Mechanism of Balloon Angioplasty —
The Forgotten Art

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Disclosures

Consultant:
• ThermopeutiX, Inc.

Stockholder:
• ThermopeutiX, Inc.
Angioplasty Mechanism

Dilatation ≠ Plaque Compression
Angioplasty Mechanism

Plaque Fracture

Stretching of Vessel Wall

Lumen Expansion


Angioplasty Mechanism

Balloon inflation
Too little $\rightarrow$ Elastic recoil $\rightarrow$ Restenosis

Too much $\rightarrow$ Neointimal hyperplasia $\rightarrow$ Restenosis

“Angioplasty is a controlled injury”
Vessel injury is related to the rate at which the vessel wall is stretched (strain rate)


“All I Ever Needed to Know in Life, I Learned in Kindergarten”

Silly Putty
In Vivo Porcine Study of Balloon Inflation Rate

Slow to 8 atm

Rapid to 8 atm
Clinical studies show - gradual, low pressure inflations minimize trauma


Heterogeneous plaque morphology and composition leads to inadequate, unpredictable acute results, especially in complex lesions.
Challenge for POBA

Resistant Lesion

High P
The Solution:

• Use stress concentrator to fracture plaque at low inflation pressures, before balloon is fully inflated

• Then, gradually increase the pressure to slowly stretch the vessel
POBA at 1 atm: max stress 200kPa

(~2 atm)

R. Solar, D. Meany, R. Miller, D. Rahdert, M. Ratcliff, G. Rieß and T. Ischinger,
GERMAN JOURNAL OF CARDIOLOGY, 84(4, Suppl. 1):227, 1995
FFA at 1 atm: max stress > 10,000 kPa

(~100 atm)

R. Solar, D. Meany, R. Miller, D. Rahdert, M. Ratcliff, G. Rieß and T. Ischinger,
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Focal Force Balloons

BSC Peripheral Cutting Balloon

AngioScore AngioSculpt PTA catheter

Bard VascuTrak PTA catheter
Peroneal Dilatation
No Adjunctive Tx

Pre

3.0mm x 120mm VascuTrak
3 atm, 3 min

Post

Courtesy of Chris Hebert
Lafayette, LA
65 y.o. Male
Calcified CTO popliteal

Courtesy of Dr. David Cohen
Valley Hospital, Ridgewood, NJ
Take Home Message

• Balloon Angioplasty works by cracking the plaque and stretching the vessel wall.

• Injury is a function of how fast the vessel stretches.

• **USE SLOW, GRADUAL, LOW PRESSURE LONG INFLATIONS**

• Focal force techniques can crack plaque at lower inflation pressures, and allow slow vessel stretching to improve outcomes.
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