

DIAGNOSTYKA I LECZENIE URAZÓW CZASZKOWO-MÓZGOWYCH

Izabela Duda

nomenklatura

- Traumatic brain injury
 - Brain injury
 - Head injury
 - Traumatic cerebral injury
 - Head trauma
 - Traumatic brain
- Urazowe obrażenia mózgu
 - Urazy czaszkowo-mózgowe
 - Uraz mózgu
 - Uraz głowy
 - Obrażenia czaszkowo-mózgowe
 - Obrażenia głowy

Acta Neurochirurgica 2006; 148:255-268

Table 6. Comparison of selected epidemiological parameters for European, U.S., Australian, Asian and Indian data on TBI; adults, various years

Parameter	Place				
	Europe ¹	U.S. ²	Australia ³	Asia ⁴	India ⁵
Incidence rate ^{6,7}	235	103	226	344	160
Prevalence rate ⁶	NR	1893	NR	709	97
Mortality rate ⁶	15.4	18.1	NR	38	20
Severity (% Mi/Mo/Sev)	79/12/9	80/10/10	76/12/11	78/9/13	71/15/13
Case fatality rate ⁸	2.7 ^a	6.2	2.4	11	6
External cause (% Fall/MVC/Vio)	37/40/7	21/25/6	49/25/9	23/65/7	59/25/14
Outcomes ⁹ (% GOS unfavor)	50 ^b	64 ^c	NR	27	9

¹ Source: this report, ² source: aggregate data from references 24, 23, 47, ³ source: aggregate data from references 42, 16, 5, ⁴ source: Chiu, [8],

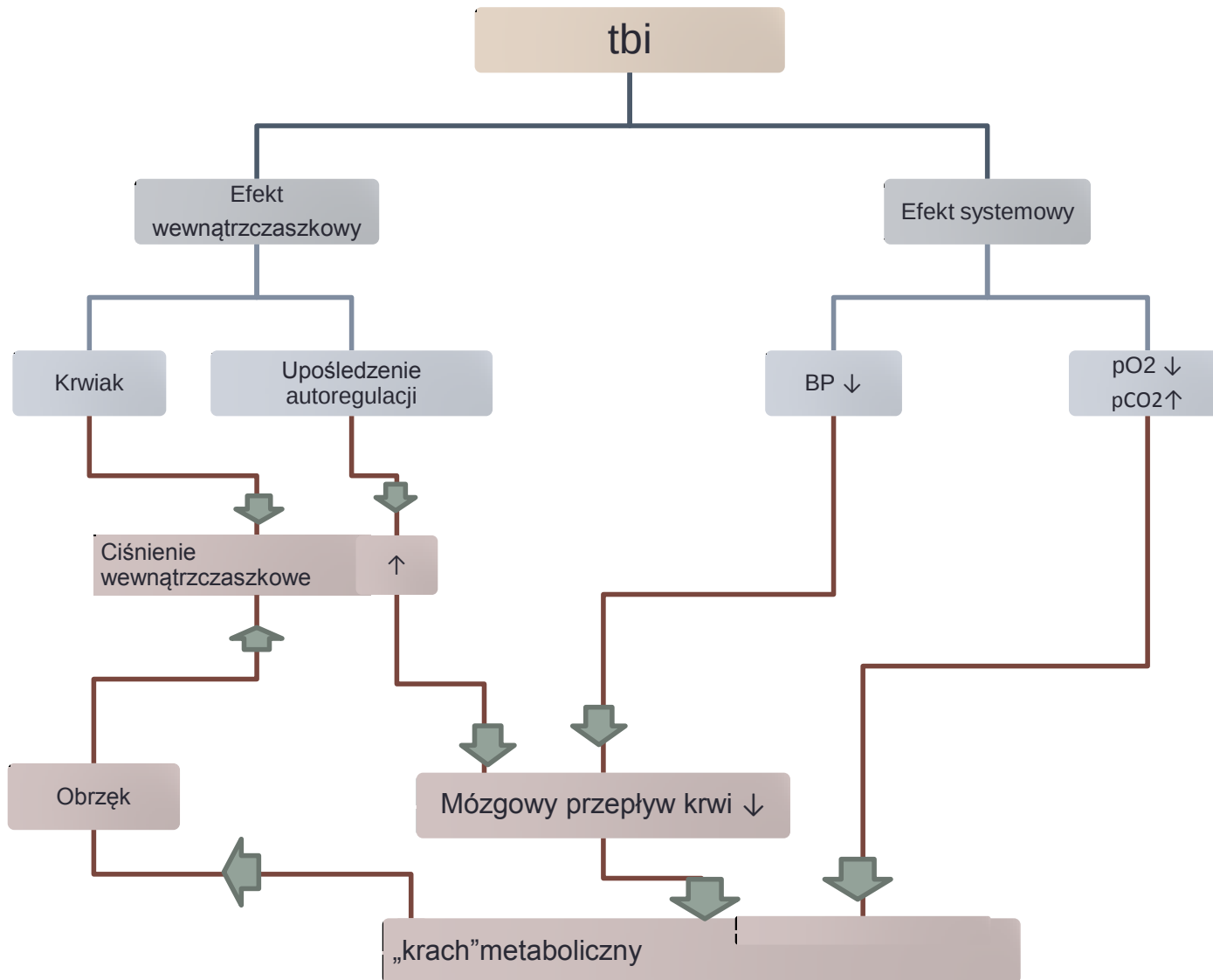
⁵ source: Gururaj, [14], ⁶ per 100,000 population, ⁷ includes hospitalized & deaths, ⁸ rate per 100 hospitalized, ⁹ unfavorable includes deaths, PVS, and severe disability.

Mechanizmy uszkodzenia

- Rozlane uszkodzenie aksonów
- Niedokrwienie mózgu
- Obrzmienie/ obrzęk mózgu
- Krwotok
- Pourazowe krwawienie podpajęczynówkowe
- Wodogłowie
- Niewydolność neurotransmiterów
- Toksyczne substancje przechodzące przez uszkodzoną BBB
- Zakażenie/zapalenie
- Drgawki/napady padaczkowe
- Zanik mózgu

Poziomy ciężkości TBI

TBI	GCS	PTA (pourazowa niepamięć)	LOC (utrata przytomności)
łagodne	13 -15	< 1hr	< 30min.
umiarkowane	9 -12	30 min. – 24 hr	1 do 24 hr
ciężkie	< 8	< 1 dzień	> 24 hr



Postępowanie terapeutyczne

Rekomendacje amerykańskie:

CPP > 70mmHg

w celu utrzymania na odpowiednim poziomie CBF
obniżenie ciśnienia systemowego oraz wzrost ICP prowadzi do odruchowej wazodylatacji naczyń mózgowych i wzrostu CBV;
wywołany przyrostem CBV dalszy wzrost ICP powoduje dalsze obniżenie CPP

Lund metoda:

50mmHg < CPP < 70mmHg

utrzymanie przepływu mózgowego na poziomie wystarczającym dla prawidłowego zaopatrzenia tkanek w tlen i glukozę, bez zwiększania ciśnienia hydrostatycznego w kapilarach, mogącego nasilić obrzęk mózgu

Glasgow Outcome Scale i GOS-E



I – zgon
II – pacjent w stanie wegetatywnym
III – ciężko upośledzony (porażenie, głęboki niedowład)
IV – niewielkie ubytki neurologiczne
V – stan bardzo dobry

TBI NATIONAL DATABASE COLLECTION FORM

Patient Name: _____ Date of Rating: _____

Name of Person Completing Form: _____

DISABILITY RATING SCALE:

Disability Rating Scale ratings to be completed within 72 hours after Rehab. Admission. And within 72 hours before Rehab. Discharge.

A. EYE OPENING:

- ☐ (0) Spontaneous
- ☐ (1) To Speech
- ☐ (2) To Pain
- ☐ (3) None

0-SPONTANEOUS: eyes open with sleep/wake rhythms indicating active arousal mechanisms, does not assume awareness.

1-TO SPEECH AND/OR SENSORY STIMULATION: a response to any verbal approach, whether spoken or shouted, not necessarily the command to open the eyes. Also, response to touch, mild pressure.

2-TO PAIN: tested by a painful stimulus.

3-NONE: no eye opening even to painful stimulation.

B. COMMUNICATION ABILITY:

- ☐ (0) Oriented
- ☐ (1) Confused
- ☐ (2) Inappropriate
- ☐ (3) Incomprehensible
- ☐ (4) None

0-ORIENTED: implies awareness of self and the environment. Patient able to tell you a) who he is; b) where he is; c) why he is there; d) year; e) season; f) month; g) day; h) time of day.

1-CONFUSED: attention can be held and patient responds to questions but responses are delayed and/or indicate varying degrees of disorientation and confusion.

2-INAPPROPRIATE: intelligible articulation but speech is used only in an exclamatory or random way (such as shouting and swearing); no sustained communication exchange is possible.

3-INCOMPREHENSIBLE: moaning, groaning or sounds without recognizable words, no consistent communication signs.

4-NONE: no sounds or communications signs from patient.

C. MOTOR RESPONSE:

- ☐ (0) Obeying
- ☐ (1) Localizing
- ☐ (2) Withdrawing
- ☐ (3) Flexing
- ☐ (4) Extending
- ☐ (5) None

0-OBEYING: obeying command to move finger on best side. If no response or not suitable try another command such as "move lips," "blink eyes," etc. Do not include grasp or other reflex responses.

1-LOCALIZING: a painful stimulus at more than one site causes limb to move (even slightly) in an attempt to remove it. It is a deliberate motor act to move away from or remove the source of noxious stimulation. If there is doubt as to whether withdrawal or localization has occurred after 3 or 4 painful stimulations, rate as localization.

2-WITHDRAWING: any generalized movement away from a noxious stimulus that is more than a simple reflex response

3-FLEXING: painful stimulation results in either flexion at the elbow, rapid withdrawal with abduction of the shoulder or a slow withdrawal with adduction of the shoulder. If there is confusion between flexing and withdrawing, then use pinprick on hands.

Prewencja wtórnego niedokrwienia i redukcja uszkodzenia mózgu po tbi

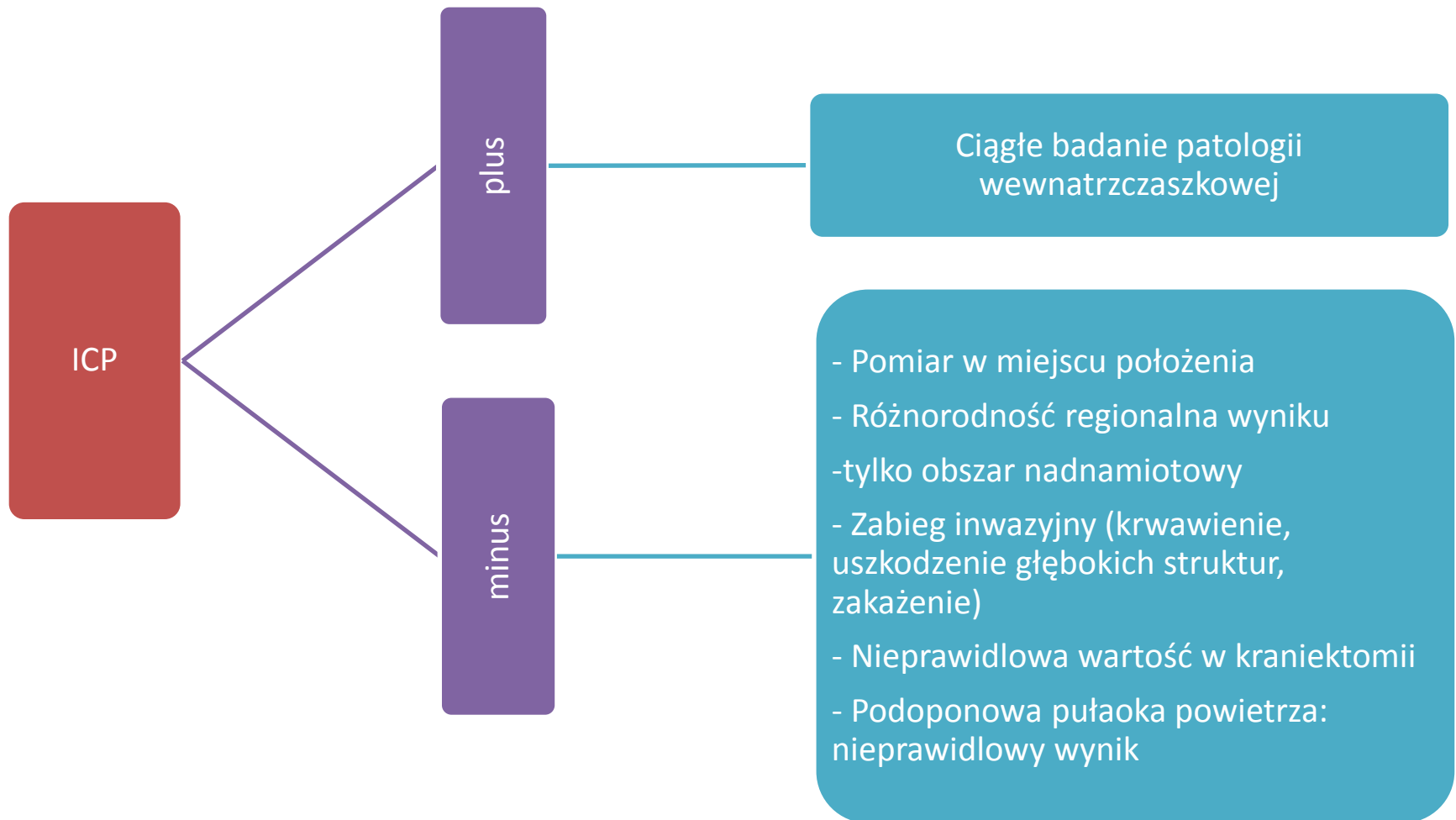
Jak rozpoznać stan mózgu
w czasie śpiączki i sedacji
farmakologicznej?

Ciśnienie wewnątrzczaszkowe

- wartość prawidłowa – 4-12mmHg
- wysokie ciśnienie wewnątrzczaszkowe > 20mmHg



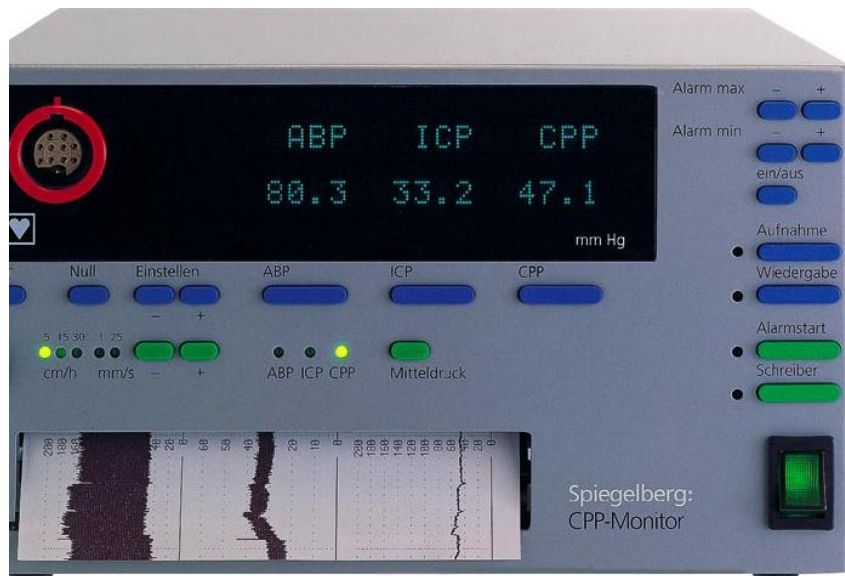
Ciśnienie wewnątrzczaszkowe



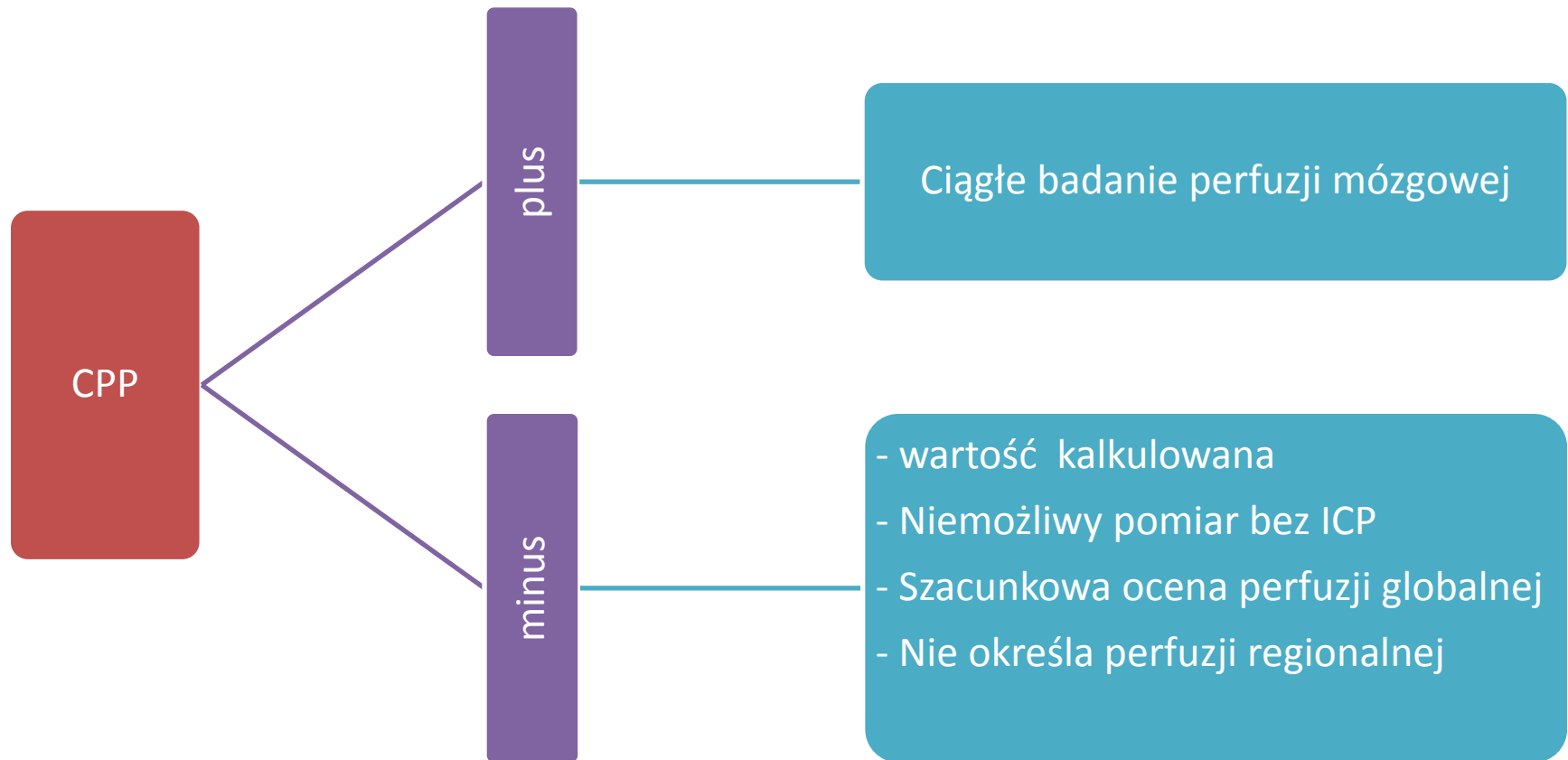
Mózgowe ciśnienie perfuzyjne

$$CPP = MAP - ICP$$

$CPP < 70\text{mmHg}$ – zły
czynnik prognostyczny



Mózgowe ciśnienie perfuzyjne

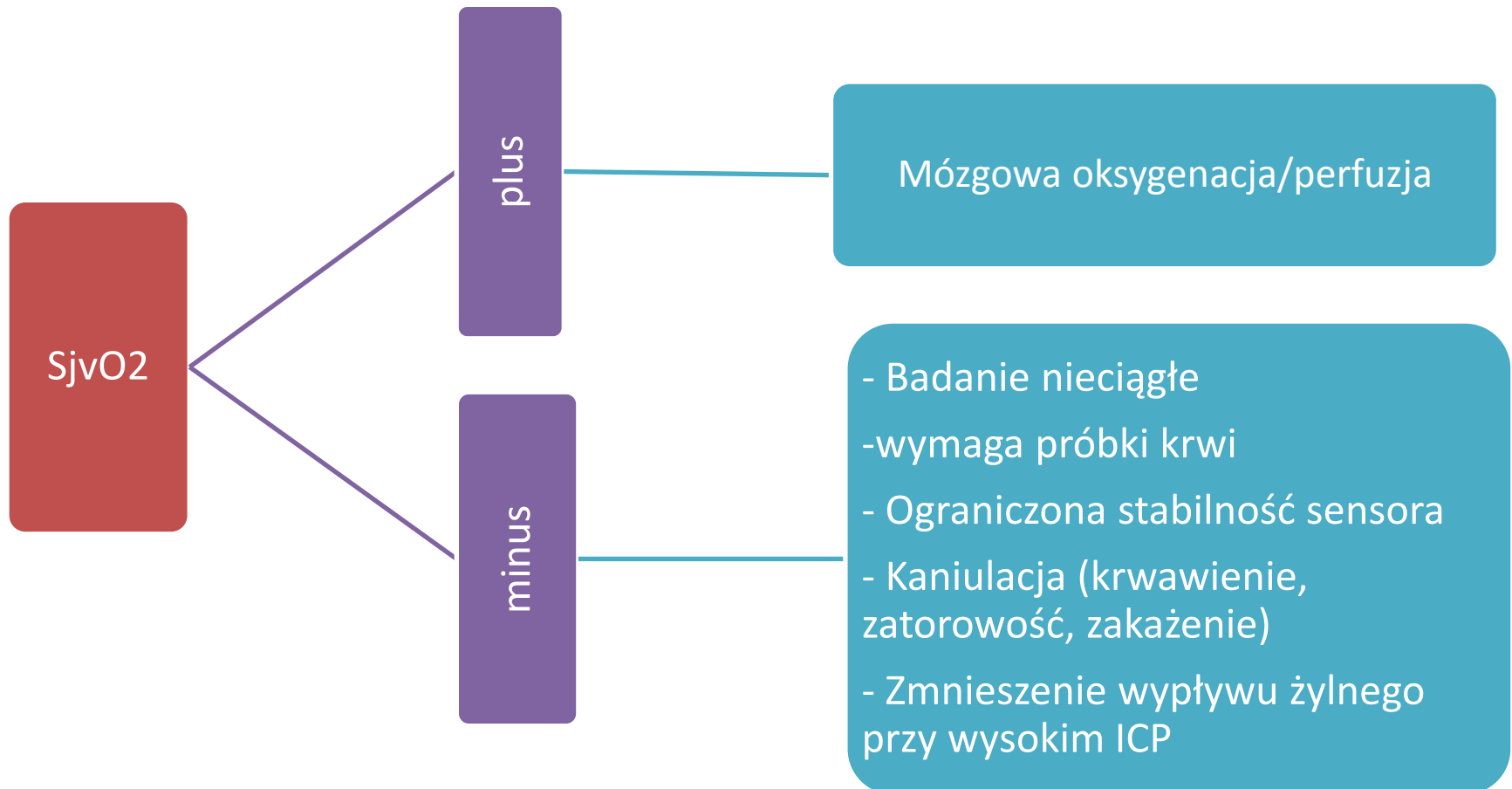


Saturacja opuszki żyły szyjnej wewnętrznej



- $SjO_2 < 55 \%$
potencjalne zagrożenie niedokrwieniem
- $SjO_2 < 40 \%$
niebezpieczeństwo głębokiego niedokrwienia

Saturacja opuszki żyły szyjnej wewnętrznej

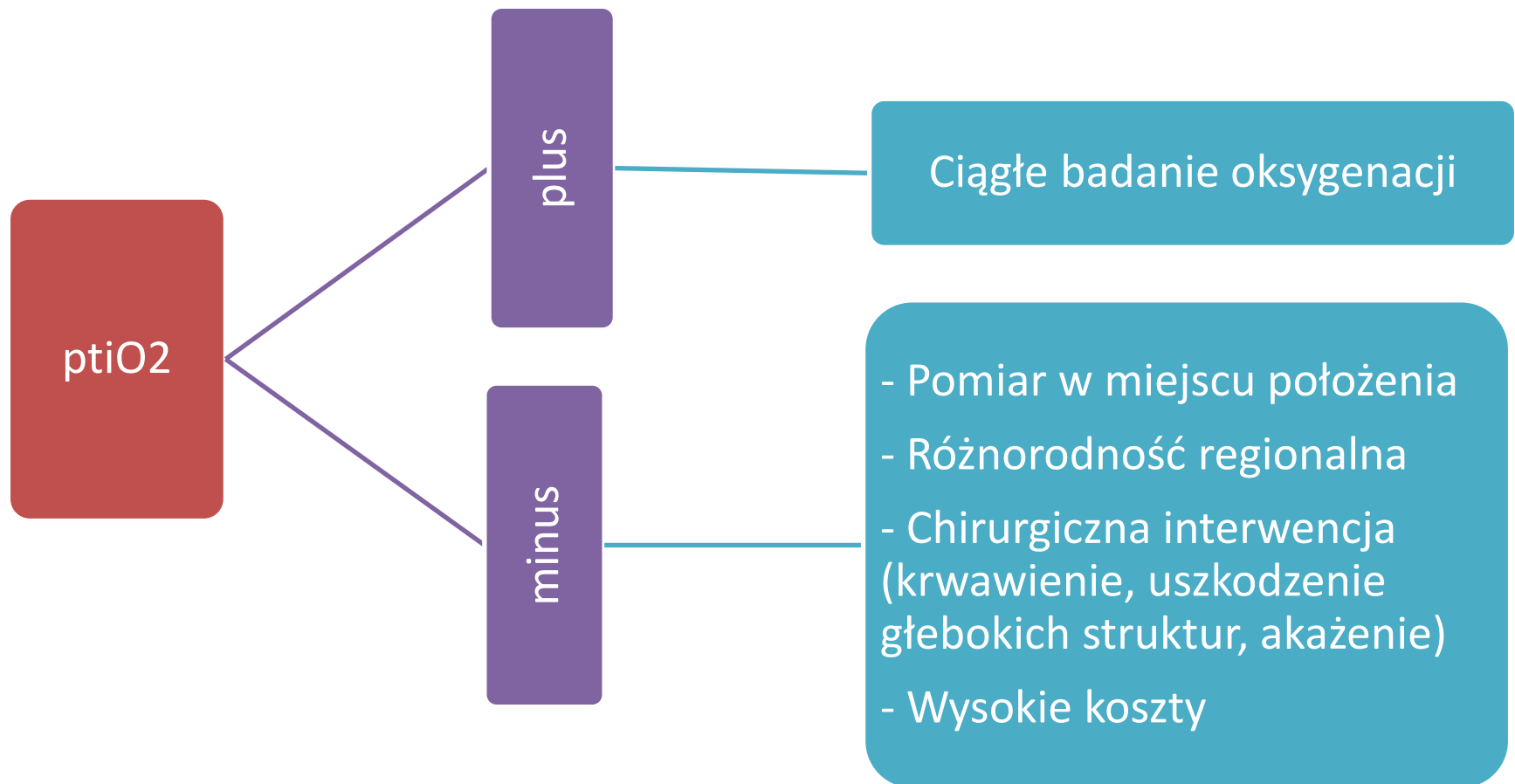


Ciśnienie parcjalne tlenu w mózgu

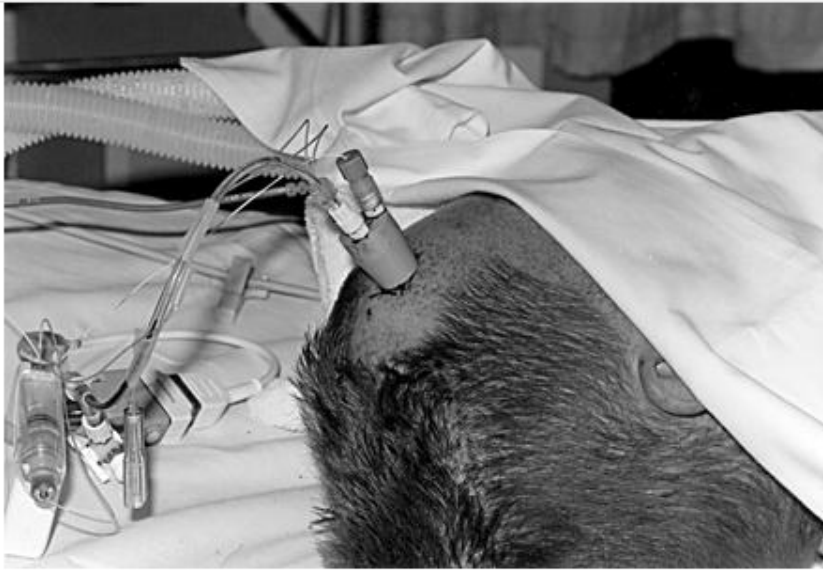


- $\text{ptiO}_2 < 10\text{mmHg}$ dłużej niż 15 minut wiąże się ze wzrostem śmiertelności
- Najlepiej w korelacji z SjvO_2

Ciśnienie parcjalne tlenu w mózgu

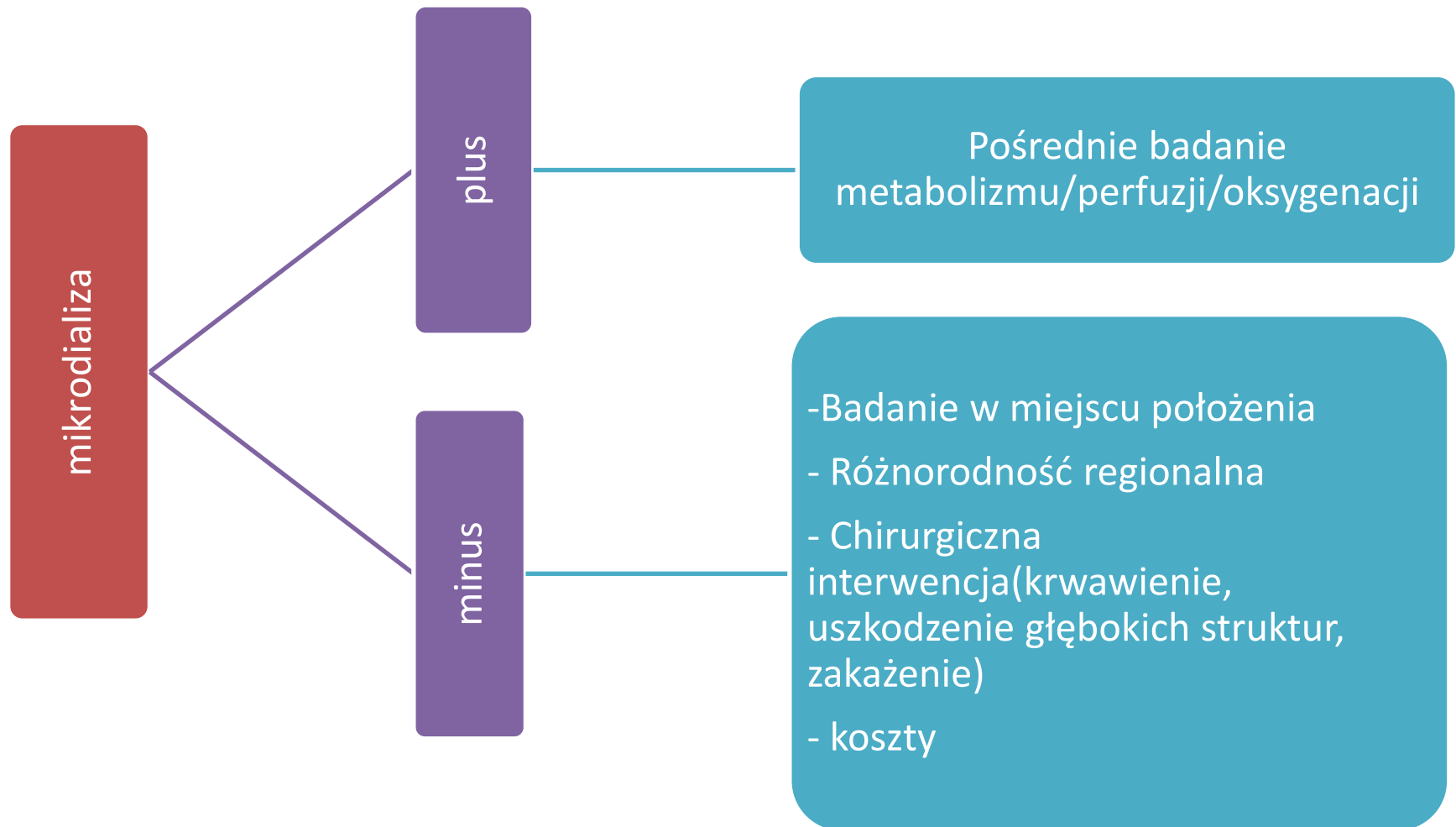


Mikrodializa



- *dialysis* (rozdzielać)
- monitoruje skład płynu w przestrzeni pozakomórkowej
- porównanie stężeń z sondy w obszarze nieuszkodzonej tkanki i z drugiej sondy w prenumbrze

Mikrodializa



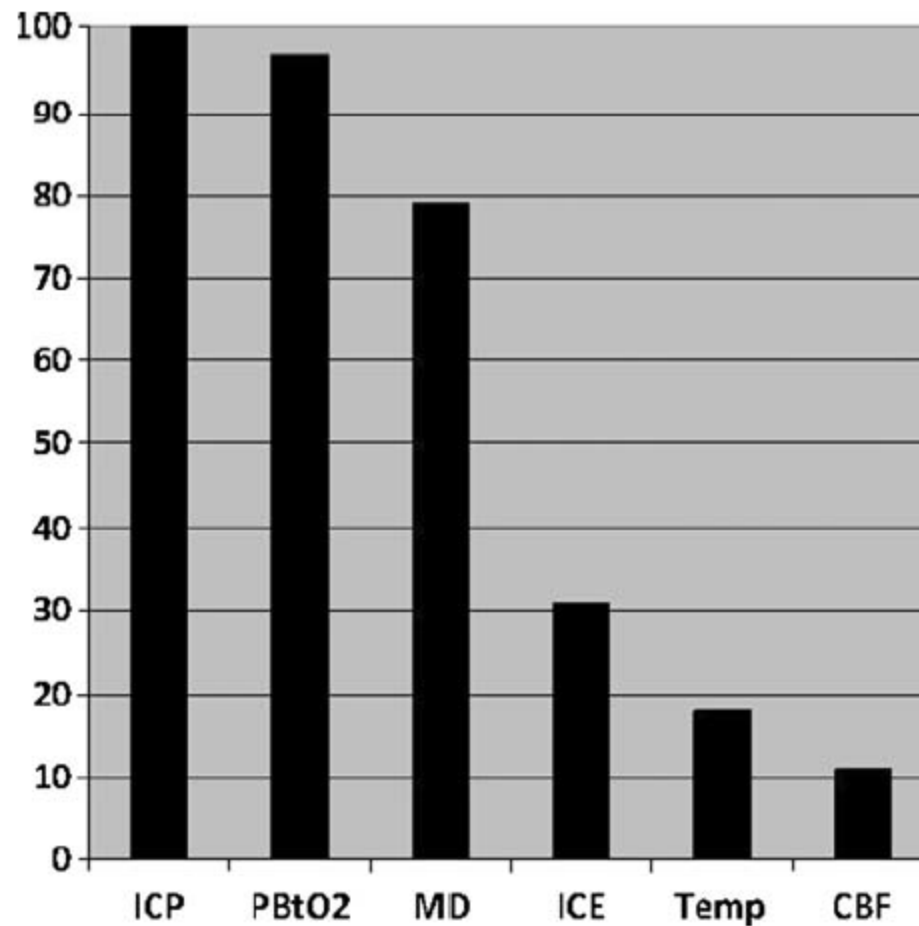


Fig. 2 Frequency of individual modalities monitored. Data are given as *N*% (*N* = 61). *ICP* intracranial pressure, *PbtO₂* brain oxygenation, *Temp* brain temperature, *MD* microdialysis, *CBF* cerebral blood flow, *ICE* intracortical electroencephalography

European Journal of Public Health, Vol. 18, No. 6, 575–580

© The Author 2008. Published by Oxford University Press on behalf of the European Public Health Association. All rights reserved.
doi:10.1093/eurpub/ckn079 Advance Access published on 15 September 2008

Epidemiology, treatment and outcome of patients after severe traumatic brain injury in European regions with different economic status*

Walter Mauritz^{1,2}, Ingrid Wilbacher², Marek Majdan³, Johannes Leitgeb⁴,
Ivan Janciak², Alexandra Brazinova^{2,3}, Martin Rusnak^{2,3}

European Journal of Public Health, Vol. 18, No. 6, 575–580

Table 2 Prehospital and hospital treatment

Economy	HI	<i>n</i>	UMI	<i>n</i>	LMI	<i>n</i>	<i>P</i> -value
Prehospital treatment							
Intubation (%)	82 (78–86)	334	35 (30–40)	118	52 (47–56)	221	<0.0001
Other airway (%)	0	0	23 (18–27)	76	18 (14–22)	76	<0.0001
No airway (%)	18 (14–22)	72	42 (37–48)	143	31 (27–35)	132	<0.0001
IV infusion (%)	92 (89–94)	374	76 (71–81)	257	90 (87–93)	387	<0.0001
IV volume (ml; mean/pt)	963 (911.1–1014.9)	382	907 (774.8–1039.2)	308	1504 (1393.6–1614.4)	406	<0.0001
EM physician attending (%)	97 (94–98)	393	91 (87–93)	305	51 (46–56)	219	<0.0001
Transport by helicopter (%)	38 (33–43)	154	7 (5–10)	24	1 (0–2)	3	<0.0001
Hospital treatment							
Secondary transfer (%)	16 (12–19)	63	40 (36–46)	136	45 (41–50)	194	<0.0001
CT scans (mean/pt)	3.5 (3.3–3.8)	395	2.6 (2.5–2.7)	289	1.5 (1.4–1.6)	402	<0.0001
Immediate neurosurgery (%)	69 (64–73)	278	67 (62–72)	225	45 (40–50)	192	<0.0001
Steroids used (%)	4 (3–7)	17	6 (4–9)	19	64 (60–69)	276	<0.0001
Days of sedation (mean/pt)	10 (8.9–10.7)	378	6.9 (6.1–7.7)	274	5.1 (4.4–5.6)	355	<0.0001
Days of ventilation (mean/pt)	12.0 (11–13)	398	6.1 (5.6–6.6)	290	5.5 (4.8–6.2)	378	<0.0001
ICU days (mean/pt)	17.6 (15.9–19.3)	400	8.6 (7.8–9.4)	294	8.1 (6.6–9.6)	371	<0.0001
ICP monitoring (%)	61 (56–66)	248	54 (49–60)	183	2 (1–4)	10	<0.0001
Quality scores							
Prehospital	6.16 (5.83–6.62)	392	0.98 (0.73–1.87)	297	1.66 (1.21–2.11)	361	<0.0001
Hospital	10.21 (9.54–10.67)	392	8.9 (8.11–9.68)	297	–2.21 (–2.93 to –1.51)	361	<0.0001
System	6.0 (6–6)	392	3.11 (3.07–3.15)	297	1.84 (1.7–1.98)	361	<0.0001

Data are presented as mean values or percentages (95% CI in parenthesis)

HI = high income; UMI = upper middle income; LMI = lower middle income; EM = Emergency Medicine; ICP = intracranial pressure;

Table 3 Outcomes

Economy	HI	<i>n</i>	UMI	<i>n</i>	LMI	<i>n</i>	<i>P</i> -value
Parameters							
ICU mortality (%)	31 (26–35)	124	38 (33–44)	129	46 (41–51)	197	<0.0001
Lung infection (%)	8 (6–11)	32	23 (18–27)	76	14 (11–17)	59	<0.0001
Sepsis (%)	4 (2–6)	14	17 (13–21)	56	8 (6–11)	33	<0.0001
GCS at ICU discharge	10.7 (10.2–11.2)	290	9.1 (8.5–9.7)	224	9.6 (9–10.2)	348	<0.001
90-day mortality (%)	42 (37–47)	170	48 (43–54)	162	55 (50–59)	234	<0.01
Favourable outcome (%)	34 (29–39)	138	28 (23–33)	93	34 (30–39)	146	NS

Data are presented as mean values or percentages (95% confidence intervals in parenthesis)

HI=high income; UMI=upper middle income; LMI=lower middle income; NS=not significant

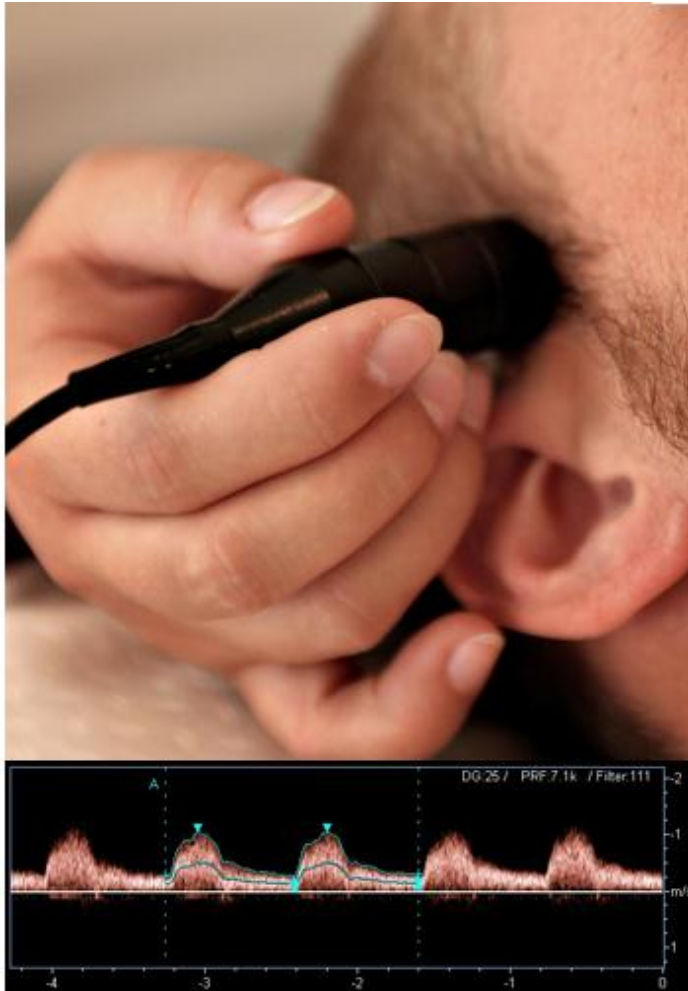
Emerg Med J 2009;26:769–772.

Table 2 Survey of organisation of head injury management at 160 Nordic hospitals in 2003

	Denmark (n = 35)	Finland (n = 15)	Norway (n = 51)	Sweden (n = 59)	Total (n = 160)	p Value
Hospitals admitting TBI patients	30 (86%)	15 (100%)	48 (94%)	57 (97%)	150 (93%)	0.188
Protocol for trauma management	31 (89%)	12 (80%)	37 (72%)	54 (92%)	134 (84%)	0.043
Practical training in trauma management	24 (67%)	11 (73%)	37 (73%)	52 (88%)	124 (78%)	0.075
Protocol for TBI management	24 (69%)	13 (87%)	31 (61%)	39 (66%)	107 (67%)	0.311
24-h endotracheal intubation available	34 (97%)	15 (100%)	47 (92%)	59 (100%)	155 (97%)	0.109
24-h CT scanning available	27 (77%)	15 (100%)	48 (94%)	59 (100%)	149 (93%)	<0.001
Teleradiological image transfer to neurosurgical department possible	13 (37%)	11 (73%)	26 (51%)	44 (75%)	94 (59%)	<0.001

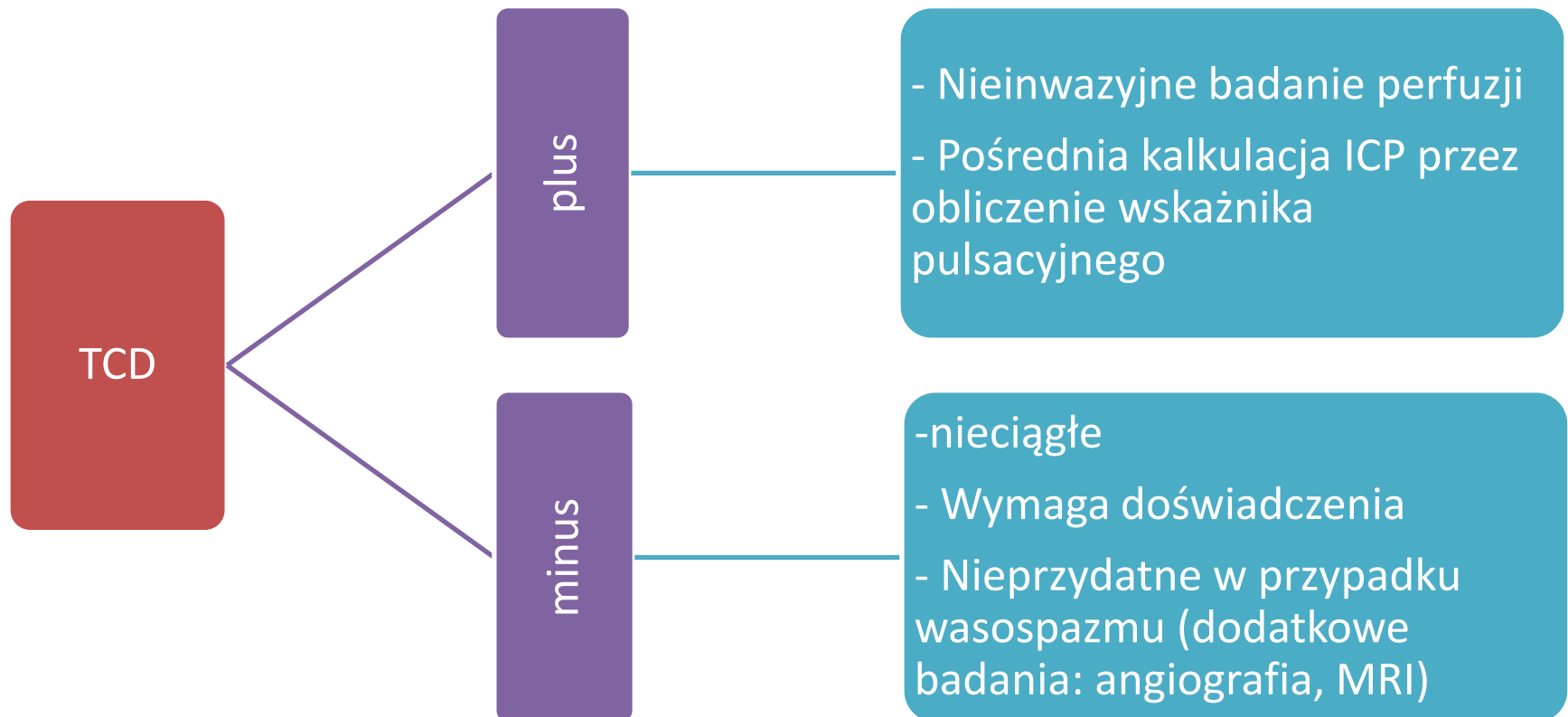
Data are numbers of hospitals. CT, computed tomography; TBI, traumatic brain injury.

Przezczaszkowa ultrasonografia dopplerowska



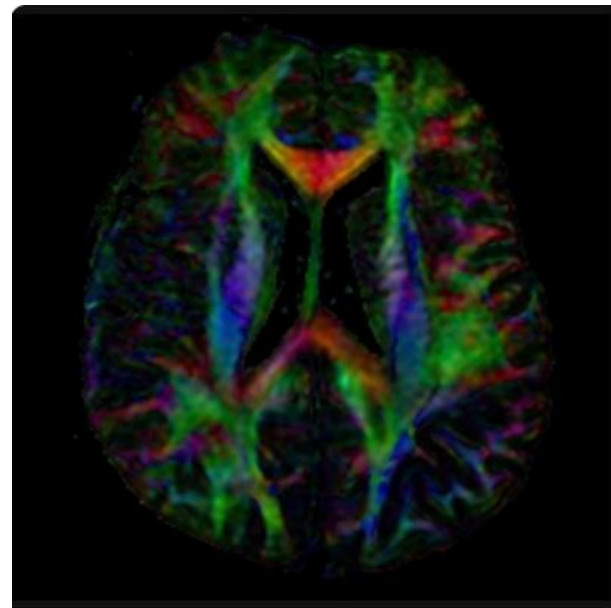
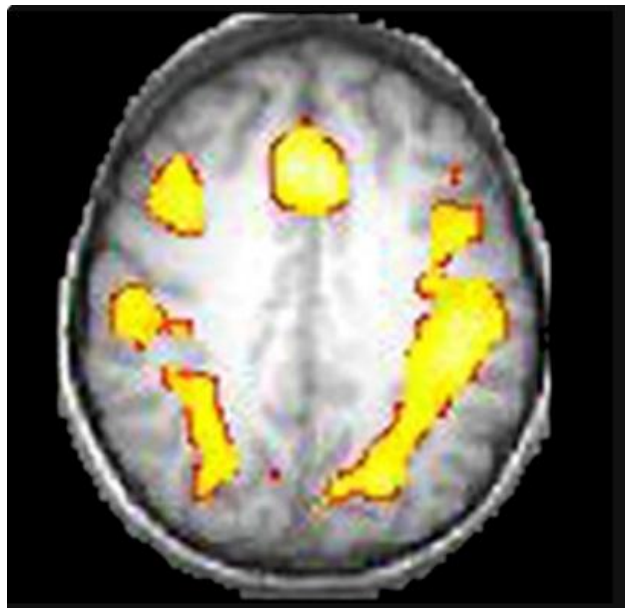
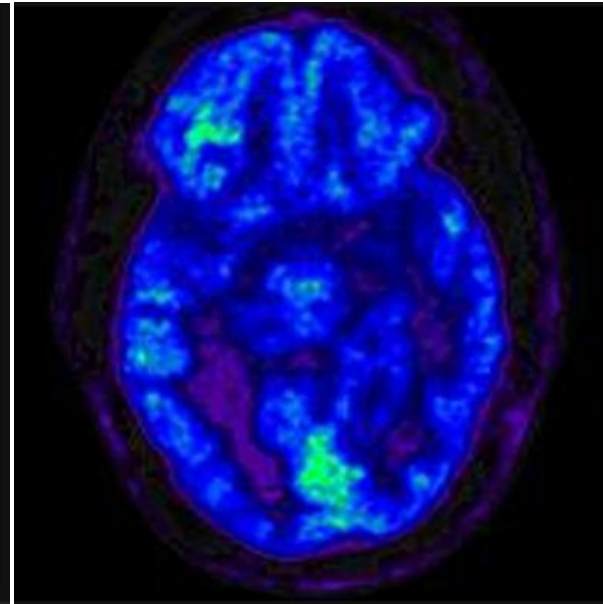
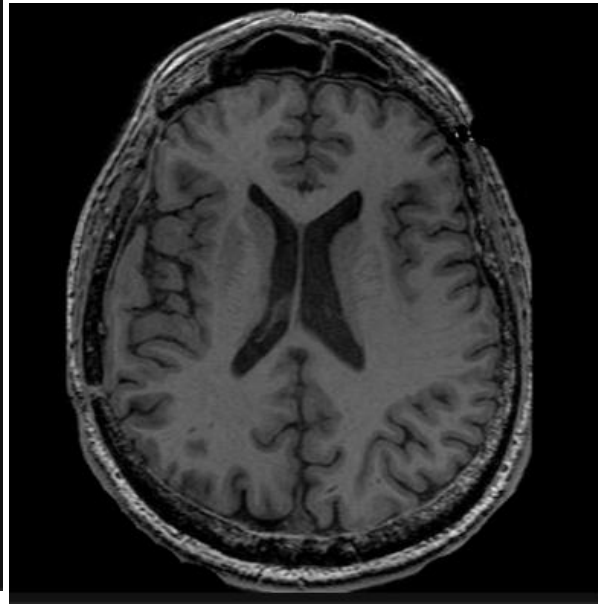
- Zmiany wskaźnika pulsacyjnego i średniej prędkości przepływu krwi korelują z ICP: rośnie ICP rośnie PI i spada BFV
- pressure reactivity index: $PRx > 0,3 = ICP > 20\text{mmHg}$

Transcranial doppler



Nieinwazyjny pomiar ciśnienia wewnątrzczaszkowego



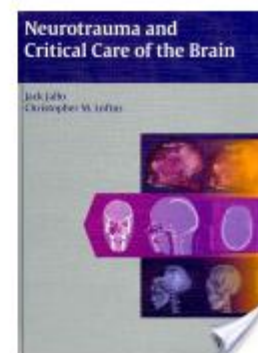
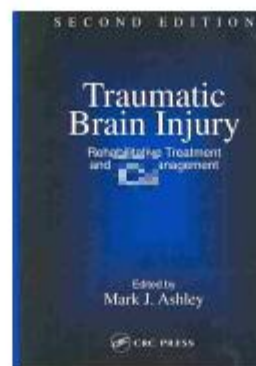
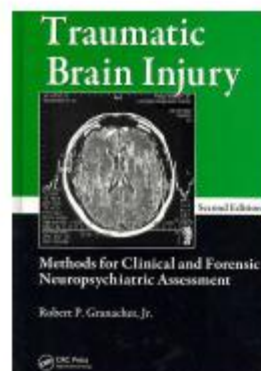
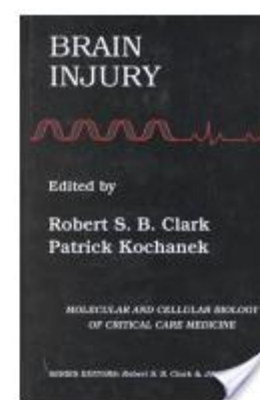
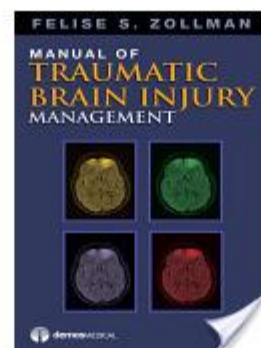
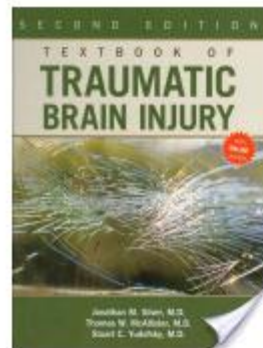




Dashboard | My settings | My library | Applications |

traumatic brain injury

Books	(19)
Conferences	(494)
Full text articles	(667)
Theses & Dissertations	(5)



**Prehospital Severe TBI Guidelines**

Guidelines for Prehospital Management of Severe Traumatic Brain Injury, 2nd Edition

[Download PDF](#)

**Inhospital Severe TBI Guidelines**

Guidelines for the Management of Severe Traumatic Brain Injury, 3rd Edition

[Download PDF](#)

**Surgical Management of TBI**

Guidelines for the Surgical Management of Traumatic Brain Injury

[Download PDF](#)

**Pediatric Severe TBI Guidelines**

Guidelines for the Acute Medical Management of Severe Traumatic Brain Injury in Infants, Children, and Adolescents

[Download PDF](#)

**Combat-Related Head Trauma Guidelines**

Guidelines for the Field Management of Combat Related Head Trauma

[Download PDF](#)

Methods

- I Blood Pressure and Oxygenation
- II Hyperosmolar Therapy
- III Prophylactic Hypothermia
- IV Infection Prophylaxis
- V Deep Vein Thrombosis Prophylaxis
- VI Indications for Intracranial Pressure Monitoring
- VII Intracranial Pressure Monitoring Technology
- VIII Intracranial Pressure Thresholds
- IX Cerebral Perfusion Thresholds
- X Brain Oxygen Monitoring and Thresholds
- XI Anesthetics, Analgesics, and Sedatives
- XII Nutrition
- XIII Antiseizure Prophylaxis
- XIV Hyperventilation
- XV Steroids

Rekomendacje:

Level I – standard

Level II – wytyczne

Level III - opcja

Recommendations***A. Level I***

There are insufficient data to support a Level I recommendation for this topic.

A. Level I

The use of steroids is not recommended for improving outcome or reducing intracranial pressure (ICP). In patients with moderate or severe traumatic brain injury (TBI), high-dose methylprednisolone is associated with increased mortality and is contraindicated.



TBI Click and Learn™

[Guidelines](#) [TBITrac](#) [Comment](#) [Help](#)

TBI Click and Learn™ is an online interactive *severe TBI* guidelines compliance reporting tool. Your treatment data will be measured against BTF's Traumatic Brain Injury Guidelines. Click and Learn can then generate a detailed compliance report. BTF also provides an advanced online compliance tracking tool, **TBI-trac™**. [Learn more.](#)



Click

Reset

Exam

• Patient Identifier (Optional)		
• Treatment Date (Optional)		
• Days after TBI		
• Patient age		
• Patient Weight Units		
• Patient weight		
• CT scan normal?	☐ Yes ☐ No	
• GCS Motor		
• GCS Eyes		
• GCS Total (calculated using GCS Verbal=1)		

Blood Pressure

• Systolic blood pressure ≥ 90 mmHg?	☐ Yes ☐ No	
• Mean arterial blood pressure		
• PaO ₂ ≥ 60 mmHg or O ₂ saturation $\geq 90\%$	☐ Yes ☐ No	

ICP

• ICP monitor inserted?	☐ Yes ☐ No	
-------------------------	--	--



Learn

Compliance Score: 0/0

Off

- ☐ ICP Monitoring
- ☐ ICP Treatment
- ☐ ICP Monitoring Technology
- ☐ CPP Maintenance
- ☐ SBP and Oxygenation Maintenance
- ☐ Steroids Administration
- ☐ Antiseizure Prophylaxis
- ☐ Nutrition
- ☐ Antibiotic Prophylaxis
- ☐ Brain Oxygen Monitoring
- ☐ DVT Prophylaxis
- ☐ Hyperventilation
- ☐ Hypothermia

Compliance Report

• Patient weight		
• CT scan normal?	☐ Yes ☐ No	
• GCS Motor		
• GCS Eyes		
• GCS Total (calculated using GCS Verbal=1)		

Blood Pressure

- Systolic blood pressure ≥ 90 mmHg?
- Mean arterial blood pressure
- PaO₂ ≥ 60 mmHg or O₂ saturation $\geq 90\%$

ICP

- ICP monitor inserted?

Other

- Intubated?
- PaCO₂ value
- Steroid administration for brain injury?
- Calories/day administered:
- Calories per kg per day (calculated as kcal/kg)
- Brain Oxygen Monitoring?
- Use of (1) Graduated compression stockings or (2) int stockings or (3) Low molecular weight heparin (LMWH)
- Prophylactic Hypothermia $\leq 35^\circ\text{C}$?

Infection Prophylaxis

Recommendations

Overview
Process
Scientific Foundation
Summary

A. Level I

There are insufficient data to support a Level I recommendation for this topic.

B. Level II

Periprocedural antibiotics for intubation should be administered to reduce the incidence of pneumonia. However, it does not change length of stay or mortality.

Early tracheostomy should be performed to reduce mechanical ventilation days. However, it does not alter mortality or the rate of nosocomial pneumonia.

C. Level III

Routine ventricular catheter exchange or prophylactic antibiotic use for ventricular catheter placement is not recommended to reduce infection.

Early extubation in selected patients can be done without increased risk.

Excerpted from Guidelines for the Management of Severe Traumatic Brain Injury, 3rd

- Age over 40 years
- Abnormal motor posturing
- Hypotension as defined by age

[Guidelines...](#)

ICP Treatment

Compliance:

- When ICP is elevated (≥ 20), enact any of the following treatments...

[Guidelines...](#)

- Mannitol administered at $\geq 0.25\text{gm/kg}$ and $\leq 1\text{gm/kg}$

[Guidelines...](#)

- Highdose barbiturates or propofol administered

[Guidelines...](#)

- Hyperventilation while maintaining average PaCO₂ between 26-35 mmHg

[Guidelines...](#)

ICP Monitoring Technology

CPP Maintenance

SBP and Oxygenation Maintenance

Steroids Administration

Antiseizure Prophylaxis

Nutrition

Antibiotic Prophylaxis

Compliance:

- Periprocedural antibiotics for intubation should be administered to reduce the incidence of pneumonia
- Periprocedural antibiotics for ventricular ICP Monitor should be administered to reduce the incidence of infection

[Guidelines...](#)

Brain Oxygen Monitoring

DVT Prophylaxis

Compliance Evaluation tbiclickandlearn.org

• Ventricular catheter is recommended ICP monitoring method in terms of accuracy and reliability.

• ICP monitor inserted? No

CPP Maintenance N/A

Compliance:

• For patients with an ICP monitor, every day monitor is present: CPP between 50-70mmHg (age-based)

Your Responses:

• Patient age 44

• Mean arterial blood pressure 45

• ICP monitor inserted? No

SBP and Oxygenation Maintenance Non-Compliant

Compliance:

X Maintenance of SBP every day: SBP ≥ 90 mmHg (age-based)

X Maintenance of oxygen levels every day

Your Responses:

• Systolic blood pressure ≥ 90 mmHg? No

• PaO2 ≥ 60 mmHg or O2 saturation ≥ 90% No

Steroids Administration Non-Compliant

Compliance:

X No steroid administration for brain injury on any day

Your Responses:

• Steroid administration for brain injury? Yes

Antiseizure Prophylaxis N/A

Compliance:

• Anticonvulsants discontinued by day 8 if the patient is seizure-free during the first 7 days"

Your Responses:

• Days after TBI 3

Nutrition Non-Compliant

Compliance:

X Patients receive suggested caloric intake (>25 kcal/kg/day) on any day by day 7 in the ICU

Your Responses:

• Patient Weight Units kg

• Patient weight 98

• Calories/day administered: 1000

• Calories per kg per day (calculated as kcal/kg) 10.2



Learn

Compliance Score: 0/5



- X ICP Monitoring
- ⊖ ICP Treatment
- ⊖ ICP Monitoring Technology
- ⊖ CPP Maintenance
- X SBP and Oxygenation Maintenance
- X Steroids Administration
- ⊖ Antiseizure Prophylaxis
- X Nutrition
- ⊖ Antibiotic Prophylaxis
- ⊖ Brain Oxygen Monitoring
- X DVT Prophylaxis
- ⊖ Hyperventilation
- ⊖ Hypothermia

Compliance Report

