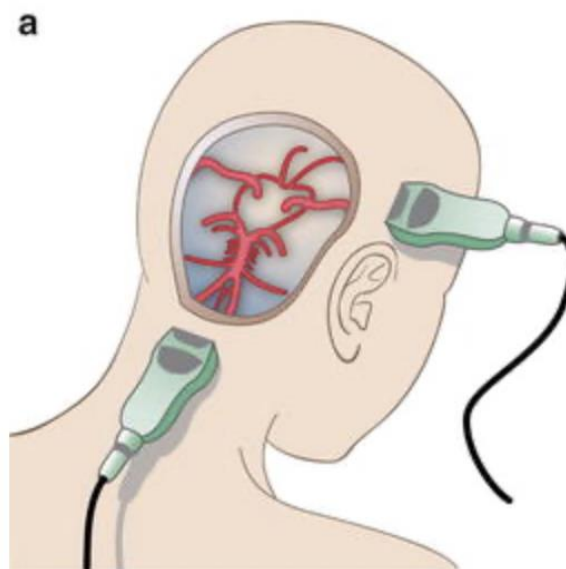
# TCD/TCCD

Vazospazmy

Odhad nitrolebného tlaku

Smrt mozku

III. komora

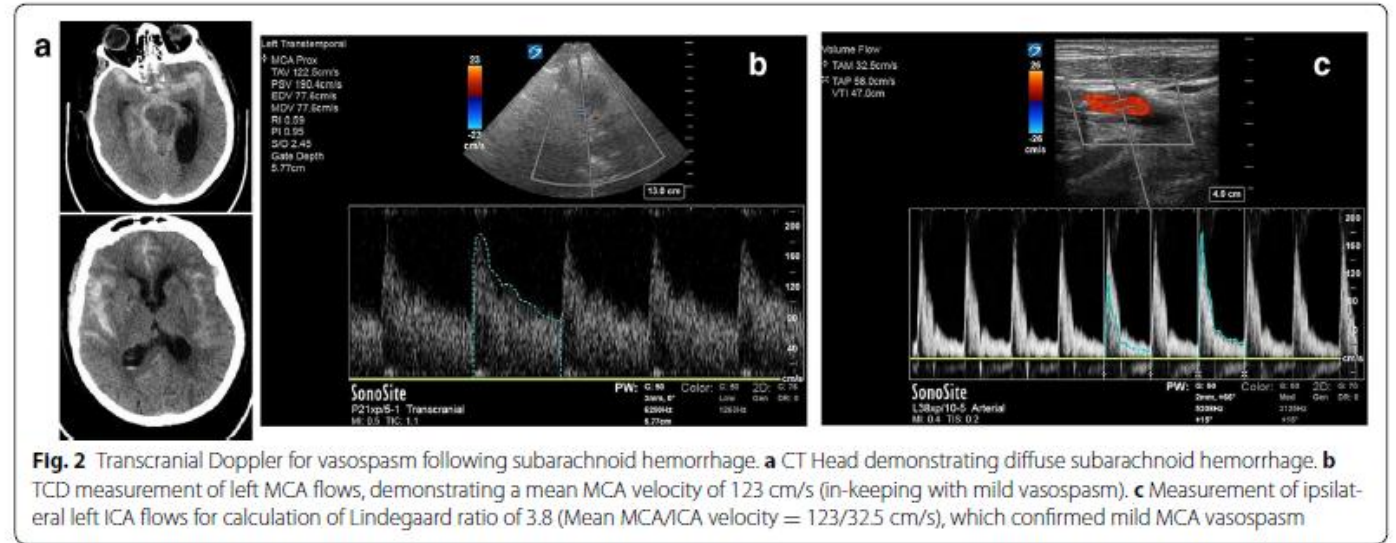


# Vazospazmy

Komplikace SAH

TCD od 2. dne

Příčina neurologického deficitu

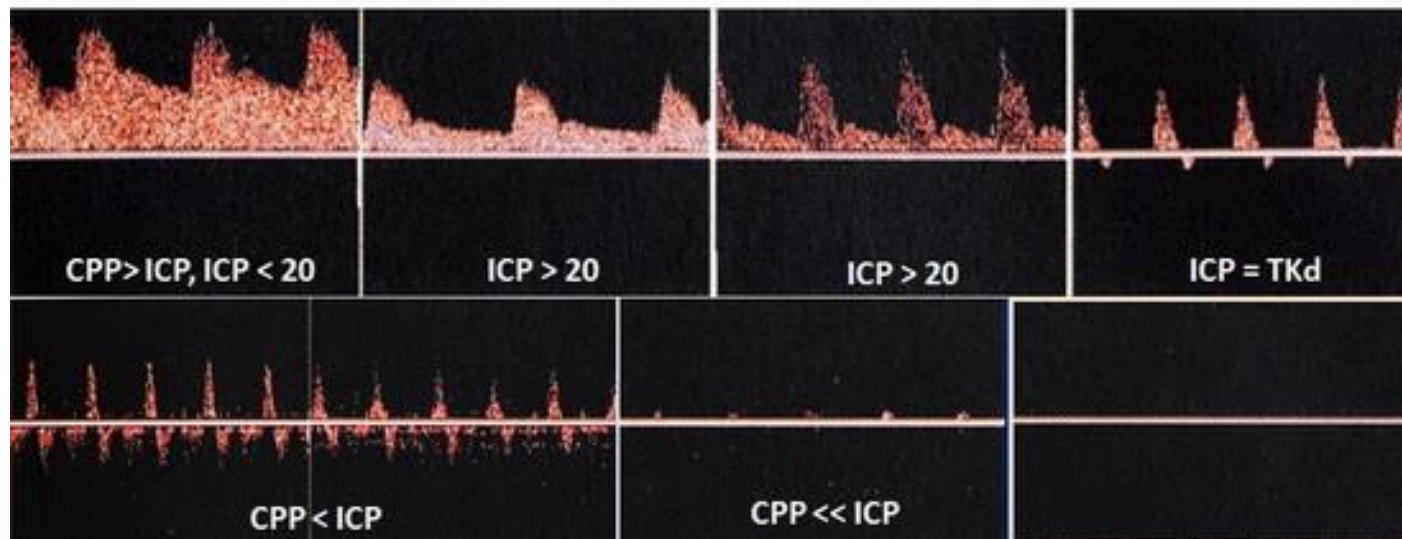
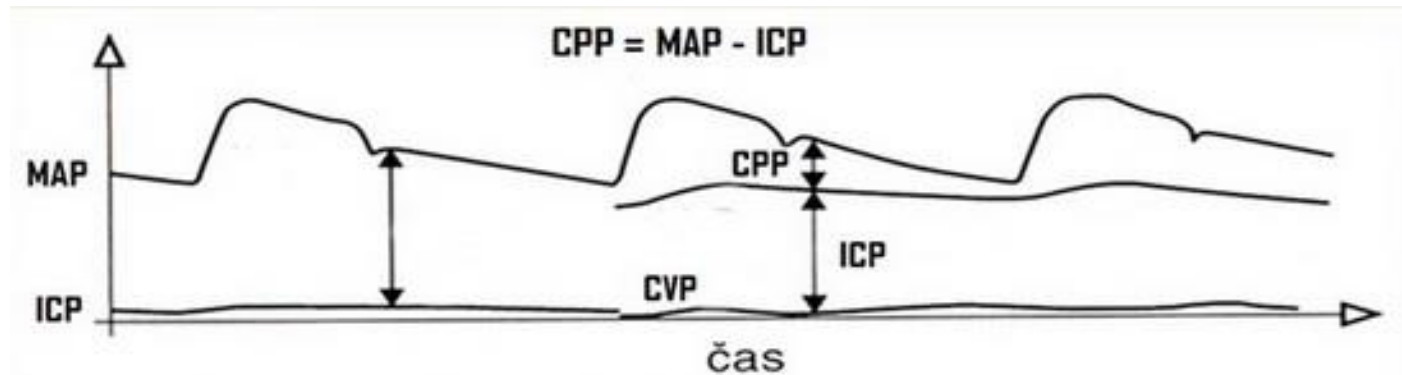


**Table 2**  
Quantitative Parameters for Assessing Vasospasm of the MCA

Severity of Vasospasm	PSV (cm/sec)	MFV (cm/sec)	Lindegaard Ratio
Mild	200–250	120–150	3–4.5
Moderate	250–300	150–200	4.5–6.0
Severe	>300	>200	>6



# Nitrolební hypertenze



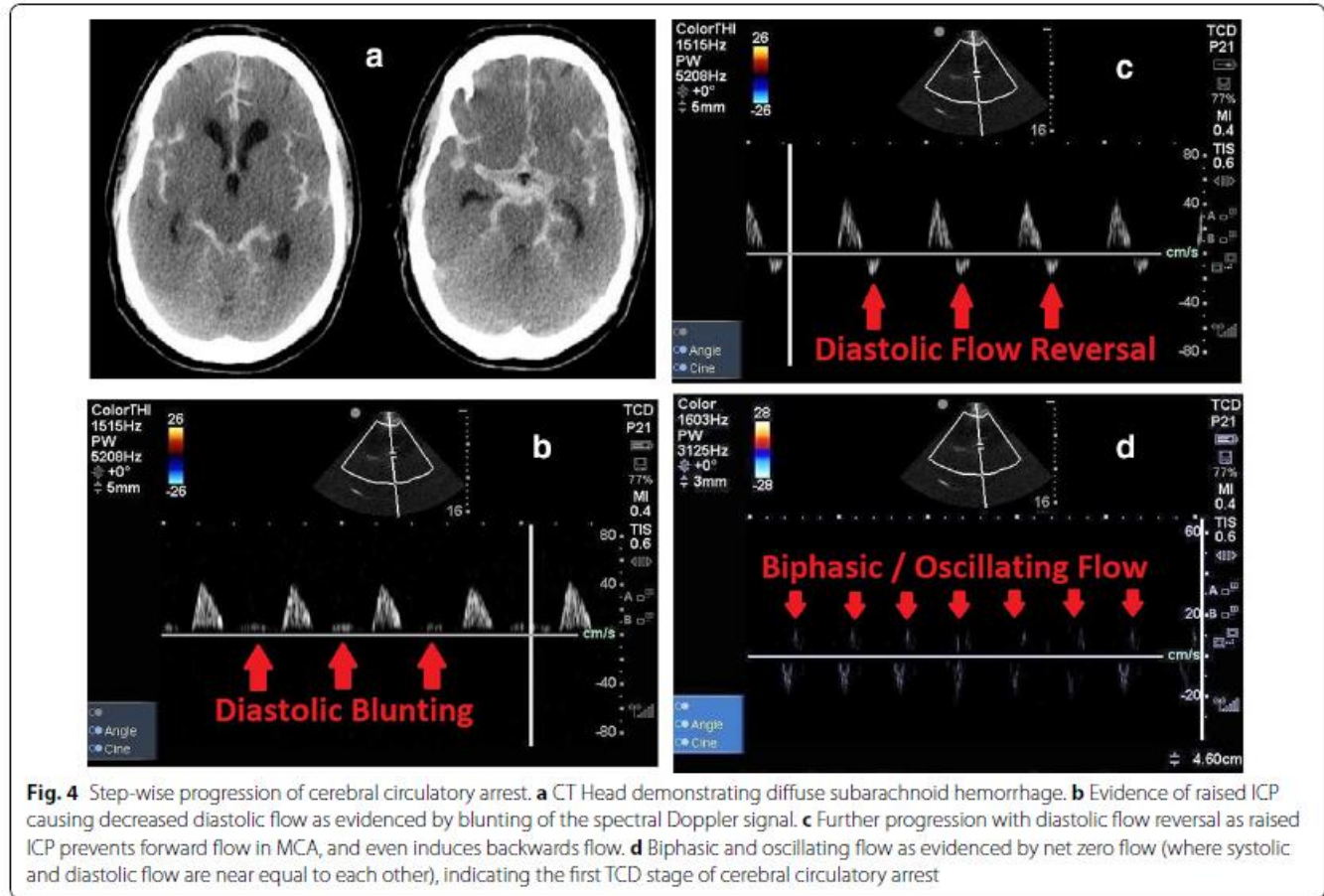
# Smrt mozku

Progrese nárůstu ICP

Oslabení toku

Reverzní tok

Žádný tok



# Smrt mozku



## 3. Potvrzení nevratnosti klinických známek smrti mozku

### 3.1. angiografie mozkových tepen

zjištěna absence náplně cerebrálních úseků mozkových tepen:

.....  
datum                      hodina                      jméno a podpis vyšetřujícího lékaře

### 3.2. mozková perfuzní scintigrafie

zjištěna absence záchyty radiofarmaka v mozkové tkáni:

.....  
datum                      hodina                      jméno a podpis vyšetřujícího lékaře

### 3.3. vyšetření sluchových kmenových evokovaných potenciálů

časně akusticky evokovaná potencionála mozkového kmene vlny II - V vyhaslé oboustranně (ano/ne)

.....  
datum                      hodina                      jméno a podpis vyšetřujícího lékaře

### 3.4. transkraniální dopplerovská sonografie

zjištěna zástava toku v mozkových tepnách:

.....  
datum                      hodina                      jméno a podpis vyšetřujícího lékaře

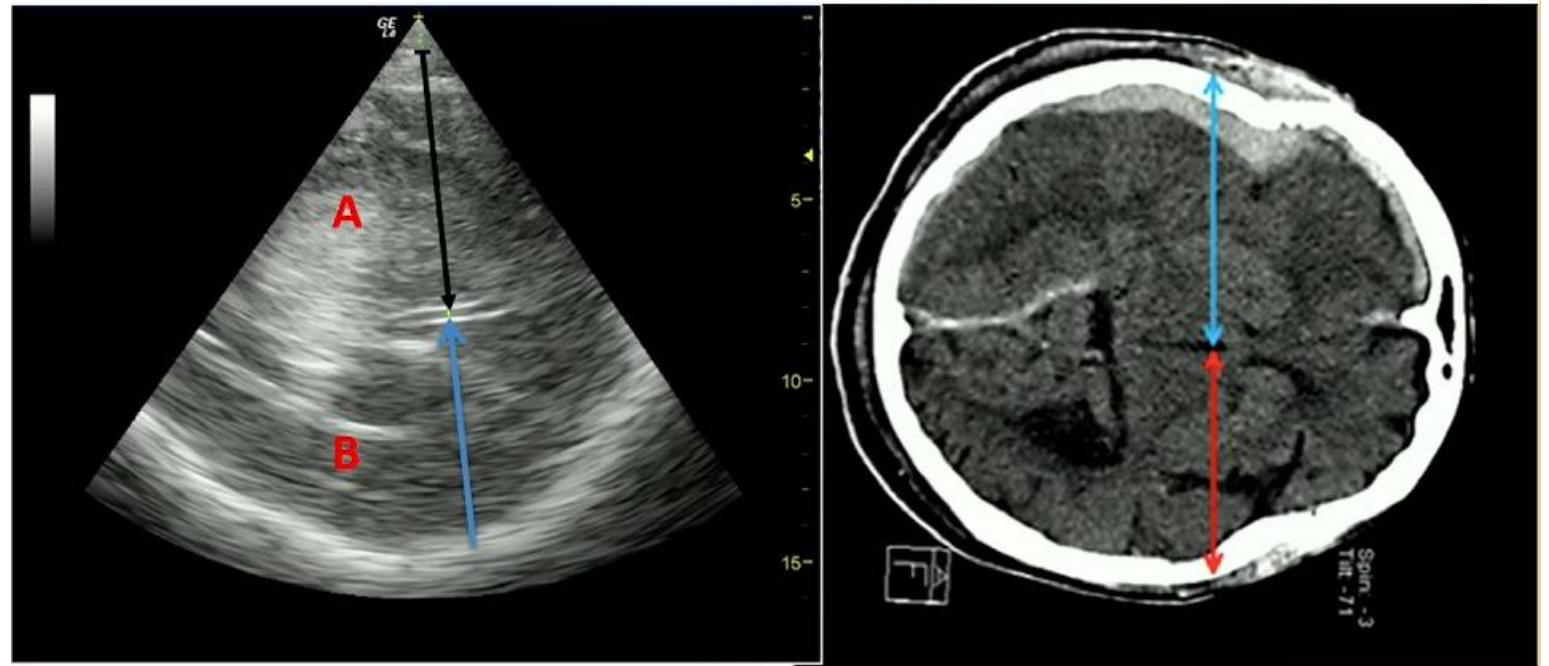
### 3.5. CT angiografie

zjištěna absence náplně cerebrálních úseků mozkových cév

# Středočárový posun mozkových struktur

Temporální okno

III. Komora

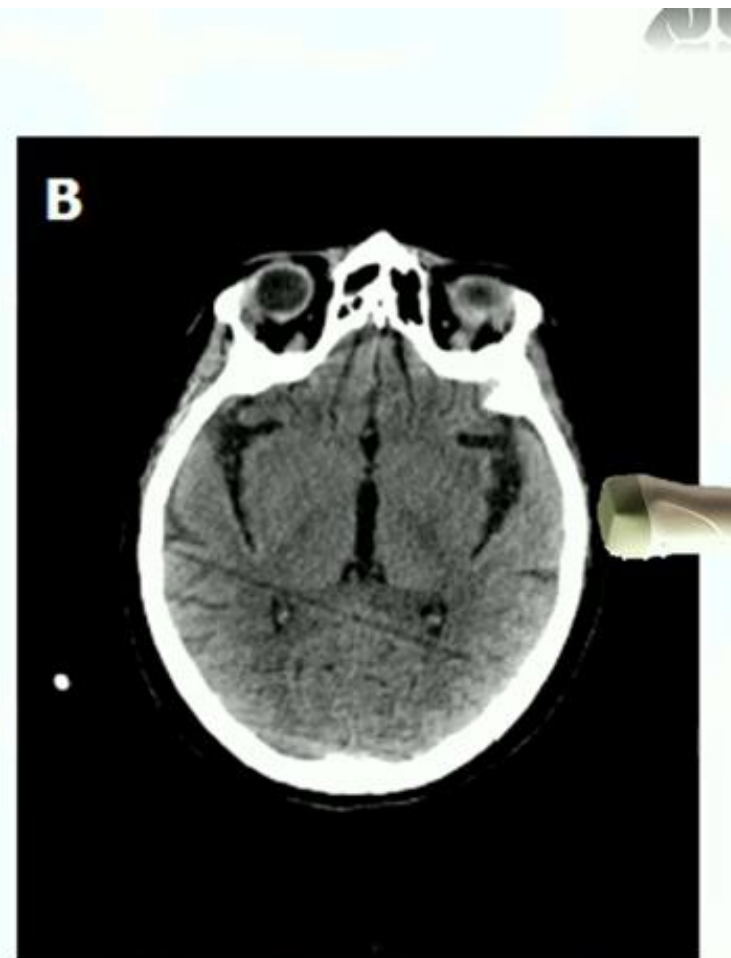
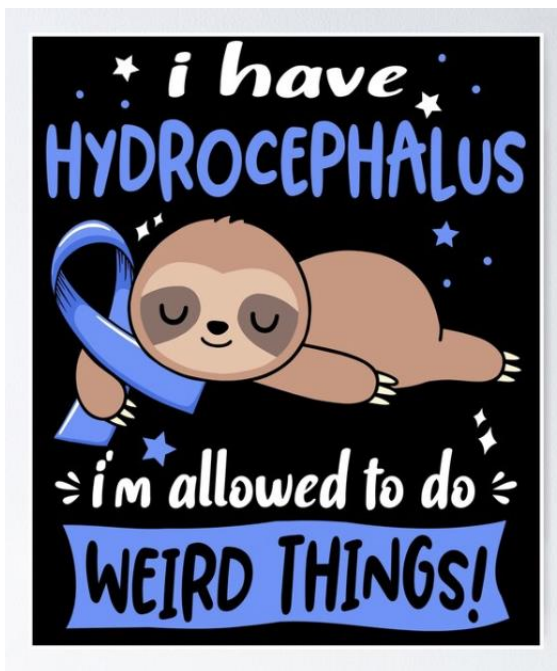


Midline lateral displacement =  $A-B/2$

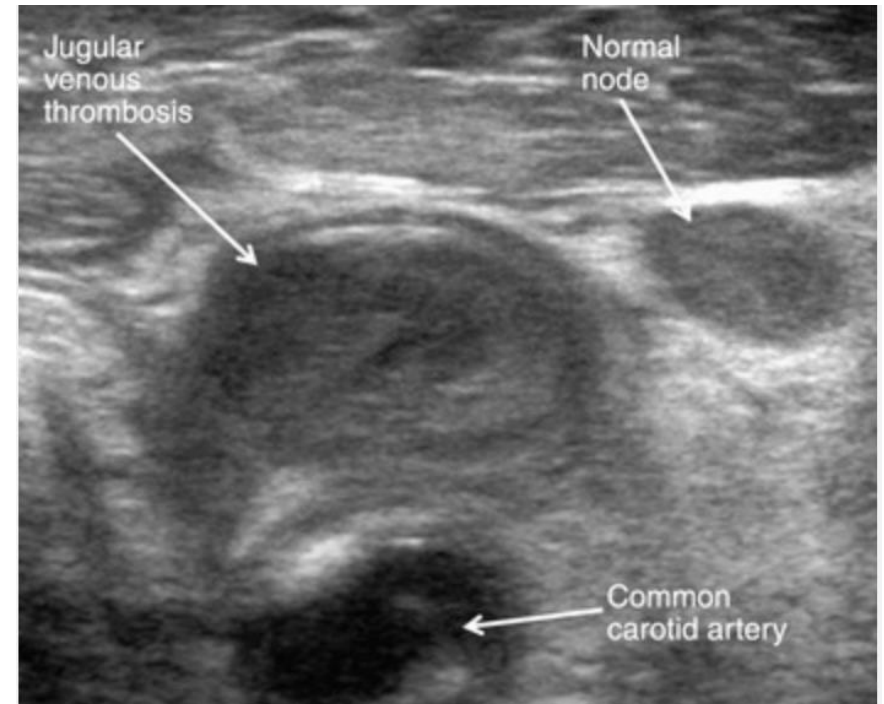
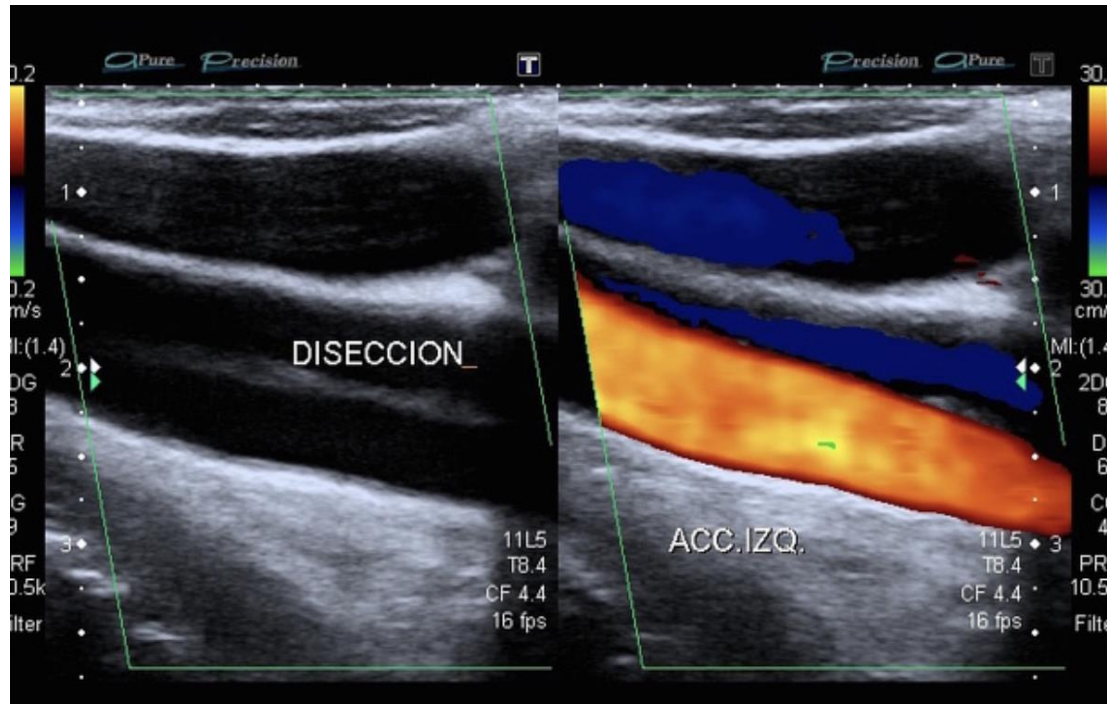
# Hydrocefalus

Šíře III. komory

- $> 5,5\text{mm}$



# Krční cévy



# POCUS + bezvědomí

## Kraniocerebrální POCUS (= neurosonologie)

- Vyšetření orbity
- Průtok krve hlavních mozkových tepen (TCD, TCCD)
- Vyšetření krčních cév

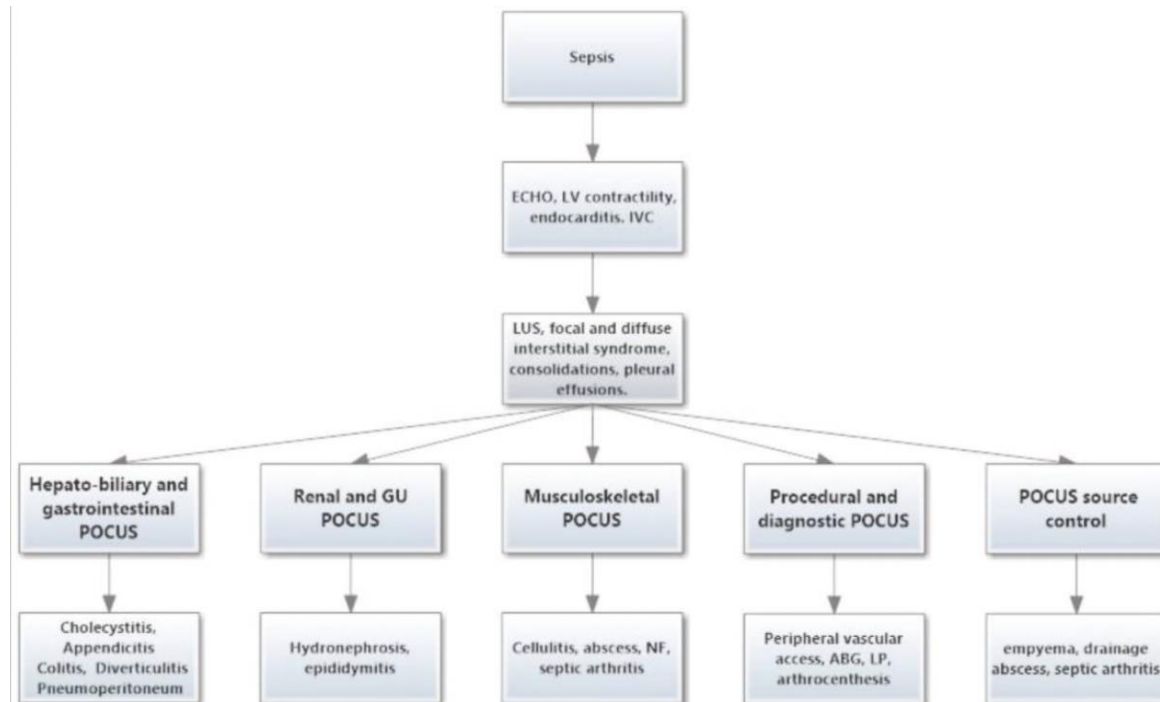
## Extrakraniální POCUS

- Srdce
- Onemocnění pleury a plic
- HŽT
- Šok
- Aorta
- Zdroj infekce



# Zdroj infekce - POCUS urychluje diagnostiku

The presentation of a patient with altered mental status to the emergency department begins a long list of possible differentials which must be investigated and ruled out. The sooner the differential can be narrowed down; the sooner the patient is able to receive the appropriate care. As Coretello et al demonstrated, with the aid of Point-of-Care-Ultrasound (POCUS), the final diagnosis of septic source had a sensitivity of 73 % and specificity of 95%, with an accuracy of 75%; while the diagnosis of septic sources based only on clinical impressions without POCUS showed a sensitivity of 48%, specificity of 86%, and an accuracy of 52.5%. In this study, POCUS-implemented diagnoses were always obtained within 10 minutes while non-POCUS guided clinical impression identified a source within an hour only 22% of the time and 53% of the time within 3 hours.



## Accuracy of point of care ultrasound to identify the source of infection in septic patients: a prospective study

Francesca Cortellaro <sup>1</sup>, Laura Ferrari <sup>2</sup>, Francesco Molteni <sup>3</sup>, Paolo Aseni <sup>1</sup>, Marta Velati <sup>1</sup>, Linda Guarnieri <sup>1</sup>, Katia Barbara Cazzola <sup>1</sup>, Silvia Colombo <sup>1</sup>, Daniele Coen <sup>1</sup>



# POCUS + hypermagnezemie



## Clinical Communication

**Utility of Point-of-Care  
Ultrasound (POCUS) for  
predicting risk of magnesium  
toxicity in critically ill  
pre-eclamptic patients**

# POCUS u pacienta v bezvědomí

Může pomoci v diagnostice

Vstupní data další sledování (stp. KPR, CMP..)

Nenahrazuje CT/CTAg, NMR (CAVE: riziko z prodlení)

Gravidita posouvá risk/benefit těchto metod

