Costo efectividad de FFR, IVUS y OCT

HOSPITAL ITALIANO de Buenos Aires

Dr. Alejandro Diego Fernández
Sub Jefe Servicio de Hemodinamia y Cardiología Intervencionista

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Low Diagnostic Yield of Elective Coronary Angiography

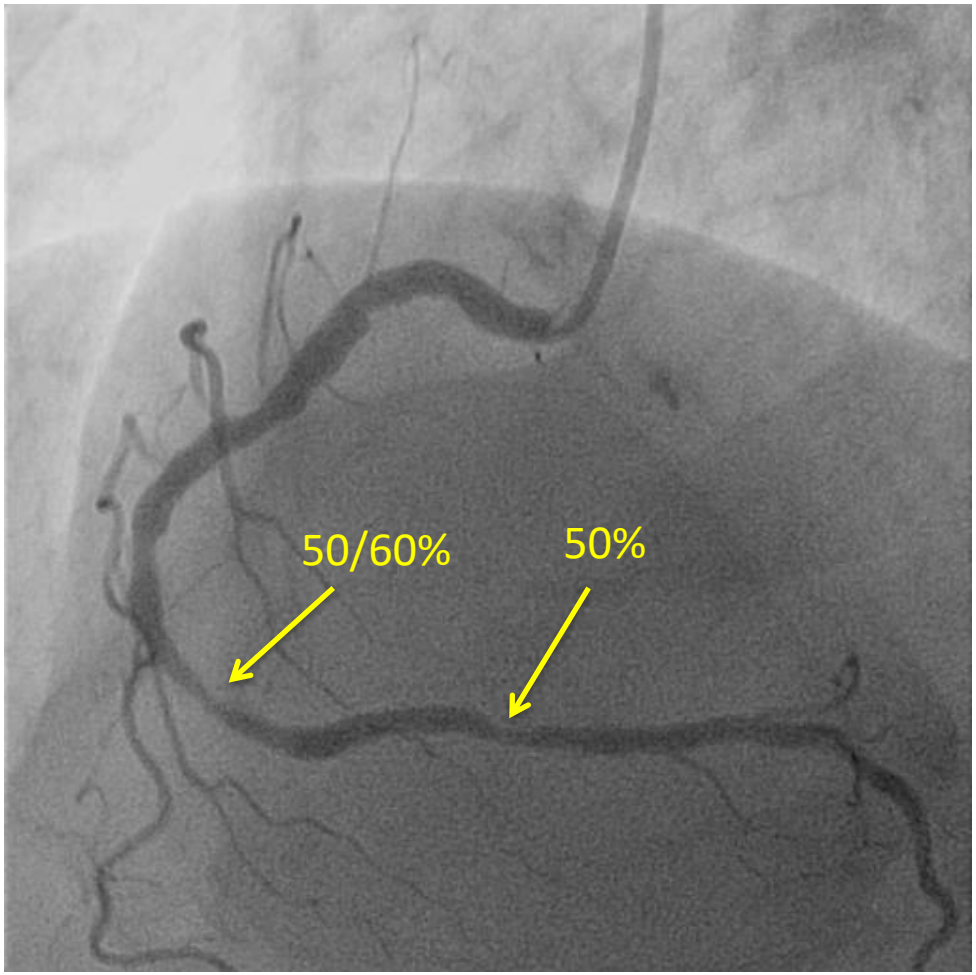
Manesh R. Patel, M.D., Eric D. Peterson, M.D., M.P.H., David Dai, M.S., J. Matthew Brennan, M.D., Rita F. Redberg, M.D., H. Vernon Anderson, M.D., Ralph G. Brindis, M.D., and Pamela S. Douglas, M.D.

398,978 pacientes

83.9% Stress Test

59.0% con Stress test POSITIVO **NO** tenían lesiones significativas

Manesh R. Patel et al. N Engl J Med 2010;362:886-96

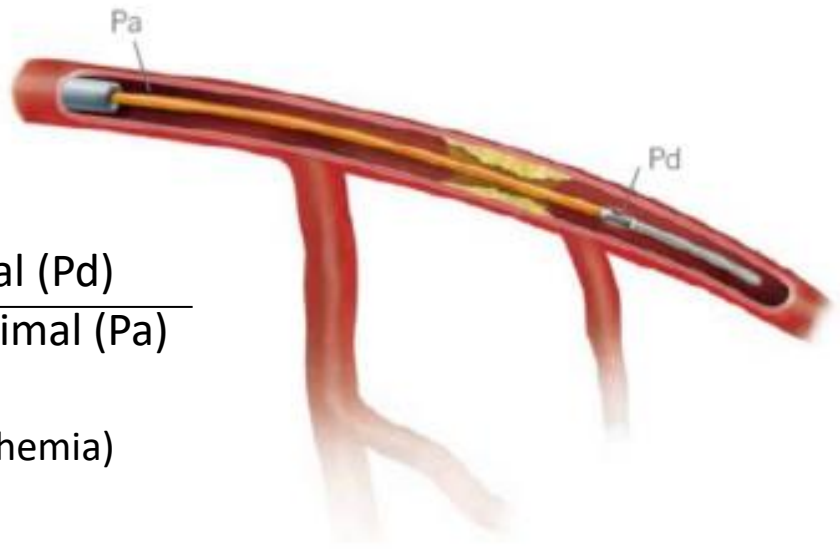

50/60%
50%

Reserva Fraccional de Flujo

FFR

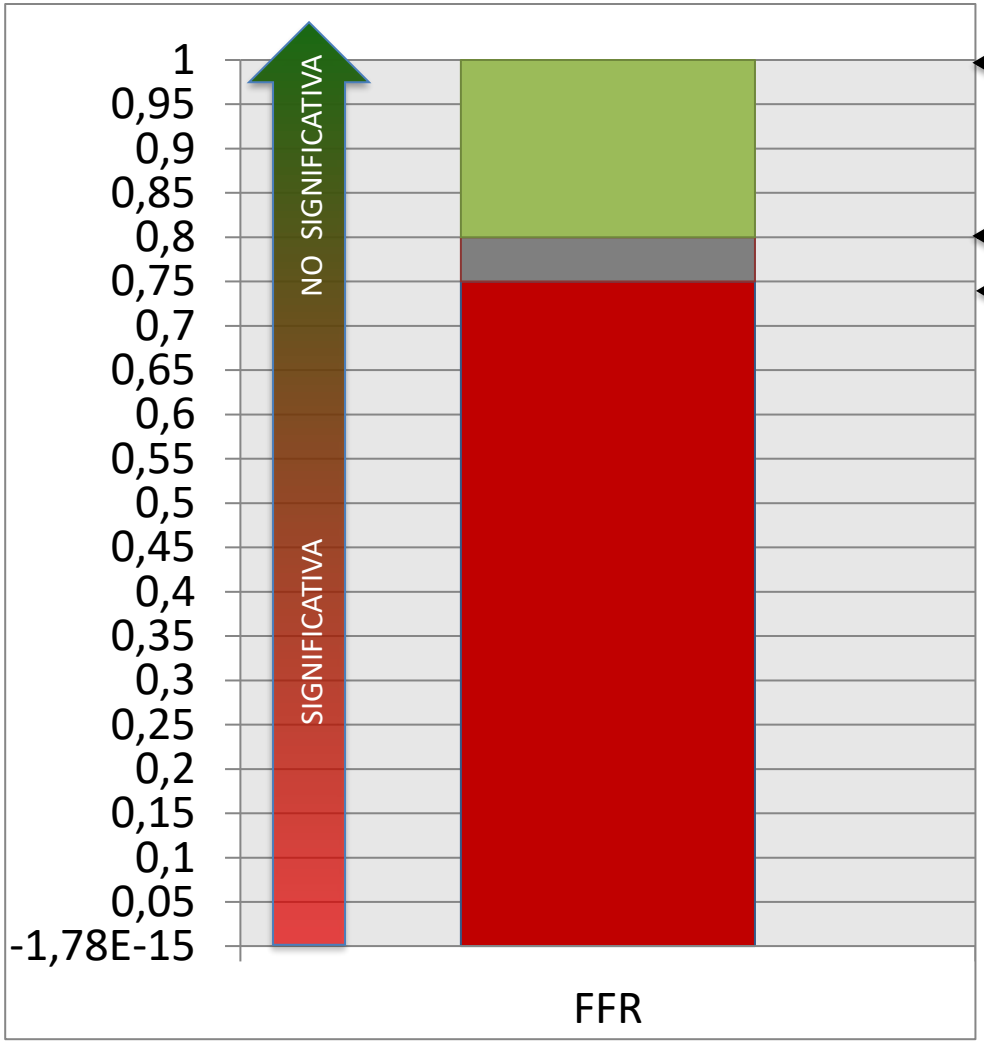
$$\textbf{FFR} = \frac{\text{Presión Coronaria Distal (Pd)}}{\text{Presión Coronaria Proximal (Pa)}}$$

(Durante Máxima Hiperhemia)

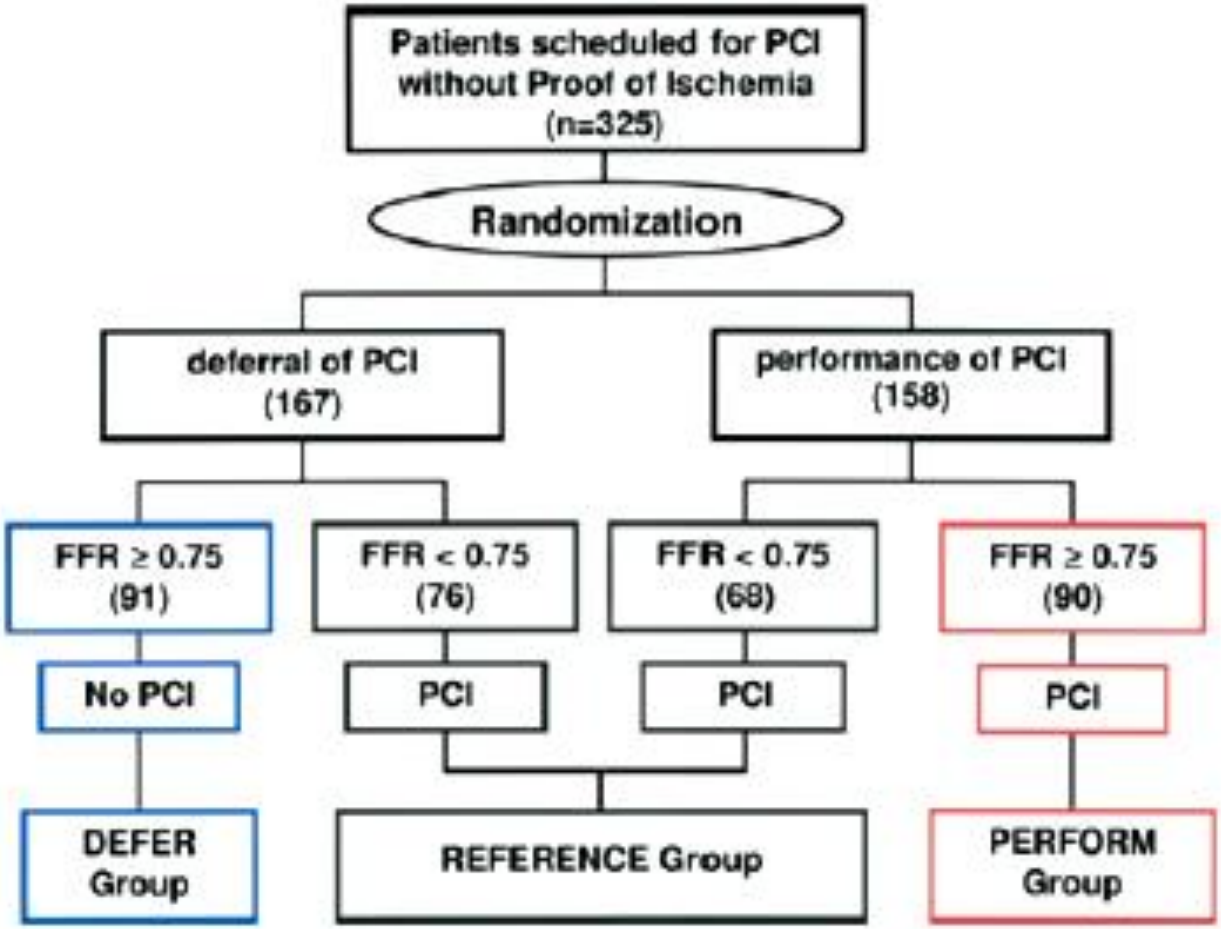


Reserva Fraccional de Flujo

FFR

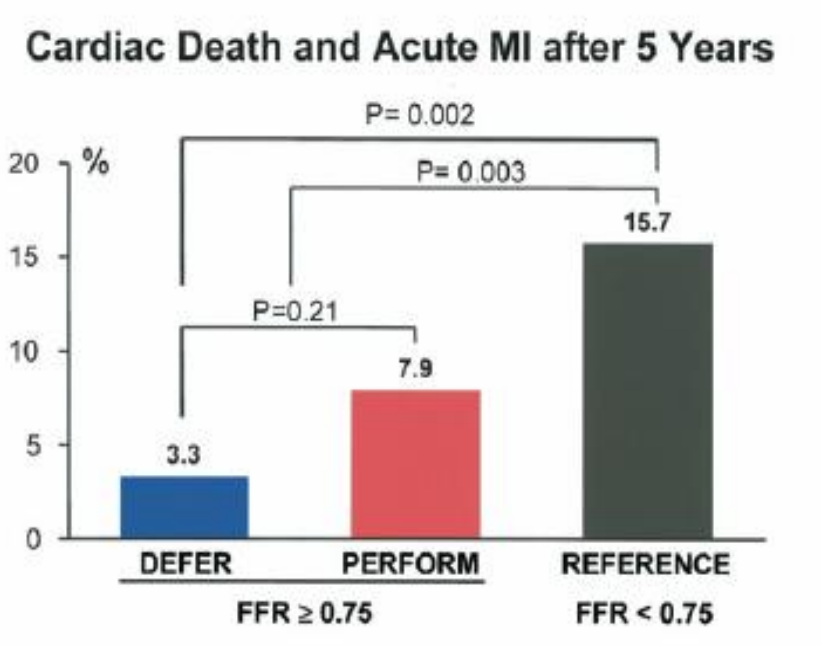


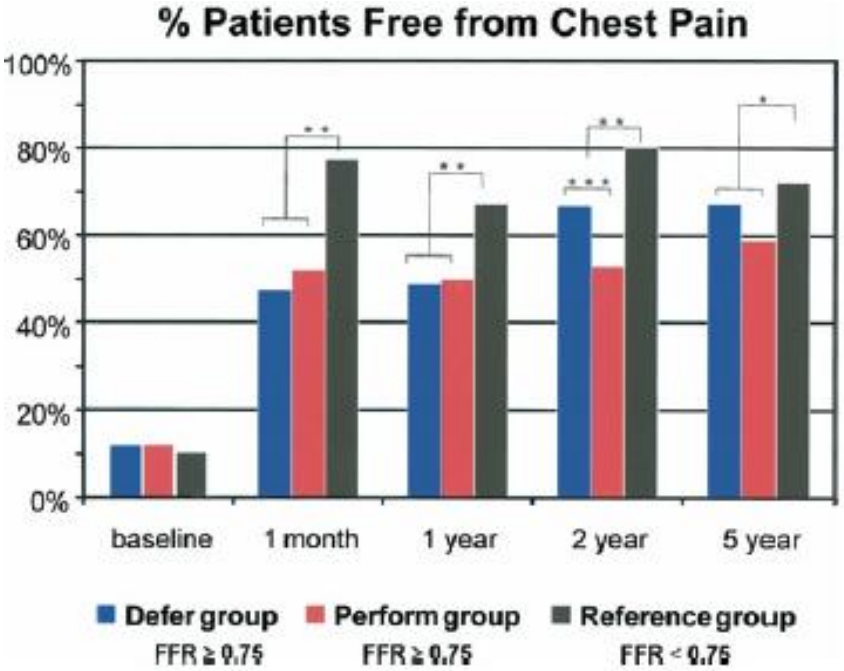
Estudio DEFER



JACC Vol. 49, No. 21, 2007 Pijls et al. 2107 May 29, 2007:2105–11

Estudio DEFER





JACC Vol. 49, No. 21, 2007 Pijls et al. 2107 May 29, 2007:2105–11

Estudio DEFER

Results 15-year follow-up

All cumulative events

	Any death	Any MI	Any revascularization
Defer	30	2	60
Perform	28	13	53
Reference	52	19	86

NS (Any death: Defer vs Perform)

* (Any MI: Defer vs Perform)

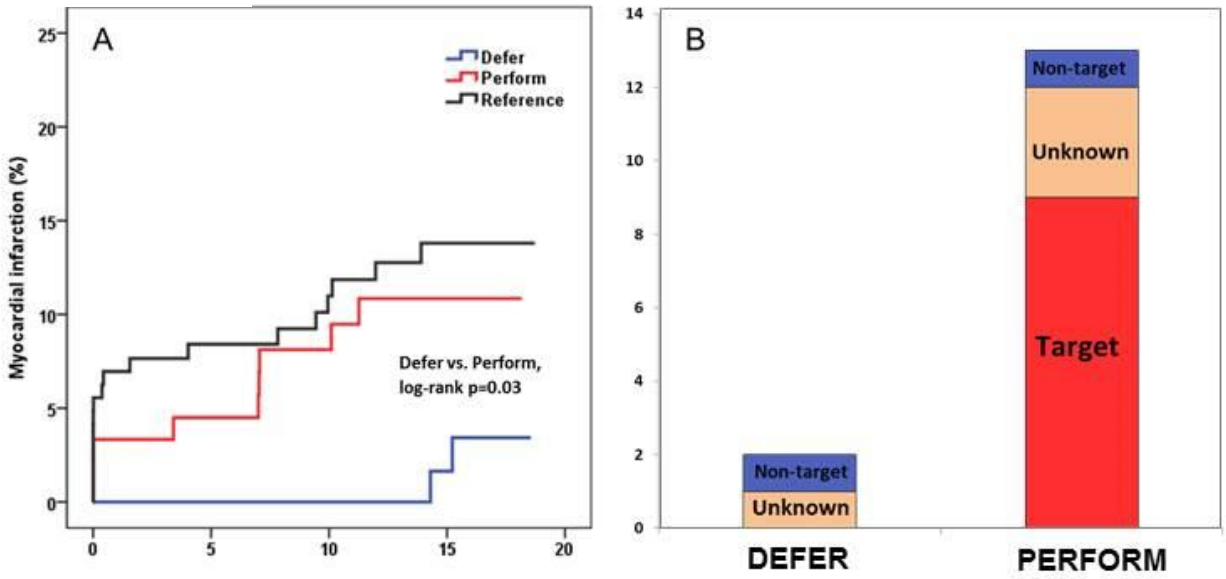
NS (Any revascularization: Defer vs Perform)

* $p < 0.02$

European Heart Journal (2015) 36, 3182–3188

Estudio DEFER

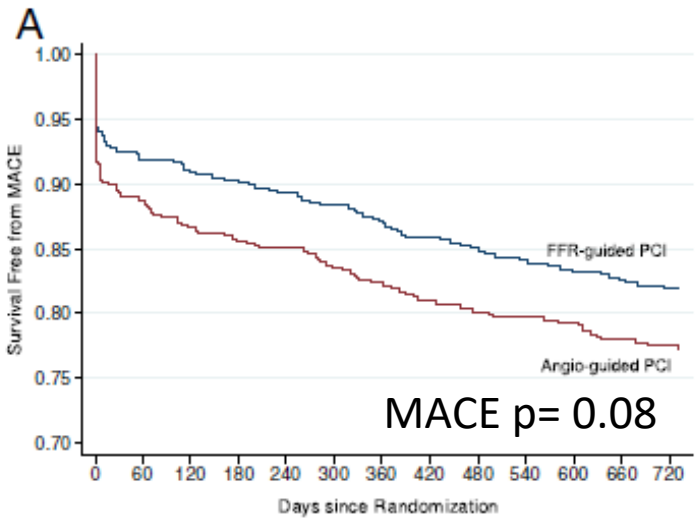
Myocardial infarction



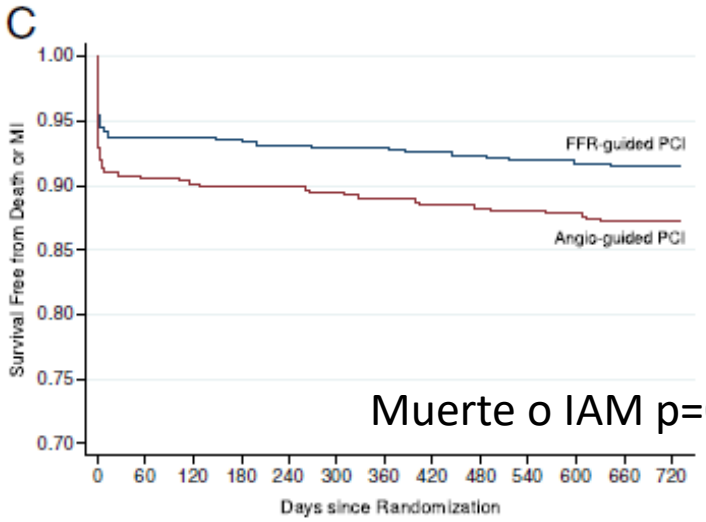
- *Significant higher infarct rate in perform group (p < 0.03)*
- *Most infarctions related to target vessel*

European Heart Journal (2015) 36, 3182–3188

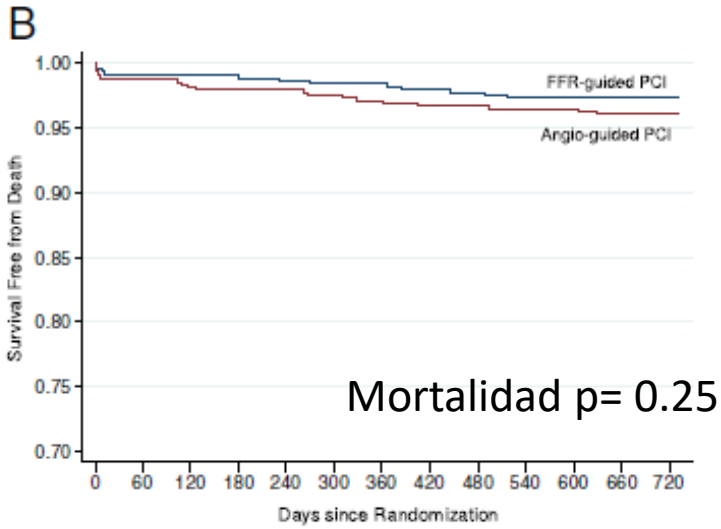
FAME



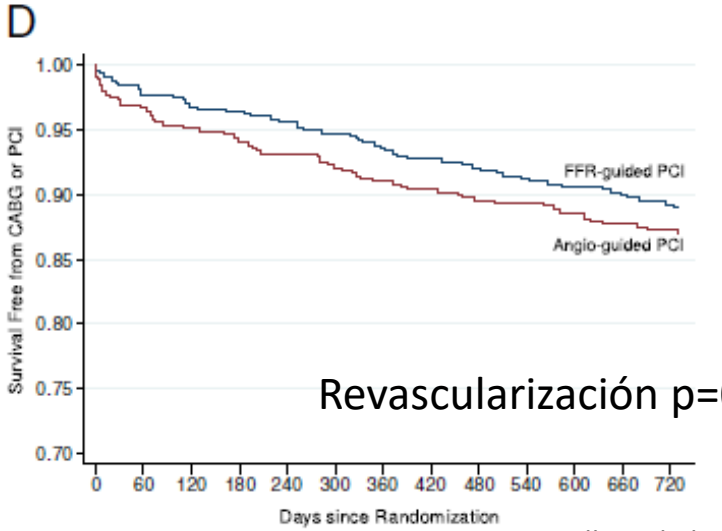
MACE p= 0.08



Muerte o IAM p=0.02



Mortalidad p= 0.25



Revascularización p=0.3

J Am Coll Cardiol. ***6 2010;55;25:2816***

Archivos de Cardiología de México

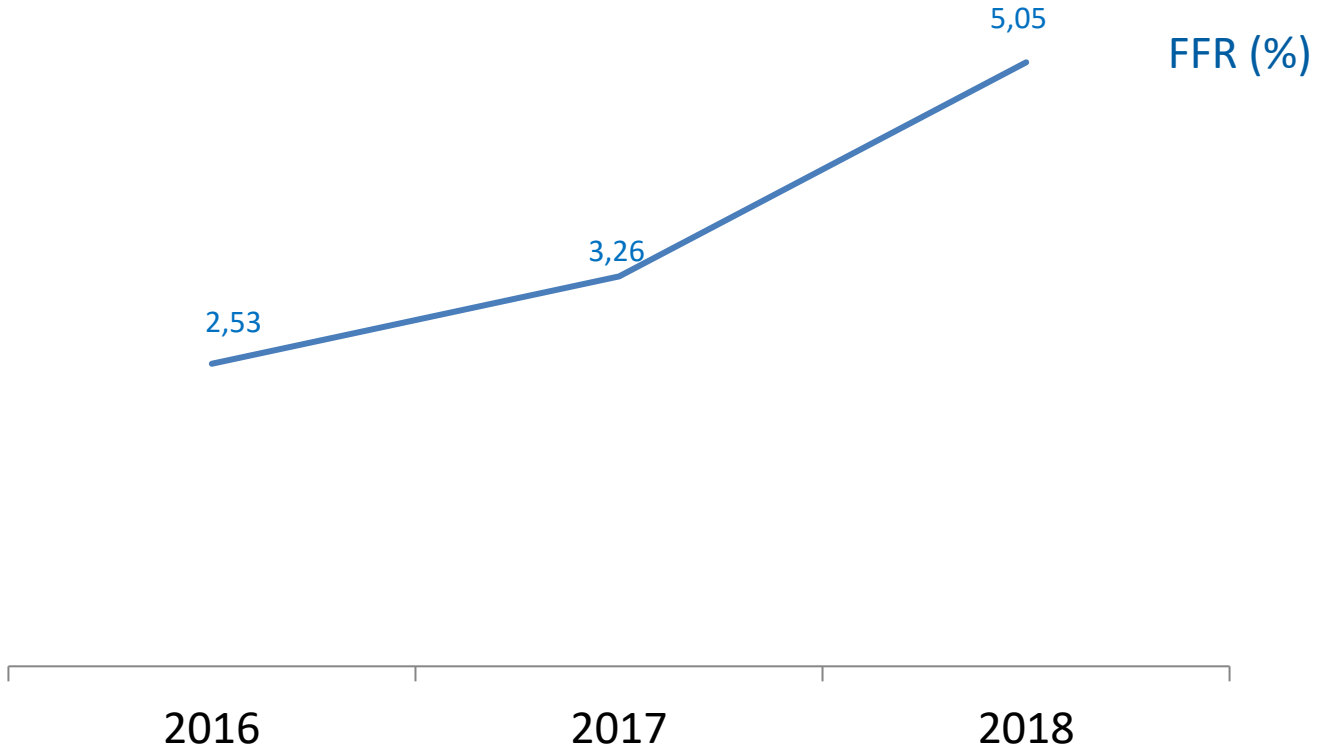
Beneficio económico en la utilización de reserva fraccional de flujo en lesiones coronarias intermedias y su impacto clínico a un año

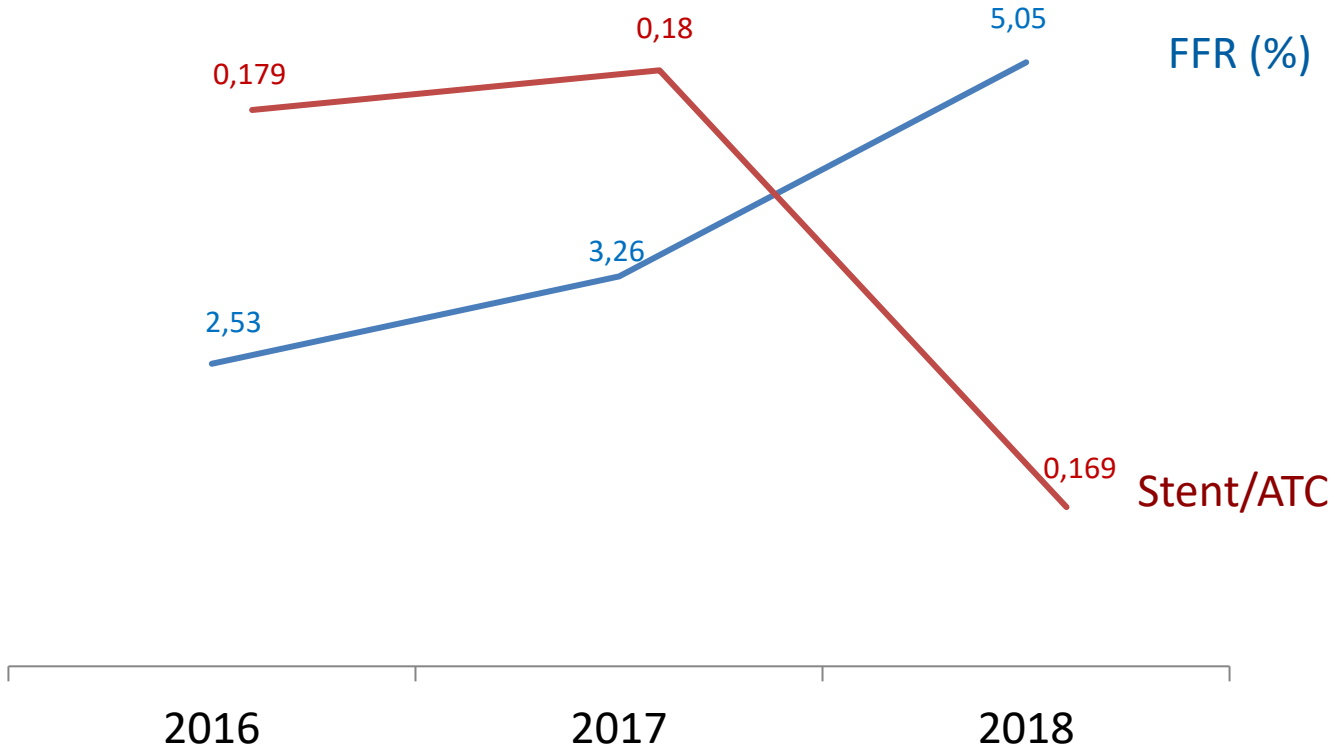
Economic benefits of fractional flow reserve utilization on intermediate lesions and its clinical impact after one year-follow up

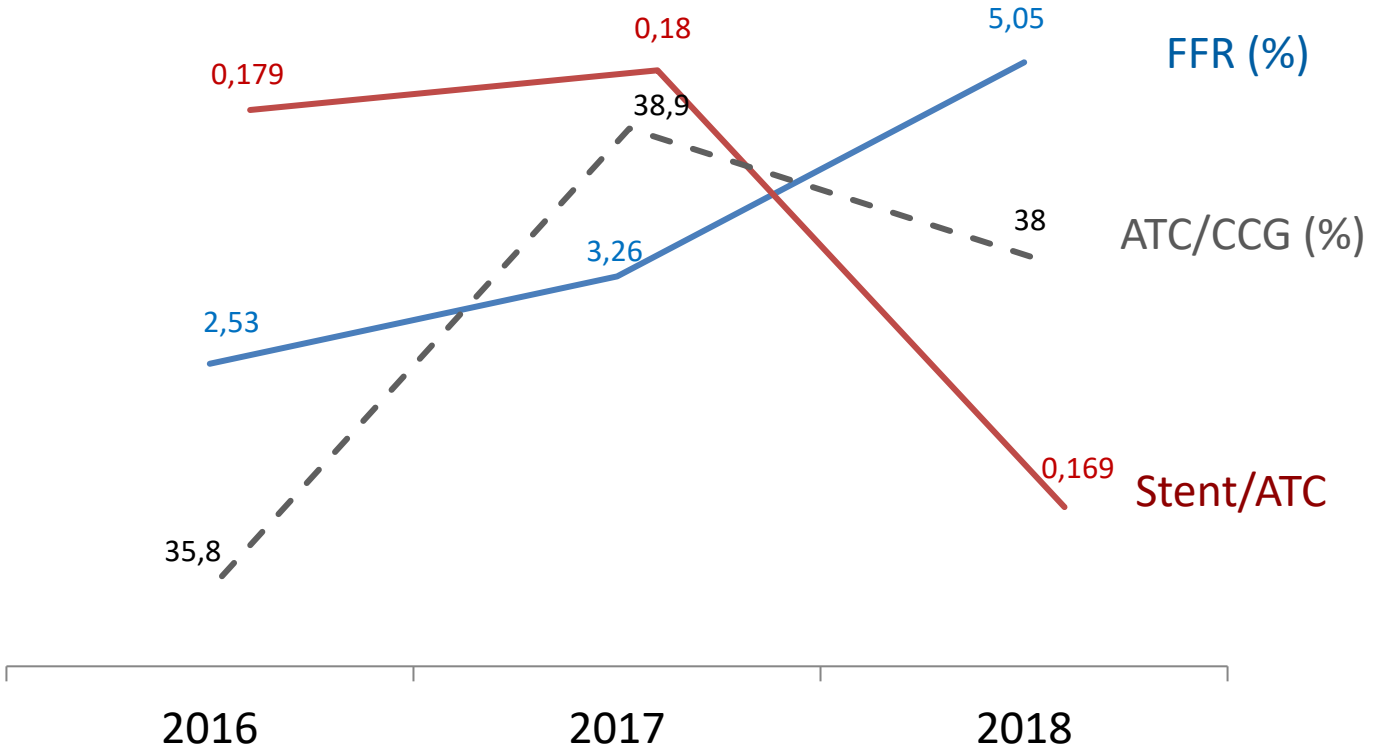
Servicio de Hemodinamia y Cardiología Intervencionista, Hospital Italiano. Buenos Aires, Argentina

Tabla 1. Características Basales	n = 100
Edad (media +-DS)	69,5(±11,1)
Sexo Masculino	56%
Factores de riesgo cardiovascular - Hipertensión - Diabetes - Dislipemia - Tabaquismo actual	 72% 26% 61% 13%
Antecedentes coronarios - Enfermedad coronaria conocida - Angioplastía previa - CRM previa	 47% 35% 6%
Otros - Cirugía cardiovascular distinta a CRM - Enfermedad vascular extracoronaria - Anticoagulación - Internado - Apremio positivo	 3% 26% 9% 61% 51% (SPECT 38% - EcoStress 4% Angio TC 5%)

Fernandez AD , et al. Arch Cardiol Mex. 2019;89(3):1-7

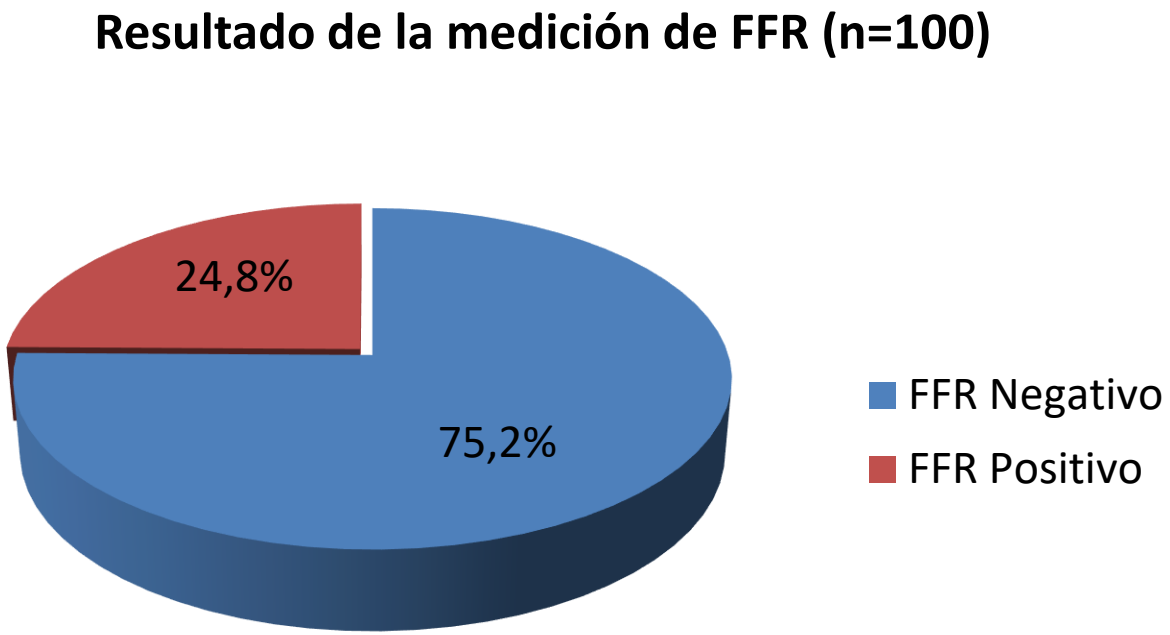

5,05
FFR (%)
3,26
2,53
2016
2017
2018


0,179
0,18
0,169
Stent/ATC
2,53
3,26
5,05
FFR (%)
2016
2017
2018


0,179
0,18
5,05
FFR (%)
38,9
38
ATC/CCG (%)
3,26
2,53
0,169
Stent/ATC
35,8
2016
2017
2018

Resultados

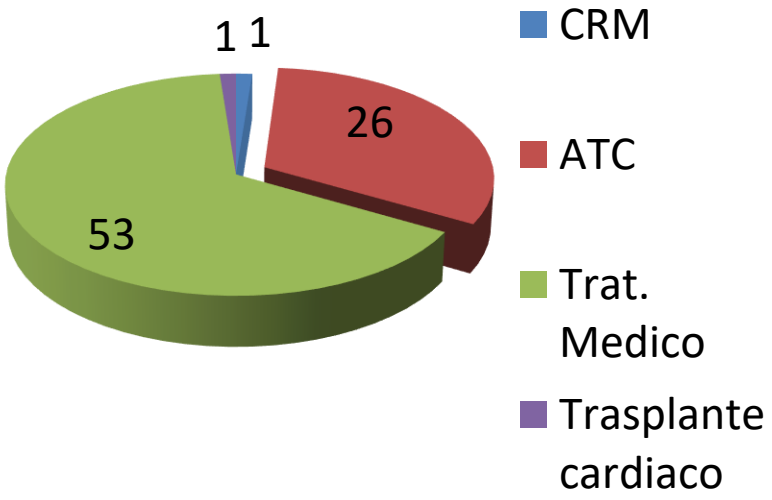
- Se analizaron 137 lesiones coronarias intermedias en 100 pacientes.
- No hubo diferencias significativas entre los grupos.



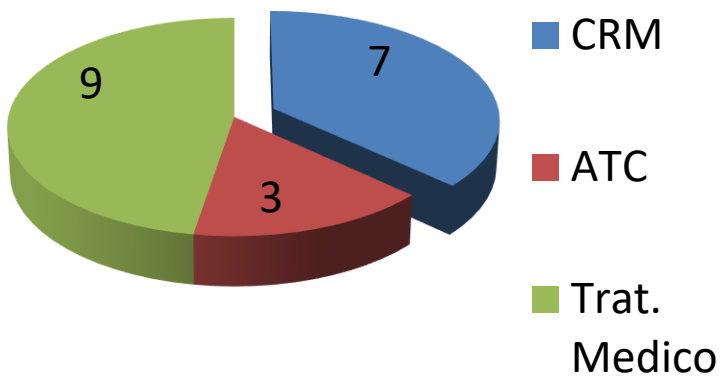
Fernandez AD , et al. Arch Cardiol Mex. 2019;89(3):1-7

Cambio en la estrategia inicial de Tratamiento

Estrategia inicial ATC (n=81)



Estrategia inicial CRM (n=19)



Fernandez AD , et al. Arch Cardiol Mex. 2019;89(3):1-7

Resultados

Costos en recursos y procedimientos

CCG	$ 23505
FFR	$ 27648,24
Angioplastía	$ 96053,98
DES	$ 44781,73
BMS	$ 16967,45
UCIC 24 hs	$ 35609,58
CRM	$ 453536,58
Anestesia	$ 56512,5

Mediante la medición de FFR en las 137 lesiones intermedias evaluadas, se realizó angioplastía en 29 pacientes. 8 pacientes presentaron indicación de CRM. El costo total de dichos procedimientos fue de **$ 15.000.101,77**

Sin la utilización de FFR (asumiendo significancia hemodinámica en todas las lesiones intermedias evaluadas) se llevarían a cabo 81 angioplastías y 19 CRM. El costo total hubiese sido **$ 30.730.982,38**

*La utilización de FFR en lesiones intermedias significó un ahorro de **52** angioplastias, **87** stents, **11** cirugías y **95** días de internación en Unidad Coronaria. La utilización de FFR generó un ahorro de **$ 15.730.880,60** lo que representó el **48,8%** del costo total.*

Fernandez AD , et al. Arch Cardiol Mex. 2019;89(3):1-7

Clinical Outcomes and Cost-Effectiveness of Fractional Flow Reserve–Guided Percutaneous Coronary Intervention in Patients With Stable Coronary Artery Disease

Three-Year Follow-Up of the FAME 2 Trial (Fractional Flow Reserve Versus Angiography for Multivessel Evaluation)

BACKGROUND: Previous studies found that percutaneous coronary intervention (PCI) does not improve outcome compared with medical therapy (MT) in patients with stable coronary artery disease, but PCI was guided by angiography alone. FAME 2 trial (Fractional Flow Reserve Versus Angiography for Multivessel Evaluation) compared PCI guided by fractional flow reserve with best MT in patients with stable coronary artery disease to assess clinical outcomes and cost-effectiveness.

METHODS: A total of 888 patients with stable single-vessel or multivessel coronary artery disease with reduced fractional flow reserve were randomly assigned to PCI plus MT (n=447) or MT alone (n=441). Major adverse cardiac events included death, myocardial infarction, and urgent revascularization. Costs were calculated on the basis of resource use and Medicare reimbursement rates. Changes in quality-adjusted life-years were assessed with utilities determined by the European Quality of Life–5 Dimensions health survey at baseline and over follow-up.

RESULTS: Major adverse cardiac events at 3 years were significantly lower in the PCI group compared with the MT group (10.1% versus 22.0%; $P<0.001$), primarily as a result of a lower rate of urgent revascularization (4.3% versus 17.2%; $P<0.001$). Death and myocardial infarction were numerically lower in the PCI group (8.3% versus 10.4%; $P=0.28$). Angina was significantly less severe in the PCI group at all follow-up points to 3 years. Mean initial costs were higher in the PCI group ($9944 versus $4440; $P<0.001$) but by 3 years were similar between the 2 groups ($16 792 versus $16 737; $P=0.94$). The incremental cost-effectiveness ratio for PCI compared with MT was $17 300 per quality-adjusted life-year at 2 years and $1600 per quality-adjusted life-year at 3 years. The above findings were robust in sensitivity analyses.

CONCLUSIONS: PCI of lesions with reduced fractional flow reserve improves long-term outcome and is economically attractive compared with MT alone in patients with stable coronary artery disease.

CLINICAL TRIAL REGISTRATION: URL: https://www.clinicaltrials.gov. Unique identifier: NCT01132495.

William F. Fearon, MD*
Takeshi Nishi, MD*
Bernard De Bruyne, MD, PhD
Derek B. Boothroyd, PhD
Emanuele Barbato, MD, PhD
Pim Tonino, MD, PhD
Peter Jüni, MD
Nico H.J. Pijls, MD, PhD
Mark A. Hlatky, MD
for the FAME 2 Trial Investigators

*Drs Fearon and Nishi contributed equally.

Correspondence to: William F. Fearon, MD, Division of Cardiovascular Medicine, Stanford Cardiovascular Institute, Stanford University School of Medicine, 300 Pasteur Dr, H2103, Stanford, CA 94305–5218. E-mail wfearon@stanford.edu

Sources of Funding, see page 486

Key Words: angiography ■ coronary artery disease ■ fractional flow reserve, myocardial ■ percutaneous coronary intervention ■ stents

Circulation. 2018;137:480–487. DOI: 10.1161/CIRCULATIONAHA.117.031907

Nam et al. Cost Eff Resour Alloc (2015) 13:19
DOI 10.1186/s12962-015-0045-9

COST EFFECTIVENESS AND RESOURCE ALLOCATION

RESEARCH Open Access

Fractional flow reserve (FFR) versus angiography in guiding management to optimise outcomes in non-ST segment elevation myocardial infarction (FAMOUS-NSTEMI) developmental trial: cost-effectiveness using a mixed trial- and model-based methods

Julian Nam[1], Andrew Briggs[1], Jamie Layland[2], Keith G. Oldroyd[3], Nick Curzen[4], Arvind Sood[5], Kanarath Balachandran[6], Raj Das[7], Shahid Junejo[8], Hany Eteiba[3], Mark C. Petrie[3], Mitchell Lindsay[3], Stuart Watkins[3], Simon Corbett[4], Brian O'Rourke[5], Anna O'Donnell[3], Andrew Stewart[9], Andrew Hannah[9], Alex McConnachie[10], Robert Henderson[11] and Colin Berry[2,3*]

Abstract

Background: In the Fractional flow reserve (FFR) versus angiography in guiding management to optimise outcomes in non-ST elevation myocardial infarction (FAMOUS) clinical trial, FFR was shown to significantly reduce coronary revascularisation, compared to visual interpretation of standard coronary angiography without FFR. We estimated the cost-effectiveness from a UK National Health Service perspective, based on the results of FAMOUS.

Methods: A mixed trial- and model-based approach using decision and statistical modelling was used. Within-trial (1-year) costs and QALYs were assembled at the individual level and then modelled on subsequent management strategy [coronary artery bypass graft (CABG), percutaneous coronary intervention (PCI) or medical therapy (MT)] and major adverse coronary events (death, MI, stroke and revascularisation). One-year resource uses included: material, hospitalisation, medical, health professional service use and events. Utilities were derived from individual EQ5D responses. Unit costs were derived from the literature. Outcomes were extended to a lifetime on the basis of MACE during the 1st year. Costs and QALYs were modelled using generalized linear models whilst MACE was modelled using logistic regression. The analysis adopted a payer perspective. Costs and outcomes were discounted at 3.5 %.

Results: Costs were related to the subsequent management strategy and MACE whilst QALYs were not. FFR led to a modest cost increase, albeit an imprecise increase, over both the trial [£112 (−£129 to £357)] and lifetime horizons [£133 (−£199 to £499)]. FFR led to a small, albeit imprecise, increase in QALYs over both the trial [0.02 (−0.03 to 0.06)] and lifetime horizons [0.03 (−0.21 to 0.28)]. The mean ICER was £7516/QALY and £4290/QALY over the trial and lifetime horizons, respectively. Decision remained high; FFR had 64 and 59 % probability of cost-effectiveness over trial and lifetime horizons, respectively.

Heart, Lung and Circulation (2014) 23, 807–810
1443-9506/04/$36.00
http://dx.doi.org/10.1016/j.hlc.2014.03.027

ORIGINAL ARTICLE

Cost Benefit for Assessment of Intermediate Coronary Stenosis with Fractional Flow Reserve in Public and Private Sectors in Australia

J.C. Murphy, MBBCh PhD [a], P.S. Hansen, MBBS FRACP PhD [b], R. Bhindi, MBBS PhD FRACP [b], G.A. Figtree, MBBS PhD FRACP [b], G.I.C. Nelson, MBBS FRACP PhD [b], M.R. Ward, MBBS(Hons) FRACP PhD [b*]

[a]Royal North Shore Hospital
[b]University of Sydney

Received 10 April 2013; received in revised form 28 November 2013; accepted 22 March 2014; online published-ahead-of-print 2 April 2014

Background Fractional Flow Reserve (FFR) is a proven technology for guiding percutaneous coronary intervention (PCI), but is not reimbursed despite the fact that it is frequently used to defer PCI.

Methods Costs incurred with use of FFR were compared in both the public and private sectors with the costs that would have been incurred if the technology was not available using consecutive cases over a two year period in a public teaching hospital and its co-located private hospital.

Results FFR was performed on 143 lesions in 120 patients. FFR was < 0.80 in 37 lesions in 34 patients and 25 underwent PCI while 11 had CABG. It was estimated that without FFR 78 lesions in 70 patients would have had PCI with 17 patients having CABG with 35 additional functional tests. Despite a cost of $A1200 per wire, FFR actually saved money. Mean savings in the public sector were $1200 per patient while in the private sector the savings were $5000 per patient.

Conclusions FFR use saves money for the Federal Government in the public sector and for the Private Health Funds in the private sector. These financial benefits are seen in addition to the improved outcomes seen with this technology.

Keywords Coronary intervention • Fractional flow reserve • Cost effectiveness • Revascularisation • Coronary artery bypass grafting

Original Article

Fractional Flow Reserve Guided Percutaneous Coronary Intervention Improves Clinical Outcome with Reduced Cost in Contemporary Clinical Practice

Po Hu[1,2], Meng-Yao Tang[2], Wen-Chao Song[2], Jun Jiang[1,2], Yong Sun[1,2], Xian-Bao Liu[1,2], Chang-Ling Li[1,2], Xin-Yang Hu[1,2], Jian-An Wang[1,2]

[1]Department of Cardiology, Second Affiliated Hospital, College of Medicine, Zhejiang University, Hangzhou, Zhejiang 310009, China
[2]Key Laboratory for Diagnosis and Treatment of Cardiovascular Disease of Zhejiang Province, Second Affiliated Hospital, School of Medicine, Zhejiang University, Hangzhou, Zhejiang 310009, China

Abstract

Background: Fractional flow reserve (FFR) is currently considered as the gold standard for evaluating the functional significance of coronary stenosis. However, its potential benefits in real-world practice remain unknown in China. This study aimed to test the hypothesis that the use of FFR is associated with improved outcome and reduced cost in Chinese real-world clinical practice.

Methods: A retrospective cohort study was carried out using the database of Second Affiliated Hospital of Zhejiang University, a tertiary and high-volume center in China. Clinical events were compared using the Cox proportional hazards model during a median follow-up of 13 months.

Results: The study cohort consisted of 366 consecutive patients referred for coronary revascularization with adjunct FFR and 366 matched controls, from 2010 to 2014. Major adverse cardiac events (MACEs) (death, myocardial infarction, repeated revascularization, or hospitalization for angina) at 4 years were found in 12.0% of angiography-guided patients and 4.9% in the FFR-guided group ($P < 0.001$). The mean number of implanted stents was significantly lower in FFR treated subjects (0.52 ± 0.82 stents) compared with the angiography-guided group (0.93 ± 0.96 stents) ($P < 0.001$). No difference in overall costs at initial hospitalization was observed between angiography-guided percutaneous coronary intervention (PCI) compared with FFR-guided PCI (RMB 33,000 Yuan, range: RMB 7393–44,700 Yuan) versus RMB 21,200 Yuan (RMB 19,100–47,100 Yuan) ($P = 0.54$). However, costs for MACEs during follow-up were significantly reduced in the FFR-guided arm ($P < 0.001$).

Conclusions: In the contemporary clinical practice, FFR-guided PCI is associated with decreased use of stents, improved clinical outcome, and reduced costs, compared with angiography-guided PCI.

Key words: Costs and Cost Analysis; Fractional Flow Reserve; Myocardial Percutaneous Coronary Intervention; Prognosis

Catheterization and Cardiovascular Interventions 00:00–00 (2014)

Original Studies

Clinical Usefulness and Cost Effectiveness of Fractional Flow Reserve Among INDian Patients (FIND Study)

G. Sengottuvelu,[1*] MD, DM, DNB, Fellowship in Interventional cardiology (France), FRCP (Glasgow), FMMC, FSCAI, FSCI, FACP, Babu Chakravarthy,[2] MD, DM, Ravindran Rajendran,[3] MD, DM, and Sreyes Ravi,[4] MBBS

Objectives: To study the clinical usefulness, cost benefit, and medium term outcome of fractional flow reserve (FFR) based management of coronary artery disease of intermediate severity. Background: In spite of the advantages of FFR there is paucity of data in Indian population who have frequent diffuse, small and multivessel disease where it would probably be more beneficial in terms of cost and outcome. Methods: The treating cardiologist's management decision with both FFR and angiographic data was compared with that of a reviewing cardiologist decision based on a retrospective analysis of angiogram alone. Results: Eighty-one vessels with intermediate lesions in 59 patients required 26 stents lesser when FFR data was added to the angiogram. The concordance of management decision was about 58% which means that >40% of intermediate lesions would be misclassified as significant based on angiography alone. There were no major events at a mean follow up of 11 ± 5 months. The net cost benefit in favor of FFR based management was INR 8,57,600 (USD 15,600) in our centre. Conclusion: Indians with more severe form of CAD benefit from a FFR based management plan for intermediate lesions, both clinically and economically.

Key words: fractional flow reserve; cost benefit; intermediate lesions; multivessel disease

Arq Bras Cardiol. 2019; 112(1):40-47

Original Article

Clinical Outcomes and Cost-Effectiveness Analysis of FFR Compared with Angiography in Multivessel Disease Patient

Edgard Freitas Quintella,[1,2] Esmeralci Ferreira,[1] Vitor Manuel Pereira Azevedo,[3,4] Denizar V. Araujo,[1] Fernando Mendes Sant`Anna,[1] Bernardo Amorim,[2] Denilson Campos de Albuquerque[1]

Hospital Universitário Pedro Ernesto - Universidade Estadual do Rio de Janeiro (UERJ),[1] Rio de Janeiro, RJ – Brazil

Instituto Estadual de Cardiologia Aloysio de Castro (IECAC),[2] Rio de Janeiro, RJ – Brazil

Cardiology Department. Hospital Clínico Universitario, INCLIVA. Universitat de València,[3] Valencia – Spain

Instituto Nacional de Cardiologia Laranjeiras (INCL),[4] Rio de Janeiro, RJ – Brazil

Abstract

Background: In multivessel disease patients with moderate stenosis, fractional flow reserve (FFR) allows the analysis of the lesions and guides treatment, and could contribute to the cost-effectiveness (CE) of non-pharmacological stents (NPS).

Objectives: To evaluate CE and clinical impact of FFR-guided versus angiography-guided angioplasty (ANGIO) in multivessel patients using NPS.

Methods: Multivessel disease patients were prospectively randomized to FFR or ANGIO groups during a 5 year-period and followed for < 12 months. Outcomes measures were major adverse cardiac events (MACE), restenosis and CE.

Results: We studied 69 patients, 47 (68.1%) men, aged 62.0 ± 9.0 years, 34 (49.2%) in FFR group and 53 (50.7%) in ANGIO group, with stable angina or acute coronary syndrome. In FFR, there were 26 patients with biarterial disease (76.5%) and 8 (23.5%) with triarterial disease, and in ANGIO, 24 (68.6%) with biarterial and 11 (31.4%) with triarterial disease. Twelve MACEs were observed – 3 deaths: 2 (5.8%) in FFR and 1 (2.8%) in ANGIO, 9 (13.0%) angina: 4(11.7%) in FFR and 5(14.2%) in ANGIO, 6 restenosis: 2(5.8%) in FFR and 4 (11.4%) in ANGIO. Angiography detected 87(53.0%) lesions in FFR, 39(23.7%) with PCI and 48(29.3%) with medical treatment; and 77 (47.0%) lesions in ANGIO, all treated with angioplasty. Thirty-nine (33.3%) stents were registered in FFR (0.45 ± 0.50 stents/lesion) and 78 (1.05 ± 0.22 stents/lesion) in ANGIO (p = 0.0001), 51.4% greater in ANGIO than FFR. CE analysis revealed a cost of BRL 5,045.97 BRL 5,430.60 in ANGIO and FFR, respectively. The difference of effectiveness was of 1.82%.

Conclusion: FFR reduced the number of lesions treated and stents, and the need for target-lesion revascularization, with a CE comparable with that of angiography. (Arq Bras Cardiol. 2019; 112(1):40-47)

Keywords: Fractional Flow Reserve, Myocardial; Cost-Benefit Analysis; Coronary Artery Disease/economics; Angioplasty, Balloon, Coronary; Stents.

Cost-Effectiveness of Intracoronary Ultrasound for Percutaneous Coronary Interventions

Christian Mueller, MD, John McB. Hodgson, MD, Christian Schindler, PhD, André P. Perruchoud, MD, Helmut Roskamm, MD, and Heinz J. Buettner, MD

The Strategy for Intravascular Ultrasound (IVUS) guided PTCA and Stenting trial included a prospectively designed economic analysis to investigate whether routine IVUS guidance intervention is cost-effective. Consecutive patients (n = 269) with 356 lesions were randomly assigned to receive provisional stenting with angiographic guidance only (ANGIO) or with IVUS guidance. The 2-year major adverse cardiac event-free survival (effectiveness) was significantly higher in the IVUS-guided group (80% vs 69%, p <0.04). In-hospital costs for procedural personnel, capital equipment, and disposable equipment were higher in the IVUS group. This was offset by lower costs for inpatient care and urgent target vessel revascularization in the IVUS group. Therefore, the total in-hospital cost was only slightly higher with IVUS (5,245 ± $2,256 [IVUS] vs 4,776 ± $2,961 [ANGIO], $/patient, p = 0.15). During a 2-year follow-up, costs for cardiac hospitalizations were slightly lower in the IVUS group, whereas costs for medication and indirect costs were similar. This resulted in identical total costs over the 2-year period (15,947 ± $8,545 [IVUS] vs 16,103 ± $9,954 [ANGIO], $/patient, p = 0.89). The incremental cost-effectiveness ratio for IVUS guidance calculated to −$1,417/major adverse cardiac event-free survival gained. In 55.3% of bootstrapping replications, IVUS was less expensive and more effective. In conclusion, when used in a provisional stenting strategy, routine IVUS imaging is cost-saving half the time.

(Am J Cardiol 2003;91:143–147)

Cost-effectiveness Analysis of Intravascular Ultrasound Guided Percutaneous Coronary Intervention versus Conventional Percutaneous Coronary Intervention

Anne L. Gaster,[1] Ulla Slothuus,[2] Jytte Larsen,[3] Per Thayssen[1] and Torben Haghfelt[1]

Endpoint	CAG guided	CAG and IVUS guided	Significance
Endpoint A: *N* (%[a])			
Restenosis, defined as QCA diameter stenosis 50% or more	13 (25)	8 (16)	NS
Endpoint B: *N* (%[b])			
Recurrence, defined as QCA diameter stenosis ≥50%, CFR <2.5 and presence of angina	10 (20)	5 (11)	$p < 0.05$
Endpoint C: *N* (%[c])			
Recurrence defined as QCA diameter stenosis >50%, FFR <0.75 and presence of angina	7 (20)	2 (5)	$p < 0.05$
TVR (target vessel revascularization) (%[a]) (%[d])	18 (35) (33)	10 (20) (19)	$p = 0.07$

Device/procedure	Amount, CAG guided group	Cost, CAG guided group *N* = 54	Amount, IVUS guided group	Cost, IVUS guided group *N* = 54
Balloons at 4096 DKK	85	348.160	86	352.256
Pre-mounted stents at 9480 DKK	62	587.760	65	616.200
IVUS catheters at 5000 DKK	–	0	54	270.000
Extra team procedure time 23 min at 333 DKK/procedure	–	0	54	17.982
Extra laboratory technician 10 min at 37 DKK/procedure	–	0	54	1.998
Extra days of hospitalization at 1374 DKK/day	37	50.838	11	15.114
Re-PTCA at 67.484 DKK/procedure	15	1012.260	7	472.388
CABG at 100.857 DKK/procedure	3	302.571	4	403.428
Total cost		2301.589		2149.366

Scand Cardiovasc J 35; 80–85, 2001