

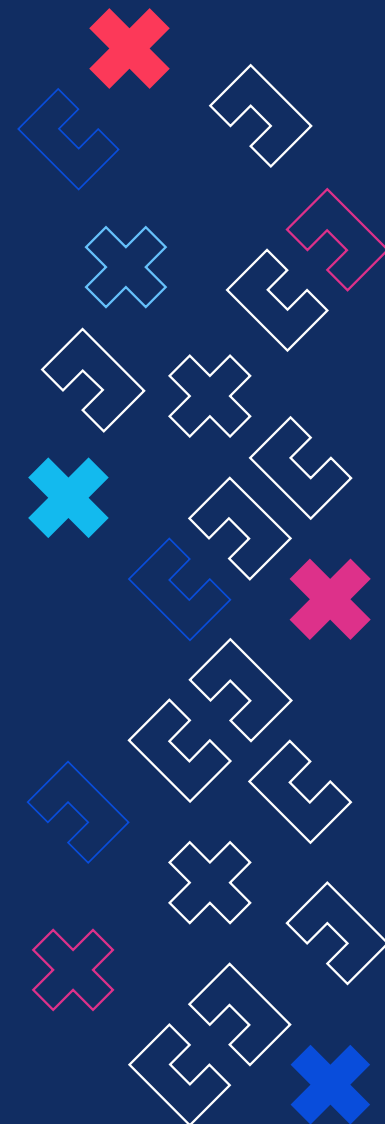
Pod tlakem

Aneb specifika podávání katecholaminů v intenzivní péči

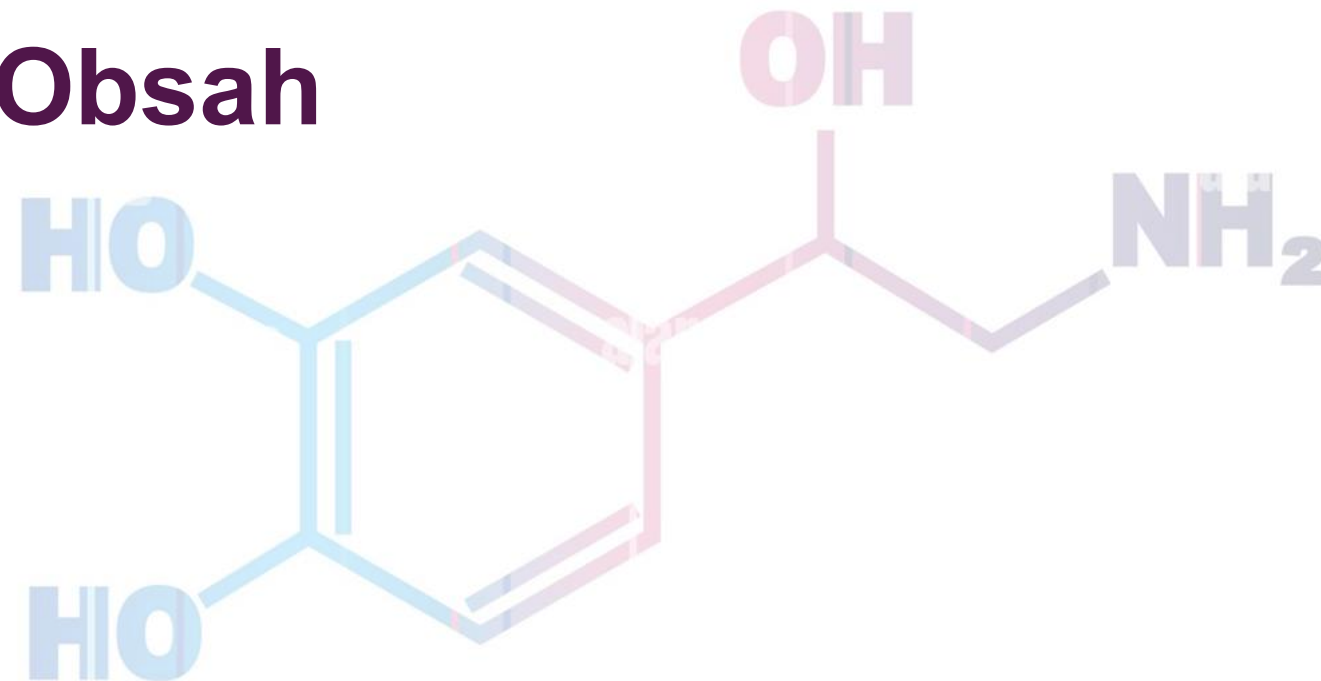
Markéta Hartmanová^{1,2}

¹ FN Brno, Klinika anesteziologie, resuscitace a intenzivní medicíny, Oddělení resuscitační a intenzivní medicíny

² Masarykova univerzita, Lékařská fakulta, Ústav zdravotnických věd



Obsah



1. Úvod

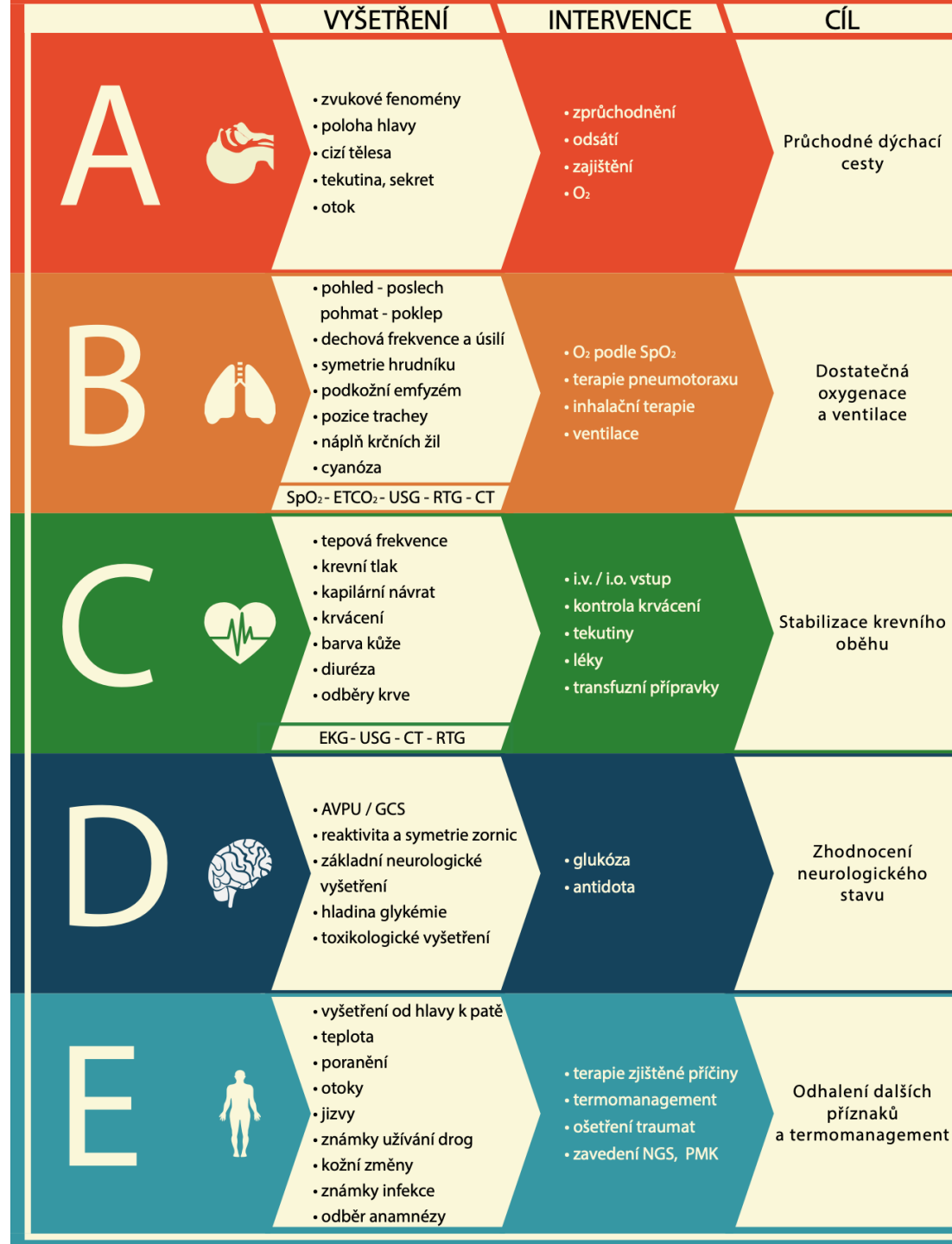
2. Noradrenalin

3. Úskalí při administraci noradrenalinu

4. Bezpečná administrace noradrenalinu

5. Závěr

Úvod



Kodet J, Peřan D, Calleroová J, et al.
ABCDE. AKUTNĚ.CZ.

www.fnbrno.cz

Úvod

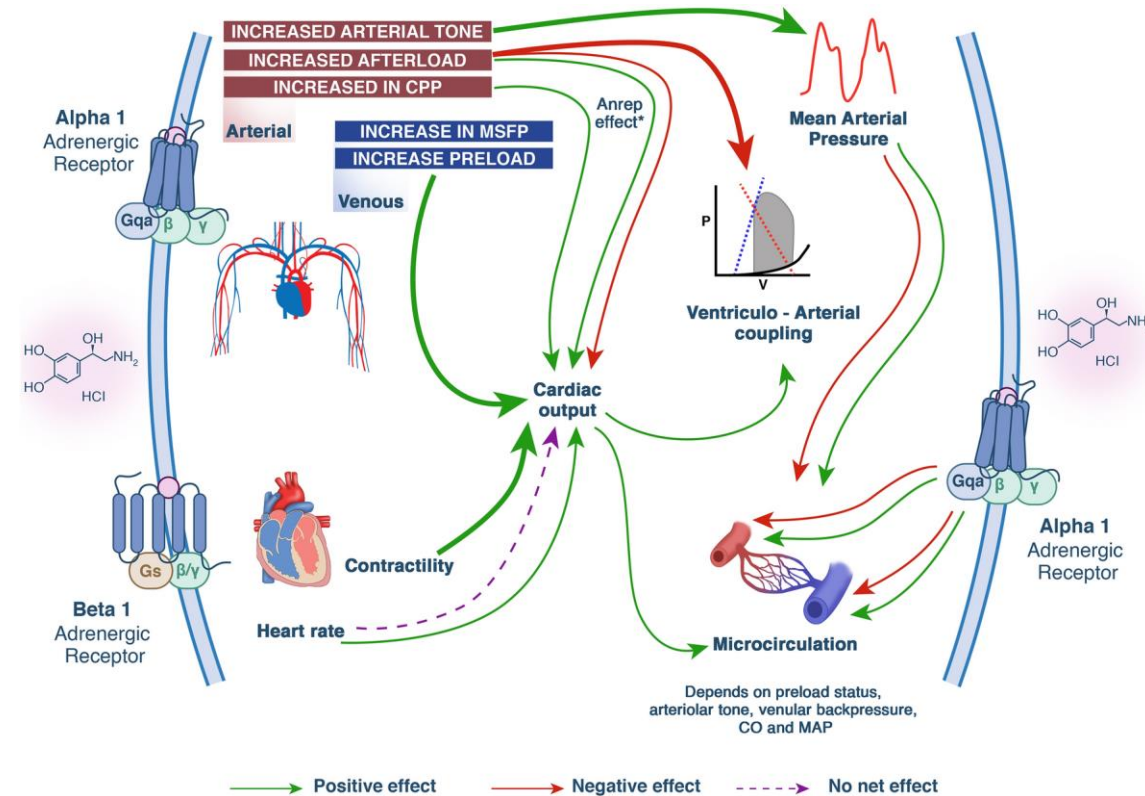


• b) bez odborného dohledu na základě indikace lékaře

1. provádět měření a analýzu fyziologických funkcí pacienta specializovanými postupy pomocí přístrojové techniky, včetně využití invazivních metod,
2. provádět katetrizaci močového měchýře mužů a chlapců starších 15 let věku,
3. zavádět gastrickou a duodenální sondu pacientovi v bezvědomí,
4. provádět výplach žaludku u pacienta se zajištěnými dýchacími cestami,
5. vykonávat činnosti u pacienta s akutním a chronickým selháním ledvin, který vyžaduje léčbu dostupnými očišťovacími metodami krve,
6. provádět tracheobronchiální laváže u pacienta se zajištěnými dýchacími cestami,
7. vykonávat činnosti spojené s přípravou, průběhem a ukončením aplikace metod léčby bolesti,
8. vykonávat činnosti při přípravě, v průběhu a bezprostředně po ukončení všech způsobů celkové a místní anestézie,
9. provádět punkci artérií k jednorázovému odběru krve a kanylaci k invazivní monitoraci krevního tlaku s výjimkou arterie femoralis,
10. podávat léčivé přípravky¹⁰⁾ do epidurálního katetru,
11. nastavovat ventilační parametry při poskytování domácí umělé plicní ventilace, které stanovuje indikující lékař,
12. titrovat léčivé přípravky k dosažení či udržení předem definovaných hodnot fyziologických funkcí nebo laboratorních hodnot, které stanovuje indikující lékař,

Noradrenalin = norepinefrin

- V ČR dostupný přípravek Noradrenalin Léčiva
- Čirý bezbarvý roztok
- V závislosti na dávce stimuluje alfa- a beta-adrenergní receptory
- Rychlý nástup účinku → krátký poločas rozpadu (<2,5 minut) → kontinuální podávání → rizika a komplikace
- Aplikace do velkých žil či centrálního žilního řečiště
- Existuje absolutní dávka?



Kattan et al., 2024

Úskalí při administraci Noradrenalinu

PACIENT

PŘÍPRAVA LÉČIVA

CESTA PODÁVÁNÍ

INFUZNÍ LINKA

PŘÍSTROJOVÁ
TECHNIKA

RYCHLOST

VÝMĚNA STŘÍKAČKY

ALARM OKLUZE

KOMPLIKACE

Bezpečná administrace noradrenalinu

- Příp
- Roz
- a dá
- Řed
- roz
- Stan
- Kni

Doporučený po
Bezpečné podá

Cvachovec K.,
J., Štourač P.,
pořadí, role/po

Česká společn
Doporučený po

	PMS ^a	ASTM ^b - RGB		ISO ^c - RGB
Induction Agents	Process Yellow C	255.255.0		255.255.0
Benzodiazepines and Tranquilizers	Orange 151	255.102.0		255.102.0
Benzodiazepine Antagonists	Orange 151 / White Diagonal Stripes	255.102.0		255.102.0
Muscle Relaxants	Florescent Red 805 ^d	255.114.118		
	Florescent Red 811 ^e			253.121.86
	Warm Red ^f			245.64.41
Muscle Relaxant Antagonists	Florescent Red / White Diagonal Stripes	255.114.118		253.121.86
Opioid/Narcotics	Blue 297	133.199.227		133.199.227
Opioid/Narcotic Antagonists	Blue 297 / White Diagonal Stripes	133.199.227		133.199.227
Major Tranquilizers and Anti-Emetics	Salmon 156	237.194.130		237.194.130
Vasopressors	Violet 256	222.191.217		222.191.217
Hypotensive Agents	Violet 256/White Diagonal Stripes	222.191.217		222.191.217
Local Anesthetics	Gray 401	194.184.171		194.184.171
Anticholinergic Agents	Green 367	163.217.99		163.217.99
Beta Blockers	Copper 876U	176.135.112		NA ^g
	White	255.255.255		255.255.255

a - Pantone Matching System

b - ASTM International; prior to 2001 it was the American Society for Testing and Materials

c - International Organization for Standardization

d - Designated by ASTM International

e - Designated by ISO

f - Designated by ISO as an alternative if Florescent Red cannot be printed

g - ISO has not designated a color for Beta Blockers

Foto: archiv autorky

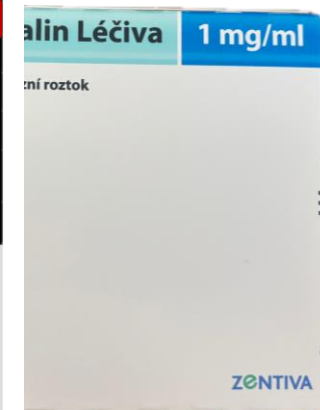
Foto: archiv autorky

NALIN

mg
l)

mg
l)

0 mg
0 ml)

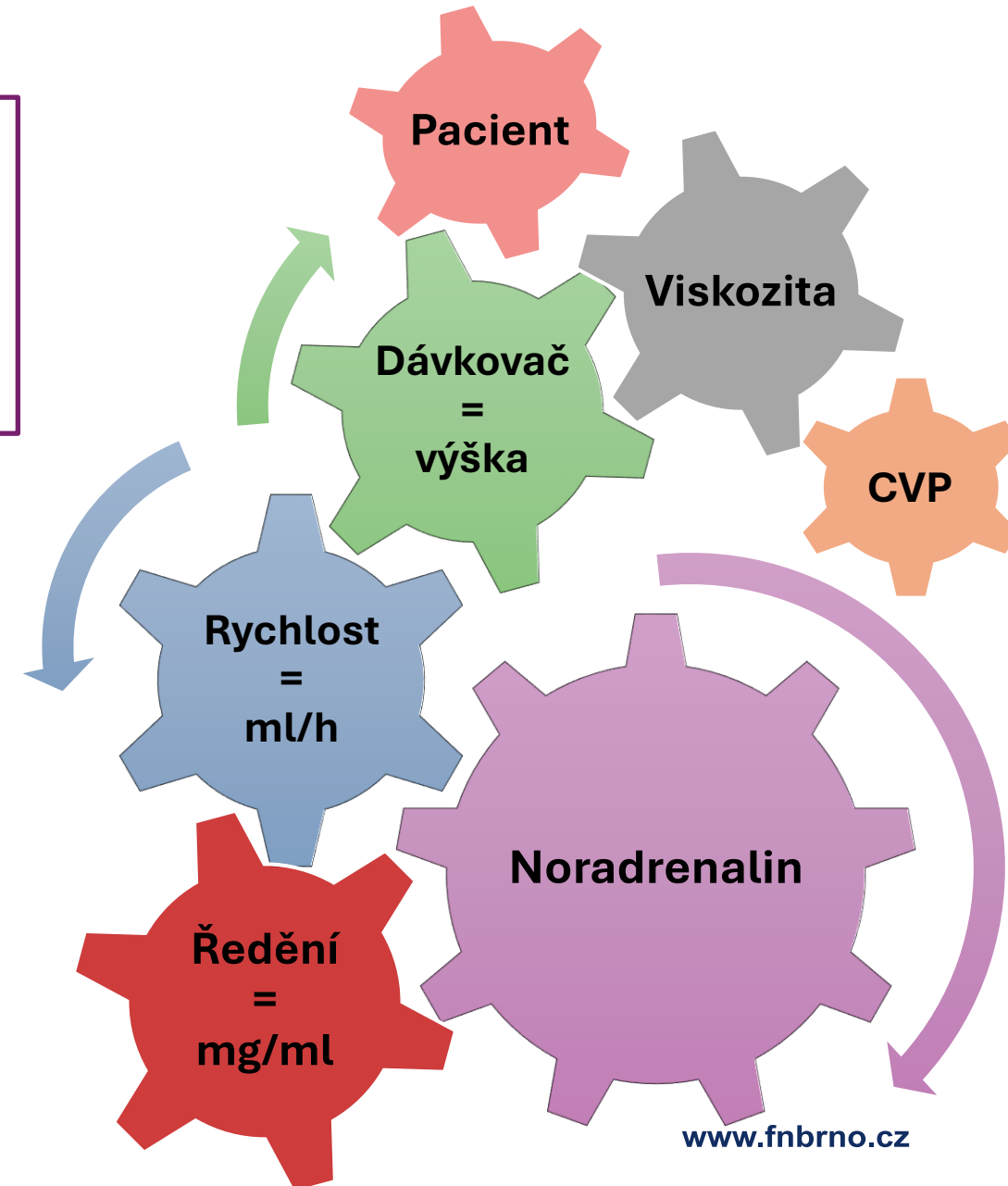


Bezpečná administrace noradrenalinu

Mikro-infuze

=
průtok o rychlosti
5-10 ml/h

- **Malá rychlost** → zpoždění podání léčiva během zahájení léčby
- **Vyšší rychlost** → (nižší koncentrace) častější výměna stříkačky a riziko hemodynamické nestability



Bezpečná administrace noradrenalinu

- Výška injekční pumpy a manipulace s ní ovlivňuje dodávku léku k pacientovy (zejména v rámci rychlostí do 5 ml/h) → transport pacienta

BJA

British Journal of Anaesthesia, 124 (2): 173–182 (2020)

doi: 10.1016/j.bja.2019.10.007

Advance Access Publication Date: 19 December 2019

Clinical Practice

Performance of modern syringe infusion pump assemblies at low infusion rates in the perioperative setting

Martina Baeckert^{1,†}, Martin Batliner^{2,†}, Beate Grass³, Philipp K. Buehler¹, Marianne Schmid Daners², Mirko Meboldt² and Markus Weiss^{1,*}

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[†]These authors contributed equally to this article.



Research Article

Simulated haemodynamic parameters and different infusion set-up affect drug delivery during syringe pump change over: A bench-top study in a laboratory setting

Alberto Lucchini^{a,b,*}, Stefano Elli^{a,c}, Alessia Burgazzi^d, Laura Malvestuto Grilli^b, Claudia Pes^c, Katia Ferrari^b, Letizia Fumagalli^b, Chiara Fiorillo^e, Marco Giani^b, Emanuele Rezoagli^g

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^e Emergency Department, Asst Bergamo Ovest, Treviglio, Italy

^f General Intensive Care Unit, Azienda Ospedaliera Policlinico di Modena, Italy

^g University of Milano-Bicocca and Department of Emergency and Intensive Care Fondazione IRCCS San Gerardo dei Tintori, Monza, Italy



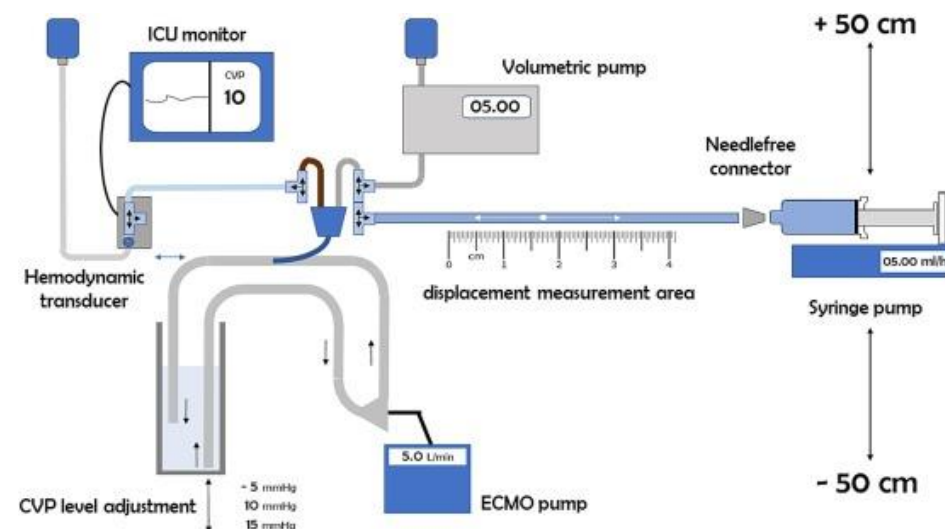
Journal of Clinical Monitoring and Computing (2024) 38:531–538
<https://doi.org/10.1007/s10877-023-01101-6>

ORIGINAL RESEARCH

Pressure-adjusted venting eliminates start-up delays and compensates for vertical position of syringe infusion pumps used for microinfusion

Markus Weiss¹ · Pedro David Wendel-Garcia² · Vincenzo Cannizzaro³ · Beate Grass³ · Philipp Karl Buehler⁴ · Maren Kleine-Brueggeny^{5,6}

Received: 13 September 2023 / Accepted: 26 October 2023 / Published online: 8 December 2023
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Lucchini et al., 2025

Bezpečná administrace noradrenalinu

Jak na to?

- Ideally, the syringe pump should be level with the distal tip of the catheter (e.g. the site of fluid delivery; if accessing a central line the syringe pump should be at the level of the patient's heart). If the pump height is raised relative to the distal tip of the catheter (e.g. during patient transport), the increase in height of the syringe pump can result in a temporary increase in fluid delivery or bolus until the flow rate stabilizes. Alternatively, if the pump is lowered relative to the distal tip of the catheter, the decrease in height of the syringe pump may result in a decrease in delivery or under-infusion until the flow rate stabilizes. Rotating the pump between the horizontal and vertical position while infusing may also result in temporary increase in fluid delivery or bolus.
- Use the smallest compatible syringe size necessary to deliver the fluid or medication; this is especially important when infusing high risk or life-sustaining medications at low infusion rates (e.g., less than 5 mL per hr, and especially flow rates less than 0.5 mL per hr). Using a larger syringe when infusing at low rates can lead to inadequate syringe pump performance including delivery inaccuracies, delay of therapy and delayed generation of occlusion alarms. This is due to the increased friction and compliance of the syringe plunger tip with larger syringes.
- Electronically prime the syringe pump system before starting an infusion or after replacing a syringe with a replacement syringe.
- Verify the fluid flow to the patient is OFF, and if enabled, use the prime function on the syringe pump to remove any mechanical slack in the system.
- Using the syringe pump's prime feature engages the mechanical components of the pump and decreases the syringe's friction and compliance (i.e. stiffness) to minimize startup delays and delivery inaccuracies, especially at low infusion rates.
- Consider the plunger force or occlusion pressure threshold setting and adjust it, as necessary. The lower the plunger force setting or occlusion pressure threshold setting, the shorter the occlusion detection time. However, when infusing viscous or thick fluids (e.g., lipids) the plunger force or occlusion pressure threshold setting may need to be adjusted to reduce false alarms. See Chapter 2.2.1 for further detail.



Vertical Positioning

Simply turn the pump either way until it clicks into notch at 90 degree/vertical position.



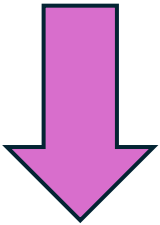
Caution: Rotating position while infusing may result in temporary increase in flow rate bolus.



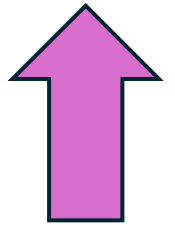
Výměna stříkačky s Noradrenalinem



HYPOTENZE



HYPERTENZE



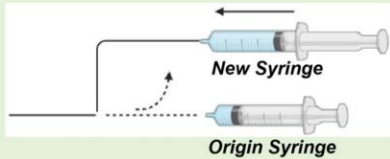
Quick Changeover (QC) Method

Phase 1: Preparation



Prepare new syringe pump; prime tubing

Phase 2: Stop & Changeover



Manual "stop-start" at the same rate

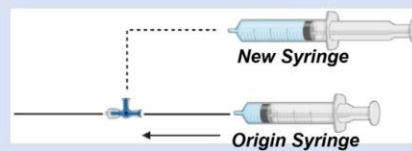
Phase 3: Remove original syringe



Remove original syringe; new syringe running

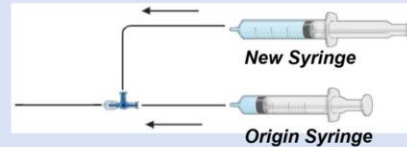
Double Pump Changeover (DPC) Method

Phase 1: Preparation



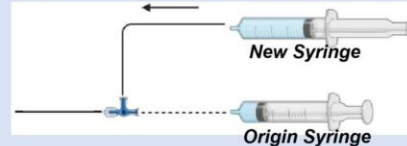
Connect new syringe to three-way stopcock

Phase 2: Syringe pump overlap



Overlap infusion: titration-up and titration-down

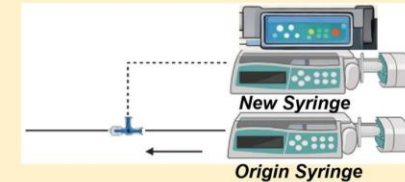
Phase 3: Stop original syringe



Stop and remove original syringe

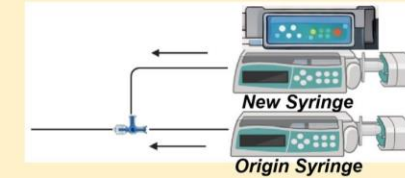
Automated Changeover (AC) Method

Phase 1: Preparation



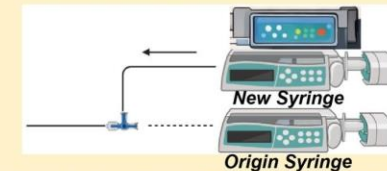
Connect both syringes to the automated system

Phase 2: Automated changover



System-led automatic transition based on sensor

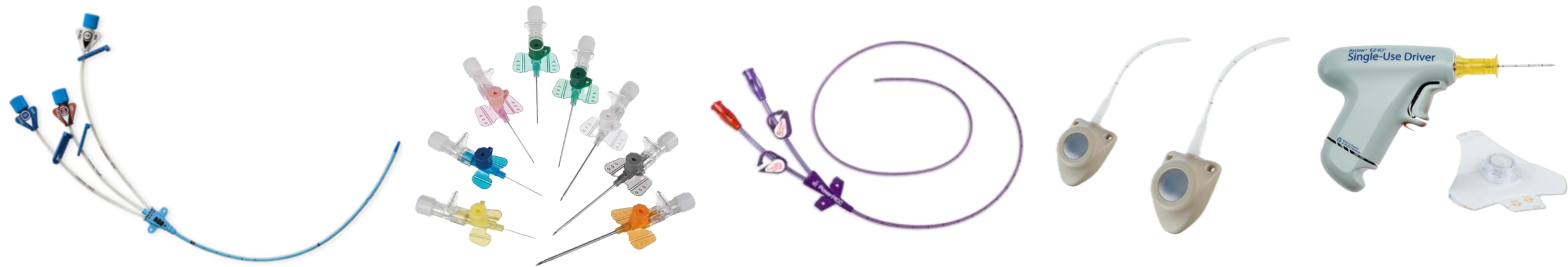
Phase 3: Stop original syringe



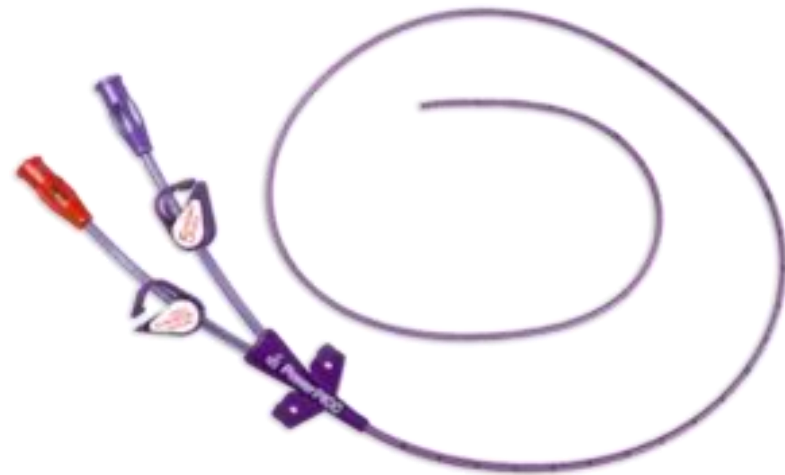
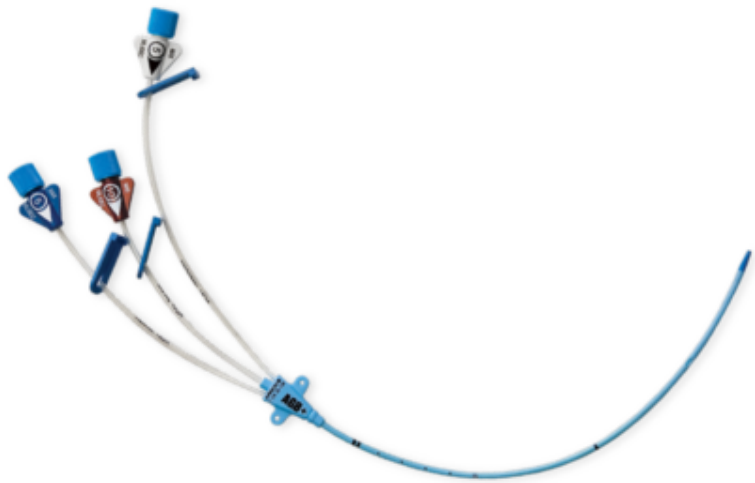
Stop the origin syringe; New syringe at the same rate

Li et al., 2025

Administrace noradrenalinu



Administrace noradrenalinu



Volba lumen centrální žilní kanyly (CŽK) pro aplikaci noradrenalinu

DOPORUČENÍ PRO PRAXI

1. Volba katétru

- druhy a jejich odlišnosti, délka, počet lumen

2. Zavedení CVK a ověření polohy

- ultrazvuková kontrola, EKG navigace, návrat krve, RTG, poloha pacienta a posun katétru

3. Péče o CVK

- volba fixace a krytí
- návrat krve
- vzdálenost katétru od místa vpichu

4. Standardizovaný postup

5. Monitorace a dokumentace

Aplikace noradrenalinu cestou periferní žilní kanyly (PŽK)

PRO

- Předpoklad krátkodobého podávání
- Dle příbalového letáku Noradrenalin léčiva možná aplikace do velkých žil
- „Snazší“/dostupnější přístup
- Komfort nemocného
- Čas pro zahájení terapie
- Minimalizace rizik v souvislosti se zavedením CVK
- Alternativa podání v zemích s omezenými zdroji

CON

- Předpoklad dlouhodobějšího podávání (via PŽK do zajištění CŽK)
- Noradrenalin = vesikant a iritant
- Riziko extravazace a poškození tkání
- Riziko selhání vstupu
- Podávání dalších vesikantů a iritantů

ANO, ale za určitých podmínek

Guidance For:

The use of Vasopressor Agents by Peripheral Intravenous Infusion in Adult Critical Care Patients

Version 1.1



Barbara Nickel, APRN-CNS, CCRN, CRNI®
Lisa Gorski, MS, RN, HHCNS-BC, CRNI®, FAAN
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Amy Kyes, MSN, APRN, AG-CNS, CV-BC™, CRNI®
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9TH EDITION
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Initiate vasopressor administration via a short PIVC for short-duration vasopressor infusion (24 hours or less in the adult) if CVAD insertion is not immediately available (eg, limited resources for insertion, patient characteristics) or if the vasopressor requirement is likely of short duration (eg, hypotension related to epidural anesthesia, high probability of successfully weaning off within 24 hours).^{2,4-6,8,29,36,41-53} (II)

GUIDELINES

Surviving Sepsis Campaign: international guidelines for management of sepsis and septic shock 2026

Hallie C. Prescott^{1,2*}, Massimo Antonelli^{3,4}, Waleed Alhazzani^{5,6,7}, Morten Hylander Møller^{8,9}, Faye Alshamsi¹⁰, Luciano C. P. Azevedo¹¹, Emilie Belley-Cote^{12,13,14}, Jan De Waele^{15,16}, Lennie Derde^{17,18}, Joanna C. Dionne^{19,20}, Laura Evans²¹, Hayley B. Gershengorn^{22,23}, Carol L. Hodgson^{24,25}, Kimia Honarmand^{26,27}, Jozef Kesecioglu²⁸, Lauralyn McIntyre^{29,30}, Mervyn Mer³¹, Mark E. Nunnally³², Simon J. W. Oczkowski^{20,27}, Bram Rochwerg^{20,27}, Olurotimi Olaolu Akinola³³, Kwame A. Akuamoah-Boateng³⁴, Laura Alberto^{35,36}, Derek C. Angus³⁷, Yaseen M. Arabi³⁸, Elie Azoulay³⁹, Maurizio Cecconi^{40,41}, Pauline F. Convocar^{42,43,44}, Gennaro De Pascale^{3,4}, Kent Doi⁴⁵, Bin Du⁴⁶, Moritoki Egi⁴⁷, Marie-Carmelle Elie-Turenne^{48,49}, Ricard Ferrer^{50,51}, Alison Fox-Robichaud^{52,53}, Craig French^{54,55}, Yonathan Freund^{55,56}, Michelle Ng Gong⁵⁷, Caleb P. Hale⁵⁸, Naomi E. Hammond^{59,60}, Madiha Hashmi⁶¹, Leo Heunks⁶², Theodore J. Iwashyna^{63,64}, Shevin T. Jacob^{65,66}, Michael Klompas^{67,68}, Arthur Kwizera⁶⁹, Murdoch Leeies^{70,71}, Joanna D. Lejniaks⁷², Mitchell M. Levy⁷³, Flavia R. Machado⁷⁴, Marcelo O. Maia^{75,76,77}, Henry Masur⁷⁸, Ryan C. Maves^{79,80}, Steven McGloughlin^{25,81}, Joanne McPeake⁸², Nicholas M. Mohr^{83,84,85}, Sheila Nainan Myatra⁸⁶, Marlies Ostermann^{87,88}, Sandra L. Peake^{89,90,91}, Mathias W. Pletz^{92,93}, Jason A. Roberts^{94,95,96}, Regis G. Rosa^{97,98,99}, Robert G. Sawyer¹⁰⁰, Christa A. Schorr^{101,102}, Steven Q. Simpson¹⁰³, Li Weng¹⁰⁴, W. Joost Wiersinga^{105,106,107}, Andrew Rhodes¹⁰⁸ and Craig M. Coopersmith¹⁰⁹

Route of vasopressor administration

Recommendation

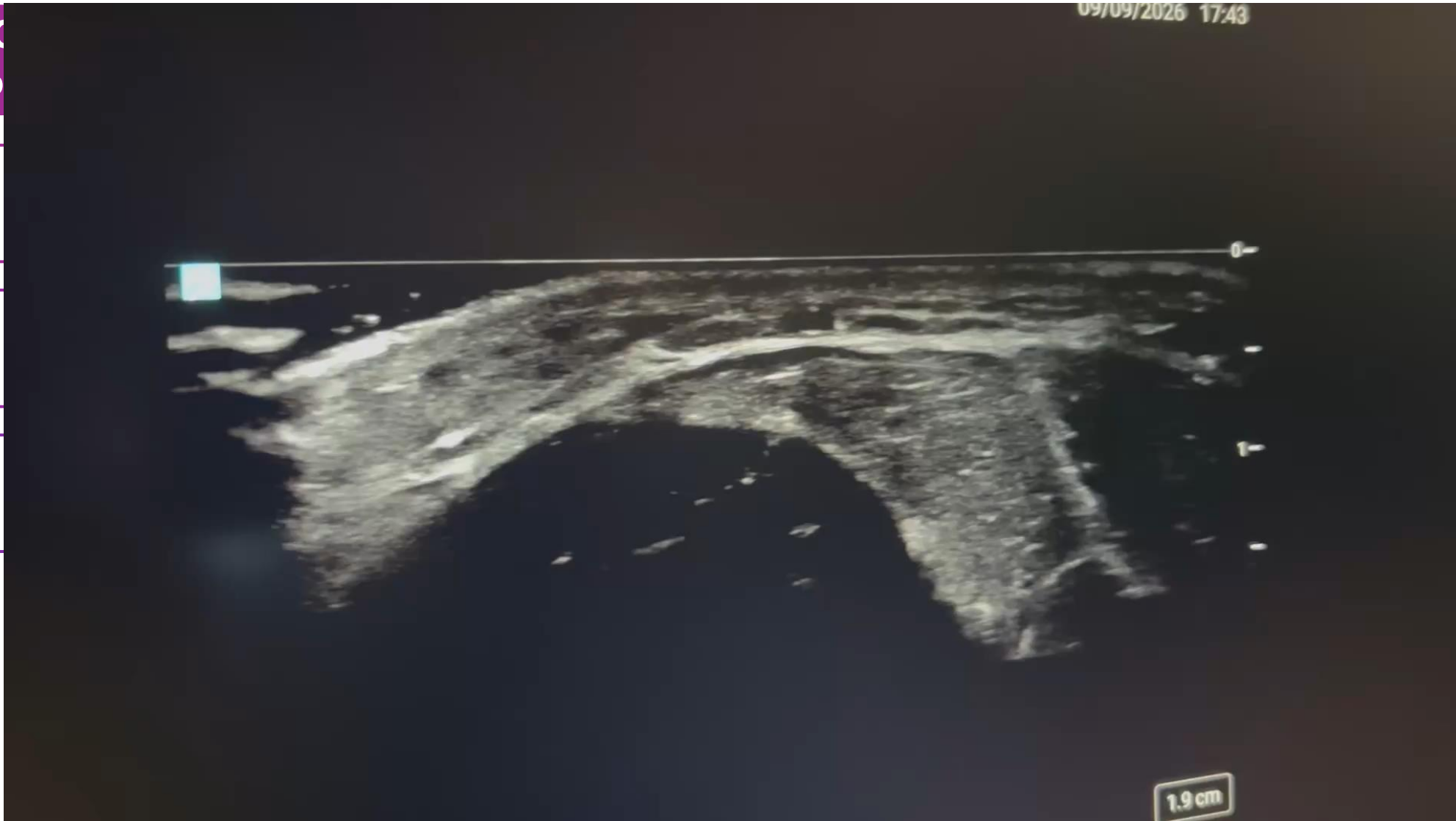
12. In adults with septic shock, we “suggest” starting vasopressors peripherally to restore mean arterial pressure rather than delaying initiation until central venous access is secured

Revisited

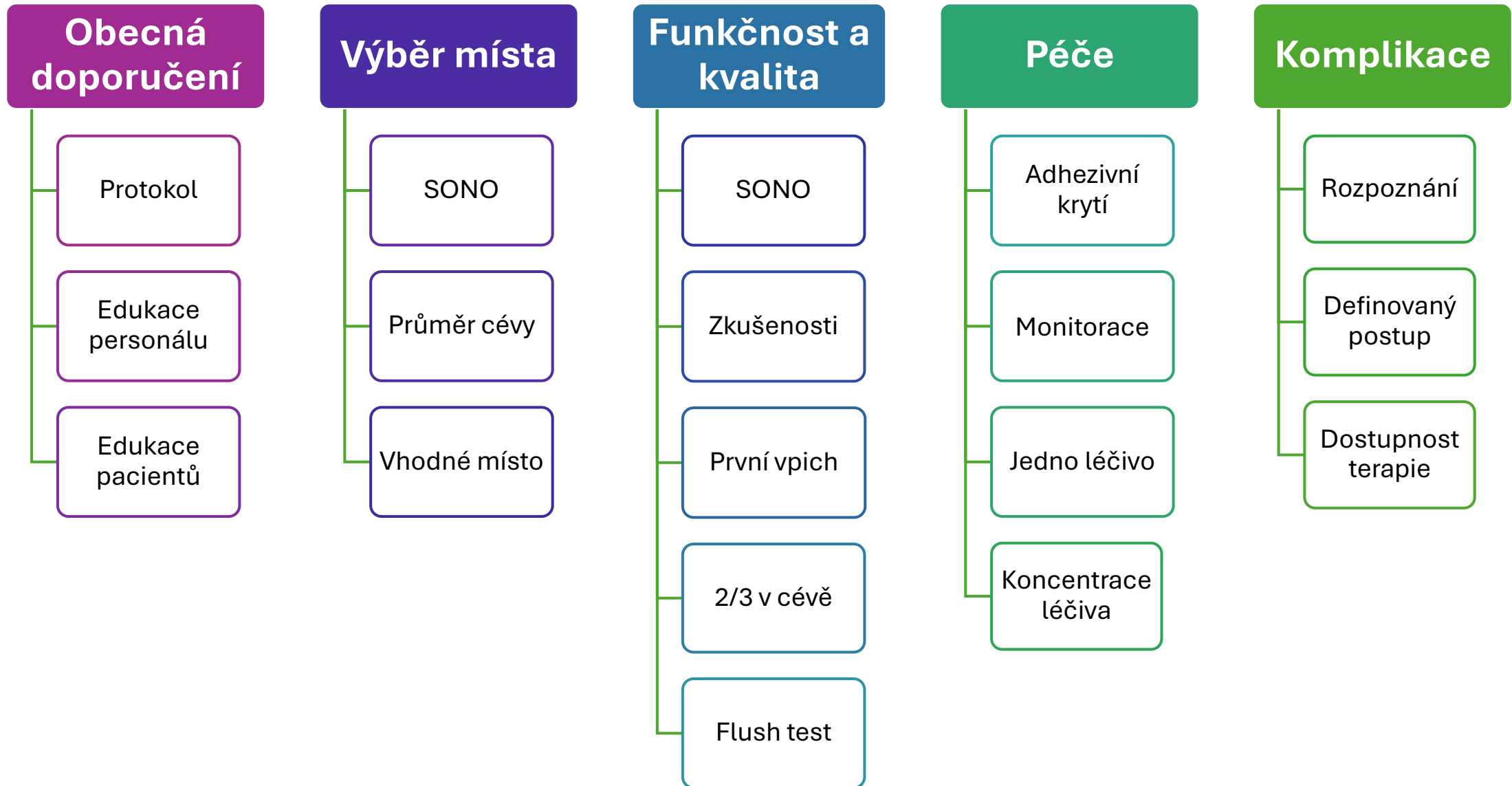
(conditional recommendation, very low certainty evidence)

Remark: Data are insufficient to recommend a duration of use, dose, or access route (size of peripheral IV line or anatomic location). Midline catheters were not considered

Podávání katecholaminů cestou PŽK



Podávání katecholaminů cestou PŽK



Podávání katecholaminů cestou PŽK

Effect of Peripherally Infused Norepinephrine on Reducing Central Venous Catheter Utilization

Sara M. Powell, Andrew C. Faust , Stephy George, Richard Townsend, Darla Eubank, Richard Kim

[Authors and Affiliations](#) >

Journal of Infusion Nursing 46(4):p 210-216, July/August 2023. | DOI: 10.1097/NAN.0000000000000508



Complication of vasopressor infusion through peripheral venous catheter: A systematic review and meta-analysis

Quincy K. Tran, MD, PhD ^{a,b,*}, Gaurika Mester ^c, Vera Bzhilyanskaya ^c, Leenah Z. Afridi, MBBS ^c, Sanketh Andhavarapu ^c, Zain Alam ^c, Austin Widjaja ^c, Brooke Andersen, ACNP-BC ^d, Ann Matta, ACNP-BC ^d, Ali Pourmand, MD, MPH ^e

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- 26 pacientům byl podáván noradrenalin via CVK
- 98 pacientům byl podáván noradrenalin via PŽK
 - 36 pacientů (37 %) s aplikací noradrenalinu via PŽK nepotřebovalo zavedení CVK (délka aplikace ≤ 12 hodin u 80 pacientů (82 %))
 - Úspora přímých nákladů byla ve výši 8 900 USD
- U žádného ze 124 pacientů nebyla zaznamenána extravazace ani další komplikace

- Metaanalýza z roku 2020
- Celkem 1835 pacientů
- Zaznamenáno 122 (7%) komplikací
 - Infiltrace → 72 %
 - Erytém → 21 %
 - Závažné komplikace → 4% (periferní žilní trombóza)
- Nižší míra komplikací byla spojena s velikostí PŽK

Extravazace noradrenalinem

Prevence

Protokol

Edukace personálu

Edukace pacienta

Monitorace á 1 hodina

Včasné rozpoznání

Dostupná terapie

Evidence komplikací

Projevy

Změna barvy

Změna teploty

Tvorba puchýřů

Nekróza

Prosak do krytí

Bolestivost

Terapie

Přerušení aplikace

Aspirace 3-5 ml z PVK

Aplikace Fentolaminu
i.v./s.c.

Extrakce PVK

Označení rozsahu

Nitroglycerinová mast

Elevace končetiny

Lokální terapie

Chirurgická terapie

Extravazace noradrenalinem



Pradhan, 2022



Kim, 2012

Závěr

- Podávání katecholaminů je:
 - rizikový výkon s celou řadou specifik a závažných komplikací
 - stále zatíženo lokálními zvyklostmi a „know how“ daného pracoviště
- Edukace personálu
- Dostupnost standardizovaného postupu/protokolu



I zdánlivé drobnosti (často neviditelné) zásadním způsobem ovlivňují kvalitu a bezpečnost péče s následnou prognózou pacienta

Děkuji za pozornost



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