

# CORONARY: The Coronary Artery Bypass Grafting Surgery Off or On Pump Revascularization Study

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on behalf of the CORONARY Investigators

Disclosures: CORONARY was funded by a grant from the Canadian Institutes of Health Research (CIHR).

# Background

- Benefits and risks of performing CABG surgery on beating heart (off pump) not clearly established.
- Majority of prior trials had few events and short follow-up.
- Meta-analyses of 59 trials involving 8961 pts
  - reduction in early strokes with off-pump
  - no differences in other major CV outcomes.

# CORONARY Trial Organization

- 79 centers in 19 countries
- 4,752 patients recruited between (November 2006 October 2011)
- Designed, coordinated, managed and data analysed and reported by the Population Health Research Institute, Hamilton Health Sciences and McMaster University in Hamilton, Canada
- The data was monitored by independent DSMB
- Funded by Canadian Institutes of Health Research

# Study Hypotheses

- Off pump CABG compared to on-pump CABG would reduce major clinical events in short-term (30 Days)
- Benefits maintained in long-term (5 yrs)

# Inclusion/Exclusion Criteria

- **Inclusion Criteria**

- **Isolated CABG with median sternotomy**

- **One of the following:**

1. Peripheral vascular disease

2. Cerebrovascular disease

3. Renal Insufficiency

4. Age  $\geq 70$  years

5. Age 60 -69 with at least one risk factor (diabetes, urgent revascularization, smoker, LVEF  $\leq 35\%$ )

6. Age 55 -59 with at least two of the above risk factors

- **Exclusions**

- **Additional cardiac procedure planned**

- **Contraindications to off-pump or on-pump CABG**

- **Emergency or re-do CABG**

# Qualifications of Surgeons

- Surgical expertise-based randomization
  - > 2 years of experience as staff cardiac surgeon  
**and**
  - > 100 cases of one or both techniques
  - Trainees were not allowed to be primary operators

# Primary Outcomes

- **1<sup>st</sup> Co-Primary Outcome**

Composite of total mortality, stroke, non fatal myocardial infarction, new renal failure at 30 days post randomization

 **results presented today**

- **2<sup>nd</sup> Co-Primary Outcome**

Composite of above outcomes plus repeat coronary revascularization over 5 yrs of follow-up (expected 2016)

# Other Outcomes – 30 Days

- **Secondary Efficacy Outcomes**

- Components of 1st co-Primary Outcome
- Cost Effectiveness\*

- **Other Outcomes**

- Recurrent angina, blood transfusions and CV mortality
- Composite of total mortality, stroke, non fatal MI, new renal failure *at hospital discharge*
- Quality of life, neurocognitive function\*

\* Further reporting



# Statistical Power

- **1<sup>st</sup> Co-Primary Outcome**

Composite of total mortality, stroke, non fatal myocardial infarction, new renal failure at 30 days post randomization

**80% power to detect a 28% risk reduction**

- **2<sup>nd</sup> Co-Primary Outcome**

Composite of above outcomes plus repeat coronary re-revascularization over 5 yrs of follow-up (expected 2016)

**90% power to detect a 20% risk reduction**

# Data Quality and Completeness

- Follow-up at 30 Days: 100% patients
- All events adjudicated
- Data: 99.9 % clean

# Baseline Characteristics

	OFF-PUMP (n = 2375)	ON-PUMP (n = 2377)
<b>Mean Age (years)</b>	67.6	67.5
<b>Males (%)</b>	80.0	81.7
<b>Prior MI</b>	33.8	35.2
<b>Previous Stroke</b>	6.7	7.8
<b>Peripheral Arterial Disease</b>	8.0	8.2
<b>Congestive Heart Failure</b>	5.9	6.6
<b>Urgent Surgery</b>	39.5	38.1
<b>Euroscore</b>		
0 – 2	28.6	27.8
3 – 5	51.7	54.2
> 5	18.1	16.8

# Baseline Disease – Pre-op Angiogram

	OFF-PUMP (n = 2375) %	ON-PUMP (n = 2377) %
Left Main	22.1	20.9
Triple Vessel	56.1	60.4
Double Vessel	18.7	16.4
Single Vessel	3.0	2.1

# Operation Details

## 4752 Randomized (ITT Analyses)

	Off Pump	On Pump			
<b>CABG ≤ 30 days</b>	<b>2148 (90.4%)</b>	<b>2183(91.8%)</b>			
<b>Cross-overs</b>	<b>184 (7.8%)</b>	<b>150 (6.4%)</b>			
	Off Pump %	On Pump %	RR	95% CI	p value
<b>Incomplete revascularization</b>	11.8	10.0	1.18	1.00-1.39	0.05
<b>Operating room (median hrs)</b>	4.0	4.2			<0.001
<b>Initial ventilation (median hrs)</b>	9.6	11.2			<0.001

# Conduits

	OFF-PUMP (n = 2375)		ON-PUMP (n = 2377)		p-value
	n	%	n	%	
<b>CABG Completed</b>	<b>2349</b>	<b>98.9</b>	<b>2356</b>	<b>99.1</b>	
<b>Total grafts performed</b>	<b>3.0</b>		<b>3.2</b>		<b>&lt;0.001</b>
<b>CONDUIT</b>					
<b>LIMA or RIMA</b>	<b>2199</b>	<b>93.6</b>	<b>2201</b>	<b>93.4</b>	<b>0.788</b>
<b>Saphenous Vein</b>	<b>2028</b>	<b>86.3</b>	<b>2117</b>	<b>89.9</b>	<b>&lt;0.001</b>

# Peri-operative Transfusions and Bleeding

	OFF-PUMP (n = 2375) %	ON-PUMP (n = 2377) %	p value
<b>Any Blood Transfusion</b>	<b>50.7</b>	<b>63.3</b>	<b>&lt;0.001</b>
<b>Antifibrinolytics</b>	<b>26.1</b>	<b>37.0</b>	<b>&lt;0.001</b>
<b>Re-operation for bleeding</b>	<b>1.4</b>	<b>2.4</b>	<b>0.02</b>

# 1<sup>st</sup> Co-Primary Outcome (30 Days)

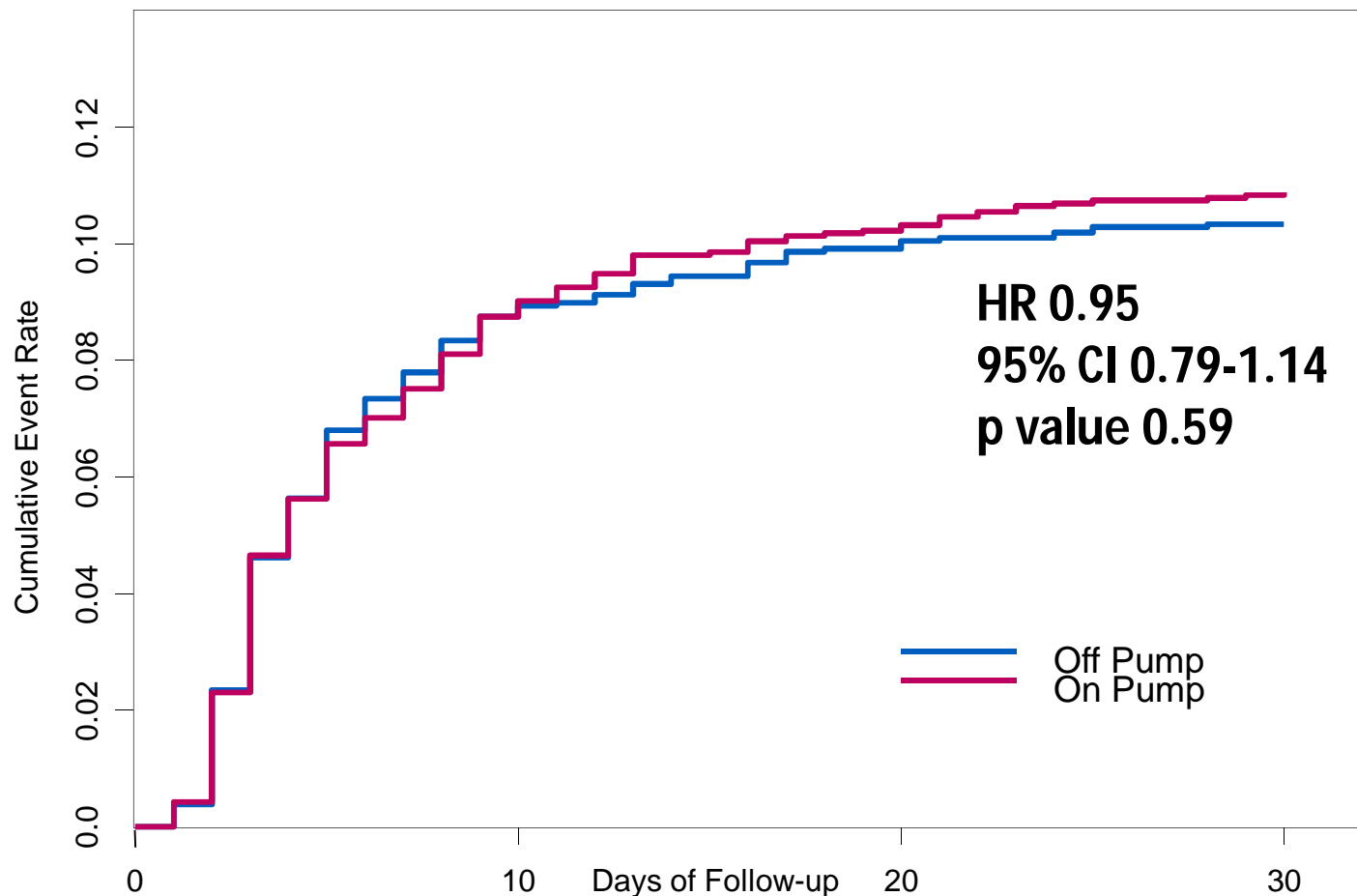
	Off Pump %	On Pump %	Hazard Ratio	95% CI	p value
<b>Primary Outcome</b> Death, Stroke, MI, Renal Failure	9.8	10.3	0.95	0.79-1.14	0.59



# 1<sup>st</sup> Co-Primary Outcome (30 Days)

	Off Pump %	On Pump %	Hazard Ratio	95% CI	p value
<b>Primary Outcome</b> Death, Stroke, MI, Renal Failure	9.8	10.3	0.95	0.79-1.14	0.59
<b>Components</b>					
Death	2.5	2.5	1.02	0.71-1.46	
Stroke	1.0	1.1	0.89	0.51-1.54	
Non Fatal MI	6.7	7.2	0.93	0.75-1.15	
New Renal Failure	1.2	1.1	1.04	0.61-1.76	

# Death/MI/Stroke/New Renal Failure at 30 Days



# at Risk

OFF	2375
ON	2377

2176
2178

2151
2146

2142
2133

# Other Outcomes at 30 days

	Off Pump %	On Pump %	Hazard Ratio	95% CI	p value
<b>Angina</b>	0.1	0.1	1.50	0.25-8.99	0.66
<b>PCI</b>	0.5	0.1	3.67	1.02-13.2	0.05
<b>Re-do CABG</b>	0.2	0.04	6.00	0.72-49.8	0.01
<b>PCI/Re-do CABG</b>	0.7	0.2	4.01	1.34-12.0	0.01
<b>All re-operations (re-do CABG)</b>	3.3	3.9	0.85	0.63-1.14	0.27
<b>All re-operations/Re-do CABG/PCI</b>	3.7	4.0	0.94	0.70-1.25	0.65

# Other Outcomes at 30 days

	Off Pump %	On Pump %	Relative Risk	95% CI	p value
<b>Respiratory Infection or failure</b>	5.9	7.5	0.79	0.63-0.98	0.03
<b>Acute Kidney Injury</b>					
AKIN Stage 1	28.0	32.1	0.87	0.80-0.96	0.01
RIFLE risk	17.0	19.6	0.87	0.76-0.98	0.02
<b>New Renal Failure requiring Dialysis</b>	1.2	1.1	1.04	0.61-1.76	0.77

Acute Kidney Injury Network (AKIN): absolute increase in serum creatinine value  $\geq 27 \mu\text{mol/L}$   
OR an increase of  $\geq 150\%$  from the baseline serum creatinine value

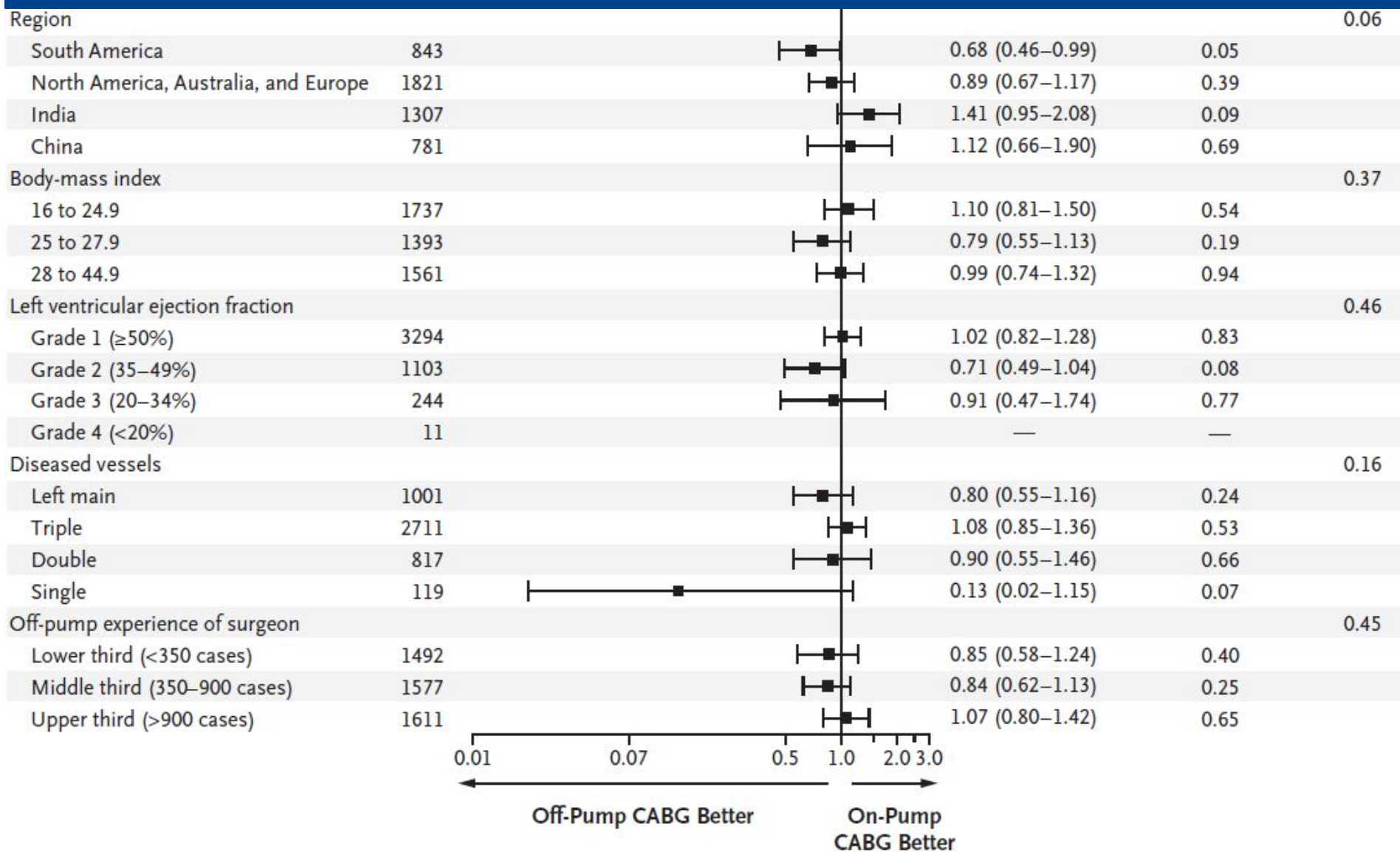
Risk, Injury, Failure, Loss and End-stage Renal Disease (RIFLE): increase of  $\geq 150\%$  from the baseline serum creatinine value

# Primary Outcome at Hospital Discharge

	Off Pump %	On Pump %	Hazard Ratio	95% CI	p value
<b>Tertiary Outcome</b> Death/MI/Stroke/Renal Failure	9.6	10.4	0.94	0.78-1.13	0.50
<b>Components</b>					
Death	2.6	2.8	0.97	0.68-1.37	
Stroke	0.9	1.0	0.94	0.52-1.69	
Non Fatal MI	6.7	7.2	0.93	0.75-1.15	
New Renal Failure	1.2	1.1	1.11	0.65-1.87	

Subgroup	No. of Patients	Hazard Ratio (95% CI)	P Value	P Value for Interaction
Age				0.46
<70 yr	2815	1.02 (0.79–1.32)	0.88	
≥70 yr	1935	0.89 (0.69–1.14)	0.37	
Sex				0.99
Male	3843	0.95 (0.77–1.16)	0.60	
Female	908	0.94 (0.65–1.36)	0.75	
Cerebrovascular disease				0.58
Yes	456	1.10 (0.66–1.83)	0.72	
No	4296	0.94 (0.77–1.14)	0.51	
Peripheral arterial disease				0.21
Yes	385	0.66 (0.36–1.21)	0.18	
No	4366	0.99 (0.82–1.19)	0.88	
Diabetes				0.08
Yes	2233	0.80 (0.61–1.04)	0.10	
No	2518	1.10 (0.86–1.41)	0.44	
Renal failure requiring dialysis				0.16
Yes	65	0.38 (0.11–1.36)	0.14	
No	4595	0.95 (0.79–1.15)	0.61	
Congestive heart failure				0.11
Yes	296	0.61 (0.34–1.09)	0.10	
No	4455	1.00 (0.83–1.21)	0.97	
EuroSCORE				0.13
0 to 2	1339	1.35 (0.92–1.99)	0.12	
3 to 5	2516	0.87 (0.68–1.11)	0.26	
>5	828	0.85 (0.58–1.25)	0.41	

# Subgroups (2)



# Conclusions

- At 30 days there was no difference in the primary outcome between Off pump CABG and On pump CABG.
- Off-pump was associated with:
  - Less transfusions and re-operation for bleeding
  - Less acute kidney injury
  - Less respiratory infections/failure
  - More early revascularizations



# Implications

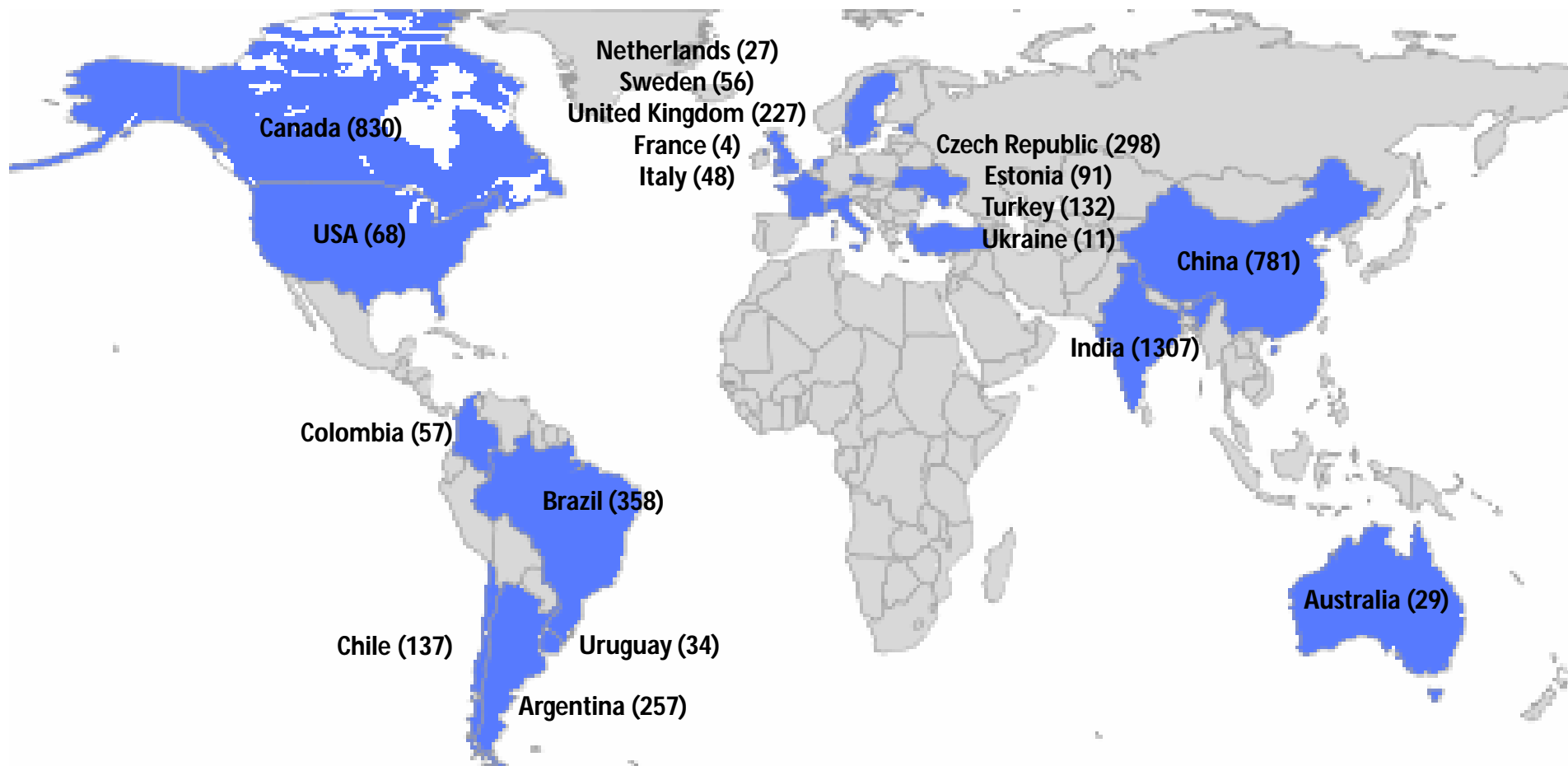
- In experienced hands, both procedures are reasonable options based on short-term results
- The difference in morbidity that was detected in the 30 days results may or may not lead to significant differences during the long-term follow-up that we are conducting

# Steering Committees

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R. Cartier	F. Lanas	Z. Straka
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# Final Recruitment by Country

*4752 patients from 79 sites in 19 countries*



ORIGINAL ARTICLE

# Off-Pump or On-Pump Coronary-Artery Bypass Grafting at 30 Days

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