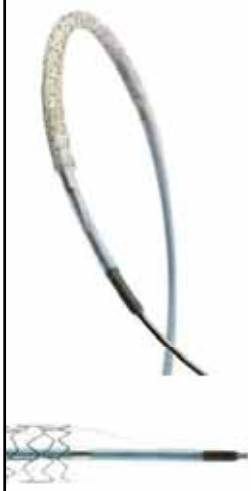

Antithrombogenic Biomaterials

Physical Model and Technology

Flavius Deleanu / Kathrin Lorenz / Dr. Alexander Rzany

Max Schaldach-Stiftungsprofessur für Biomedizinische Technik
Friedrich-Alexander-University Erlangen-Nuremberg, Germany

MB-JASS 2009

BIOTRONIK

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Stents

Arteriosclerosis

↓

Blocked coronary artery

↙ ↘

Crack open the chest and surgically bypass the stenosis

Clear the artery from within by inflating a tiny balloon and propping it open with a wire-mesh stent

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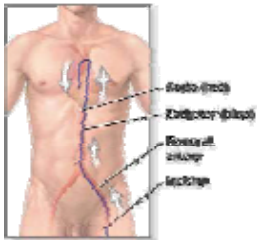
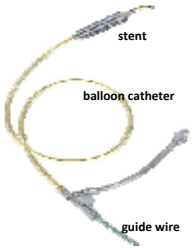
Minimal invasive therapy of arteriosclerosis

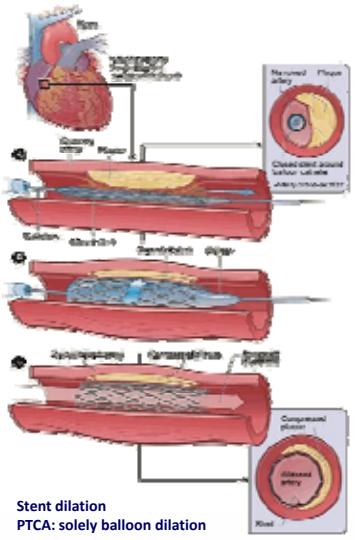


Access via the femoral artery



Stent system

Angiographic workplace in the hospital



Stent dilation
PTCA: solely balloon dilation

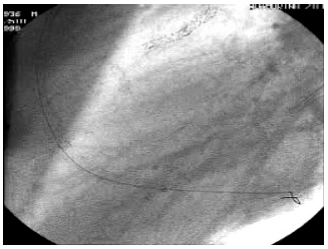
National Institute of Health: www.nih.gov

Angiographic control of stent implantation

Angiographic image of coronary stenosis

Placement of the coronary stent

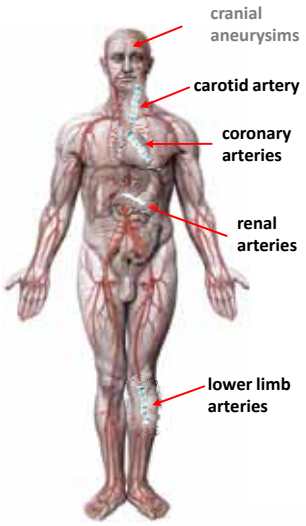
Dilation of the coronary stent



Angiographic control

Stents

- Coronary arteries
- Peripheral arteries
- Treatment of aneurysms
- Non-blood applications:
  prostate, bladder, esophagus, …



Bare Metal Stents in the vascular system

balloon expandable stents

coronary and deep peripheral arteries

Ductility: stainless steel (316L), Co/Cr-alloy (L605)

self expanding stents

superficial peripheral arteries

Superelasticity: Ni/Ti-alloy (Nitinol)

Design of modern coronary stents

Stent design optimized for specific metal/alloy:

- flexibility of the entire system
- intrinsic elastic recoil
- shortening due to the dilation
- covering of the vessel wall
- mechanical stress on the vessel

PRO-Kinetic (BIOTRONIK)

Stainless Steel (316L)	
Element	Content [%]
Iron	65
Chromium	18
Nickel	14
Molybdenum	3

Cobalt/Chromium (L605)	
Element	Content [%]
Cobalt	50.5
Chromium	20
Nickel	10
Tungsten	15
Manganese	1.5
Iron (max.)	3

Nitinol (SE508)	
Element	Content [%]
Nickel	55.8
Titanium	44.2

Transformation temperature: < 15°C

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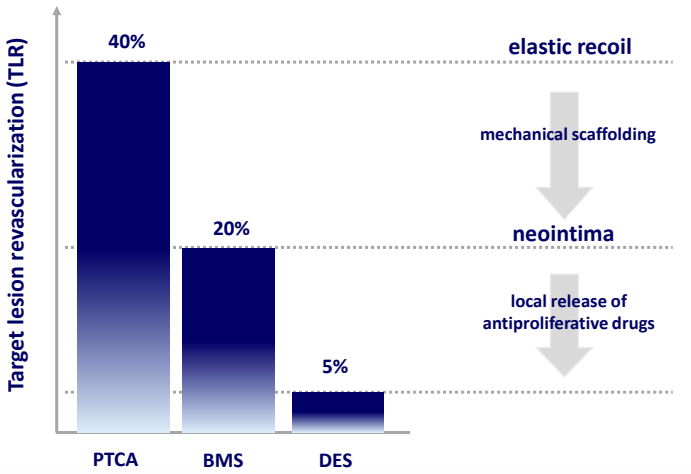
Coronary Stents – overall complication rate (1 year)



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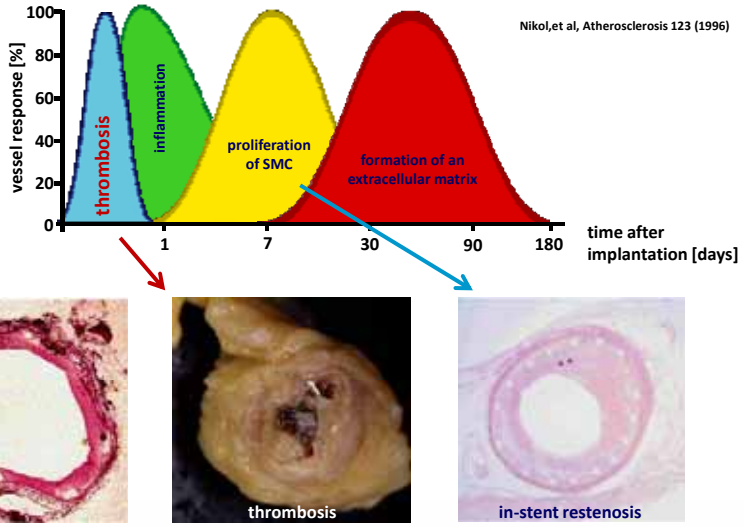
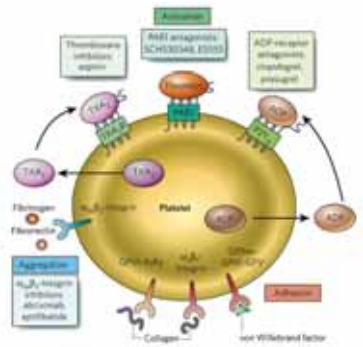
Stents - Host response



Antithrombotic treatment after stent implantation



Platelet cell-surface receptors mediate

- activation and release
- adhesion to vessel wall
- aggregation with each other

Typical post-stent systemic drugs:

- min. 1 month: 300 mg/day aspirin + 100 mg/day clopidogrel
- indefinitely : 100 mg/day aspirin

Hemocompatibility of Metals

*ELECTROCHEMICAL PRECIPITATION OF HUMAN BLOOD CELLS AND ITS POSSIBLE RELATION TO INTRAVASCULAR THROMBOSIS**

By P. N. Sawyer, W. H. Brattain, and P. J. Boddy

Departments of Surgery and Surgical Research, Downstate Medical Center, State University of New York, and Bell Telephone Laboratories

Communicated January 27, 1964

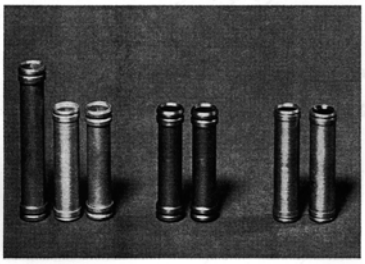


Fig. 2. Photograph of metal tube vascular prostheses, constructed of various metals, inserted into both aorta and thoracic inferior vena cava.

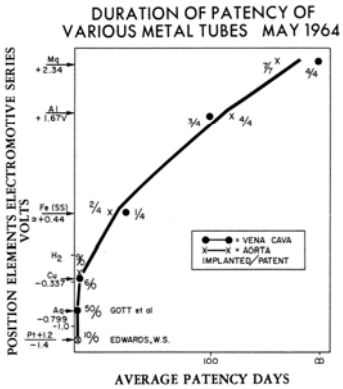
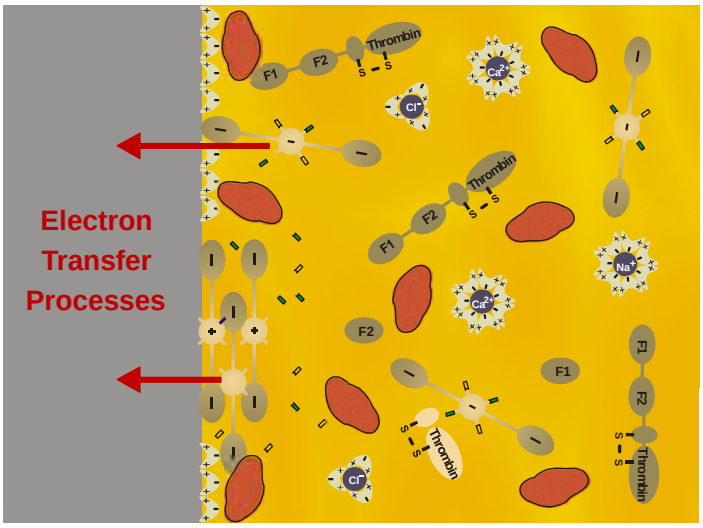


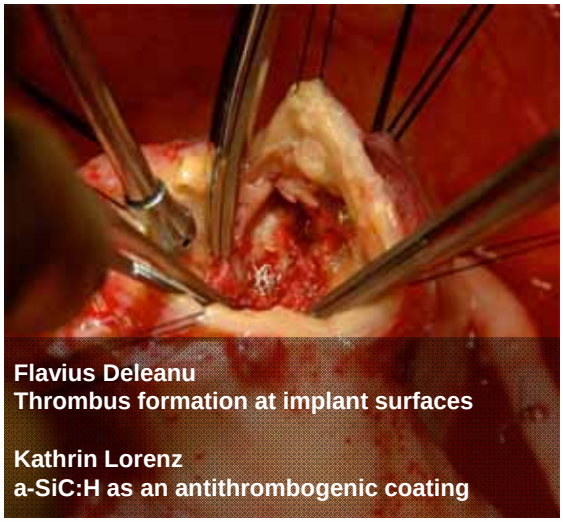
Fig. 8. Tubes constructed of either Mg or Al, high in the electromotive series, have been found to remain patent for long periods. Tubes constructed of elements lower in the series remain patent for shorter and shorter periods, until those constructed of Cu, Ag, Pt thrombose in less than one day.

"Biophysical Mechanisms in Vascular Hemostasis and Intravascular Thrombosis"
P. N. Sawyer (Ed.), New York 1965

Biomaterial-Blood Interface



Workshop Antithrombogenic Biomaterials



Flavius Deleanu
Thrombus formation at implant surfaces

Kathrin Lorenz
a-SiC:H as an antithrombogenic coating

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Silicon Carbide coated Stents

Astron (316L SS), BIOTRONIK

Philon (NiTi), BIOTRONIK

ProKinetic (CoCr), BIOTRONIK

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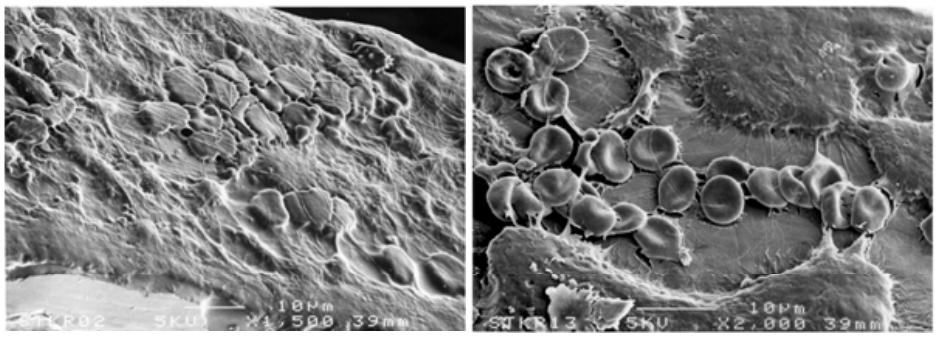
Hemocompatibility of the Silicon Carbide Coating

Stainless Steel (316L) | **Silicon Carbide (a-SiC:H)**



1 day in contact with human whole blood

10µm

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