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# Viskoelastické metody (VEM) v kontextu UP

Liberecké dny urgentní medicíny 23.-24.5.2024

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- **EBM - Proč je to důležité ?**
- **Fyziologie – buněčný model koagulace**
- **Princip metody**
- **Teorie, rozbor křivek, hardware**
- **Kazuistiky**



## GUIDELINES

Open Access

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

2023

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(Doporučený postup ČSARIM pro ŽOK + PPH 2011)

Antifibrinolytic agents

Coagulation support

Goal-directed therapy

Fibrinogen supplementation

Coagulation factor concentrate-based management

Fresh frozen plasma-based management

**Recommendation 27** If a FFP-based coagulation resuscitation strategy is used, we recommend that further use of FFP be guided by standard laboratory coagulation screening parameters (PT and/or APTT > 1.5 times normal and/or viscoelastic evidence of a coagulation factor deficiency) (Grade 1C).

We recommend that the use of FFP be avoided for the correction of hypofibrinogenemia if fibrinogen concentrate and/or cryoprecipitate are available (Grade 1C).

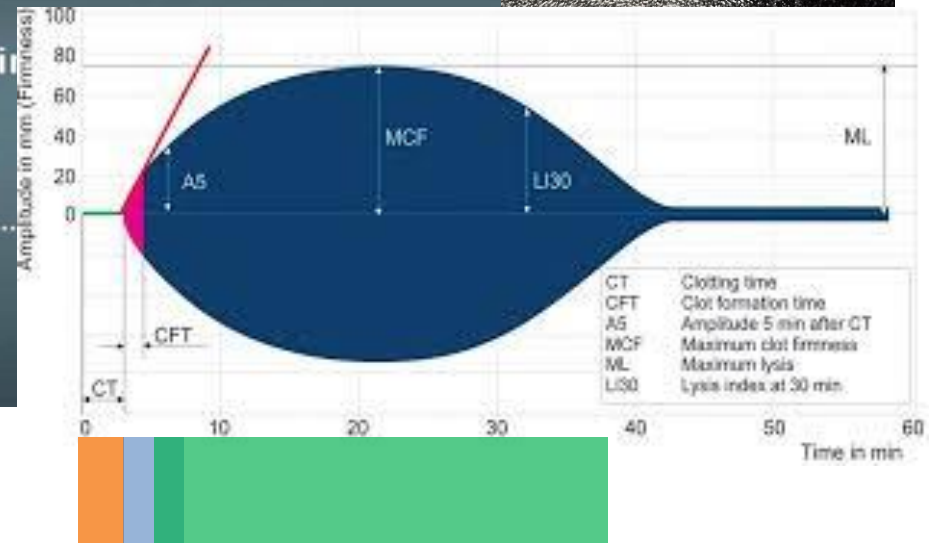
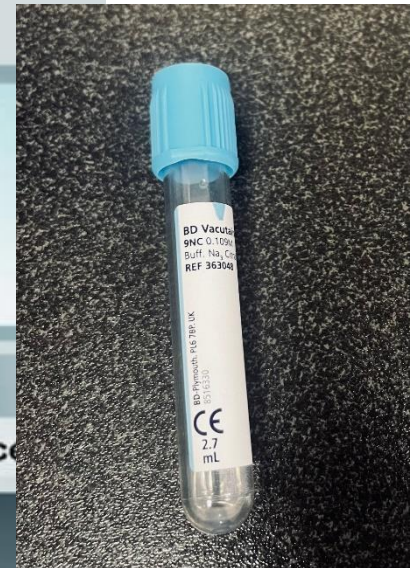
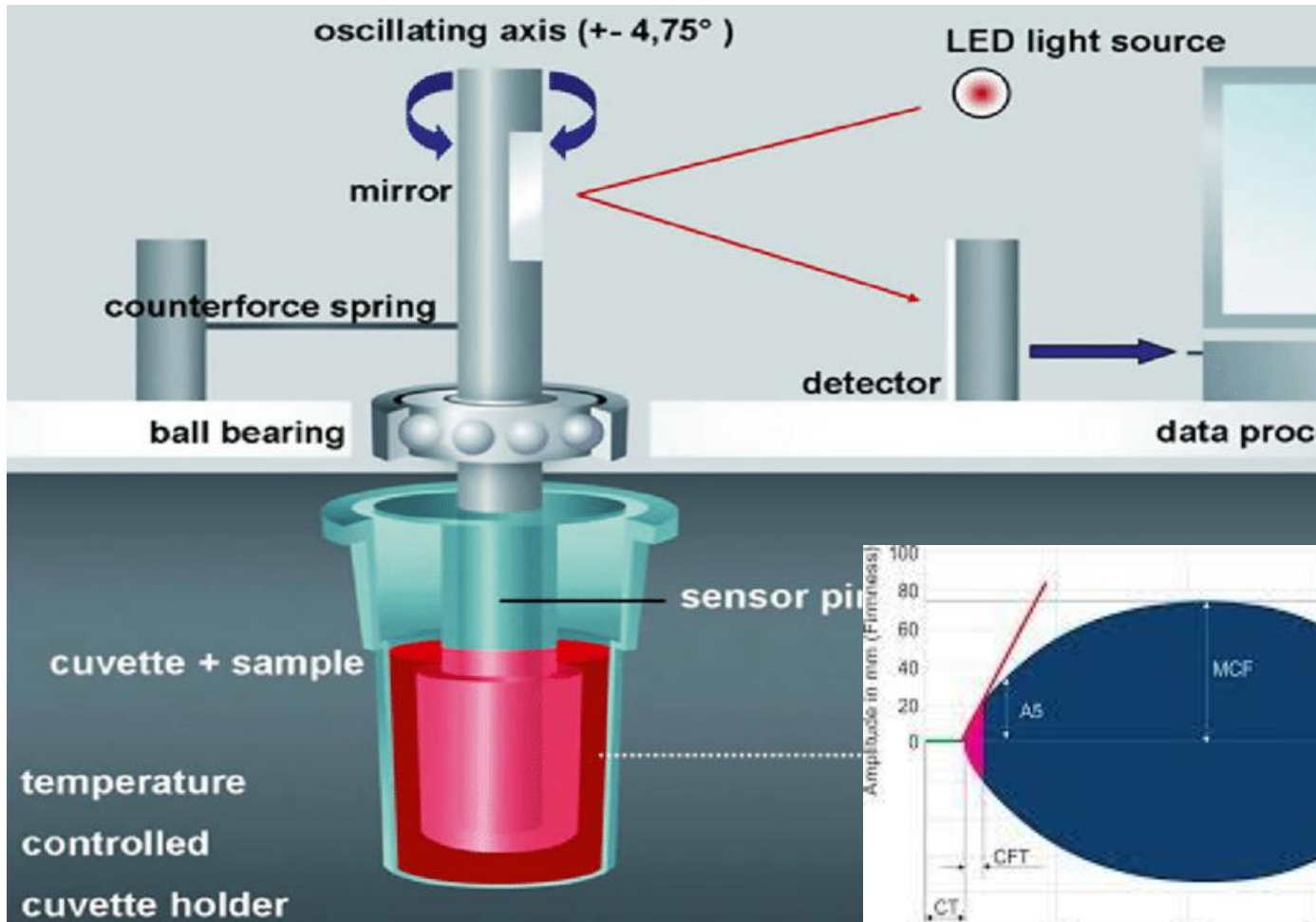


Table 3. Principles of Damage-Control Resuscitation.

- Avoid or correct hypothermia
- Apply direct pressure or a tourniquet proximal to sites of hemorrhage in the extremities; pack junctional wounds with hemostatic dressings
- Delay fluid administration until the time of definitive hemostasis in selected patients (those with penetrating trauma to the torso and short prehospital transport times)
- Minimize crystalloid infusions (<3 liters in the first 6 hr)
- Use a massive-transfusion protocol to ensure that sufficient blood products are rapidly available
- Avoid delays in definitive surgical, endoscopic, or angiographic hemostasis
- Minimize imbalances in plasma, platelet, and red-cell transfusions in order to optimize hemostasis
- Obtain functional laboratory measures of coagulation (e.g., by means of thromboelastography or rotational thromboelastometry) to guide the transition from empirical transfusions to targeted therapy
- Selectively administer pharmacologic adjuncts to reverse any anticoagulant medications and to address persistent coagulopathy

- > Časná kontrola krvácení
- > Prevence letální triády

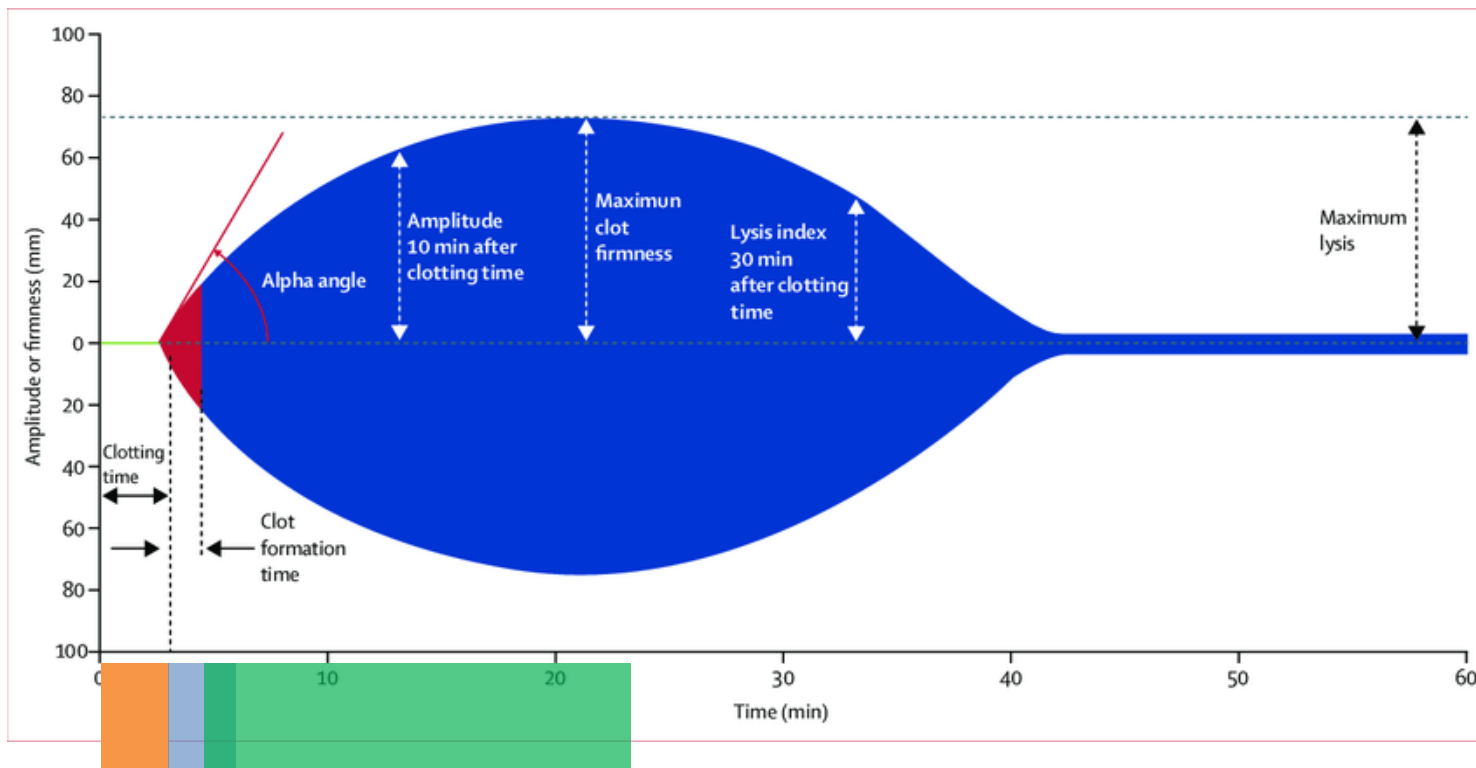




Iniciace

Propagace

Amplifikace



Iniciace  
Amplifikace  
Propagace

CT = Clotting Time [s]

CFT = Clot Formation Time [s]  
Alfa Angle [°]

MCF = Maximální pevnost sraženiny [mm]  
**A5 = amplituda 5min po CT** [mm]  
A10 = amplituda 10min po CT [mm]  
LI30/45/60 = index lýzy 30/45/60min po CT [%]  
ML = Maximální lýza [%]



## ROTEM *delta* (and *sigma*) assays

**EXTEM** CaCl<sub>2</sub> + recombinant tissue factor + polybrene

**FIBTEM** CaCl<sub>2</sub> + recombinant tissue factor + polybrene + cytochalasin D

**APTEM** CaCl<sub>2</sub> + recombinant tissue factor + polybrene + aprotinin/tranexamic acid

**INTEM** CaCl<sub>2</sub> + ellagic acid

**HEPTEM** CaCl<sub>2</sub> + ellagic acid + heparinase

**NATEM** CaCl<sub>2</sub>

## ClotPro assays (DOACs)

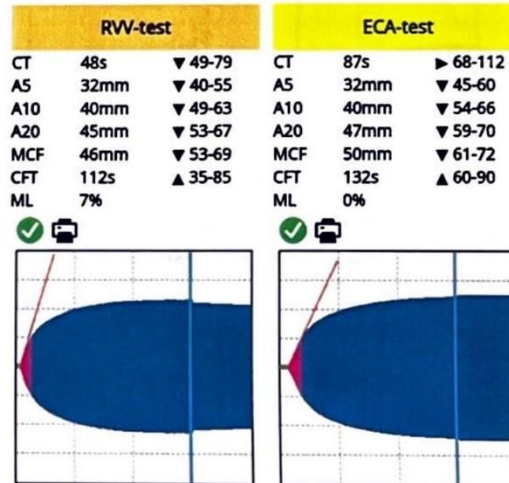
To stejné +:

**RVVtest** přímé inhibitory fXa - Xabany

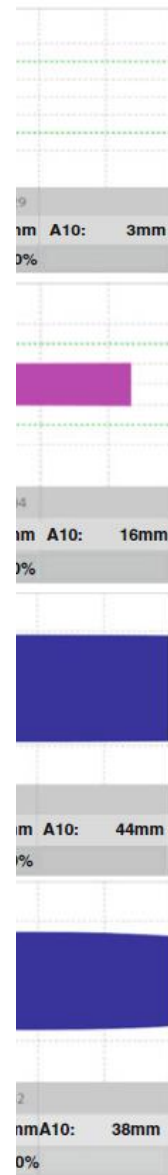
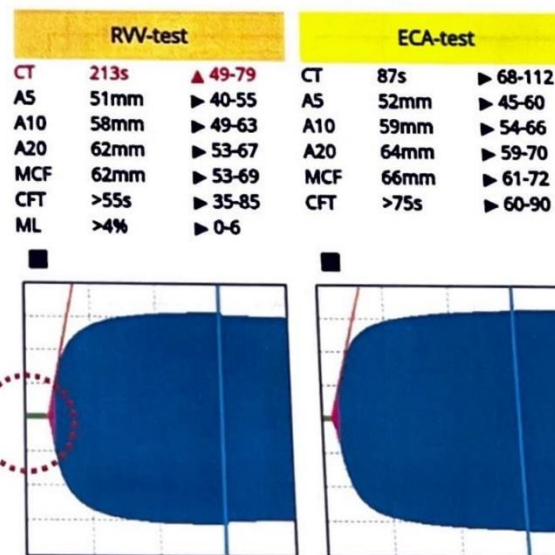
**ECAtest** přímé inhibitory thrombinu - Gatrany

Vždy porovnáваме určité kanály v kombinaci vůči sobě

## Vyloučení přímých antagonistů FXa



## Potvrzení přímých antagonistů FXa





Identifikace a kontrola krvácení

Klinický stav pacienta  
Vit.fce:TK,SF,puls,CRT,Hb,...  
Anamnéza

Kvalitní komunikace s  
interventem

-> **DMG Control Surgery**  
-> **DMG Control Resuscitation**

STOP The Lysis

CT<sub>FIB</sub> > 600s,  
ML > 5%

-> TXA 1g i.v. (profylaxe v PNP)

Při známkách hyperfibrinolýzy  
-> TXA 15-25mg/kg

Fibrinogen

A5<sub>EX</sub> < 35mm  
+  
A5<sub>FIB</sub> < 9mm

-> podat Fibrinogen

Trombocyty

A5<sub>EX</sub> < 35mm  
+  
A5<sub>FIB</sub> ≥ 9mm

-> podat Trombocyty

Koagulační faktory

CT<sub>EX</sub> > 80s  
+  
A5<sub>FIB</sub> ≥ 9mm

-> podat 4F-PCC  
(15-25 IU/kg bw)

**! Kontrola á 10-15min !**

Hladina faktoru XIII

-> podat fXIII

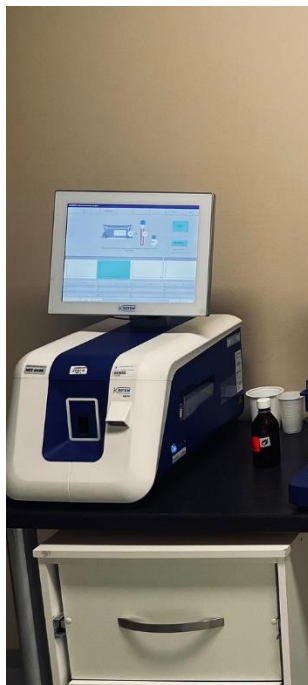




## Metody vyšetření sekundární hemostázy

### **ROTEM Sigma**

- plně automatizovaný
- minimální nároky na obsluhu
- cartridge (různé typy)
- odolný vůči otřesům





[#2356]

♂, 26 let

**M** Večer propadl sk dveřmi, šel spát nalezen babička

**I** mnohočetné řezy L předloktí, fissu

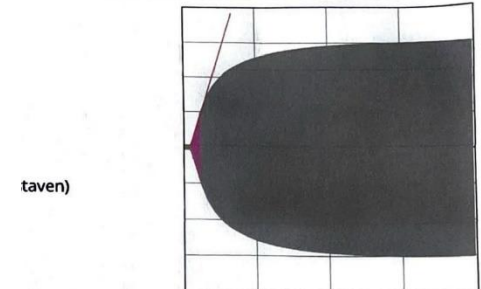
**S** TK 80/40mmHg, RR 20/min, SpO<sub>2</sub> Hb 107g/l, Tr 22:

**T** DMG control sur DMG control res

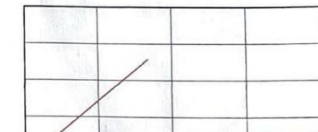


Fibrinogen 2g  
TXA 1g

P-FIB	14,7	13,0
P-APTT	11,0	11,0
P-APTK	1,34	1,18
P-APTT p	1,37	1,20
P-FBG	19,9	24,5
	28,6	28,6
	0,70	0,86
		2,07



Kanál: 1  
t: EX44844AA c:



1.2023	21.11.2023	21.11.2023	21.11.2023
0-11:42	11:42	15:02	16:57-16:58
editovář	ID, Diferenc		ID



♂, 50 let, motorkář, sražen OA

**A+B** UPV, poslech symetrický

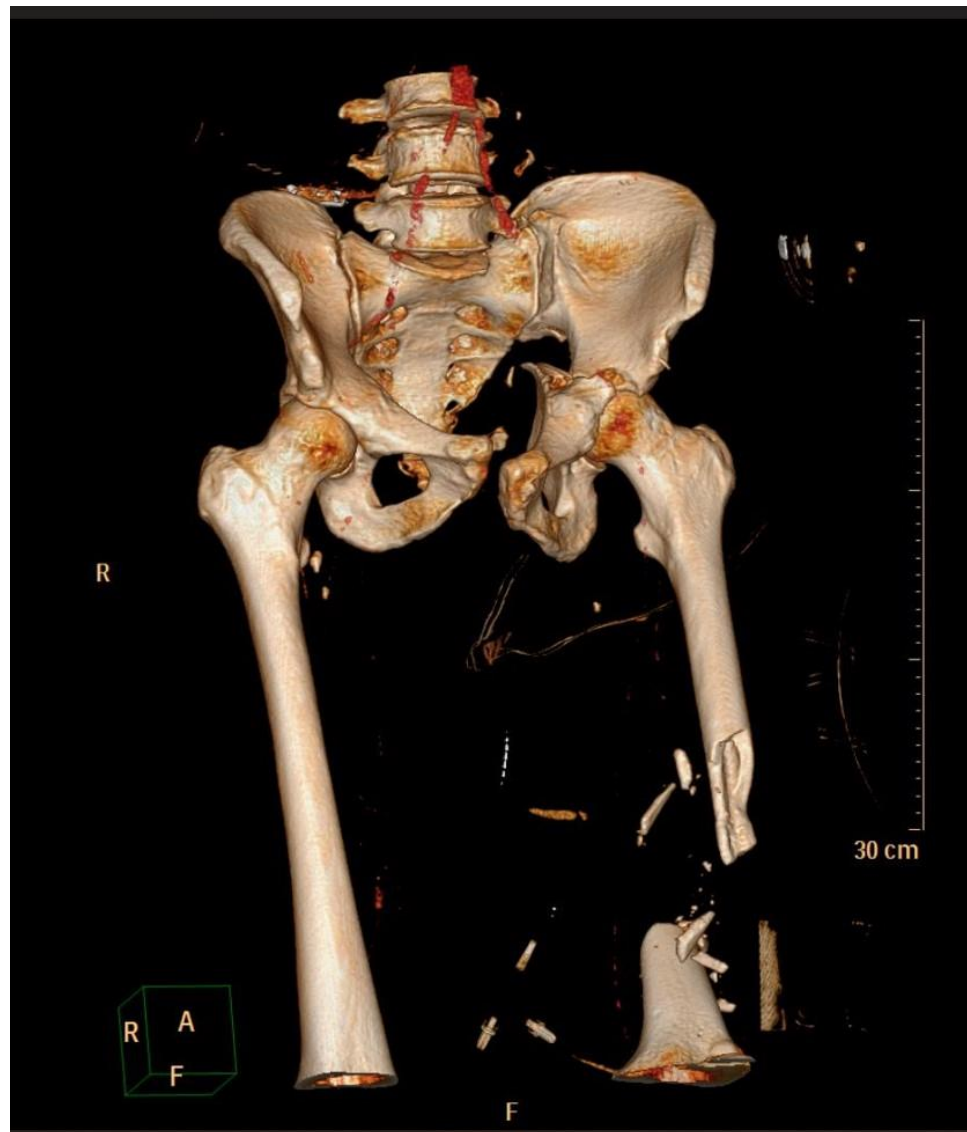
**C** Centralizace oběhu,  
eFAST negativní,  
NA0,3ug/kg/m, Hb 96g/l

**D** GCS 3, anizo

**E** fixace celotělová, Cp,  
pánevní pás,  
LDK,PDK, PHK.

**ROTEM se nedaří odebrat**

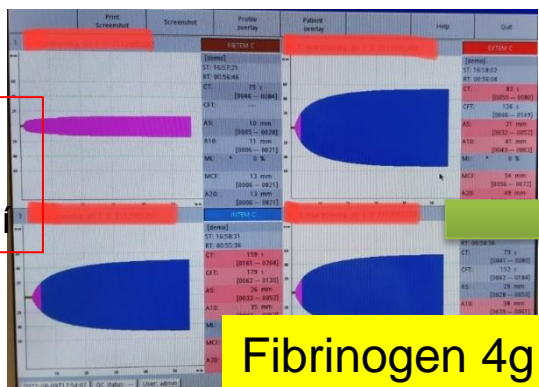
**Fibrinogen 4g (naslepo)**





OP sál

-krvácí  
-oběhově  
nestabilní



**Fibrinogen 4g**

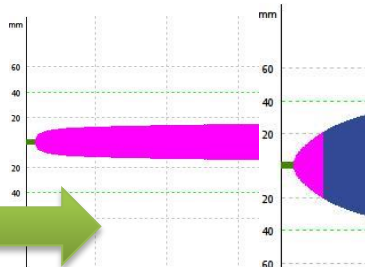
**FIBTEM**

A10 12mm

Masivní transfuzní protokol

**EXTEM**

CT 83s,  
A10 41mm  
ML 0%



**FIBTEM**

A10 12mm

**EXTEM**

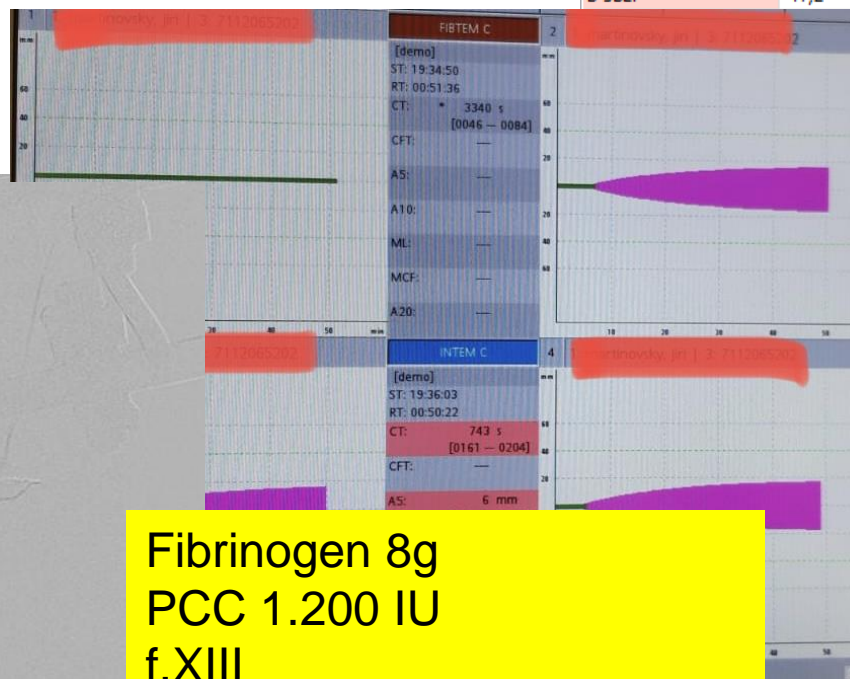
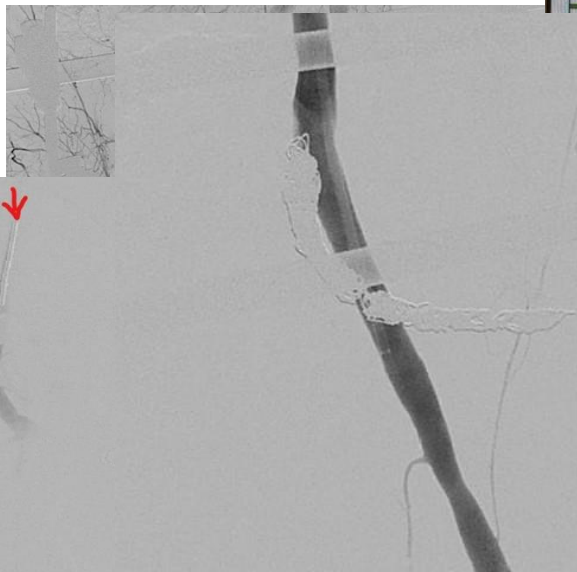
CT 91s,  
A10 32mm  
ML 0%

Datum odběru	úť 9.8. 16:43
Pozn. k odběru	
<b>Krev pro ABR</b>	
B-GLUK	19,9
B-LAKT	13,90
B-Na...	132
B-K...	6,0
B-Cl...	103
B-Cal.	1,07
B-KREV_	Arteriál
T.Teplota	37,0
--FIO2	0,400
B-HB...	70,0
B-PH...	7,034
B-PCO2	5,99
B-SBC.	10,9
B-SBE.	-17,2

ZF pánve  
+ femoru

Krvácení  
z rektu

Angiografie



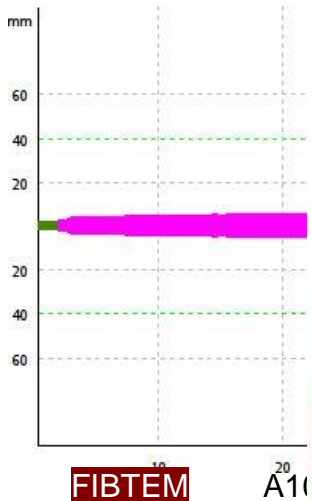
**Fibrinogen 8g**  
**PCC 1.200 IU**  
**f.XIII**

Plazma - Koagulace

PT	> 300,0 s
PTN	11,0 s
APTT	> 300,0 s
APTTN	28,6 s
Fibrinogen	< 0,30 g/l
Antitrombin	13,0 %
D-Dimery	> 6,38 mg/l FEU
TČ	40,9 s
TČN	17,8 s

Plazma - Koagulace speciální

**FXIII** 28,7 %



HR PODANÝCH TRF + KREVNÍCH DE  
44x ERD  
8x TROMBOCITY  
32x OCTOPLAZMA  
1 200 UI PROTHROMPLEX  
20g HAEMOCOMPETTAN  
10 mg NOVOSEVEN

Druhý den ráno, t.j. po 18h



- Výhody oproti standardním laboratorním metodám
  - **Časová výhoda !!** (10-15min vs 30-90min)
  - Komplexnost vyšetření



- Akutní TIC - Fibrinogen klesá jako první
- Ne „Will this patient bleed?“ ale „Why does this patient bleed ?“
- Do not treat pathologic lab.results in the absence of bleeding – TREAT THE PATIENT instead !!
- Kontrola zdroje krvácení na prvním místě

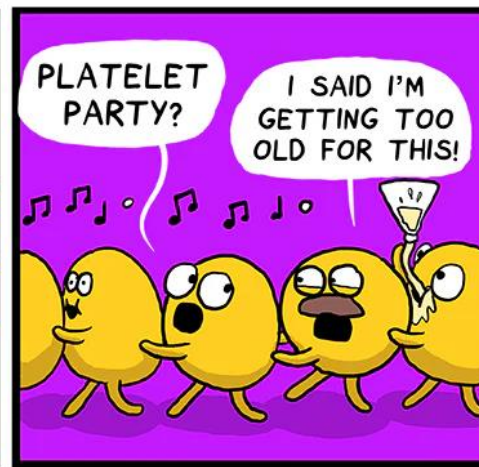
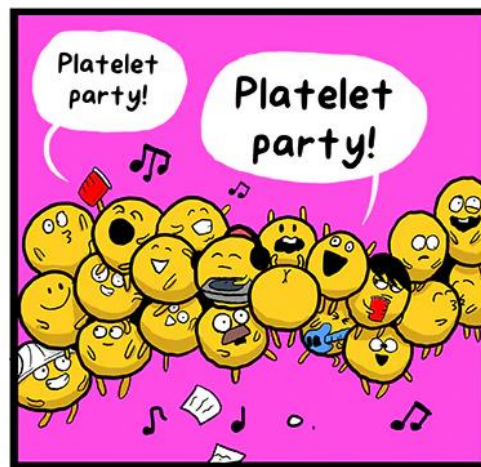
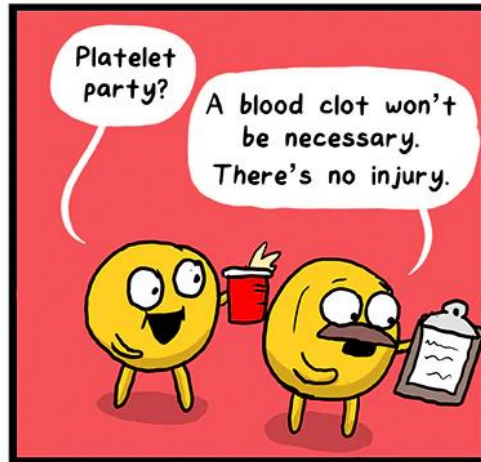




- [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9977110/pdf/13054\\_2023\\_Article\\_4327.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9977110/pdf/13054_2023_Article_4327.pdf)
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- <https://www.nature.com/articles/s41572-021-00264-3>
- <https://www.medista.cz/tromboelastografy-rotem/>
- <https://www.ipvz.cz/vzdelavaci-akce/dokumenty/19252-prof-durila-krvaceni-a-hemostaza.pdf>



# Děkuji za pozornost



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