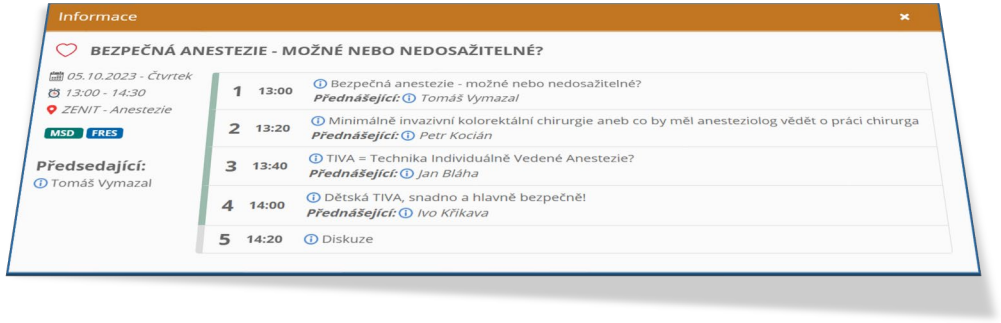
TIVA

= Technika Individuálně Vedené Anestezie ?



JAN BLÁHA

KLINIKA ANESTEZIOLOGIE, RESUSCITACE A INTENZIVNÍ MEDICÍNY

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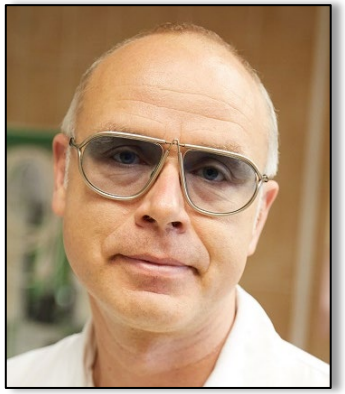

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U nás TIVA nemá tradici,
používají výjimečně jednotlivci…

…takže já zase půjdu :)

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Název: TIVA/TCI - jak to dobře nastavit (než odejdete na kávu)

PARTNER WORKSHOPU: B BRAUN SHARING EXPERTISE

LEKTOŘI:	Michal Lipš, Tereza Bartošová
POČET ÚČASTNÍKŮ:	20 na každé opakování
ČAS:	8:30-9:30; 9:45-10:45; 11:00-12:00
SÁL:	AQUARIUS
URČENO PRO:	LEK
REGISTRACE:	ZDE

POPIS:

- praktický WS o možnostech a technice cíleně řízené infuze (Target Controlled Infusion - TCI) podávání anestetik v anestezii u dospělých pacientů.

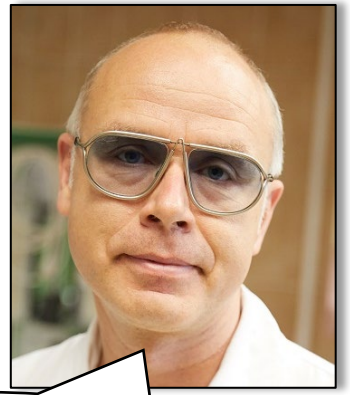
PROGRAM:

1. Proč TIVA/TCI
2. MythBusters! Čeho se není třeba bát...
3. Farmakokinetické modely v 5 minutách
4. Tipy a triky jak na to
5. Praktické ukázky na modelových situacích

VÝSTUPY Z UČENÍ:

- čistě praktický workshop vás naučí jak s technikou TIVA/TCI bezpečně a úspěšně začít

nevím výhoda, ale jednoznačná indikace jsou MEPs a maligní hypertermie



PONV, potenciálně při vyšším ICP; monitorace evokovaných potenciálů

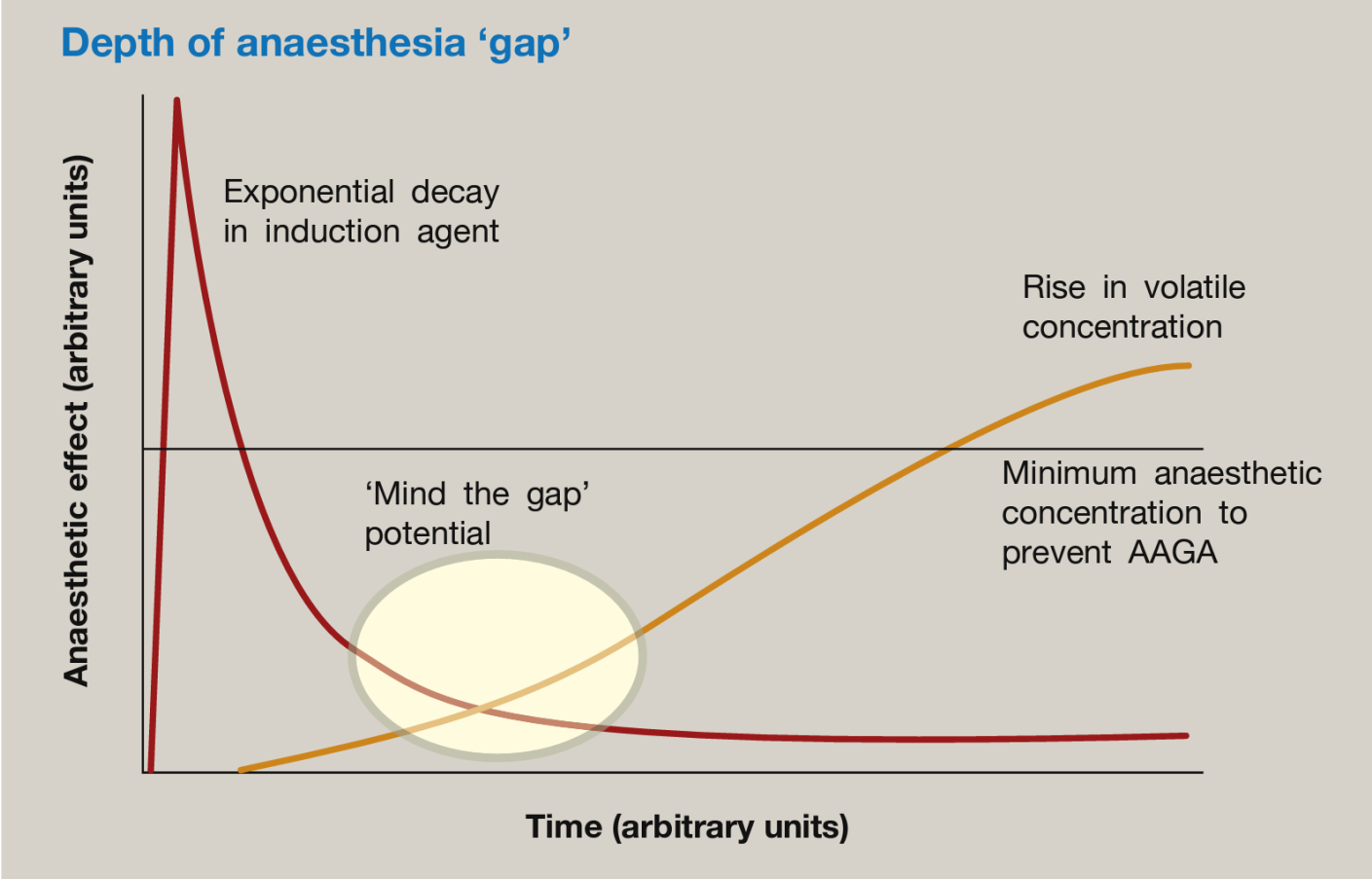
alternativa pro inhalační anestezii, tam, kde ji nelze použít (a zároveň není možná RA) - tohle je asi největší

prevence PONV ! Zažila jsem a nikomu to nepřeju.

a jednoduchost - že neměním druhy anestetik k úvodu a k udržování, a nemusím se bát špatného překryvu bolusu propofolu a nastoupání sevofluranu

hladké buzení (méně kognitivních dysfcí) PONV … ostatní jsou nepodstatné

V čem je hlavní výhoda TIVA/TCI?



Dean Ch. Royal College of Anaesthetists CPDMatrix:1A02,1E06,2A03

u PONV
a jako alternativa

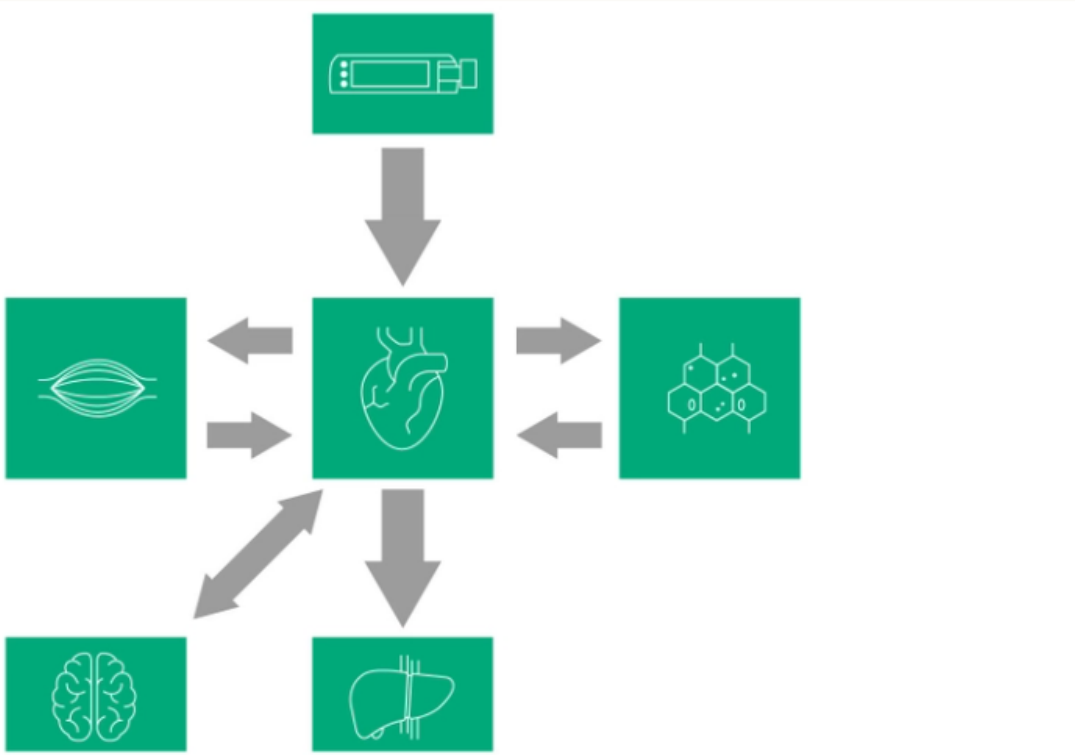
že se pokračuje stej[illegible] anestetikem jako k úvodu, a není špatný překryv bolusu propofolu a nastoupání sevofluranu

V čem je hlavní výhoda TIVA/TCI?

Advantages of TIVA/TCI

Compared generally to traditional volatile anesthetic techniques,TIVA/TCI offer several potential advantages. These include:

- Greater hemodynamic stability[2],
- Reduced incidence of post-operative nausea and vomiting[3],
- Better recovery[4],
- Less bradycardia and shorter hypotensive episodes[5] and
- Better intubation conditions[5].



Lepší hemodynamické stabilita
Nižší PONV
Lepší zotavení
Méně bradykardie a kratší hypotenzní epizody
Lepší intubační podmínky

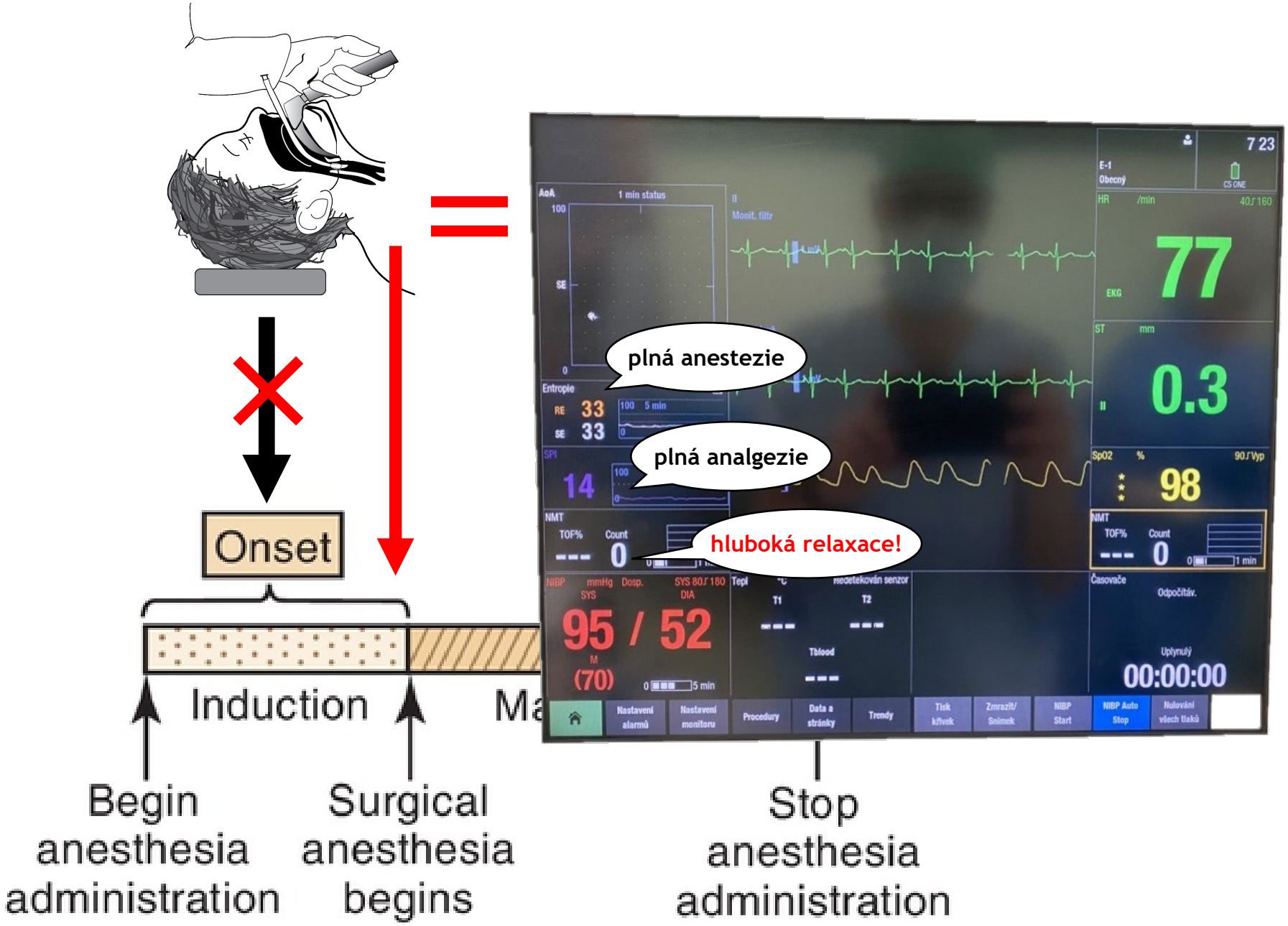

=
plná anestezie
plná analgezie
hluboká relaxace!
Onset
Induction
Begin anesthesia administration
Surgical anesthesia begins
Stop anesthesia administration

TABLE 24-1 COMMON WEIGHT SCALARS

Name	Equations
Ideal body weight	Male: 50 kg + 2.3 kg for each 2.54 cm (1 in) over 152 cm (5 ft) Female: 45.5 kg + 2.3 kg for each 2.54 cm (1 in) over 152 cm (5 ft)
Lean body mass	Male: $1.1 \times TBW - 128 \times (TBW \div Ht)^2$ Female: $1.07 \times TBW - 148 \times (TBW \div Ht)^2$
Fat free mass[35]	Male: $(9.27 \times 10^3 \times TBW) \div (6.68 \times 10^3 + 216 \times BMI)$ Female: $(9.27 \times 10^3 \times TBW) \div (8.78 \times 10^3 + 244 \times BMI)$
Pharmacokinetic mass[36,37]	$52 \div [1 + (196.4 \times e^{-0.025\ TBW} - 53.66) \div 100]$ (fentanyl only)
Corrected body weight[38,39]	IBW + 0.4* (IBW – FFM)

BMI, Body mass index; *FFM*, fat-free mass; *Ht*, height in centimeters; *IBW*, ideal body weight; *LBM*, lean body mass; *MFFM*, modified fat-free mass; *TBW*, total body weight in kg.
*The dose/kg using IBW, TBW, or FFM in an obese person are all less than the dose/kg using TBW in a nonobese patient.

TABLE 24-2 DOSING WEIGHTS BASED ON VARIOUS DOSING SCALARS

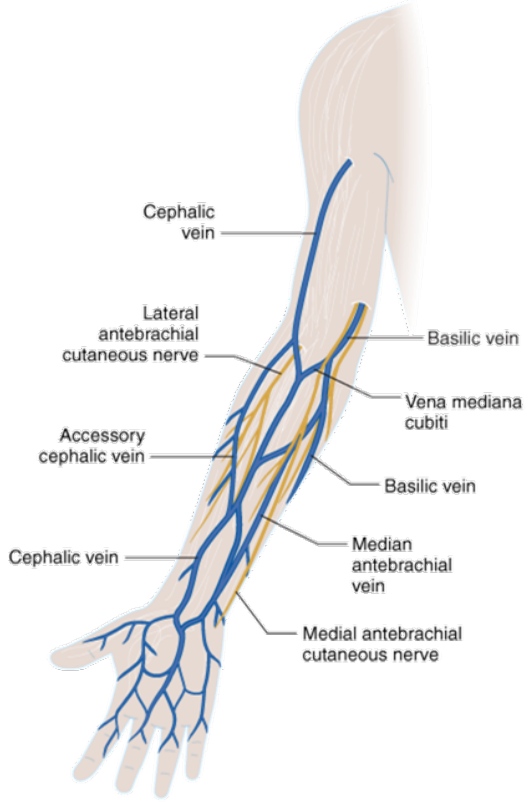
	176-cm (6-ft) Male	
	68 kg (BMI = 22)	185 kg (BMI = 66)
Dosing Scalar	Dosing Weight (kg)	Dosing Weight (kg)
Total body weight (TBW)	68	185
Ideal body weight (IBW)	71	71
Lean body mass (LBM)	55	62
Fat-free mass (FFM)	55	87
Corrrected body weight (CBW)	68	115

MI, Body mass index (kg/m2)

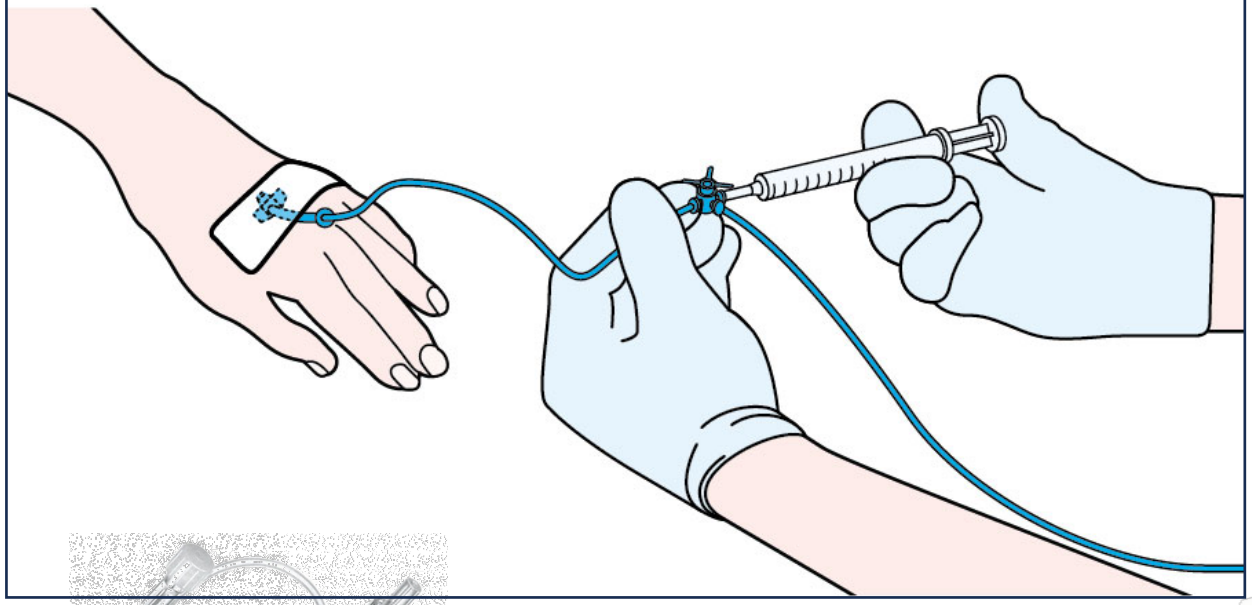
Table 2.1 Utilization of total body weight (TBW), lean body weight (LBW) or ideal body weight (IBW) to calculate dosing schemes in morbidly obese patients

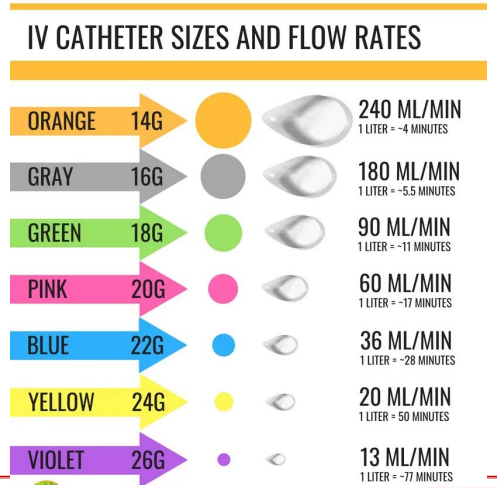
Drug	Recommended dosing	References[a]
Propofol	Induction: IBW Induction: LBW assessed by BIA Maintenance: TBW or IBW + 0.4 excess weight	Kirby. *Anaesthesia* 1987; 42:1125–1126 Ingrande. *Anesth Analg* 2011; 113:57–62 Servin. *Anesthesiology* 1993; 78:657–665 Albertin. *Br J Anaesth* 2007; 98:66–75
Thiopental	7.5 mg/kg IBW TBW	Buckley. *Can J Anaesth* 1994; 41:R94–R100 Jung. *Anesthesiology* 1982; 56:269–274
Midazolam	TBW for initial dose IBW for continuous dose	Greenblatt. *Anesthesiology* 1984; 61:27–35 Reves. *Anesthesiology* 1985; 62:310–324
Vecoronium	IBW	Weinstein. *Anesth Analg* 1988; 67:1149–1153
Cisatracurium	TBW IBW	Kirkegaard-Nielsen. *Anesth Analg* 1996; 83:1076–1080 Leykin. *Anesth Analg* 2004; 99:1090–1094
Rocuronium	IBW	Leykin. *Anesth Analg* 2004; 99:1086–1089
Succinylcholine	TBW	Bentley. *Anesthesiology* 1982; 57:48–49
Neostigmine	TBW	Kirkegaard-Nielsen. *Can J Anaesth* 1998; 45:39–41
Suggamadex	IBW + 40% excess weight	Van Lancker. *Anaesthesia* 2011; 66:721–725
Alfentanil	IBW or corrected weight TBW	Bentley. *Anesth Analg* 1983; 62:245–262 Salihoglu. *EJA* 2002; 19:125–128 Maitre. *Anesthesiology* 1987; 66:3–12
Fentanyl	TBW Corrected weight = IBW + (0.4x excess weight) pharmacokinetic mass = $52/[1 + (196.4 \times e^{-0.025kg} - 53.66)/100]$	Bentley. *Anesth Analg* 1981; 60:548–551 Salihoglu. *EJA* 2002; 19:125–128 Shibutani. *Anesthesiology* 2004;101: 603–613
Sufentanil	TBW Corrected weight BMI >40	Schwartz. *Anesth Analg* 1991; 73:790–793 Slepchenko. *Anesthesiology* 2003; 98:65–73
Remifentanil	LBM (James equation) LBM (Janmahasatian equation)	Egan. *Anesthesiology* 1998; 89:562–573 La Colla. *Clin Pharmacokinet* 2010; 49:131–139
Morphine	IBW	Choi. *Obes Surg* 2000; 10:154–159
Paracetamol	IBW	Lee. *J Clin Pharmacol* 1981; 21: 284–287

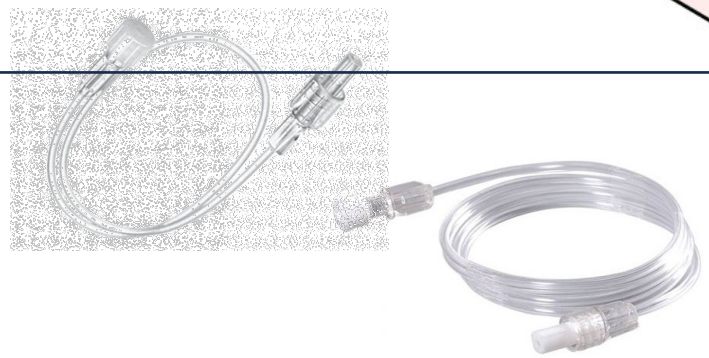
[a] First author, journal abbreviation, year of publication, volume, pages

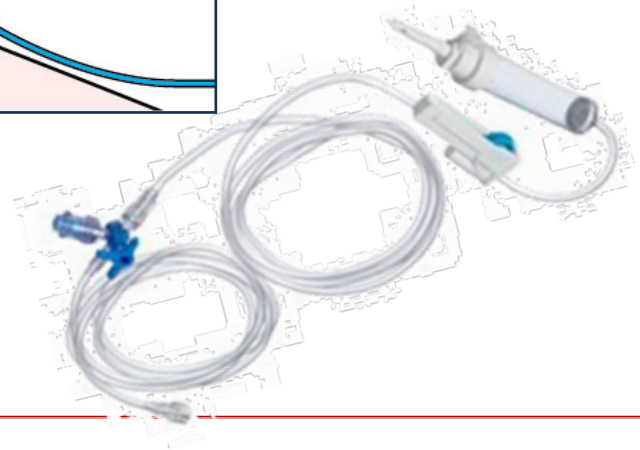


Doba nástupu účinku myorelaxancia záleží ale i na způsobu aplikace !!









Anaesthesia 2020, 75 (Suppl. 1), e90–e100

Influence of propofol-based total intravenous anaesthesia on peri-operative outcome measures: a narrative review

M. G. Irwin,[1] **C. K. E. Chung,**[2] **K. Y. Ip**[2] and **M. D. Wiles**[3]

1 Professor and Head, Department of Anaesthesiology, The University of Hong Kong, Hong Kong Special Administrative Region, China
2 Associate Consultant, Department of Anaesthesiology, Queen Mary Hospital, Hong Kong Special Administrative Region, China
3 Consultant, Department of Anaesthesia, Sheffield Teaching Hospitals NHS Foundation Trust, Sheffield, UK

Summary

Propofol-based total intravenous anaesthesia is well known for its smooth, clear-headed recovery and anti-emetic properties, but there are also many lesser known beneficial properties that can potentially influence surgical outcome. We will discuss the anti-oxidant, anti-inflammatory and immunomodulatory effects of propofol and their roles in pain, organ protection and immunity. We will also discuss the use of propofol in cancer surgery, neurosurgery and older patients.

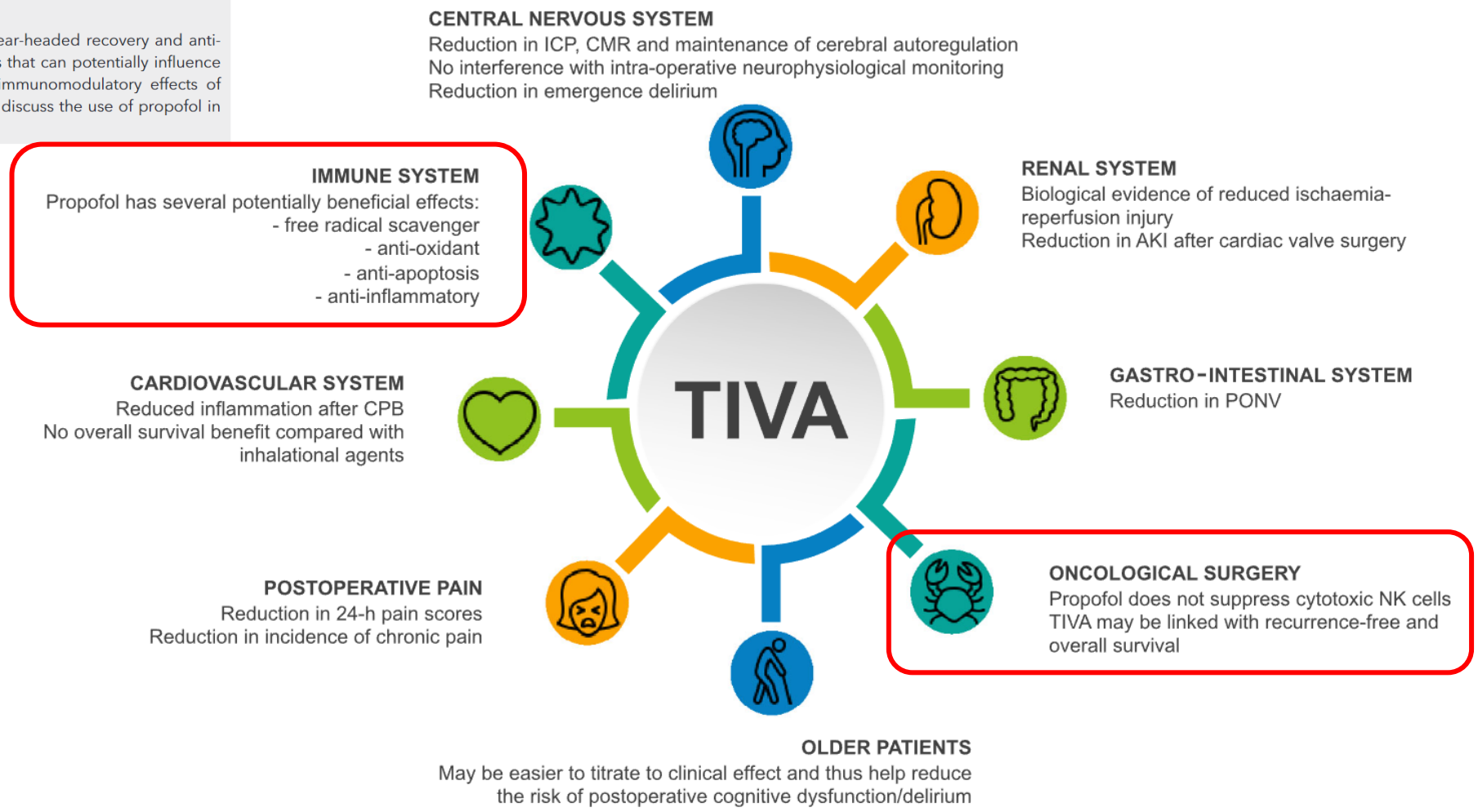


Figure 1 A summary of the potential benefits of propofol-based TIVA. TIVA, total intravenous anaesthesia; ICP, intracranial pressure; CMR, cerebral metabolic rate; AKI, acute kidney injury; CPB, cardiopulmonary bypass; PONV, postoperative nausea and vomiting; NK, natural killer.

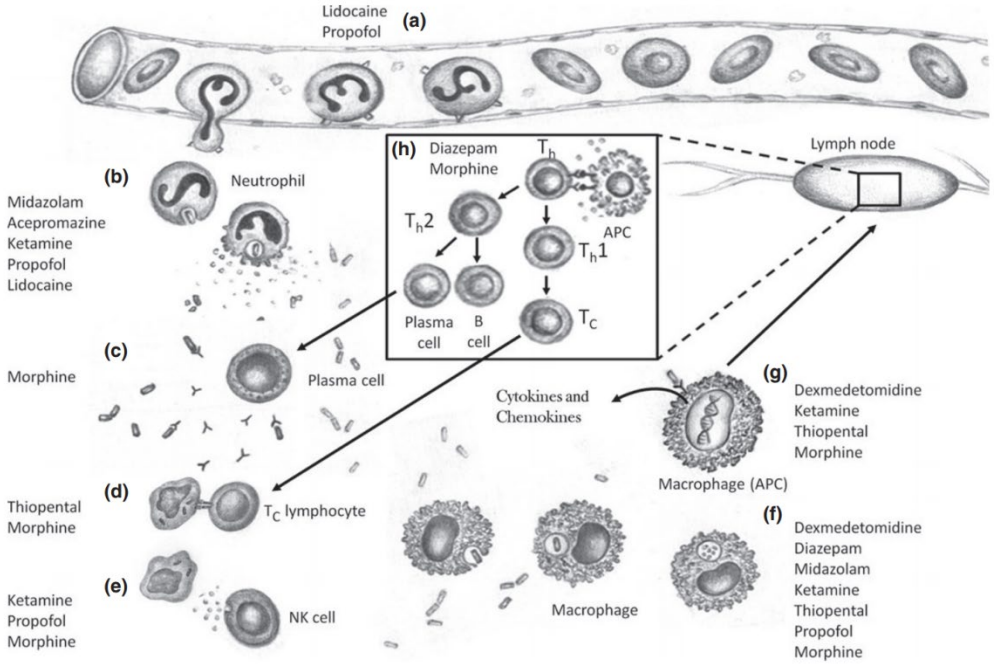


Figure 1 The immunomodulatory effects of injectable anesthetic drugs as described in Table 1 on the immune response to microbial invasion. (a) Extravasation of a neutrophil. Neutrophils roll (mediated by selectins), tether (mediated by E-selectin), and adhere to endothelial cells (mediated by intracellular adhesion molecules, ICAM), then diapedese between endothelial cells (mediated by platelet endothelial cell adhesion molecule, PECAM) out of the blood vessels. (b) Neutrophils phagocytose pathogens and produce reactive oxygen species (ROS). (c) Plasma cells release antibodies to neutralize antigens. (d) Cytotoxic T lymphocytes (T_C) recognize non-self or stress peptides presented by infected or dysfunctional cells, respectively, on their major histocompatibility complex 1 (MHC1) receptors. Once an abnormal cell is recognized, the T_C lymphocyte releases cytotoxins to induce apoptosis, resulting in the cell's death. (e) Natural killer (NK) cells function similarly to T_C lymphocytes, however, they can recognize abnormal cells with or without presentation on the MHC1 receptors. (f) Macrophages phagocytose pathogens and kill them in phagosomes via respiratory burst. (g) Macrophages recognize non-self molecular patterns with pattern recognition receptors leading to activation of intracellular signaling, upregulation of appropriate gene expression (e.g. nuclear factor kappa B (NFκB) pathway), and release of chemokines and cytokines. (h) Antigen presenting cells (APC), such as macrophages, travel through the lymph to a lymph node where they present their antigen to naïve T helper (T_h) cells. A T_h1 response results in the production of cytotoxic T cells (T_C) to generate a cell-mediated response. A T_h2 response results in the production of B cells and plasma cells to generate a humoral or antibody-mediated response.

Table 1. In vitro effects of anaesthetic agents used in general anaesthesia.

Agent	In vitro effects	References
Thiopental	Inhibits bactericidal functions of leukocytes	Krumholz et al[12]
	Inhibits neutrophil functions (chemotaxis, adherence, phagocytosis, respiratory burst)	O'Donnell et al;[13] Skoutelis et al;[14] Hulse et al;[15] Heine et al;[16] Nishina et al;[17] Krumholz et al;[18]
	Inhibits monocyte functions (phagocytosis, respiratory burst)	Heller et al;[19] Davidson et al;[20]
	Inhibits lymphocyte proliferation	Devlin et al;[21] Chanimov et al;[22]
	Reduces CD14 + expression	Rossano et al;[23] Larsen et al;[24] Takaono et al;[25]
	Inhibits IL-1ra release; increases IL-10 release	
	Depresses antigen induced IL-2 release	Correa-Sales et al[26]
	Inhibits transcription factors	Ichiyama et al;[27] Loop et al[29]
	Decreases activity of nitric oxidase synthase	Galley et al[31]
Propofol	Impairs neutrophil function	O'Donnell et al;[13] Skoutelis et al;[14] Galley and Webster[41]
	Inhibits monocyte functions (oxidative burst, phagocytosis)	Jensen et al;[33] Murphy et al;[34] Fröhlich et al[35]
	Inhibits protein kinase effects generated by lipid solvent	Mikawa et al[36]
		Nagata et al[39]
		Cleary and Pickering;[37] Kelbel et al;[38] Ohmizo et al[40]
	Lymphocyte proliferation not impaired	Pirttikangas et al;[43] Salo et al[45]
	Cytokine release not impaired	Larsen et al;[24] Hoff et al[46]
Sufentanil/ alfentanil	Reduces migration of transendothelial leukocytes	Hofbauer et al[64]
	Inhibits lymphocyte proliferation	Sacerdote et al[65]
Fentanyl	No effect on polymorphonuclear cells	Jaeger et al[62]
	No effects on spontaneous and endotoxin-stimulated cytokine response	Larsen et al[24]
	Enhances natural killer cell cytotoxicity	Yeager et al[60]
	Numbers of T- and B- lymphocytes unchanged	Jacobs et al[61]
Volatile anaesthetics	Dose and time-dependent	
	Inhibitory effects on neutrophil functions	Welch;[66] Nakagawara et al;[67] Fröhlich et al[68]
	Depresses lymphocyte proliferation	Ferrero et al;[69] Hamra and Yaksh[70]
	Suppressive effects on cytokine release	Stevenson et al;[71] Mitsuhata et al[72]
	Depresses cytokine in alveolar cells	Giraud et al[73]
	Increases pro-inflammatory cytokines	Kotani et al[74]

IL, interleukin.

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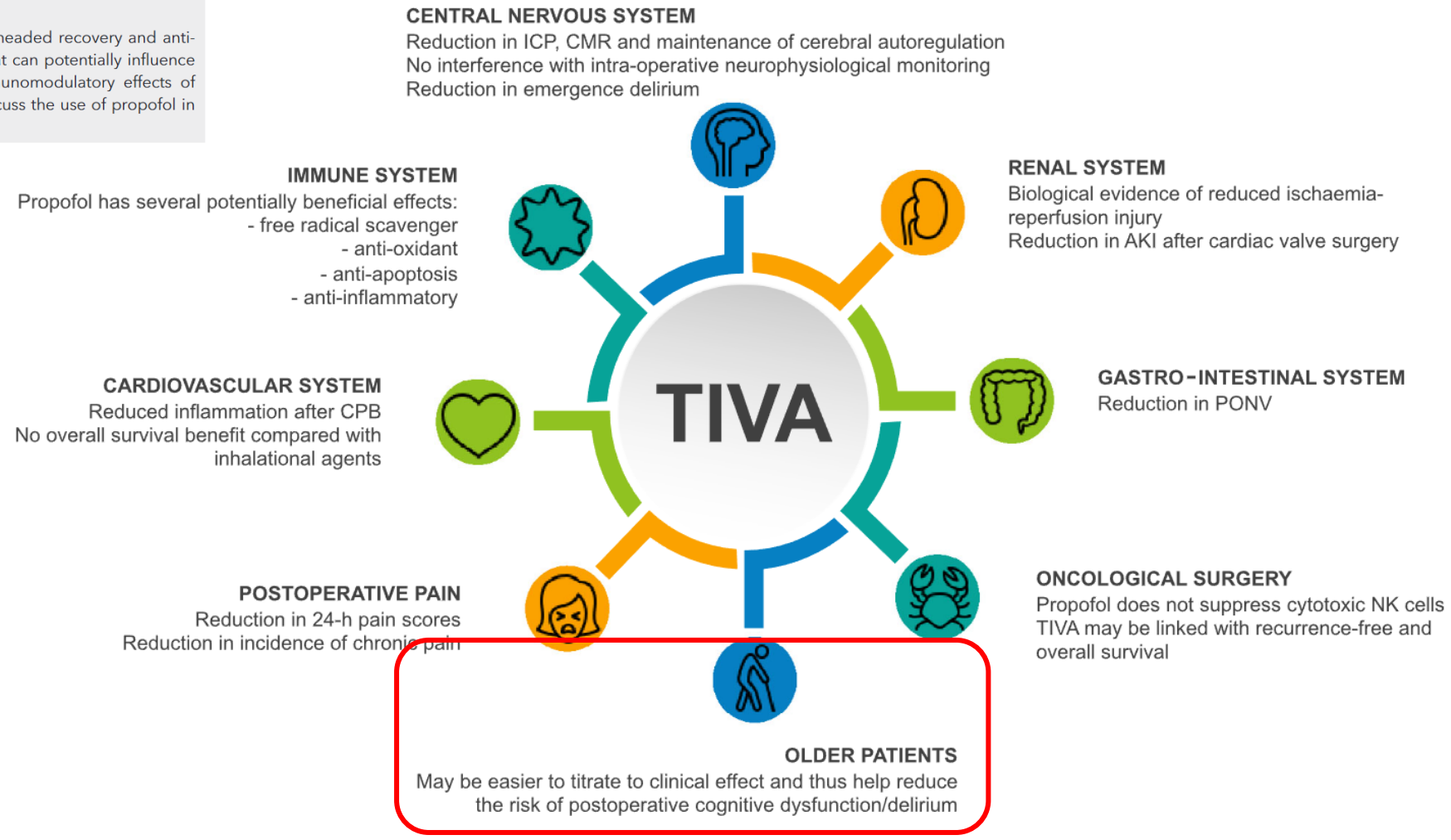


Figure 1 A summary of the potential benefits of propofol-based TIVA. TIVA, total intravenous anaesthesia; ICP, intracranial pressure; CMR, cerebral metabolic rate; AKI, acute kidney injury; CPB, cardiopulmonary bypass; PONV, postoperative nausea and vomiting; NK, natural killer.

Journal of Pharmacokinetics and Pharmacodynamics (2020) 47:145–161

Age progression from vicenarians (20–29 year) to nonagenarians (90–99 year) among a population pharmacokinetic/pharmacodynamic (PopPk-PD) covariate analysis of propofol-bispectral index (BIS) electroencephalography

Ashraf A. Dahaba[1] · Zhaoyang Xiao[2,3] · Peter Rehak[4] · Sieglinde Zelzer[5] · Kun Wang[6] · Gilbert Reibnegger[7]

Background Pharmacokinetic/pharmacodynamic (PK/PD) modeling has made an enormous contribution to intravenous anesthesia. Because of their altered physiological, pharmacological and pathological aspects, titrating general anesthesia in the elderly is a challenging task.

Methods Eighty patients were consecutively enrolled divided by decades from vicenarians (20–29 year) to nonagenarians (90–99 year) into eight groups. Using target controlled infusion (TCI) and electroencephalographic (EEG)-derived bispectral index (BIS) we set propofol plasma concentration (C_p) to gradually reach 3.5 μg mL^{-1} over 3.5-min. In each patient, we constructed a PK/PD model and conducted a population PK/PD (PopPK-PD) covariate analysis.

Results Age was significant covariate for baseline BIS effect (E_0), inhibitory propofol concentration at 50% BIS decline (IC_{50}) and maximum BIS decline (E_{max}). First-order rate constant K_{e0} of 0.47 min^{-1} in vicenarians (20–29 year) gradually increased with age-progression to 1.85 min^{-1} in nonagenarians (90–99 year). Simulation modelling showed that clinically recommended C_p of 3.5 μg mL^{-1} for 20–29 year BIS 50 should be reduced to 3.0 for 30–49 year, 2.5 for 50–69 year and 2.0 for 80–89 year.

Conclusion We quantified and graded EEG-BIS age-progression among different age groups divided by decades. We demonstrated deeper BIS values with decades' age progression. Our data has important implications for propofol dosing. The practical information for physicians in their daily clinical practice is using propofol C_p of 3.5 μg mL^{-1} might not yield BIS value of 50 in elderly patients. Our simulations showed that the recommended regimen of C_p 3.5 μg mL^{-1} for 20–29 year should be gradually decreased to 2.0 μg mL^{-1} for 80–89 year.

Nastavení TCI: dosažení plazmatické koncentrace propofolu (Cp) 3,5 μg/ml během 3,5 minuty.

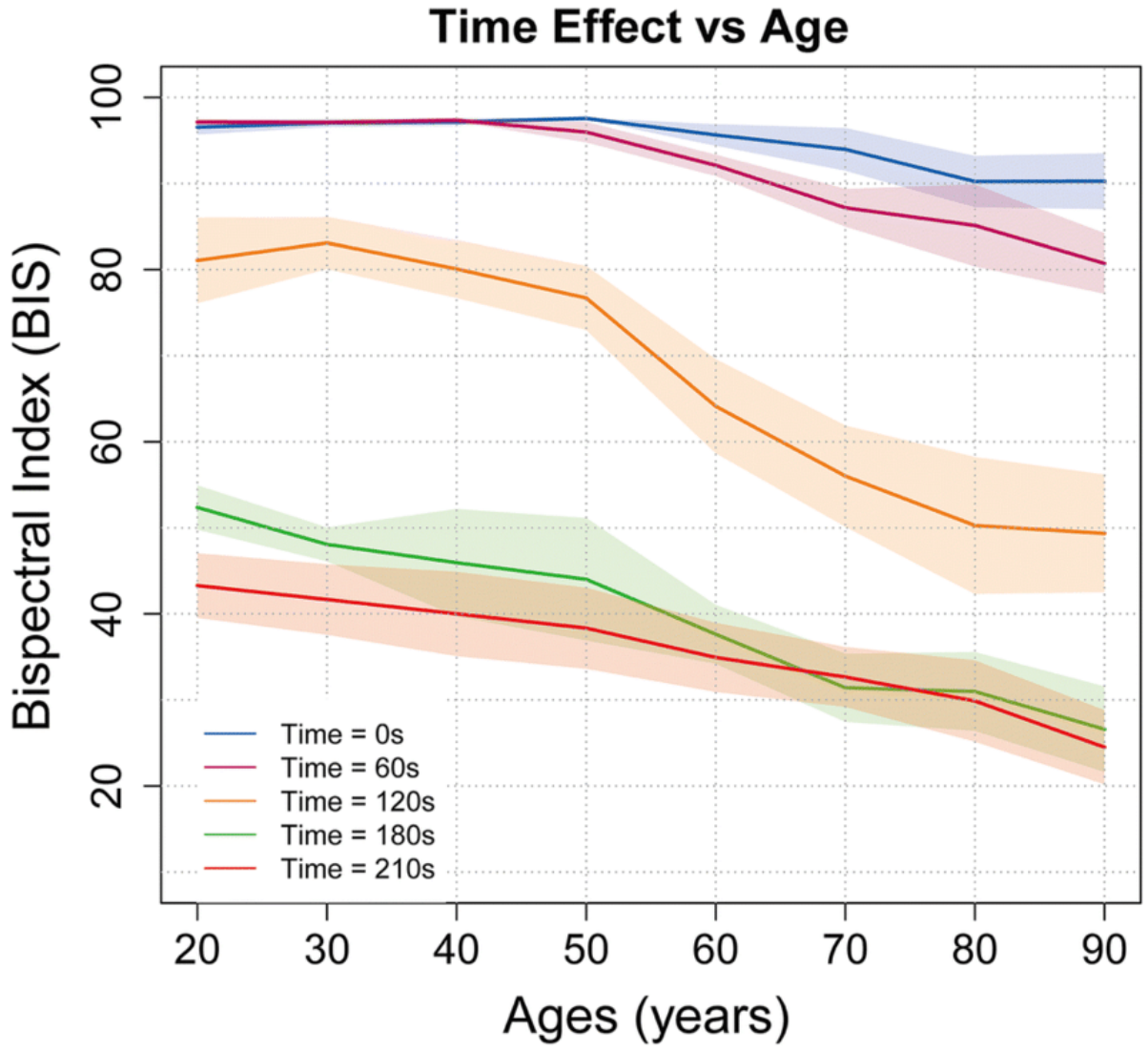
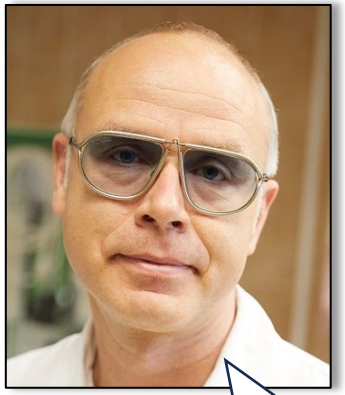


Fig. 5 Observed BIS vs Ages at different time (0, 60, 120, 180, and 210 s). The solid lines are the mean of each group. The corresponding shaded area represent 95% CI of each group

doporučený režim Cp 3,5 μg/ml pro 20-29leté by měl být postupně snížen až na 2,0 μg/ml pro 80tileté

Dahaba et al. Journal of Pharmacokinetics and Pharmacodynamics (2020) 47:145–161

alergie na propofol, genetická porucha lipidového metabolismu



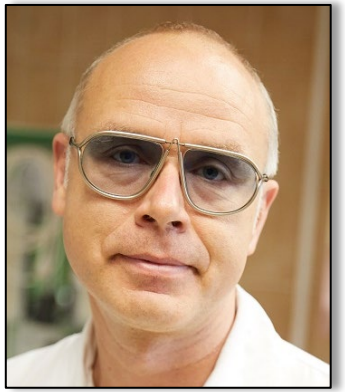
alergie na složku propofolu

K.I. propofolu, dlouhý výkon s potřebou rychlého probuzení

na porodnici 😉
a samozřejmé při alergiích. Nejčastěji ale, když nemam dostupný TCI perfuzor

omezený žilní přístup a čekám krevní ztráty, nedostatečné technické vybavení, nemám pod kontrolou infuzní systém, kterým TIVA aplikuji

V jakých případech určitě TIVA/TCI nedáváte?


V jakých případech určitě TIVA/TCI nedáváte?

a bez techniky to nejde !

alergie na propofol, nebo složku

Tota
Anes
Cont

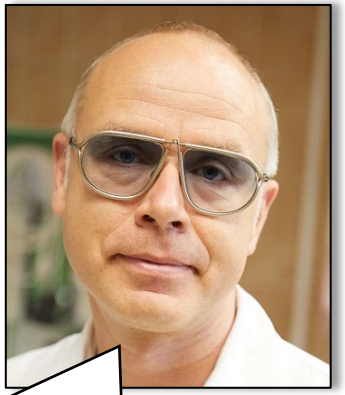
EXTRAS ONL

Table 32.1 Advantages and disadvantages and risks of TIVA/TCI

Advantages
• Reduced postoperative nausea and vomiting
• Useful in procedures that require evoked potential monitoring
• Quality of recovery from anesthesia
• Independent of an anesthesia machine
• Target controlled infusions administer intravenous drugs using target effect site concentrations, an approach this is similar to how anesthesiologists administered potent inhaled agents with a vaporizer
Disadvantages and risks
• Small increased risk of awareness, especially with neuromuscular blockade
• Hemodynamic instability with propofol, especially in the setting of severe blood loss
• Risk of hyperalgesia increased with high dose opioid techniques often used with TIVA
• Requires more equipment to deliver anesthetic (syringe infusion pumps, drug administration lines with anti-reflux and anti-syphon valves)
• Infusion rates are not automatically recorded on an electronic medical record
• Syringe pumps require frequent re-loads during long surgical procedures
• No ability to monitor drug concentrations in real time
• Dependent on continuity of functioning intravenous line
• Pain on injection with propofol
• May require processed EEG monitoring, especially with neuromuscular blockade
• Pharmacokinetic models used to drive TCI infusion pumps may inaccurately predict target concentrations in selected patients (i.e., obese patients)
• More difficult to titrate in patients with opioid or benzodiazepine tolerance
• Cost

asleep-awake-asleep

sufentanil vždy,
remifentanil jen
u obézních a AAA



sufentanil, ale TIVA u
kratších výkonu do hodiny
(nemáme modely v pumpách)

sufentanil,
skoro furt

rutinně používám sufentanil
- není nutné kontinuální podávání
a mám ji nejvíc v ruce

sufentanil, když nemám
2 perfuzory s TCI nebo
ho vezu na RES na UPV,
jinak remifentanil,
když mám dva perfuzory
a pac. chci vzbudit na sále

Jaký jiný opioid
než remifentanil
používáte a kdy?

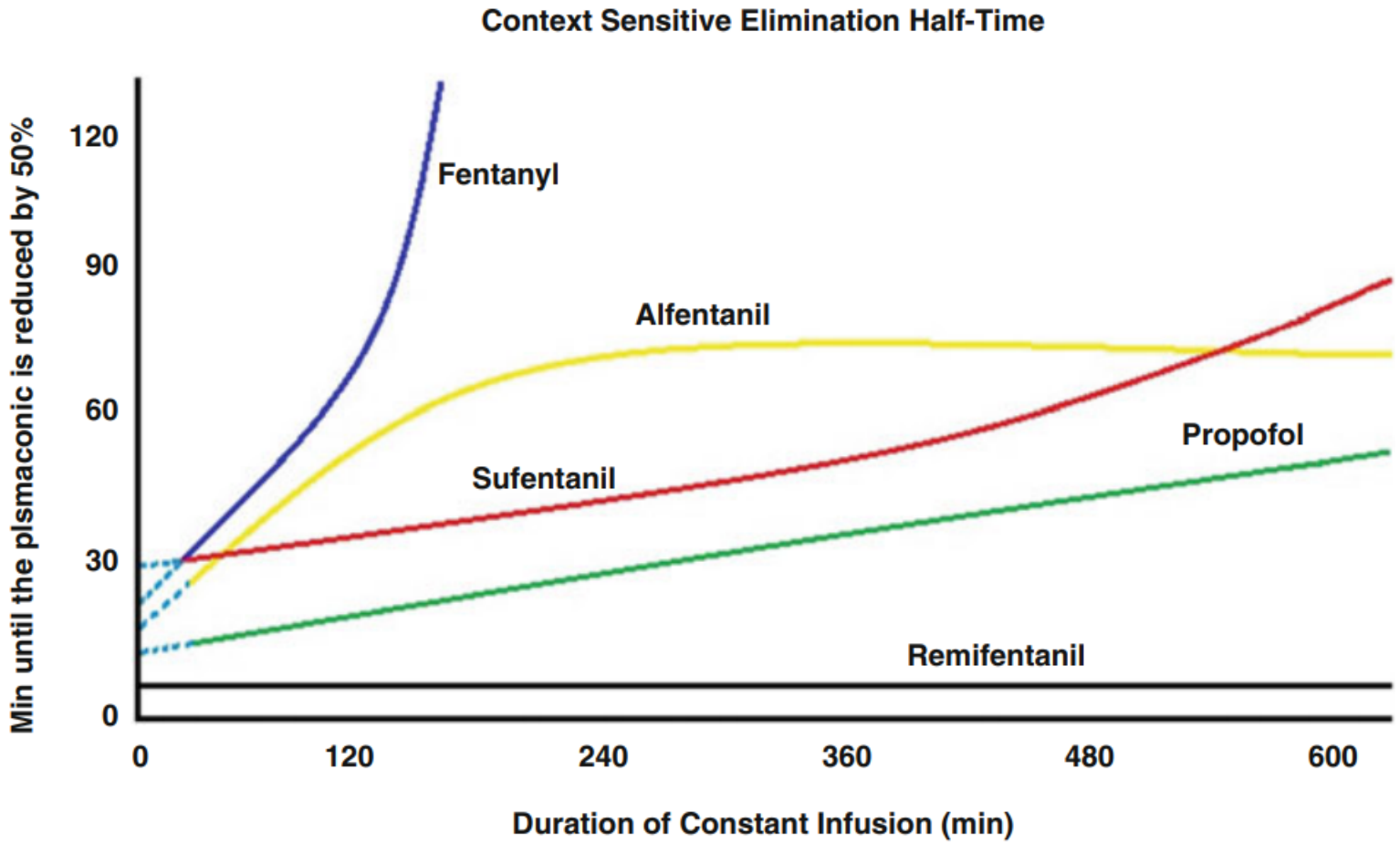


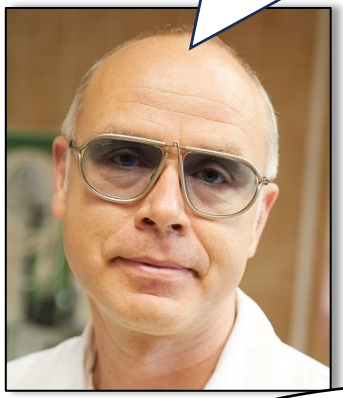
Fig. 6.14 This is a drawing of context-sensitive half-life of five relevant drugs as defined by duration of an infusion for constant plasma level

GEPTS pro sufentu
nemáme zatím Eleveld pro opioidy

ELEVELD pro propofol
má nejvíce farmako dat, je nejvíce přiblížen metabolismu, věku, hmotnosti a pohlaví

MINTO pro remifentanil
jiný naše pumpy nemají

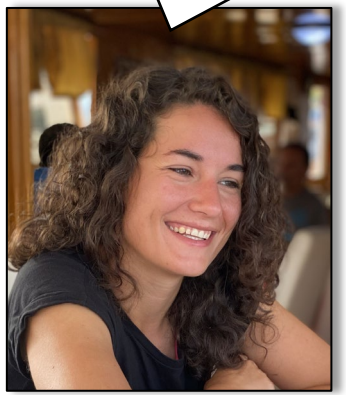
SCHNIDER pro propofol
pacientka není nepříliš hmotná



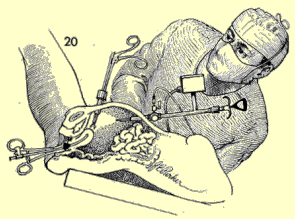
SCHNIDER pro propofol

sufentanyl bolusy
a ketamin bolusy

ELEVELD pro propofol,
a buď sufentu bolusově
nebo remifentanil v **MINTO**



ELEVELD pro propofol
MINTO pro remifentanil
protože mě to tak Tereza naučila



Pacientka 60 let, LPSK (myomektomie)
výška 168 cm, hmotnost 82 kg
v anamnéze astma, tč. bez terapie

Jaká farmaka a
jaký TIVA/TCI model
si vyberete?

MARSH

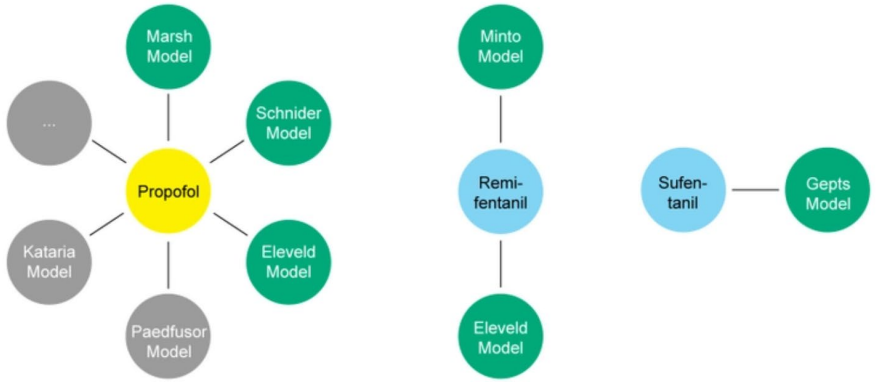
- nejstarší
- zadávám: váha
- plasma kompartment = 0,228 x hmotnost (kg)
- primárně bez K_{eo} (dodaná až v modifikované verzi a liší se mezi výrobci)
- plasma targetting
- max. váha = 150 kg

SCHNIDER

- komplexnější
- výška, váha, pohlaví, věk
- plasma kompartment = vždy 4,27 L
- menší vypočítané dávky než u Marshe
- effect targetting
- vypočítává „libovou váhu“ dle Jamese

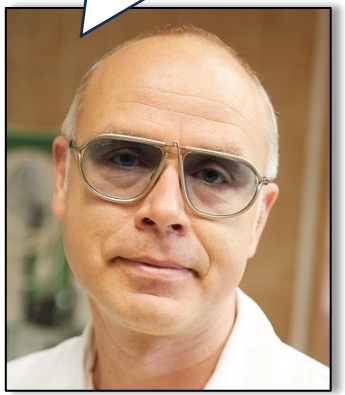
ELEVELD

- **universální řešení**
- nejnovější model, první tzv „general purpose“ model
- jako jediný zohledňuje synergický efekt opiodů
- zadávám: výška, váha, pohlaví, věk, opioidy – ANO/NE
- vypočítává fat free mass – zadám opravdovou váhu a pumpa si poradí
- použitelný i pro děti od 3 let
- o něco nižší Cet než u Schnidera – stejné cílování by vedlo k vyšším dávkám
- přijatelné odchylky u starých i obézních = OPRAVDU UNI



vždy efektivní !
propofol 3,2
sufenta 0,2

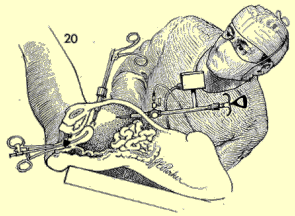
propofol plasmatickou,
remifentanil efektivní,
hladina 5 a 5 na úvod



efektivní,
na úvod 5-5,5 ug/ml,
dále 2,5-3,5 podle
BIS/Entropy/Conox)

Efektivní;
u propofolu 3, remi 5

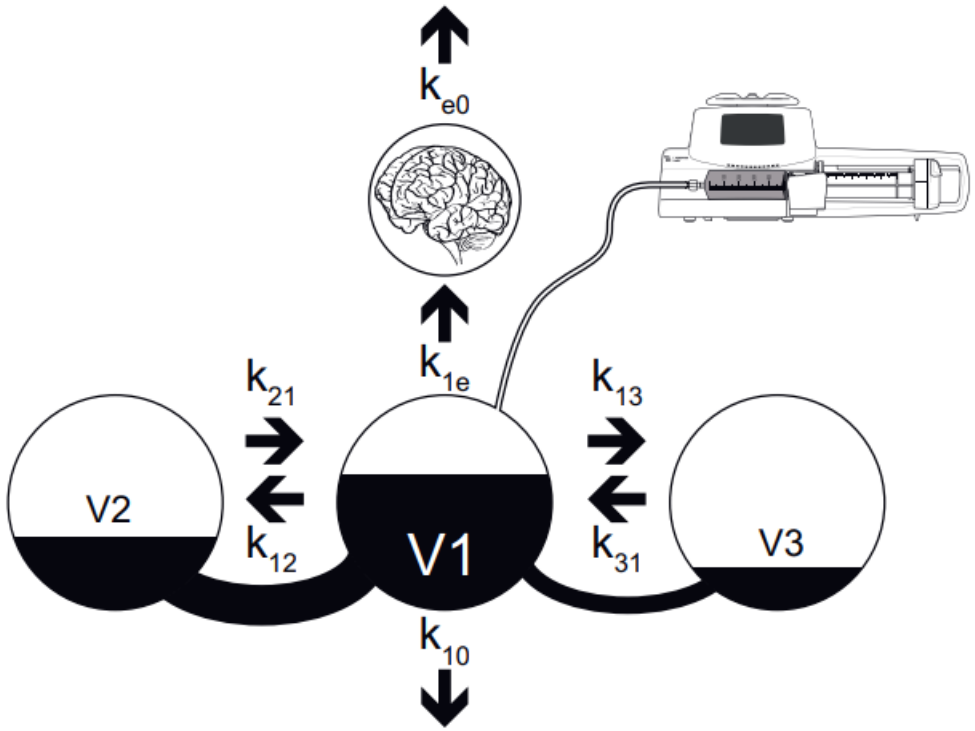
propofol efektivní v mozku 2-4
dle toho, kdy mi pacientka usne
při úvodu, ale tipuju tak 2,5-3
remifentanil efektivní cíl 5



Pacientka 60 let, LPSK (myomekto
výška 168 cm, hmotnost 82 kg
v anamnéze astma, tč. bez terapie

Plasmatická nebo efektivní koncentrace, a jakou hladinu nastavíte?

CÍLOVÁ KONCENTRACE



- **Koncentrace v plazmě**: koncentrace léku v centrálním kompartmentu (V1)
- **Koncentrace v místě účinku**: odhad koncentrace ve 4. kompartmentu.

Tento kompartment (který představuje místo účinku léku) nemá žádný fyzický objem a s centrálním kompartmentem je virtuálně spojen pomocí rozdělovacího koeficientu s názvem k_{e0}

Legenda	
V1	Objem centrálního kompartmentu (primární, krev)
V2	Objem rychlého kompartmentu
V3	Objem pomalého kompartmentu
k_{ij}	Rozdělovací koeficienty, které určují rychlost přechodu léku mezi jednotlivými kompartmenty
k_{10}	Konstanta představující rychlost eliminace v centrálním kompartmentu
k_{e0}	Konstanta představující rovnováhu mezi plazmou a místy účinku / v orgánu

C_{et} nebo C_{pt}? – mentální koncept

Zadávám plazmatickou koncentraci

Zadávám koncentraci v „místě efektu“

koncentrace v plazmě

koncentrace v mozku

rychlost infuze

Table 6.1 Delay (min) from drug being in plasma until effect

	*T*½ for equilibration	Time to maximal effect between plasma and effect site (*T*½keO) after a bolus dose
Barbiturates (thiopenthone)	1.2	1.0–2.0
Propofol	2.6	1.5–3.5
Midazolam	5.6	5–7
Diazepam	2	1–3
Opioids		
Remifentanil	1.2	1–2
Alfentanil	1.1	1.5–3
Fentanyl	5.8	4–5
Morphine	?	10–20
NSAID	?	15–30
Corticosteroid	?	60–120

The table shows in the middle column the half-life of equilibration from plasma to effect site for some relevant drugs (means that good data are not available), whereas the right column shows the time to maximal effect after a single bolus dose. The figures in both columns are average estimates from different sources and may vary considerably, whereas the *ranking* of speed between different drugs are better established

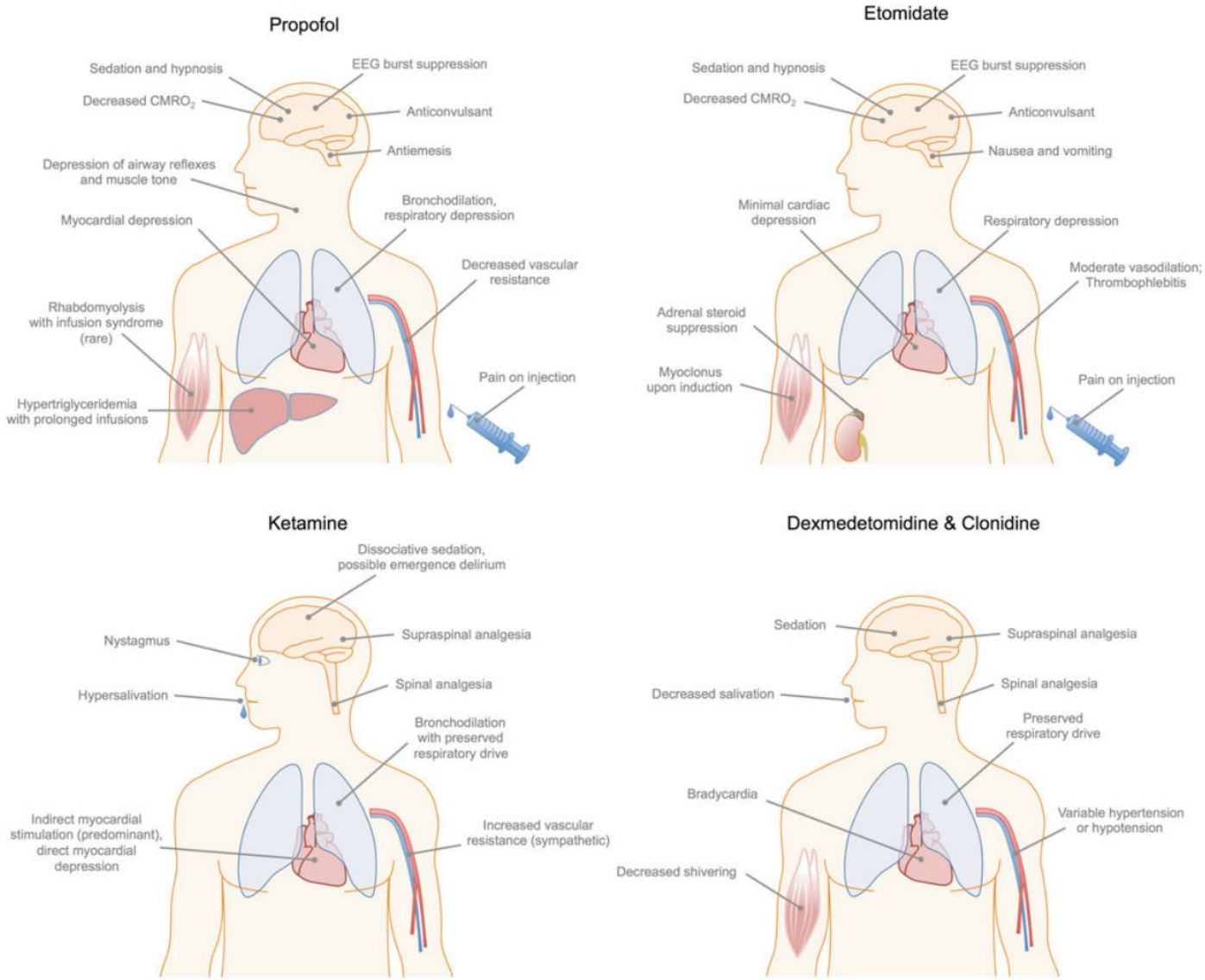
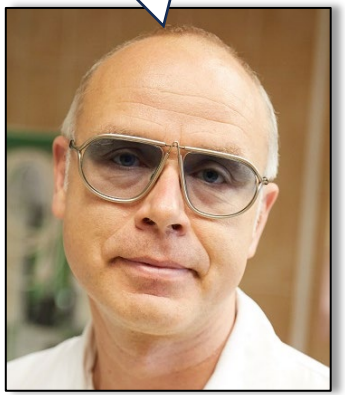


Fig. 5.3 Prominent effects and undesirable side effects of propofol, etomidate, ketamine, and the α_{2A} adrenoceptor agonists dexmedetomidine and clonidine. *$CMRO_2$* cerebral metabolic rate for oxygen, *EEG* electroencephalography

základní
+ vždy entropie

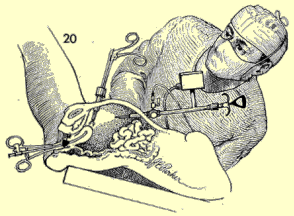
standardně (bez BIS)



přístrojovou metodou
monitorace adekvátnosti anestezie
- v mém případě entropie/Conox

relaxometrie, entropie

relaxometrie a
hloubka anestezie



Pacientka 60 let, LPSK (myomektomie)
výška 168 cm, hmotnost 82 kg
v anamnéze astma, tč. bez terapie

Jak budete pacientku (nad běžný standard) monitorovat?

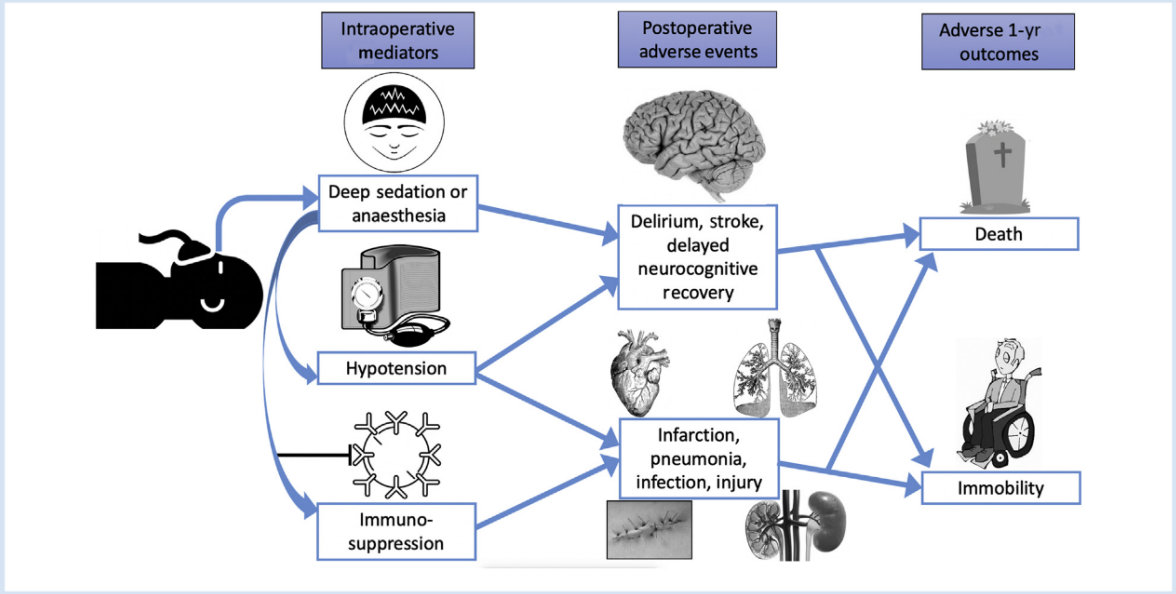


Fig 1. Deep sedation or anaesthesia and poor intermediate-term outcomes. This figure illustrates possible intraoperative mediators and postoperative adverse events associated with 'deeper' hypnosis during sedation or general anaesthesia, which could in turn increase the likelihood of intermediate-term immobility and death.

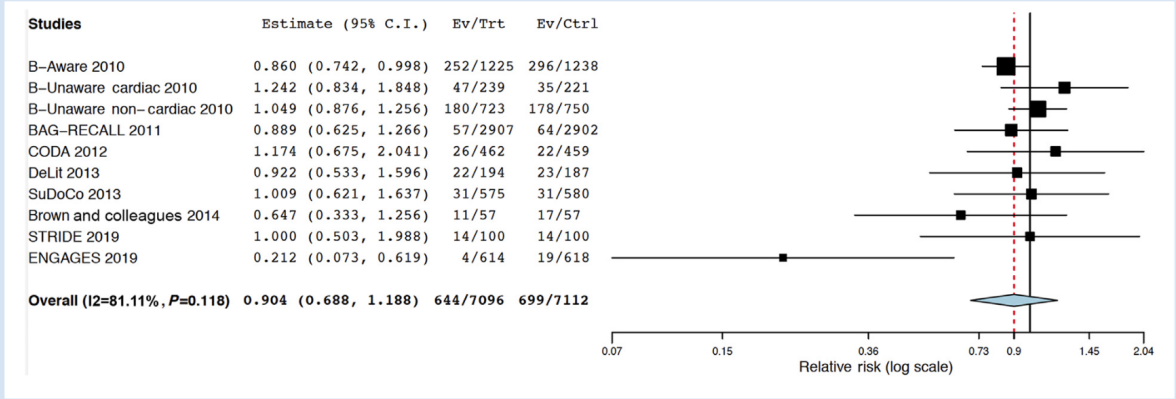


Fig 2. Meta-analysis summarising 10 trials in which the intervention group had received EEG or bispectral index (BIS) guidance, with or without the explicit goal of 'light' anaesthesia or sedation. This analysis was conducted using OpenMetaAnalyst.[22] As shown in the figure, the estimated overall risk ratio for death with the intervention (BIS-guided [reduction in] sedation/anaesthesia)=0.904 (95% confidence interval, 0.688–1.188, P=0.471).

British Journal of Anaesthesia, 122 (4): 421–427 (2019) doi: 10.1016/j.bja.2019.01.012

Hypnotic depth and postoperative death: a Bayesian perspective and an Independent Discussion of a clinical trial

Phillip E. Vlisides[1], John P. A. Ioannidis[2] and Michael S. Avidan[3,*]

[1]University of Michigan Medical School, Departme
University, Meta-Research Innovation Center,
School of Medicine, Department of Anesth

Abychom detekovali 1% pokles mortality,
Potřebovali bychom 27 000 pacientů !

In designing a trial to detect an absolute decrease in 1-yr mortality from 10% to 9% (10% relative reduction) with >80% power and a statistical significance level of <0.05, the trial would require 13 500 patients per group.

Yet a 1% absolute reduction in death should be considered clinically meaningful, as this would mean that for every 100 patients treated with 'lighter' anaesthesia, one life would be saved.

Vlisides et al. British Journal of Anaesthesia, 122 (4): 421e427 (2019)

Nallasamy N. The Neuroscientist 2011. 17(1) 94–106

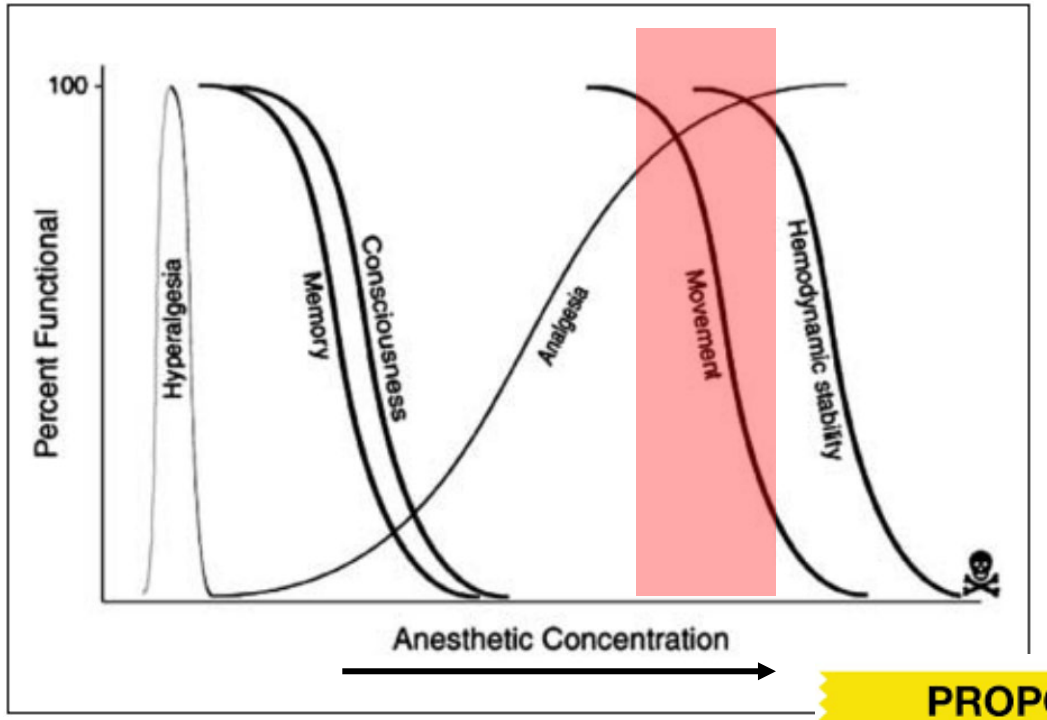


Figure 2. The dose-response curves for endpoints of anesthesia (Antognini and Carstens 2002). Higher anesthetic concentrations are toward the right. The key endpoint for relative anesthetic potency and the dose typically needed for anesthesia with surgery is that point where the minimum alveolar concentration (MAC) of an inhaled anesthetic prevents 50% of patients from moving in response to a surgical stimulus (Eger and others 1965). At very low doses of agents, typically around 0.1 MAC, a paradoxical hyperalgesia (pain-enhancing) effect occurs (Zhang and others 2000). Next, analgesia begins and increases with an increasing dose until, at much deeper levels, no movement occurs with any stimulation. The memory effects of anesthesia occur at around 0.1 to 0.3 MAC (Alkire and Gorski 2004) and deeper. Consciousness is typically lost at approximately 0.3 to 0.4 MAC, or at about 30% to 40% of the anesthetic dose actually needed for surgery. Doses much above those needed to prevent movement can cause a lethal collapse of the cardiovascular system. Adapted from Alkire and Miller (2005).

PROPOFOL
10 mg/mL
Exp. Dt./Tm. _____

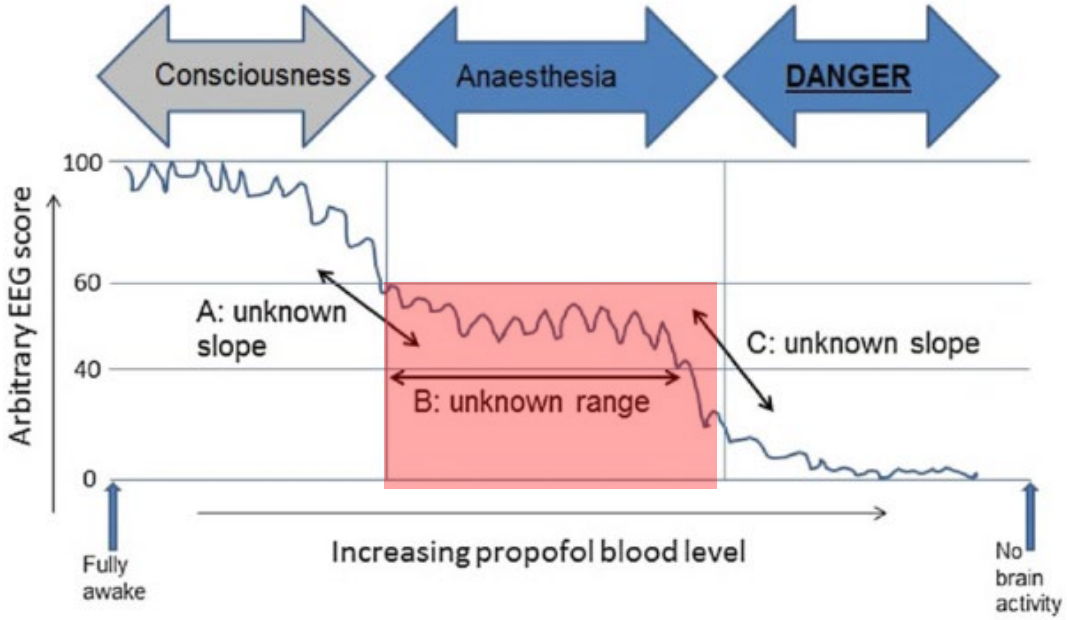


Fig. 19.5 Non-linear relationship between propofol blood level and EEG score. A probable relationship between increasing blood level of propofol and an arbitrary EEG score. For this construction it is proposed that the anaesthesia range of EEG score is between 60 and 40, and a score less than 25 may be dangerous. If these are accepted, the range of propofol blood level (B) capable of keeping an EEG score in the anaesthesia range is unknown: it may be narrow or very wide. The slopes at A and C represent the changes in EEG score leading into and out of the anaesthesia range, and these are also unknown. Similar ideas about variability of the dose response have been discussed by Escallier et al. [35]

Sury MRJ. EEG Monitoring of Depth of Anesthesia in ,
Total Intravenous Anesthesia and Target Controlled Infusions (2017)

„povědomí“ / „bdělost“

vědomí sebe vědomí okolí

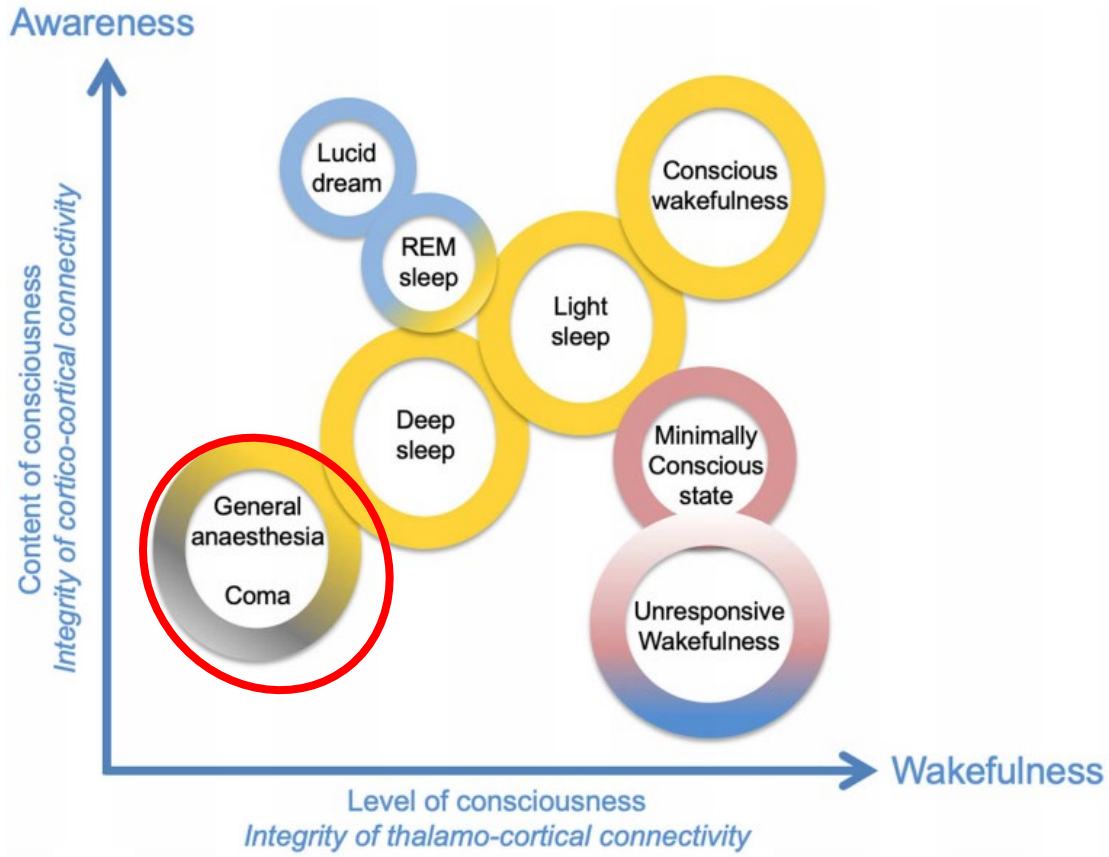


Figure 1. Wakefulness and awareness are two essential dimensions of consciousness. In this diagram, several qualitatively different states of consciousness have been positioned on the two-dimensional matrix as a function of the associated axes “content of consciousness” (awareness) and “level of consciousness” (wakefulness). Adapted from Laureys (2005).

Modolo J et al. Network Neuroscience 2020, 4(2), 315–337.

Journal of Pharmacokinetics and Pharmacodynamics (2020) 47:145–161

Age progression from vicenarians (20–29 year) to nonagenarians (90–99 year) among a population pharmacokinetic/pharmacodynamic (PopPk-PD) covariate analysis of propofol-bispectral index (BIS) electroencephalography

Ashraf A. Dahaba[1] · Zhaoyang Xiao[2,3] · Peter Rehak[4] · Sieglinde Zelzer[5] · Kun Wang[6] · Gilbert Reibnegger[7]

Background Pharmacokinetic/pharmacodynamic (PK/PD) modeling has made an enormous contribution to intravenous anesthesia. Because of their altered physiological, pharmacological and pathological aspects, titrating general anesthesia in the elderly is a challenging task.

Methods Eighty patients were consecutively enrolled divided by decades from vicenarians (20–29 year) to nonagenarians (90–99 year) into eight groups. Using target controlled infusion (TCI) and electroencephalographic (EEG)-derived bispectral index (BIS) we set propofol plasma concentration (C_p) to gradually reach 3.5 μg mL^{-1} over 3.5-min. In each patient, we constructed a PK/PD model and conducted a population PK/PD (PopPK-PD) covariate analysis.

Results Age was significant covariate for baseline BIS effect (E_0), inhibitory propofol concentration at 50% BIS decline (IC_{50}) and maximum BIS decline (E_{max}). First-order rate constant K_{e0} of 0.47 min^{-1} in vicenarians (20–29 year) gradually increased with age-progression to 1.85 min^{-1} in nonagenarians (90–99 year). Simulation modelling showed that clinically recommended C_p of 3.5 μg mL^{-1} for 20–29 year BIS 50 should be reduced to 3.0 for 30–49 year, 2.5 for 50–69 year and 2.0 for 80–89 year.

Conclusion We quantified and graded EEG-BIS age-progression among different age groups divided by decades. We demonstrated deeper BIS values with decades' age progression. Our data has important implications for propofol dosing. The practical information for physicians in their daily clinical practice is using propofol C_p of 3.5 μg mL^{-1} might not yield BIS value of 50 in elderly patients. Our simulations showed that the recommended regimen of C_p 3.5 μg mL^{-1} for 20–29 year should be gradually decreased to 2.0 μg mL^{-1} for 80–89 year.

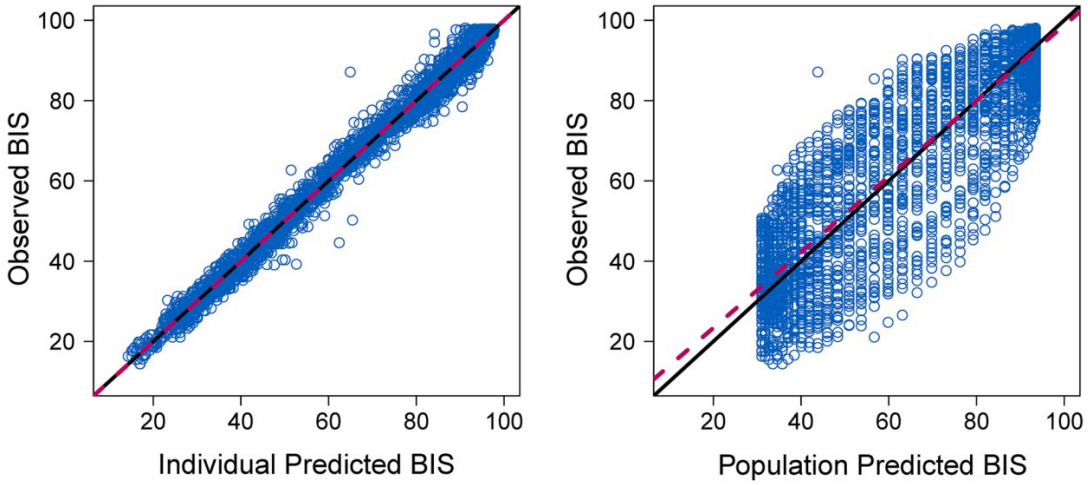


Fig. 6 Goodness of fit plot of base model. Observed versus individual predicted concentrations (left) and observed versus population predicted concentrations (right) for the final model. The solid black line in each plot is the line of identity. Points are individual data. Red dashed lines represent the regression.

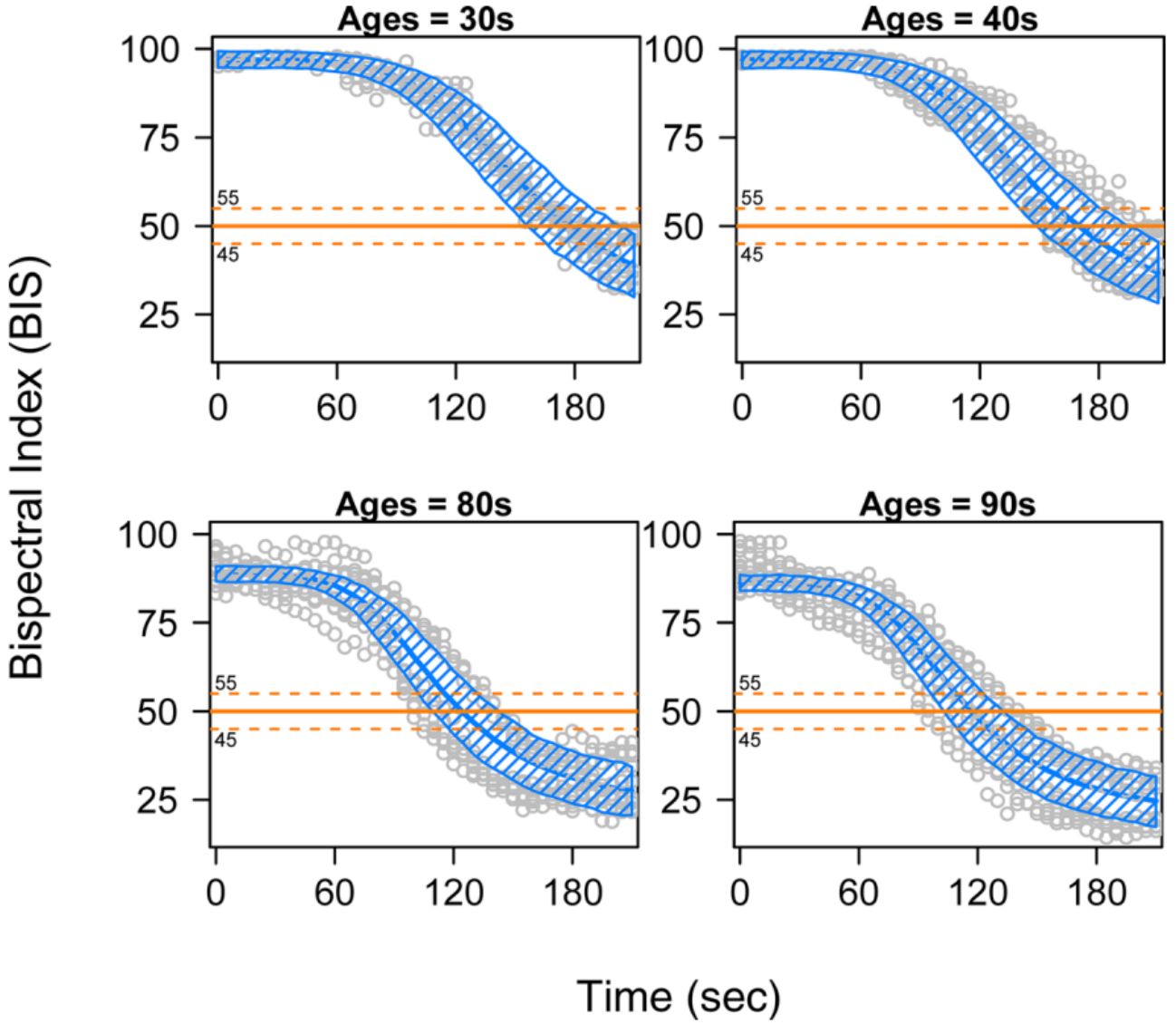


Fig. 4 Visual predictive check stratified by age groups. The circle represents the observed BIS. The thick blue lines are the median BIS of 1000 simulation of each

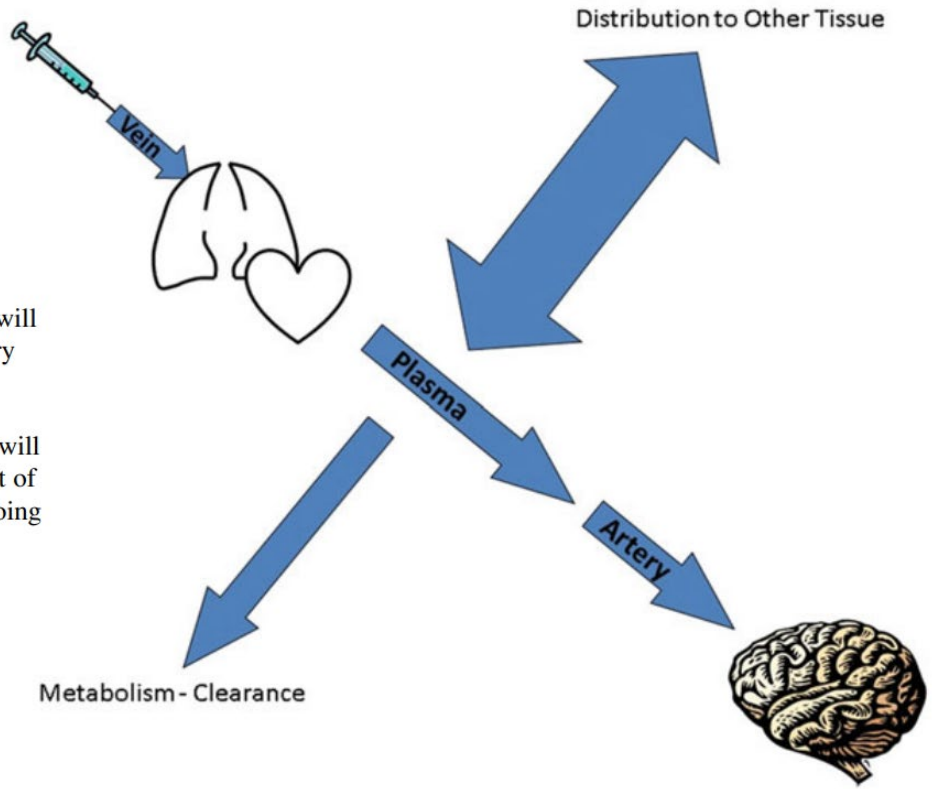


Fig. 6.2 Any injected drug will rapidly be distributed in artery blood to the central nervous system (brain in figure). However, on the way, much will be lost by uptake into the rest of the body (tissue) and by ongoing elimination (metabolism clearance)

How much water should be filled for adequate effect?

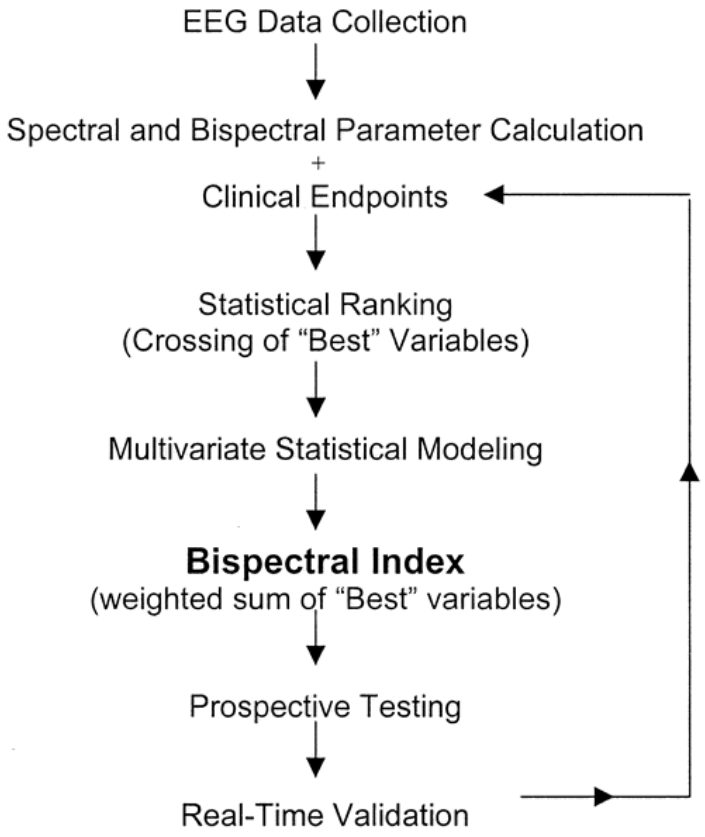
→ *Foot bath !! (10 cm water)*

Fig. 6.6 The footbath analogy: how much water (=volume for distribution) do you need to fill in to have an adequate *level* of water to get your feet wet: not much in the sink—a huge amount in the pool. An adequate amount of water to soak the feet with an appropriate concentration of salt (see text)

Anesthesiology 2000; 93:1336–44

Development and Clinical Application of Electroencephalographic Bispectrum Monitoring

Jay W. Johansen, M.D., Ph.D., Peter S. Sebel, M.B., B.S., Ph.D., M.B.A.†*



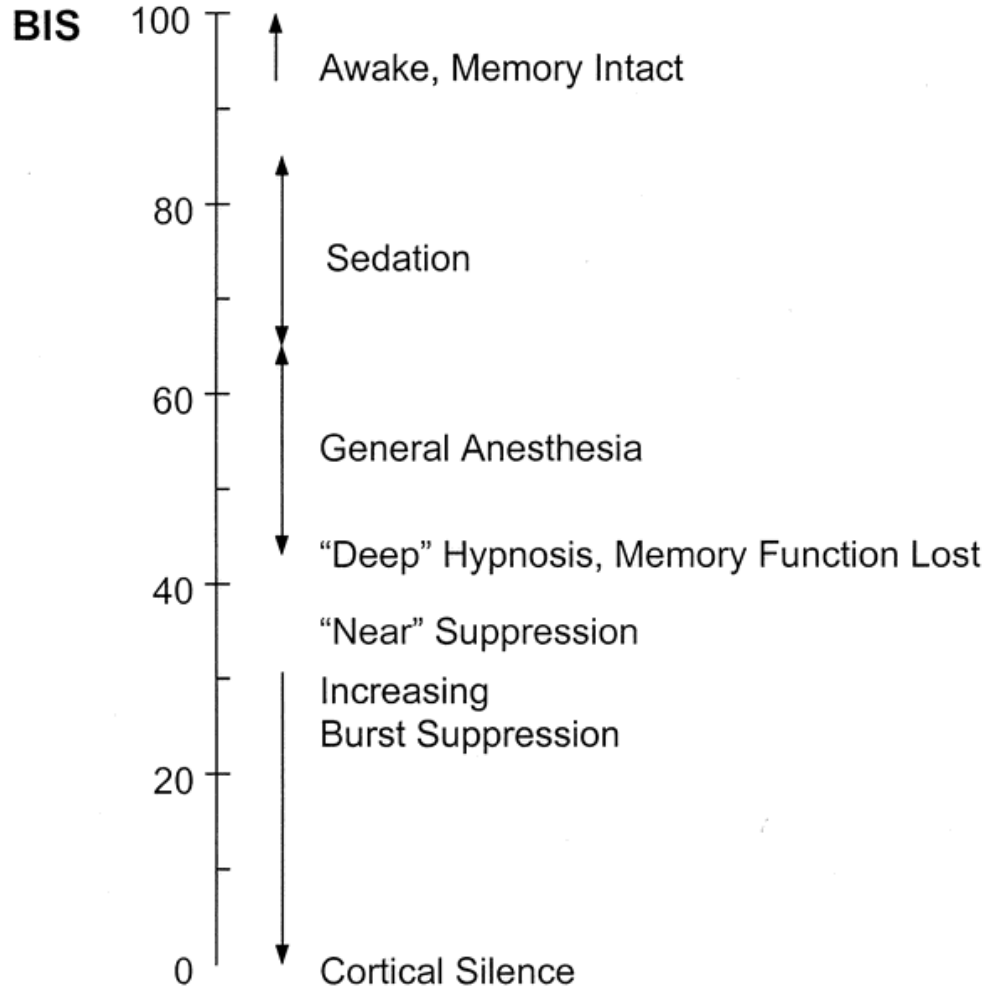
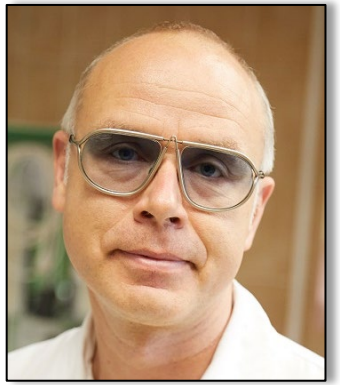


Fig. 1: The Bispectral Index Scale (BIS versions 3.0 and higher) is a dimensionless scale from 0 (complete cortical electroencephalographic [EEG] suppression) to 100 (awake). BIS values of 65–85 have been recommended for sedation, whereas values of 40–65 have been recommended for general anesthesia. At BIS values lower than 40, cortical suppression becomes discernible in raw EEG as a burst suppression pattern.







FRESENIUS KABI

TIVA Academy

U nás TIVA nemá tradici,
používají výjimečně jednotlivci…

Nejčastěji TIVA nedávám, když
nemám dostupný TCI perfuzor.

Dělám to takhle proto,
že mi to tak Tereza řekla…

TIVA Academy

Proč TIVA ACADEMY:

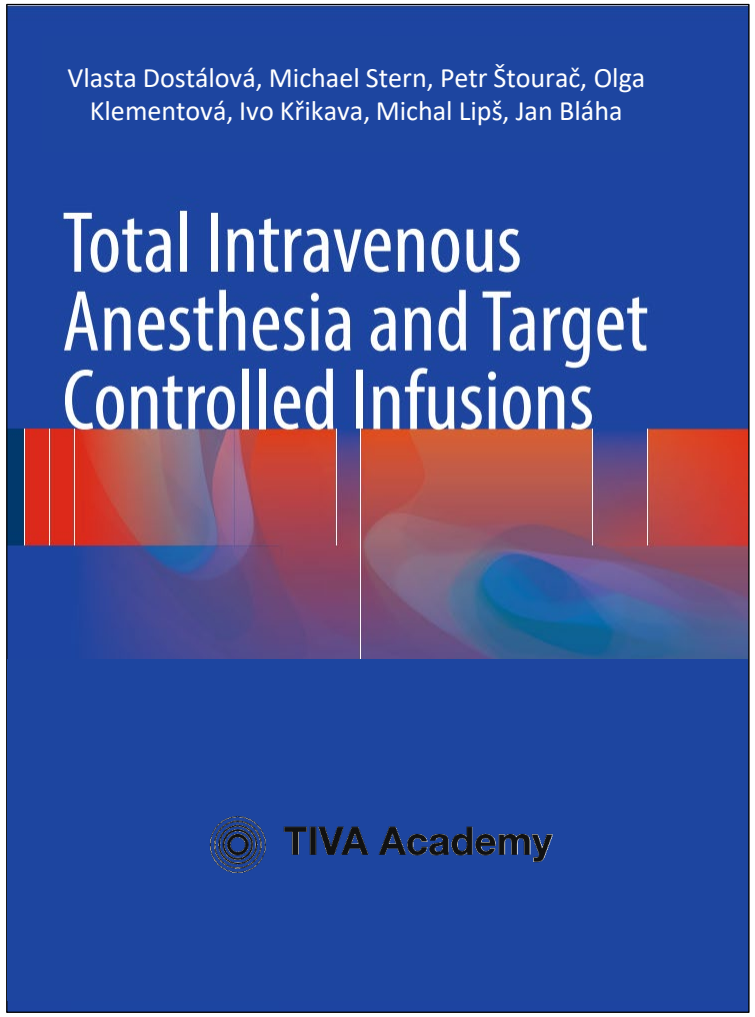
- TIVA není v ČR dostatečně etablována, záleží na zkušenostech/nastavení pracoviště
- přitom rozrůstající se ambulantní sektor podávající TIVA, často za nestandardních podmínek
- neexistují standardizované požadavky a podmínky pro podávání TIVA
- není kvalifikace pro podávání TIVA (otázka především bezpečnosti)
- zájem o naučení se TIVA přitom existuje, např. právě pro práci v soukromém sektoru

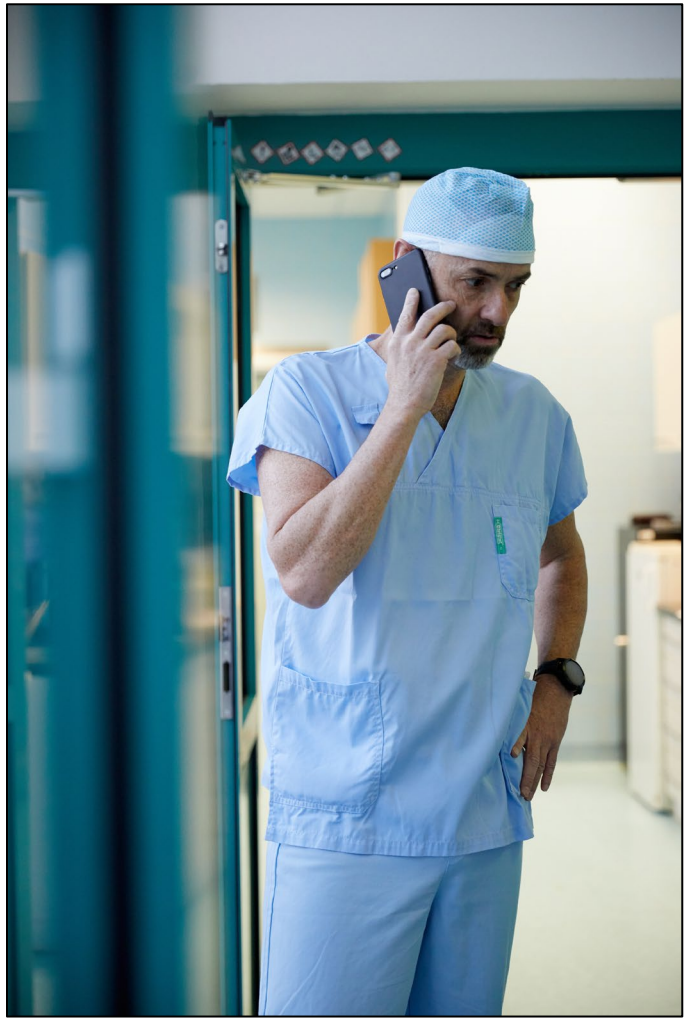
TIVA Academy

Cíle TIVA ACADEMY:

- vytvořit síť pracovišť zapojených do projektu a poskytujících formalizovanou výuku TIVA/TCI
- teoretická podpora (doporučení, návody) na úrovni projektu i ČSARIM
- e-learning
- praktická podpora zájemců (kurzy TIVA/TCI) i absolventů (mobilní rady, návštěva na pracovišti)

Farmakokinetický model
Marsh
Schnider
Minto
Gepts
Scott
Paedfusor
Kataria
Eleveld





jan.blaha@vfn.cz