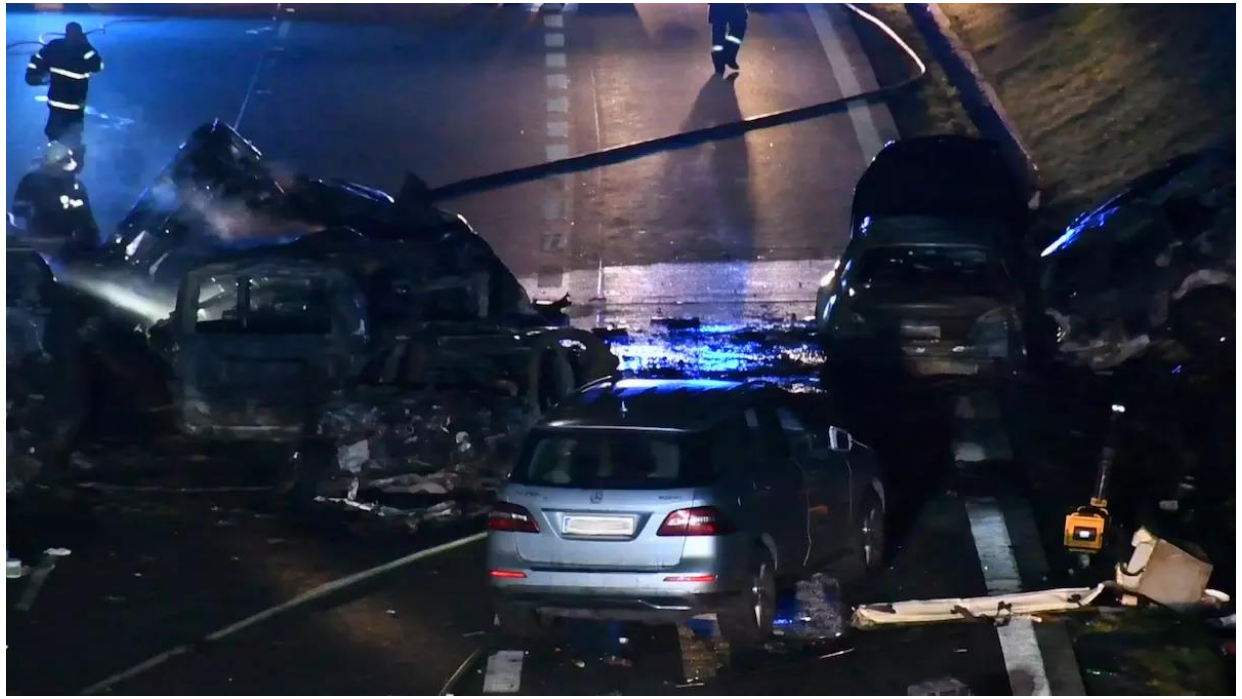
Aktuální trendy v použití intraoseálního přístupu u pacienta s masívním krvácením

Jana Kubalová
Zdravotnická záchranná služba Jihomoravského kraje

Polytrauma, Kongres Košice, 18. 10. 2019

Závažné trauma?



Závažné trauma

- 48% všech TCA je příčinou CA hemorhagie
- 13% pacientů TCA - obstrukce DC a traumatická asfyxie
- 13% všech TCA tenzní PNO

- Správná péče o těžce zraněného pacienta je velká výzva
- Cíl: dovézt pacienta živého a neškodit

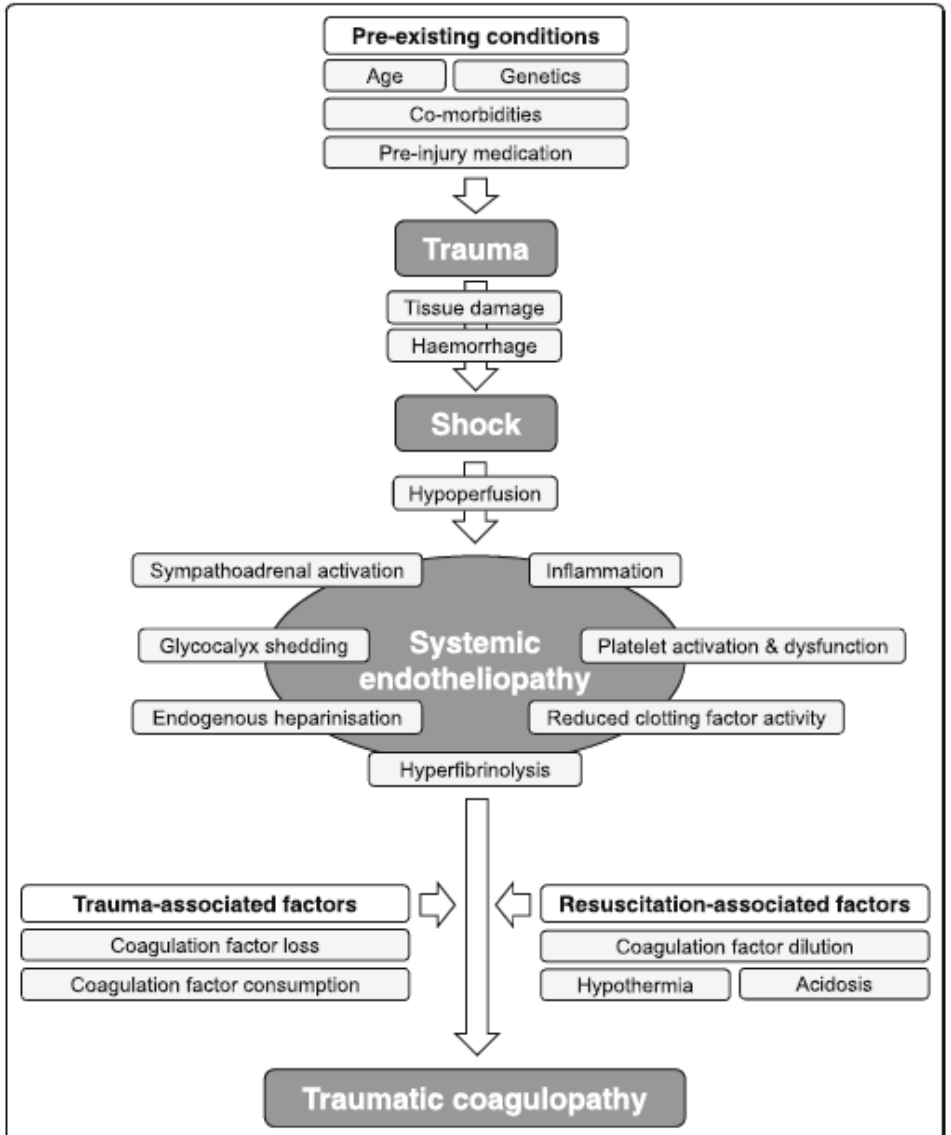


Fig. 1 Schematic drawing of the factors, including those that are preexisting as well as those related to both trauma and resuscitation measures, that contribute to traumatic coagulopathy. Adapted from [20, 24, 30–32, 38]

k vytčenému cíli

- Řešit potenciálně reverzibilní příčiny:
  - ✓Hypoxémie
  - ✓Hypovolémie
  - ✓Tenzní PNO
  - ✓Tamponáda perikardu

Minimalizovat čas přednemocniční fáze

Direktně traumacentrum

Potřebujeme intravaskulární vstup?

(X)ABCDE

... o lidech a pro lidi ...

X

Spahn et al. Critical Care (2019) 23:98
https://doi.org/10.1186/s13054-019-2347-3

Critical Care

RESEARCH Open Access

The European guideline on management of major bleeding and coagulopathy following trauma: fifth edition

Donat R. Spahn[1], Bertil Bouillon[2], Vladimir Cerny[3,4,5,6], Jacques Duranteau[7], Daniela Filipescu[8], Beverley J. Hunt[9], Radko Komadina[10], Marc Maegele[11], Giuseppe Nardi[12], Louis Riddez[13], Charles-Marc Samama[14], Jean-Louis Vincent[15] and Rolf Rossaint[16*]

- Zástava kompresibilního krvácení – končetiny turniket

- Nekompresibilní krvácení

IV? NE

A + B

- Vyhnout se hypoxémii, maximalizovat oxygenoterapii (15l/min)
- 13% všech TCA tenzní PNO - odhalit tenzní PNO!
- OTI? Ventilace pozitivním přetlakem zhoršuje srdeční návrat

A – intubace?

IV?
ANO/NE

- Indikace OTI: vždy hypoventilace, hypoxémie,
- GCS < 8? (zvaž)
- hemoragický šok?? (zvažuj dvakrát – čas, transport LZS....)
- RSI (rapid sequens intubation), DAI (drug asisted intubation), DSI (delayed sequens intubation), NIV (noninvasive ventilation),
- Ketamin ★
- Paralysis paradox
- Vt 6 ml/kg, normoventilace ETCO2 cíl: 35 – 40 mmHg (5,0 – 5,5 kPa)

... o lidech a pro lidi ...

C

- Damage control resuscitation
- Pánevní pás již při podezření (MÚ)

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Pelvic ring closure and stabilisation

Recommendation 19 We recommend that patients with pelvic ring disruption in haemorrhagic shock undergo immediate pelvic ring closure and stabilisation. (Grade 1B)

Tekutiny?

Type of fluid

Recommendation 15 We recommend that fluid therapy using isotonic crystalloid solutions be initiated in the hypotensive bleeding trauma patient. (Grade 1A)

We recommend the use of balanced electrolyte solutions and the avoidance of saline solutions. (Grade 1B)

We recommend that hypotonic solutions such as Ringer's lactate be avoided in patients with severe head trauma. (Grade 1B)

We recommend that the use of colloids be restricted due to the adverse effects on haemostasis. (Grade 1C)

výj.skupina	T koag. min	T ne koag. min	V celk. ml	V koag. ml	V sine ml
LZS	73	72,7	1391	1600	1243
LZS/RL	96,1	95,1	1448	2018	1135
RL/D	104	105	1217	2125	957
RL/N	85,5	107	1358	2250	1120
celkem	89,37	98,4	1366	1987	1100

Spolupráce ZZS KV a traumacentra FN Brno Bohunice, Traumaprotokol

Vaňatka Tomáš, Vaníčková Kateřina

ZZS Kraje Vysočina, OUP FN Brno Bohunice

2013

Kyselina tranexamová

- Podat v iniciální dávce 1g na 10 min, co nejdříve, do 3 hodin po úrazu
- Grade 1 A
- Děti: 15 – 30 mg/kg

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In order to ensure that TXA is administered early, TXA administration at the pre-hospital site of injury needs to be planned, and we recommend that protocols for the management of bleeding patients strongly consider administration of the first dose of TXA at the site of injury. El-Menyar et al. looked at the efficacy of

ZZS JMK
... o lidech a pro lidi ...

Krev a deriváty krve

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https://doi.org/10.1186/s13054-019-2347-3

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Initial coagulation resuscitation

Recommendation 24 In the initial management of patients with expected massive haemorrhage, we recommend one of the two following strategies:

- FFP or pathogen-inactivated FFP in a FFP:RBC ratio of at least 1:2 as needed. (Grade 1C)
- Fibrinogen concentrate and RBC. (Grade 1C)

... o lidech a pro lidi ...

C

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- Permisivní hypotenze (TKs 80 – 90 mmHg, CAVE: TBI MAP > 80 mmHg)
- Cíl: hmatný puls na periférii

IV? ANO

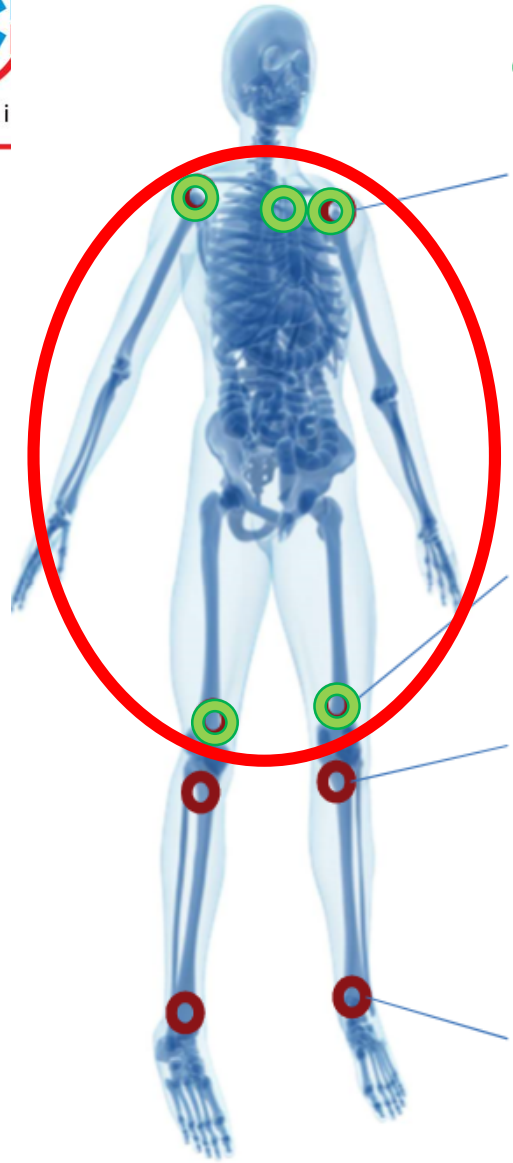
1 X CÉVNÍ VSTUP, DOSTATEČNÝ PRŮSVIT, ALTERNATIVA I. OS – HUMERUS

tísňová linka 155

I. os. zavedení

- Děti zástava oběhu nebo dekompenzovaný šok (adrenalin, tekutiny): i. os = 1. volba (manuál EPALS, CPR GL 2015)

Místa zavedení



4 Sites, 8 Targets

Proximal Humerus

Preferred site for adults

Optimal site for high flow and quick drug uptake

Awake, responsive patients

Less painful

Distal Femur

Best under 12 years

Proximal Tibia

Unresponsive

Unfamiliarity with other sites

Unable to landmark other sites

Distal Tibia

Larger patient

Unable to access other sites

Site selection

Dependent upon:

- No previous IO in 48 hours
- Absence of contraindications
- Accessibility
- Ability to secure & monitor

Semi-automatické Arrow EZ–IO™ - EZ (Easy) IO (IntraOsseal) access

- Rychlejší zavedení
- Vysoké procento úspěšnosti
- Minimální riziko komplikací
- Lepší, než manuální a jiné semi-automatické pomůcky

Efficacy and safety of the EZ-IO™ intraosseous device: Out-of-hospital implementation of a management algorithm for difficult vascular access☆,☆☆

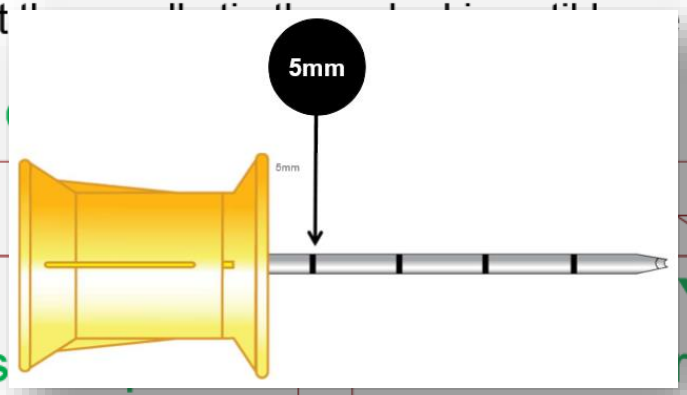
Nicolas Gazin[a], Harold Auger[a], Patricia Jabre[a,b,c], Christine Jaulin[a], Eric Lecarpentier[a], Catherine Bertrand[a], Alain Margenet[a], Xavier Combes[a,*]

Weiser G et al, Current advances in intraosseous infusion - a systematic review, Resuscitation, 2012 Jan;83(1):20-6. doi: 10.1016/j.resuscitation.2011.07.020. Epub 2011 Aug 24. (179 => 10)

Klause A, Williams B., Intraosseous access in the prehospital setting: literature review. Prehosp Disaster Med. 2012 Oct;27(5):468-72. doi: 10.1017/ S1049023X12001124. Epub 2012 Aug 9. (2100 => 20)

Thin tissue over bone site	Moderate tissue over bone site	Thick tissue over bone site	Humerus bone site (Adults)
15 mm	25 mm	45 mm	45 mm

Insert felt



No
Select next s
or different site

Yes
t needle

EZ-IO

Mýty? Fakta?

- CVK je zavedený stejně rychle?
- Průtok je pomalý?
- Riziko vážných komplikací?
- Poškození růstové ploténky?

IO vs. CVK

Patient Safety in Surgery

Research

Is the intraosseous access route fast and efficacious compa conventional central venous catheterization in adult patien resuscitation in the emergency department? A prospectiv observational pilot study

Bernd A Leidel*[1,3], Chlodwig Kirchhoff[2], Viktoria Bogner[2], Julia Ste Wolf Mutschler[2], Karl-Georg Kanz[2] and Volker Braunstein[2]

Address: [1]Department of Emergency Medicine, Charité - University Medicine Berlin, Campus Benjamin Franklin, Hindenburg Berlin, Germany, [2]Department of Trauma, University Medical Centre of Munich, Downtown, Nussbaum Street 20, 80336 Mu [3]Helicopter Emergency Medical Service Christoph 31, ADAC Luftrettung air rescue services, Charité - University Medicine Ber Benjamin Franklin, Hindenburgdamm 30, 12203 Berlin, Germany

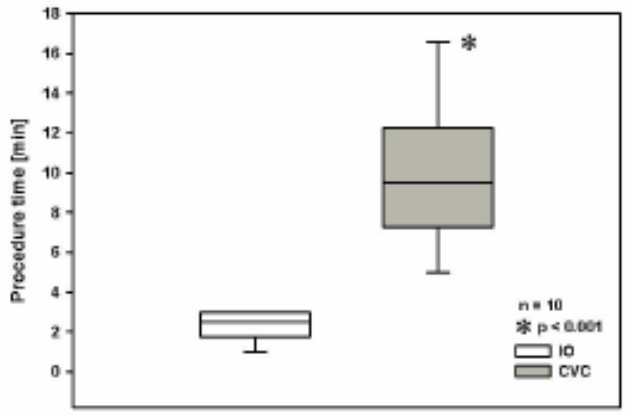


Figure 3
Procedure time of intraosseous (IO) cannulation was significantly shorter than central venous catheterization (CVC) for vascular access to enable drug and fluid administration in adult emergency patients under resuscitation.

jugular or subclavian veins. The success rate on first attempt was 90% for IO insertion versus 60% for CVC. Mean procedure time was significantly lower for IO cannulation (2.3 min ± 0.8) compared to CVC (9.9 min ± 3.7) ($p < 0.001$). As for complications, failure of IO access was observed in one patient, while two or more attempts of CVC were necessary in four patients. No other relevant

impossible peripheral IV access. Furthermore, IO cannulation requires significantly less time to enable administration of drugs or infusion solutions compared to CVC. Because CVC was slower

IO vs. CVK

Dolister M et al, Intraosseous vascular access is safe, effective and costs less than central venous catheters for patients in the hospital setting, J Vasc Access 2013; 14(3): 216 – 224

„Results:

- 105 cases, six centers
- 94% of placements were successful on the first attempt
- mean time to IO access was 103.6±96.2 seconds
- one serious complication – a lower extremity compartment syndrome
- IO access costs $100/patient.

Conclusions:

- IO catheter placement than reported for CVCs, few complications and high user satisfaction

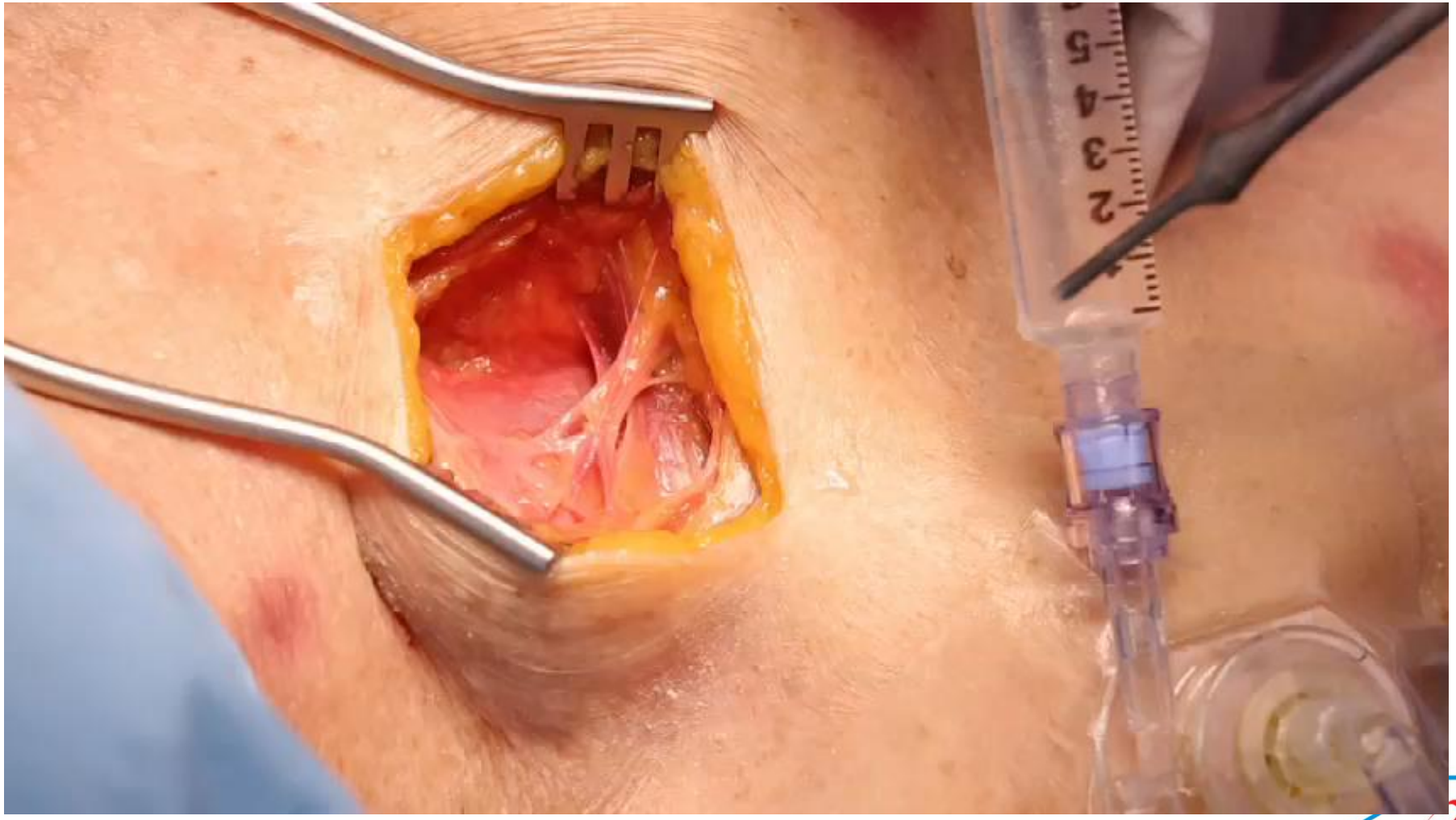
Průtok kanylou

- Hagen-Poiseuilleoův zákon: $Q=\pi r4 \,.\, \Delta P/8\mu l$
  - Q = průtok
  - r = poloměr kanyly
  - ΔP = tlakový gradient mezi začátkem a koncem
  - M = viskozita podávaného roztoku
  - l = délka kanyly

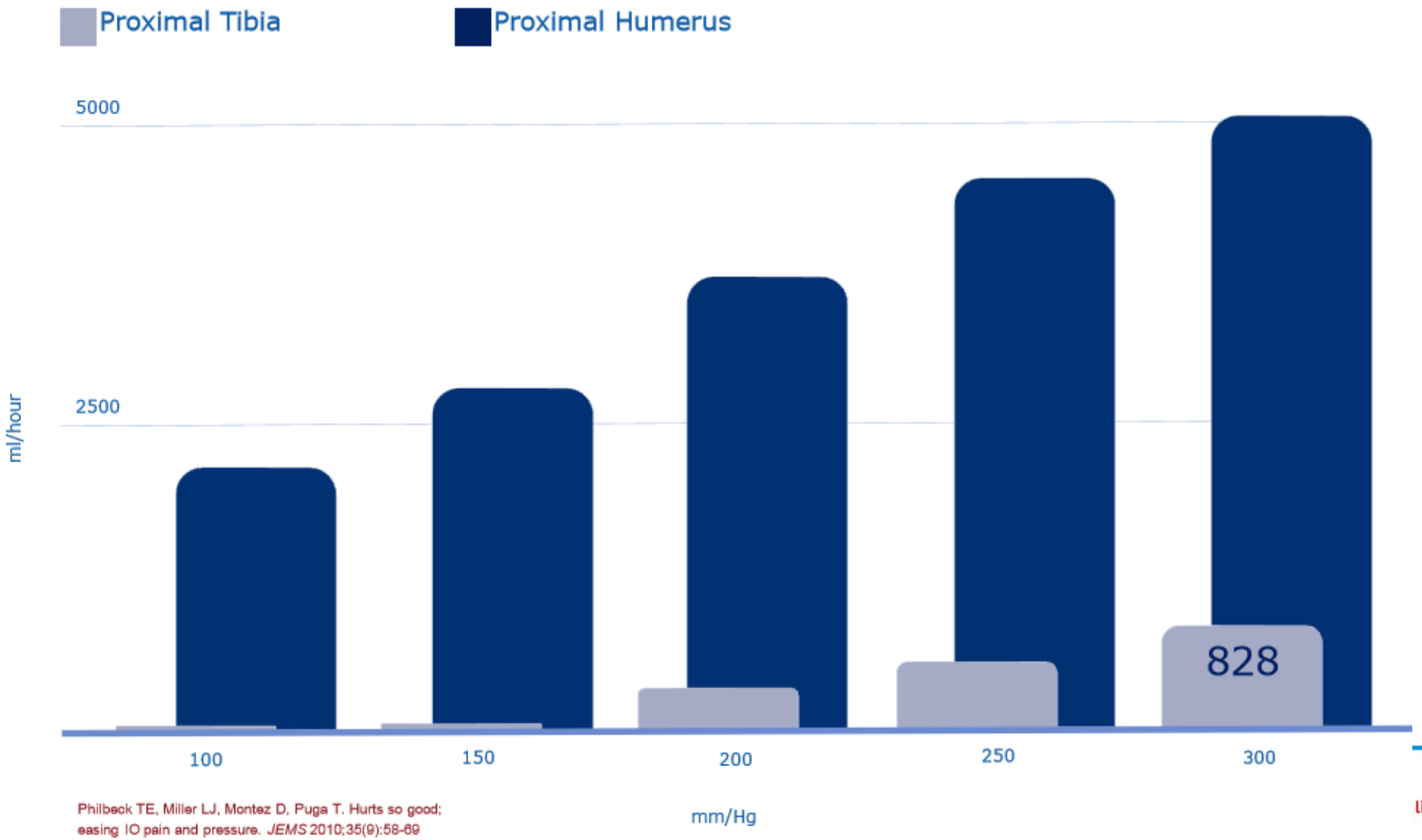
⇒ průtok závisí přímo úměrně na čtvrté mocnině poloměru

⇒ průtok krátkou kanylou zavedenou do PŽ (l=4,5cm) bude min. 3x↑ než průtok katétrem téhož kalibru zavedeném do CŽ (l=15 – 20cm)

⇒ video



Průtok v závislosti na přetlaku



Philbeck TE, Miller LJ, Montez D, Puga T. Hurts so good; easing IO pain and pressure. *JEMS* 2010;35(9):58-69

ASPIROVAT, APLIKOVAT BOLUS!!!
(během 5 s 5 - 10 ml FR, děti 2 – 5 ml)

Máme se bát komplikací?

- Možné závažné komplikace IO: osteomyelitis, fraktura, infekce, extravazace, kompartment syndrom a poranění růstové ploténky, tuková embolie

Serious Complications of Intraosseous Access during Infant Resuscitation

Jiri Molacek[1] Karel Houdek[1] Václav Opatrný[1] Jiri Fremuth[2] Lumir Sasek[2] Inka Treskova[3] Vladislav Treska[1]

[1] Department of Vascular Surgery, University Hospital in Pilsen, Pilsen, Czech Republic
[2] Department of Pediatric Intensive Care Unit, University Hospital in Pilsen, Pilsen, Czech Republic
[3] Department of Plastic Surgery, University Hospital in Pilsen, Pilsen, Czech Republic

Address for correspondence Jiri Molacek, MD, PhD, Department of Vascular Surgery, University Hospital in Pilsen, alej Svobody, Pilsen 30460, Czech Republic (e-mail: molacek@fnplzen.cz).

Eur J Pediatr Surg Rep 2018;6:e59–e62.

We report on a 2.5-month-old infant with ischemia of the left leg and compartment following intraosseous needle application during resuscitation. Unfortunately, this event led to major limb amputation. The cause, mechanism, and prevention of this severe complication are discussed in this article.

Komplikace - statistiky

- Děti – osteomyelitis < 0, 6% (4200 pacientů, komplikace = bakteriémie v době vpichu, prodloužená doba inserce)

Rossetti, VA, Thompson, BM, Miller, J et all. Intraosseus infusion: an alternative route of pediatric access. Ann Emerg Med 1985; 14:885-8

- Na histopat. změny ve dřeni po IO inf. nemá vliv ani rychlost ani osmolalita (u prasat)

Brickman KR, Rega P, Schoolfield L, Harkins K, Weisbrode SE, Reynolds G: Investigation of bone developmental and histopathologic changes from intraosseous infusion. Ann Emerg Med October 1996;28:430-435

... o lidech a pro lidi ...

West J Emerg Med. 2013 September; 14(5): 440–443.
doi: 10.5811/westjem.2013.1.12000
PMCID: PMC3789903

Complication with Intraosseous Access: Scandinavian Users' Experience

Peter Hallas, MD,* Mikkel Brabrand, MD,† and Lars Folkestad, MD‡

Table. Complication rate with intraosseous access (IO) reported by Scandinavian users - listed by device.

IO-equipment used	All	%	EZ-IO	B.I.G	Cook	Others	p-value*
Cases reported	1,802	100.0	861	255	418	268	
Start complications							
Equipment difficult to assemble	36	2.0	4	21	5	6	< 0.0001
Difficult to identify correct anatomical site	57	3.2	28	17	5	7	0.0013
Bended or broken needle	72	4.0	11	17	20	24	< 0.0001
Patient discomfort / pain	128	7.1	73	13	20	22	0.0663
Difficult to penetrate the periosteum	186	10.3	18	56	51	61	< 0.0001
Difficult to aspirate bone marrow	221	12.3	92	51	38	40	< 0.0001
Complications in use							
Difficult to inject fluid and drugs	133	7.4	59	33	27	14	0.0026
Slow infusion despite use of pressure bag	159	8.8	77	32	34	16	0.0610
Displacement after insertion	153	8.5	47	50	38	18	< 0.0001
Extravasation	66	3.7	25	12	17	12	0.4089
Late complications							
Compartment syndrome	10	0.6	6	1	1	2	0.796
Osteomyelitis	7	0.4	4	1	1	1	1.000
Skin infection	6	0.3	4	1	1	0	0.829

Poranění růstové ploténky?

- Žádné abnormality na růstové ploténce při klinickém i rtg vyšetření u 3. – 4. týdenních prasat (FR, NaHCO3)

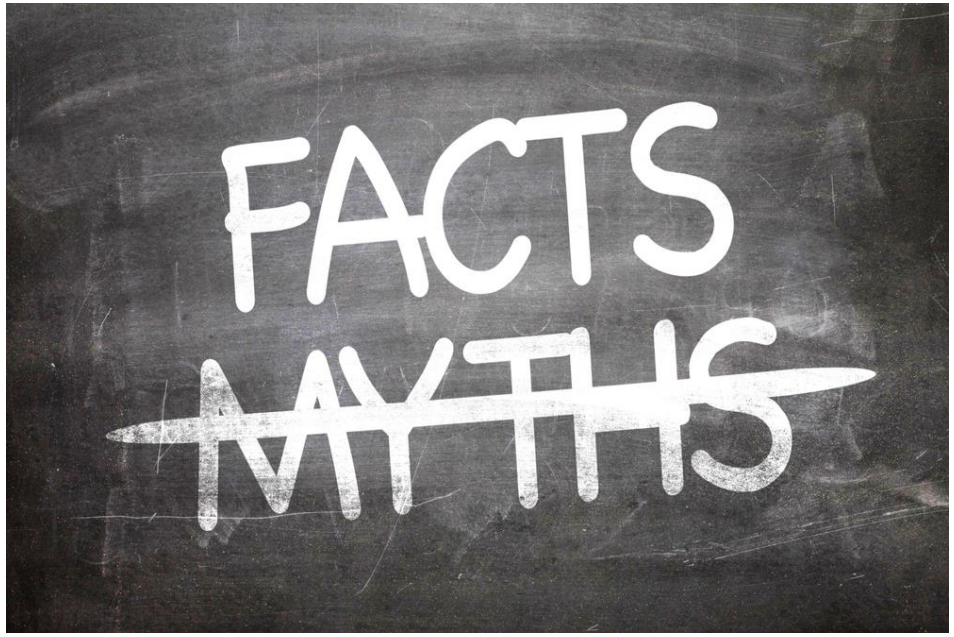
Brickman KR, Rega P, Koltz M, Guinness M. Analysis of growth plate abnormalities following intraosseous infusion through the proximal tibial epiphysis in pigs. Ann Emerg Med. 1988 Feb. 17(2):121-3.

- 23 dětí, prox. tibie, prům. věk 18.6m, zavedení 5 hodin, objem 225 ml, rtg vyš. za 29,2 m, porovnání obou končetin, žádné signifikantní změny mezi punktovanou a kontrolní končetinou

Claudet I., Baunin C., Laporte-Turpin E., Marcoux MO, Grouteau E., Cahuzac JP: Long-term effects on tibial growth after intraosseous infusion: a prospective, radiographic analysis. Ped. Emerg. Care. 2003 Dec;19(6):397-401.

Mýty

- CVK je zavedený stejně rychle
- Průtok je pomalý
- Riziko komplikací
- Poškození růstové ploténky



Správné provedení

- Správné místo, správná technika, správná délka jehly, častá kontrola – eliminace komplikací

1. VYHLEDAT MÍSTO VPICHU

- Dle situace
- Dle věku
- Dle dostupného zařízení
- EZ-IO zvolit správnou délku jehly

2. PŘÍPRAVA MÍSTA VPICHU

- Dezinfekce
- Asepse

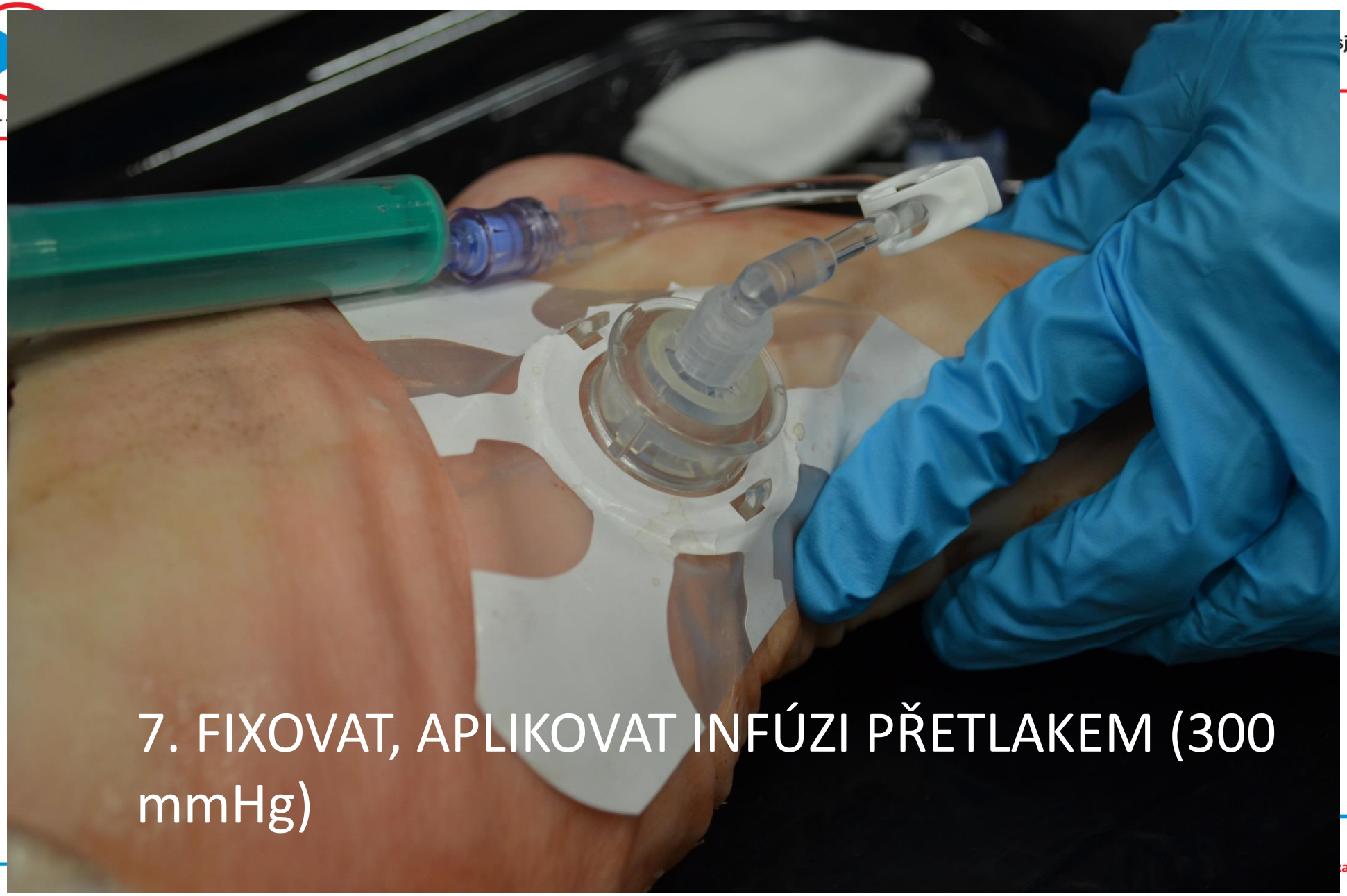
3. PROPÍCHNOUT KŮŽI

4. VRTAT (frézovat)…

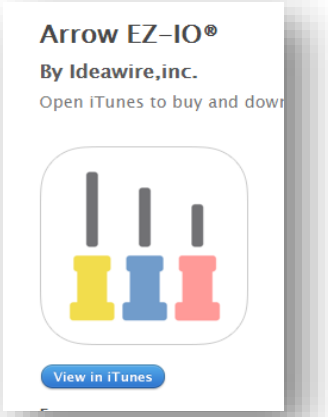
….. DO ZTRÁTY ODPORU

5. ROZŠROUBOVAT

6. ASPIROVAT, APLIKOVAT BOLUS!!! (během 5 s 5 - 10 ml FR, děti 2 – 5 ml)



7. FIXOVAT, APLIKOVAT INFÚZI PŘETLAKEM (300 mmHg)



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kubalovaj@zzsjmk.cz