

# **Rheohaemapheresis**



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# What is Rheology?



- ⌘ The Rheology examines the measuring and description of the fluidity of solid and fluid matters
- ⌘ Two basic qualities are distinguished:
  - elastic behaviour
  - viscous behaviour
- ⌘ How to measure the rheological behaviour in blood?

# Rheology of blood is influenced by...



⌘ Hematocrit-erythrocytes

⌘ Viscosity of plasma-protein concentration,

in particular

- Fibrinogen

-  $\alpha_2$ -Macroglobulin

- Immunoglobulin

- LDL-Cholesterol

⌘ Diameter and nature of the vessels

# Effects of lower blood viscosity are:



⌘ Hagen-Poiseuilles law: blood flow and viscosity are inversely proportional

⌘ But we have shear thinning

⌘ Increase of the cardiac output

-> The organ perfusion is ameliorated and with it the oxygenation of the tissue

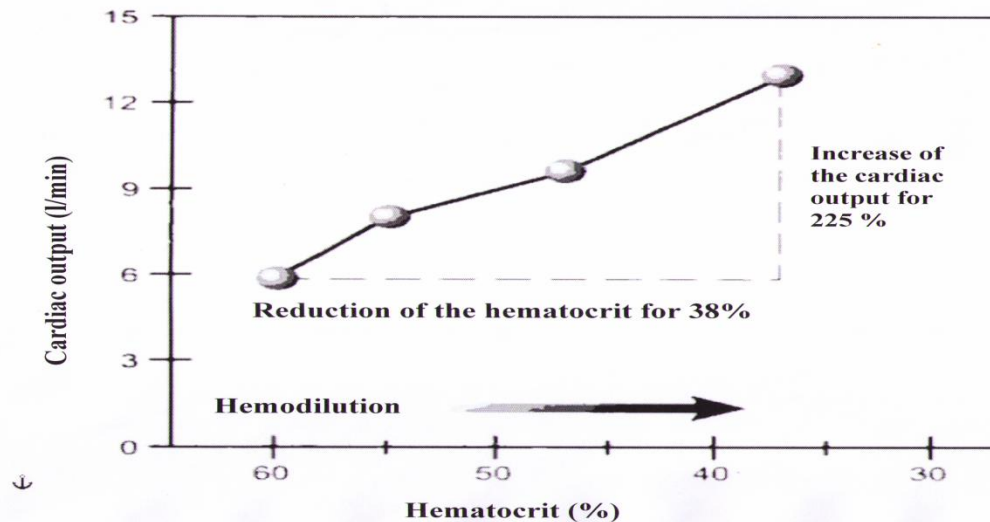
# How to enhance the blood fluidity?



- ⌘ Bloodletting - reduction of erythrocytes
- ⌘ Infusion therapy, f. e. by HES
- ⌘ Reduction of high molecular plasma components by apheresis procedures

# Hematocrit and viscosity

⌘ Decrease of hematocrit induces an increase of cardiac output



⌘ LeVeen et al. Lowering blood viscosity to overcome vascular resistance, Surg Gynecol Obstet 1980; 150; 139

# Indications for the Rheohemapheresis



- ⌘ Age-Related Macula Degeneration (AMD)
- ⌘ Idiopathic Sudden Hearing Loss (ISHL)
- ⌘ Central Retinal Vein Occlusion
- ⌘ Diabetic Perfusion Disorders:
  - Ischemic Diabetic Foot Syndrome
  - Diabetic Retinopathy
- ⌘ Other disorders of microcirculation
- ⌘ Hyperviscosity syndrome

# AMD:



- ⌘ Etiology and pathogenesis are not clear
- ⌘ The leading cause of severe and irreversible vision loss in the western world among people older than 50 years
- ⌘ Disease of the retinal pigment epithelium and the Bruch`s membrane; chorioidal neovascularization
- ⌘ Dry and wet form
- ⌘ CFH, C3 and ARMS2 as risk loci for susceptibility

# AMD Stages



## 1. Early AMD

No symptoms

Several small drusen

## 2. Intermediate AMD

Irritations in the center of vision

Many medium sized drusen

## 3. Advanced AMD

The blurred spot gets bigger

Several large drusen

# AMD Treatment



AIM of the treatment of the AMD is to stop or to slow the progression of this disease

# AMD Treatment



- ⌘ Brunner et al. 2000
- ⌘ 40 patients, visual acuity measured by ETDRS-scale
- ⌘ 20 patients treated by cascade filtration with 5 treatments in 21 weeks  
20 patients as controls
- ⌘ Treated patients: mean improvement of 1.8 lines after a single treatment, 1.6 lines after 21 weeks  
Control group: deterioration of 0.6 lines

# AMD Treatment



- ⌘ RheoNet-Registry analysis 2007
- ⌘ 7209 treatments in 1062 patients
- ⌘ 279 patients (428 eyes) could be analysed  
8.1 treatments within 15 weeks
- ⌘ 42% of the eyes had an improvement of 0.6 lines or more after 6 months  
2 lines or more: 28% in treatment group, 8% in control group
- ⌘ No severe adverse effects

# AMD Treatment



- ⌘ Widder et al. 2002
- ⌘ 20 patients
- ⌘ Mean 6 treatments per year
- ⌘ Patients were treated at minimum for three years
- ⌘ Mean improvement of visual acuity:
  - after two years: 1.9 lines (15/20 patients,  $p < 0.05$ )
  - after three years: 1.2 lines (15/20 patients,  $p < 0.05$ )
  - after four years: 0,8 lines (7/20 patients,  $p = 0.77$ )

# AMD Treatment



⌘ Koss et al. 2009

⌘ 43 patients, analysis 7.5 months after begin of treatment

⌘ 22 patients treated by apheresis  
21 patients as control

⌘ mean difference of 0.95 ETDRS-lines (  $p=0.01$  )


⌘ improvement $\geq 2$ lines	apheresis 9%	control 0%
deterioration	apheresis 0%	control 24%

# AMD Treatment



- ⌘ Rencova et al. 2009
- ⌘ 16 patients treated with cascade filtration  
16 patients in the control group
- ⌘ 8 treatments in 10 weeks
- ⌘ Positive influence on the absorption of the soft drusen,  
reduction of the retinal pigment epithelium detachment
- ⌘ Possible improvement of the visual acuity of the treated  
patients
- ⌘ the rheohaemapheresis as a well tolerated method may  
cause the retardation or stop of the unfavorable course of  
the AMD

# Idiopathic Sudden Hearing Loss (ISHL)



- ⌘ Etiology and pathogenesis are unclear
- ⌘ Incidence up to 300/100000 persons/year in Germany
- ⌘ Acute inner ear dysfunction
- ⌘ LIN et al. 2008: risk of stroke 1.64 times higher five years after ISHL

# Clinical aspects of ISHL



- ⌘ Normally unilateral sudden hearing loss
- ⌘ the list of differential diagnoses is very long
- ⌘ Is ISHL a therapeutic emergency?

# ISHL Treatment



- ⌘ Glucocorticoids
- ⌘ Plasma expanders
- ⌘ Local therapy
- ⌘ Fibrinogen reduction

# ISHL Treatment

- ⌘ Suckfüll et al. 2002
- ⌘ HELLP-apheresis (n=122, 1 treatment) versus standard therapy for 10 days (n=61)
- ⌘ Pure tone thresholds in the apheresis-group improved more, but not significantly
- ⌘ Remission rate of speech perception was significantly higher in the apheresis-group than in the control group (Freiburg speech test)

# ISHL Treatment



- ⌘ Balletshofer et al. 2005
- ⌘ Pilot study with six patients, 1 single treatment
- ⌘ Average hearing threshold improved from 42 dB to 29 dB
- ⌘ Relative hearing improvement was more than 40% for four patients
- ⌘ Significant reduction of
  - total cholesterol 228 to 98 mg/dl
  - LDL cholesterol 153 to 83 mg/dl
  - Fibrinogen 364 to 142 mg/dl

# ISHL Treatment



- ⌘ Mösges et al. 2008
- ⌘ 94 patients treated with apheresis, 99 as control
- ⌘ Average hearing threshold improved
  - 23.95 dB in apheresis group
  - 24.95 dB in control group
  - same efficacy ( $p < 0.001$ )
- ⌘ A significant increase of health-related quality of life could be documented by SF 36-questionnaire for the apheresis group

# ISHL Treatment



- ⌘ Uygun-Kiehne 2007
- ⌘ Retrospective examination of 25 patients with  $2.1 \mp 0.4$  ISHL
- ⌘ Refractory to infusion therapy according Stennert regimen
- ⌘ After two apheresis 40% of the patients showed a total remission, 28% a partial remission

# Central Retinal Vein Occlusion



- ⌘ Erdtracht et al. 2002
- ⌘ Case report: 41 year old female after her third pregnancy complicated by preeclampsia with acute CRVO in the left eye
- ⌘ 6 treatments within 3 months  
-> Restitutio ad integrum

# Diabetic Retinopathy



- ⌘ Lüke et al. 2001
- ⌘ Leading cause of blindness among people in the working age in the western world
- ⌘ Measurement of visual acuity (ETDRS) 24 hours pre and post each treatment (two sessions per cycle) and at follow up (mean 9 weeks)
- ⌘ Compared to baseline examination visual acuity was improved by a mean of  
1.4 lines after the last treatment  
1.3 lines at follow up

# Ischemic Diabetic Foot Syndrome

- ⌘ Klingel et al. 2003
- ⌘ Pilot Trial, 8 patients with non-healing foot ulcers, no wound healing for two months under standard wound care
- ⌘ 7 Apheresis treatments in 11 weeks
- ⌘ 4 patients (Wagner 2): accelerated wound healing
- 2 patients (Wagner 2): no change in wound healing but minor amputation(tcPO<sub>2</sub> ↑)
- 2 patients (Wagner 4,5): no improvement in foot lesions
- > Rheohemapheresis may prevent an amputation or reduce the extent of amputation

# Rheohaemapheresis is...



- ⌘ an effective therapy when indicated
- ⌘ well tolerated
- ⌘ in some cases more comfortable for the patient as other therapy-options
- ⌘ sadly too little applied and so a disadvantage for the patient

# **Thank you**



**for your attention  
and your patience**

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