SEPSIS

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SEPSIS, septicemia

1. Local infection- localised to the place of entry
2. Bacteriemia- invasion to the blood
3. Sepsis - Organ dysfunction

Sepsis is life-threatening organ dysfunction due to a dysregulated host response to infection, mortality 10%

Septic shock is a subset of sepsis in which underlying circulatory and cellular/metabolic abnormalities are profound enough to substantially increase mortality to ≥ 40%

Sepsis definition

- Sepsis: organ dysfunction is defined as an increase ≥ 2 points in the Sequential Organ Failure Assessment (SOFA) score

- Septic shock: is characterised by hypotension not reacting to volume - requiring vasopressors to maintain MAP over 65 mm Hg, and Lactate over 2 mmol/L, mortality 40%

Table 1. The Sequential Organ Failure Assessment (SOFA) Score*

Variables	SOFA Score 0	1	2	3	4
Respiratory Pao_2/FIO_2, mm Hg	>400	≤400	≤300	≤200†	≤100†
Coagulation Platelets $\times 10^3/\mu L$‡	>150	≤150	≤100	≤50	≤20
Liver Bilirubin, mg/dL‡	<1.2	1.2-1.9	2.0-5.9	6.0-11.9	>12.0
Cardiovascular Hypotension	No hypotension	Mean arterial pressure <70 mm Hg	Dop ≤5 or dob (any dose)§	Dop >5, epi ≤0.1, or norepi ≤0.1§	Dop >15, epi >0.1, or norepi >0.1§
Central nervous system Glasgow Coma Score Scale	15	13-14	10-12	6-9	<6
Renal Creatinine, mg/dL or urine output, mL/d‖	<1.2	1.2-1.9	2.0-3.4	3.5-4.9 or <500	>5.0 or <200

*Norepi indicates norepinephrine; Dob, dobutamine; Dop, dopamine; Epi, epinephrine; and FIO_2, fraction of inspired oxygen.
†Values are with respiratory support.
‡To convert bilirubin from mg/dL to μmol/L, multiply by 17.1.
§Adrenergic agents administered for at least 1 hour (doses given are in μg/kg per minute).
‖To convert creatinine from mg/dL to μmol/L, multiply by 88.4.

http://clincalc.com/icumortality/sofa.aspx

qSOFA ("HAT"); 2 or more of:

Hypotension: SBP ≤100 mmHg

Altered mental status GCS < 15

Tachypnea: RR ≥ 22

Old sepsis definition

- SIRS to infection
- But not all patients with organ dysfunction have fulfilled SIRS criteria

- New definiton is important for ER stratification of the patients

TT 38.6, leu 25000, CRP 120, HR 100, fully conscious - standard unit

TT 37.1, leu 12000, HR 88, somnolent, creat 350 - ICU

Treatment

Treatment of infection

- ATB
- Surgical treatment
- Symptomatic treatment:
  Oxygen delivery-fluids, catecholamines, corticosteroids

Corticosteroids

- Not recommended to treat adult septic shock if adequate fluid resuscitation and vasopressor therapy are able to restore hemodynamic stability

- If this is not achievable, use of hydrocortisone 200 mg/day, continuous flow

- Meningococcal meningitis – dexamethasone 0,15 mg/kg á 6 hrs

Initial Resuscitation

Goals during first 6 hrs

CVP 8 – 12 mmHg

MAP over 65 mmHg

Urine output over 0,5 ml/kg/h

Central venous (superior vena cava) or mixed venous oxygen saturation 70% or 65% respectively

Diagnosis

Blood cultures

At least 2 sets (aerobic and anaerobic),

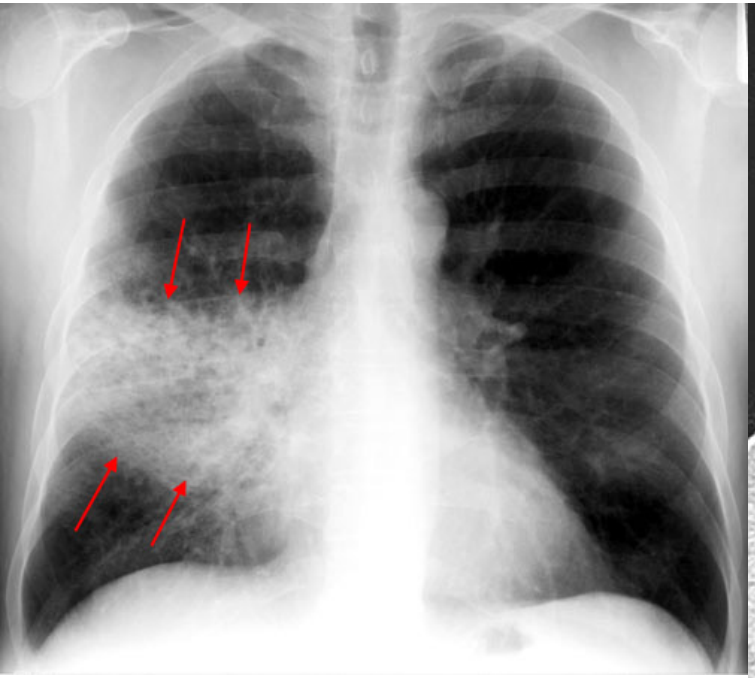
Cultures from other sites

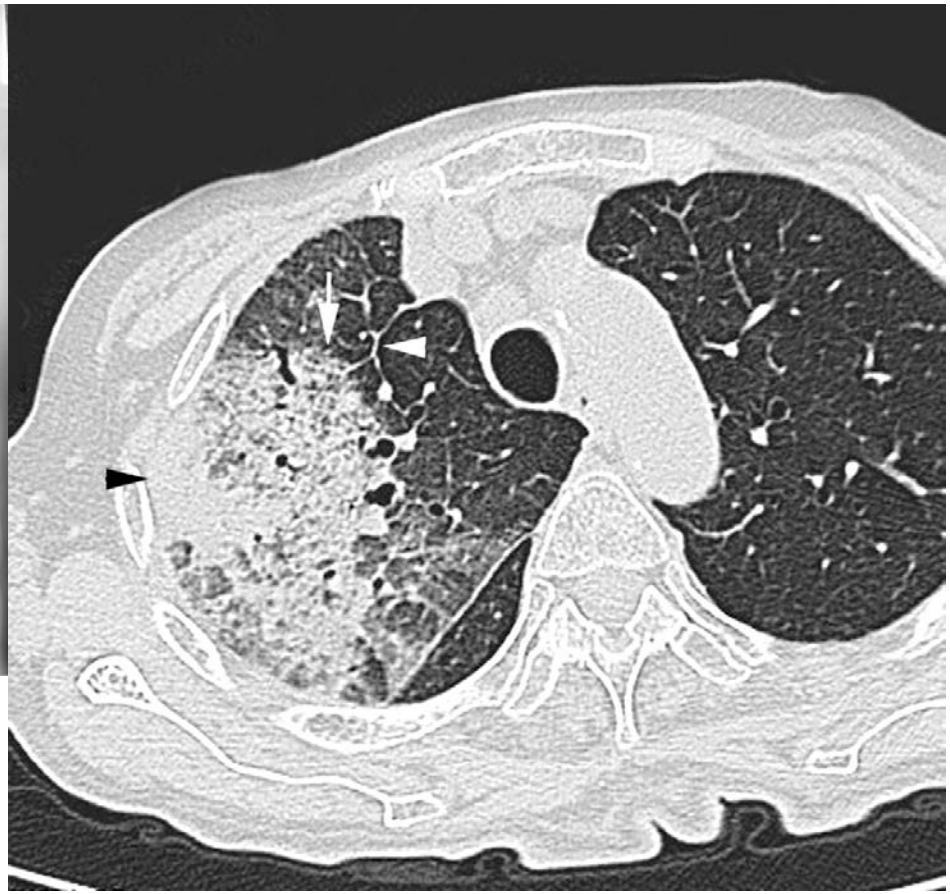
sputum, urine, CSF, drain content, wounds

Laboratory

Procalcitonine, CRP, leukocytes

Imaging studies





- ECHO, USG !!

SIRS

= systemic inflammatory response syndrome to any insult, adaptive process but can also lead to MODS and MOF

- Trauma
- Burns
- Pancreatitis
- Ischemia
- Hemorrhage
- Surgery
- Pulmonary embolism
- Anaphylaxis, Drug overdose…

SIRS

Production of cytokines and release into circulation with MODS and MOF

1. Temperature — below 36 °C or above 38 °C
2. Heart rate — over 90/min
3. Breathing — RR over 20/min, $PaCO_2$ < 4.3kPa
4. WBC — < 4 000/mm3 or >12 000/ mm3 or more than 10% of bands

SIRS can be diagnoses when 2 or more criteria present

Pathophysiology of SIRS/sepsis

Dysfunction of endothelium and mitochondrial dysfunction

- capillary leak-no fluid responsevness

Inflammation is connected with coagulation abnormalities

- hypercoagulation,
- inhibited fibrinolysis
- Both lead to microvascular occlusion and ischemia and Impaired tissue oxygenation leading to MODS and MOF

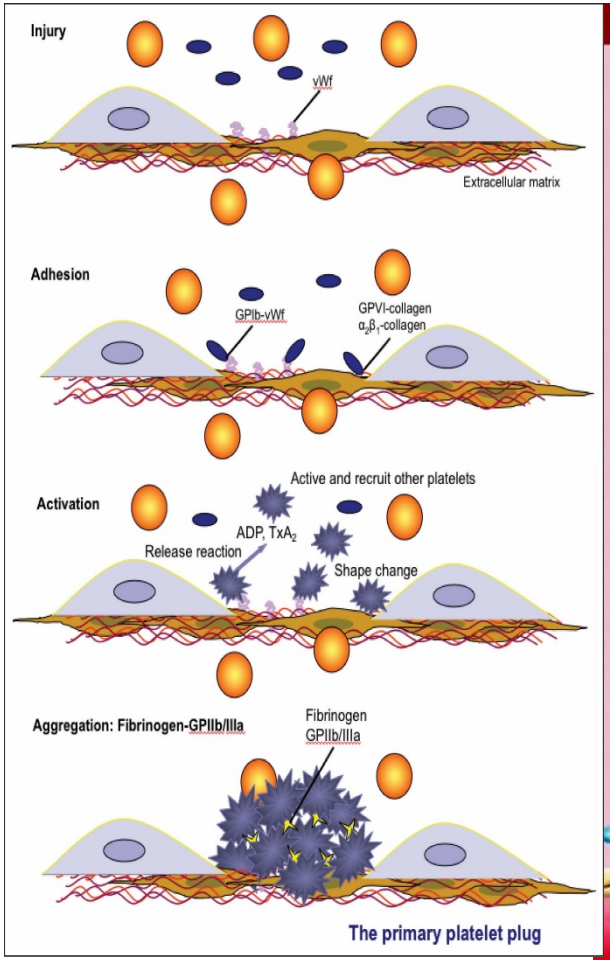
Treatment

- Causal and symptomatic
- The most critical period 2-3 days

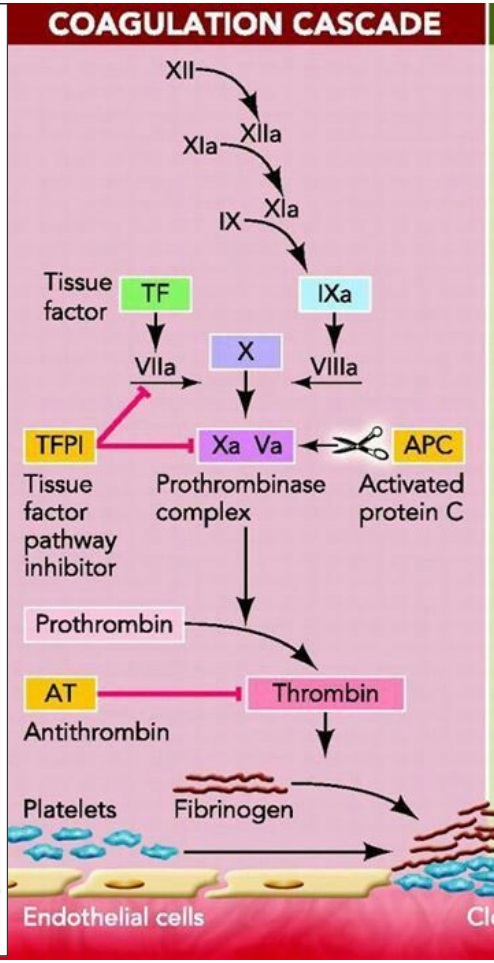
Hemostasis

hemostasis

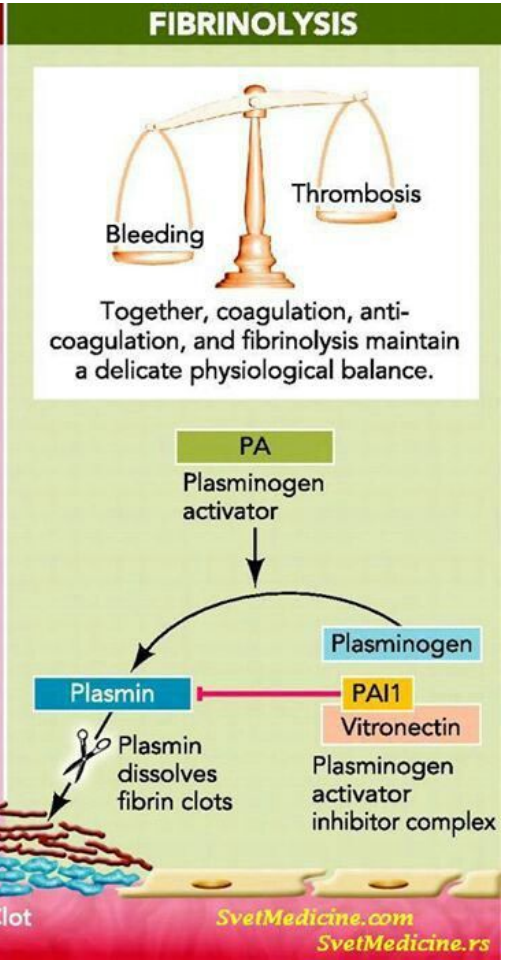
1. phase=Plt clot



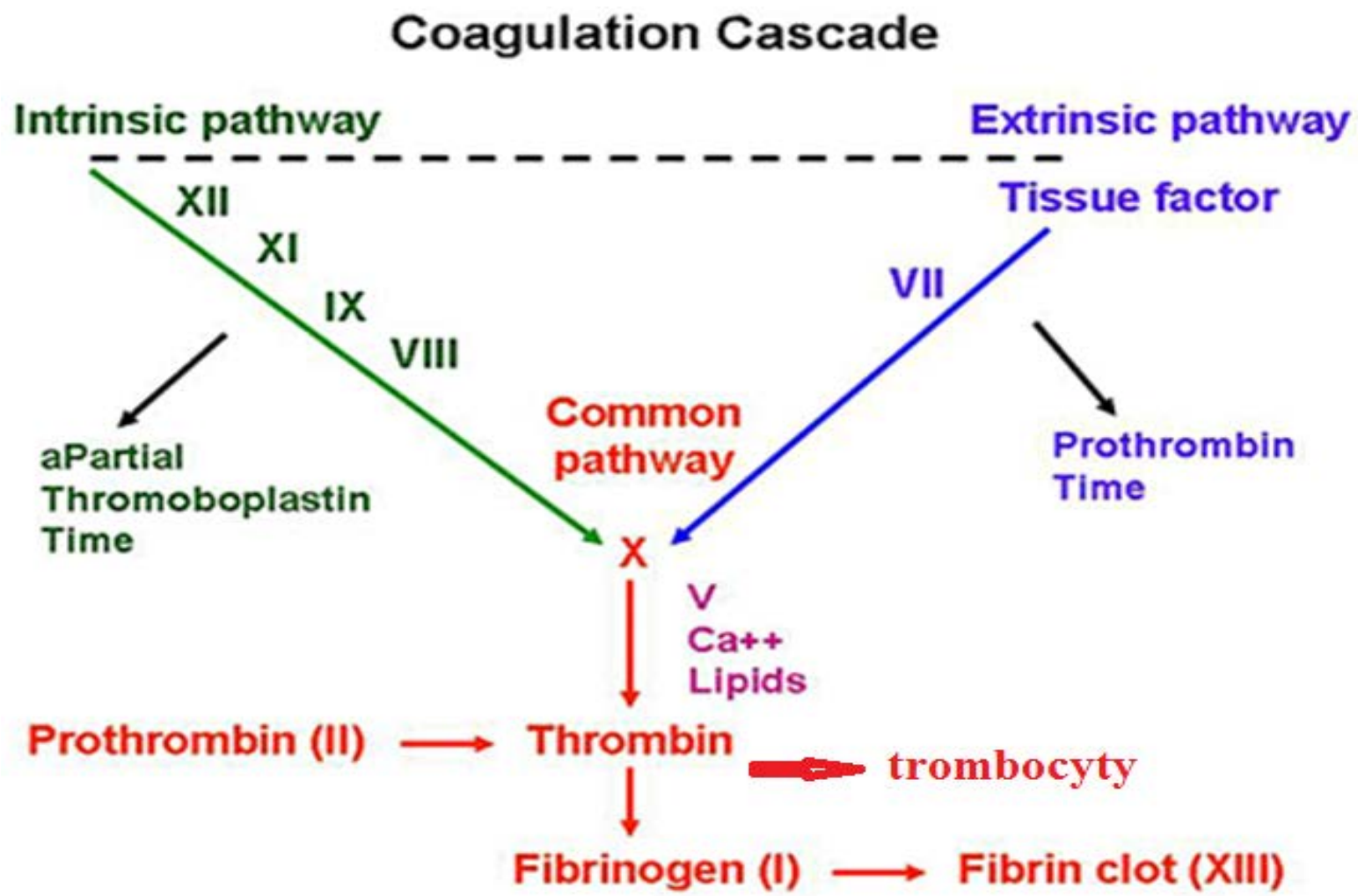
2. phase=fibrin clot



3. phase=lysis

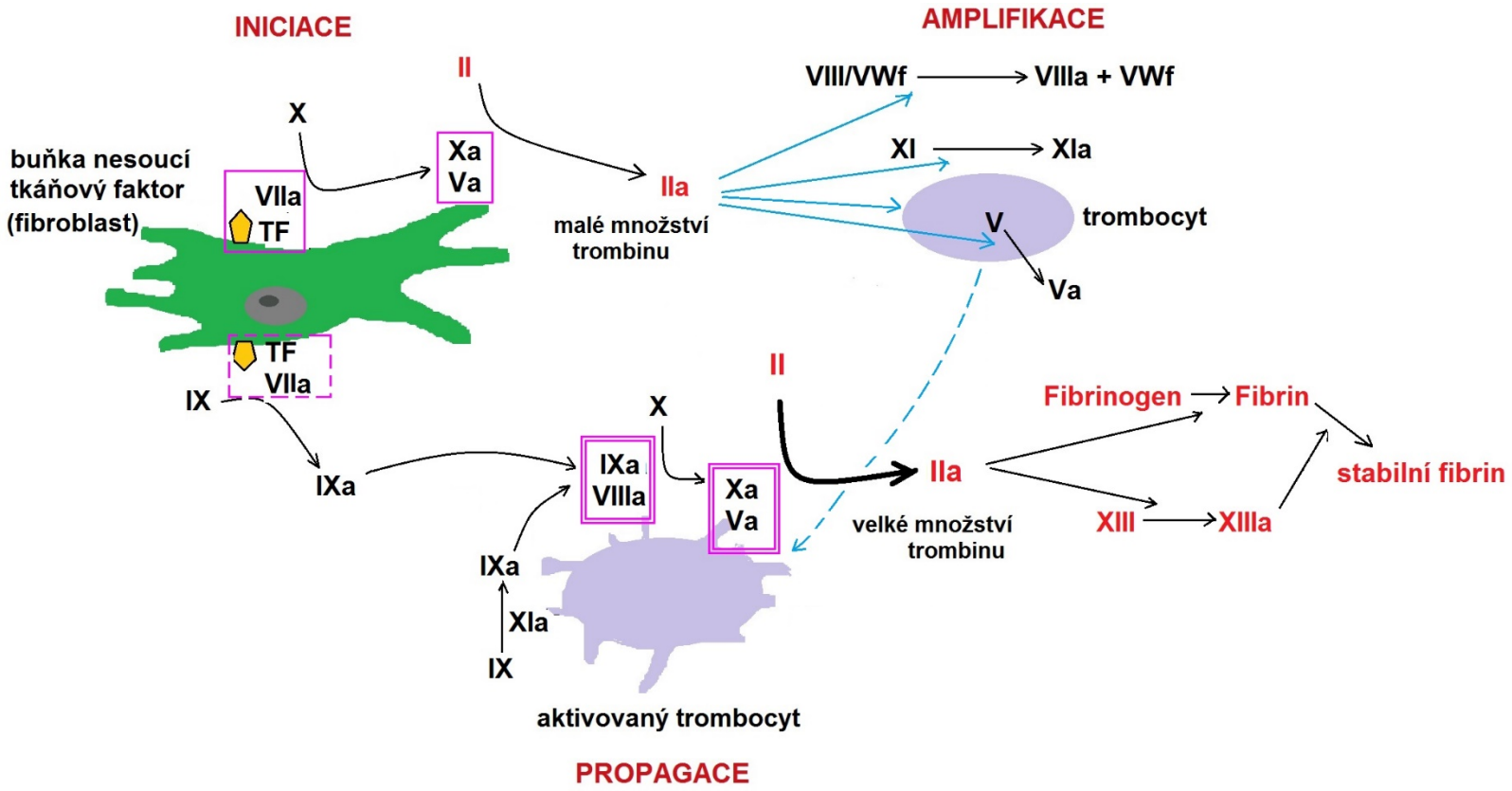


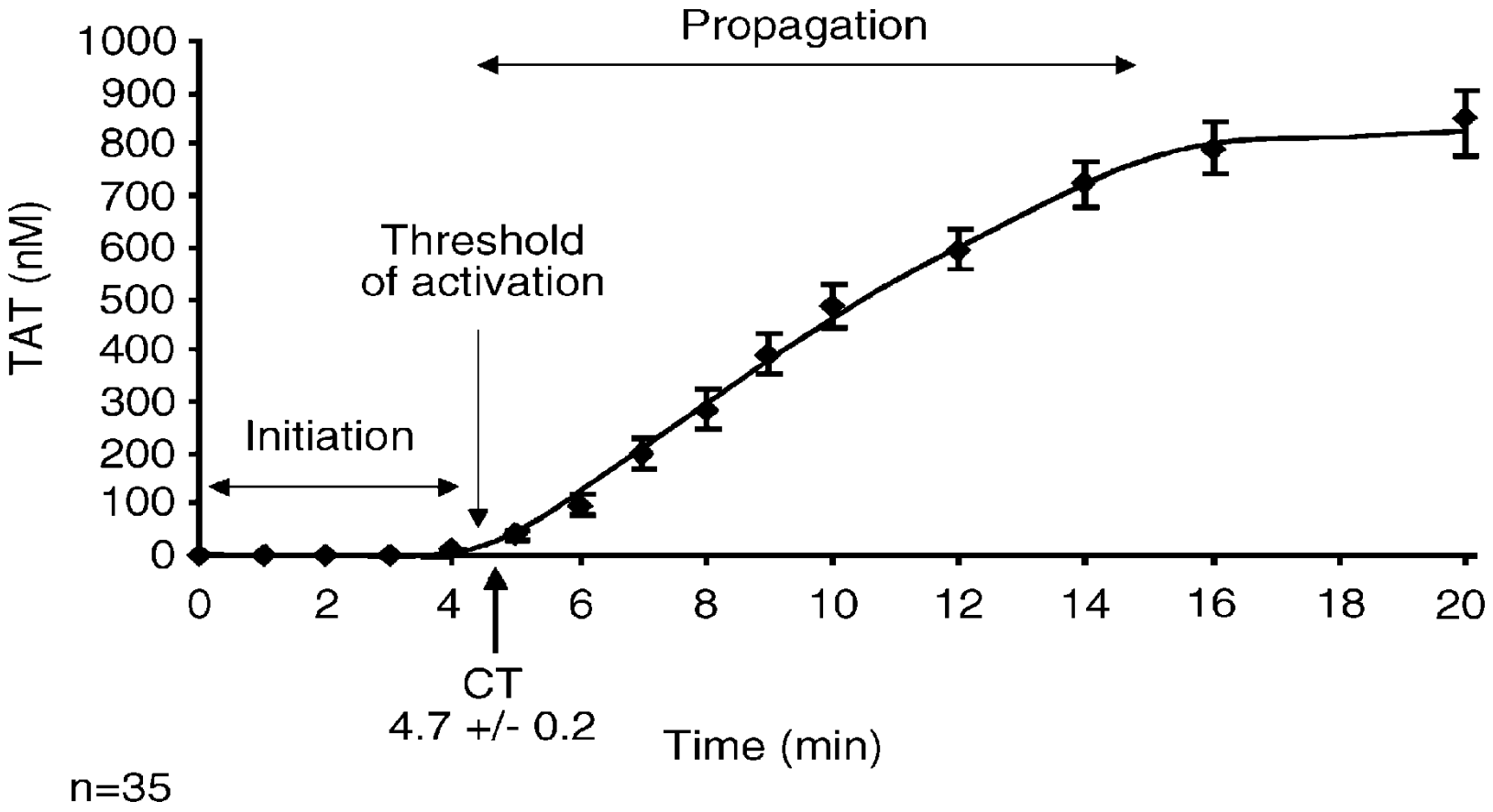
Cascade-old model secondary coagulation



Cell-based-new model of secondary hemostasis

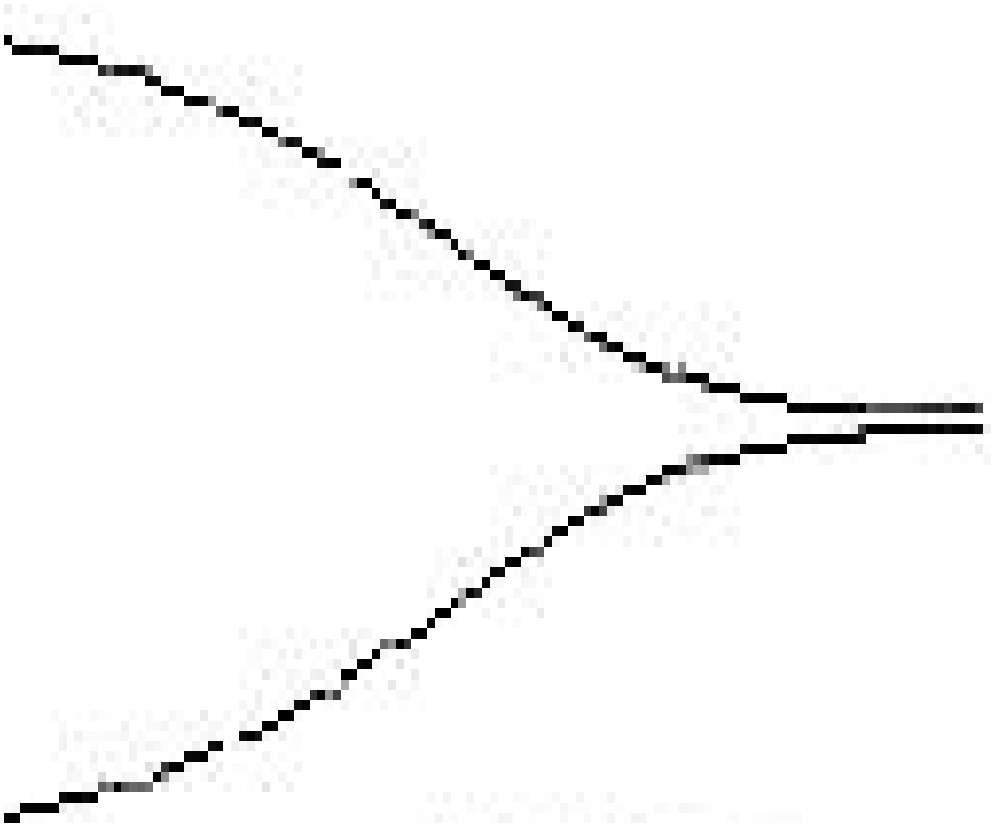
Cell-based-buněčný – nový model koagulace



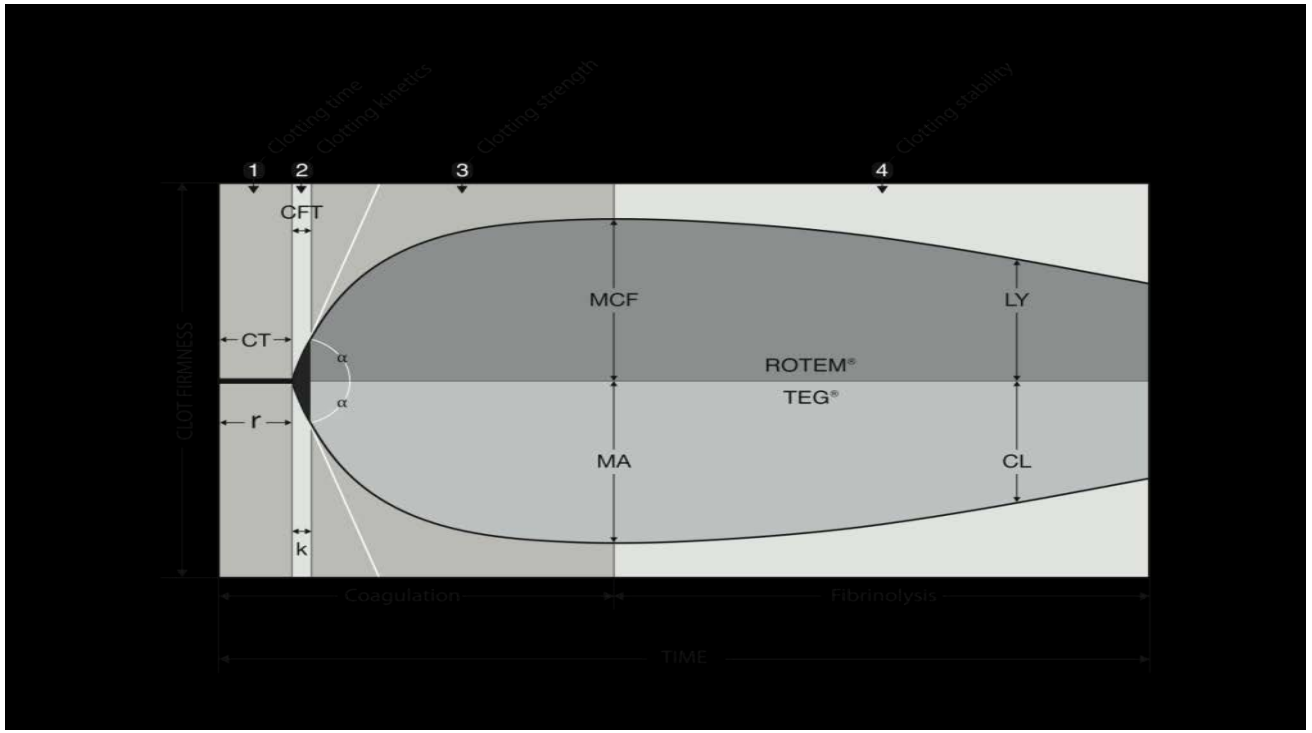


K. G. MANN, K. BRUMMEL and S . BUTENAS, 2003, Journal of Thrombosis and Haemostasis

Fibrinolysis



Thromboelastometry /ROTEM/



CT – reaction time

- CFT – clot formation time
- MCF – maximum clot firmness
- Li 30 a LI 60 – percentage of lysis

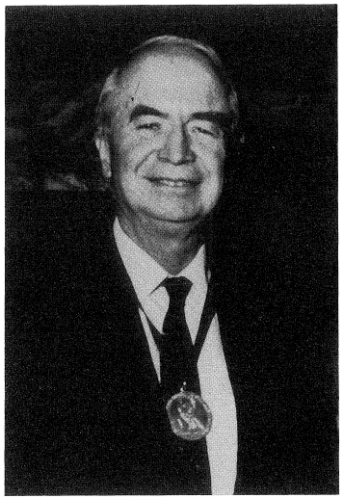
ROTEM

- evaluates viscoelastic properties of whole blood coagulation, all phases
  - ,,bed side“
- Limits: no detection of primary haemosthasis / better is PFA 100/

TEG/ROTEM

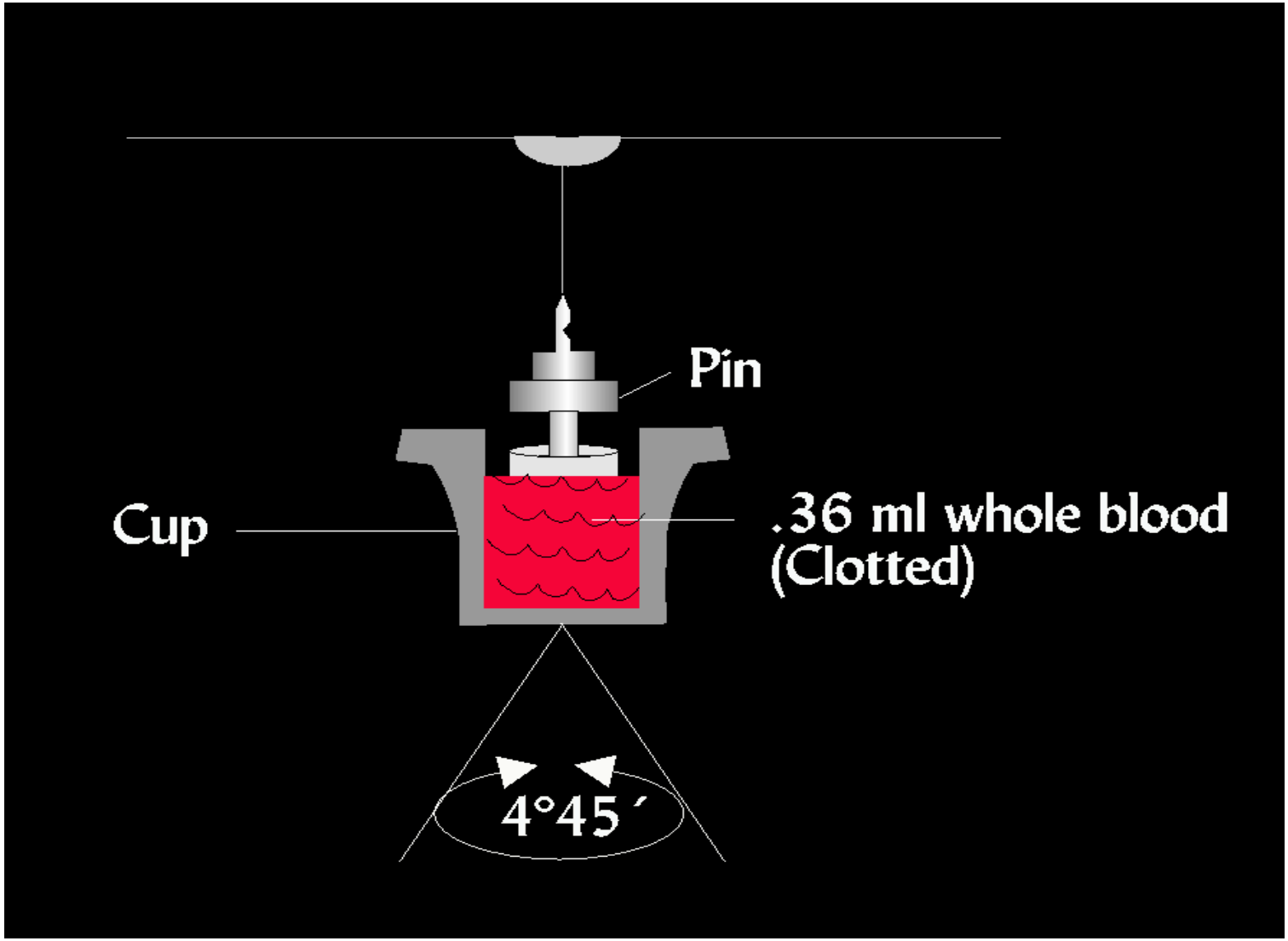
Prof. Helmut Hartert, Germany

**TEG Haemoscope,
Niles, IL, USA**



**RoTEM Pentapharm GmbH,
Munich, Germany**

Principle TEG



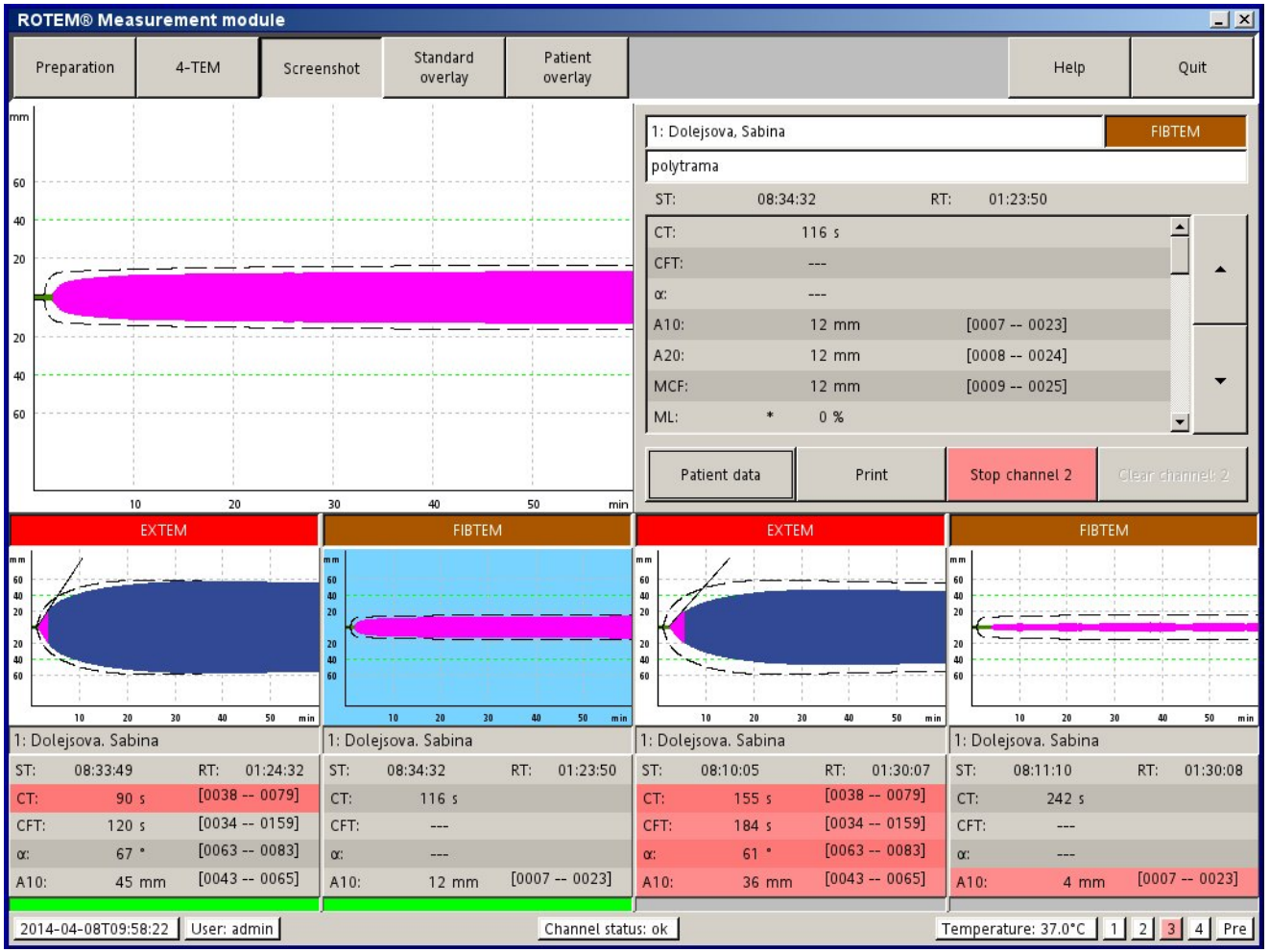
The European guideline on management of major bleeding and coagulopathy following trauma: 4th edition.

Rossaint R et al., Crit Care, 2016

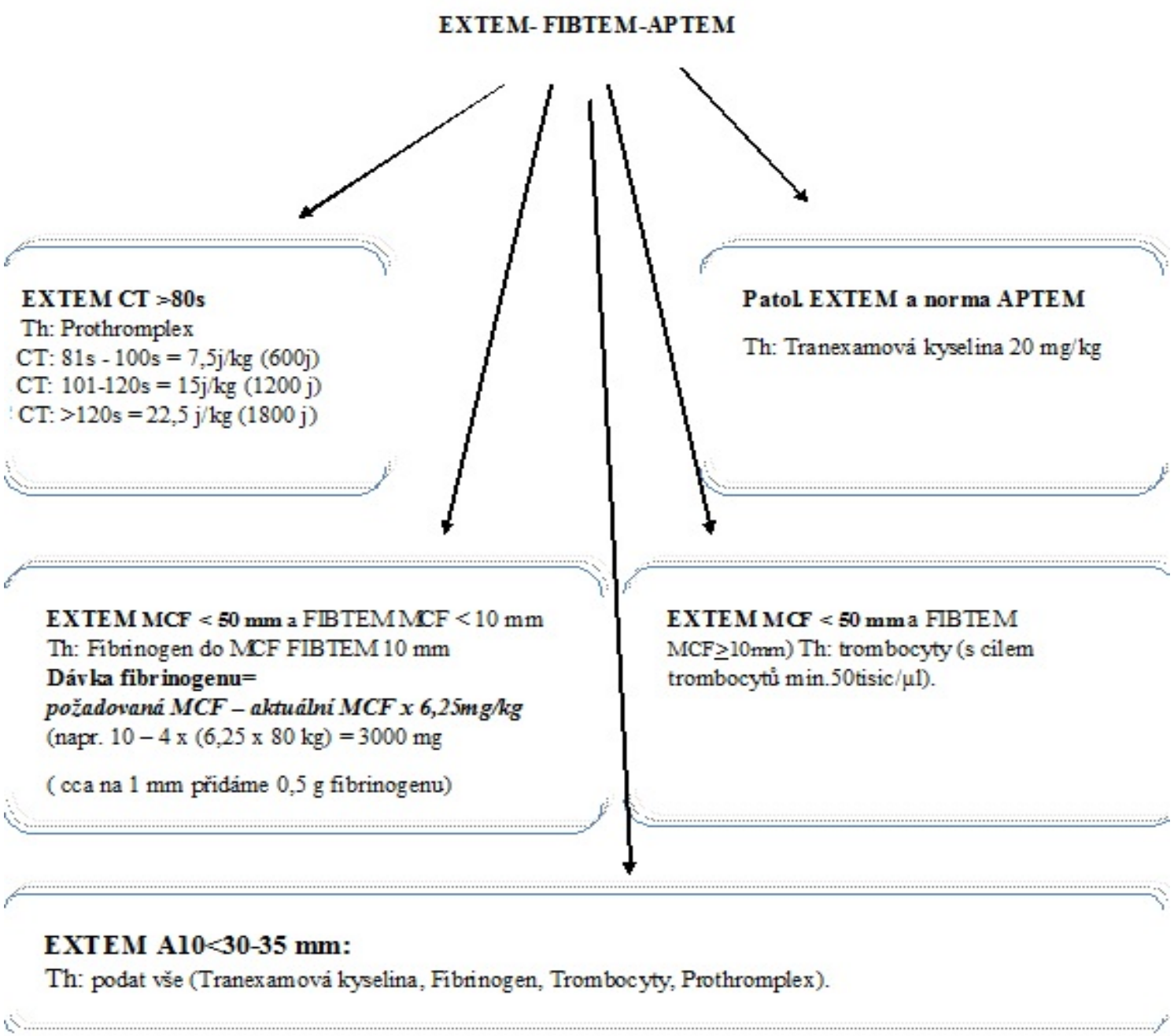
Management of severe perioperative bleeding: Guid elines from the European Society of Anaesthesiology.

Kozek-Langenecker SA et al. Eur J Anaesthesiol. 2013

Fall from 8 floor, polytrauma, INR 2,9, APTT 60 s

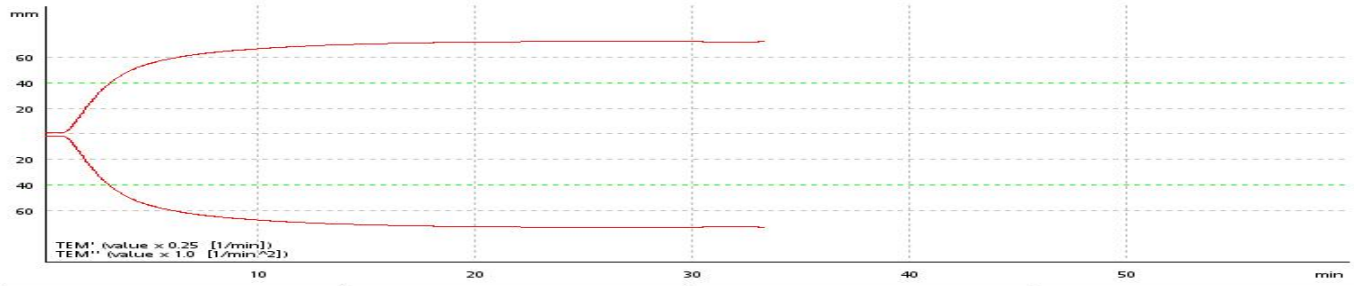


Vyšetření rotační tromboelastometrie (ROTEM) při ŽOK



Fibrinogen is essential

ROTEM vs PT/APTT



EXTEM

PatientID:

SampleID: 441015071

Name: malecek, jiri

INR 1,84 pred TSK

CT	:	60	s
CFT	:	56	s
α	:	79	°
A10	:	68	mm
A20	:	73	mm
MCF	:	73	mm
ML	: *	0	%
LI30	:	100	%
LI45	:		%
LI60	:		%
MAXV	:	23	
MAXV-t	:	90	s
AUC	:	7230	
MCE	:	267	
MCF-t	:	1290	s
CFR	:	80	°
LOT	:		s
CLR	: *	4	°
LT	:		s
ACF	: *	73	mm
G	:	1332	
A5	:	60	mm
A15	:	71	mm
A25	:	73	mm
A30	:	73	mm
AR5	:	399	mm²
AR10	:	1050	mm²
AR15	:	1751	mm²
AR20	:	2470	mm²

Consumption of FFP after ROTEM

ROTEM

Period	FFP consumption (units)	Kč
3/2014 – 3/2015	2990	2 492 556 Kč
4/2013 – 4/2014	4028	3 357 866 Kč
4/2012 – 4/2013	6331	5 153 183 Kč
4/2011 – 4/2012	6138	4 926 769 Kč
4/2010 – 4/2011	7809	6 357 334 Kč
4/2009 – 4/2010	6097	4 924 800 Kč

Static blood tests-not whole blood

- APTT - for monitoring of heparin
- PT - for monitoring of warfarin [coumadin]
- TT
- Fibrinogen
- FDP (d dimer, etanolový test)
- Trombocyty
- AT III

Coagulation factor deficiency

- low production-hepatopathy, warfarin…
- High consumption- DIC, trauma, bleeding…

Disseminated intravascular coagulopathy

Increased unregulated intravascular production of thrombin resulting in formation of thrombus and occlusion of microcirculation accompanied by organ ischemia and bleeding due to consumption of factors such as plt, fibrinogen, AT, VII, IX

Variable	Overt DIC by ISTH	Overt DIC by KSTH
Platelet count	50,000–100,000/µL: 1 point	< 100,000/µL: 1 point
	< 50,000/µL: 2 points	
PT/aPTT	Prolongation of PT	Prolongation of PT
	3–6 sec: 1 point	> 3 sec: 1 point or
	> 6 sec: 2 points	prolongation of aPTT
		> 5 sec: 1 point
Fibrinogen	< 100 mg/dL: 1 point	< 150 mg/dL: 1 point
D-dimer	0.5–1 µg/mL: 1 point	Increase: 1 point
	1–2 µg/mL: 2 points	
	≥ 2 µg/mL: 3 points	
Total	Overt DIC ≥ 5 points	Overt DIC ≥ 3 points

http://reference.medscape.com/calculator/dic-score

Causes of DIC

- Sepsis
- Trauma
- tumors
- Obstetric complication-fluid embolisation

- Time course-minutes to days

Therapy

- If not bleeding – stop initiation phase with antithrombin and heparin

- If bleeding – stop bleeding by FFP, PCC, platelets, EBR-HCT 0,3, fibrinogen, and then again stop initiation by AT and heparin

Warfarin – urgent surgery

- Prothromplex /II,VII, IX, X/
- FFP has INR 1.4-1,5

Thank you for your attention