



ASAN
Medical Center



UNIVERSITY OF ULSAN
COLLEGE OF MEDICINE

Surgical Techniques of CABG

김준범

2018 대한흉부심장혈관학회 전공의 연수교육

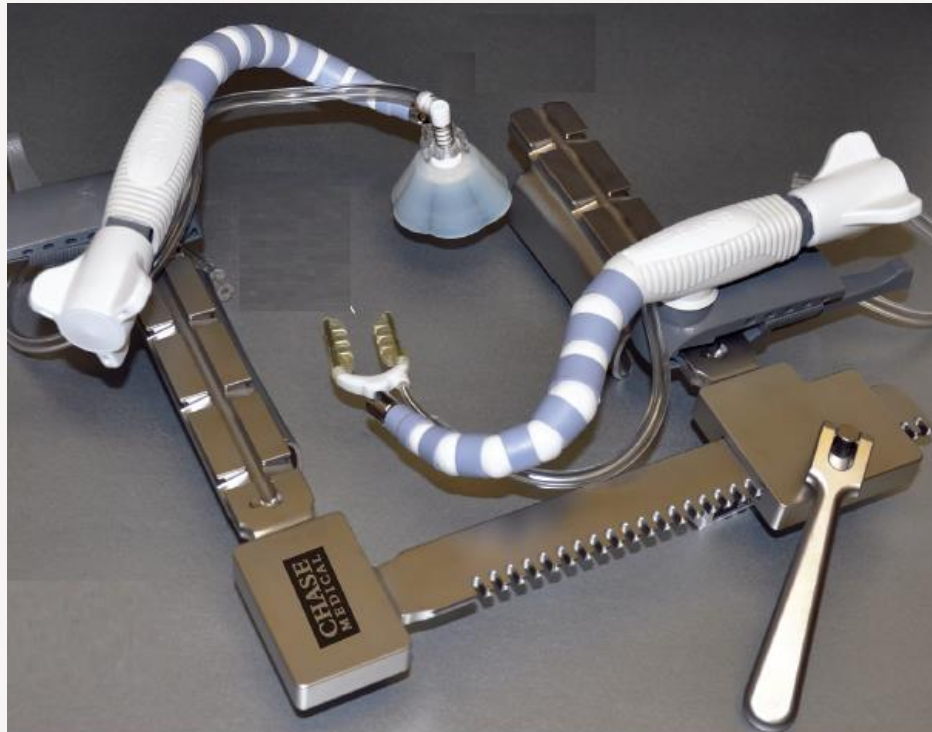
울산대학교 의과대학
서울아산병원 흉부외과학교실

Standard CABG

- **Use of CPB**
- Aortic cannulation
- Aortic clamping
- Cardioplegic arrest
- Contact of blood to the foreign materials
 - Inflammatory responses
 - Destruction of blood components



Off-Pump CABG



Cardiac stabilizing devices



Findings Summary

Findings Favoring On-Pump CABG or OPCAB

Findings favoring OPCAB

Probably less bleeding

Probably less renal dysfunction

Probably less short-term neurocognitive dysfunction, especially if aorta is calcified

Possibly shorter overall length of hospital stay

Findings favoring on-pump CABG

Less technically demanding

Shorter "learning curve"

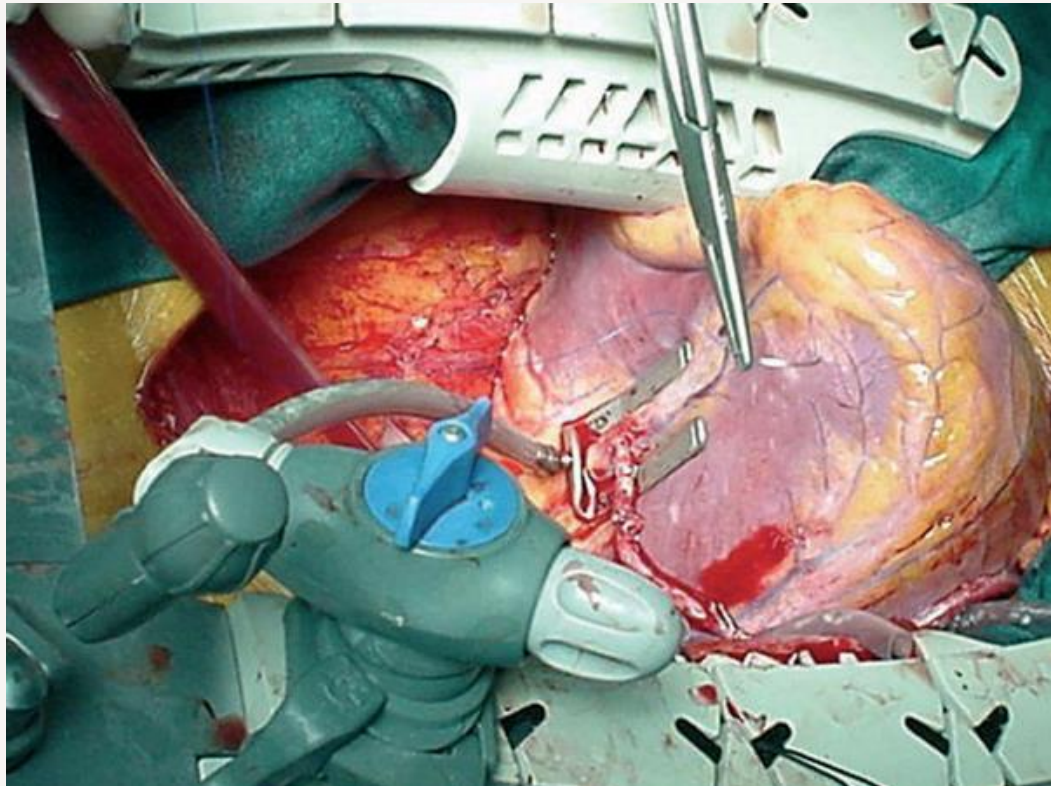
Possibly better long-term graft patency

Easier to graft posterior (circumflex) bypass targets

Probably more bypass grafts constructed

Contraindication of Off-Pump CABG

- Unstable hemodynamics during CABG
(Cardiac positioning: posterior surface)



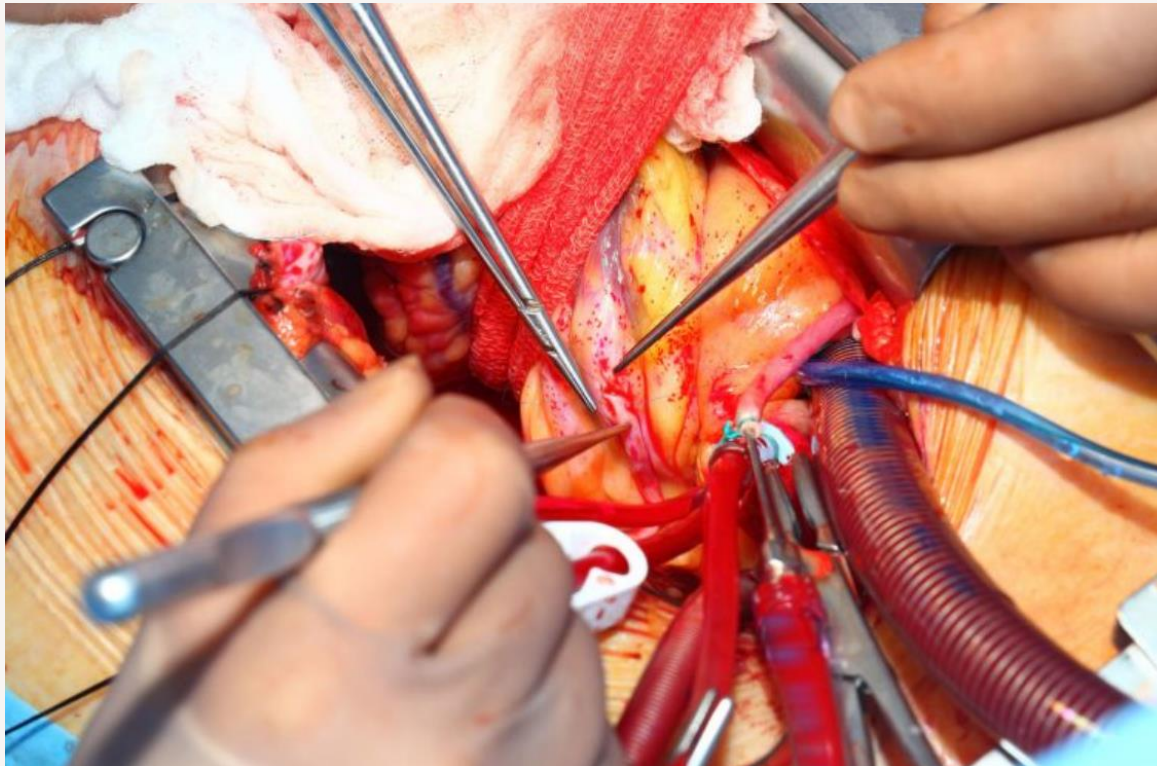
Contraindication of On-Pump CABG

- No adequate arterial cannulation site



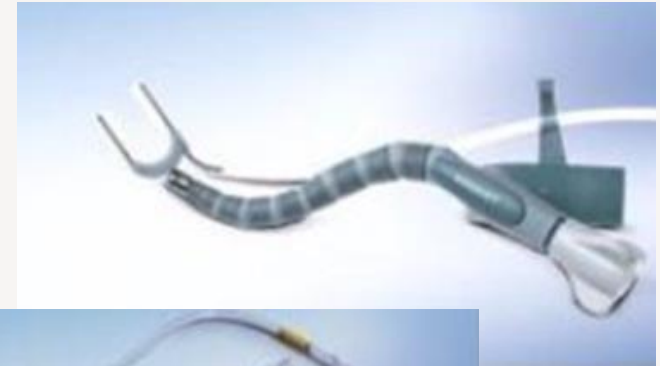
On-Pump CABG

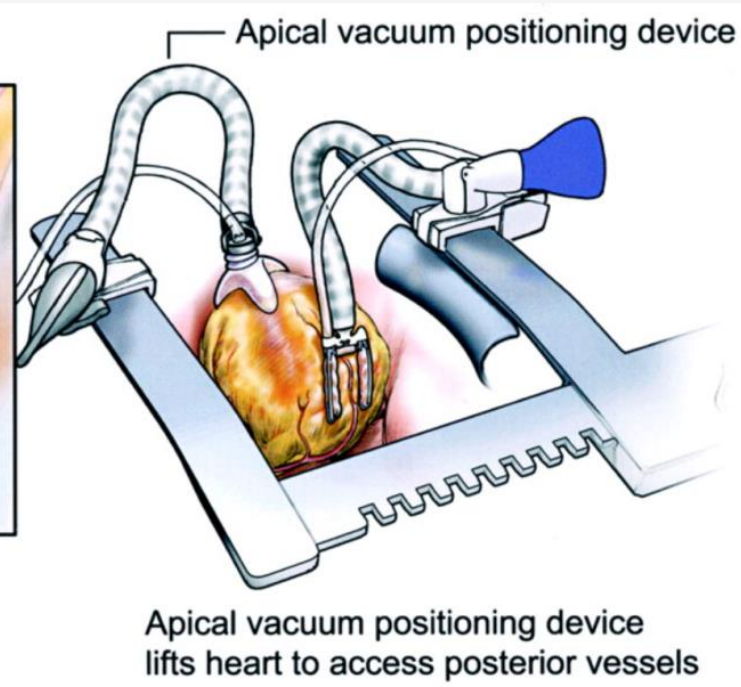
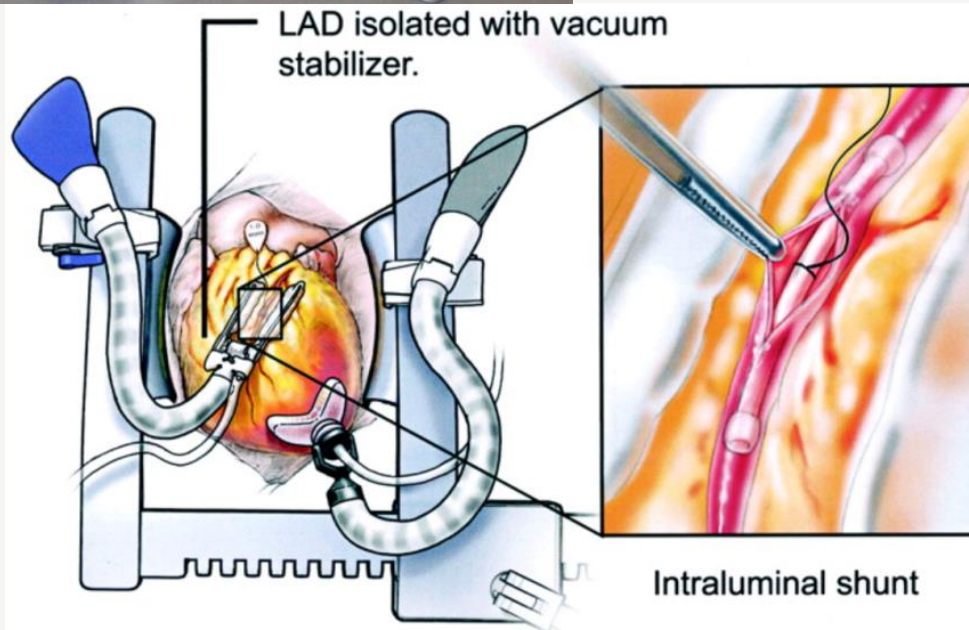
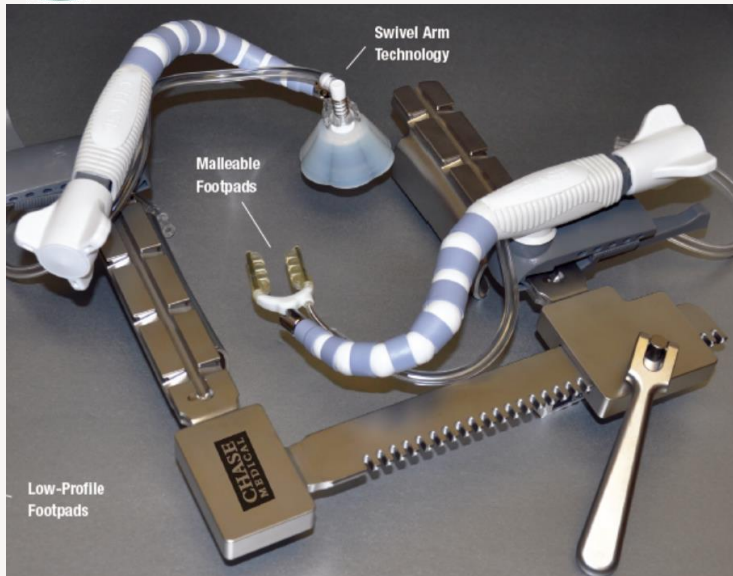
- Pump
- Gauzes or Hands



Off-Pump CABG

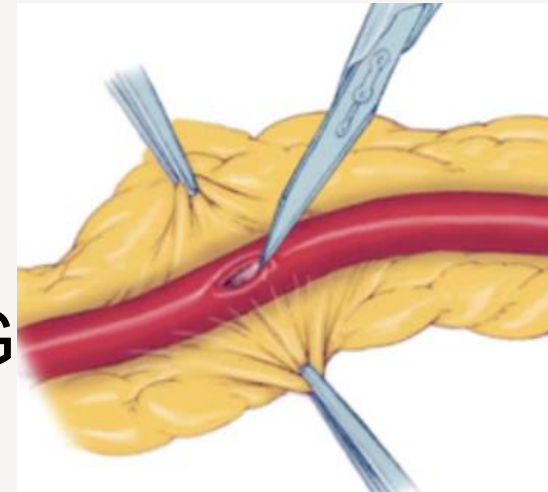
- Stabilizer
- Apical stabilizer (suction)
- CO2 blower
- Coronary shunt





On- and Off-Pump CABG

- Anastomosis order:
“LAD first” vs. “LAD last”
- Coronary atriotomy:
More caution in on-pump CABG
- Length / configuration adjustment
Easier with off-pump CABG





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On- vs. Off-Pump CABG



The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812

NOVEMBER 5, 2009

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ROOBY Trial By Residents >60%

and Dimitri Novitzky, M.D., Ph.D., for the Veterans Affairs Randomized On/Off Bypass (ROOBY) Study Group

METHODS

We randomly assigned 2203 patients scheduled for urgent or elective CABG to either on-pump or off-pump procedures. The primary short-term end point was a composite of death or complications (reoperation, new mechanical support, cardiac arrest, coma, stroke, or renal failure) before discharge or within 30 days after surgery. The primary long-term end point was a composite of death from any cause, a repeat revascularization procedure, or a nonfatal myocardial infarction within 1 year after surgery. Secondary end points included the completeness of revascularization, graft patency at 1 year, neuropsychological outcomes, and the use of major resources.



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

André Lamy, M.D., P.J. Devereaux, M.D., Ph.D., Dorairaj Prabhakaran, M.D.,
David P. Taggart, Ph.D., Shengshou Hu, M.D., Ernesto Paolasso, M.D.,

CORONARY Investigators Trial Expert surgeons only! (> 100 cases)

Toomas-Andres Sulling, M.D., Richard P. Whitlock, M.D., Yongning Ou, M.Sc.,
Jennifer Ng, M.Sc., Susan Chrolavicius, B.A., and Salim Yusuf, D.Phil.,
for the CORONARY Investigators*

BACKGROUND

The relative benefits and risks of performing coronary-artery bypass grafting (CABG) with a beating-heart technique (off-pump CABG), as compared with cardiopulmonary bypass (on-pump CABG), are not clearly established.

METHODS

At 79 centers in 19 countries, we randomly assigned 4752 patients in whom CABG was planned to undergo the procedure off-pump or on-pump. The first coprimary outcome was a composite of death, nonfatal stroke, nonfatal myocardial infarction, or new renal failure requiring dialysis at 30 days after randomization.

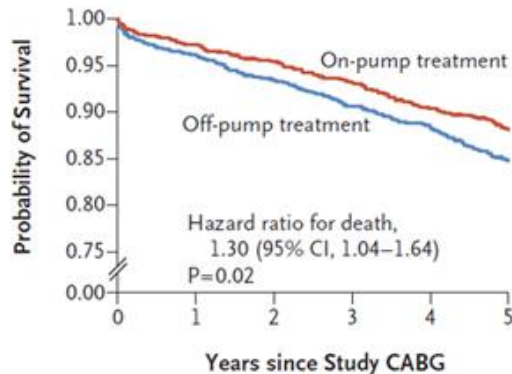
5-Year Outcomes

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Five-Year Outcomes after On-Pump and Off-Pump Coronary-Artery Bypass

A. Laurie Shroyer, Ph.D., Brack Hattler, M.D., Todd H. Wagner, Ph.D., Joseph F. Collins, Sc.D., Janet H. Baltz, R.N., Jacquelyn A. Quin, M.D., G. Hossein Almassi, M.D., Elizabeth Kozora, Ph.D., Faisal Bakaeen, M.D., Joseph C. Cleveland, Jr., M.D., Muath Bishawi, M.D., and Frederick L. Grover, M.D., for the Veterans Affairs ROOBY-FS Group*



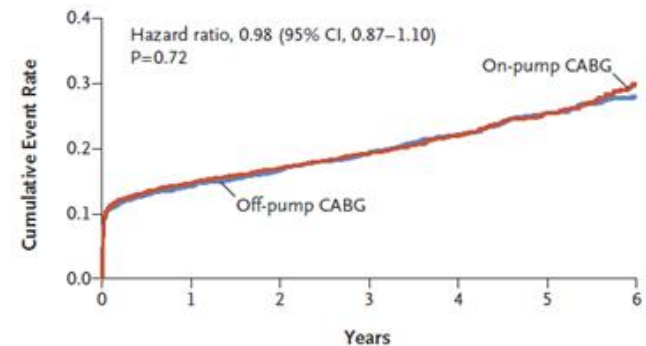
ROOBY:
On-pump better

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Five-Year Outcomes after Off-Pump or On-Pump Coronary-Artery Bypass Grafting

André Lamy, M.D., P.J. Devereaux, M.D., Ph.D., Dorairaj Prabhakaran, M.D., David P. Taggart, Ph.D., Shengshou Hu, M.D., Zbynek Straka, M.D., Leopoldo S. Piegas, M.D., Alvaro Avezum, M.D., Ahmet R. Akar, M.D., Fernando Lanus Zanetti, M.D., Anil R. Jain, M.D., Nicolas Noiseux, M.D., Chandrasekar Padmanabhan, M.D., Juan-Carlos Bahamondes, M.D., Richard J. Novick, M.D., Liang Tao, M.D., Pablo A. Olavegogeoascoechea, M.D., Balram Airan, M.D., Toomas-Andres Sulling, M.D., Richard P. Whitlock, M.D., Yongning Ou, M.Sc., Peggy Gao, M.Sc., Shirley Pettit, R.N., and Salim Yusuf, D.Phil., for the CORONARY Investigators*



CORONARY Investigator:
Comparable on- and off-pump

Big Fight at Asan Medical Center
The winner has not been determined



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Cardiac Surgery

Long-Term Survival Following Coronary Artery Bypass Grafting

Off-Pump Versus On-Pump Strategies



Joon Bum Kim, MD, PhD,* Sung-Cheol Yun, PhD,† Jae Wong Lim, MD,* Soo Kyung Hwang, MD,*
Sung-Ho Jung, MD,* Hyun Song, MD, PhD,‡ Cheol Hyun Chung, MD, PhD,*
Jae Won Lee, MD, PhD,* Suk Jung Choo, MD, PhD*

Seoul, South Korea

Objectives

This study sought to compare long-term survival after off- and on-pump coronary artery bypass grafting (CABG).

Background

Although several large-scale clinical trials have compared the surgical outcomes between off- and on-pump CABG, the long-term survival has not been compared between the 2 surgical strategies in a reasonably sized cohort.

Methods

We evaluated long-term survival data in 5,203 patients (age 62.9 ± 9.1 years, 1,340 females) who underwent elective isolated CABG (off-pump: $n = 2,333$; on-pump: $n = 2,870$) from 1989 through 2012. Vital statuses were validated using the Korean National Registry of Vital Statistics. Long-term survival was compared with the use of propensity scores and inverse probability weighting to adjust selection bias.

Results

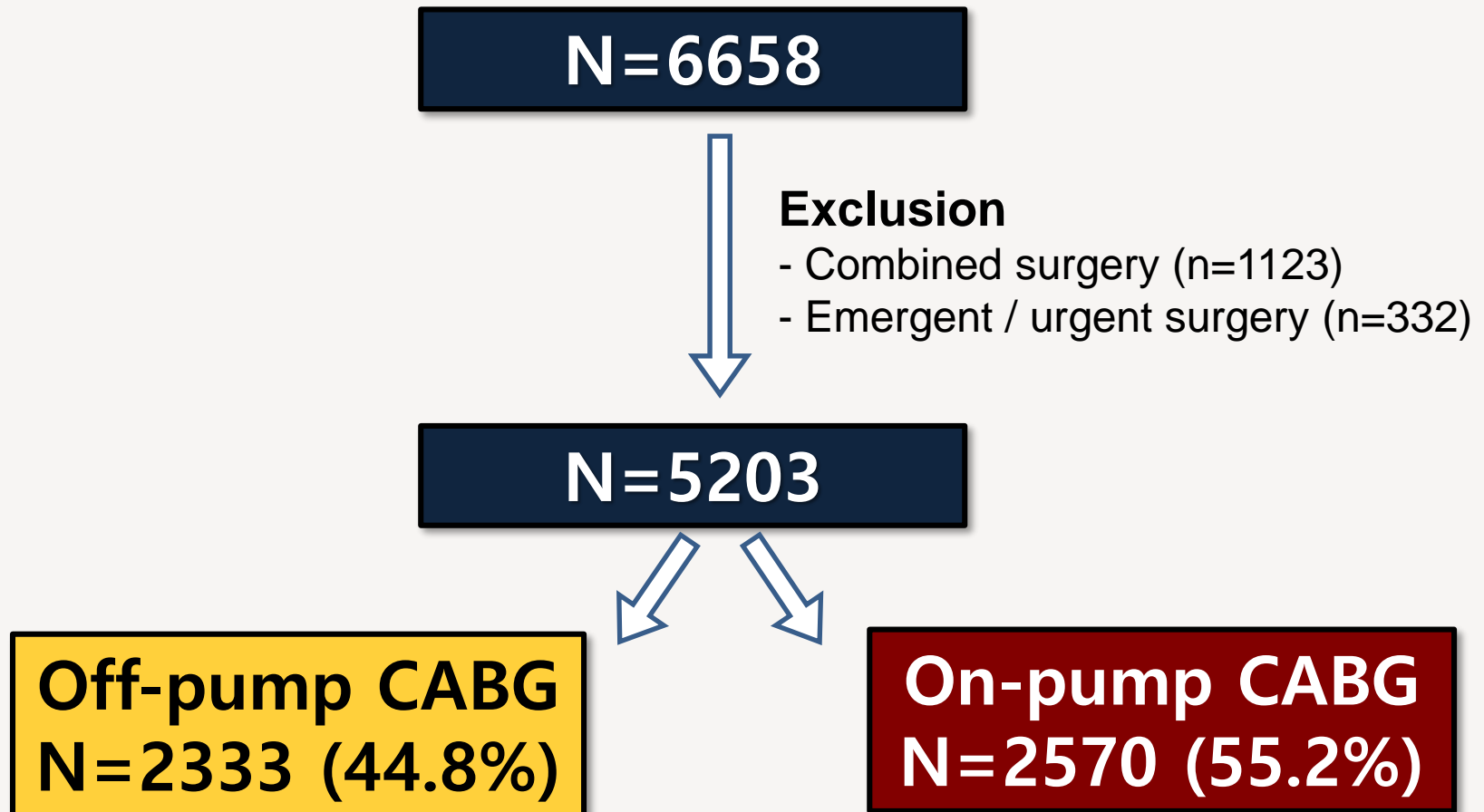
Patients undergoing on-pump CABG had a higher number of distal anastomoses than those undergoing off-pump CABG (3.7 ± 1.2 vs. 3.0 ± 1.1 ; $p < 0.001$). Survival data were complete in 5,167 patients (99.3%), with a median follow-up duration of 6.4 years (interquartile range: 3.7 to 10.5 years; maximum 23.1 years). During follow-up, 1,181 patients (22.7%) died. After adjustment, both groups of patients showed a similar risk of death at 30 days (odds ratio: 0.70; 95% confidence interval [CI]: 0.35 to 1.40; $p = 0.31$) and up to 1 year (hazard ratio [HR]: 1.11; 95% CI: 0.74 to 1.65; $p = 0.62$). For overall mortality, however, patients undergoing off-pump CABG were at a significantly higher risk of death (HR: 1.43; 95% CI: 1.19 to 1.71; $p < 0.0001$) compared with those undergoing on-pump CABG. In subgroup analyses, on-pump CABG conferred survival benefits in most demographic, clinical, and anatomic subgroups compared with off-pump CABG.

Conclusions

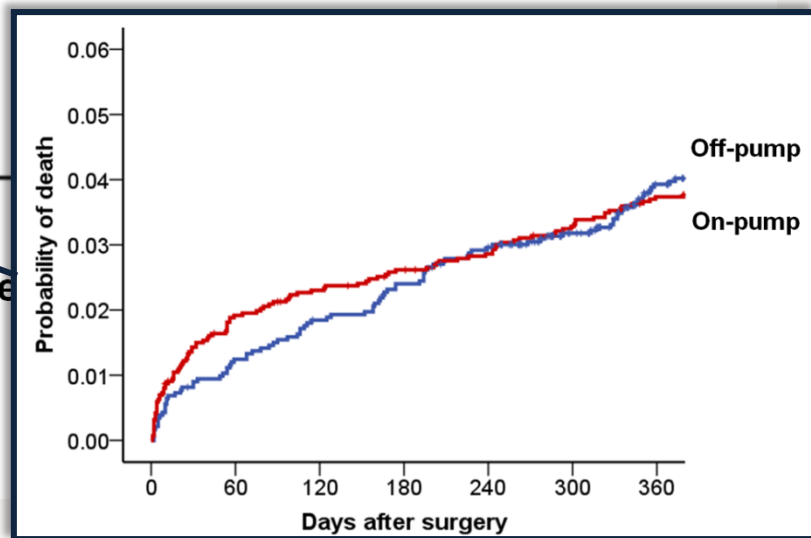
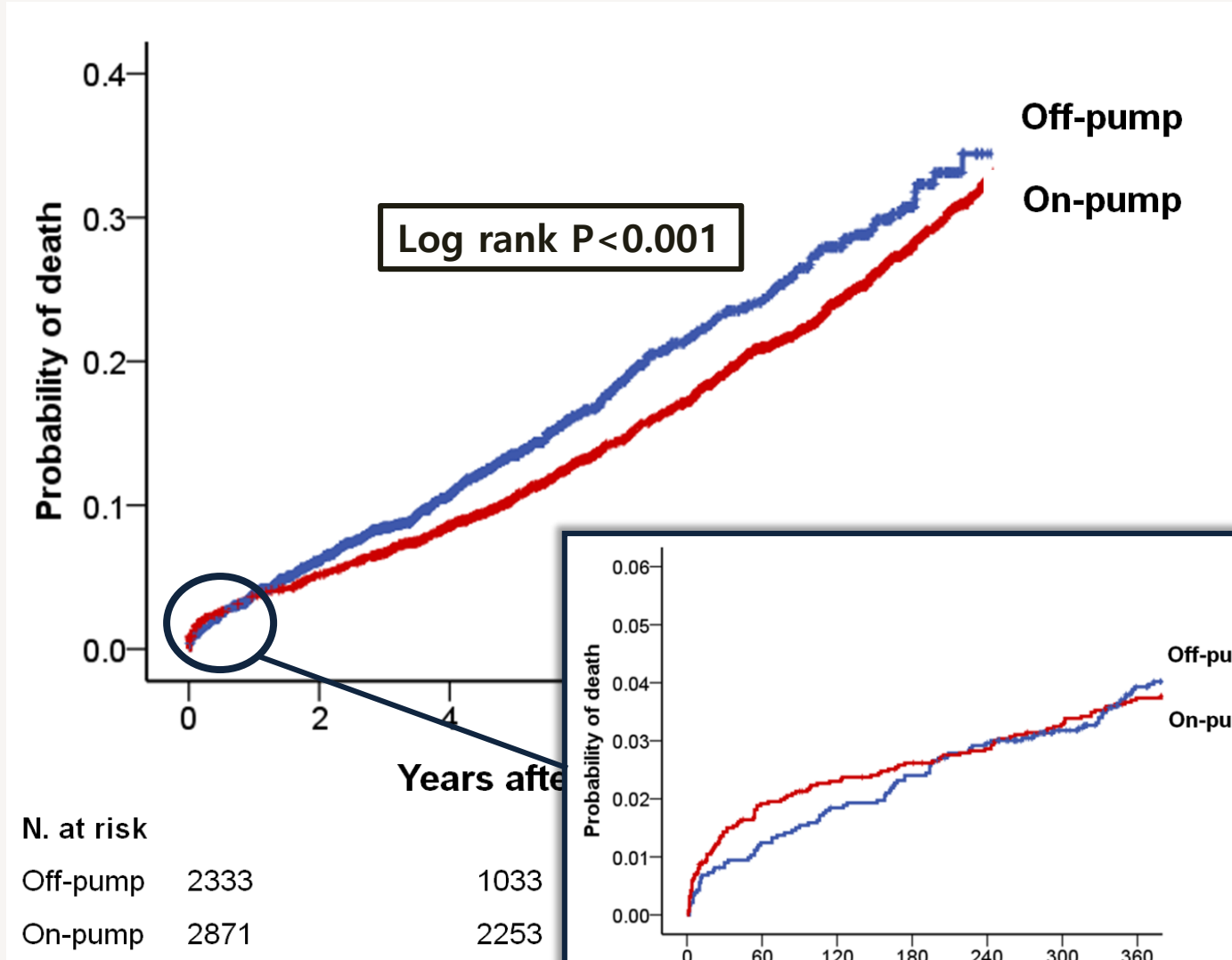
In patients undergoing elective isolated CABG, on-pump strategy conferred a long-term survival advantage compared with off-pump strategy. (J Am Coll Cardiol 2014;63:2280–8) © 2014 by the American College of Cardiology Foundation

Methods

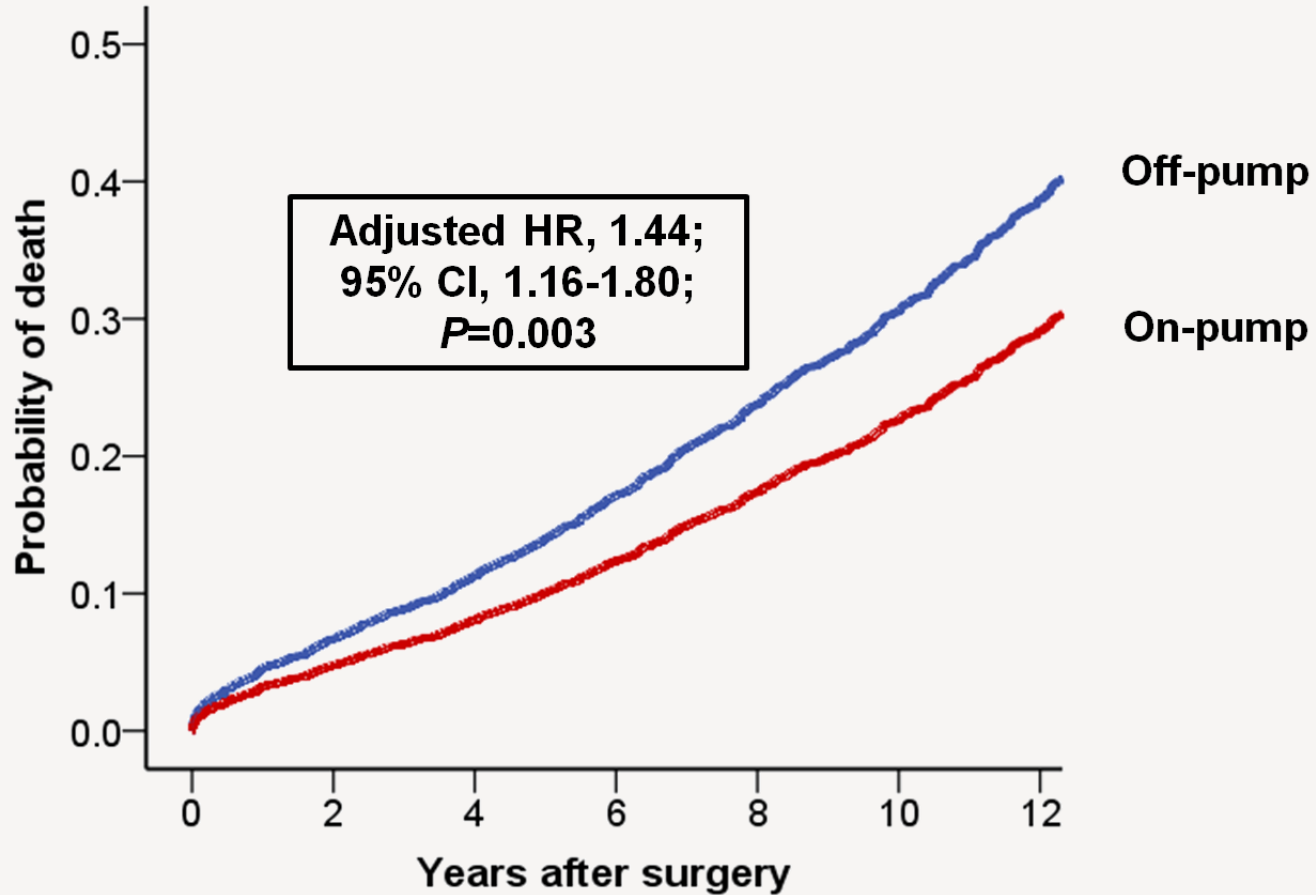
**CABG between April 1989 and April 2012
at the Asan Medical Center, Seoul, Korea,**



Unadjusted Death Rates



Adjusted Mortality (IPTW)



N. at risk

Off-pump	2333	1033	258
On-pump	2871	2253	1230

Korea Nationwide Results

- South Korea:



- Strong enthusiasm for off-pump CABG (>50%)
- Universal nationwide claims database of the National Health Insurance Service (mandatory for all residents)
- Detailed data on baseline, procedural and follow-up parameters are available. (100% complete)

- Sound environment to allow analyses on comparative effectiveness between the on- and off-pump CABG reflecting real-world practices.



28,650 patients
Aged 18 years or older receiving CABG
between Jan 2004 and Dec 2013

4,822 Excluded
96 Revascularization within 2 years before
4,649 Acute myocardial infarction at index day
77 Unstable hemodynamics

23,828 patients

12,639 Off-pump

11,189 On-pump

PS matching

6,483 Off-pump

6,483 Off-pump

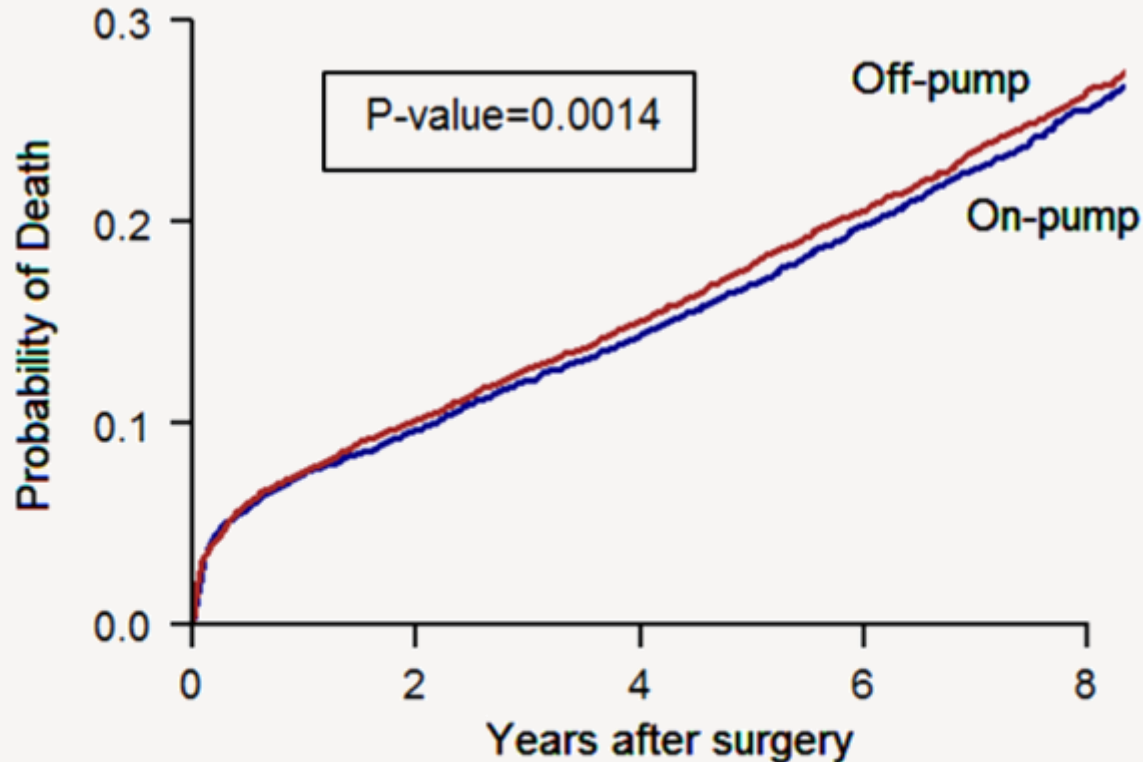


Worldwide Trends

15%~20% of CABG are performed using the
“Off-Pump Technique”

*The STS 2009 Report.
Adult Cardiac Database Executive Summary*

Adjusted Death in PS Matched Cohort

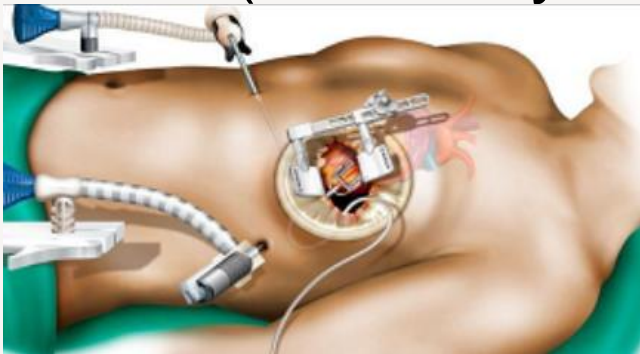


N. at risk

Off-pump	6483	5366	4160	2886	1565
On-pump	6483	5362	4150	2806	1589

Other Techniques

- **On-pump beating CABG**
- **MIDCAB** (Minimally-Invasive Direct CABG)



- **TECAB** (Totally Endoscopic CABG)

