PERSPECTIVES

Patrick W. Serruys MD, PhD

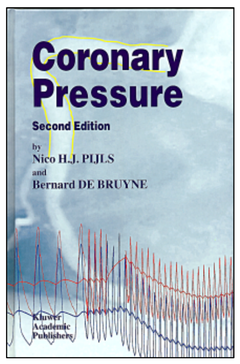
Imperial College of London, United Kingdom

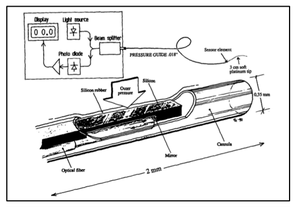
1975 **D. Young** $\frac{\Delta p}{\rho U^2} = \frac{K_v}{Re} + \frac{K_t}{2}\left(\frac{A_0}{A_1} - 1\right)^2$

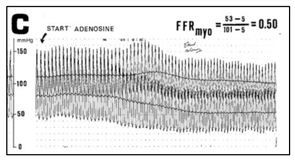
1978 **K. Lance Gould** $\Delta P = FV + SV^2 + D\,(V/V_r\text{-}1)V^2$

1983 **R. Kirkeeide**

1988 **PW. Serruys** Flow-velocity validation







1991 **Pressure wire**

1993 P.W. Serruys (Double-wire Pressure-velocity)

1993 Håkan Emanuelsson, P.W. Serruys (SFR)

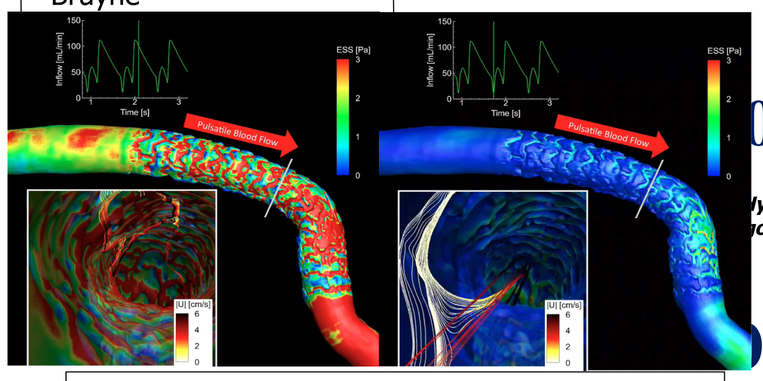
1993 Carlo Di Mario, P.W. Serruys (Hyperemic Index)

2004 M. Siebes, J.J Piek (Single wire Pressure-velocity)

1994 **FFR** → **2001**

Nico Pijls
Bernard De Bruyne

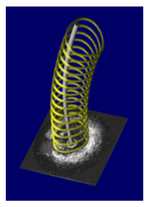
DEFER



1997

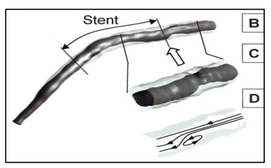
2001 **ANGUS**

Slager C, P.W. Serruys



2002 **Shear stress**

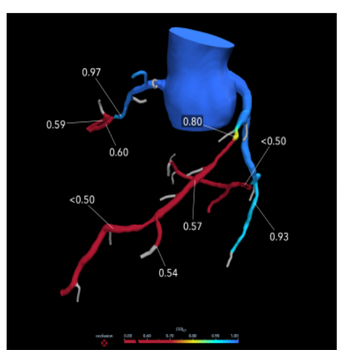
Thury A, Wentzel J, P.W. Serruys



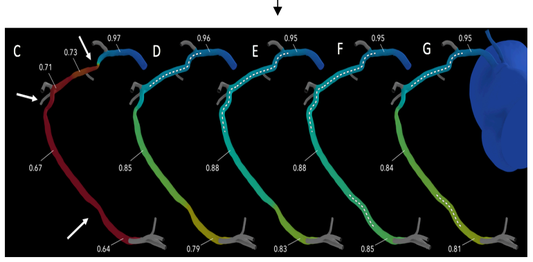
Non-Newtonian Pulsatile
Shear-stress microenvironment
(fusion OCT/IVUS and angiography).

2010 **FFR_{CT}**

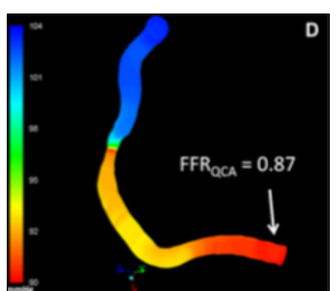
DISCOVER FLOW
DE FACTO
NXT TRIAL
PLATFORM
SYNTAX III



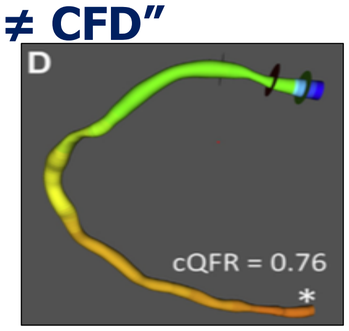
FFR_{CT} PLANNER

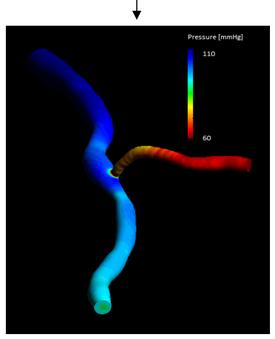


3D Angiography
+
"CFD"
+ Papafaklis, P.W. Serruys
+
TIMI Frame Count
Tu S



3D Angiography
or
2D Angiography
+
Lance Gould
"≠ CFD"





3D Bifurcation QCA
CFD
Finite Elements
Navier-Stokes

011 **iFR®**

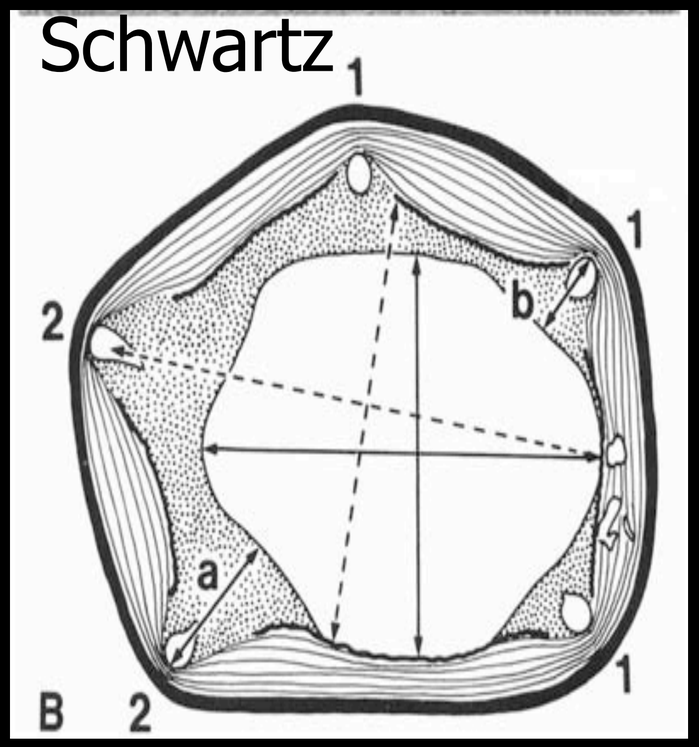
Hybrid Algorithm

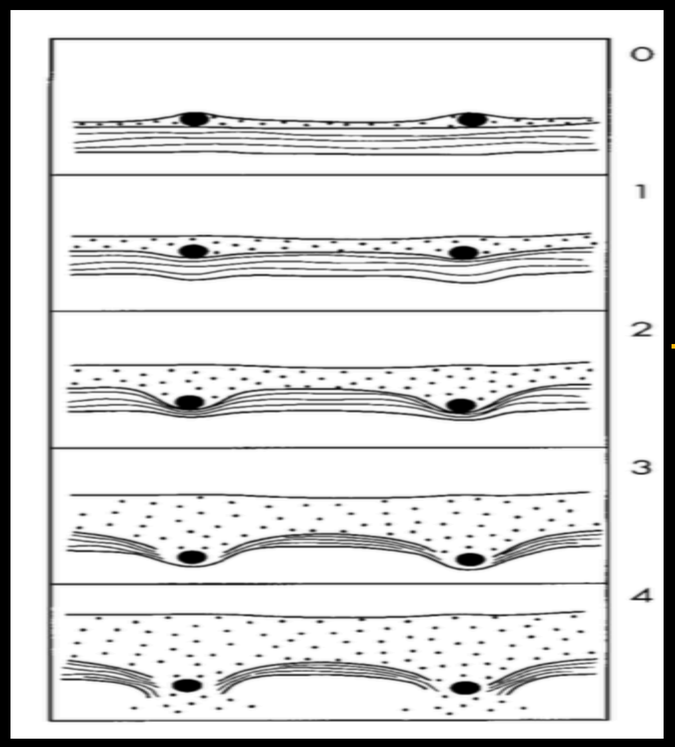
ADVISE
ADVISE II
SYNTAX II

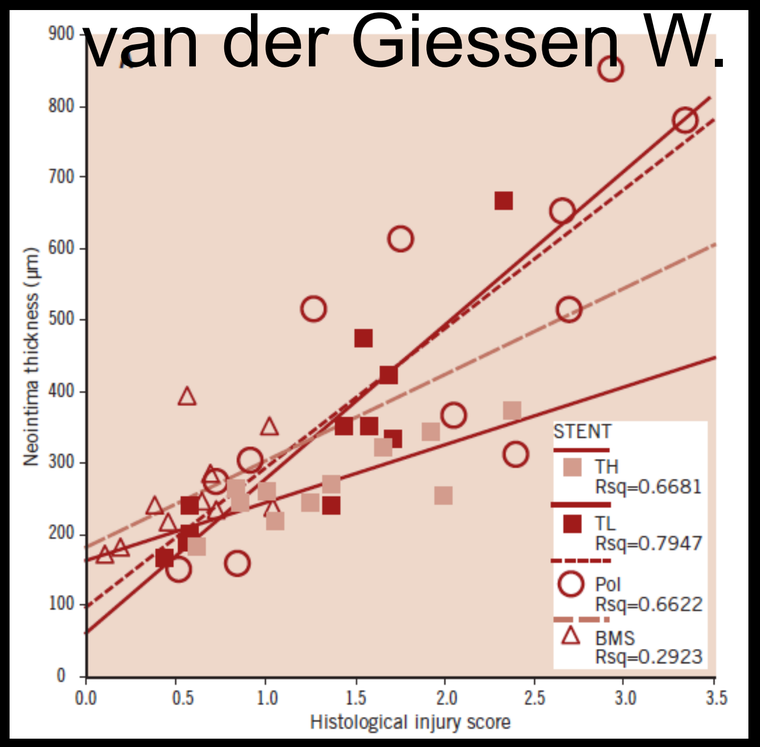
017 **iFR®**

DEFINE-FLAIR
SWEDEHEART

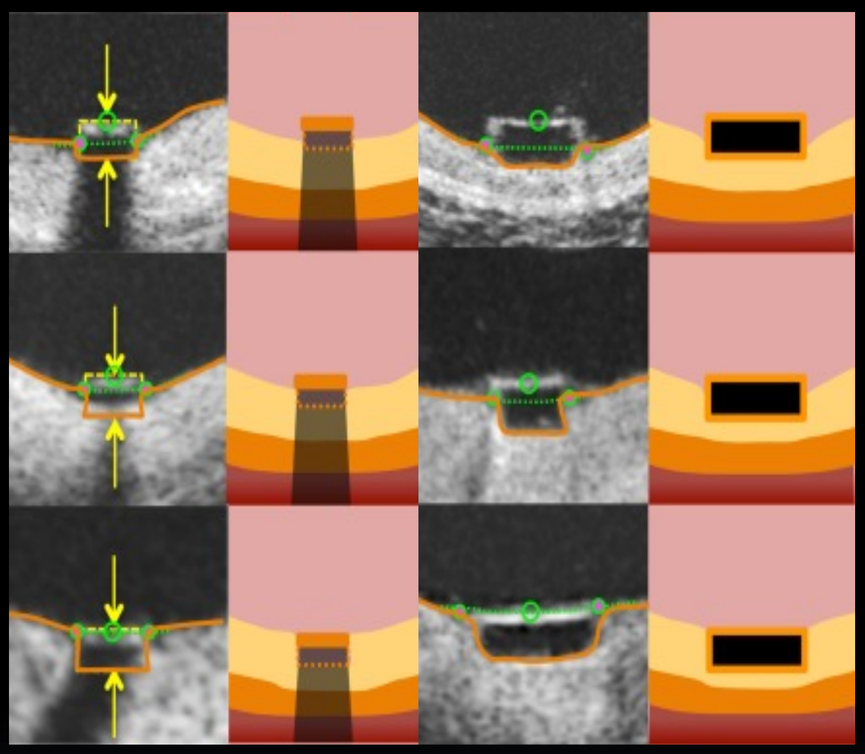
INJURY SCORE AND INJURY INDEX

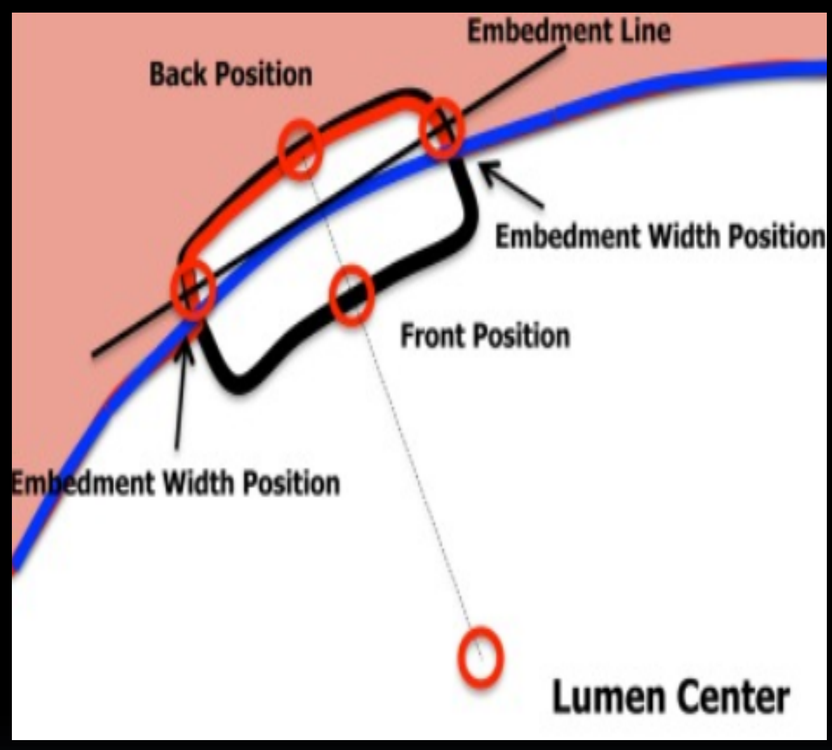




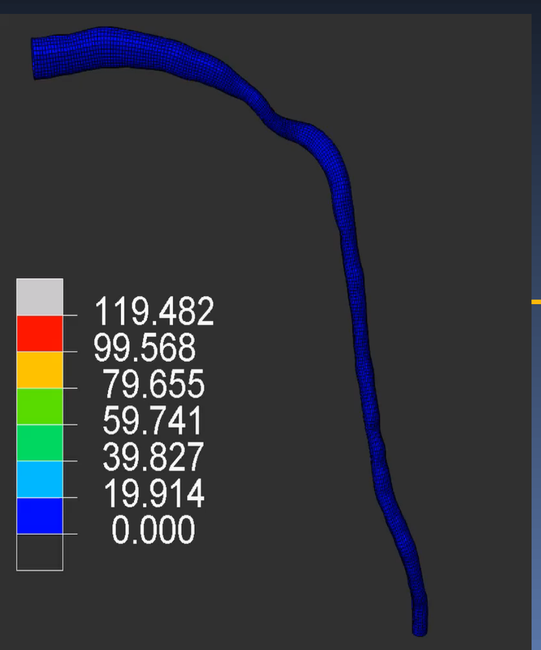


OCT ASSESSMENT OF EMBEDMENT

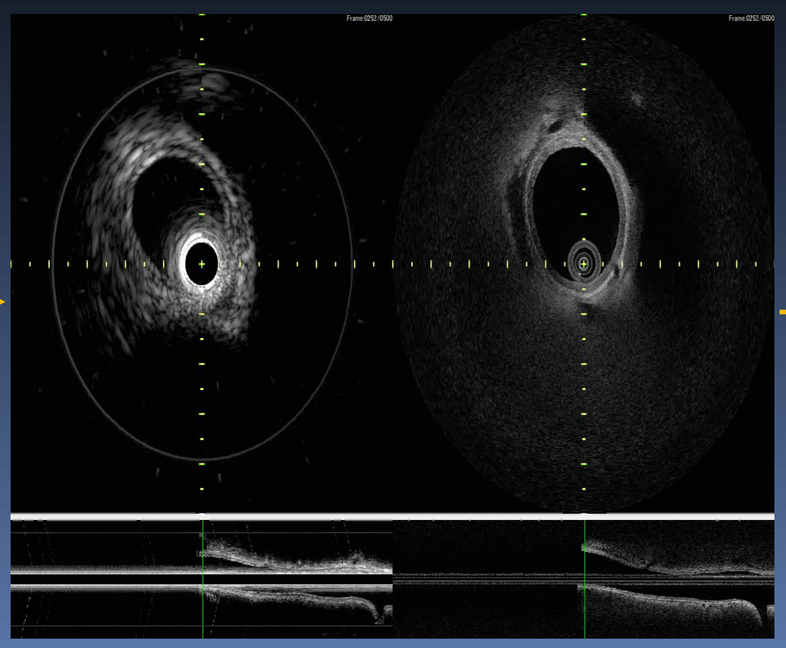




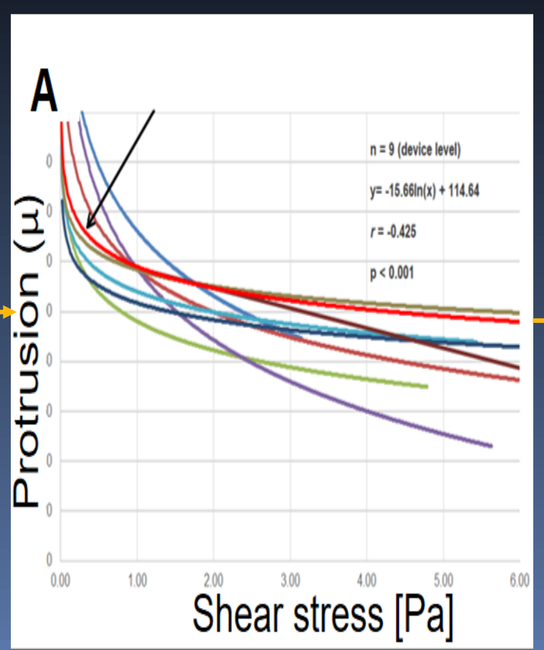
4D WALL STRESS

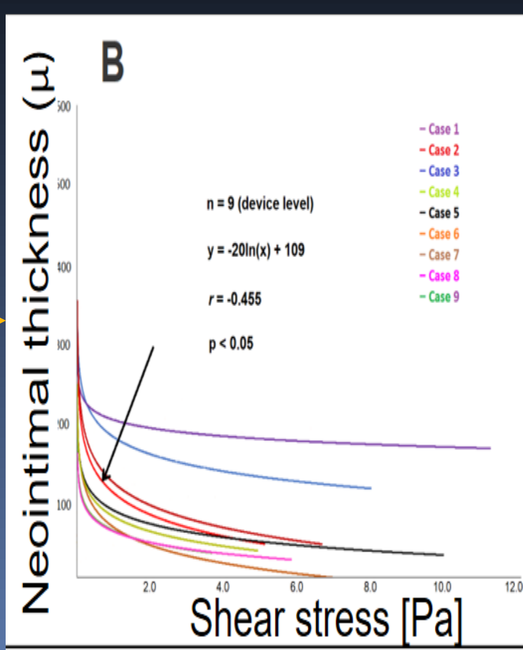


FUSION OF ANGIO, IVUS, OCT



FLOW DISTURBANCE AND NEOINTIMAL REPONSE

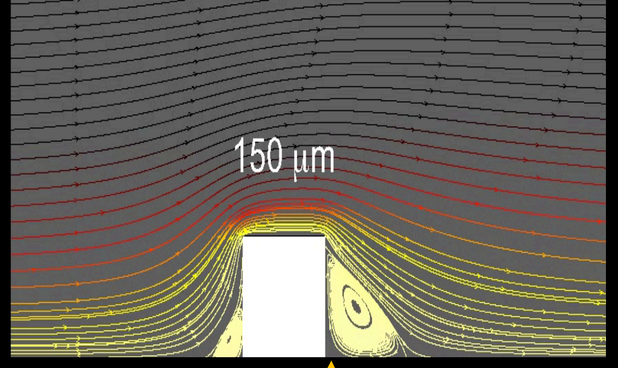




Genomics

Anatomic substrate of vessel wall

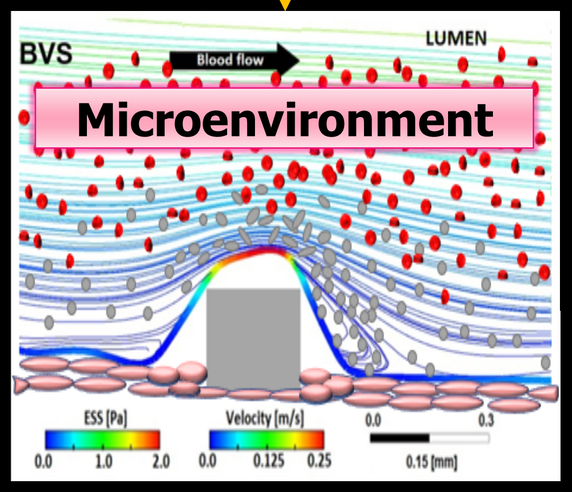
Necrotic core, Fibrofatty tissue, Fibrous tissue, Calcification,oxidized LDL, Cell composition (foam cell, macrophage, etc.)



Residency time ↑ Thrombus Restenosis

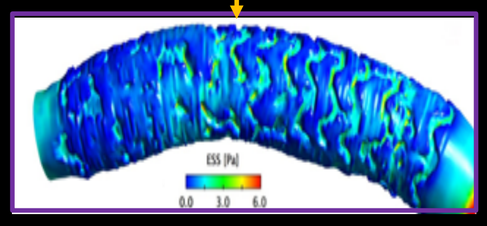
PCSK9 LDL-C Monocytes, Platelets

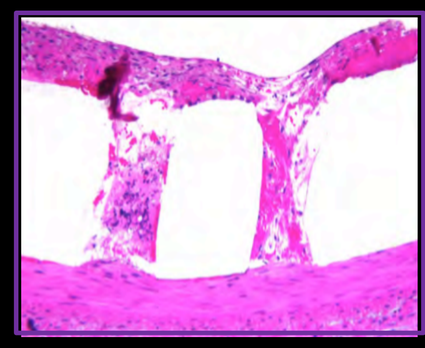
Disrupted flow



Low shear stress(pulsatile non-Newtonian, cell tracking)

Neointimal tissue





Vessel response

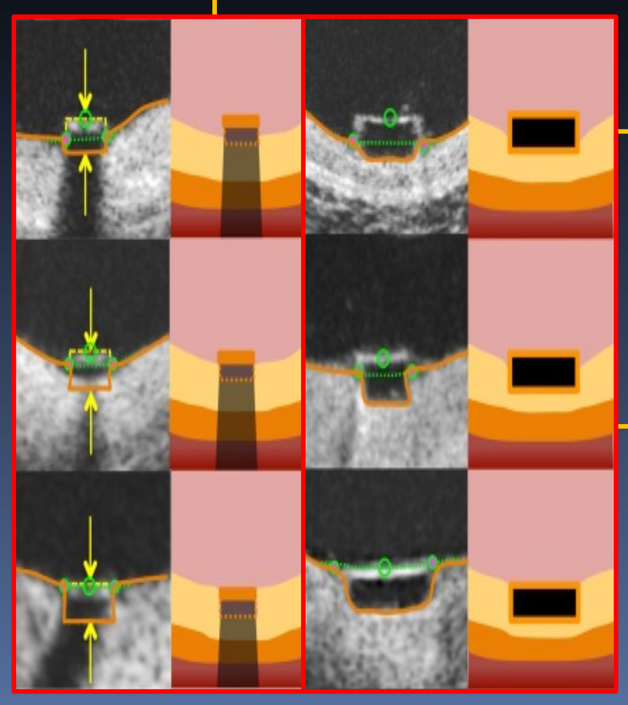
following coronary stent implantation

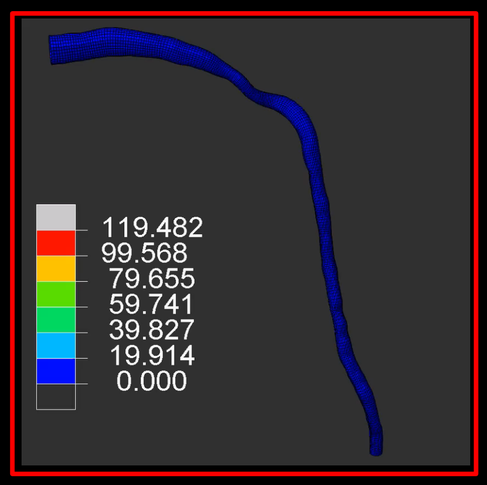
Protrusion

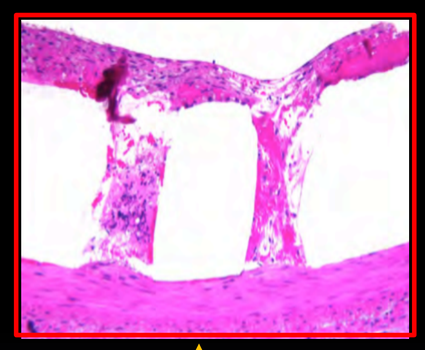
YIN

Embedment

yang







4D-circumferential wall stress

Neointimal tissue

Change from contractile to synthetic phenotype + Inflammatory and migratory process

"Circulating Milieu"
(Blood →IL-6, monocyte, white blood cells, macrophage,PCSK9…etc)

Genomics

thanks