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Medizintechnik

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Neue Methode zur Bestimmung
metabolischer Zustände:

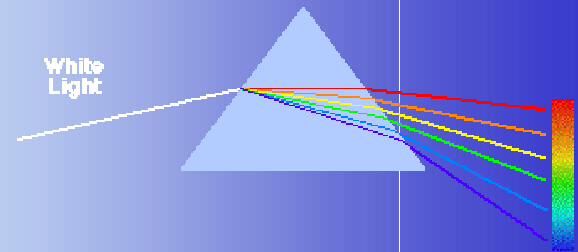
- In Zellen über den Cytochrom-Redox-Zustand und
- im Gewebe durch die Bestimmung der postkapillären Sauerstoffsättigung sowie des kapillären Blutflusses.

Key Technologies

- Laser Spectroscopy



- White Light Spectrometry



- Glas Fibre Technology

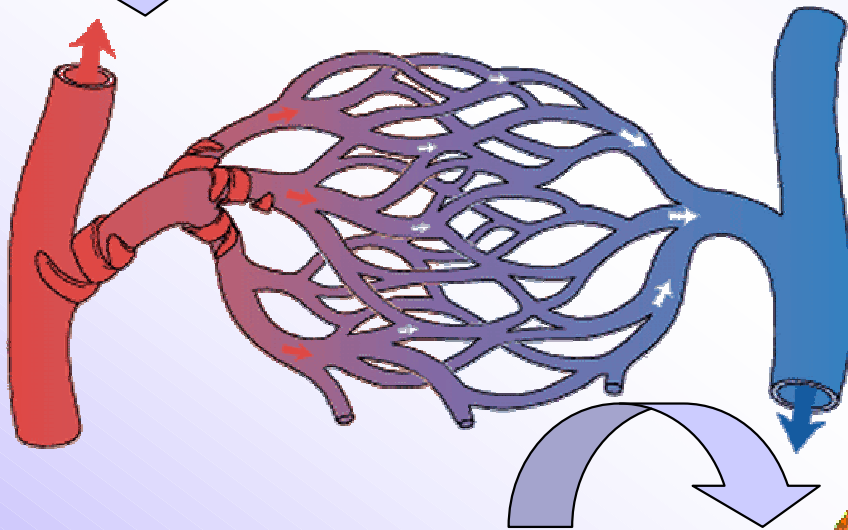
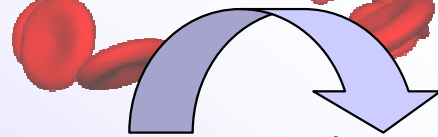


- Optical Sensors
(worldwide patents)



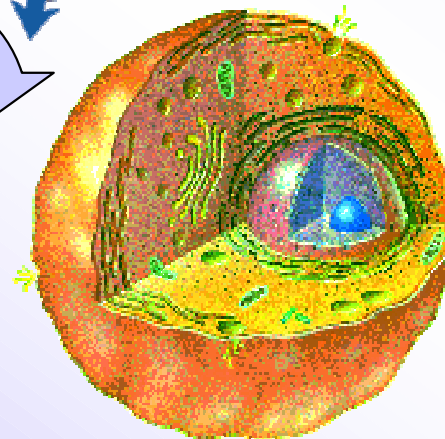
Oxygen consumption / metabolism

the key parameter for monitoring of
cell function - in any organ ...



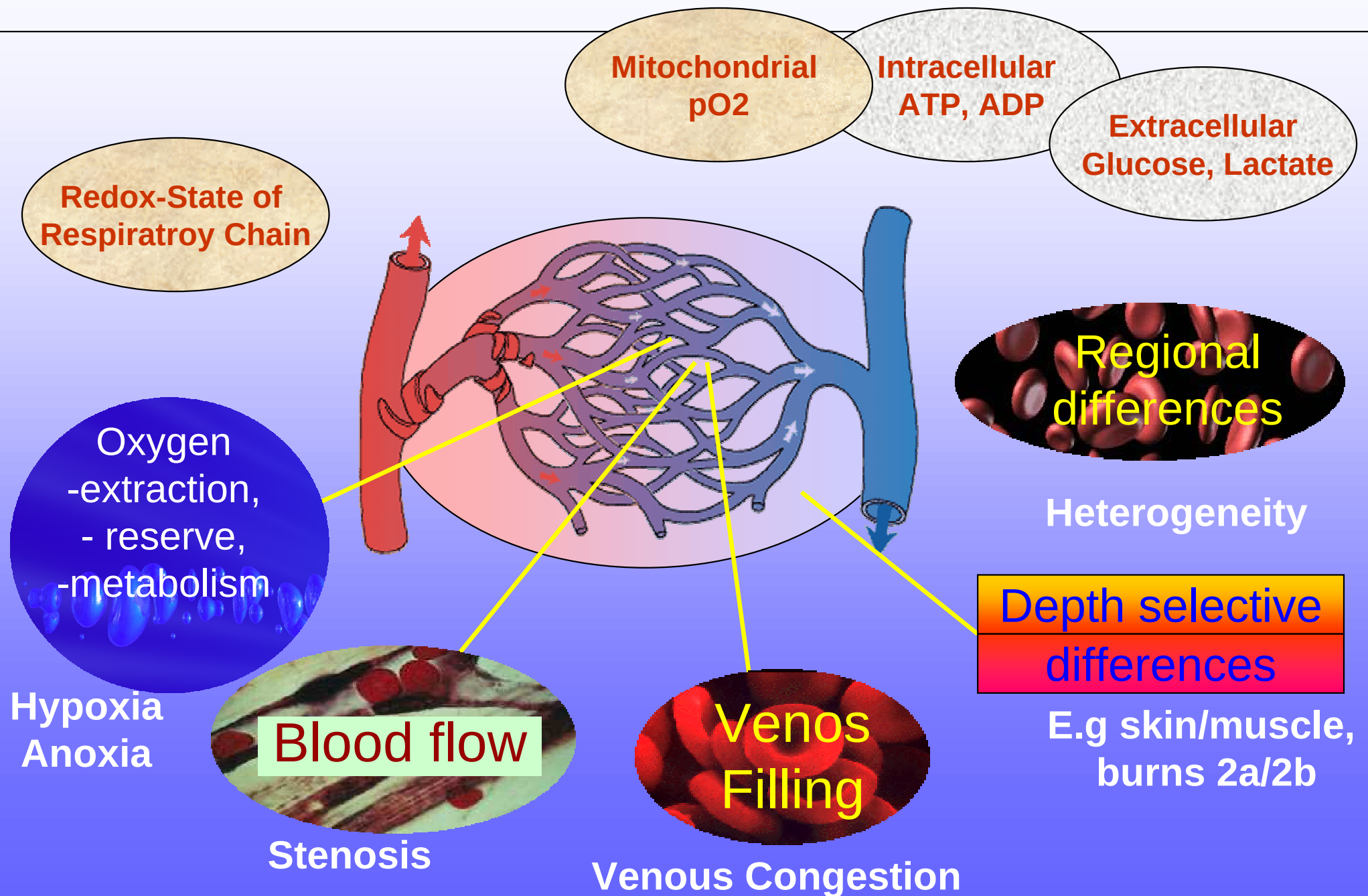
O_2

... In the capillary
network the **oxygen**
gets **exchanged** and
consumed by the cells.

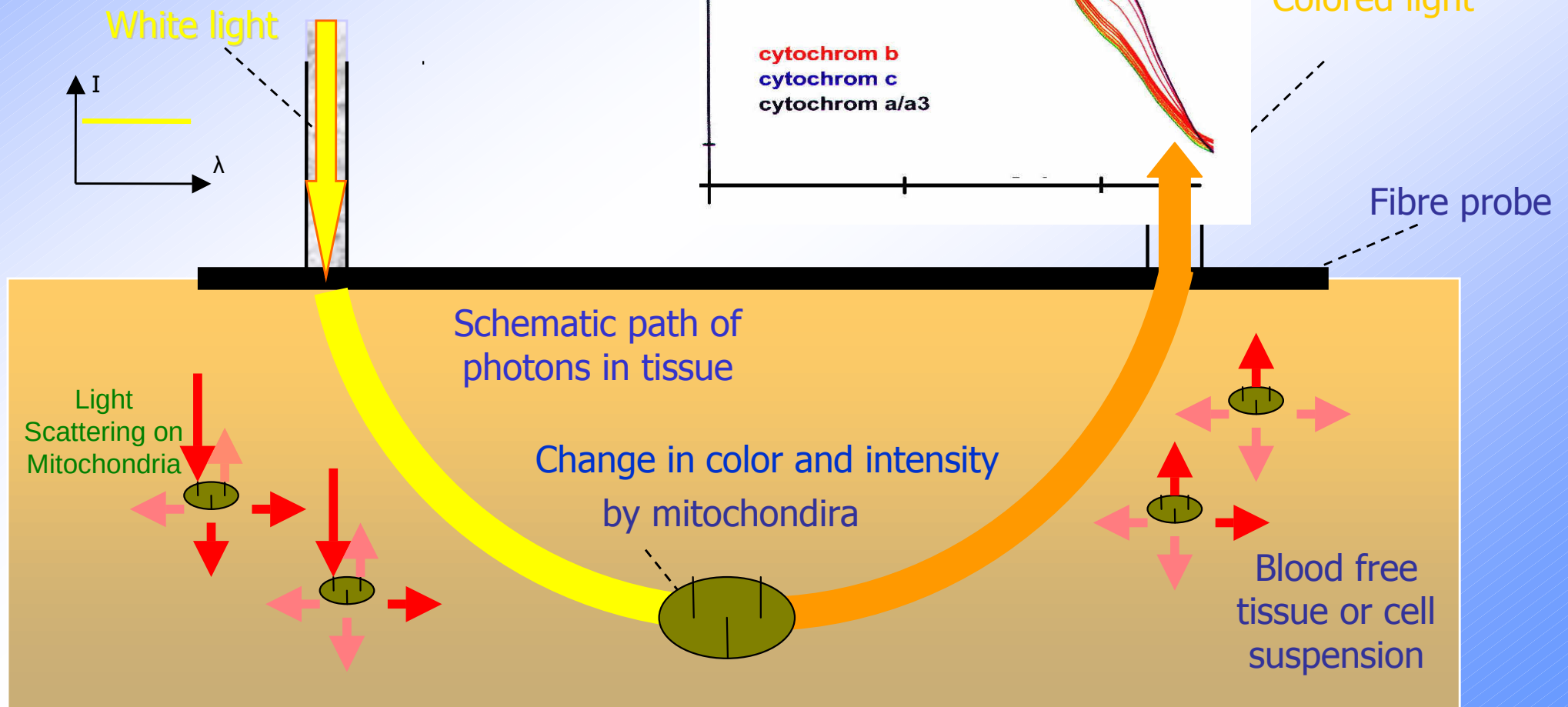
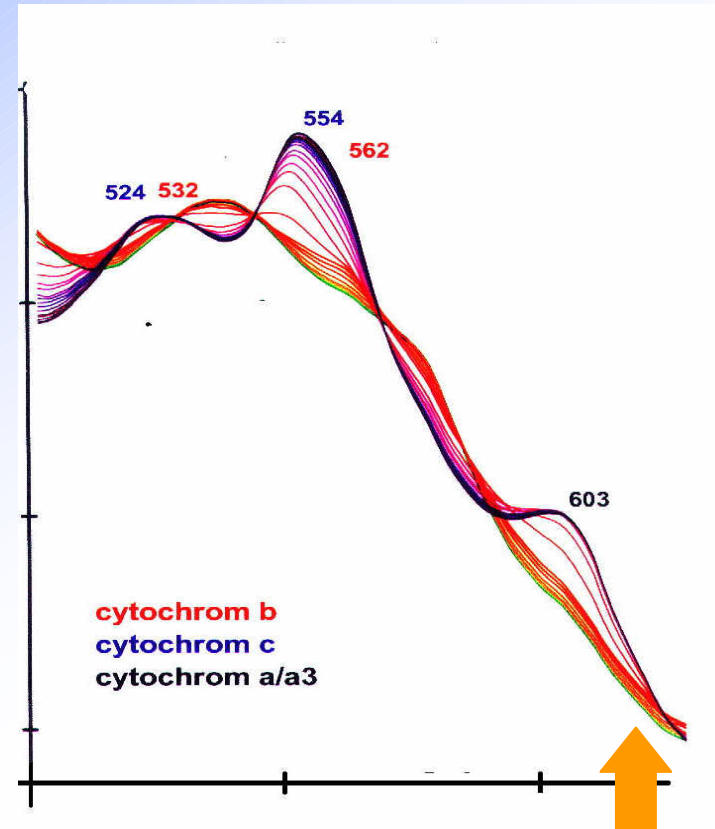


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Requirements for a tissue monitoring



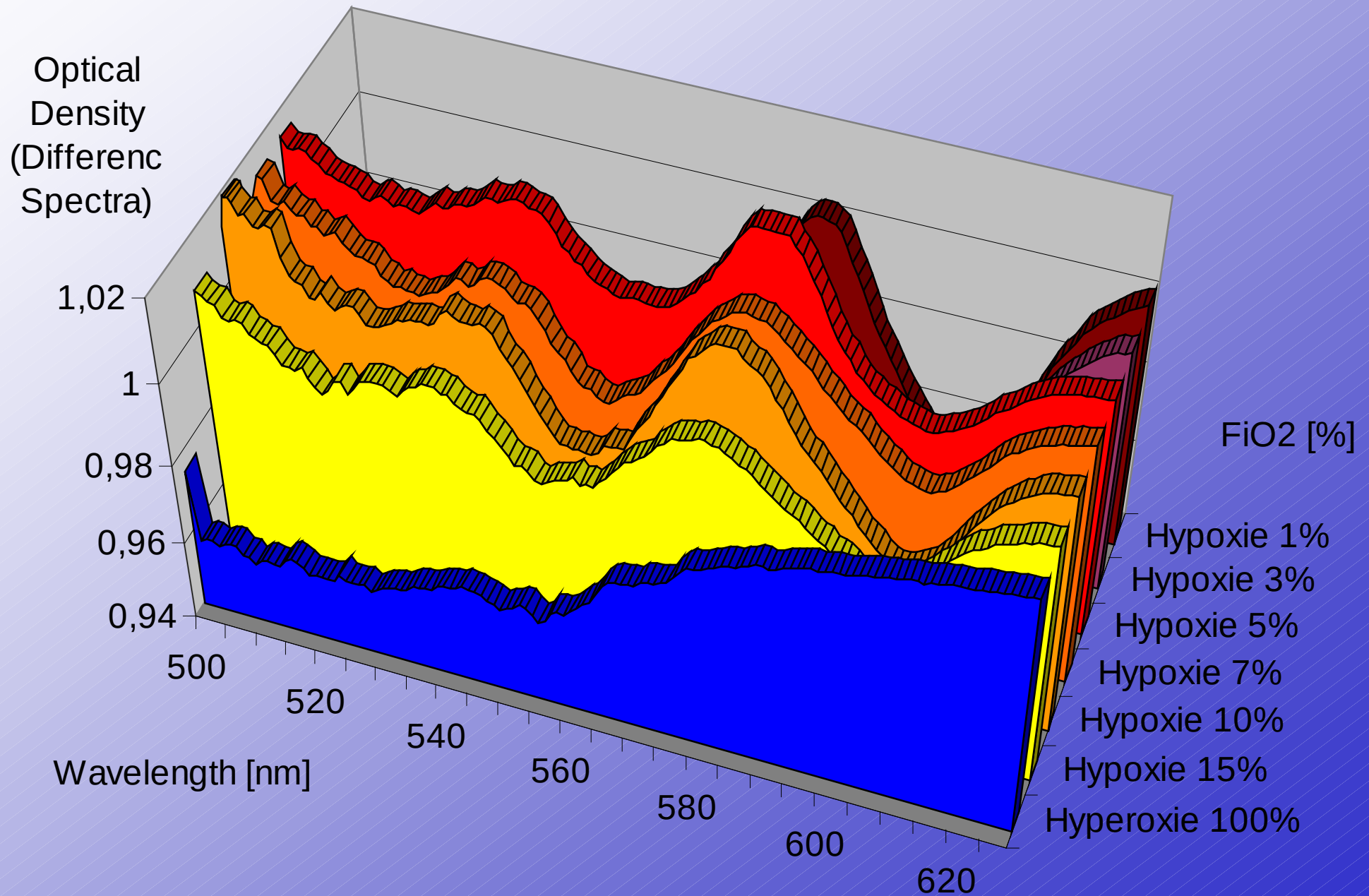
**Cell/Tissue Spectrophotometry for
determination of
mitochondrial activity by
recording of cytochrome spectra
for
determination of cytochrome
b, c and aa3 redox state**



Cytochrome Measurements on isolated perfused rat liver

=> Reduced Cytochromes at $\text{FiO}_2 < 15\%$

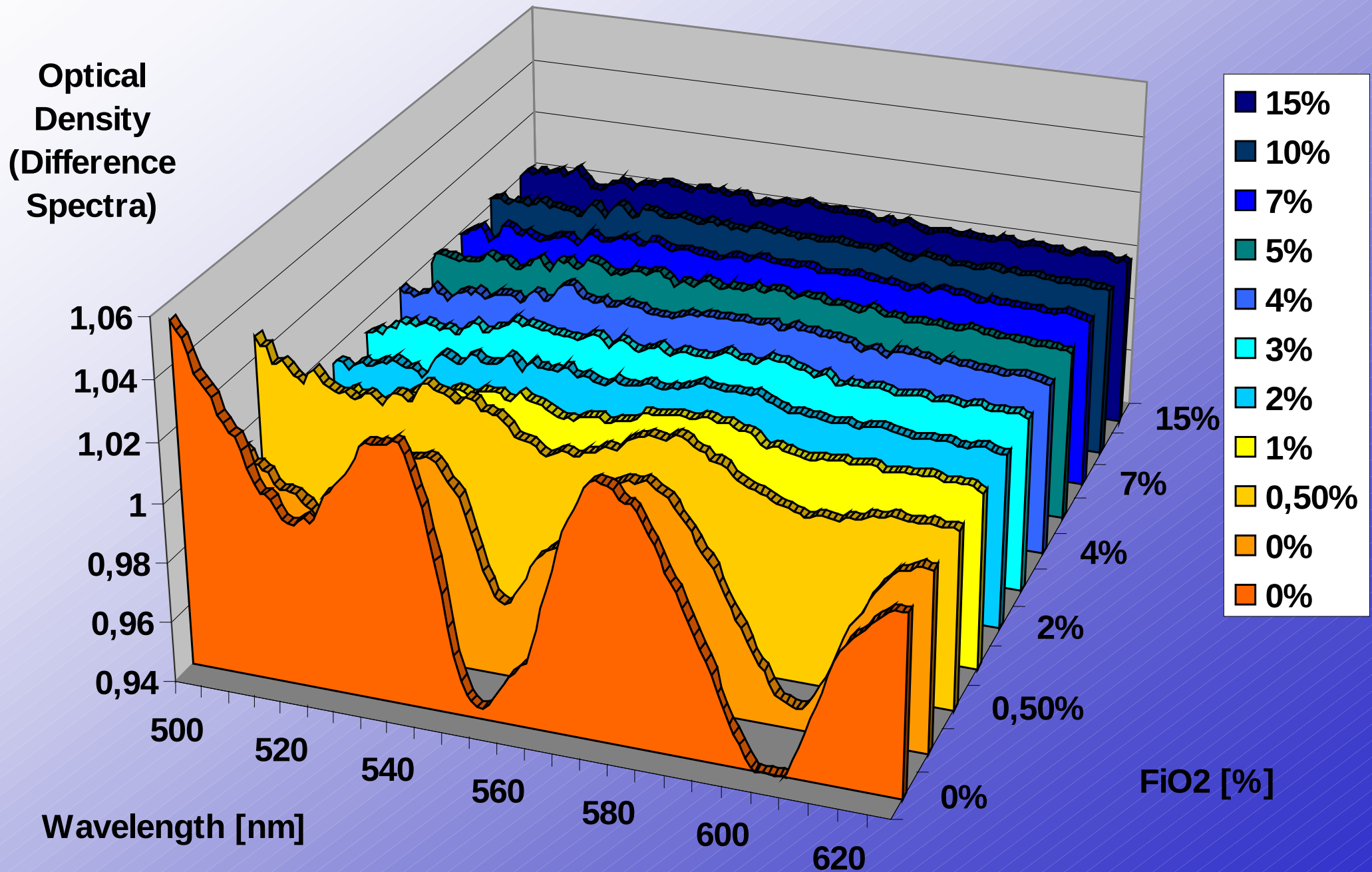
(Sommer N., Seeger W., Weissmann N., Universitätsklinikum Giessen, Medizinische Klinik II)



Cytochrome Measurements on isolated Mitochondria of Liver

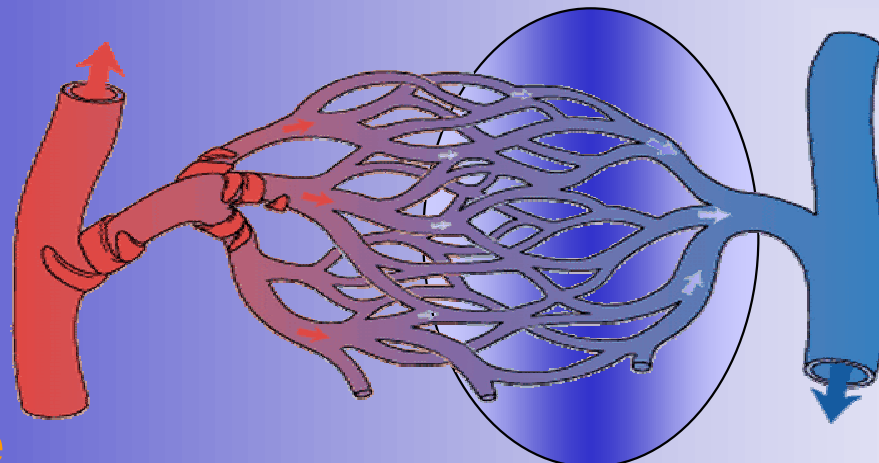
=> Reduced Cytochromes at $\text{FiO}_2 < 1\%$

(Sommer N., Seeger W., Weissmann N., Universitätsklinikum Giessen, Medizinische Klinik II)



O2C (oxygen to see)

- Laser- and White-light spectroscopy
- continuous monitoring of
- blood flow (capillary microcirculation)
- venular oxygen saturation (hypoxia)
- capillar-venular filling with blood (venous congestion)
- 50 ms measurement time
- depth selectiv (e.g. skin, muscle, bone) 100 μ m - 15 mm

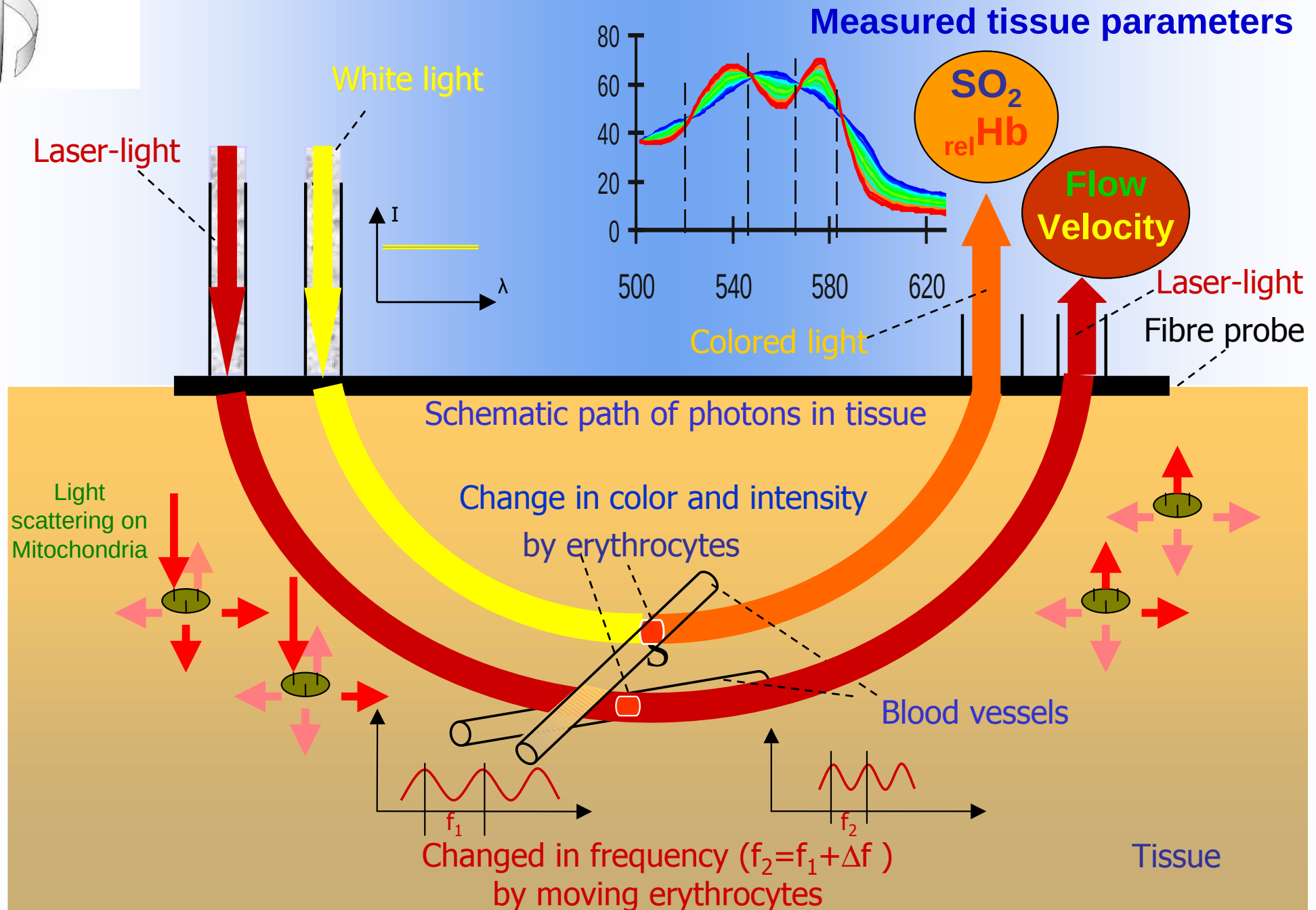


Blood volume
distribution

10 : 14 : 76 %



White light spectrometry and Laser-Doppler



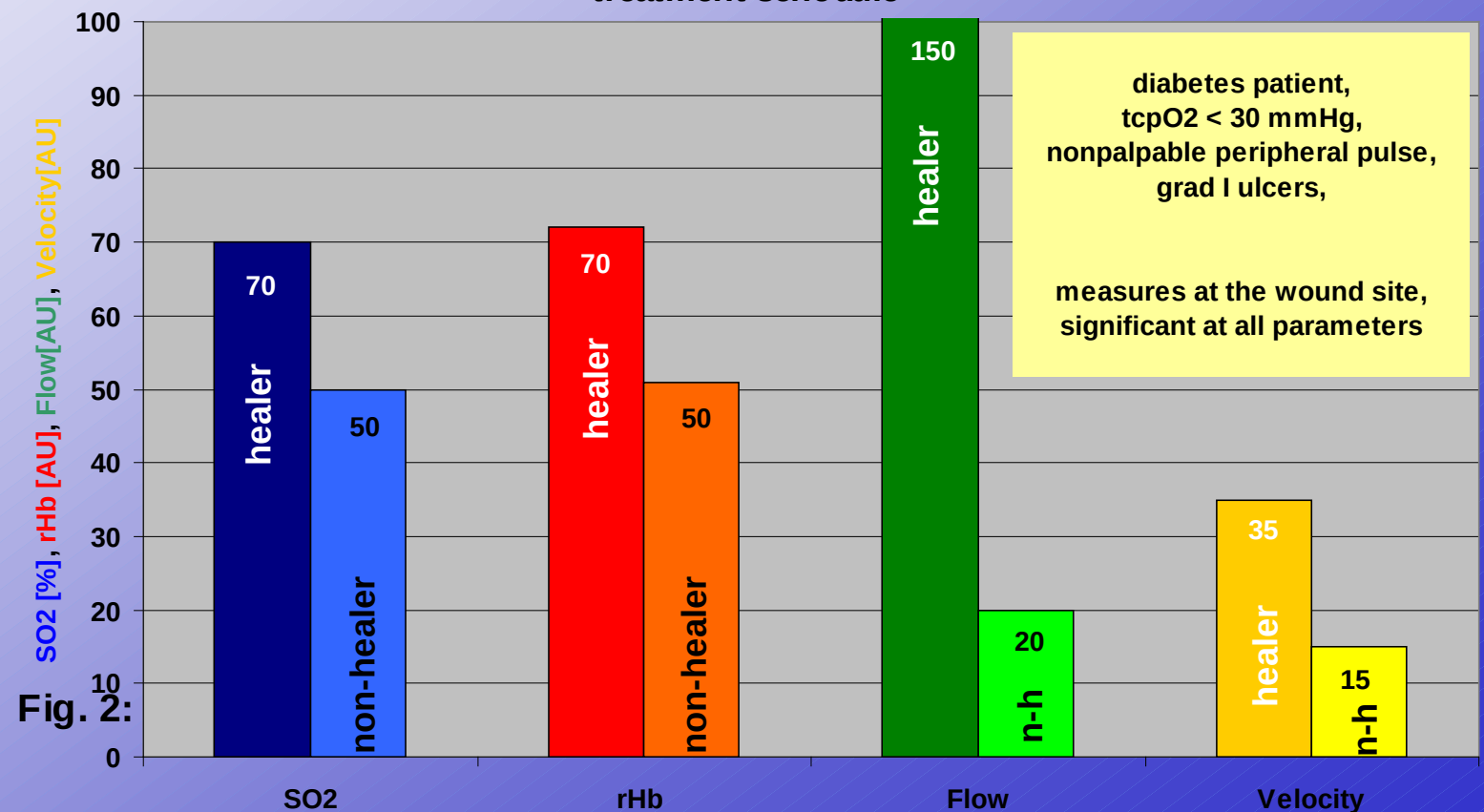
The Impact of O2C for the Quantification of Tissue Ischemia in Diabetic Foot Ulcers (Diabetes Care, Vol. 27, Dec. 2004)

- Patient lying on his back
- Start of measurement after 10 minutes rest
- Definition of constant measurement time
- Opsite®-Film between wound and probe
- Same application pressure of the probe by fixation of the probe with Opsite®-Film of constant size
- No movement of the extremities during measurement

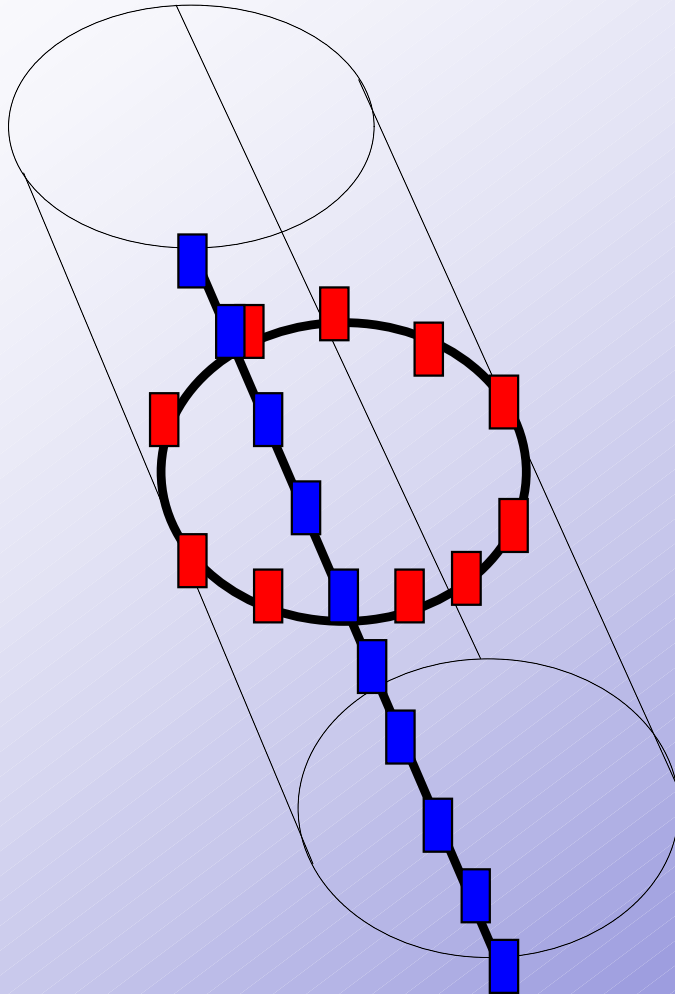
S. Beckert, A. Königsrainer, M. Witte, S. Coerper
 Universitätsklinikum Tübingen, Klinik für Allgemeine Chirurgie

“The O2C is a reliable and valid method, for the assessment of tissue microperfusion.

Measurements are easy to perform and not time consuming. Results are accurate ... detect clinically relevant ischemia earlier, predict the future healing process and choose appropriate treatment schedule”



Amputation level assessment using lightguide spectrophotometry



Investigation scheme on the lower leg,

- 10 locations on a circle and
- 10 locations in a row

Prosthet Orthot Int 1995 Dec;19(3):139-47
Amputation level assessment using lightguide spectrophotometry.

Harrison DK, McCollum PT, Newton DJ, Hickman P, Jain AS

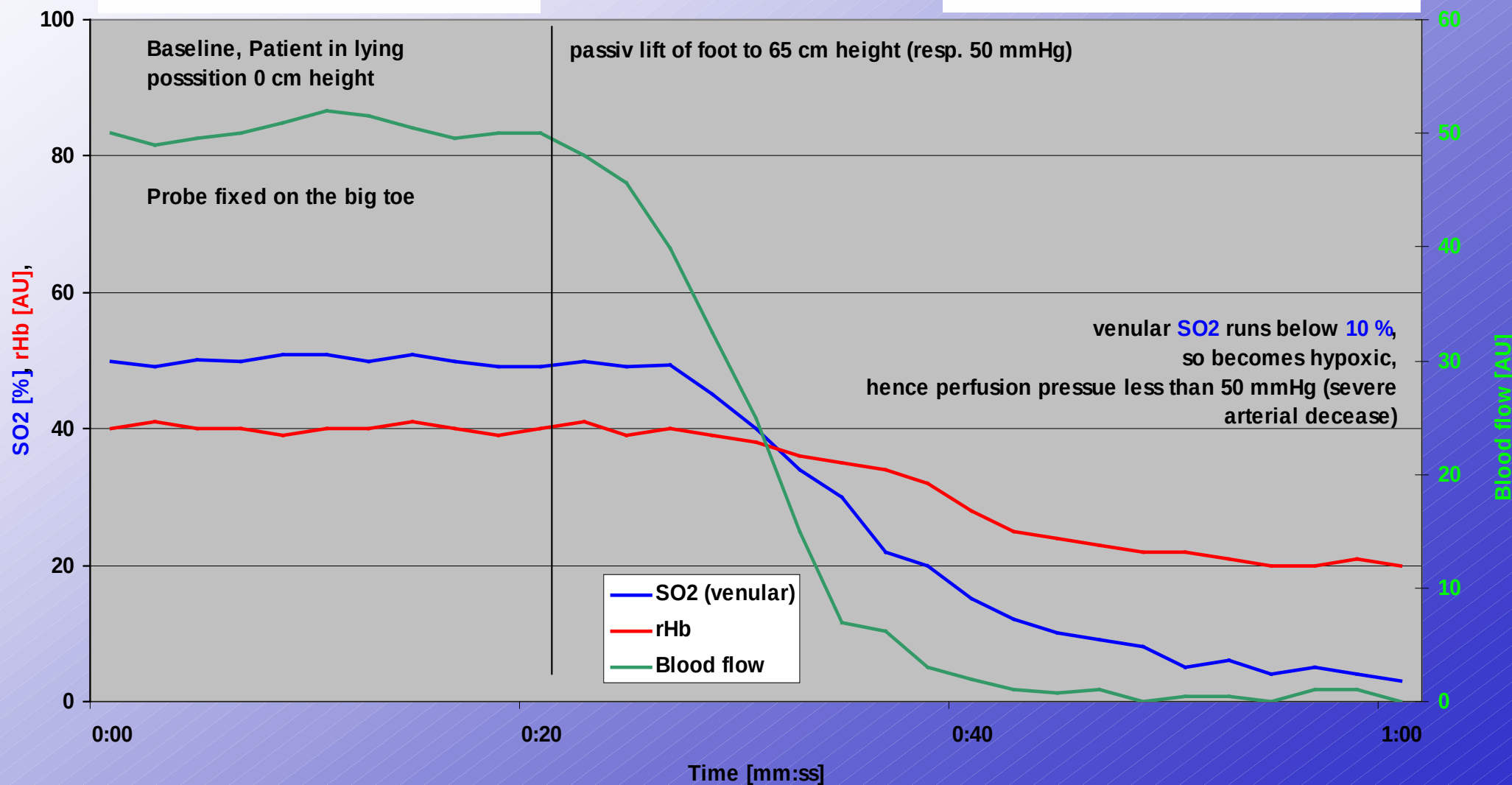
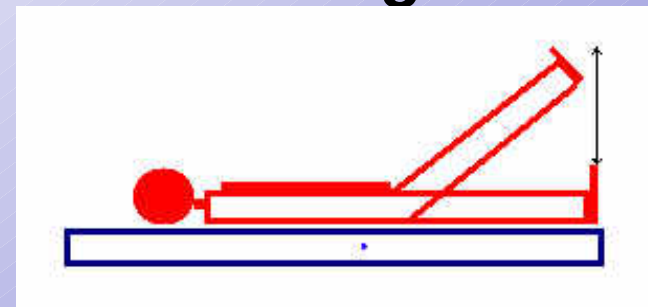
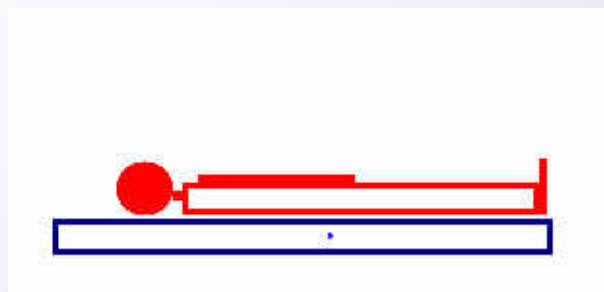
Criteria for amputation due to insufficient wound healing

- Mean value greater than 30% in SO₂
- and
- Lowest values below 10% SO₂ only 3 out of 20 values.

The combination of these criteria gave a sensitivity and selectivity of 1.0 for prediction of a successful outcome of transtibial amputations.



O2C (oxygen to see) investigation on toe (D1), test of 50 mmHg perfusion pressure at angle



Postprandiale Dysfunktion der Mikrozirkulation nach einer Mahlzeit reich an Advanced Glycation Endproducts (AGE) bei Patienten mit Typ 2 Diabetes mellitus - protektive Rolle von Benfotiamin

Stirban A., et. al.; Bad Oeynhausen,
Poster, 40. Jahrestagung DDG, Berlin 5/2005

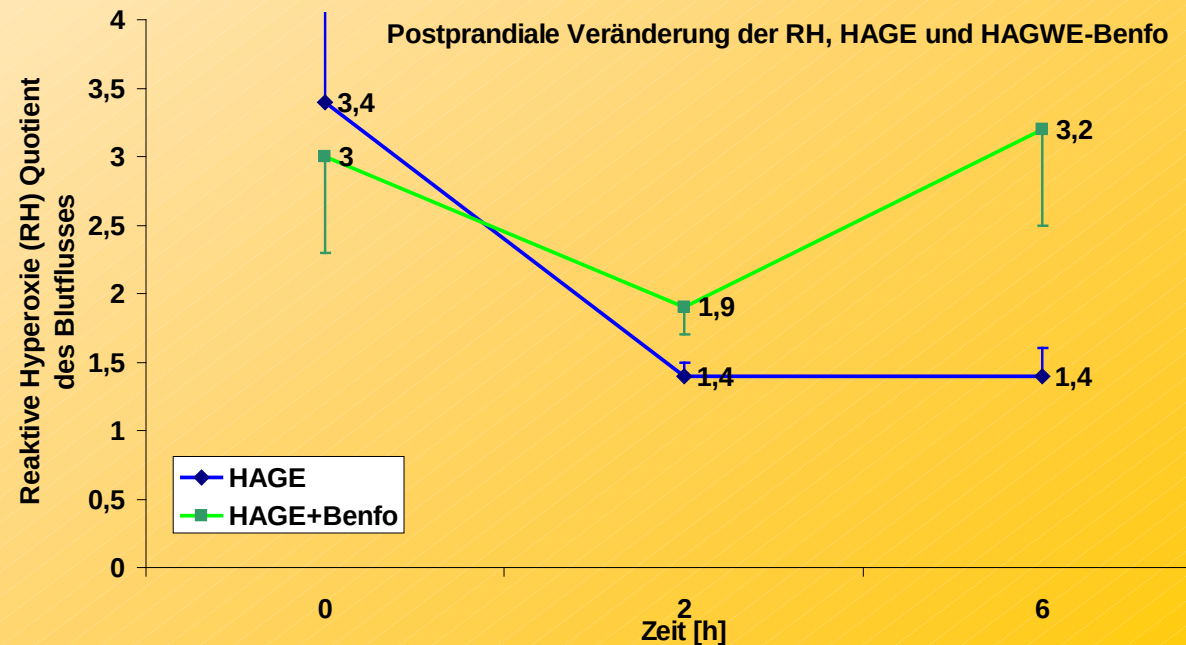
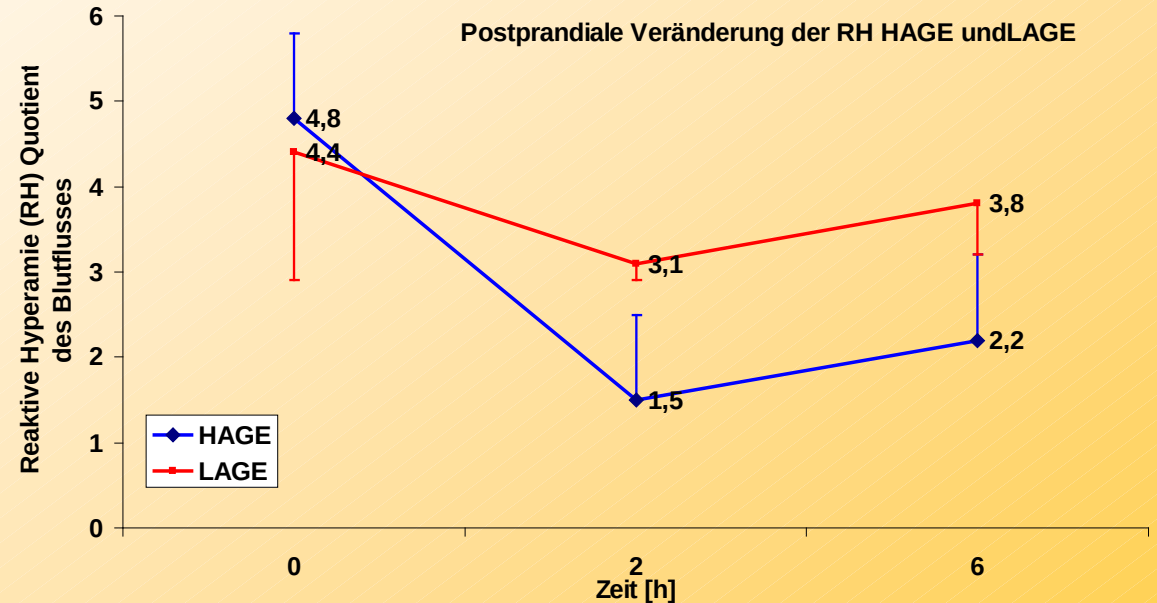
Methoden:

AGE-reiche Mahlzeit (HAGE): 15.100 kU AGE
gebacken/gebraten
- 220°C, 20 Min

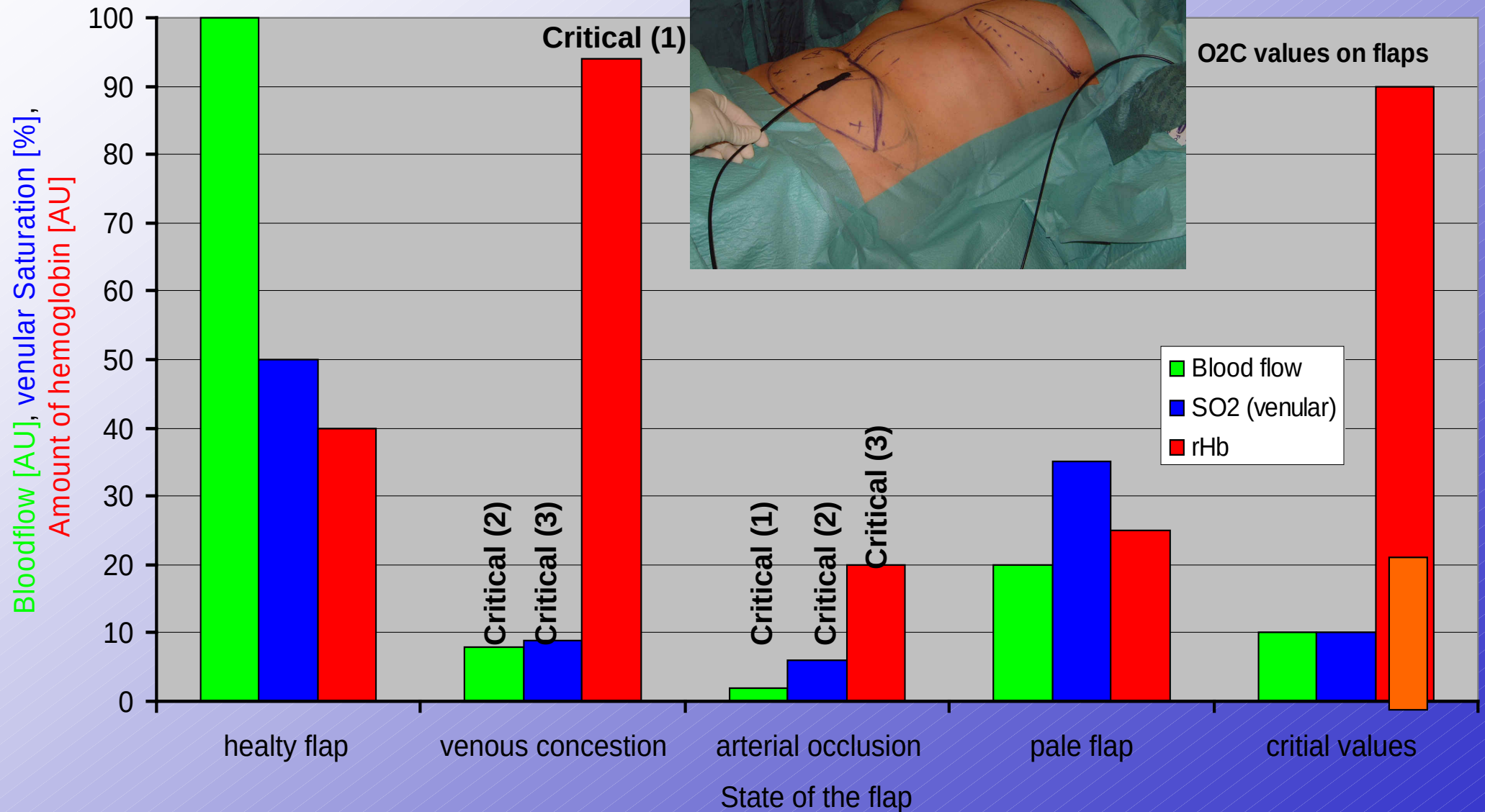


AGE-arme Mahlzeit (LAGE): 2750 kU AGE
gekocht/gedünstet
- 100°C, 10 Min

- Eine **AGE-reiche**, Mahlzeit führt zu einem signifikanten **Abfall der Gefäßfunktion der Mikrozirkulation** (O2C oxygen to see), der mindestens 6 Stunden anhält und ausgeprägter ist als nach einer AGE-armen Mahlzeit
- Benfotiamin kann diesen negativen Effekt **reduzieren**

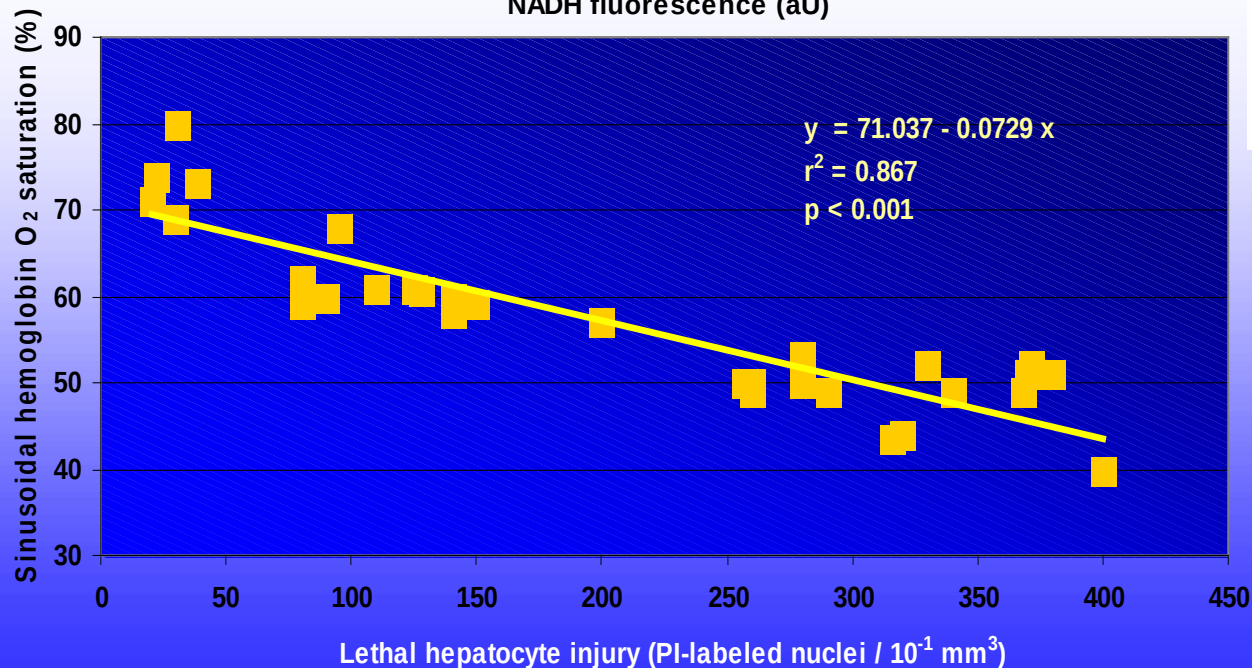
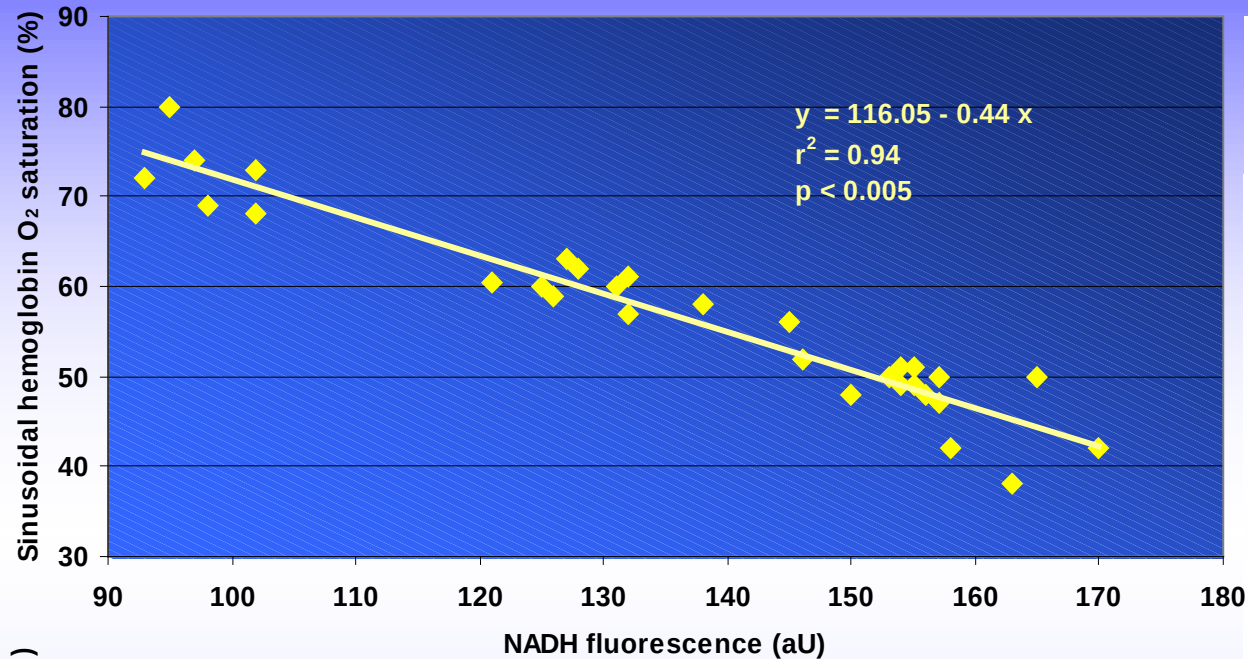


O2C (oxygen to see) values typical for flaps



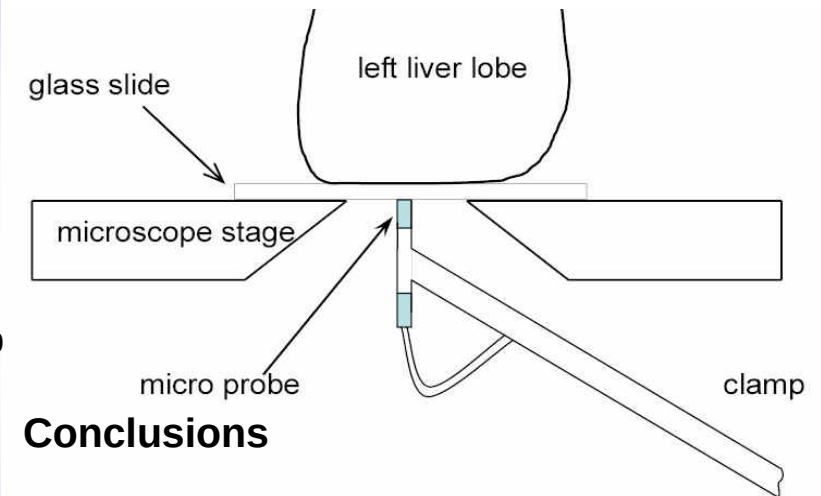
A remission spectroscopy system for *in vivo* monitoring of hemoglobin oxygen saturation in murine hepatic sinusoids, in early systemic inflammation

(Comparative Hepatology 2005, 4:1 doi:10.1186/1476-5926-4-1)



C. Wunder, R. Brock, A. Krug, N. Roewer, O. Eichelbrönnner

Anesthesiology, University of Würzburg, Germany
Department of Pharmacology & Toxicology, University of Arkansas, USA



Conclusions

Remission spectroscopy (O₂C) represents a simple and reliable method for hepatic sinusoidal SO₂ determination.

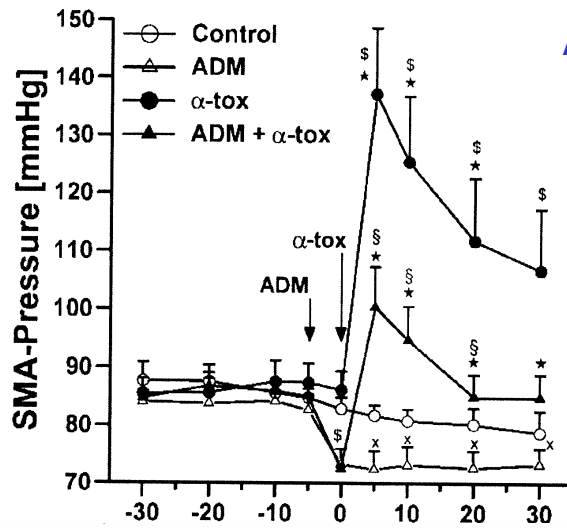
Significant reduction in hepatic SO₂ during early stages of systemic inflammation in parallel an increasing NAD(P)H autofluorescence (=inadequate oxygen supply)

Increase microvascular permeability and perfusion mismatch are hallmarks of sepsis and septic shock

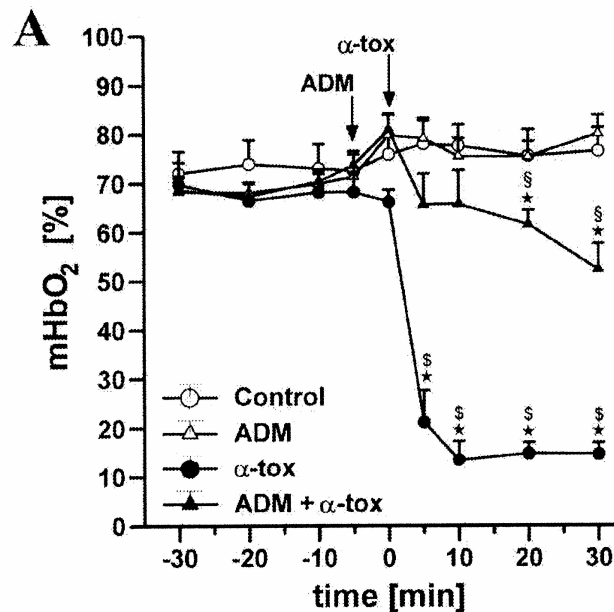
B. Brell, B. Temmesfeld-Wollbrück, et. Al. Department of
Internal Medicine/ Infection Diseases, University Medicine
Berlin, Germany

Crit. Care Med. 2005 Vol. 33, No.4 pp 819-826

Adrenomedullin reduces Staphylococcus aureus α -toxin-
induced rat ileum microcirculatory damage



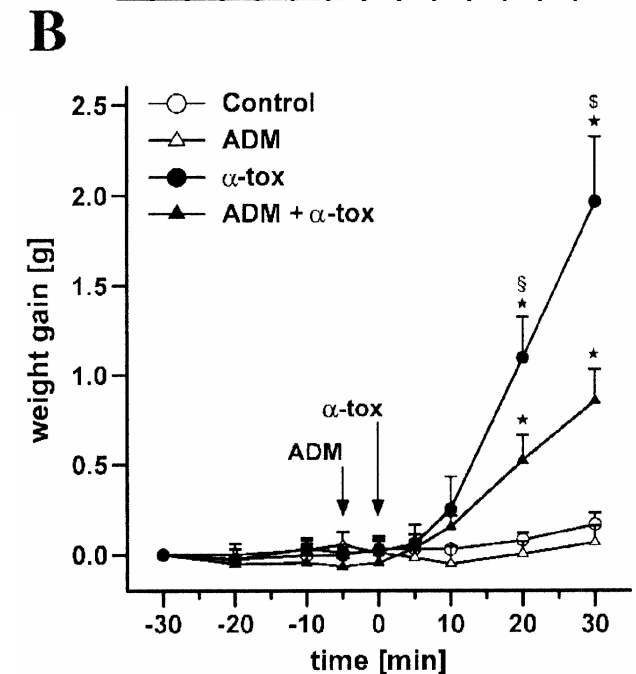
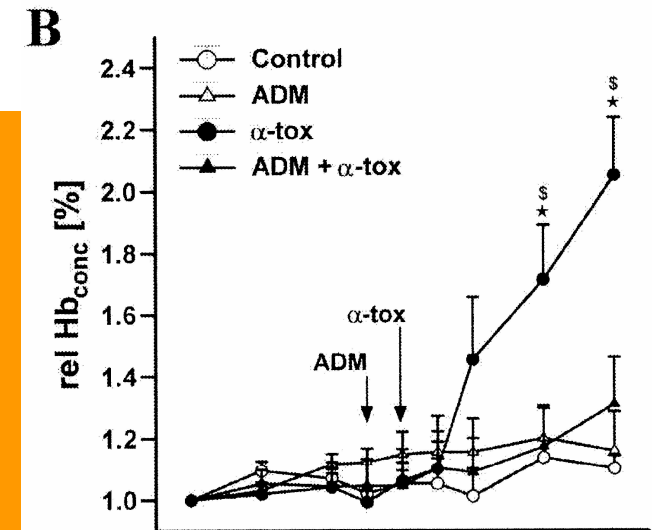
Measures in mucosa
show good correlation
between perfusion
pressure (SMA-
Pressure)
and
mucosal oxygen
saturation SO_2
(mHbO₂) measured by
O₂C



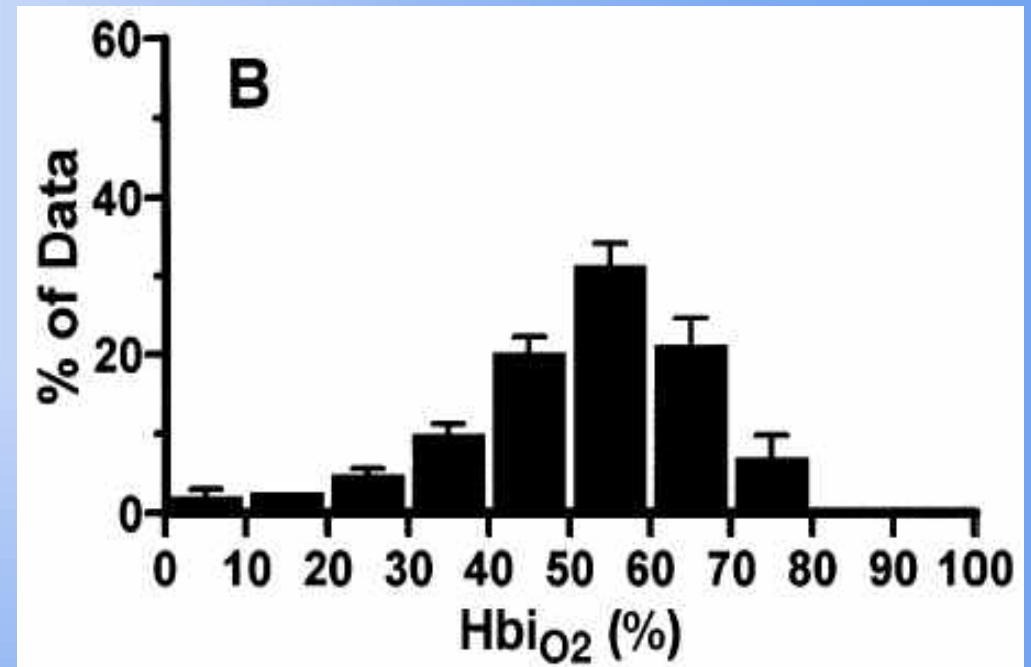
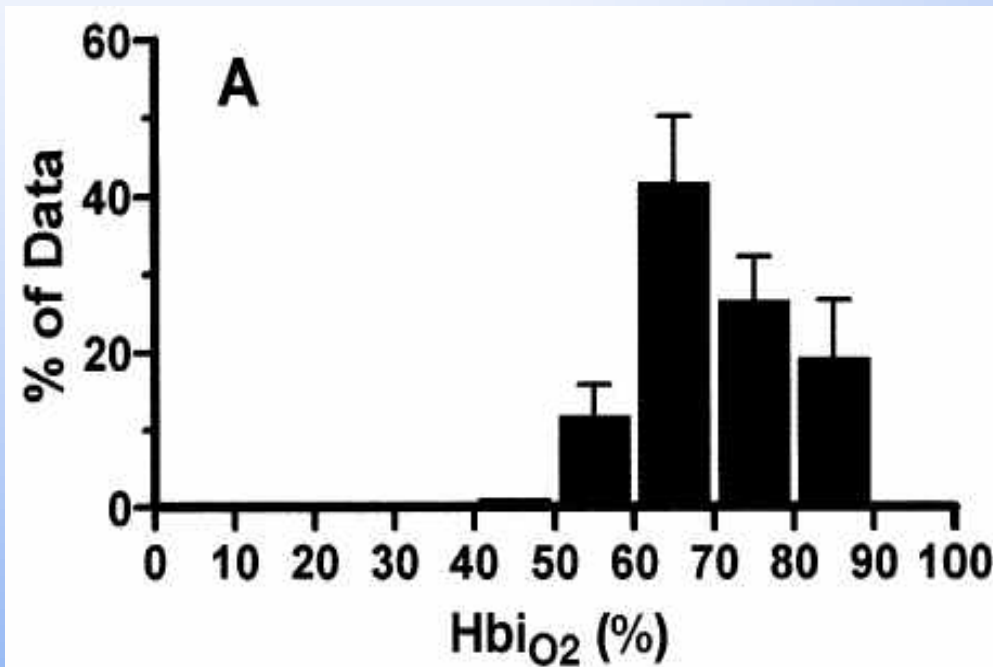
Measures on mucosa
show good correlation
between

- amount of hemoglobin
rel.Hbcon
and
- gain in weight of the
gut

-> (venous congestion,
edema)



Oxygen Saturation of mucosa of stomach in healthy persons (A) and patients with sepsis (B) taken from (10) recorded by O₂C(oxygen to see)



(10) Am J Respir Crit Care Med 1998 May;157(5 t 1):1586-92

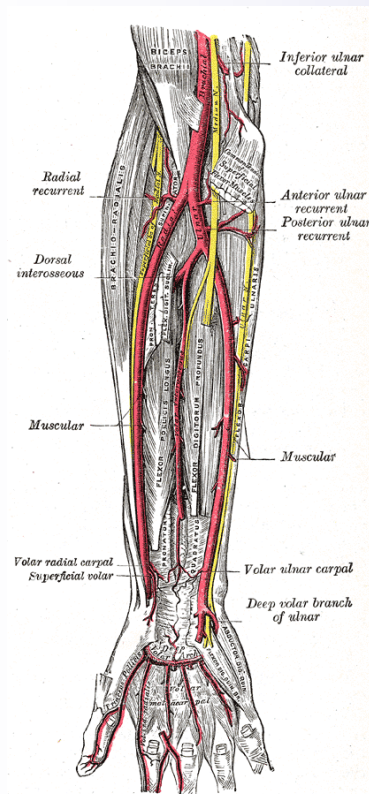
Abnormalities of gastric mucosal oxygenation in septic shock: artial responsiveness to dopexamine.

Temmesfeld-Wollbruck B, Szalay A, Mayer K, Olschewski H, Seeger W, Grimminger F.

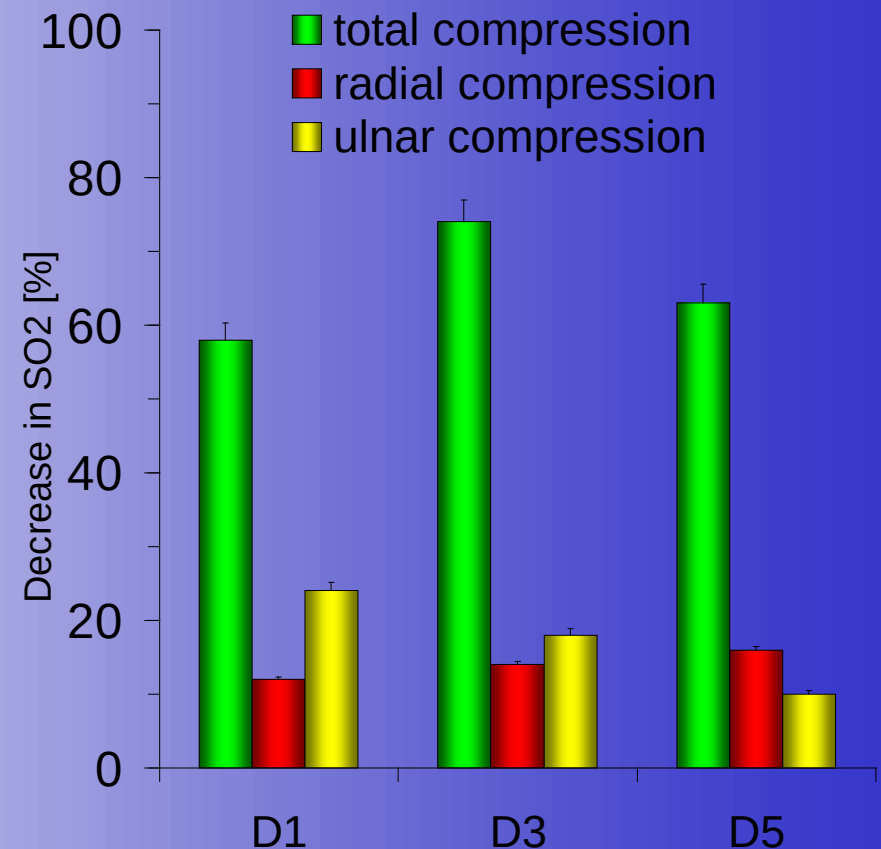
Palmar Microcirculation After Harvesting of the Radial Artery in Coronary Revascularization

Methods: In this study, 23 patients (16 males) were enrolled who were scheduled for complete arterial bypass grafting. Pre- and postoperative evaluation were performed using O2C

“Oxygen-to-see is an objective novel method to detect parameters of microcirculation in the hand. It is a safe and quantitative method.”



K. Knobloch, A. Lichtenberg, M. Pichlmaier, S. Tomaszek, A. Krug, A. Haverich, Thoracic and Cardiovascular Surgery, MHH Hannover, Ann. Thorac. Surg. 2005;79:1026-30



Percent decrease of tissue oxygen saturation (SO2) after total forearm compression, selective radial or ulnar compression preoperatively. * $p < 0.05$

MYOCARDIAL MICROCIRCULATION DURING ISCHEMIC PRECONDITIONING IN OFF-PUMP BYPASS SURGERY

Methods: 21 patients (14 males) scheduled for OPCAB were enrolled in the study. Intraoperatively, the LAD was occluded for 2 min followed by a 2 min reperfusion interval. The procedure was repeated three times.

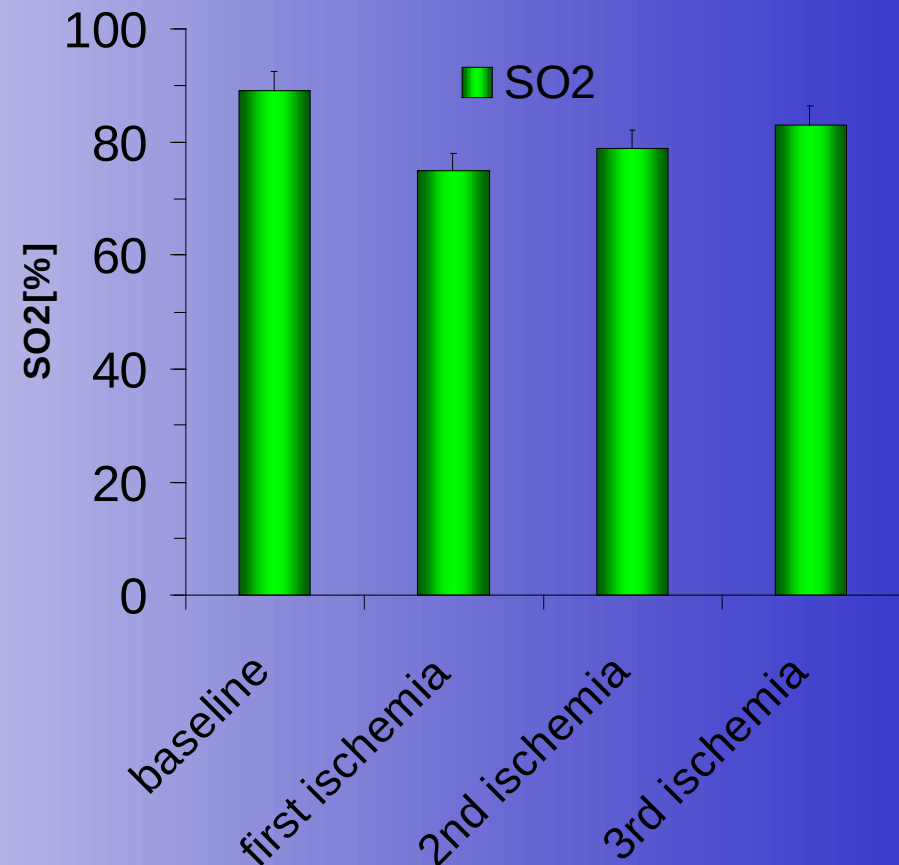
Tissue SO₂ increased going from the first to the third occlusion from 75±11% to 83±8% (p<0.001). rHb as a marker of postcapillary venous haemoglobin concentration increased significantly (77±8 vs. 85±6, p=0.002). Superficial and deep myocardial blood flow decreased significantly (317±17 vs. 308±36, p <0.001; 402±56 vs. 350±50, p < 0.001; respectively).



“Oxygen-to-see system is capable of detecting myocardial microcirculation in vivo real time.

A. Lichtenberg, K. Knobloch, M. Pichlmaier, St. Ringes-Lichtenberg, H. Mertsching, U. Klima, A. Haverich

*Thoracic and Cardiovascular Surgery
Medizinische Hochschule Hannover, Germany*



Microcirculation on the ankle after AIRCAST Cryo Cuff

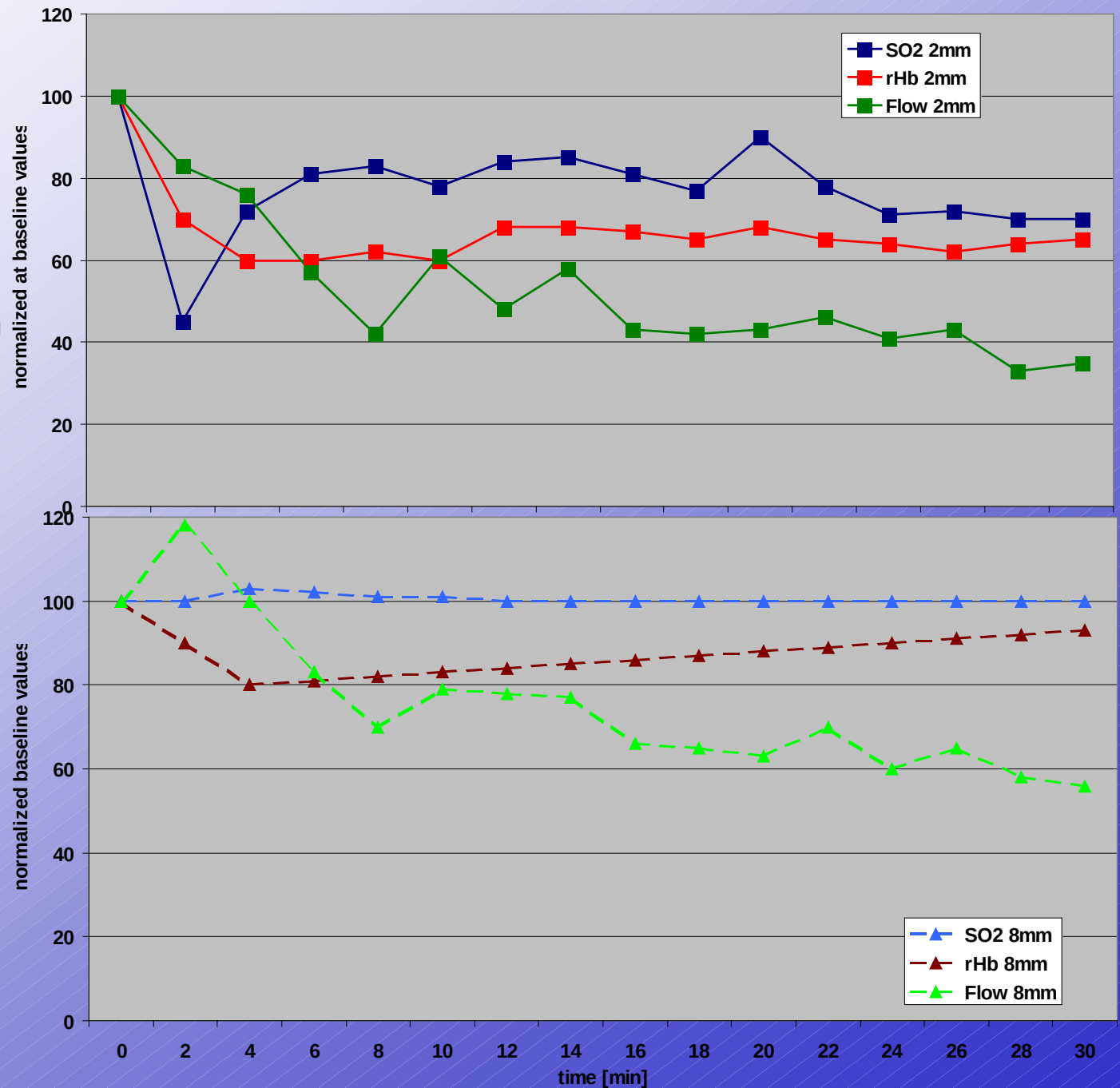
Knobloch et.al, Trauma
Department Hannover, Medical
School, Germany

Cryo Cuff applies compression
and low temperature of 15°C
Measurement with O2C in 2/8mm

21 patients, healthy volunteers

**O2C(oxyge to see) allowed to
demonstrate significant effects
of the CyroCuff device!**

- Blood Volume reduction (rHb)
- Flow reduction (Flow)
- Oxygen reduction in 2mm depth (SO₂)

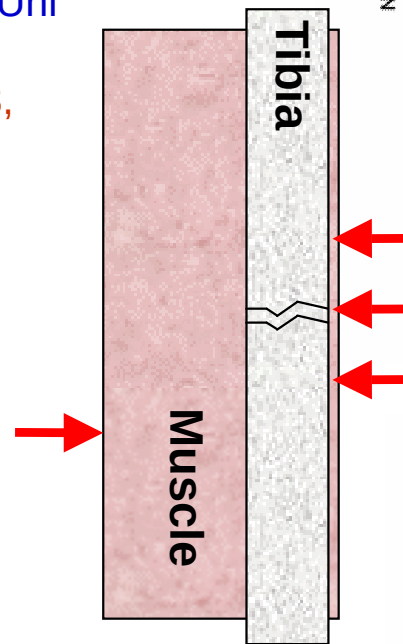


Influence of haemorrhagic shock on fracture healing

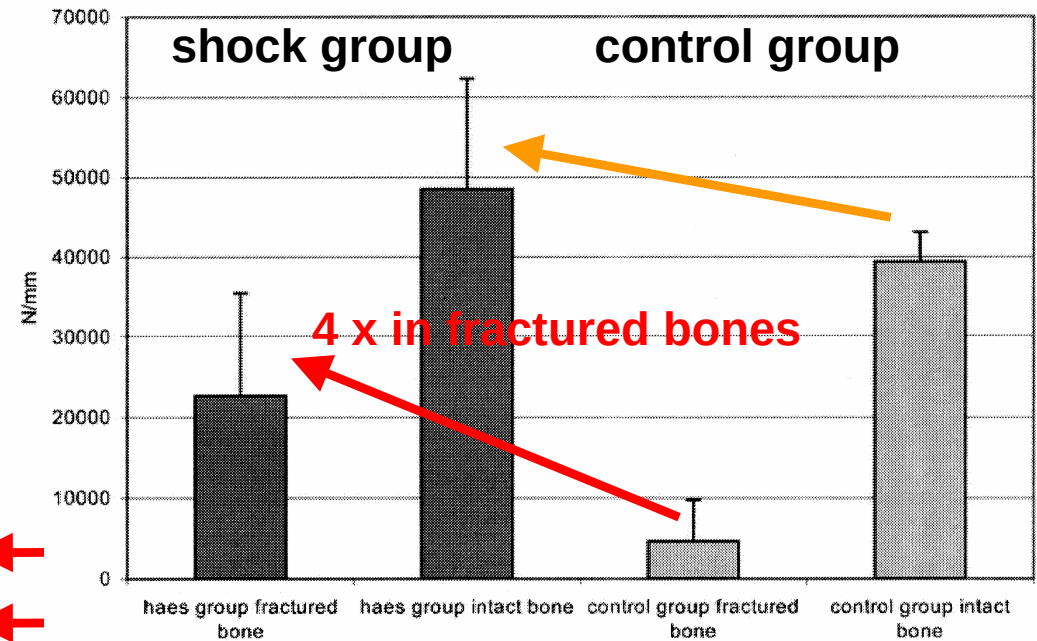
M. Bumann, T. Henke, H. Gerngross, L. Claes, P. Augat,
Department of Orthopaedic
Research and Biomechanics, Uni
Ulm, Germany
Langenbecks Arch Surg. 2003,
Oct.,388(5):331-8.

Measurement at the level of
fracture (tibia), 1cm
distal/proximal and soft tissue
with O₂C(oxygen to see)
Shock group with volume
resuscitation
Control group without

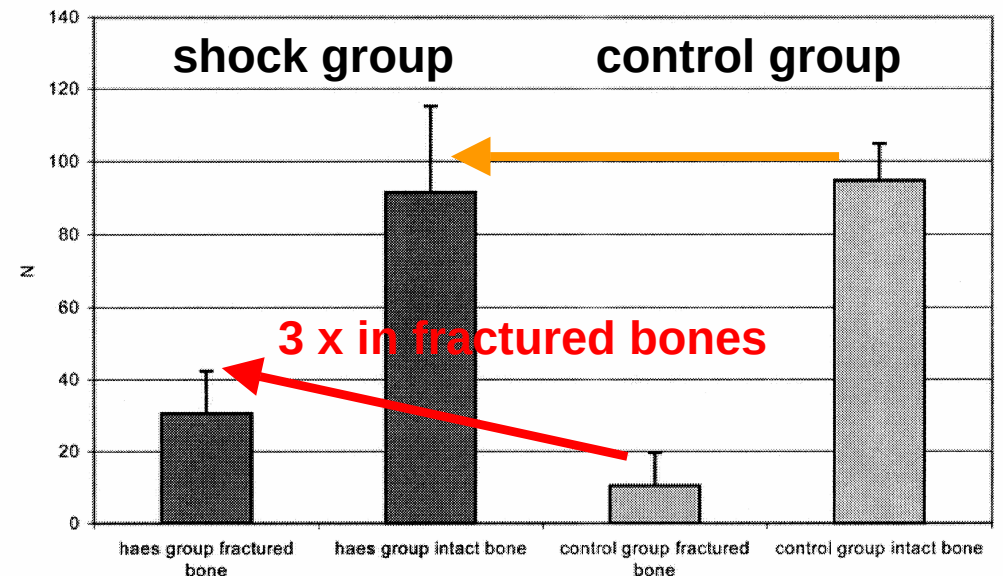
**Shock group with volume
substitution has no reduction in
blood flow in the distal and
soft tissue regions
and
shows a better fracture healing
outcome.**



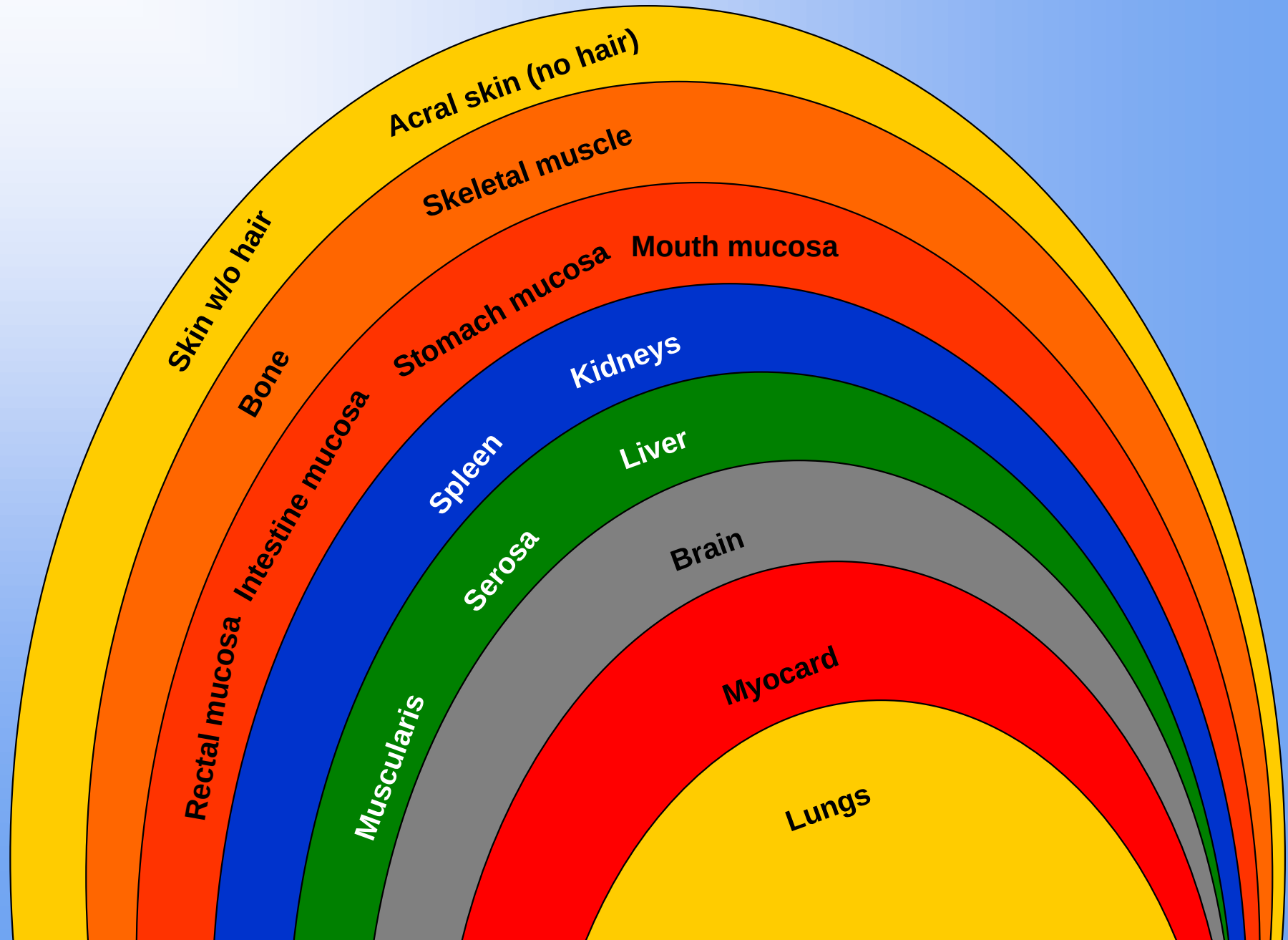
Flexural rigidity



Failure load

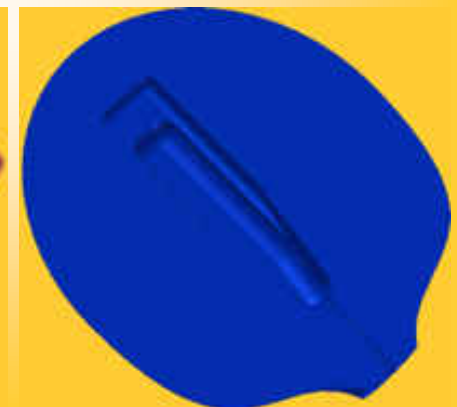
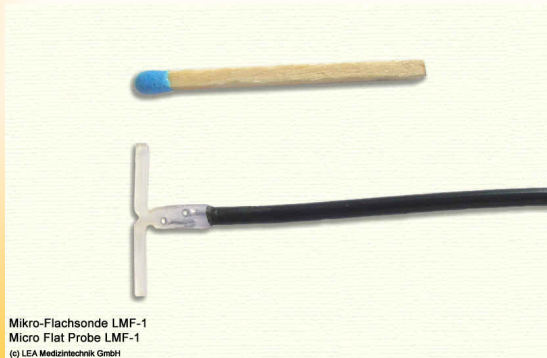


Monitoring of regional circulatory system - on a functional basis



Probetypes

- Flat probes for skin and muscle (e.g 2 and 8 mm depth)
- Muscle probe 16 mm depth
- Micro-probes 0.8 mm and 2.3 mm diameter
- Redong probe for buried flaps



Thank you

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