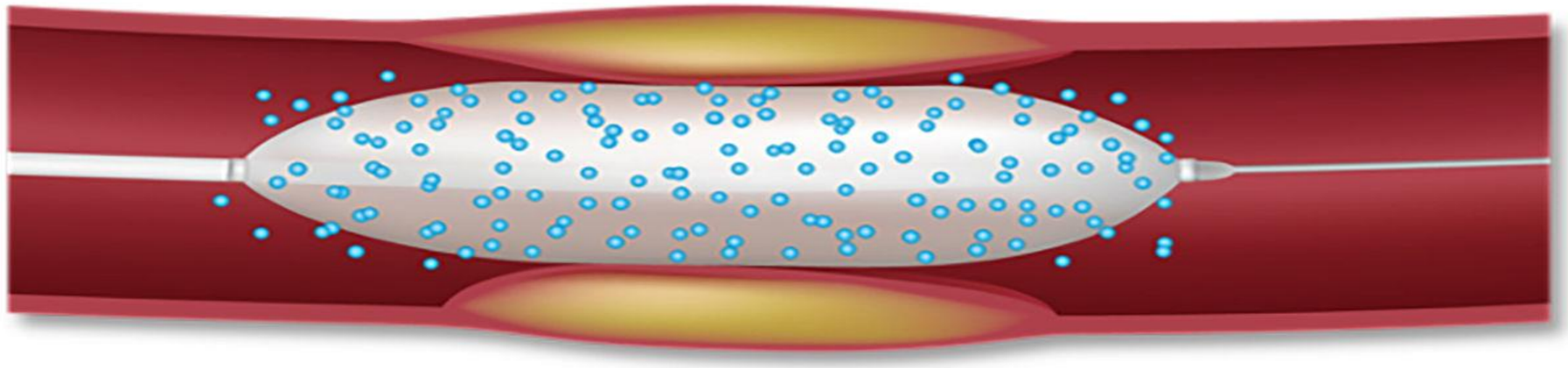
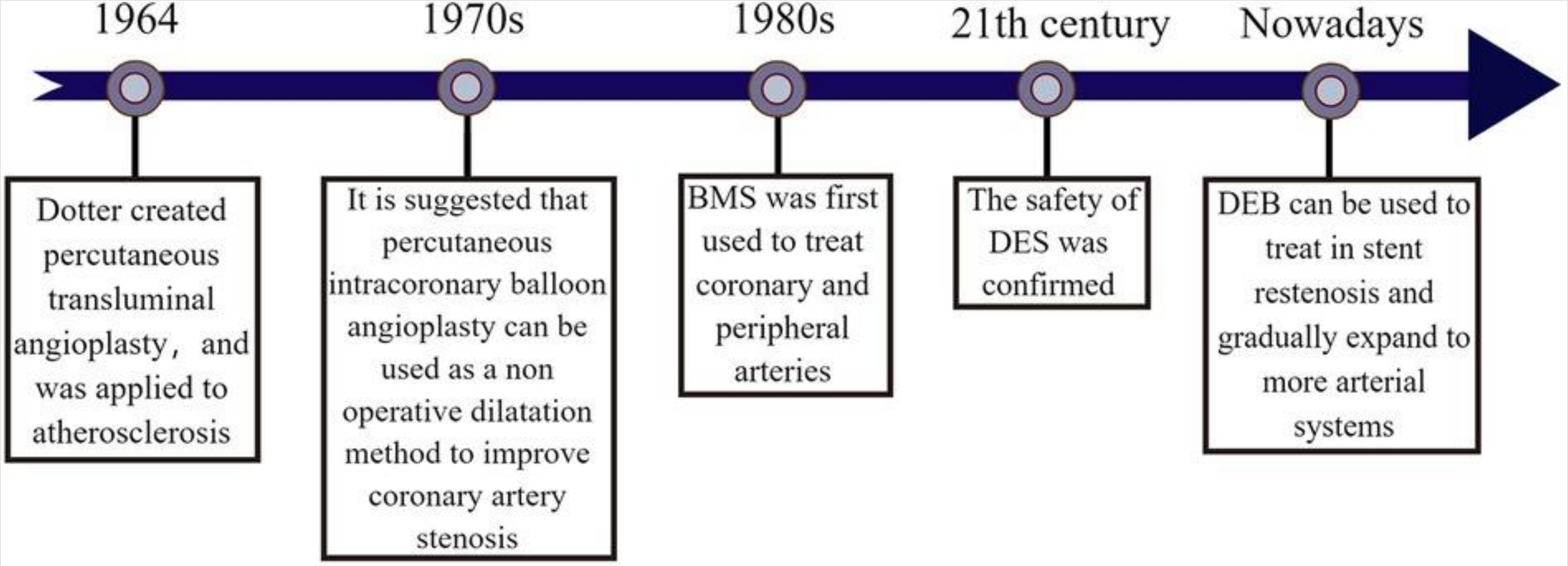
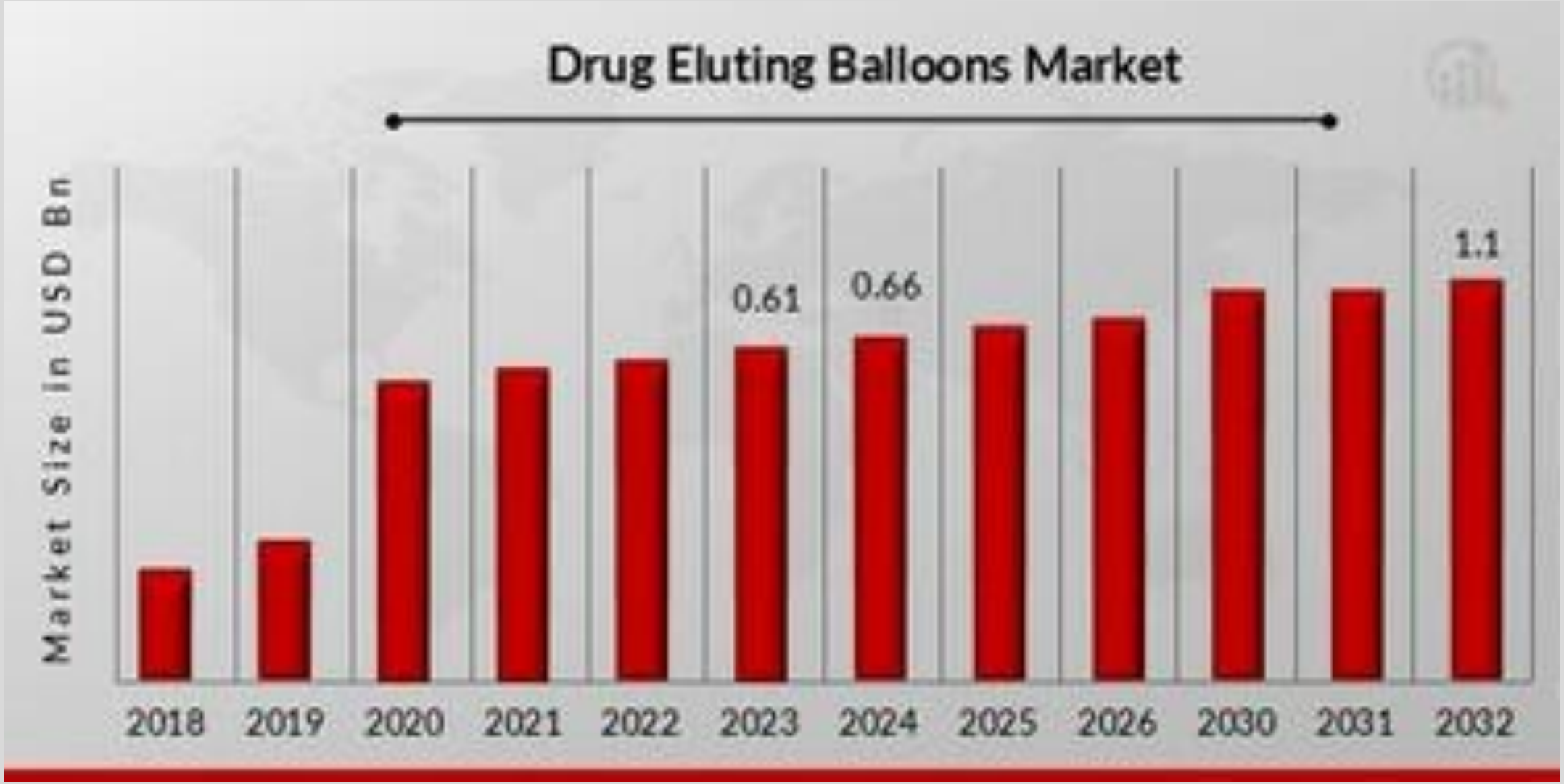
# Drug Eluting Ballons



Dr. JC Rama
Mayo 2025


**Drug-eluting balloons (DEBs) represent an enhancement of the therapeutic repertoire for the interventional cardiologist. The therapeutic concept of DEBs is promising, notably on the basis of initial studies in patients with diffuse in-stent restenosis (ISR). At present, however, a number of questions regarding long-term efficacy and safety remain, specifically in indications other than diffuse ISR.**


1964
Dotter created percutaneous transluminal angioplasty, and was applied to atherosclerosis
1970s
It is suggested that percutaneous intracoronary balloon angioplasty can be used as a non operative dilatation method to improve coronary artery stenosis
1980s
BMS was first used to treat coronary and peripheral arteries
21th century
The safety of DES was confirmed
Nowadays
DEB can be used to treat in stent restenosis and gradually expand to more arterial systems


Drug Eluting Balloons Market
Market Size in USD Bn
0.61
0.66
1.1
2018
2019
2020
2021
2022
2023
2024
2025
2026
2030
2031
2032

1977

## 1. Balloon (PTCA):

Andreas Gruntzig performs the first PTCA in Zurich, Switzerland

1988

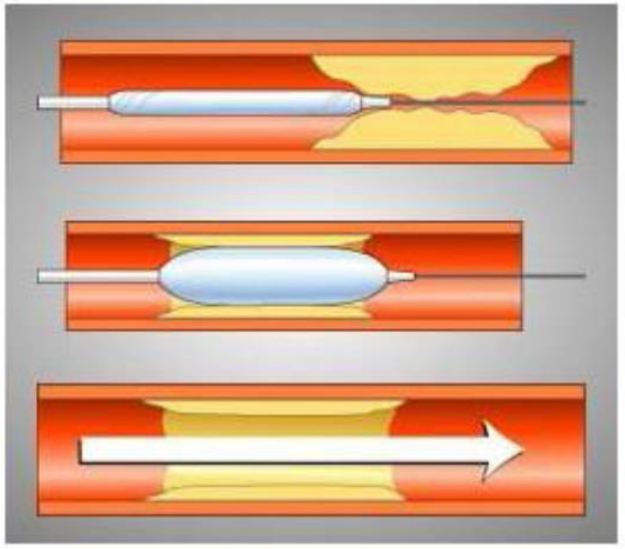
## 2. Bare Metal Stent (BMS):

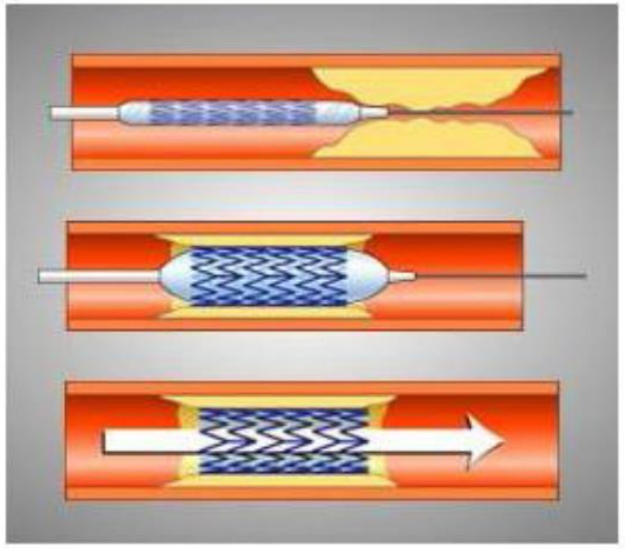
Julio Palmaz and Richard Schatz develop a stainless steel stent for coronary applications

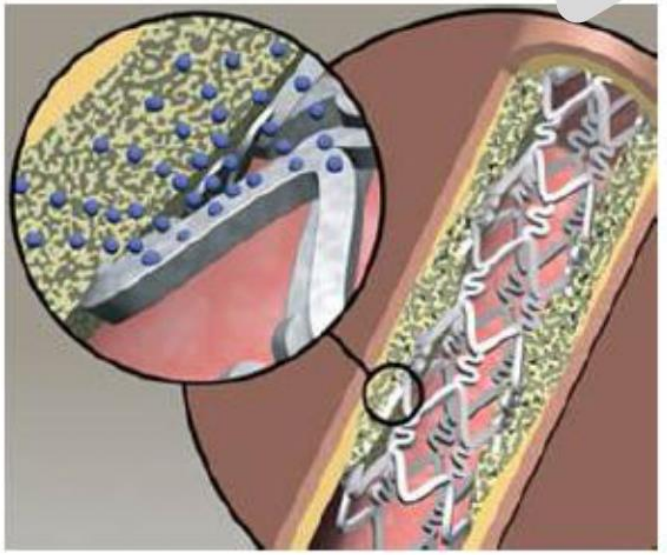
2002 - 2003

## 3. Drug-eluting stents (DES):

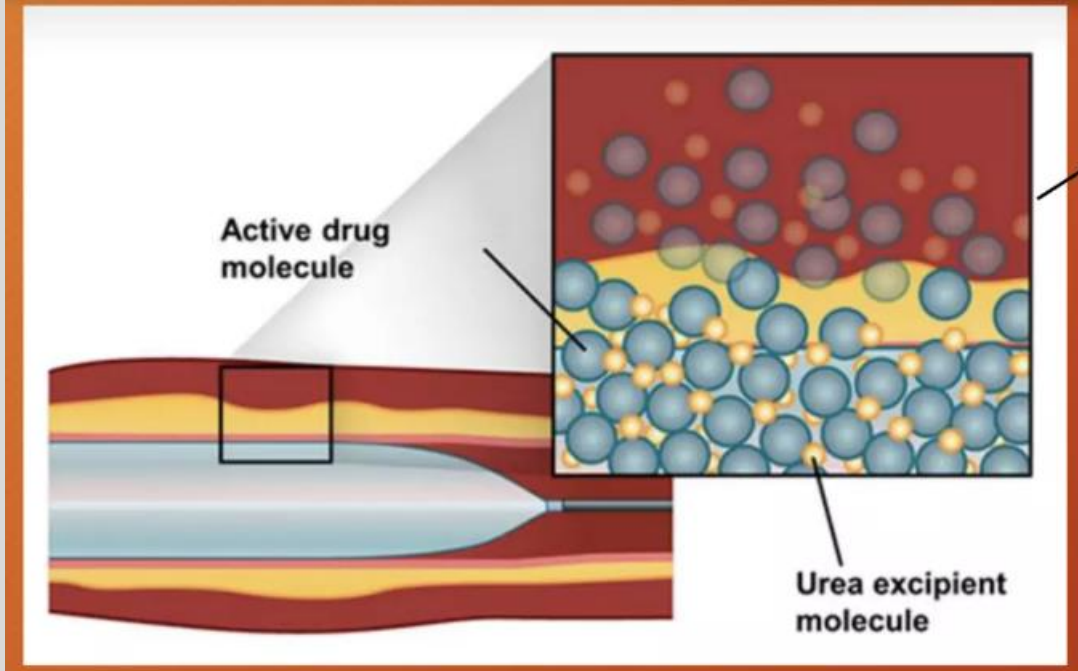
introduced to the European and U.S. markets

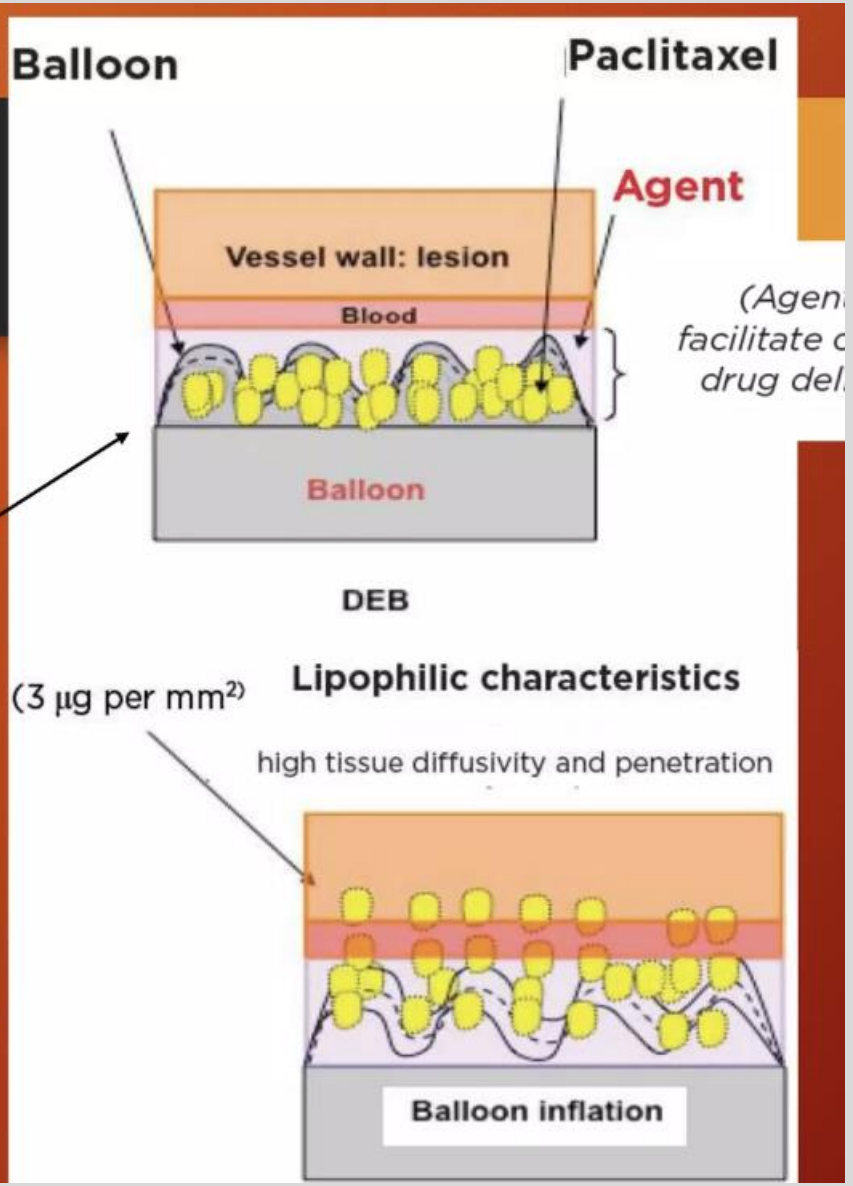






# Components of DEB



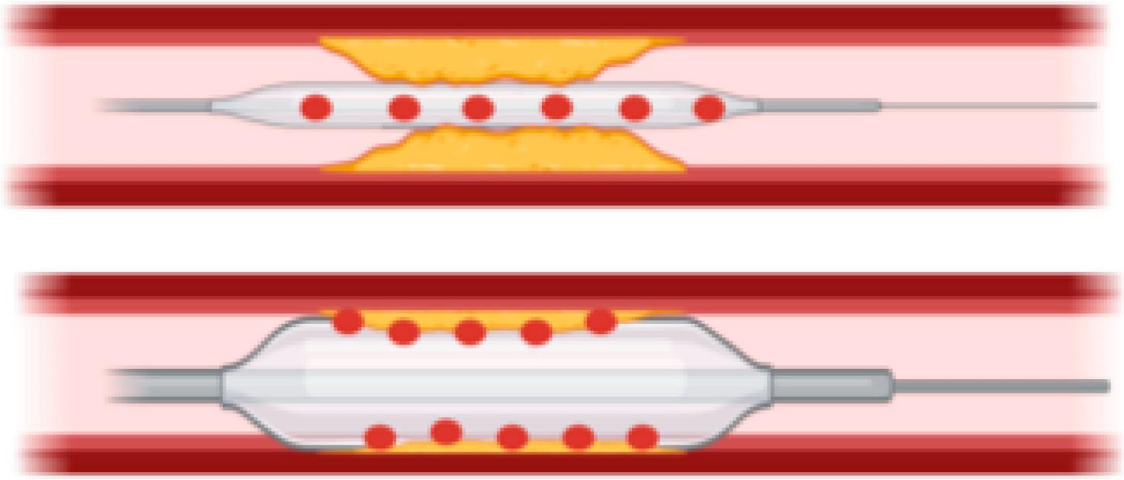
# Elements of drug-coated balloon systems

- Balloon
  - Standard
    - Wrapped configuration
  - Surface modified

- Anti-proliferative
  - Paclitaxil
  - 'limus family
  - Others?

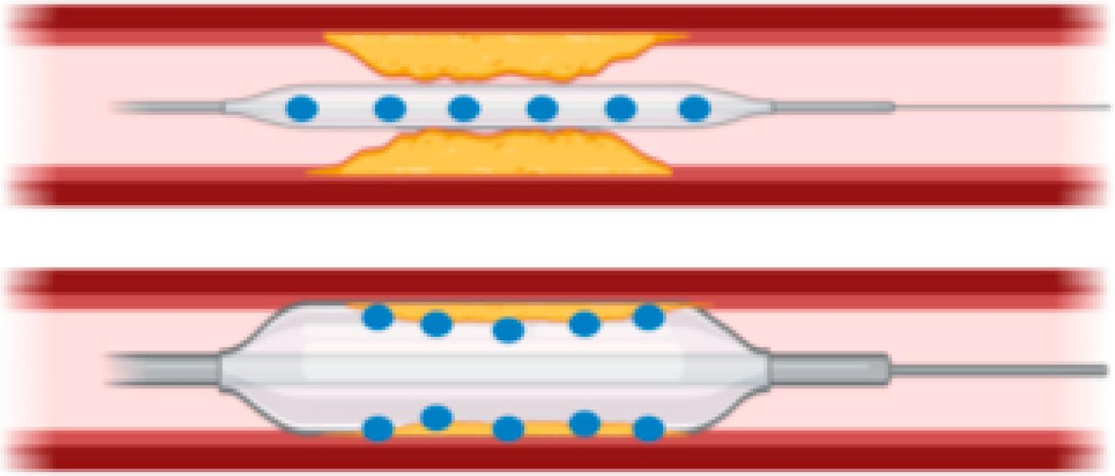
- Excipient
  - iopromide
  - urea
  - polymers
  - nanoparticles

## PACLITAXEL DCB



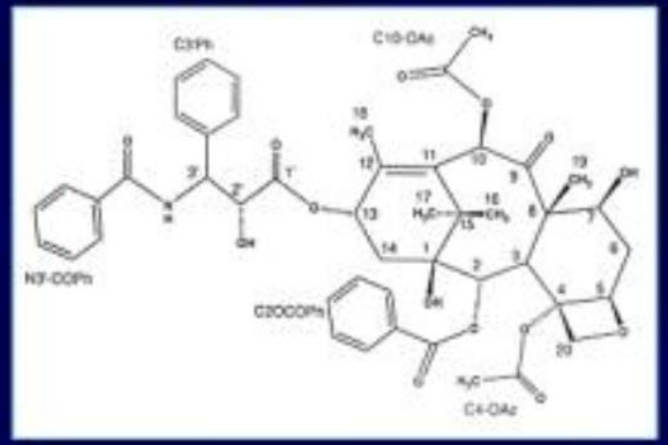
- Cytotoxic
- Narrow therapeutic range
- Fast tissue absorption
- Long tissue retention

## SIROLIMUS DCB



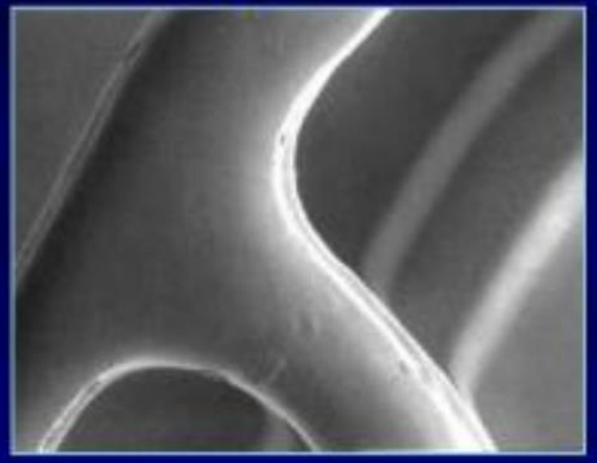
- Cytostatic
- Wide therapeutic range
- Slow tissue absorption
- Short tissue retention

## Paclitaxel



- Binds tubulin
- Microtubular dynamics
- Multicellular
- Multifunctional

## Polymer



- Uniformity
- Durability
- Biphasic Controlled Release Kinetics

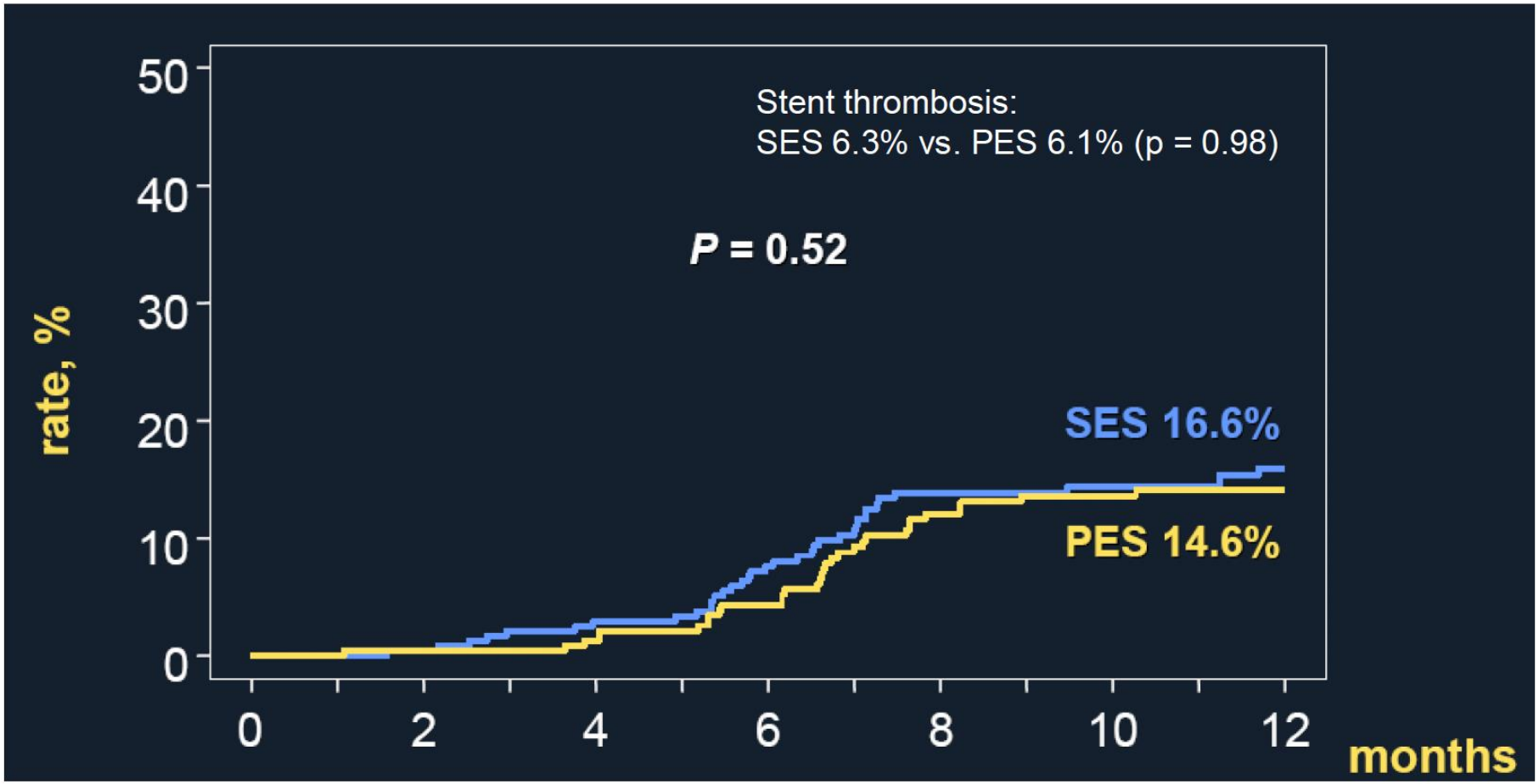
## Platform

- Express™ Stent
- Tandem Architecture Flexibility
- Maverick™ Balloon

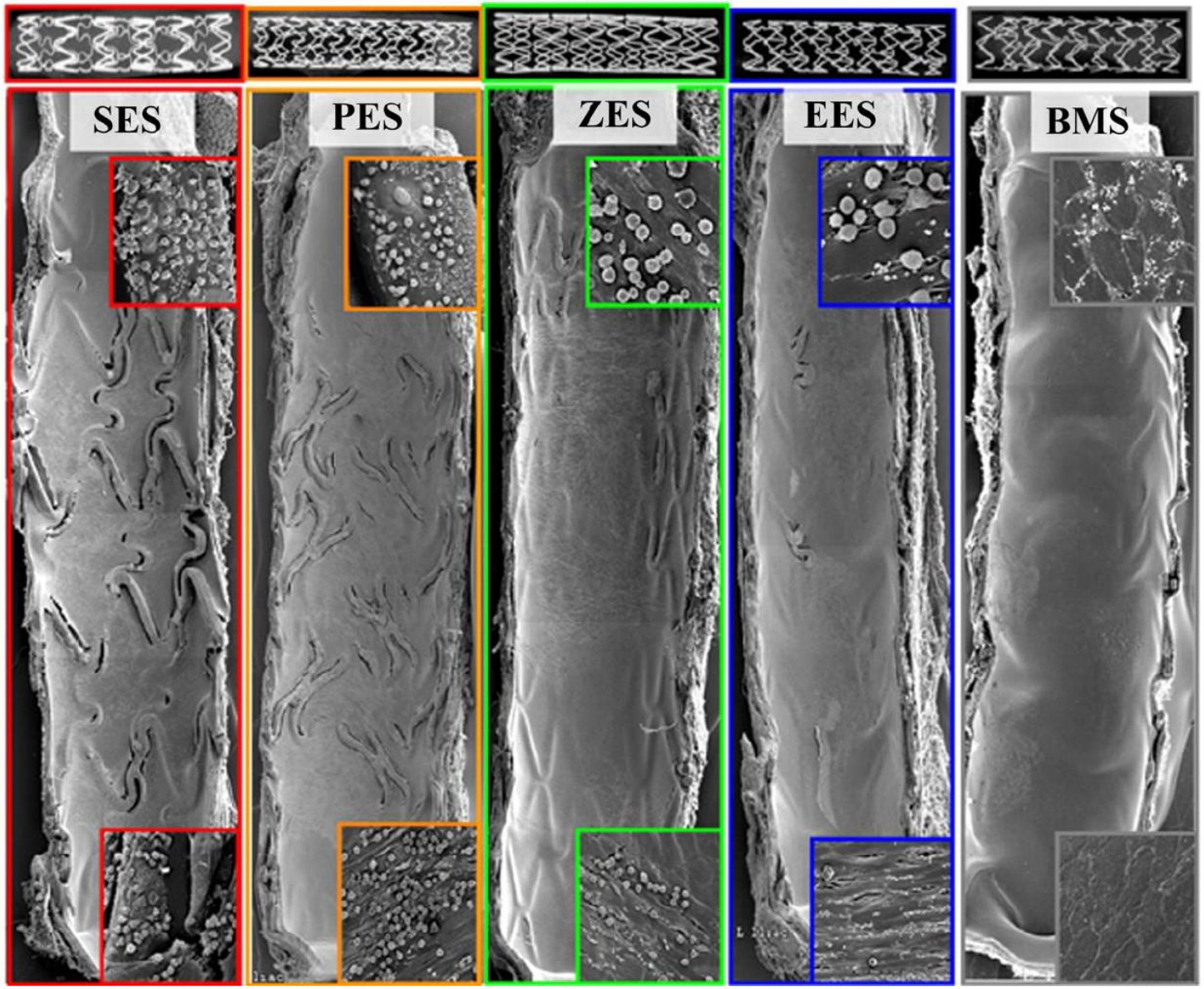
## Without Drug Coating

## With Drug Coating

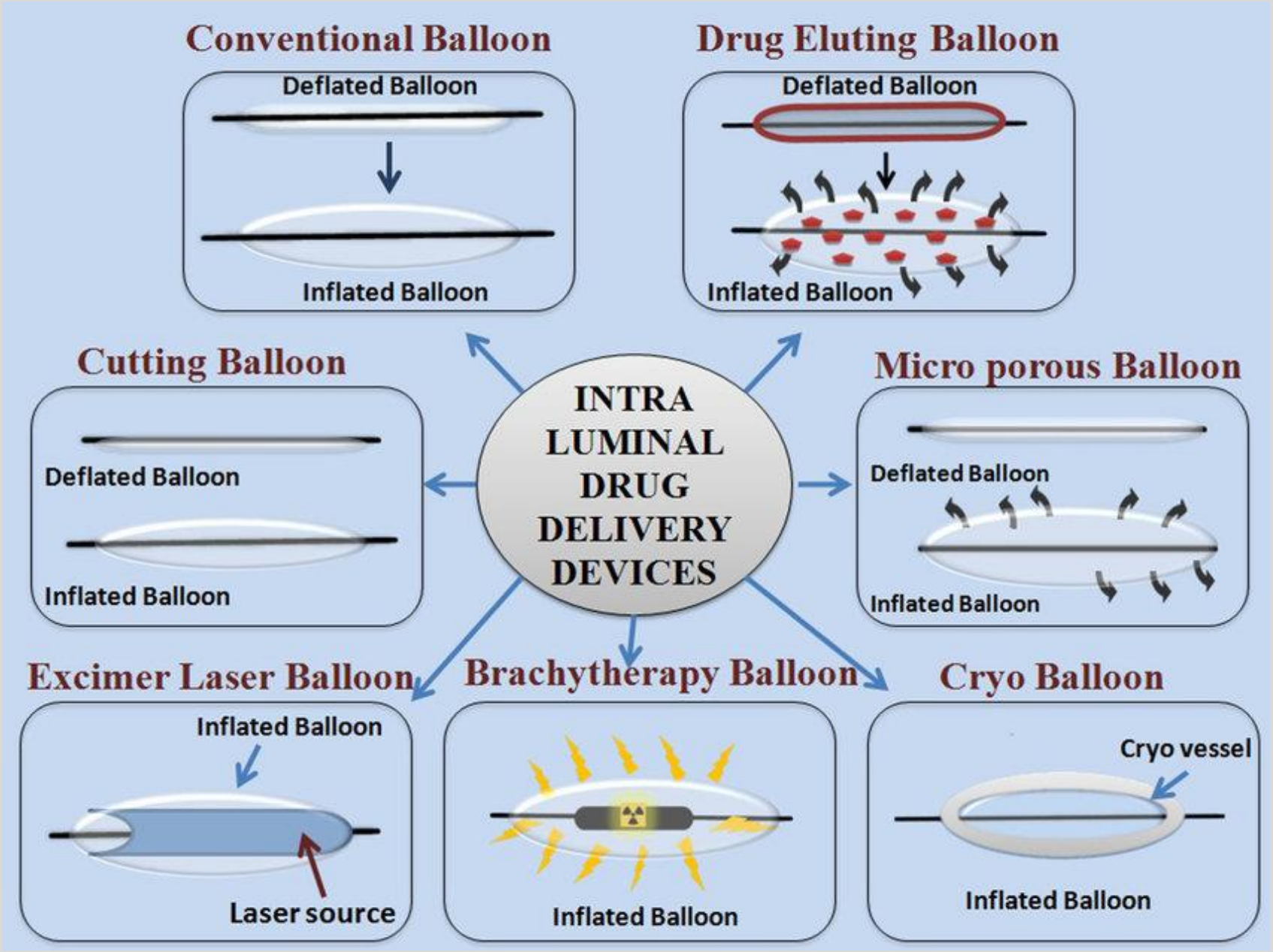
# ⇨ ISAR-DESIRE 2: TLR




Byrne, R, TCT 2009




Joner M et al. J Am Coll Cardiol, 2008; 52:333-342


Conventional Balloon
Deflated Balloon
Inflated Balloon
Drug Eluting Balloon
Deflated Balloon
Inflated Balloon
INTRA LUMINAL DRUG DELIVERY DEVICES
Cutting Balloon
Deflated Balloon
Inflated Balloon
Micro porous Balloon
Deflated Balloon
Inflated Balloon
Excimer Laser Balloon
Inflated Balloon
Laser source
Brachytherapy Balloon
Inflated Balloon
Cryo Balloon
Cryo vessel
Inflated Balloon

In-Stent Restenosis

Small Vessel Disease

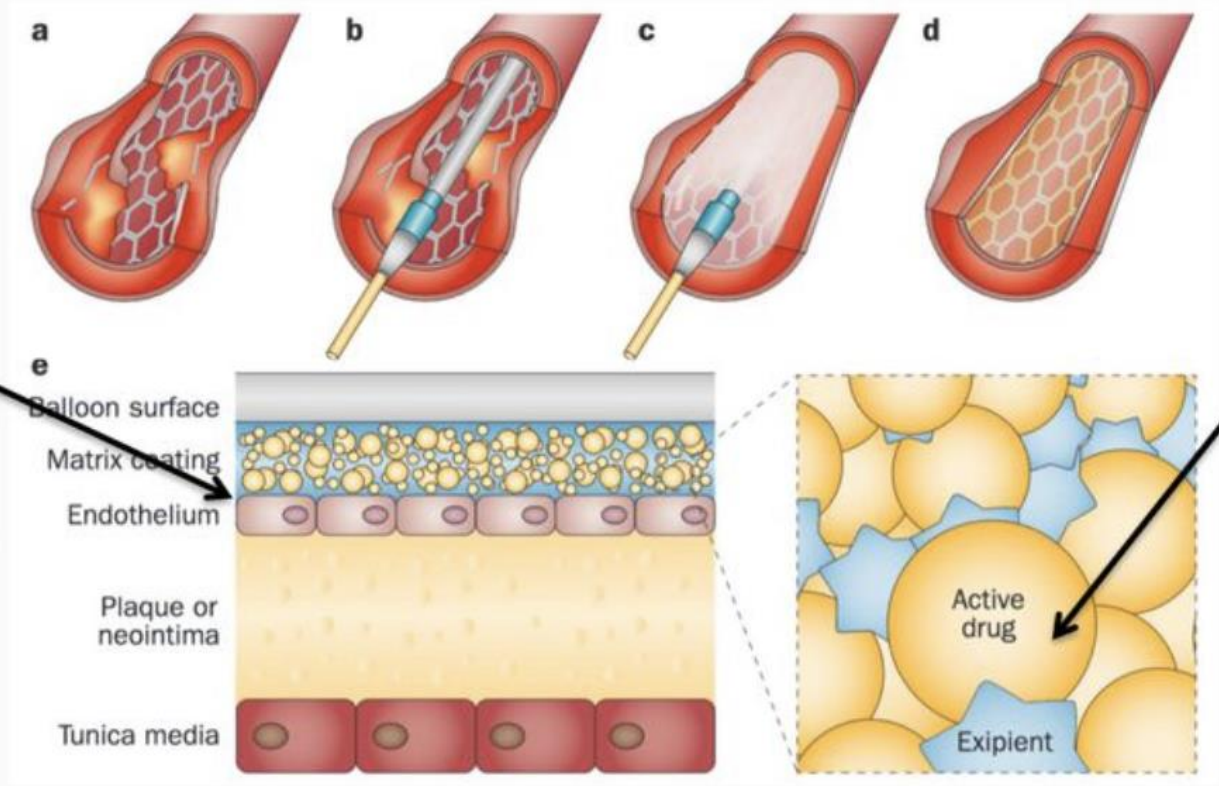
Bifurcation Lesions

De-Novo Coronary Lesions

# BASKET-SMALL 2

## Background: Drug-Coated Balloons

Fast and homogenous drug delivery into the vessel wall



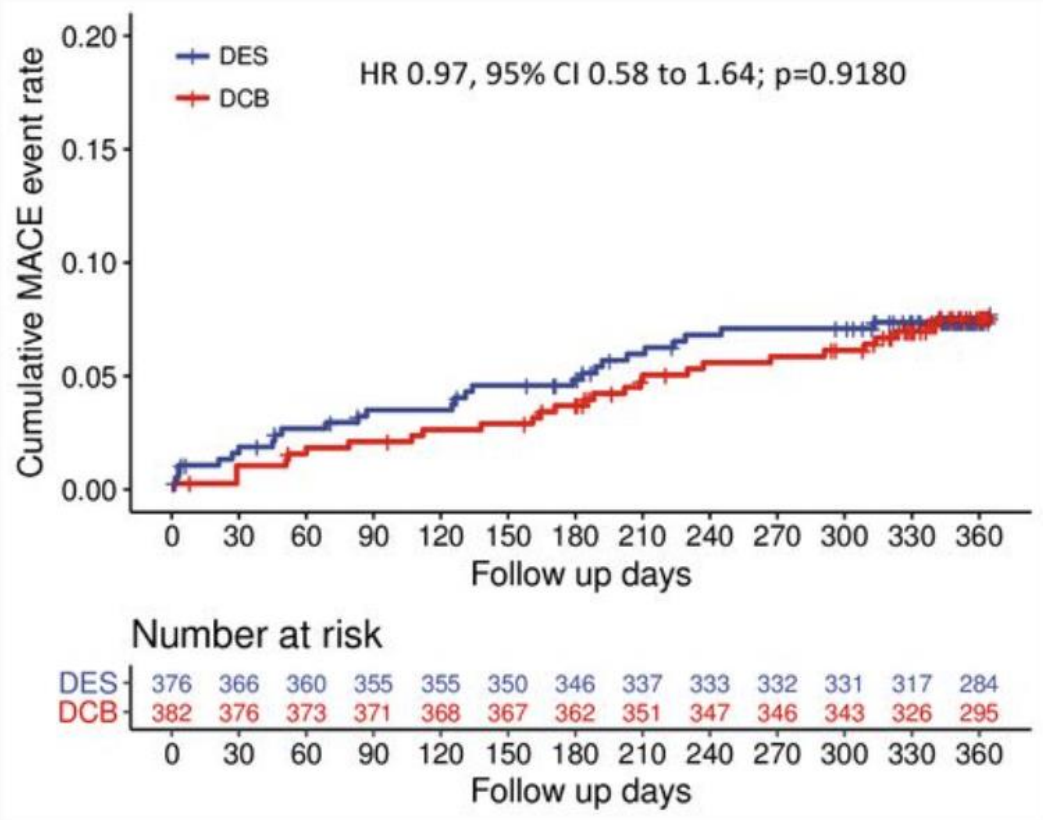

Highly lipophilic drug & coating matrix



Byrne RA et al, Nat Rev Cardiol 2014;11:13-23

# BASKET-SMALL 2

## MACE (12 Months)



The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

# Treatment of Coronary In-Stent Restenosis with a Paclitaxel-Coated Balloon Catheter

Bruno Scheller, M.D., Christoph Hehrlein, M.D., Wolfgang Bocksch, M.D., Wolfgang Rutsch, M.D., Dariush Haghi, M.D., Ulrich Dietz, M.D., Michael Böhm, M.D., and Ulrich Speck, Ph.D.

## ABSTRACT

### BACKGROUND

Treatment of coronary in-stent restenosis is hampered by a high incidence of recurrent in-stent restenosis. We assessed the efficacy and safety of a paclitaxel-coated balloon in this setting.

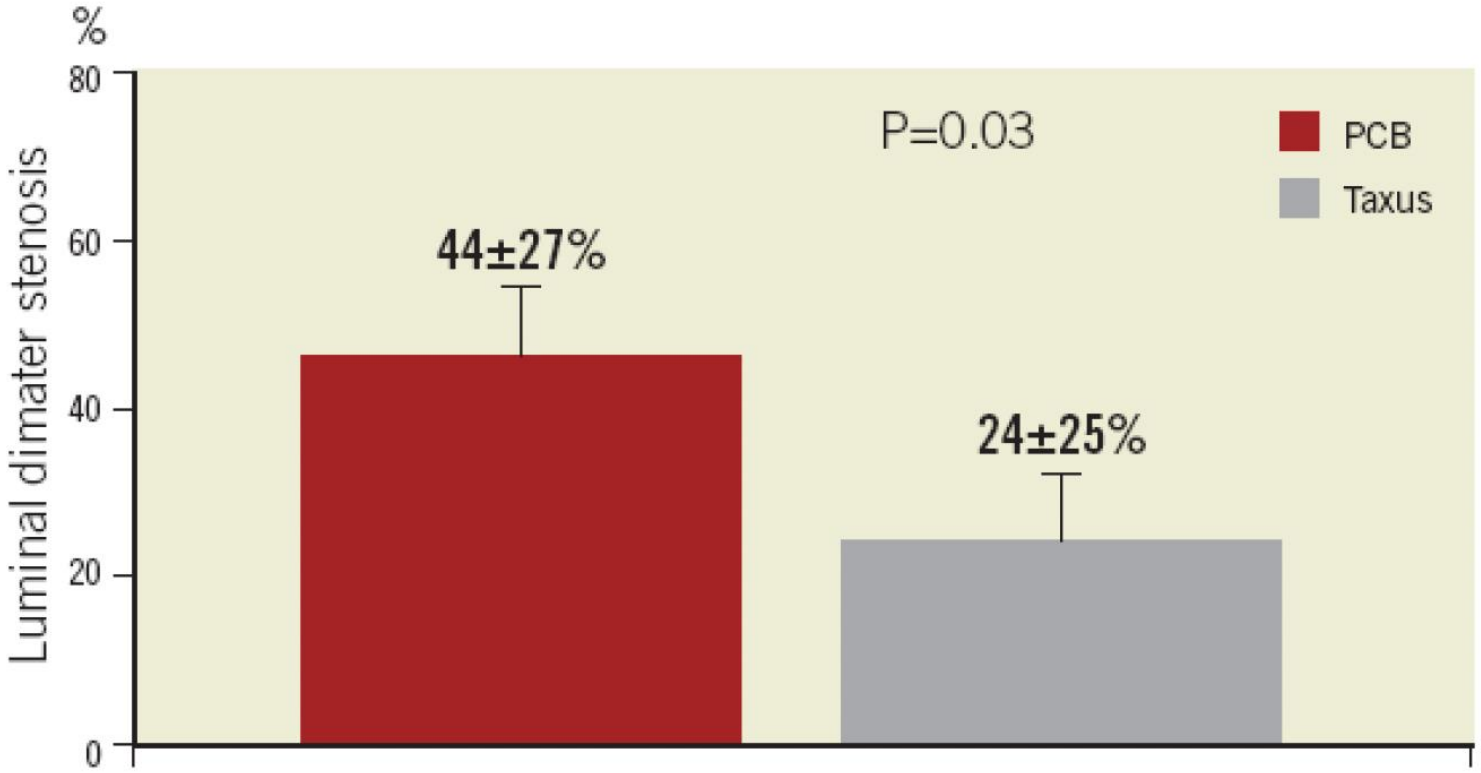
### METHODS

We enrolled 52 patients with in-stent restenosis in a randomized, double-blind, multicenter trial to compare the effects of a balloon catheter coated with paclitaxel (3 μg per square millimeter of balloon surface area) with those of an uncoated balloon catheter in coronary angioplasty. The primary end point was late luminal loss as seen on angiography. Secondary end points included the rates of restenosis (a binary variable) and major adverse cardiac events.

From Universitätsklinikum des Saarlandes, Homburg/Saar (B.S., M.B.); Universitätsklinikum, Freiburg (C.H.); Campus Virchow-Klinikum (W.B.) and Campus Charité Mitte (W.R., U.S.), Universitätsklinikum Charité, Berlin; Universitätsklinikum Mannheim, Ruprecht Karls Universität Heidelberg, Mannheim (D.H.); and Deutsche Klinik für Diagnostik, Wiesbaden (U.D.) — all in Germany. Address reprint requests to Dr. Scheller at the Klinik für Innere Medizin III, Universitätsklinikum des Saarlandes, Homburg/Saar, Germany, or at bruno.scheller@uniklinikum-saarland.de.

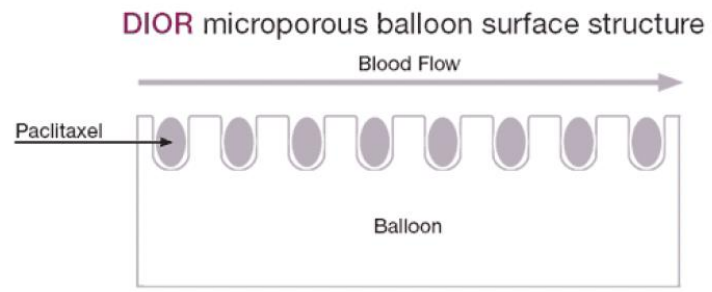
Scheller B et al. N Engl J Med 2006; 355:2113-2124

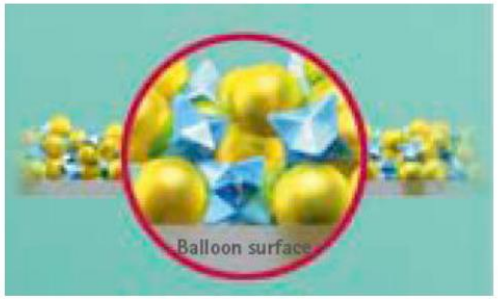
# Paclitaxel-coated balloon DIOR® vs. Taxus DES in small coronary vessels (≤ 2.75 mm), n=28 + 29 patients

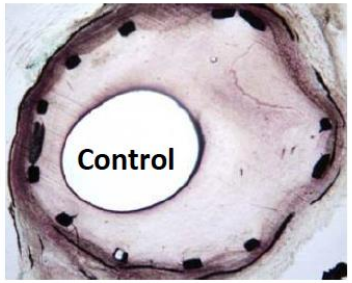


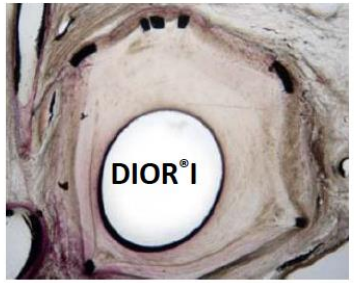

Cortese B et al. Heart 2010;96:1291-1296

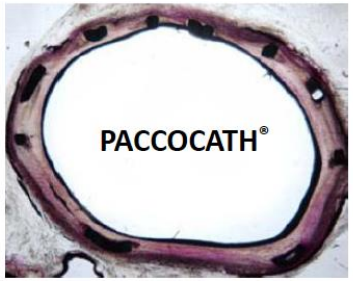
## Matrix Coating - Paclitaxel Iopromide
## Sequent Please

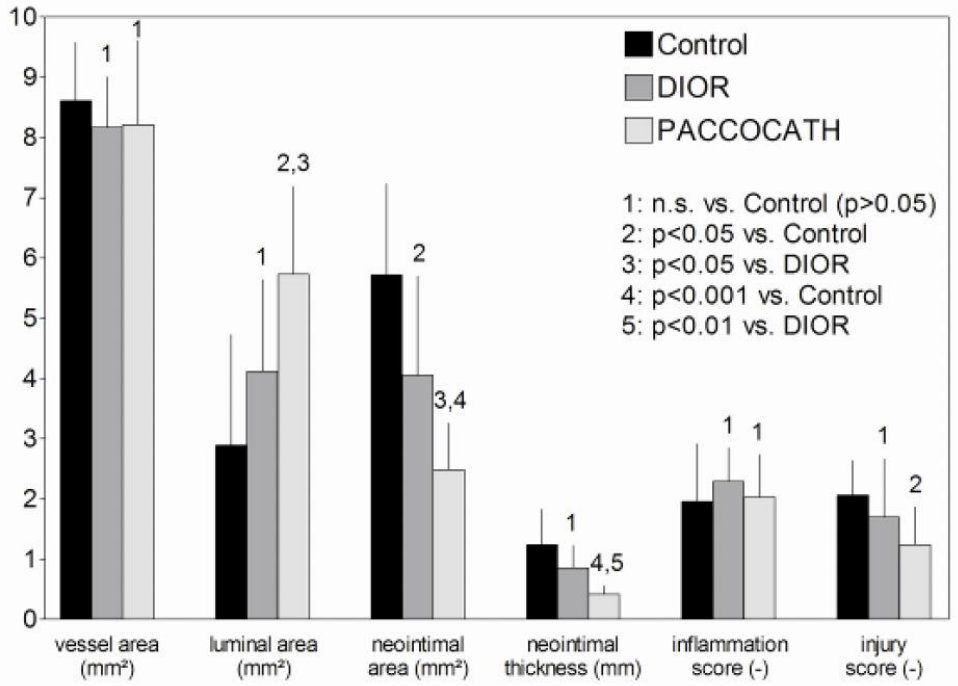


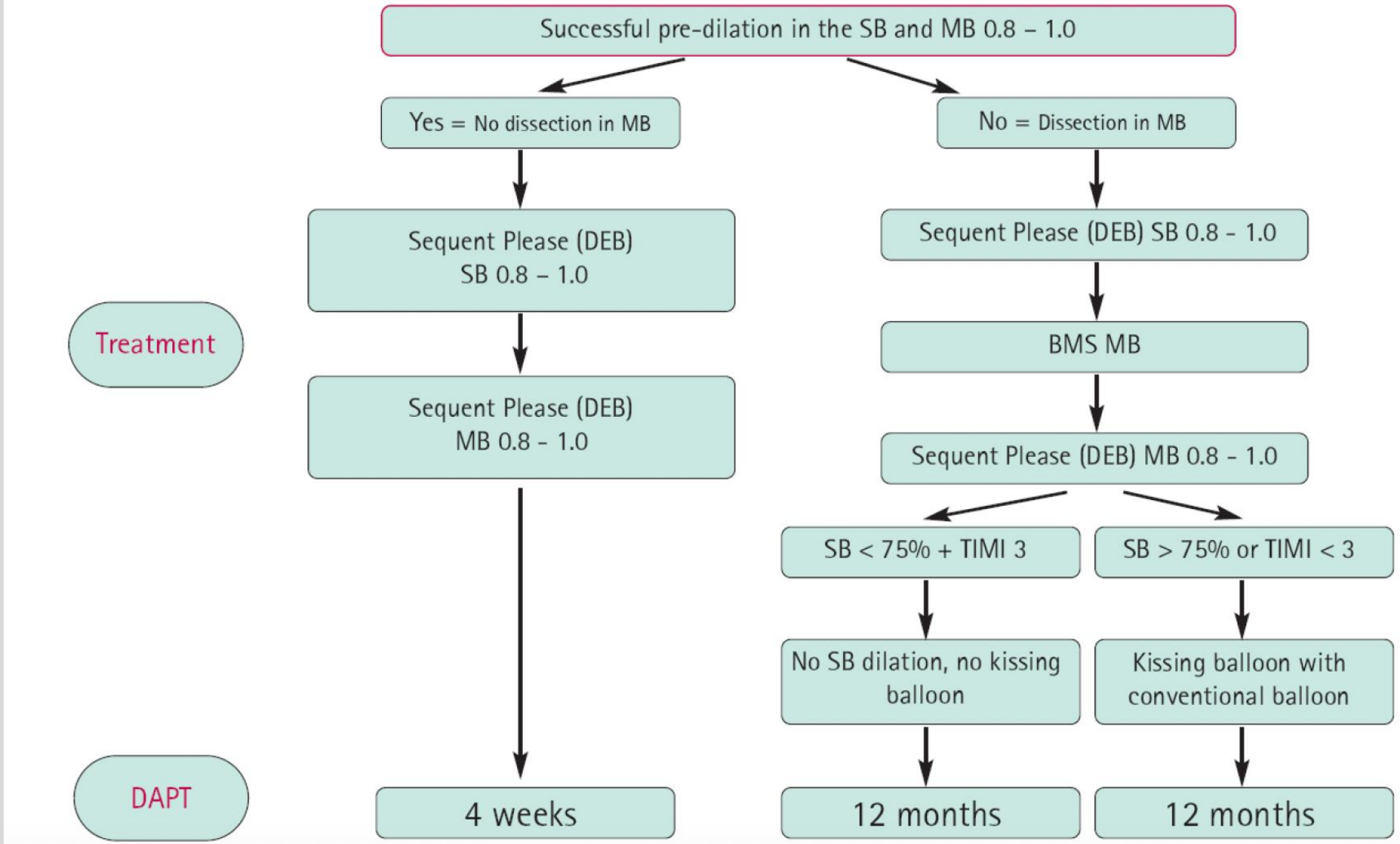



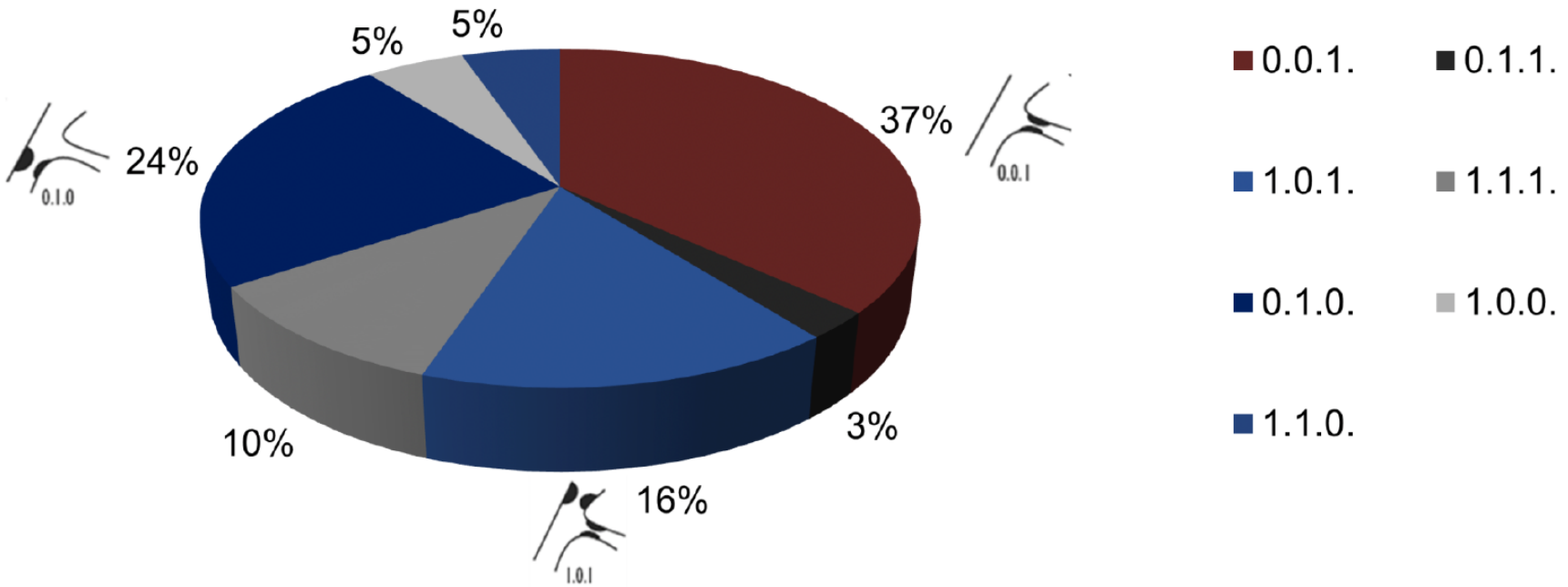




Cremers B et al., Clin Res Cardiol 2009; 98: 325–330




Eurointervention 2011;7:K125-128

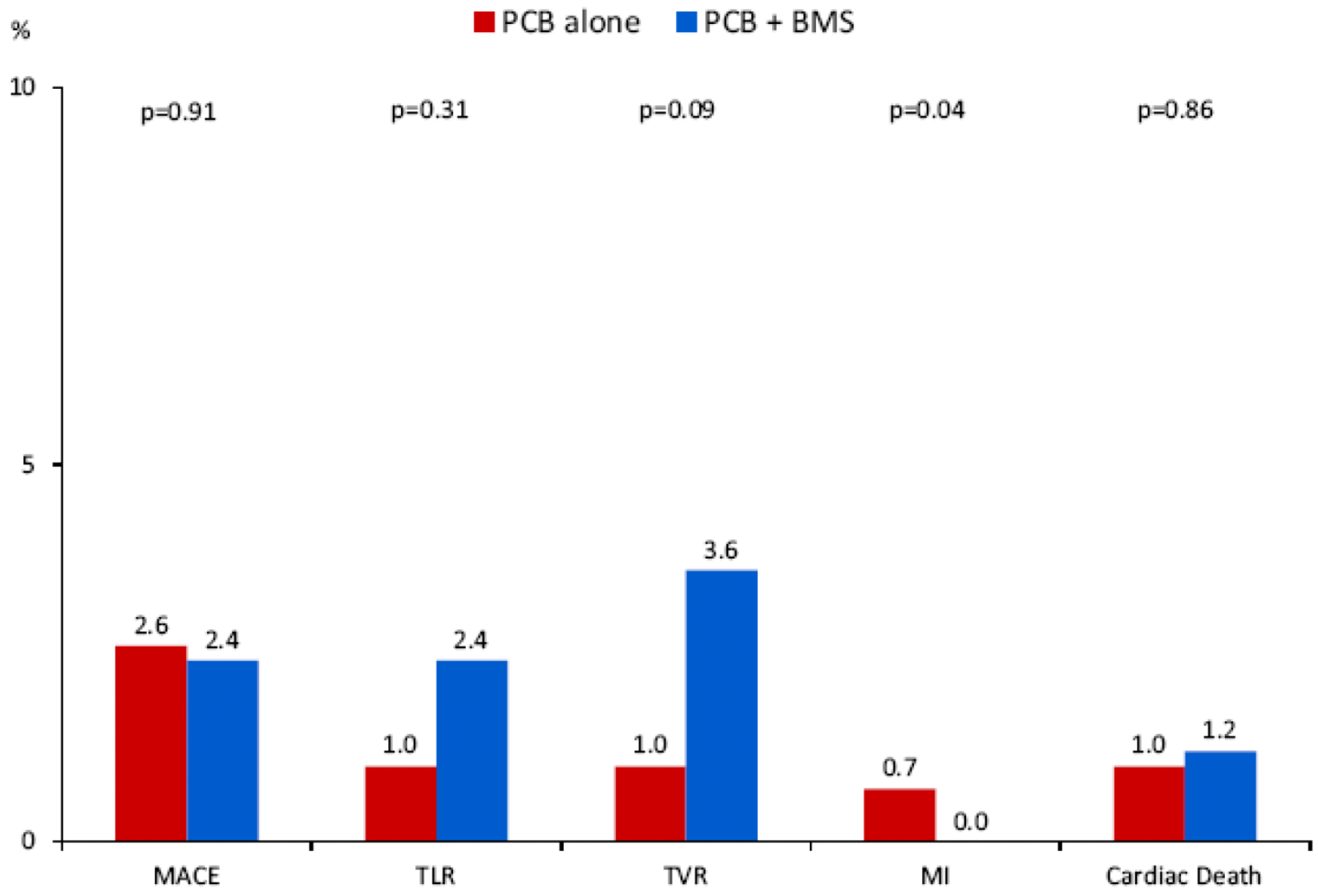



- ⇨ 38 interventions
- ⇨ The procedure was successful in all patients.
- ⇨ Additional stenting of the main branch was needed in 3 (7.9%) interventions.

Bonaventura K, Asia PCR 2013

| Trial<br>Number of patients | Intervention | Indication | Late lumen loss | Follow-up |
|---|---|---|---|---|
| PEPCAD I SVD[1]<br>(n=118) | SeQuent™ Please<br>(n=82)<br>vs. SeQuent™<br>Please + BMS | De novo,<br>small vessels | 0.16 mm | 6 months |
| PEPCAD V[2]<br>(n=28) | SeQuent™ Please | De novo,<br>bifurcation<br>(side branch) | 0.21 mm | 6 months |
| PICCOLETO[3]<br>(n=60) | Dior™ II (n=29)<br>vs. DES | De novo,<br>small vessels | Not published | 6 months |
| DEBUIT[4]<br>(n=117) | Dior™ (n=40)<br>vs. Dior™ + BMS<br>vs. DES | De novo,<br>bifurcation | 0.11 mm | 9 months |
| Valentines II[5] | Dior™ II | De novo | 0.30 (overall) | 6-9 months |

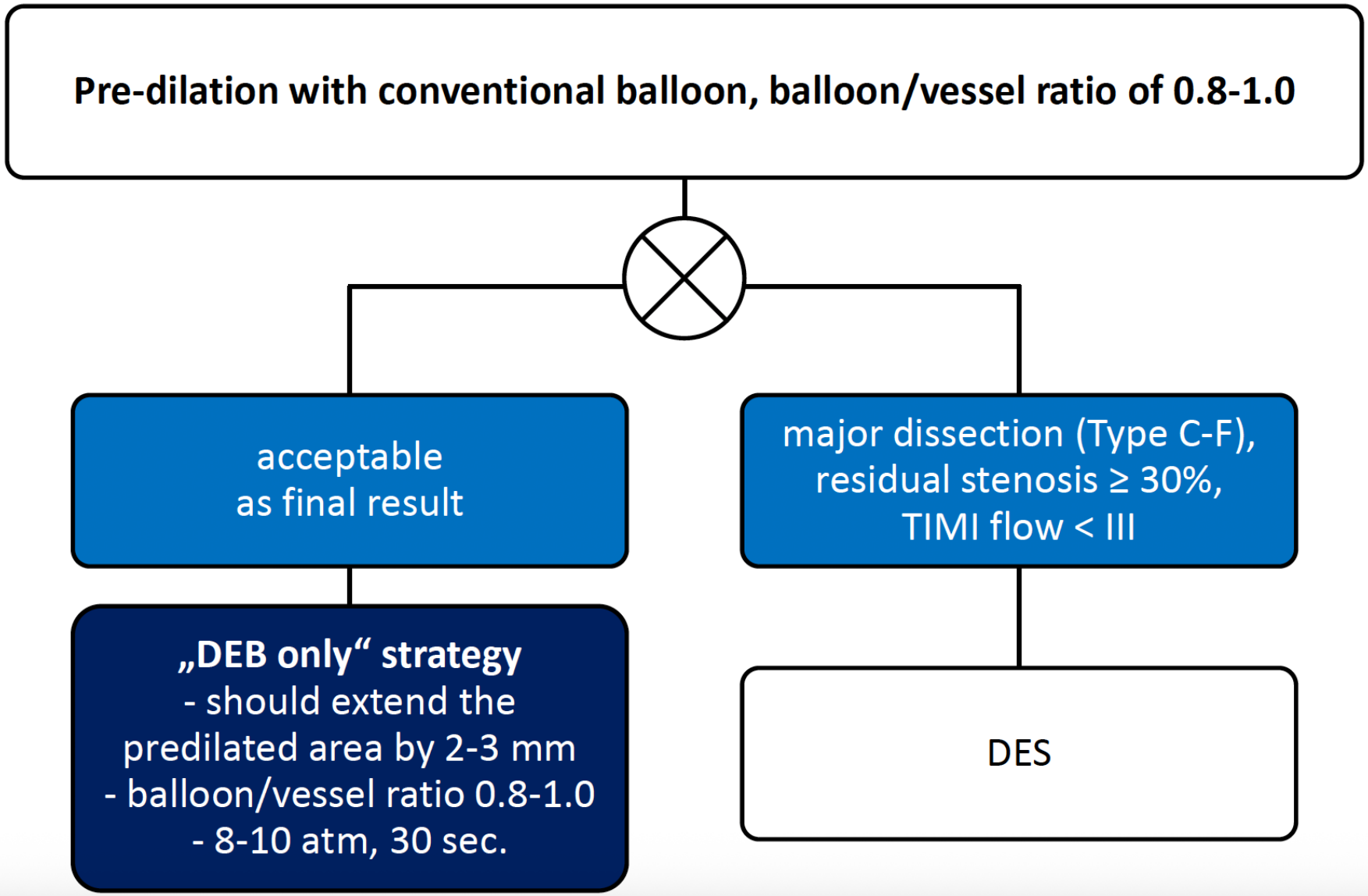
*[1]Unverdorben M et al. Clin Res Cardiol. 2010 Mar;99(3):165-74. [2]Mathey DG; Eurointervention 2011;7:K61-65.*
*[3]Cortese B et al. Heart 2010;96:1291-1296. [4]Stella R, TCT 2010, [5]Serra CRT 2012.*




Woehrle J et al. J Am Coll Cardiol. 2012 Oct 30;60(18):1733-8

| Trial<br>Number of patients | Intervention | Indication | Duration of DAPT | Acute and late thrombosis at follow-up |
|---|---|---|---|---|
| PEPCAD I SVD[1]<br>(n=118) | SeQuent™ Please (n=82) vs. SeQuent™ Please + BMS | De novo, small vessels | 1 month | DCB: 0%,<br>DCB + BMS: 6.3% |
| PEPCAD V[2]<br>(n=28) | SeQuent™ Please | De novo, bifurcation (side branch) | 3 months | DCB: 0% |
| PICCOLETO[3]<br>(n=60) | Dior™ II (n=29) vs. DES | De novo, small vessels | 1 month in cases of stable angina and lone DEB use,<br>3 months in cases of DEB and provisional stent implantation | DCB: 0%,<br>DES: 0% |
| DEBUIT[4]<br>(n=117) | Dior™ (n=40) vs. Dior™ + BMS vs. DES | De novo, bifurcation | DEB: 3 months, DEB + BMS: 3 months, DES: 12 months | DCB: 0%<br>DCB + BMS: 0%,<br>DES: 2.5% |
| **Potsdam Heart Center (n=85)**[5] | **SeQuent™ Please** | **De novo** | **5.4 months** | **DCB: 0%** |

*[1]Unverdorben M et al. Clin Res Cardiol. 2010 Mar;99(3):165-74. [2]Mathey DG; Eurointervention 2011;7:K61-65.*
*[3]Cortese B et al. Heart 2010;96:1291-1296. [4]Stella R, TCT 2010. [5]Bonaventura K, TCT 2012*


Pre-dilation with conventional balloon, balloon/vessel ratio of 0.8-1.0
acceptable
as final result
major dissection (Type C-F),
residual stenosis ≥ 30%,
TIMI flow < III
„DEB only“ strategy
- should extend the
predilated area by 2-3 mm
- balloon/vessel ratio 0.8-1.0
- 8-10 atm, 30 sec.
DES

- ⇨ The use of DCB in **in-stent restenosis**, **bifurcation lesions** and **small vessel disease** is **established.**
- ⇨ **Favorable results in de-novo coronary artery disease**
- ⇨ **No class-effect** of DCB
- ⇨ DEB only is **not** associated with a higher rate of acute or late **thrombosis**.
- ⇨ Localized **haziness** after DCB angioplasty in de-novo lesions does **not** increase the risk of acute coronary thrombosis.