

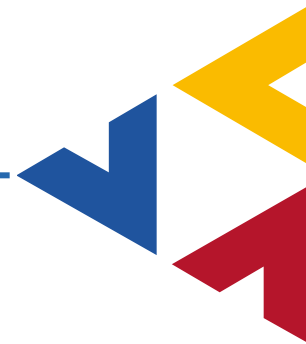
Point-of-Care Diagnostic



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University Hospital of Tübingen**

Januar 28, 2018



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Universitätsklinikum Tübingen

Point-of-Care Diagnostic Tools

- coagulation



- blood gases analysis



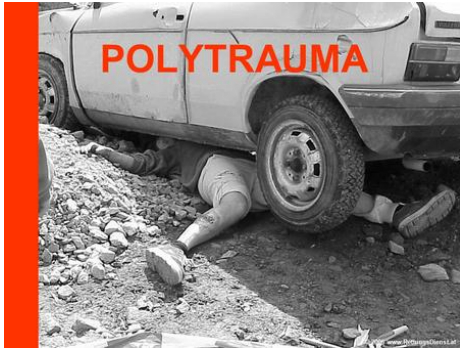
Coagulation – Point-of-Care Monitoring

Why?



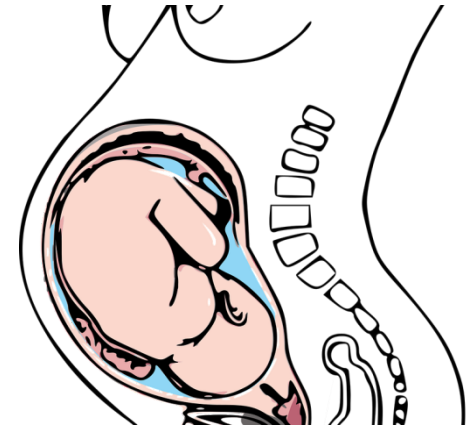
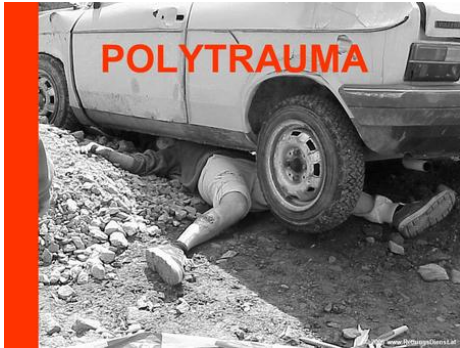
Coagulation – Point-of-Care Monitoring

Why?



Coagulation – Point-of-Care Monitoring

Why?

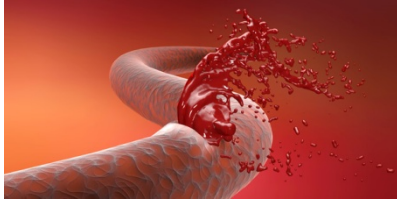


Coagulation – Point-of-Care Monitoring

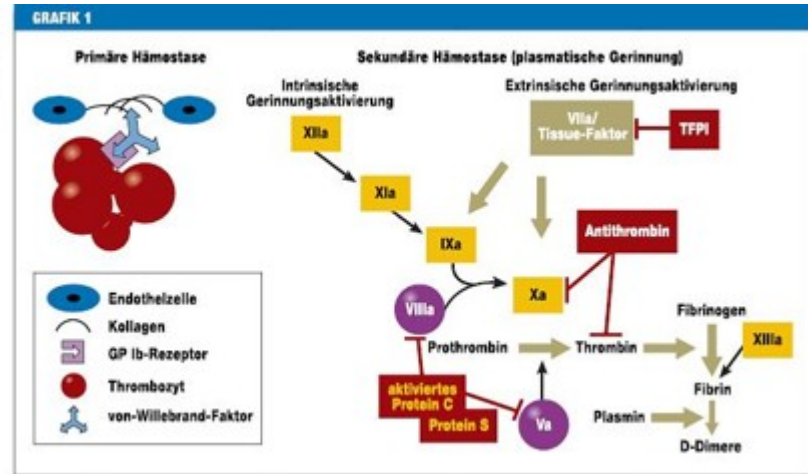


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Why?

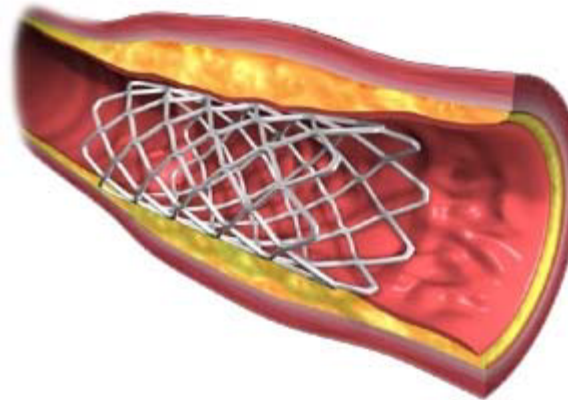
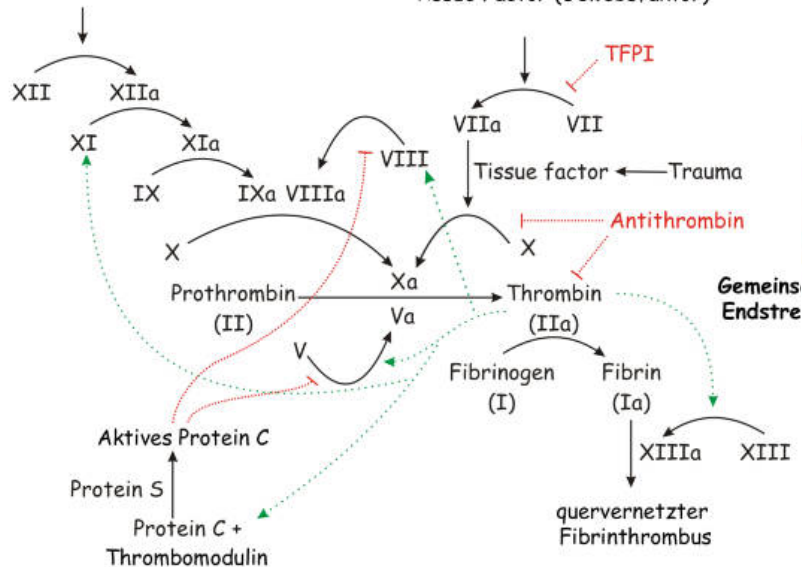


Schematische Darstellung der primären und sekundären Hämostase

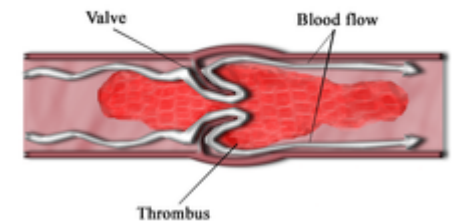


Intrinsischer Weg

Extrinsischer Weg
Freisetzung von
Tissue Factor (Gewebsfaktor)



Blood Clot Diagram



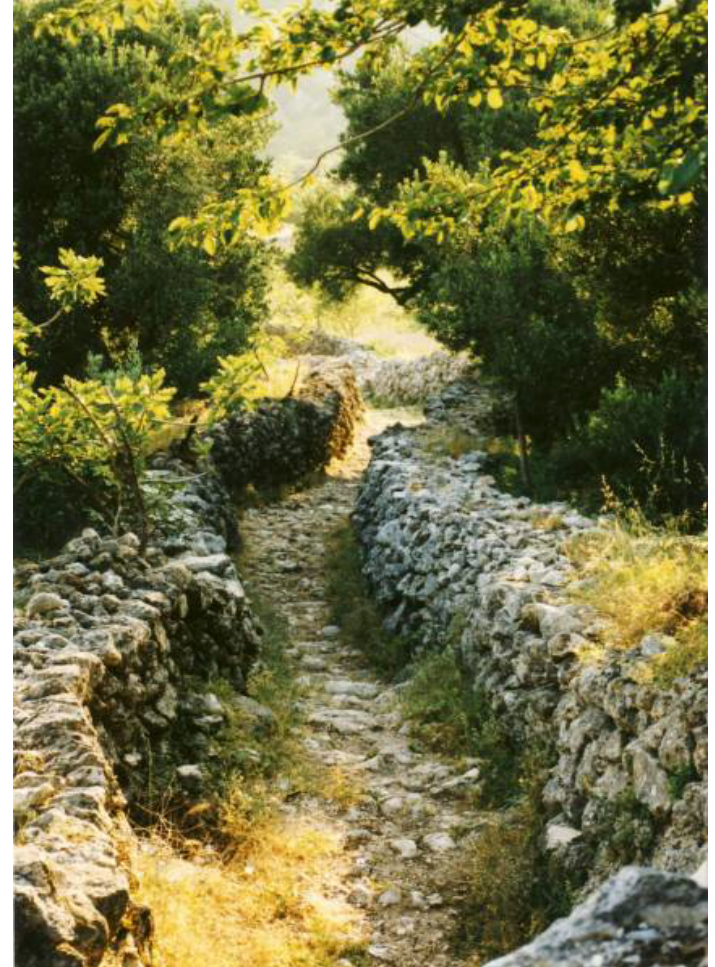
Coagulation – Point-of-Care Monitoring



Coagulation – Point-of-Care Monitoring

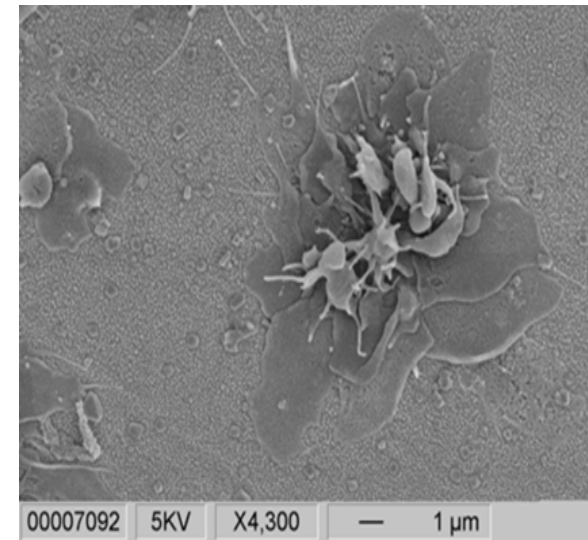


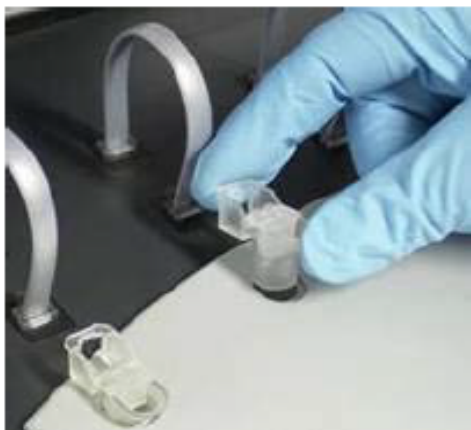
Coagulation – Point-of- Care Monitoring



Multiplate platelet function analyzer

- ▶ Based on principle of impedance aggregometry (Cardinal und Flower, 1979)
- ▶ Whole blood function analysis of thrombocytes
- ▶ Point-of-care tool

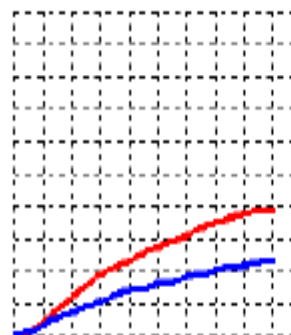




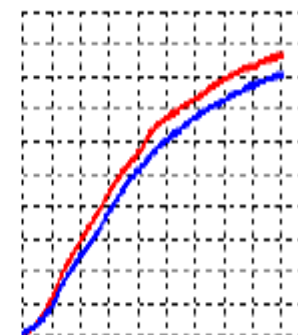
**300µl blood +
300µl NaCl 0,9%**

Application of activators

- Quick performance (10 minutes)
- fast answers
- less blood drawn

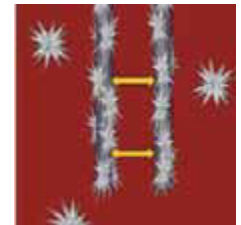
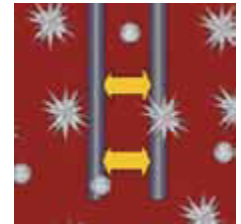
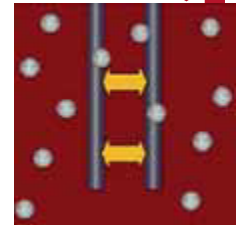
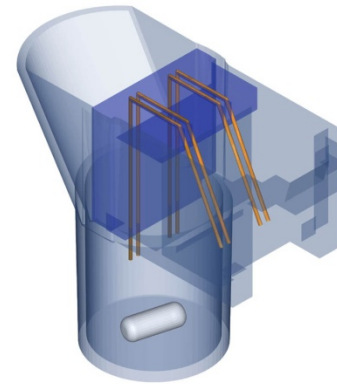


with ASS

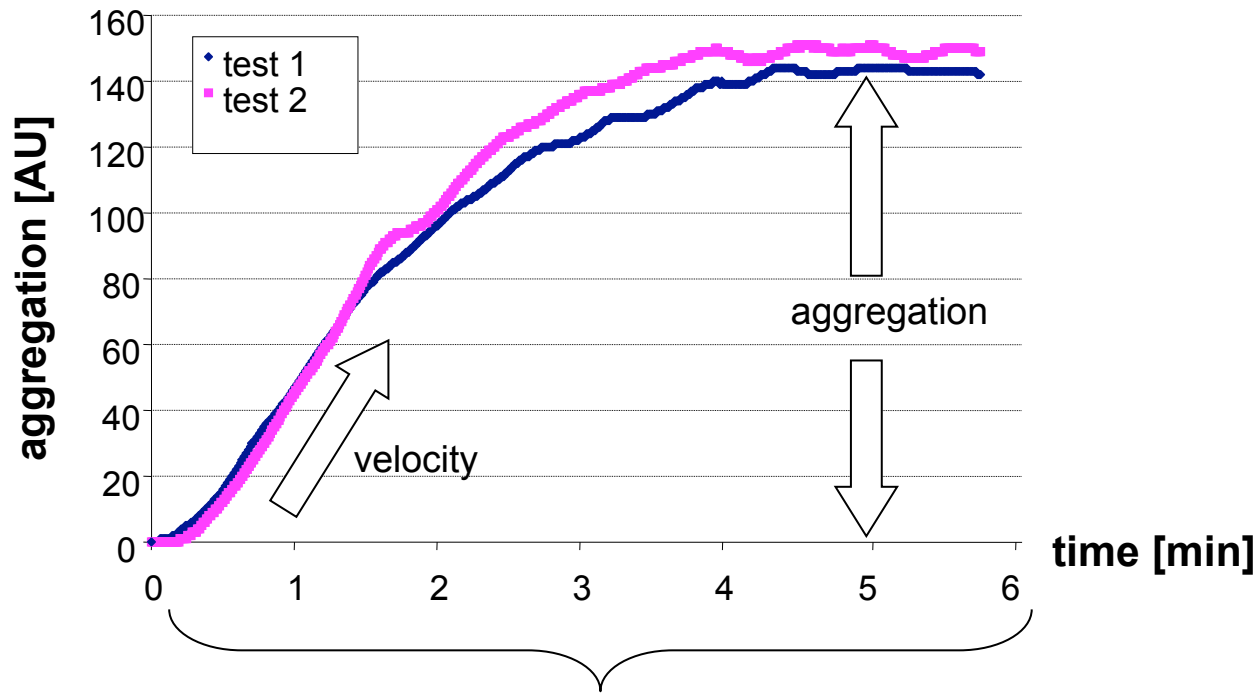


without ASS

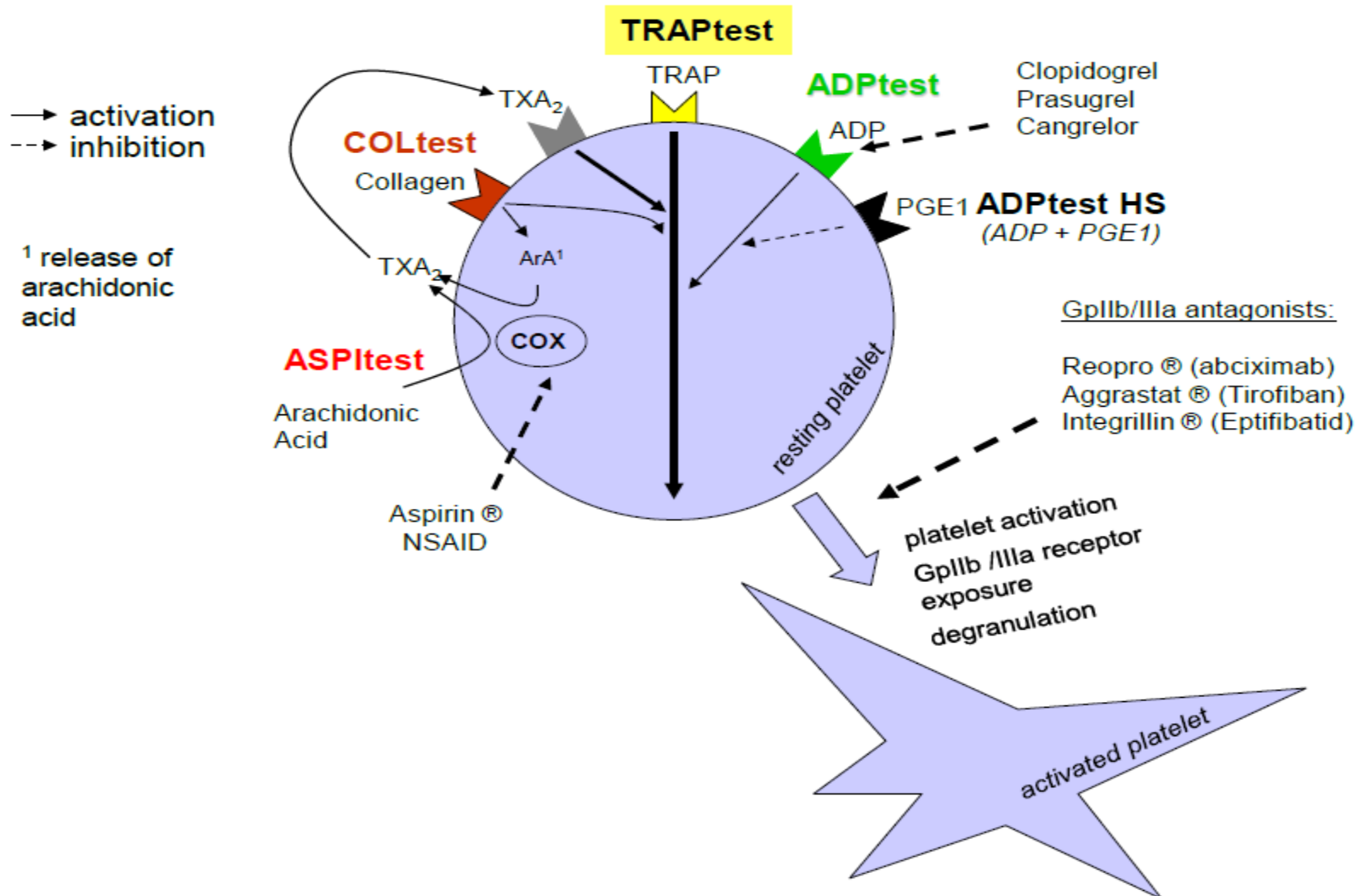
Multiplate platelet function analyzer



- Activated platelets adhere on the surface of the sensor
- Platelets aggregates form an insulation layer
- The impedance between the electrodes rises



Area under the curve = AUC



Case report 1

women, 78 years old

Re – ACVB

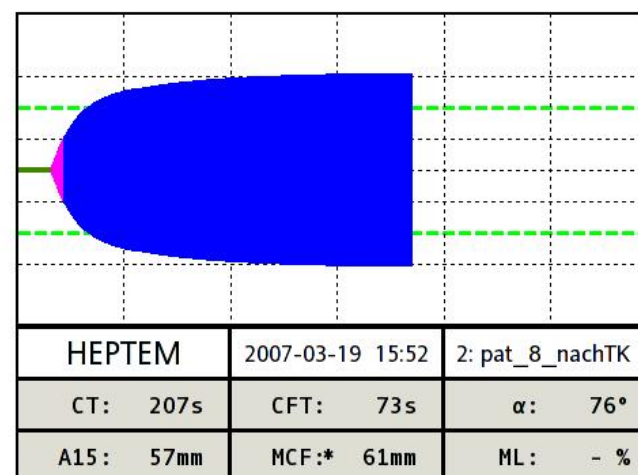
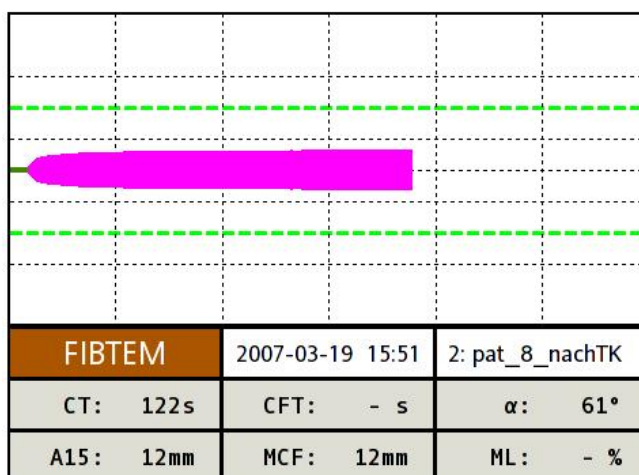
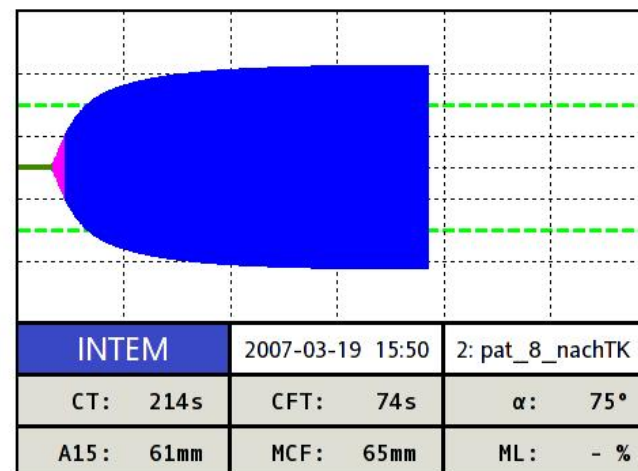
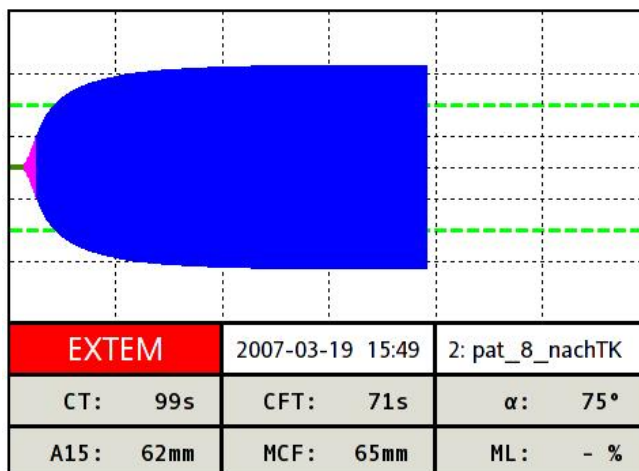
HLM: 125 min

Blood lose: 1000 ml postoperative

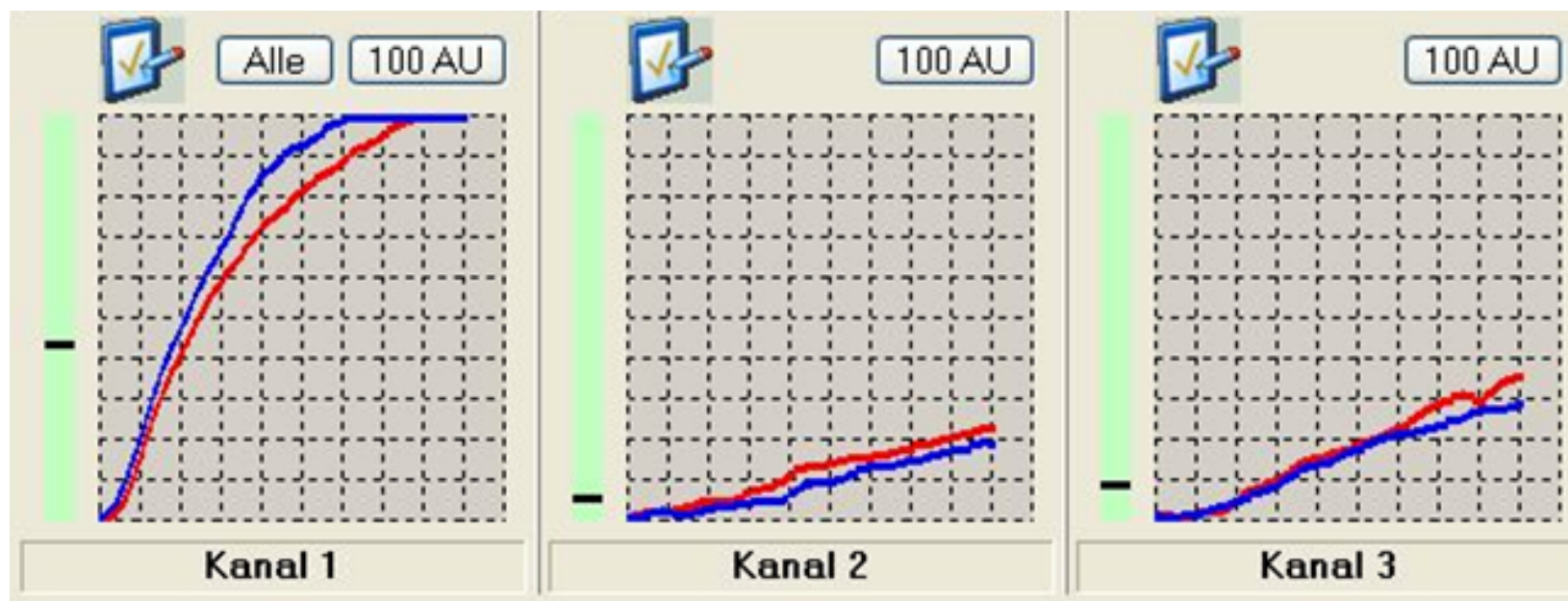


Auftragsnummer	Referenzbereich	Einheit	V853288	V853289	80918460	61945880	80918462	80923779
Probenentnahmedat.			3.9.2008	3.9.2008	4.9.2008	4.9.2008	4.9.2008	4.9.2008
Probenentnahmezeit			00:00	00:00	01:13	07:00	07:00	18:00
Thrombozyten im BB	150 - 440	/ nl			152		178	96
Gerinnung-Routine								
TPZ	70 - 120	%			120		114	63
INR					0.89		0.92	1.39
PTT	28 - 38	sec			43		35	38
Fibrinogen	150 - 450	mg/dl			225		227	204
Antithrombin-Aktivität (FII-Inhib.)	> 80	%			64		97	62
Thrombinzeit	16 - 20	sec						15

Rotem



Multiplate



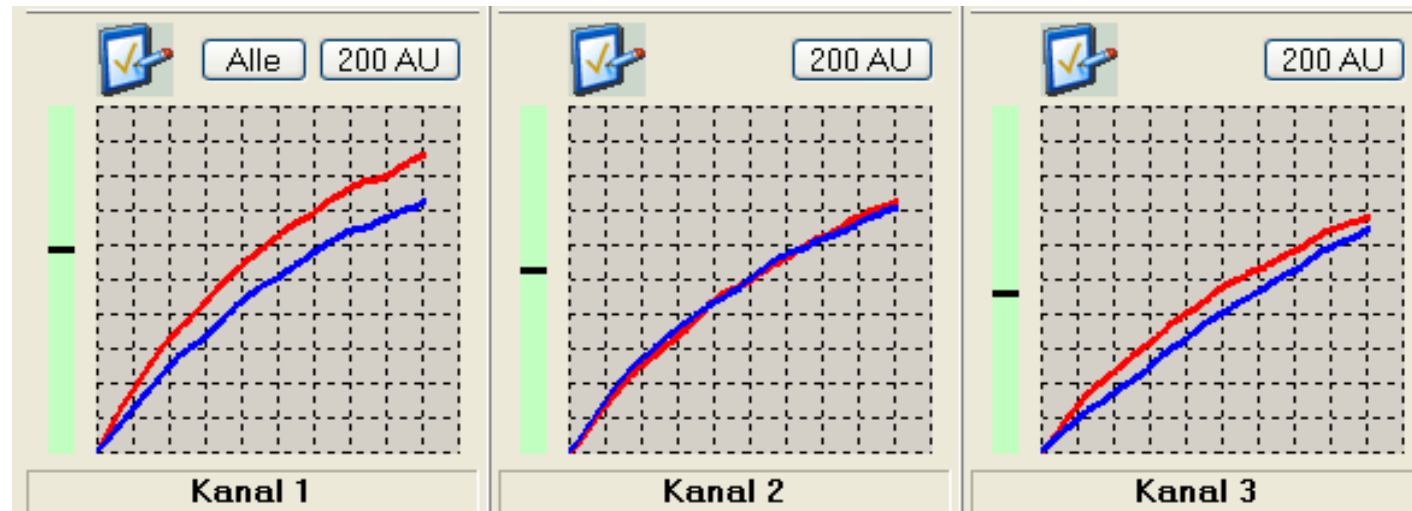
TRAPtest

ASPItest

ADPtest

Multiplate

after 3 platelet rich plasma concentrate



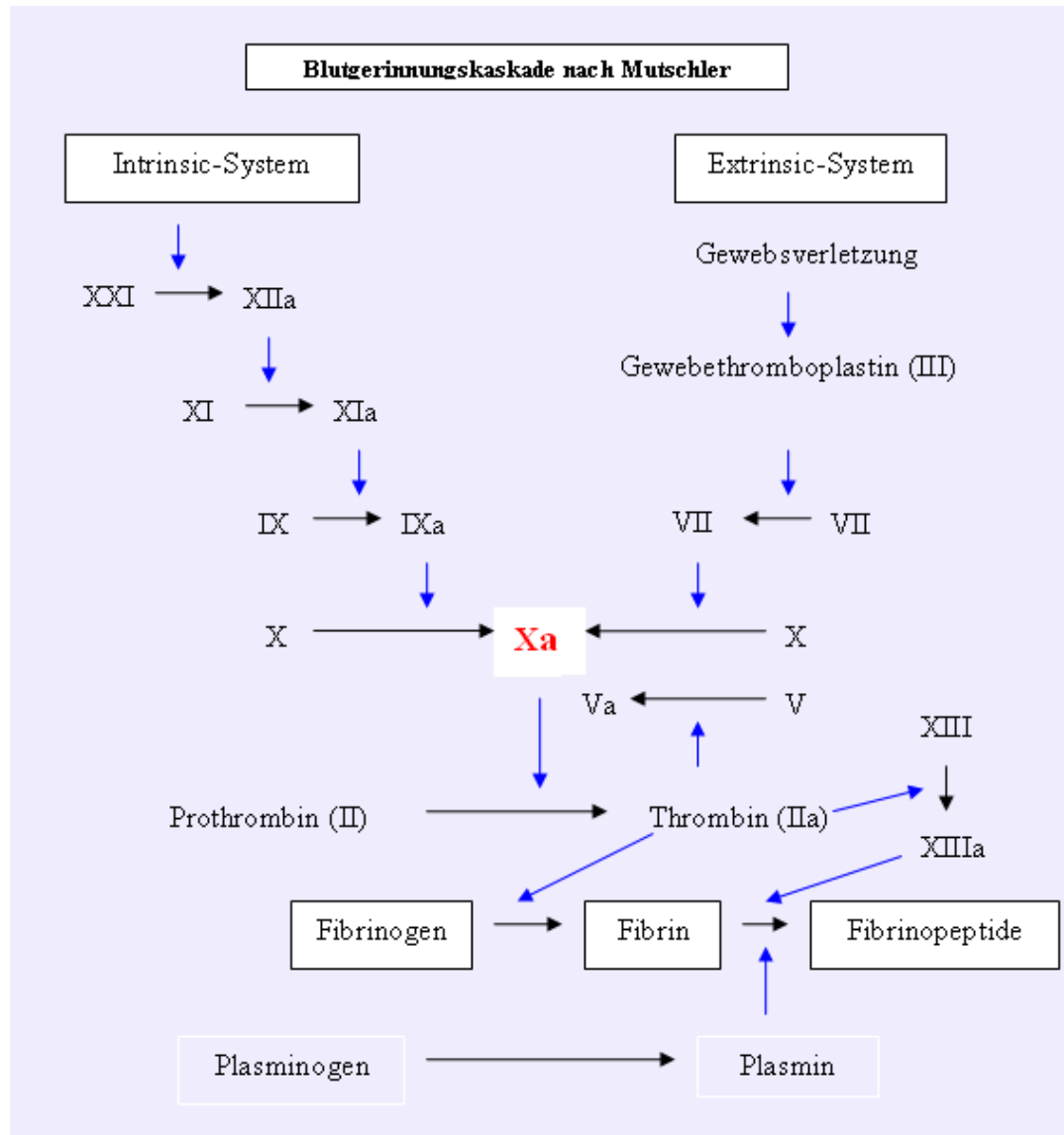
TRAPtest

ASPItest

ADPtest

Standard coagulation analysis

aPTT



**Quick /
INR**

**Fibrinogen
-level**

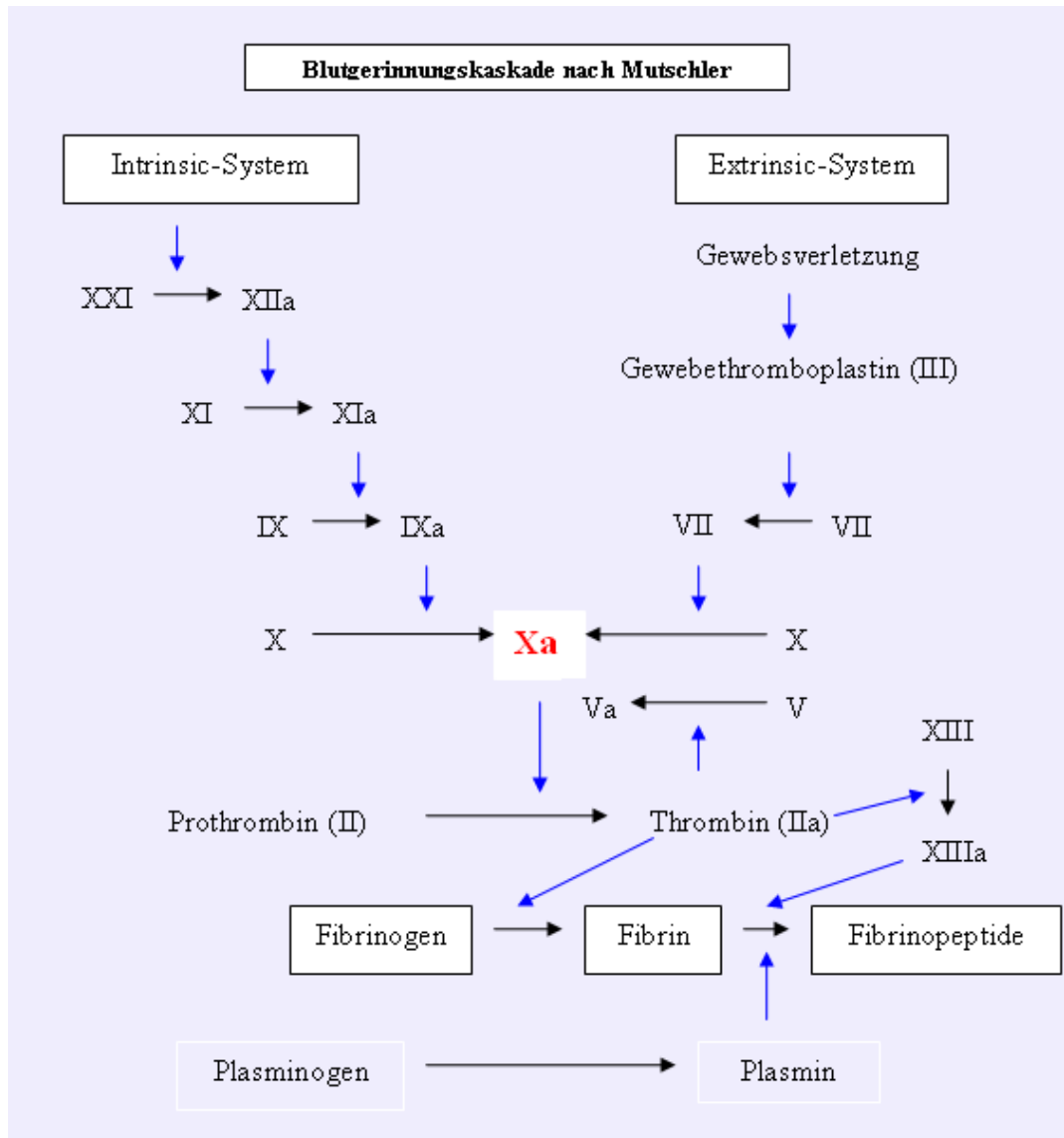
FXIII-level

Rotem/TEG – Point-of-care analysis



Rotem – Point-of-care analysis

**inTEM/
hepTEM**

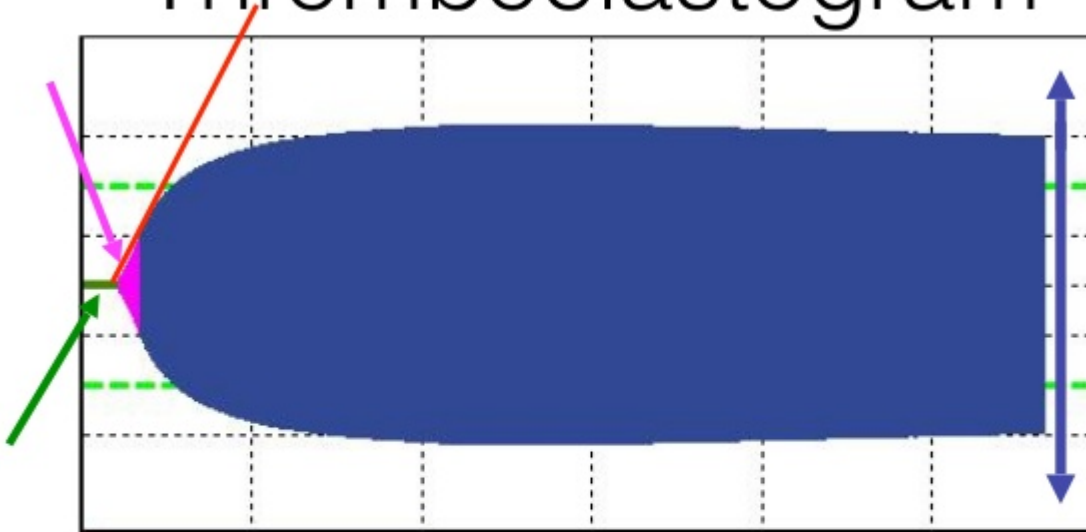


exTEM

fibTEM

apTEM

Thromboelastogram



ROTEM is een meting van viscoelasticiteit over tijd

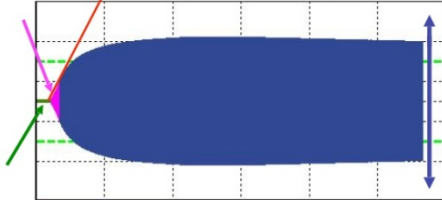
CT – clotting time; “initiation phase”

CFT – Clot formation time; “propagation phase”

α -angle – propagation phase

MCF – Maximum Clot formation;

Thromboelastogram



ROTEM is een meting van viscoelasticiteit over tijd

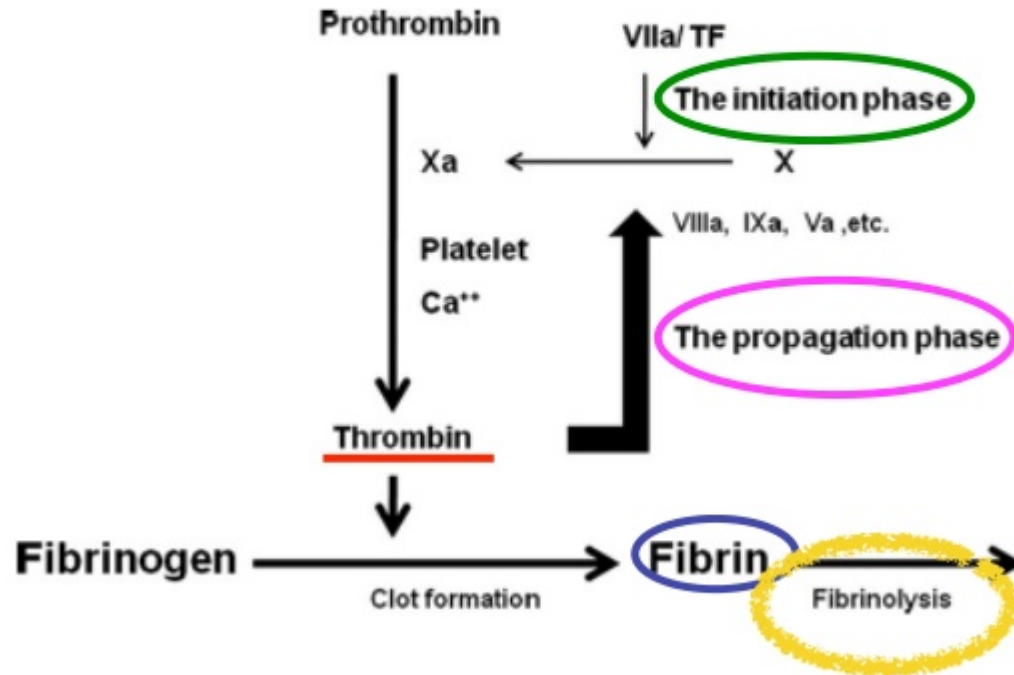
CT – clotting time; "initiation phase"

CFT – Clot formation time; "propagation phase"

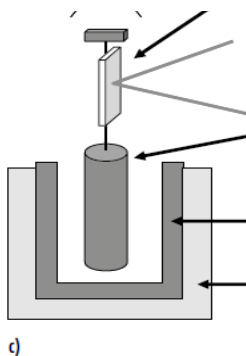
α -angle – propagation phase

MCF – Maximum Clot formation;

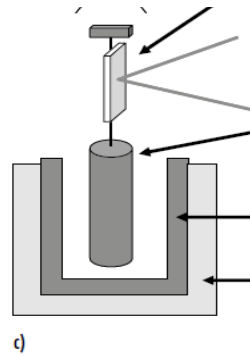
Stolling



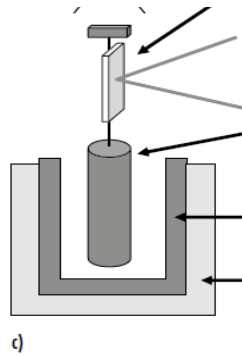
(1) Extem



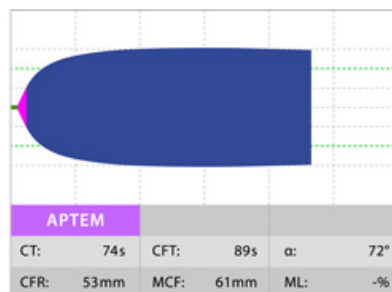
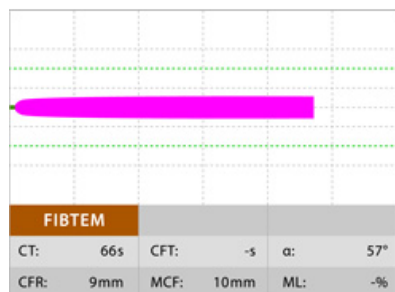
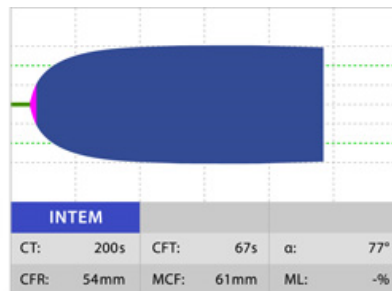
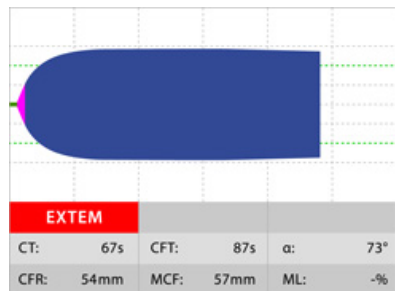
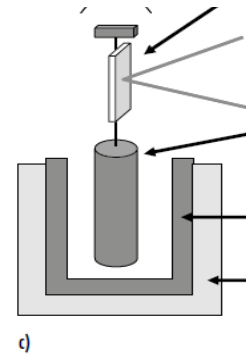
(2) Intem



(3) Fibtem



(4) Hep/Aptem



Laboratory Value	Interpretation	Blood Product Transfusion	QUALITATIVE INTERPRETATION — PATTERN RECOGNITION
R less than 4 min	Enzymatic Hypercoagulability	No treatment if bleeding	 Normal R/K/MA/Angle=Normal
R between 11-14 min	Low clotting factors	Plasma and RBC's	 Anticoagulants/hemophilia Factor Deficiency R/K = Prolonged MA/Angle = Decreased
R greater than 14 min	Very low clotting factors	Plasma and RBC's	
a-angle < 45 degrees	Low fibrinogen level	Cryoprecipitate/ Fibrinogen /Platelets	 Platelet Blockers Thrombocytopenia/Thrombotic R = Normal; K = Prolonged MA = Decreased
MA between 46-54 mm	Low platelet function	Platelets/ Cryoprecipitate/ Fibrinogen	
MA between 41-45 mm	Very low platelet function	Platelets/ Cryoprecipitate/ Fibrinogen	 Fibrinolysis R = Normal; MA = Continuous Decrease
MA at 40 mm or less	Extremely very low platelet function	Platelets/ Cryoprecipitate/ Fibrinogen	
MA greater than 73 mm	Platelet Hypercoagulability	No treatment if bleeding	 Hypercoagulation R/K = Decreased MA/Angle = Increased
LY30 greater than 3% , CI less than 1.0	Primary fibrinolysis	Tranexamic acid 1g IV over 10 minutes followed by 1g in 250cc NS infused over 8 hours	
			 D.I.C. Stage 1 - Hypercoagulable + secondary fibrinolysis
			 State 2 - Hypocoagulable state

• Refer to TEG analysis tree for values outside these ranges



Laboratory Value	Interpretation	Blood Product Transfusion	QUALITATIVE INTERPRETATION — PATTERN RECOGNITION
R less than 4 min	Enzymatic Hypercoagulability	No treatment if bleeding	 Normal R;K;MA;Angle=Normal  Anticoagulants/hemophilia Factor Deficiency R;K = Prolonged MA;Angle = Decreased  Platelet Blockers Thrombocytopenia/Thrombo- R - Normal; K = Prolonged MA = Decreased  Fibrinolysis R - Normal; MA = Continuous Decrease  Hypercoagulation R;K = Decreased MA;Angle = Increased  D.I.C. Stage 1 - Hypercoagulable s secondary fibrinol  Stage 2 - Hypocoagulable st
R between 11-14 min	Low clotting factors	Plasma and RBC's	
R greater than 14 min	Very low clotting factors	Plasma and RBC's	
a-angle < 45 degrees	Low fibrinogen level	Cryoprecipitate/ Fibrinogen /Platelets	
MA between 46-54 mm	Low platelet function	Platelets / Cryoprecipitate/ Fibrinogen	
MA between 41-45 mm	Very low platelet function	Platelets / Cryoprecipitate/ Fibrinogen	
MA at 40 mm or less	Extremely very low platelet function	Platelets / Cryoprecipitate/ Fibrinogen	
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- Refer to TEG analysis tree for values outside these ranges

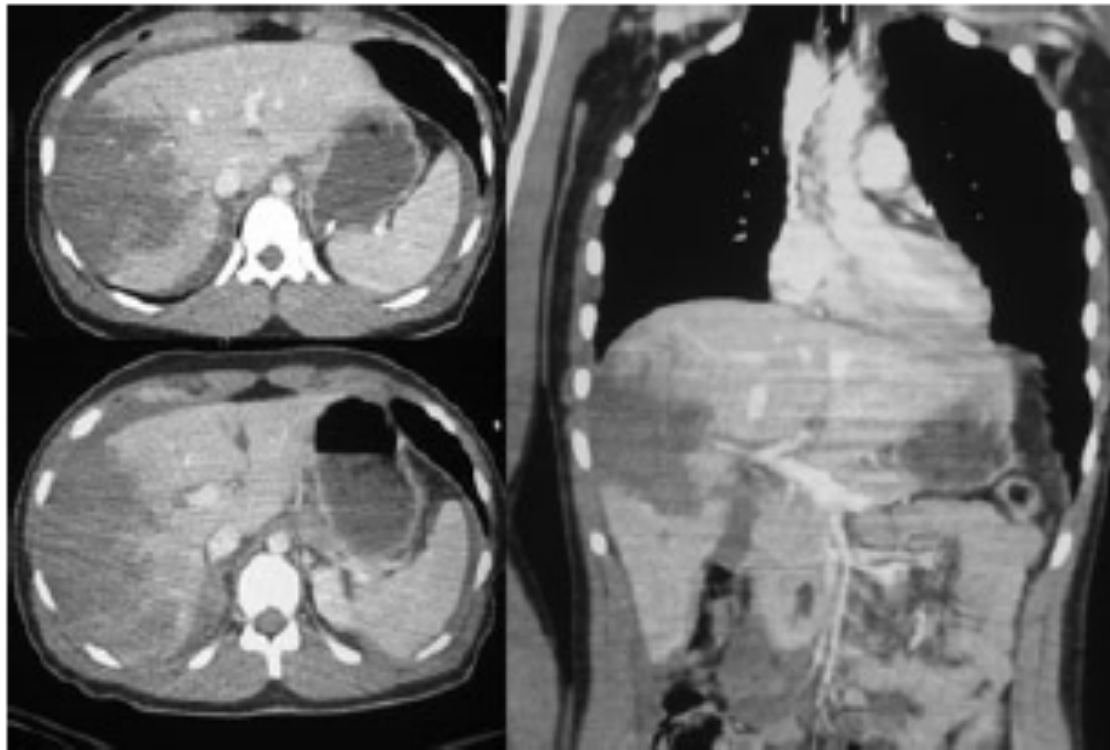
Case report 2



- women, 17 years old
- drop down 7m eter (climb accident)
- Sings of volumen deficiency shock
- Intubation and volumen challenge
- Helicopter transfer to hospital



- Thoracic trauma
- Liver purely tore
- Pelvic fracture



Case report 2

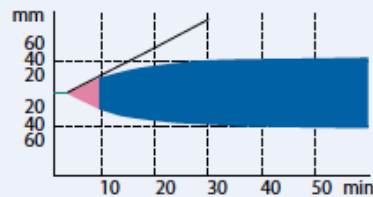
Eintrittslaborwerte

Quick-Wert (70-100%) **49%**
INR **1,4**
Thrombozytenzahl (120-150 G/l) **145 G/l**

Gerinnungsstatus

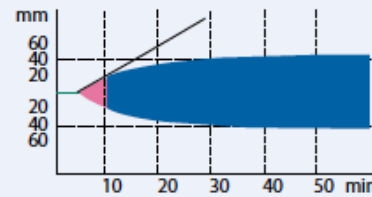
Quick-Wert (70-100%) **45%**
INR **1,4**
PTT (29-41 s) **55 s**
Fibrinogen (4-8 g/l) **0,7 g/l**
Thrombozytenzahl (120-150 G/l) **88 G/l**

EXTEM



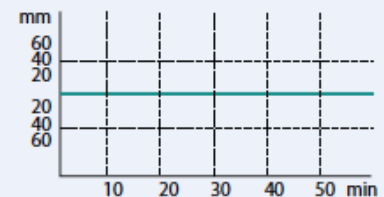
CT: 166 s (42-74 s)
CFT: 351 s (46-148 s)
MCF 42 mm (49-71 mm)

INTEM



CT: 250 s (137-246 s)
CFT: 335 s (40-100 s)
MCF 45 mm (52-72 mm)

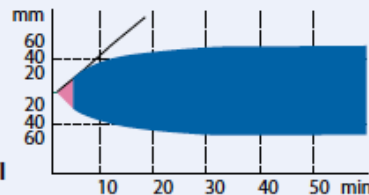
FIBTEM



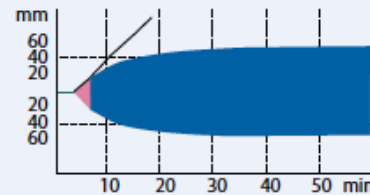
MCF 0 mm (9-25 mm)

4 g Fibrinogen; 2000 IE PPSB; 1250 IE Faktor XIII; 2 g Tranexamsäure

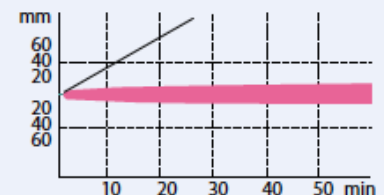
Quick-Wert (70-100%) **59%**
INR **1,2**
PTT (29-41 s) **46 s**
Fibrinogen (4-6 g/l) **1,8 g/l**
Thrombozytenzahl (120-150 G/l) **102 G/l**



CT: 55 s (42-74 s)
CFT: 194 s (46-148 s)
MCF 55 mm (49-71 mm)

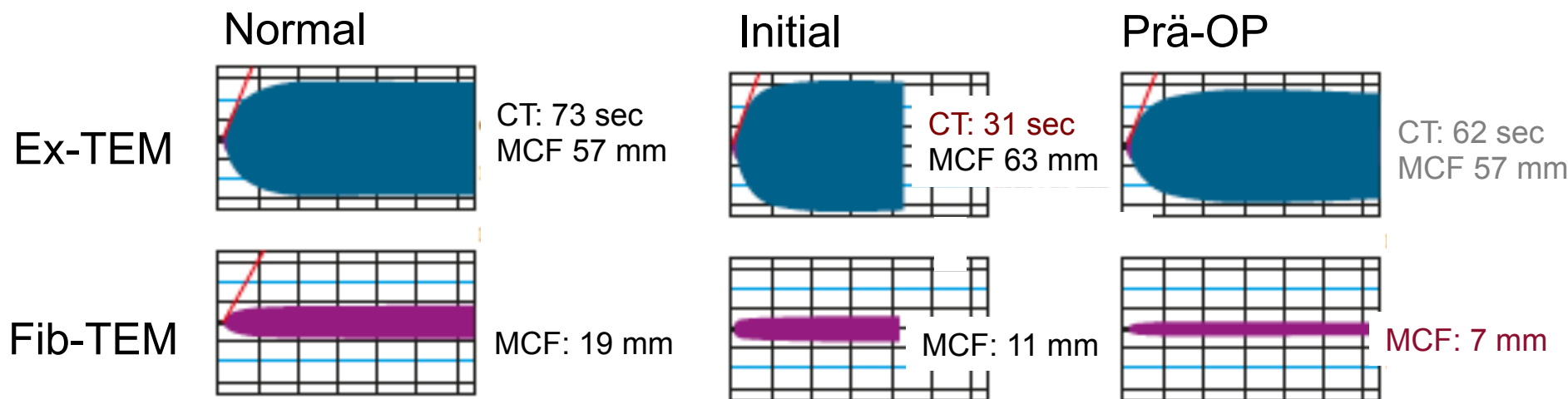


CT: 197 s (137-246 s)
CFT: 171 s (40-100 s)
MCF 54 mm (52-72 mm)



MCF 10 mm (9-25 mm)

Hemoglobin: 9,1 g/dl
 Hematocrit: 20%
 Thrombocyte counts: $263 \times 10^3/\mu\text{l}$
 Prothrombintime: 20.7 sec (Norm: 11-13.5 sec)
 aPTT: 38 sec (normal: 26 - 35 sec)
 Fibrinogen 1,33 g/l (Norm: 2 - 4.5 g/l)
 Temperature = 34°C



Intra-OP:

- Partial hepatectomy (Segm. VI – VIII) and Packing
- 12 EK
- 9 g Fibrinogen

Post-OP

ICU –
2000E PPSB

ICU:
2000E PPSB
4g Fibrinogen

Ex-TEM



CT: 100 sec
MCF 47 mm

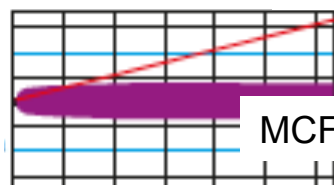


CT: 85 sec
MCF 44 mm



CT: 58 sec
MCF 47 mm

Fib-TEM



MCF: 13 mm



MCF: 9 mm



MCF: 16 mm

Blood gases analysis – Point-of-care

CRITICAL SECOND PTY LTD. 2010

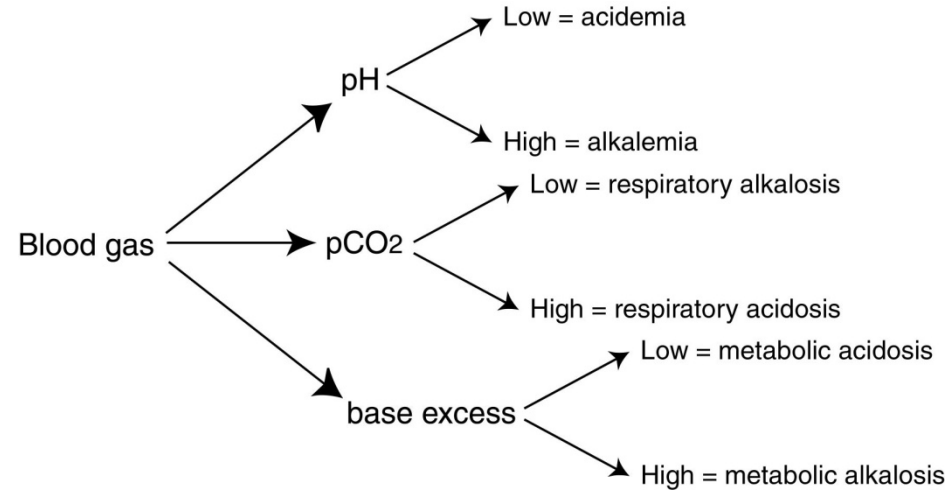
BLOOD GAS ANALYSIS

Blood Gases: Normal Values	
Arterial	Venous
7.35-7.45	pH 7.31-7.41
80-100 mm Hg	pO ₂ 30-40 mm Hg
35-45 mm Hg	pCO ₂ 41-51 mm Hg
21-25 mEq/L	HCO ₃ ⁻ 22-29 mEq/L
90%-98%	O ₂ sat 60%-85%
-2 to +2	BE 0 to +4

Interpreting ABG's

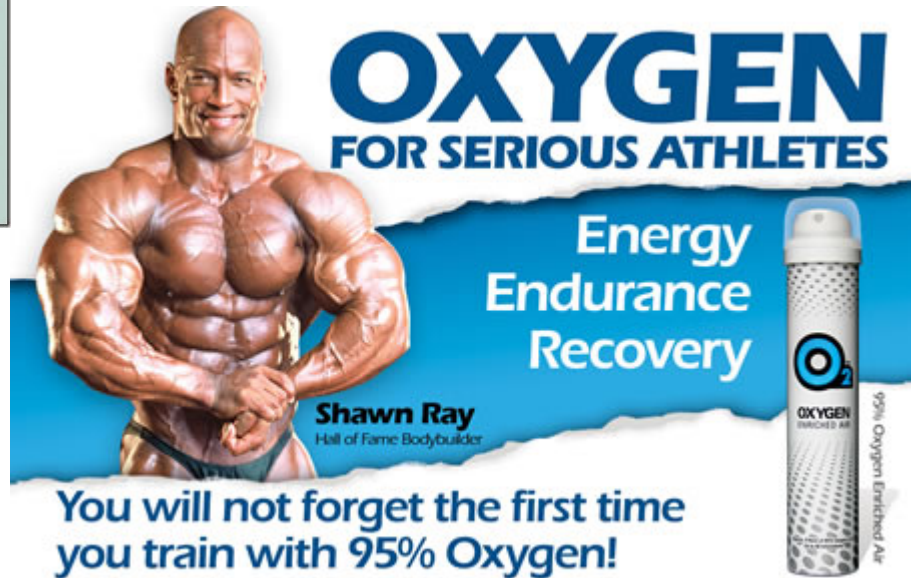
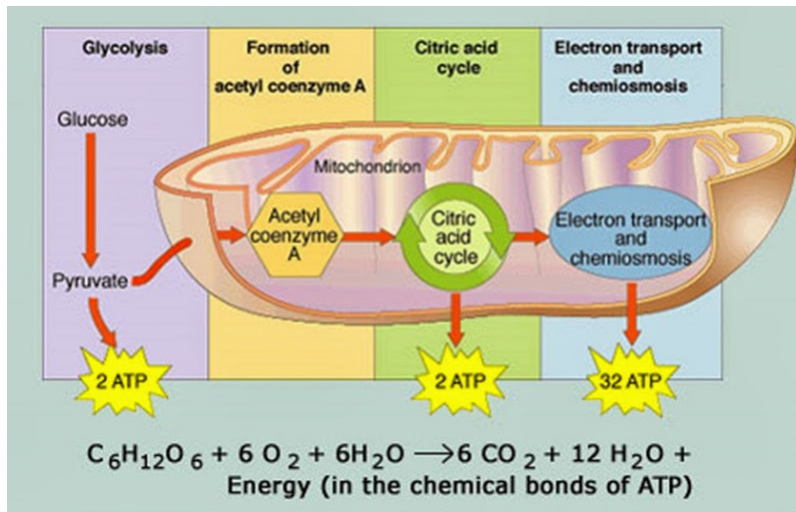
1. Check pH
 - ↑ = alkalosis; ↓ = acidosis
2. Check pCO₂
 - ↑ = CO₂ retention (hypoventilation); respiratory acidosis or compensating for metabolic alkalosis
 - ↓ = CO₂ blown off (hyperventilation); respiratory alkalosis or compensating for metabolic acidosis
3. Check HCO₃⁻
 - ↑ = nonvolatile acid is lost; HCO₃⁻ is gained (metabolic alkalosis or compensating for respiratory acidosis)
 - ↓ = nonvolatile acid is added; HCO₃⁻ is lost (metabolic acidosis or compensating for respiratory alkalosis)
4. Determine imbalance
5. Determine whether compensation exists

www.criticalsecond.com



Blood gases analysis – Point-of-care

What do we need oxygen for?



OXYGEN
FOR SERIOUS ATHLETES

Energy
Endurance
Recovery

Shawn Ray
Hall of Fame Bodybuilder

You will not forget the first time
you train with 95% Oxygen!

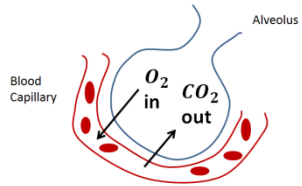
OXYGEN
ENRICHED AIR
95% Oxygen Enriched Air

Respiration

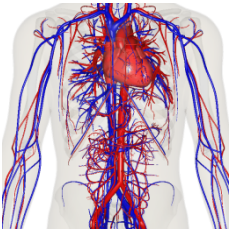


- **ventilation**

movement of air between the environment and the lungs via inhalation and exhalation



- **gas exchange**



- **oxygen transport**

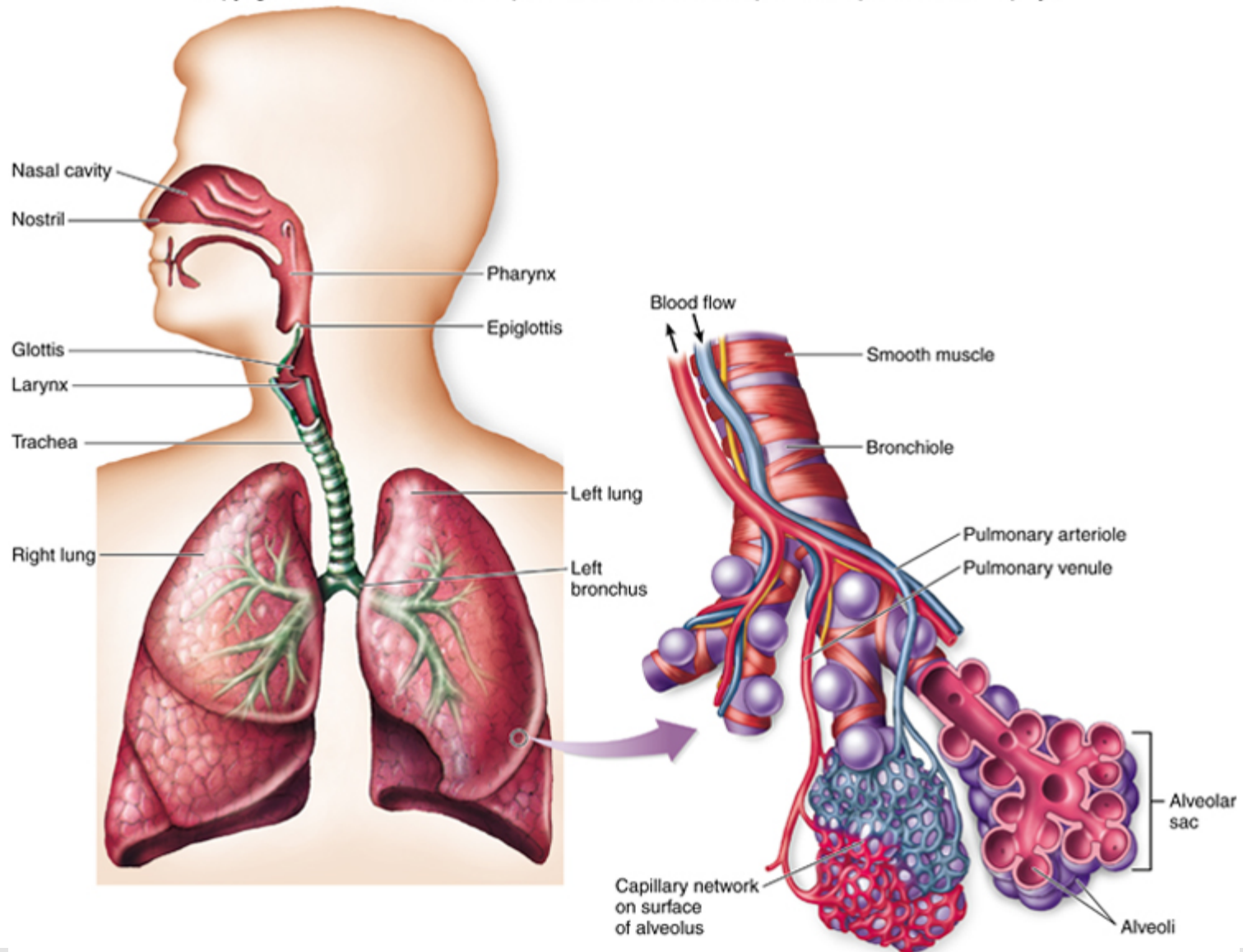


- **oxygen consumption**



Ventilation

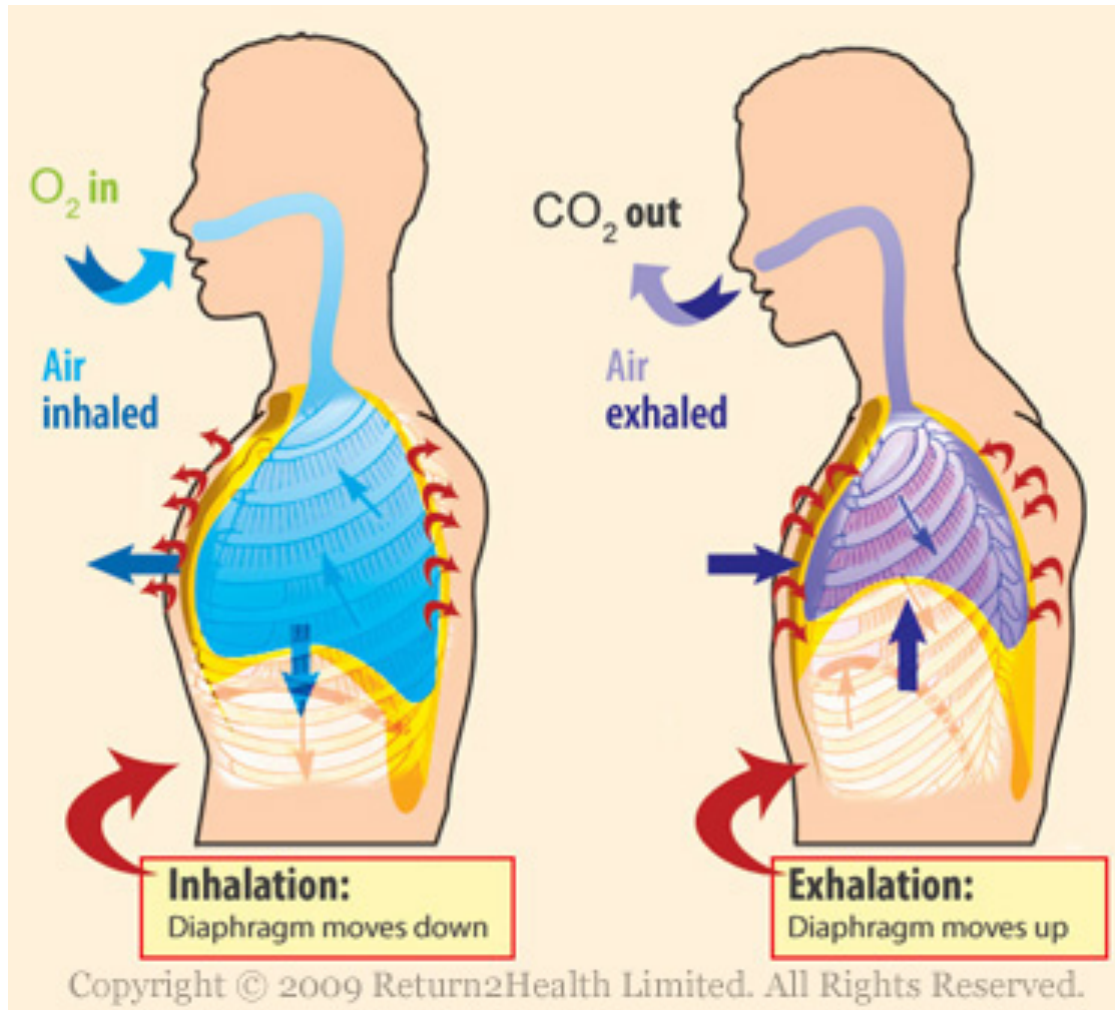
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Ventilation mechanics

Why is the air travelling into the lungs?

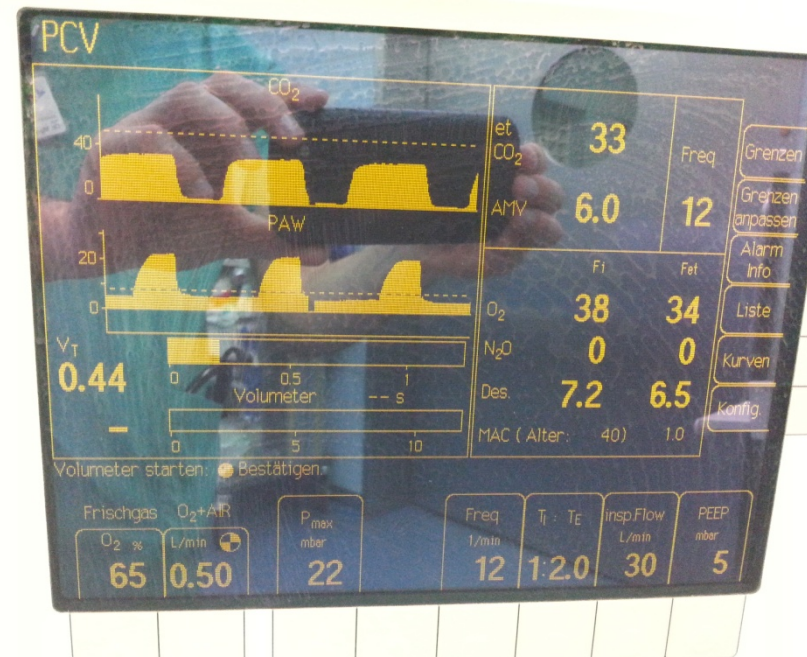




Ventilators

Parameters to control ventilation/ ventilators:

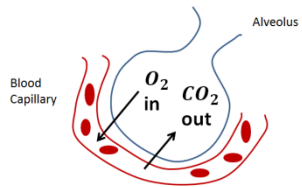
- **respiratory rate** 12-15 /min
- **respiratory volume** ~7 ml /kgKG
- **respiratory pressure** 15-20 mmHg
- **inspiratory time : expiratory time** 1:2
- **inspiratory flow** 30 l/min
- **end-expiratory pressure** 5-10 mml



Respiration

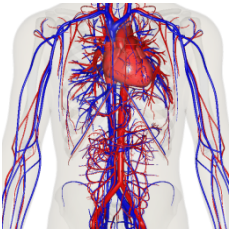


- ventilation



- **gas exchange:**

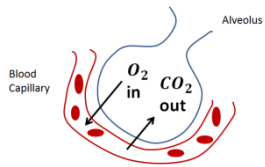
diffusion of O₂ from into the blood,
diffusion of CO₂ out of the blood



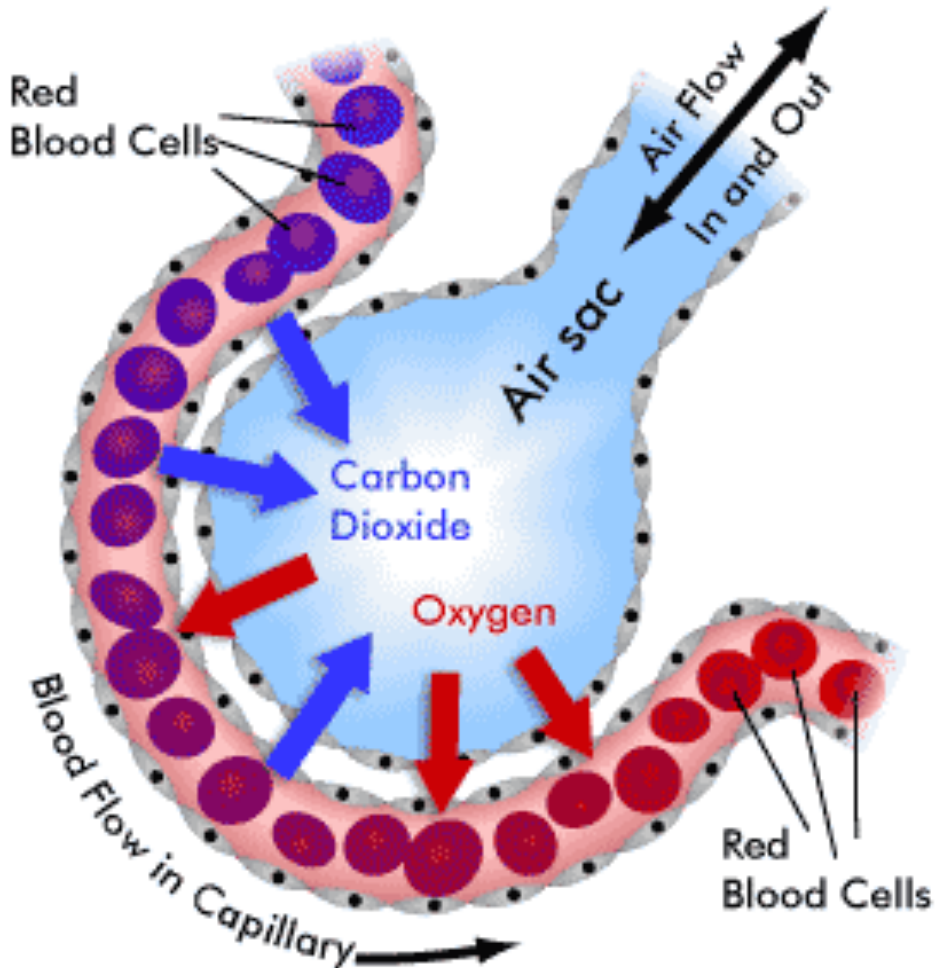
- oxygen transport



- oxygen consumption



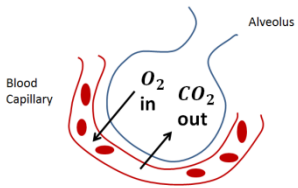
Gas exchange



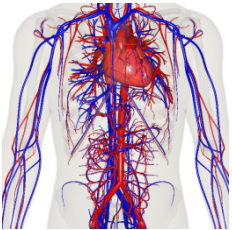
Respiration



- ventilation



- gas exchange



- **oxygen transport:** Perfusion is the process by which the cardiovascular system pumps blood throughout the lungs to place of oxygen consumption

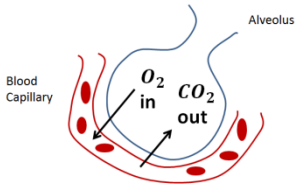


- oxygen consumption

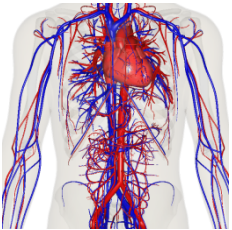
Respiration



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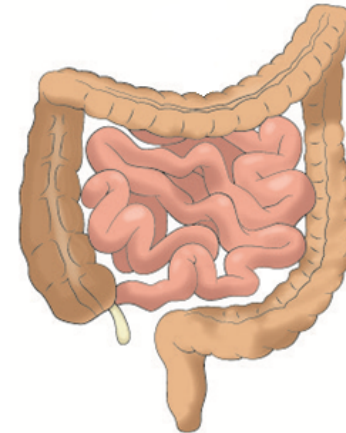
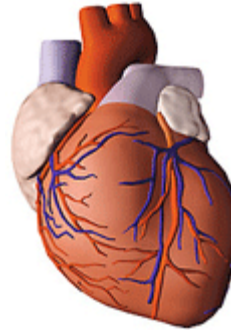
- oxygen transport



- oxygen consumption



Oxygen consumption

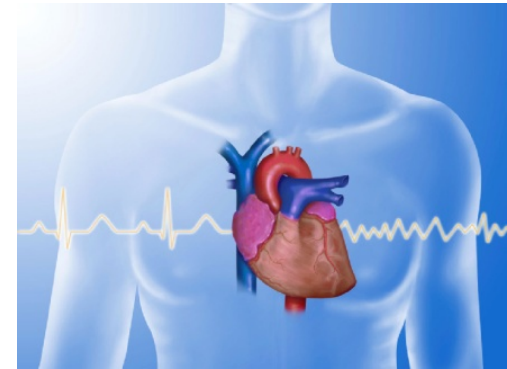
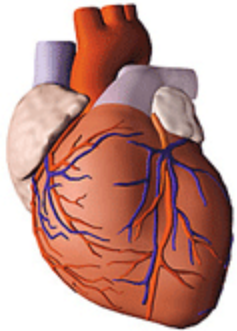




Oxygen consumption



Inadequate oxygen supply



CPR



**Cardio
Pulmonary
Resuscitation**



Arterial blood gases



After a pulse is found, a blood sample is taken from the artery

ADAM.

measurement :

- pH
- pO_2
- pCO_2
- HCO_3^-
- And many more (not primarily ventilation associated)

Normal Blood Gas Values

	Arterial	Venous	Capillary
pH	7.35 - 7.45	7.31-7.41	7.35-7.45
pCO₂	35 - 45 mm Hg	40-50	Same
pO₂	75 - 100 mm Hg	36-42	< than arterial
HCO₃	22-26 meQ/L	Same	Same
BE	-2 to +2	Same	Same
Oxygen Saturation	>95%	60-80	< than arterial

Case report - What do you do?

Patient:

- 65 years
- Smoker
- no medical history

Situation:

- intubated, anestezied for
- laparoscopic cholecystectomy
- SpO₂: shows 85% and rings alert

• Suregon asks you:
„Is there a problem?“



What do you do?

Pulse oxymetry:

- Is there a good plethysmograph? – Is there a good curve?
 - If no, check patient! -> blood pressure, capnography, device position
 - If yes, check -> capnography

Capnography:

- Is the CO₂ within the range of 35mmHg -40mmHg?
 - If below -> Is the patient still adequately ventilated, what is the blood pressure
- What does the curve look like?

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- What does the curve look like?

Check ventilation and connections

Auscultate patients chest

Draw arterial blood gases

- Arterial blood gas analysis reveals:

Inspired oxygen

85% (FiO_2 0.85) estimated
normal values

PaO_2 19.5 kPa (147 mmHg)

> 10 kPa (75 mmHg) on air

pH 7.10

7.35 – 7.45

PaCO_2 18.0 kPa (135 mmHg)

4.7 – 6.0 kPa (35 – 45 mmHg)

HCO_3^- 36 mmol l^{-1}

22 – 26 mmol l^{-1}

BE + 12 mmol l^{-1}

+/- 2 mmol l^{-1}

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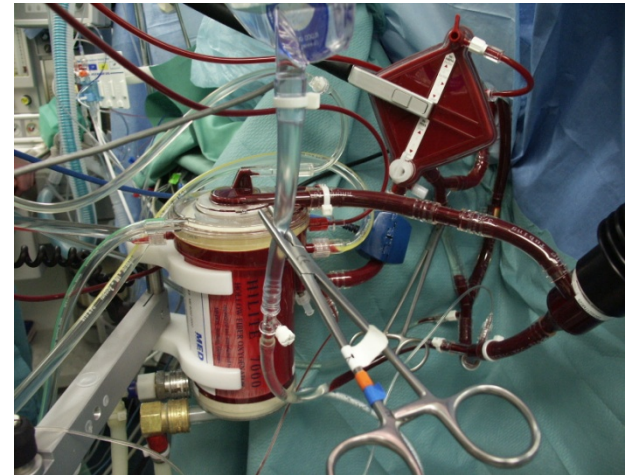
BE + 12 mmol l^{-1}

+/- 2 mmol l^{-1}

Summary: The significant acidemia pH 7.10 indicate an acute respiratory acidosis as a result of a respiratory arrest.

Take home

- Point-of-care analysis
 - bedside
 - quick performance and fast results
 - quick re-evaluation of the case
 - economical?!



Thank you for your attention!