A photograph of a modern hospital atrium. The space is multi-storied with glass railings on the upper levels. A prominent feature is a large, cylindrical central pillar. The walls are light-colored with several windows, some of which have large white circular decorations. The lighting is bright and even. The overall atmosphere is clean and professional.

Cardiac Anaesthesia for Off-Pump Coronary Artery Bypass Grafting March 2021

Dr Elizabeth M C Ashley
Assistant in Cardiothoracic Anaesthesia
And Intensive Care

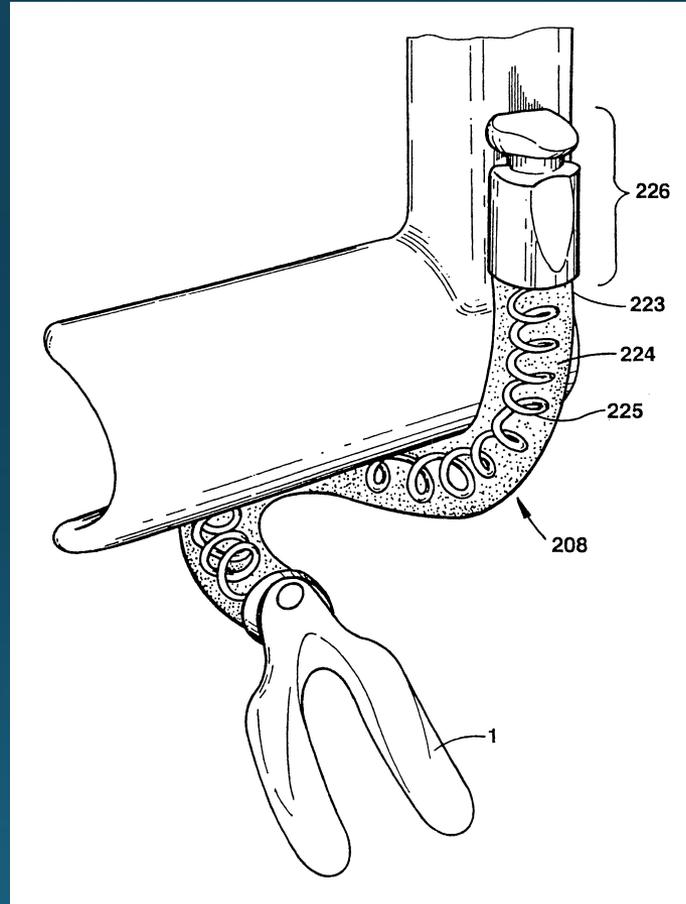
Introduction

- Cardiopulmonary bypass is associated with complications
- Beating Heart coronary artery surgery avoids bypass, but presents its own challenges
- Approx 20% CABG OPCAB

Off-Pump Technology

- Sponge beneath heart
- 4 Pericardial Sutures – Lima Sutures (Brazil)
- Single pericardial suture
- Bristol fork-like compression device
- Suction stabilisers

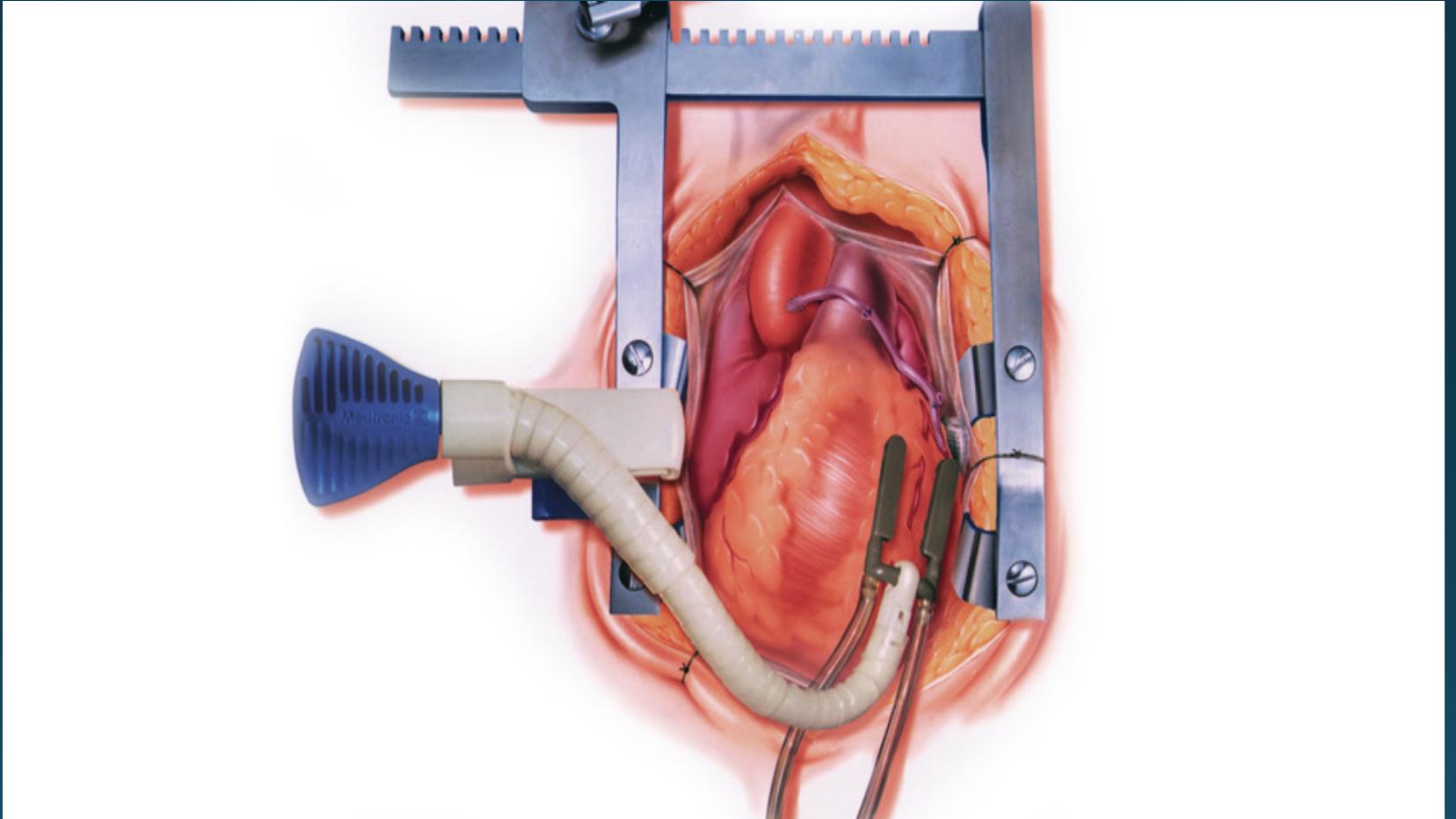
Angelini Retractor



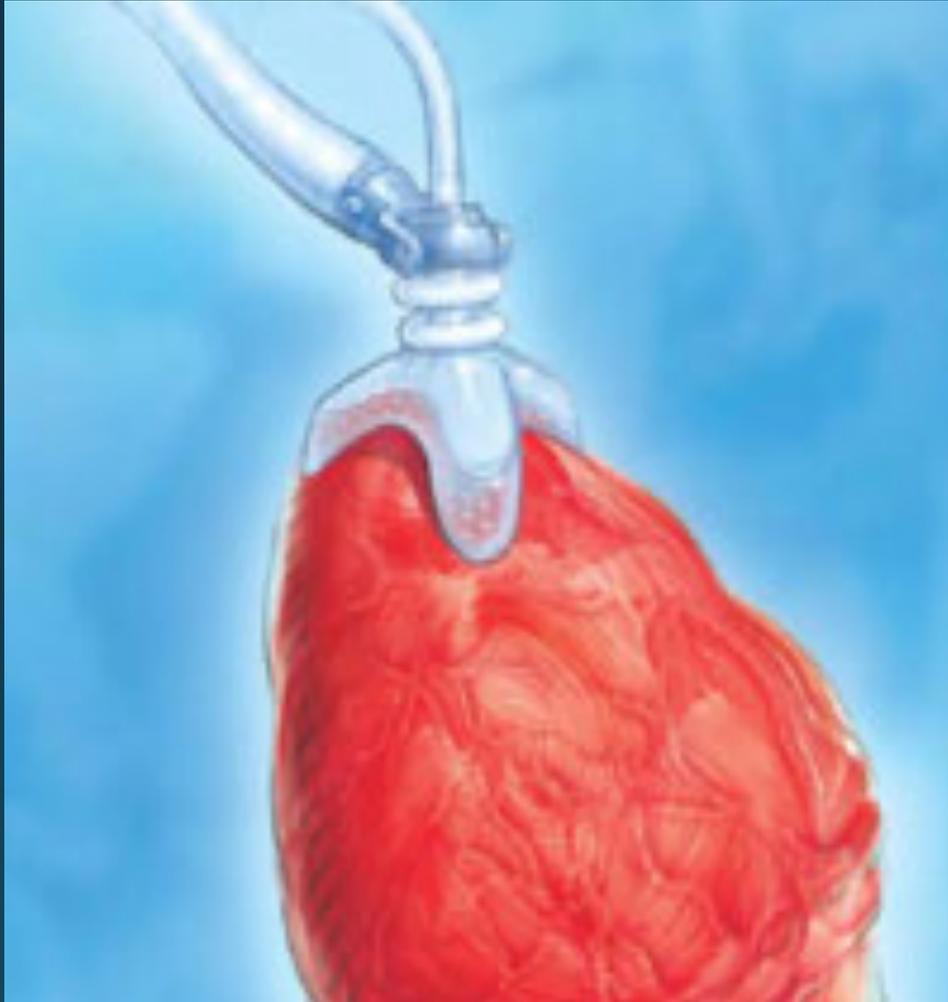
Octopus Retractor



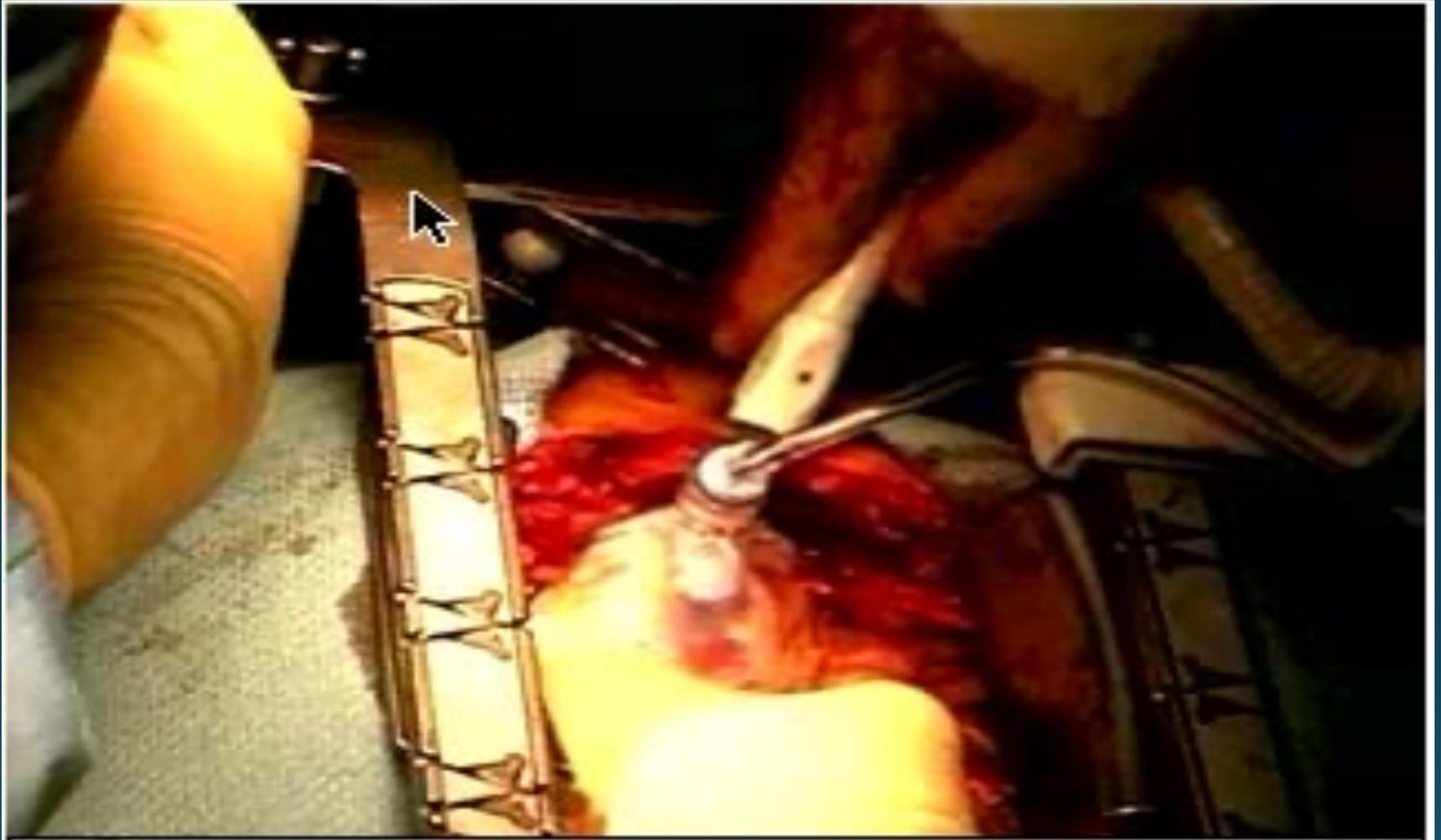
Distal Anastomosis with Octopus



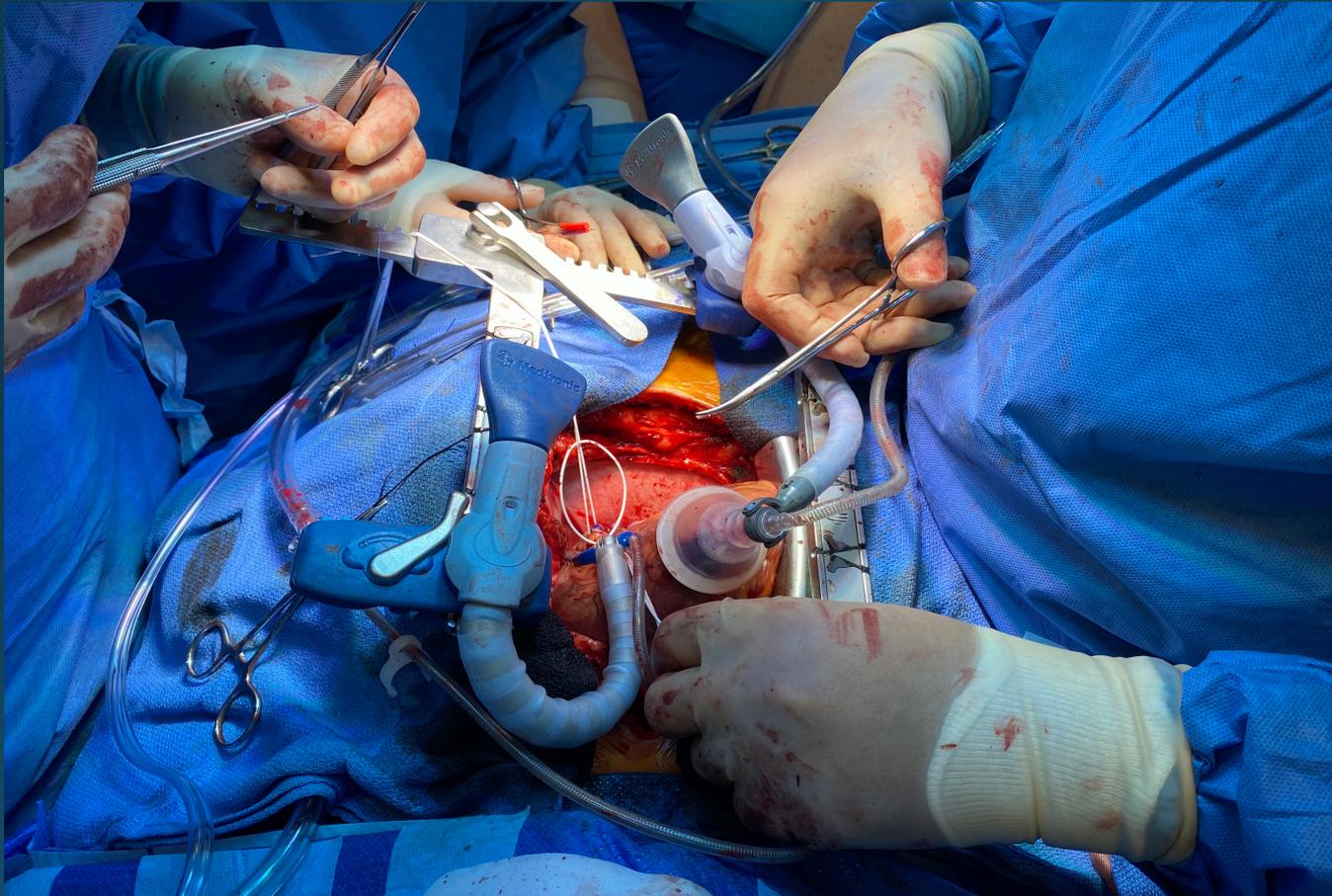
Starfish



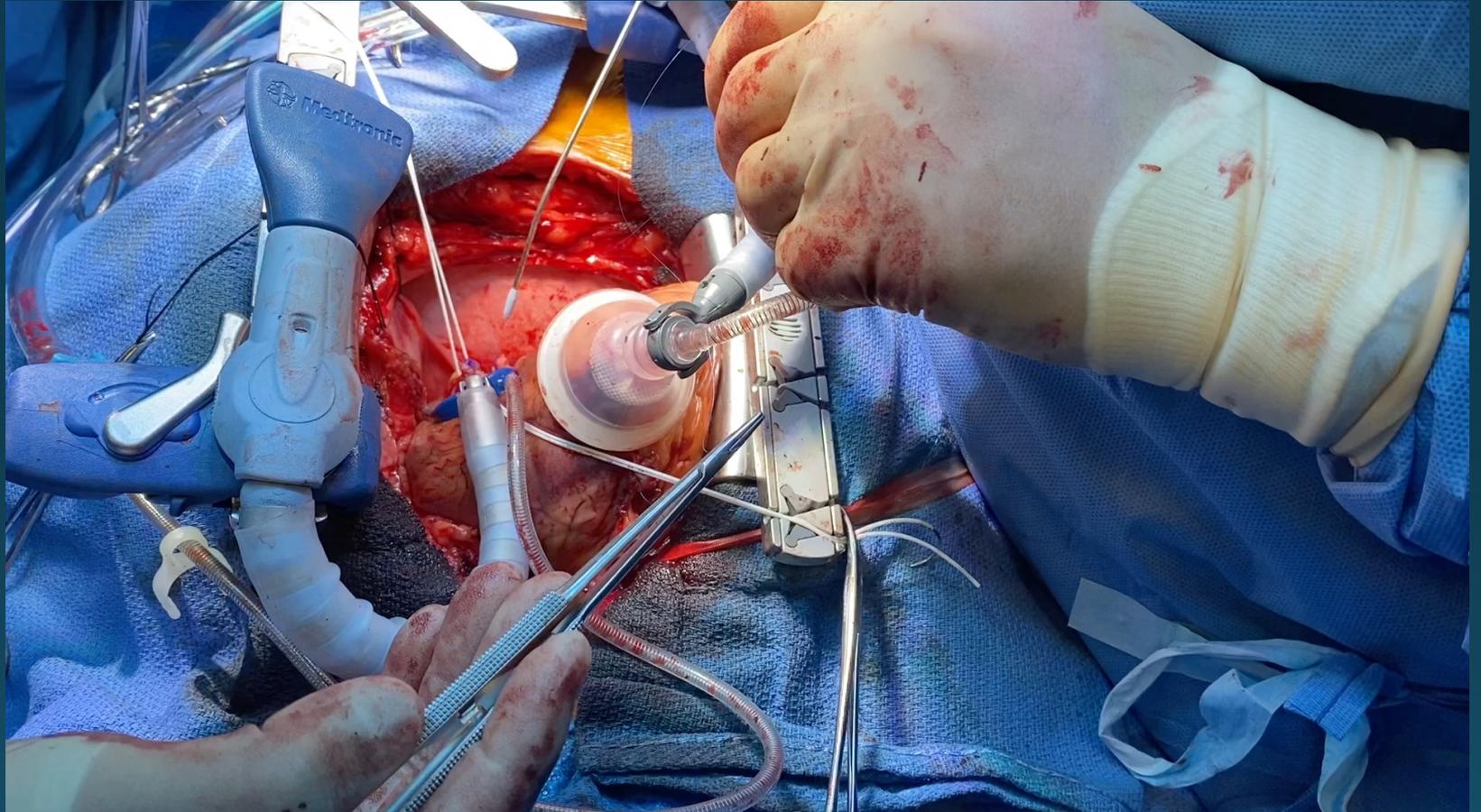
Starfish



The Urchin



Positioning the Heart for Lateral Grafts



Intracoronary Shunts



Blower/Mister



Complications of CPB

- Stroke 0.7% aged 50
- 8% aged 80
- Memory loss / mild personality changes
- 16% incidence of AKI if Creatinine > 130 mmol/l
- Coagulation dysfunction
- Immunological dysfunction
- Pulmonary dysfunction

Perceived Advantages:

Reductions in:

- Post-op ventilation
- ITU stay
- Blood loss and transfusion
- SIRs
- Post-op arrhythmias
- Neurological morbidity
- Hospital stay
- Cost savings

Patient Selection

- Initially single vessel disease / good LV function
- Multiple grafts, Poor LV, IABP, ?AF
- Patients with intercurrent disease
- The elderly
- Emergency salvage cases
- Calcification of ascending aorta

Contraindications

- Small vessels to bypass
- Distal Disease
- Intra-myocardial vessels
- MAP < 50 mm Hg on lifting the heart
- Persistent Myocardial ischaemia despite shunts
- Arrhythmias

Pre-operative Assessment and Pre-medication

- Coronary anatomy, severity of disease
- Ejection fraction, valvular disease, recent MI
- Pre-op ECG, AF
- Intercurrent disease Renal/Neurological/Diabetes
- Drug treatment

Anaesthetic Technique I

- Aim to maintain haemodynamic stability
- Early extubation
- Avoid high dose opiates and long-acting muscle relaxants
- TIVA vs Inhalational Techniques
- ? Thoracic Epidural

Anaesthetic Technique II

- Active warming
- Warming mattress, Fluid warmers, Sterile warm air blanket, Foil hats, Increase theatre temperature
- Patient positioning
Head down, Right Lateral Rotation
- Cell Saver
- Perfusion standby ? Pump primed

Haemodynamic Manipulation

- Episodes of regional ischaemia
- Ischaemic Pre-conditioning
- Filling
- Inotropic support during grafting
- Vasoconstrictors
- Prevent arrhythmias, K^+ , Mg^{++} , Amiodarone

Infusions

- Anaesthesia : Propofol / Remifentanyl
- Tight glycaemic control : Insulin
- Haemodynamic : GTN
- Inotropes : Dopamine Adrenaline Enoximone
- Vasoconstrictors : Metaraminol Noradrenaline

Haemodynamic Manipulation

- MAP 60-80 mm Hg prior to grafting
- Rate 80-90/min during distal anastomoses
- Avoid tachycardia
- Systolic < 100 mm Hg for top ends

Grafting Strategy

- Anterior grafts first
- Proximal anastamoses first
- Graft LAD first to improve cardiac function
- Patients with severe disease more able to tolerate vessel occlusion - collaterals
- Time for myocardial recovery

Conversion from OPCAB to ONCAB

- Rate varies 0.4% to 9.8% (Prague -4 trial)
- 70% due to advanced CAD
- 30% due to haemodynamic instability

Monitoring I

- EtCO₂
- IBP
- ECG ST Analysis
- ? Epicardial ECG
- CVP ? Unreliable
- PA ? Elevated due to displacement
- SVO₂
- ABG's

Monitoring II

- TOE – New RWMA
- Direct observation of heart
- PiCCO/Flowtrack – Pulse Contour Analysis

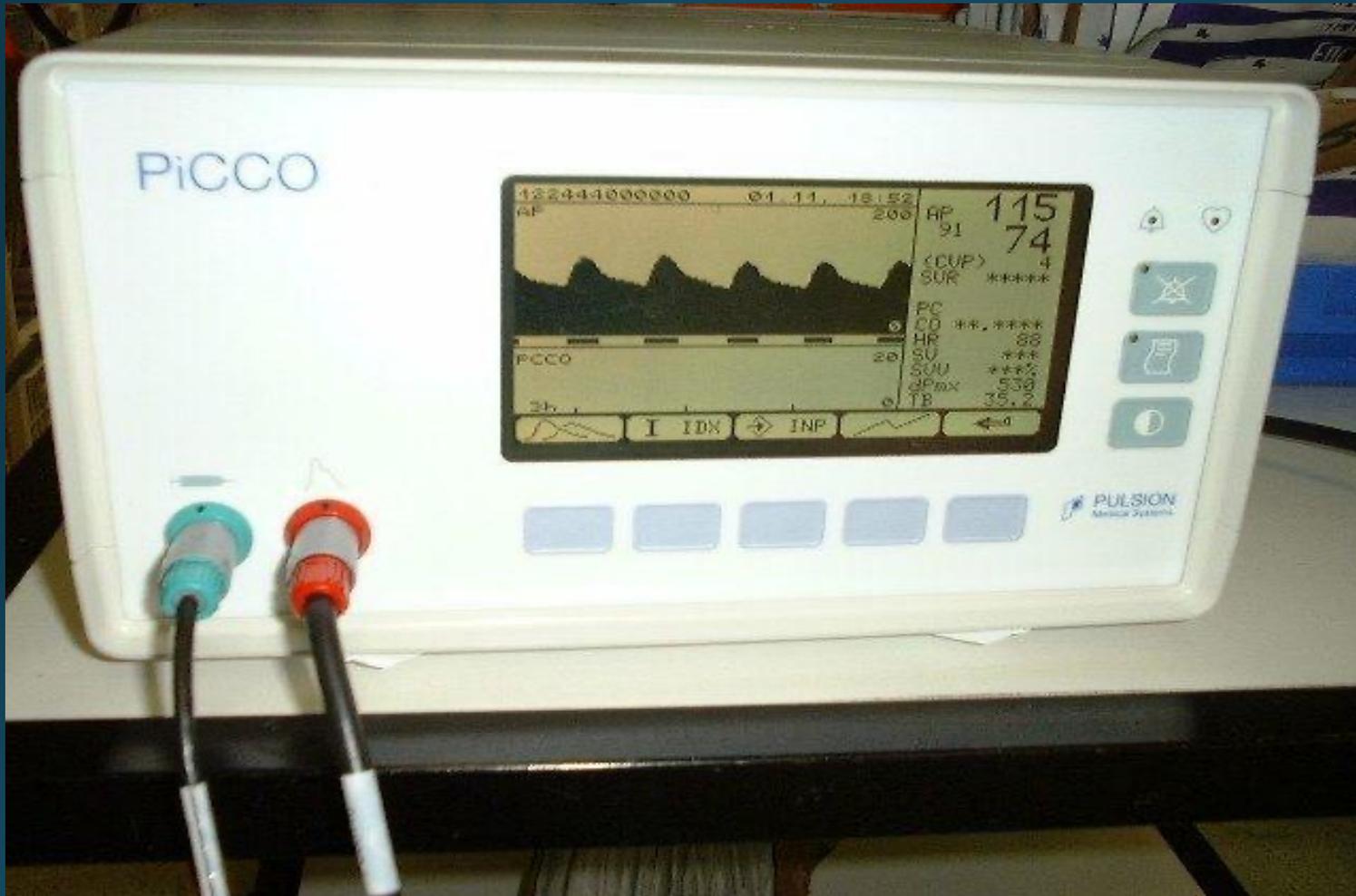
TOE 4 chamber view



TOE and LV Function



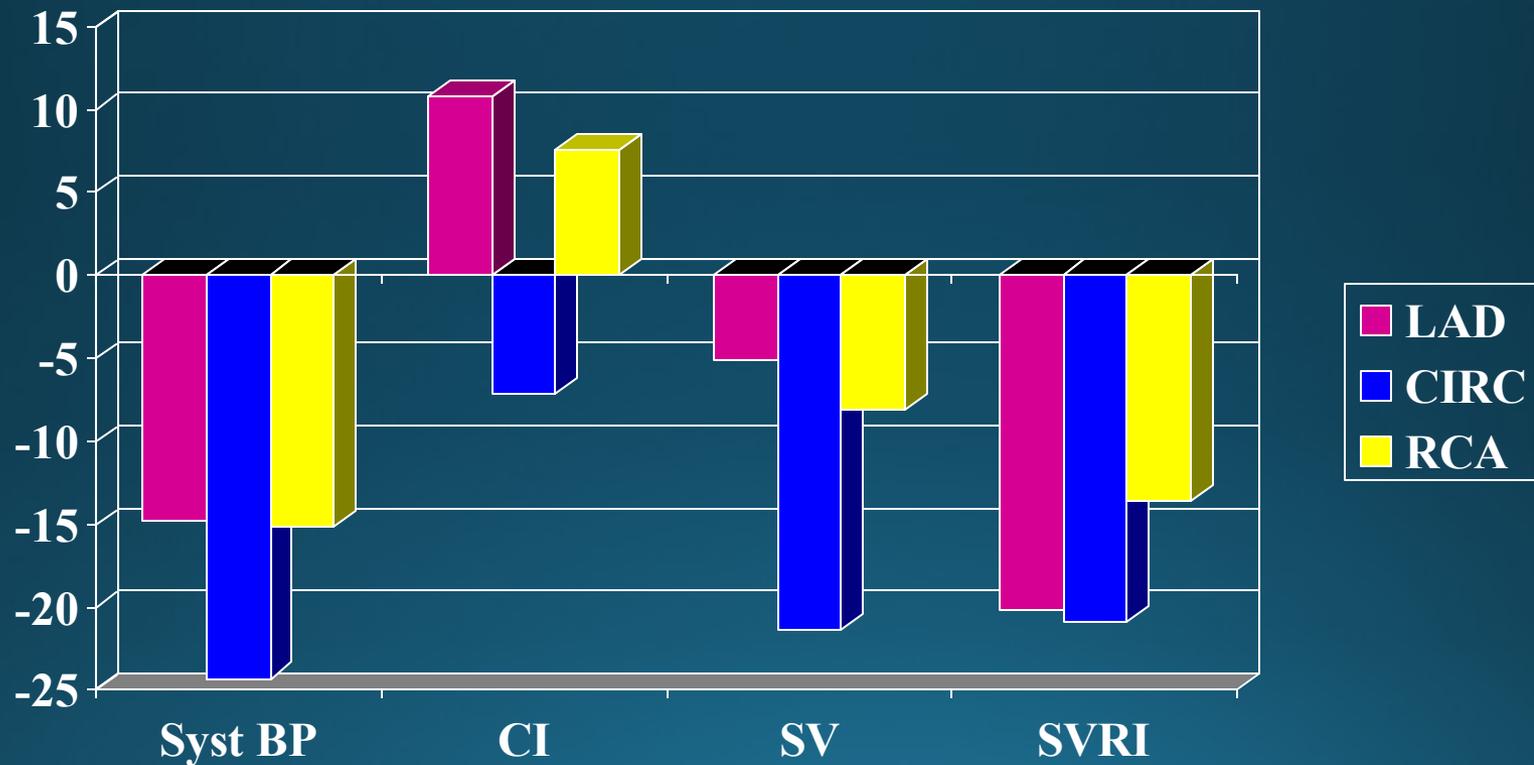
PiCCO



Cardiovascular changes during grafting

Coronary Artery Territory	% Change in Systolic BP	% Change in Cardiac Index	% change in Stroke Volume
LAD	- 14.8%	+ 10.8%	- 5.1%
Circumflex	- 24.3%	- 7.2%	- 21.4%
Right Coronary Artery	- 15.2%	+ 7.5%	- 8.1%

Cardiovascular changes during Grafting



Anticoagulation

- Controversial
- ACT > 300 secs.
- Approx half bypass dose of heparin
- ? Reverse with protamine
- Now full dose heparin and ACT > 450 secs.
- Graft patency
- Post-op Aspirin
- LMW Heparin

Blood Transfusion

- Try to avoid
- OPCAB avoids haemodilution
- HB 80 g/l adequate
- Tramexamic Acid
- Cell saver
- TEG
- Formal tests of Coagulation



SORIN XTRA
Press to start processing
Patd
288
1027
Automatic
Vacuum 1300
Waste Bag 1040
MADONNA

Sodium Chloride 0.9% w/v
Baxter
17A2STUAM 12/2016

Baxter
Sodium Chloride 0.9% w/v
17A2STUAM 12/2016

SORIN XTRA

SIVG Nova

Post-operative

- Transfer to ICU
- Monitoring
- Routine orders
- Ventilation / weaning
 - Temperature
 - Bleeding
 - Haemodynamic stability
 - Blood gases

Graft Patency

Montreal 1000 OPCAB patients from 1996-2004
Graft Occlusion Rates

- Circumflex 23%
- PDA 35%
- ITA 4%
- SVGs 25%
- Radial Arteries 29%

Compares favourably with ONCAB

Format: Abstract ▾

Send to ▾

[Eur Heart J](#). 2004 May;25(9):765-70.

Beating heart against cardioplegic arrest studies (BHACAS 1 and 2): quality of life at mid-term follow-up in two randomised controlled trials.

[Ascione R](#)¹, [Reeves BC](#), [Taylor FC](#), [Seehra HK](#), [Angelini GD](#).

+ Author information

Abstract

AIMS: Off-pump coronary bypass grafting (OPCAB) has short-term benefits compared to conventional bypass grafting using the heart-lung machine (CABG-CPB) but may compromise longer term outcome. We aimed to compare generic and disease specific quality of life (QoL) two to four years after surgery in participants in two randomised controlled trials of OPCAB vs. CABG-CPB.

METHODS AND RESULTS: Trial participants were sent four questionnaires (SF-36, EuroQol/EQ5D, Seattle Angina Questionnaire (SAQ) and Coronary Revascularisation Outcome Questionnaire (CROQ)) to assess generic and disease-specific quality of life (QoL). Of 401 participants, 22 (5.5%) had died; of the 379 survivors, 328 responded (86.5%; 159 CABG-CPB and 169 OPCAB). Median duration of follow-up was three years. QoL scores for both groups were very similar and differences between groups were not significant ($p > 0.05$ for all questionnaires and dimensions). Summary SF-36 scores showed poorer than normal physical QoL but normal mental QoL. Among all responders, there was a tendency for CROQ scores (core total, physical and psychosocial functioning and satisfaction with treatment) to deteriorate with time after the operation ($p < 0.05$).

CONCLUSION: Two to four years after surgery, patients randomised to OPCAB and CABG-CPB had similar symptoms, generic and disease-specific QoL.

PMID: 15120887 DOI: [10.1016/j.ehj.2003.11.015](https://doi.org/10.1016/j.ehj.2003.11.015)

[Indexed for MEDLINE]

Full text links

OXFORD
ACADEMIC

Save items

★ Add to Favorites

Similar articles

[Early and midterm outcome of off-pump coronary artery bypass grafting compared with on-pump coronary artery bypass grafting: a systematic review and meta-analysis](#)[Comparing on-pump and off-pump coronary artery bypass grafting: a meta-analysis](#)[Economic evaluation of off-pump coronary artery bypass grafting surgery](#)[Review](#) [Off-pump coronary artery bypass grafting. State of the art review][Review](#) Coronary artery surgery: a systematic review**Cited by 11 PubMed Central articles**

BHACAS 1 and 2

No differences in:

- 30 day mortality
- Stroke
- ONCAB patients - more grafts
- OPCAB less inotropes, blood Tx, AF, decreased ventilation time, decreased ITU stay, shorter hospital stay, ↓CK elevation
- No difference in quality of life @ 2-4 years



Off-pump surgery decreases postoperative complications and resource utilization in the elderly

Presented at Evolving Techniques and Technologies in Minimally Invasive Cardiac Surgery Meeting, San Antonio, TX, Jan 22–23, 1999.

W.Douglas Boyd, MD, [✉ Email the author MD W.Douglas Boyd](#), Nimesh D. Desai, BSc, Dario F. Del Rizzo, MD, PhD, Richard J. Novick, MD, F.Neil McKenzie, MD, Alan H. Menkis, MD

Altmetric 0

Article Info

Background. Bypass surgery in the elderly (age >70 years) has increased mortality and morbidity, which may be a consequence of cardiopulmonary bypass. We compare the outcomes of a cohort of elderly off-pump coronary artery bypass (OPCAB) patients with elderly conventional coronary artery bypass grafting (CABG) patients.

Methods. Chart and provincial cardiac care registry data were reviewed for 30 consecutive elderly OPCAB patients (age 74.7 ± 4.2 years) and 60 consecutive CABG patients (age 74.9 ± 4.1 years, $p = 0.82$) with similar risk factor profiles: Parsonnet score 17.2 ± 8.1 (OPCAB) versus 15.6 ± 6.5 (CABG), $p = 0.31$; and Ontario provincial acuity index 4.5 ± 1.9 (OPCAB) versus 4.3 ± 2.0 (CABG), $p = 0.65$.

Results. Mean hospital stay was 6.3 ± 1.8 days for OPCAB patients and 7.7 ± 3.9 days for CABG patients ($p < 0.05$). Average intensive care unit stay was 24.0 ± 10.9 h for OPCAB patients versus 36.6 ± 33.5 h for CABG patients ($p < 0.05$). Atrial fibrillation occurred in 10.0% of OPCAB patients and 28.3% of CABG patients ($p < 0.05$). Low output syndrome was observed in 10% of OPCAB patients and 31.7% of CABG patients ($p < 0.05$). Cost was reduced by \$1,082 (Canadian) per patient in the OPCAB group. Postoperative OPCAB graft analysis showed 100% patency.

Conclusions. OPCAB is safe in the geriatric population and significantly reduces postoperative morbidity and cost.



Advantages of Beating Heart CABG I

AGE > 70	OPCAB Parsonnet 17.2	CABG Parsonnet 15.6
Mean Hospital Stay in days	6.3 +/- 1.8	7.7 +/- 3.9*
Mean ITU Stay Hrs	24 +/- 10.9	36.6 +/- 33.5 *
Incidence of AF	10.0 %	28.3% *
Incidence of Low Output Syndrome	10.0 %	31.7 % *
Cost	Saving of \$1082 per patient	

Advantages of Beating Heart CABG II

LMS Disease	BHS (n=67)	CPB (n=192)
Grafts per patient	3.1 +/- 0.7	2.9 +/- 0.7
Periop MI	2.9%	3.1%
Blood Transfusion	38%	64% *
Inotrope Requirements	Similar	Similar
Periop Mortality	0%	4.7% *
Mean Hospital Stay in Days	6.8	7.6

Deterioration of Neurological Function

- Macroemboli → CVA
 - Aortic atheroma
 - Hx of neurological disease
 - Diabetes
 - CPB, Aortic Cannulation, Cross-clamping
 - Air, calcium, fibroelastoma, fibrin, fat
- Micro emboli → Deterioration in intellectual function
 - memory deficit
 - seizures
 - ↑ Alcohol consumption
 - atrial arrhythmia



Beating heart surgery: why expect less central nervous system morbidity?

Presented at Evolving Techniques and Technologies in Minimally Invasive Cardiac Surgery, San Antonio, TX, Jan 22–23, 1999.

John M Murkin, MD  [Email the author MD John M Murkin](#), [W.Douglas Boyd, MD](#), [Sugantha Ganapathy, MD](#), [Sandra J Adams, RN](#),
[Mononda C Peterson, MA](#)



0

Article Info

Background. The incidence and etiology of brain dysfunction after conventional coronary artery bypass surgery using cardiopulmonary bypass (CPB) are reviewed.

Methods. Stroke rates and incidences of cognitive dysfunction from various studies are considered. Mechanisms of injury including cerebral embolization as detected by transcranial Doppler and retinal angiography, and imaging-based evidence for postoperative cerebral edema, are discussed. Preliminary results from a prospective clinical trial assessing cognitive dysfunction after beating heart versus conventional coronary artery bypass with CPB are discussed.

Results. Initial evidence for lower overall postoperative morbidity, and for a lower incidence of cognitive dysfunction specifically, after onpump coronary revascularization is presented.

Conclusions. Beating heart surgery results in less potential for generation of cerebral emboli and appears to produce a lower incidence of cognitive dysfunction in both short- and intermediate-term postoperative follow-up periods as compared with conventional coronary artery bypass surgery using CPB.



Feedback 

Advantages of Beating Heart CABG III Neurological Outcome

- OPCAB- less potential for generation of emboli
- But..... displacement of heart → Venous congestion and ↓ CPP
- Lower levels of S100 protein in OPCAB
- ? Lower incidence of cognitive dysfunction in short and long-term follow up periods

Cognitive Outcome

Cognitive Decline	On Pump	Off Pump
3 months	29%	21%
12 months	33.6%	30.8%
Quality of life/ stroke rate	No signif. diff.	No signif. diff.

Conclusions

Patients who received first CABG surgery without by-pass had improved cognitive outcomes at 3 months post surgery, but the effects were negligible at 12 months.

Pulmonary Function

- Leucocyte sequestration \propto

Aortic X-clamp time

length of CPB
Type equation here.

- But OPCAB \rightarrow \uparrow LA pressure, \uparrow MR and \rightarrow pulmonary congestion

Pulmonary function \downarrow due to incision, IMA harvesting, altered surfactant funcⁿ, and \downarrow Chest wall compliance

30-40% fall in FVC in ONCAB and OPCAB

Cardiovascular Function

- Decreased Troponin T levels and ?decreased myocyte injury in OPCAB
- Oxidative metabolism recovers more rapidly in OPCAB

Inflammatory response on and Off Pump

SIRS associated with CPB

- Complement activation C₃a, C₅a
- Endothelial activation P-selectin, E-selectin, ICAM, I₁8
- Proteases break down collagen and elastin => Capillary leak
- Sequestration of WBC's by lungs
- Bleeding
- Microvascular thromboemboli
- Endothelial dysfunction
- Multiorgan dysfunction

SIRS associated with CPB

Cytokine response α

Length of CPB

Aortic cross Clamp time

Worsens with

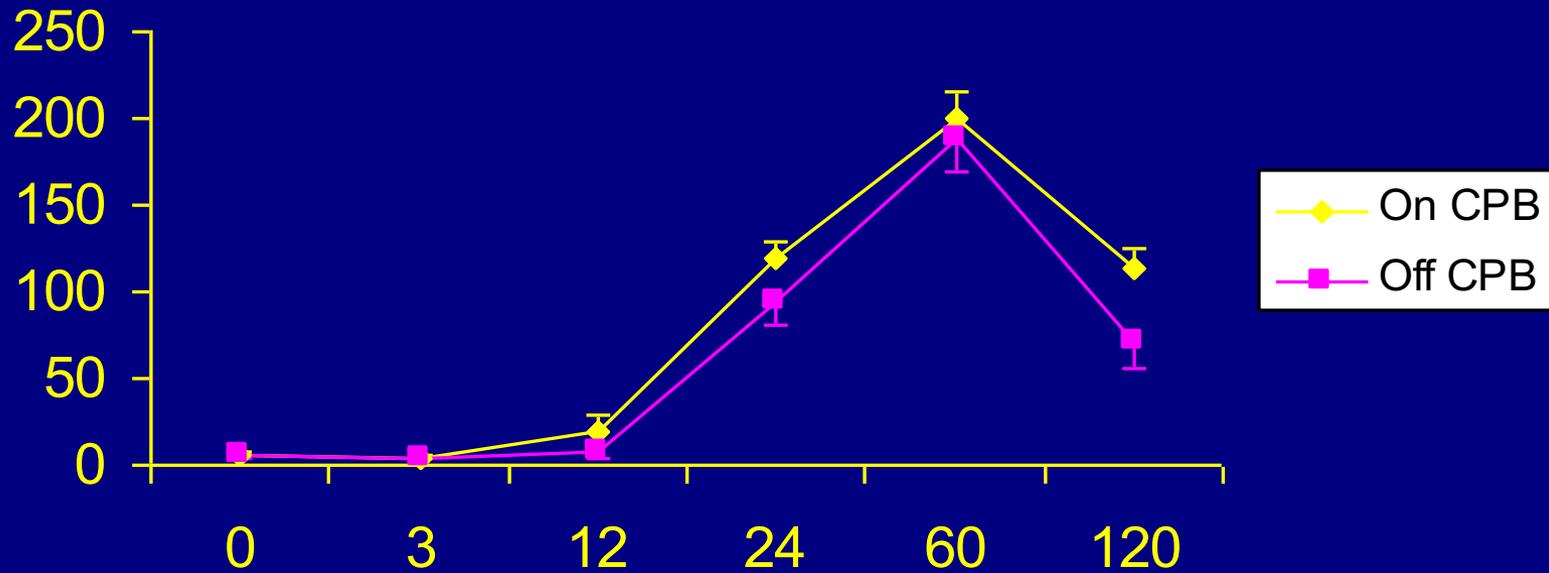
Cardiogenic shock

Infection

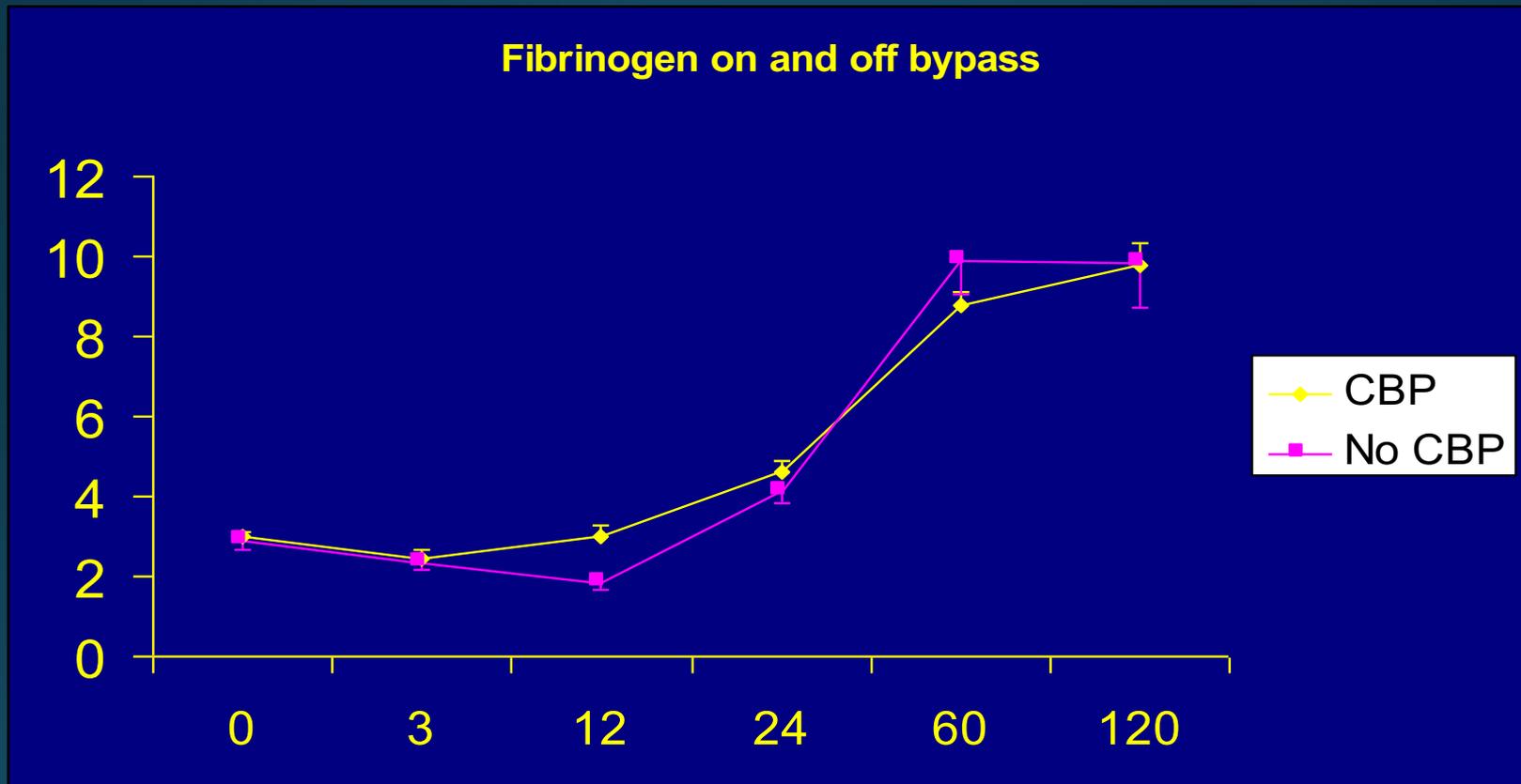
Subsides 24-48 hours after surgery

CRP on and Off Bypass

CRP on and off bypass $p=0.06$ at 5/7

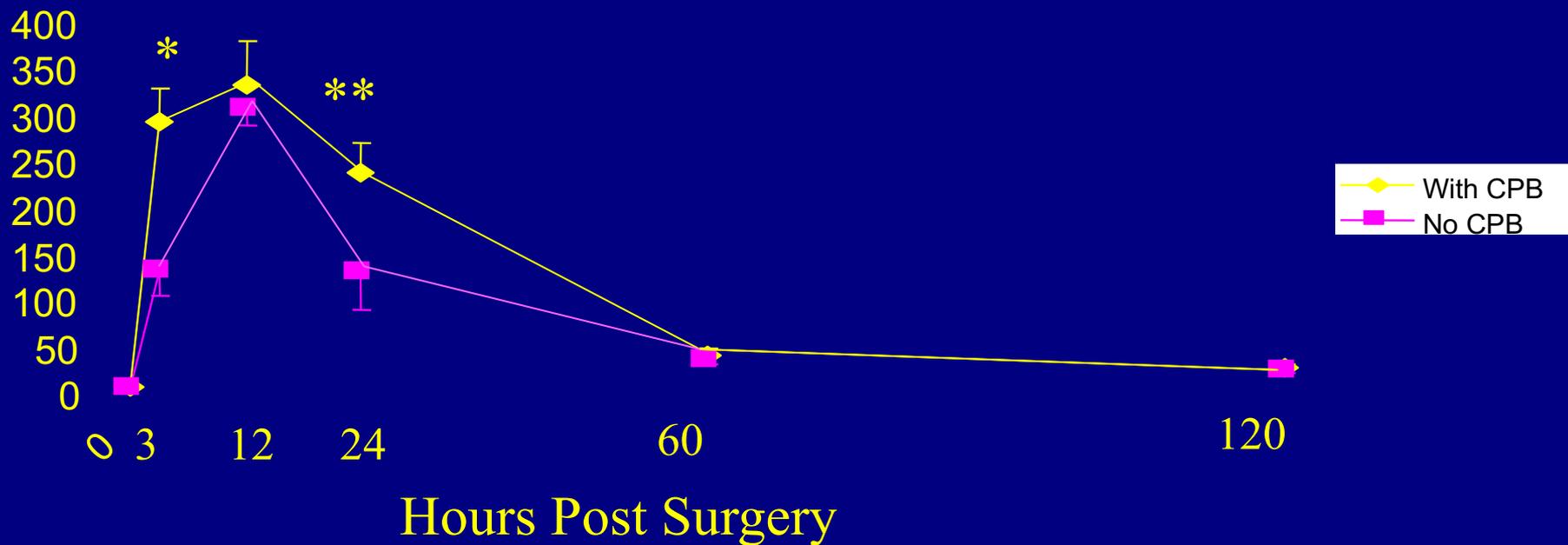


Fibrinogen on and off Bypass



IL-6 production (pg/ml) On and Off Bypass

IL-6 production with and without bypass



* = $P < 0.005$

** $P = 0.05$

Randomized Trial Comparing Off-Pump to On-Pump Coronary Artery Bypass Grafting in High-Risk Patients

(#2003-13903 . . . June 27, 2003)

Michel Carrier, MD,¹ Louis P. Perrault, MD, PhD,¹ Hugues Jeanmart, MD,¹
Raymond Martineau, MD,² Raymond Cartier, MD,¹ Pierre Pagé, MD¹

Departments of ¹Surgery and ²Anesthesia, Montreal Heart Institute, Montreal, Quebec, Canada

ABSTRACT

Objective: The subset of patients most likely to benefit from off-pump coronary artery bypass grafting (CABG) remains a controversial issue, but the technique has been proposed to decrease postoperative mortality and morbidity. The objective of this study was to compare off-pump to on-pump CABG in patients with known risk factors for mortality and morbidity.

Methods: Between October 2001 and September 2002, 65 high-risk patients were prospectively randomized to undergo off-pump or on-pump CABG. Recruited patients had at least 3 of the following criteria: age greater than 65 years, high blood pressure, diabetes, serum creatinine greater than 133 $\mu\text{mol/L}$, left ventricular ejection fraction lower than 45%, chronic pulmonary disease, unstable angina, congestive heart failure, repeat CABG, anemia, and carotid atherosclerosis. Hospital mortality and morbidity were the primary end-points of the study.

Results: Six patients (9%) crossed over from the original randomized group. Twenty-eight patients averaging 70 ± 8 years of age underwent 3 ± 1 grafts off pump, and 37 patients averaging 70 ± 6 years of age underwent 3.4 ± 1 grafts on pump. Revascularization was considered complete in 21 (75%) of off-pump patients compared to 33 (89%) of on-pump patients ($P = .1$). There were no hospital deaths in off-pump patients, and 2 patients (5%) undergoing on-pump CABG died early following surgery ($P = .2$). Two off-pump (7%) compared to 11 on-pump (30%) of patients presented composite end-points including death, neurological injury, renal failure, respiratory failure, and operative myocardial infarction after CABG ($P = .02$).

Conclusion: The present study suggests that off-pump CABG, when technically feasible, significantly reduces morbidity following surgery in a group of high-risk patients.

Presented at the Sixth Annual Meeting of the International Society for Minimally Invasive Cardiac Surgery, San Francisco, California, USA, June 19-21, 2003.

Received June 25, 2003; accepted June 27, 2003

Address correspondence and reprint requests to: Michel Carrier, MD, Department of Surgery, Montreal Heart Institute, 5000 Belanger Street East, Montreal, Quebec, H1T 1C8, Canada; 514-376-3330; fax: 514-376-4766 (e-mail: michel.carrier@icm-mbi.org).

INTRODUCTION

Coronary artery bypass grafting (CABG) is currently performed with or without the use of the cardiopulmonary bypass system (CPB). Although both techniques are being used with success [Van Dijk 2001], a debate is raging between advocates and opponents of off-pump CABG about patient outcomes and surgical indications for one or the other technique [Bonchek 2002].

Several authors have suggested that off-pump CABG could be especially useful and effective in improving clinical outcomes in high-risk patients who require surgical revascularization [Hoff 2002, Al-Ruzzeh 2003]. Elderly patients and those with significant comorbidities are more susceptible to the deleterious effects of CPB and are most likely to benefit from the use of off-pump CABG compared to the standard on-pump approach [Demaria 2002].

The objective of the present study was to compare outcomes between off-pump CABG and a standard technique of CABG with CPB and cardioplegic arrest in a group of patients at high risk of postoperative mortality and morbidity.

METHODS

Study Population

Between October 2001 and September 2002, 65 patients undergoing CABG at the Montreal Heart Institute were prospectively randomized into 2 groups: one undergoing off-pump CABG and the other undergoing standard on-pump CABG. After the patients had agreed to participate in the study, fulfilled inclusion criteria, and signed an informed consent form, they were randomized in the operating room just before the beginning of the operation. Randomization by blocks of 4 was used to obtain equal sample size in the 2 groups.

Recruited patients had at least 3 of the following criteria: age greater than 65 years, high blood pressure, diabetes, serum creatinine greater than 133 $\mu\text{mol/L}$, left ventricular ejection fraction lower than 45%, chronic pulmonary disease, unstable angina, congestive heart failure, repeat CABG, anemia, and significant carotid atherosclerosis. In our database, patients with at least 3 of the above criteria had a risk of combined hospital mortality and of significant morbidity averaging 30%. The study sample size was chosen to show a decrease of 30% of the following combined end-points (with an alpha error of 5% and a power of 80%): hospital mortality,

Which patients benefit?

OPERATIVE MORTALITY	CABG with CPB	OPCAB
Low-risk group	1.1 %	1.4 %
Medium-risk group	7%	6%
High-risk group	28.5%	7.7% P= < 0.008

Which Patients benefit?

- Little benefit in low to medium risk groups
- Mortality reduced in high-risk groups
 - Euro score > 5
 - LV dysfunction
 - Atheromatous aorta

But... Little benefit in

Renal failure

Age > 75

LMS Disease

Diabetes

Meta Analysis from Toronto 2005

Which Patients Benefit?

- Long term mortality α completeness of revascularization and graft patency
- OPCAB early physiological benefits
- But, Long-term survival of OPCAB maybe worse

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. Olavegogeochea, 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*

ABSTRACT

BACKGROUND

We previously reported that there was no significant difference at 30 days or at 1 year in the rate of the composite outcome of death, stroke, myocardial infarction, or renal failure between patients who underwent coronary-artery bypass grafting (CABG) performed with a beating-heart technique (off-pump) and those who underwent CABG performed with cardiopulmonary bypass (on-pump). We now report the results at 5 years (the end of the trial).

The authors' affiliations are listed in the Appendix. Address reprint requests to Dr. Lamy at the Population Health Research Institute, Hamilton Health Sciences, McMaster University, Hamilton, ON L8L 2X2, Canada, or at lamya@mcmaster.ca.

*A complete list of investigators in the CABG Off or On Pump Revasculariza-

RESULTS

There were no significant differences between the off-pump group and the on-pump group in the rate of the composite outcome (23.1% and 23.6%, respectively; hazard ratio with off-pump CABG, 0.98; 95% confidence interval [CI], 0.87 to 1.10; $P=0.72$) or in the rates of the components of the outcome, including repeat coronary revascularization, which was performed in 2.8% of the patients in the off-pump group and in 2.3% of the patients in the on-pump group (hazard ratio, 1.21; 95% CI, 0.85 to 1.73; $P=0.29$). The secondary outcome for the overall period of the trial — the mean cost in U.S. dollars per patient — also did not differ significantly between the off-pump group and the on-pump group (\$15,107 and \$14,992, respectively; between-group difference, \$115; 95% CI, -\$697 to \$927). There were no significant between-group differences in quality-of-life measures.

CONCLUSIONS

In our trial, the rate of the composite outcome of death, stroke, myocardial infarction, renal failure, or repeat revascularization at 5 years of follow-up was similar among patients who underwent off-pump CABG and those who underwent on-pump CABG. (Funded by the Canadian Institutes of Health Research; CORONARY ClinicalTrials.gov number, NCT00463294.)

Summary

- Long term graft patency rates need to be similar
- Graft Patency and Complete revascularisation are the most important predictors of survival
- Patients who benefit most are those with poor LV function, intercurrent disease and the elderly
- Vigilant Anaesthesia and a Team Approach is essential for success

But.....

The screenshot shows the mobile interface of the New England Journal of Medicine website. At the top, the URL 'nejm.org' is visible in the browser's address bar. Below the header, there is a navigation bar with a 'SUBSCRIBE OR RENEW' button. The main content area features a 'SOUNDING BOARD' section on the left and a 'REVIEW ARTICLE' section on the right. The central focus is an 'ORIGINAL ARTICLE' titled 'Five-Year Outcomes after On-Pump and Off-Pump Coronary-Artery Bypass'. The authors listed are 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*. The article is dated August 17, 2017, and has a DOI of 10.1056/NEJMoa1614341. At the bottom, there are links for 'Article', 'Figures/Media', 'Metrics', 'References', 'Citing Articles', and 'Letters'.

16:35 39%

nejm.org

The NEW ENGLAND JOURNAL of MEDICINE

SUBSCRIBE OR RENEW

Learn how NEJM.org uses cookies at the [Cookie Information](#) page.

SOUNDING BOARD
A Framework for Ethical Payment to Research Participants

REVIEW ARTICLE
Pleural Disease

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*

August 17, 2017
N Engl J Med 2017; 377:623-632
DOI: 10.1056/NEJMoa1614341

Article **Figures/Media**

Metrics

35 References 12 Citing Articles Letters

Abstract

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*

Coronary-artery bypass grafting (CABG) surgery may be performed either with cardiopulmonary bypass (on pump) or without cardiopulmonary bypass (off pump). We report the 5-year clinical outcomes in patients who had been included in the Veterans Affairs trial of on-pump versus off-pump CABG.

METHODS

From February 2002 through June 2007, we randomly assigned 2203 patients at 18 medical centers to undergo either on-pump or off-pump CABG, with 1-year assessments completed by May 2008. The two primary 5-year outcomes were death from any cause and a composite outcome of major adverse cardiovascular events, defined as death from any cause, repeat revascularization (CABG or percutaneous coronary intervention), or nonfatal myocardial infarction. Secondary 5-year outcomes included death from cardiac causes, repeat revascularization, and nonfatal myocardial infarction. Primary outcomes were assessed at a P value of 0.05 or less, and secondary outcomes at a P value of 0.01 or less.

RESULTS

The rate of death at 5 years was 15.2% in the off-pump group versus 11.9% in the on-pump group (relative risk, 1.28; 95% confidence interval [CI], 1.03 to 1.58; $P=0.02$). The rate of major adverse cardiovascular events at 5 years was 31.0% in the off-pump group versus 27.1% in the on-pump group (relative risk, 1.14; 95% CI, 1.00 to 1.30; $P=0.046$). For the 5-year secondary outcomes, no significant differences were observed: for nonfatal myocardial infarction, the rate was 12.1% in the off-pump group and 9.6% in the on-pump group ($P=0.05$); for death from cardiac causes, the rate was 6.3% and 5.3%, respectively ($P=0.29$); for repeat revascularization, the rate was 13.1% and 11.9%, respectively ($P=0.39$); and for repeat CABG, the rate was 1.4% and 0.5%, respectively ($P=0.02$).

CONCLUSIONS

In this randomized trial, off-pump CABG led to lower rates of 5-year survival and event-free survival than on-pump CABG. (Funded by the Department of Veterans Affairs Office of Research and Development Cooperative Studies Program and others; ROOBY-FS ClinicalTrials.gov number, NCT01924442.)

IN THE 1990S, ENTHUSIASM REEMERGED FOR PERFORMING CORONARY-artery bypass grafting (CABG) surgery on a beating heart without the use of



OPCAB The Future

- Plateau and decline in USA
- Tool for use in specific clinical situations eg
 - Severe atheromatous ascending aortas
 - Severe LV dysfunction
 - ? Renal failure
- Learning curve for each surgeon

Cardiac Anaesthesia for OPCAB

- Careful
- Safe
- Aciduous monitoring

ABOVE ALL TEAMWORK!!

Association between early and three month cognitive outcome after off-pump and on-pump coronary bypass surgery

van Dijk, K G M Moons, A M A Keizer, E W L Jansen, R Hijman, J C Diephuis, C Borst, P T de Jaegere, D E Grobbee, C J Kalkman, for the Octopus Study Group

Heart 2004;**90**:431-434. doi: 10.1136/hrt.2003.010173

Objective: To describe the association between cognitive outcome in the first postoperative week and that at three months after both off-pump and on-pump coronary bypass surgery, and to make a direct comparison of early cognitive outcome after off-pump versus on-pump surgery.

Design: Randomised trial with an additional prediction study within the two randomised groups.

Setting: Three centres for heart surgery in the Netherlands.

Patients: 281 patients, mean age 61 years.

Interventions: Participants were randomly assigned to off-pump or on-pump coronary bypass surgery.

Main outcome measures: Cognitive outcome, assessed by psychologists who administered neuropsychological tests one day before and four days and three months after surgery. A logistic regression model was used to study the predictive association between early cognitive outcome, together with eight clinical variables, and cognitive outcome after three months.

Results: Cognitive outcome in the first week after surgery was determined for 219 patients and was a predictor of cognitive decline after three months. This association was stronger in on-pump patients (odds ratio (OR) 5.24, $p < 0.01$) than in off-pump patients (OR 1.80, $p = 0.23$). Early decline was present in 54 patients (49%) after off-pump surgery and 61 patients (57%) after on-pump surgery (OR 0.73, $p = 0.25$).

Conclusions: In patients undergoing first time coronary bypass surgery, early cognitive decline predicts cognitive outcome after three months. Early cognitive decline is not significantly influenced by the use of cardiopulmonary bypass.

ratio (OR) 5.24, $p < 0.01$) than in off-pump patients (OR 1.80, $p = 0.23$). Early decline was present in 54 patients (49%) after off-pump surgery and 61 patients (57%) after on-pump surgery (OR 0.73, $p = 0.25$).

Conclusions: In patients undergoing first time coronary bypass surgery, early cognitive decline predicts

end of article for
ors' affiliations

Correspondence to:
van Dijk, University
ical Centre,
partment of
esthesiology (mail stop
-511), PO Box 85500,
8 GA Utrecht,
erlands; ddiijk@azu.nl

Accepted 6 August 2003

Correspondence to:
esthesiology (mail stop
-511), PO Box 85500,
8 GA Utrecht,
erlands; ddiijk@azu.nl