A Brief History of Angioplasty: Evolution of an Art

Barry D. Rutherford MD • TCT AP 2016

“We Stand on the Shoulders of Giants”
Time Lines in Angioplasty

- **Development of Coronary Angiography**
  - 1960

- **1st Angioplasty of atheroma in the leg by “Dotter” technique**
  - 1969
  - Charles Dotter MD

- **1st Balloon Catheter**
  - 1974

- **1st Poster presentation of PTCA in dog – AHA**
  - Andreas Gruentzig
    - Zurich, Switzerland
  - 1976

- **First Human PTCA**
  - 1978

- **Development of the Angioplasty Course**
  - Sept. 1977
Melvin Judkins and Mason Sones
Miami, AHA 1976; poster presentation results of balloon angioplasty in animals
Adolph Bachman
First Angioplasty Patient; September 1977
<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
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<tr>
<td>January 1982</td>
<td>Onset of typical angina progressive course, developing rest and nocturnal pain</td>
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<td>Risk Factors</td>
<td>Strong FH of CAD; Heavy cig intake; Chol 240, HDL 30</td>
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<td>Medications</td>
<td>Inderal, NTG</td>
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<td>ECG</td>
<td>WNL</td>
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<tr>
<td>Cor Angio</td>
<td>LVEDP – 10 mm Hg; EF 60%</td>
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<td>March 1982</td>
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G.R. March 1982
RCA High Grade Distal Disease
G.R. March 1982; Coronary Angiogram

What Interventional Techniques were available at that time?
Time Lines in Angioplasty

First PTCA in the USA

First 300 PTCAs

Multiple Vessel PTCA. PTCA in Acute Myocardial Infarction

MAHI Angioplasty Teaching Courses

Loss of Gruentzig Sones Judkins Dotter

New Device Era
- Rotablator
- Laser
- Atherectomy Catheter
- Initial Stent Development
- IVUS
- Radiation Therapy
- New DES
- Biodegradable Stents

Richard Myler MD
Simon Stertzer MD
Geoffrey Hartzler MD
David MaConahay MD
Barry Rutherford MD
Mid America Heart Institute
G.R. March 1982: Successful PTCA of LAD
Unable to Cross LCX Lesion
G.R. March 1982: Successful PTCA of RCA-PL

DG-20-30 Balloon Catheter
“A great teacher never strives to explain his vision: he simply invites you to stand beside him and see for yourself”

Rev. R. Inman
Richard Myler  Simon Stertzer

First PTCAs in USA in 1980
Done on same day on East and West coasts

John B. Simpson
Developed the steerable wire and over the wire balloon
G.R.  46-Year-Old Male, Rhodes Scholar Director – IMF, Washington, DC

- Nov. 1988  Resume cig. Intake
  Bleeding ulcer, D/C aspirin
- Dec. 1988  Recurrent angina with exertion
- Jan. 1989  Vacation in New Zealand
- Feb 2, 1989  Sustained acute inferior infarct
  CPK 1000. No complication
  Received no thrombolytic agent, no PTCA
- March 1989  Returned to USA
- Mar 7, 1989  Repeat Coronary Angio, MAHI
Total occlusion RCA 30 days post-AMI
Successful PTCA RCA
Patent RCA PDA & PL

LAD was patent. Successful PTCA of LCX with steerable wire and over-the-wire balloon
Coronary angioplasty (PTCA) was successfully performed in 16 pts during acute myocardial infarction (AMI). There were 13 males and 3 females with mean age of 62 yrs (46-74 yrs) catheterized at mean 3.3 hrs (1-10 hrs, mode 2.5 hrs) following onset of continuous chest pain with ST segment elevation in 13 pts, ST depression in 3 pts and new Q-waves in 6 pts. Intracoronary streptokinase (ICSK) opened 6 of 8 total occlusions and removed thrombus in 2 pts with subtotal occlusions (STO) prior to PTCA of residual high-grade atheromatous stenoses. PTCA without ICSK was performed in 2 pts with total occlusions and 6 pts with STO. Twenty segments were dilated including LAD - 8 pts, RCA - 6 pts, Circ - 5 pts, and vein graft - 1 pt. Mean residual stenosis was 28% with reduction of intracoronary pressure gradients from mean 67 mm Hg. to 0-10 mm Hg. One laboratory death occurred following hemodynamically and angiographically successful PTCA in a pt with LV ejection fraction of 7%. A second pt underwent coronary bypass surgery because of additional inaccessible coronary stenoses. The post-procedure course was stable in all pts. Repeat cath in 11 pts at 12 days (5-36 days) showed patency of all dilated segments, improved ejection fraction in 10 pts and improved regional wall motion in 10 pts. At follow-up of 6 mo (1.5-12.5 mo) no AMI have occurred, 13 pts are asymptomatic and 2 pts are functional-Class II. We conclude that urgent PTCA w/o ICSK can relieve pain, stabilize the course and limit myocardial infarction in selected pts with AMI.
Inferior MI
Total Occlusion LCX 1981
Comparison of Invasive and Conservative Strategies after Treatment with Intravenous Tissue Plasminogen Activator in Acute Myocardial Infarction

Results of the Thrombolysis in Myocardial Infarction (TIMI) Phase II Trial

“PTCA offered no advantage in terms of reductions in mortality or reinfarction over a more conservative strategy, according to which these procedures were provided only to patients with recurrent ischemia; the latter strategy was less complex and less costly.” NEJM 1989;320:618-27

“Balloon angioplasty no longer indicated for acute myocardial infarct patients”

“The air is out of the balloon”

“Balloon Angioplasty for AMI: Was It Buried Alive?” – Bernhard Meier, MD

“Primary PCI for STEMI pts set back a decade”
When asked to recommend a lytic regimen for acute infarct patients, it is “a rapid injection of 100 milligrams of polyethylene on a balloon catheter”

~ Geoffrey O. Hartzler, MD
The “Saviors” of PTCA in AMI
G.R. July 28, 1989

- Recurrent angina
- Repeat cor angio, restenosis of RCA. Successful PTCA by Dr. K. Kent, Washington Hospital Center (DC)

What Interventional Techniques were available at that time?
Hans Wallsten

- First stent implanted in 1986 in Toulouse, France and then at Lausanne, Switzerland
- By 1989, 1200 Wallstents had been implanted!

Intravascular Stents to Prevent Occlusion and Re-Stenosis after Transluminal Angioplasty

Ulrich Sigward, MD; Jacques Puel, MD; Velimir Mirkovitch, MD; Francis Joffre, MD; and Lukas Kappenberger, MD

NEJM 1987;316:701-706
Julio Palmaz and Richard Schatz

Palmaz-Schatz: First BMS in 1994
Igaki-Tamai Scaffold

1. Polymer: PLLA
2. Deployment: Complex-Self expanding & balloon inflation w/ heated contrast
3. BMS like results in FIM coronary trial of 50 pts
4. No coronary implants for 10 yrs
5. Pts at 10 year F/U raise no safety concerns for PLA

Tamai Circulation 2000:102:399; Tamai CCT 04; Onuma EuroIntervention 2009
G.R.

  • Recurrent angina
  • Stenting of RCA with BMS – Dr Anthony Rickards, Royal Brompton Hospital, London

1996
  • Asymptomatic abnl stress test with LAD ischemia
  • New lesion of Proximal LAD stented with DES by Dr Anthony Rickards

2008
  • Retired and living in New Zealand
  • Asymptomatic
G.R.: October 2015, 80 years old

Asymptomatic
34 years after multivessel angioplasty
A Brief History of Angioplasty: *Evolution of an Art*

- Incredible innovation and persistence in technical development
- Daring, aggressive, thoughtful physicians and engineers
- International network of dedicated interventional cardiologists
- Extraordinary and courageous patients