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Yok

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Coronary-Artery Bypass Surgery in Patients with Left Ventricular Dysfunction

Eric J. Velazquez, M.D., Kerry L. Lee, Ph.D., Marek A. Deja, M.D., Ph.D., Anil Jain, M.D., George Sopko, M.D., M.P.H., Andrey Marchenko, M.D., Ph.D., Imtiaz S. Ali, M.D., Gerald Pohost, M.D., Sinisa Gradinac, M.D., Ph.D., William T. Abraham, M.D., Michael Yii, M.S., F.R.C.S., F.R.A.C.S., Dorairaj Prabhakaran, M.D., D.M., Hanna Szwed, M.D., Paolo Ferrazzi, M.D., Mark C. Petrie, M.D., Christopher M. O'Connor, M.D., Pradit Panchavinnin, M.D., Lilin She, Ph.D., Robert O. Bonow, M.D., Gena Roush Rankin, M.P.H., R.D., Robert H. Jones, M.D., and Jean-Lucien Rouleau, M.D., for the STICH Investigators*

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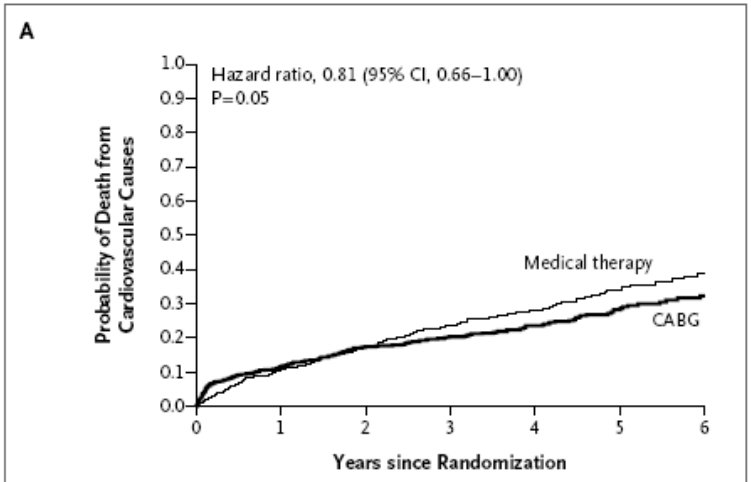

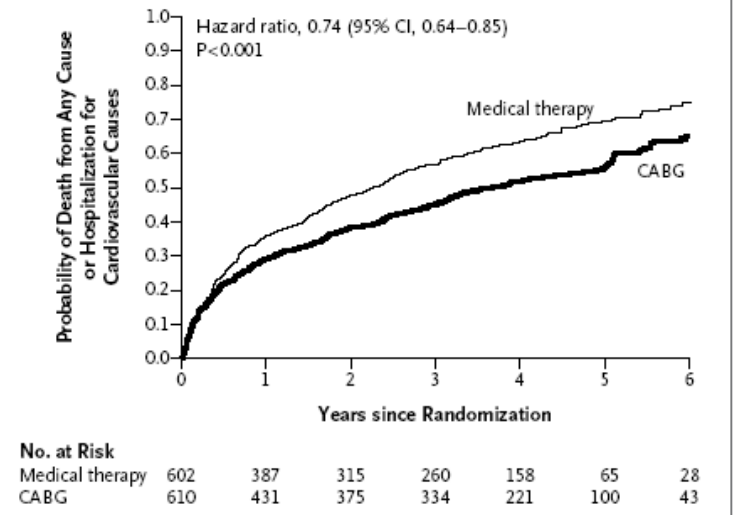

Figure 2. Kaplan–Meier Curves for the Probability of Death from Cardiovascular Causes and of Death from Any Cause or Hospitalization for Cardiovascular Causes.

CABG denotes coronary-artery bypass grafting.

The NEW ENGLAND JOURNAL of MEDICINE

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Coronary Bypass Surgery with or without Surgical Ventricular Reconstruction

Robert H. Jones, M.D., Eric J. Velazquez, M.D., Robert E. Michler, M.D., George Sopko, M.D., Jae K. Oh, M.D., Christopher M. O'Connor, M.D., James A. Hill, M.D., Lorenzo Menicanti, M.D., Zygmunt Sadowski, M.D., Patrice Desvigne-Nickens, M.D., Jean-Lucien Rouleau, M.D., and Kerry L. Lee, Ph.D., for the STICH Hypothesis 2 Investigators*

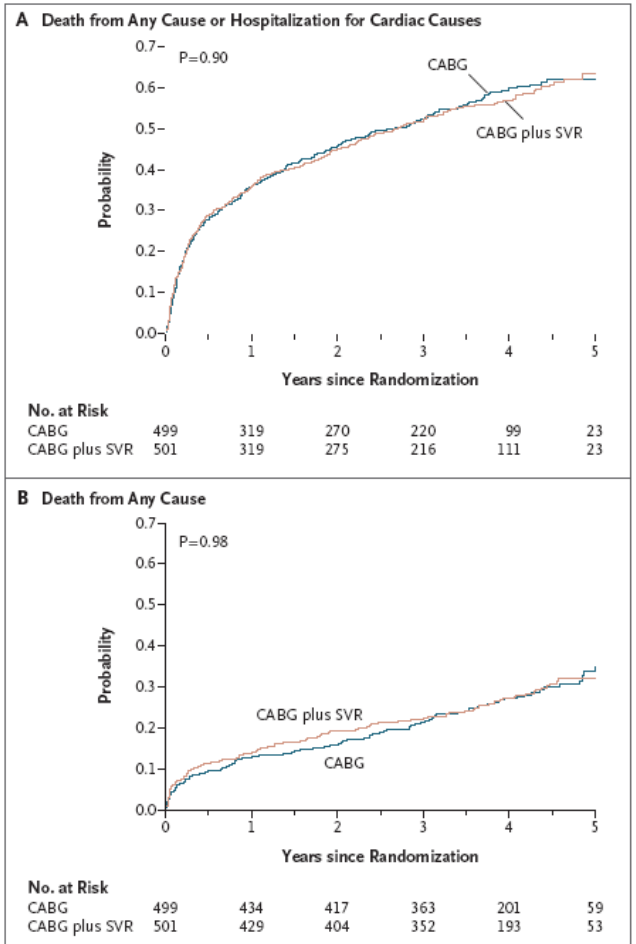

Figure 3. Kaplan–Meier Estimates of Outcomes.

Panel A shows the probability of the primary outcome (death from any cause or hospitalization for cardiac causes), which did not differ significantly between the two groups. The primary outcome occurred in 292 patients (59%) assigned to undergo coronary-artery bypass grafting (CABG) alone and in 289 patients (58%) assigned to undergo CABG with surgical ventricular reconstruction (SVR) (hazard ratio, 0.99; 95% CI, 0.84 to 1.17). Panel B shows the probability of death from any cause, which occurred in 141 patients (28%) assigned to undergo CABG and in 138 patients (28%) assigned to undergo CABG with SVR (hazard ratio, 1.00; 95% CI, 0.79 to 1.26).

Düşük EF'de cerrahi stratejiler

- Preoperatif
  - IABP
  - Levosimendan
- Perioperatif
  - Swan-Ganz
  - TEE
  - Farmakoterapi
    - Asidoz
    - Hipoksi
    - Hiperkapni
    - Volüm yükü
  - Kan kullanımı

- Perioperatif
  - Miyokard koruması
    - Kan kardiyoplejisi
      - Isı (Soğuk, sıcak, ılık)
      - İçerik (aspartat, glutamat, l-arginine)
    - Antegrad
    - Retrograd
    - Hot-shut
  - OPCAB-Onpump
  - Hibrid girişim

- Postoperatif
  - Devamlı kardiyak debi takibi
    - İdrar debisi
    - Laktat takibi
    - Asidoz
  - Mekanik destek cihazları

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ESTABLISHED IN 1812 NOVEMBER 5, 2009 VOL. 361 NO. 19

On-Pump versus Off-Pump Coronary-Artery Bypass Surgery

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BACKGROUND

Coronary-artery bypass grafting (CABG) has traditionally been performed with the use of cardiopulmonary bypass (on-pump CABG). CABG without cardiopulmonary bypass (off-pump CABG) might reduce the number of complications related to the heart–lung machine.

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.

RESULTS

There was no significant difference between off-pump and on-pump CABG in the rate of the 30-day composite outcome (7.0% and 5.6%, respectively; P=0.19). The rate of the 1-year composite outcome was higher for off-pump than for on-pump CABG (9.9% vs. 7.4%, P=0.04). The proportion of patients with fewer grafts completed than originally planned was higher with off-pump CABG than with on-pump CABG (17.8% vs. 11.1%, P<0.001). Follow-up angiograms in 1371 patients who underwent 4093 grafts revealed that the overall rate of graft patency was lower in the off-pump group than in the on-pump group (82.6% vs. 87.8%, P<0.01). There were no treatment-based differences in neuropsychological outcomes or short-term use of major resources.

CONCLUSIONS

At 1 year of follow-up, patients in the off-pump group had worse composite outcomes and poorer graft patency than did patients in the on-pump group. No significant differences between the techniques were found in neuropsychological outcomes or use of major resources. (ClinicalTrials.gov number, NCT00032630.)

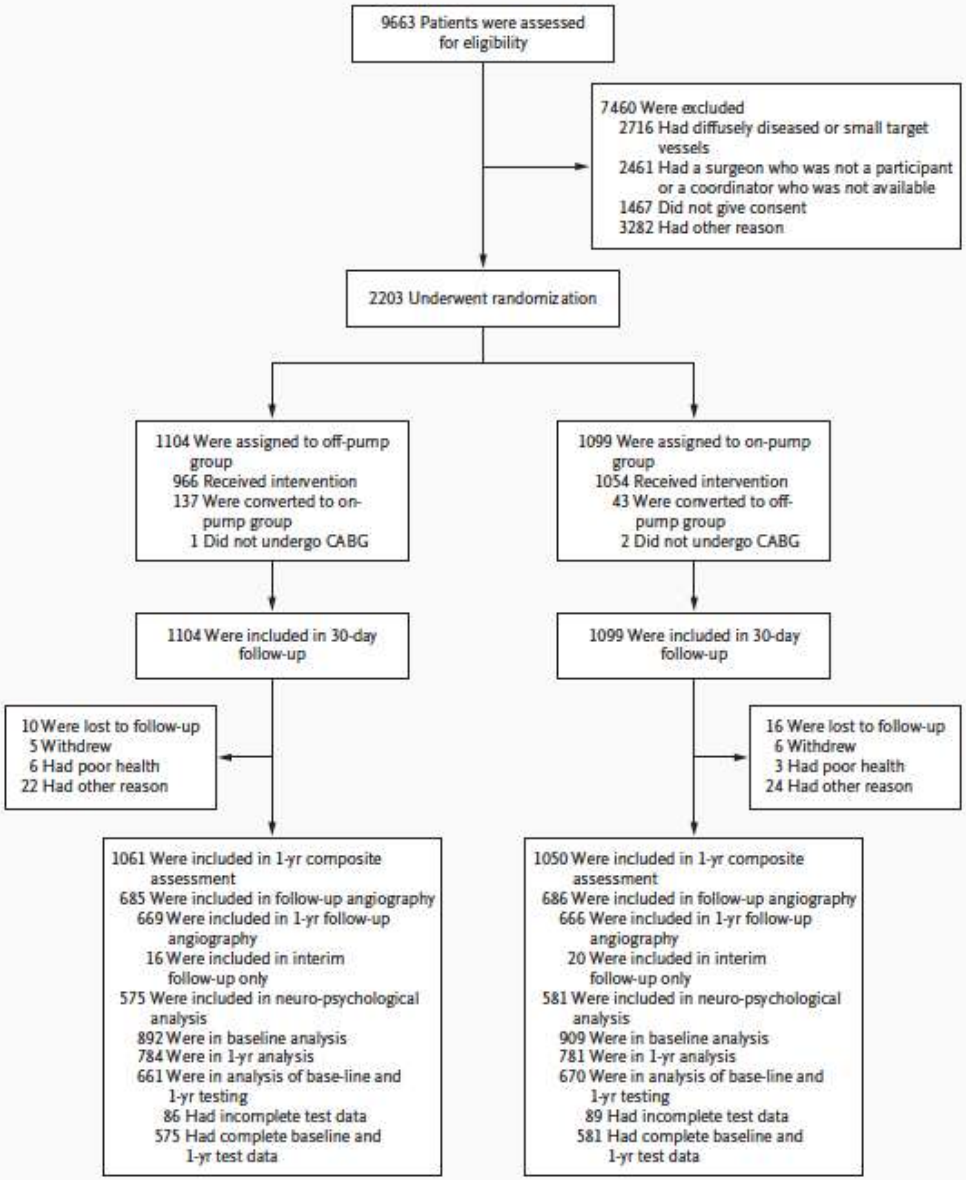

Figure 1. Enrollment, Randomization, and Follow-up of Patients.

For some of the 7460 patients who were excluded, there was more than one reason for exclusion. CABG denotes coronary-artery bypass grafting.

Table 2. Short-Term and Long-Term Primary End Points According to Treatment Group.*

Primary End Point	Off-Pump Group (N=1104)	On-Pump Group (N=1099)	Absolute Percentage-Point Difference (95% CI)	Relative Risk (95% CI)	P Value†
	no. (%)				
Short-term					
30-Day composite‡	77 (7.0)	61 (5.6)	1.4 (–0.6 to 3.5)	1.26 (0.91 to 1.74)	0.19
Death within 30 days after surgery or before discharge	18 (1.6)	13 (1.2)	0.4 (–0.5 to 1.4)	1.38 (0.68 to 2.80)	0.47
Complications within 30 days after surgery or before discharge					
Cardiac arrest	20 (1.8)	12 (1.1)	0.7 (–0.3 to 1.7)	1.66 (0.82 to 3.38)	0.21
Renal failure requiring dialysis	9 (0.8)	10 (0.9)	–0.1 (–0.9 to 0.7)	0.90 (0.37 to 2.20)	0.82
Stroke	14 (1.3)	8 (0.7)	0.5 (–0.3 to 1.4)	1.75 (0.74 to 4.14)	0.28
Coma	4 (0.4)	3 (0.3)	0.1 (–0.4 to 0.6)	1.33 (0.30 to 5.93)	1.00
Repeat cardiac surgery	8 (0.7)	8 (0.7)	–0.0 (–0.7 to 0.7)	1.00 (0.38 to 2.65)	1.00
Reoperation for bleeding	30 (2.7)	23 (2.1)	0.6 (–0.7 to 1.9)	1.30 (0.76 to 2.22)	0.40
New mechanical support	17 (1.5)	9 (0.8)	0.7 (–0.2 to 1.6)	1.88 (0.84 to 4.21)	0.17
Mediastinitis	11 (1.0)	14 (1.3)	–0.3 (–1.1 to 0.6)	0.78 (0.36 to 1.72)	0.55
Tracheostomy	5 (0.5)	7 (0.6)	–0.2 (–0.8 to 0.4)	0.71 (0.23 to 2.24)	0.58
Long-term					
1-Yr composite§	105 (9.9)	78 (7.4)	2.5 (0.1 to 4.9)	1.33 (1.01 to 1.76)	0.04
1-Yr composite with death from cardiac causes rather than from any cause	93 (8.8)	62 (5.9)	2.9 (0.6 to 5.1)	1.48 (1.09 to 2.02)	0.01
1-Yr composite with all end points from time of CABG	155 (14.6)	104 (9.9)	4.7 (1.9 to 7.5)	1.47 (1.17 to 1.86)	0.001
Nonfatal myocardial infarction between 30 days and 1 yr after surgery	21 (2.0)	23 (2.2)	–0.2 (–1.4 to 1.0)	0.90 (0.50 to 1.62)	0.76
Revascularization between 30 days and 1 yr after surgery	49 (4.6)	36 (3.4)	1.2 (–0.5 to 2.9)	1.35 (0.88 to 2.05)	0.18
Death from any cause within 1 yr	43 (4.1)	30 (2.9)	1.2 (–0.4 to 2.8)	1.41 (0.90 to 2.24)	0.15
Death from cardiac causes within 1 yr	29 (2.7)	14 (1.3)	1.4 (0.2 to 2.6)	2.05 (1.09 to 3.86)	0.03

Three-year follow-up in a subset of high-risk patients randomly assigned to off-pump versus on-pump coronary artery bypass surgery: the Best Bypass Surgery Trial

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Heart. 2011 Jun;97(11):907-13. Epub 2011 Mar 17.

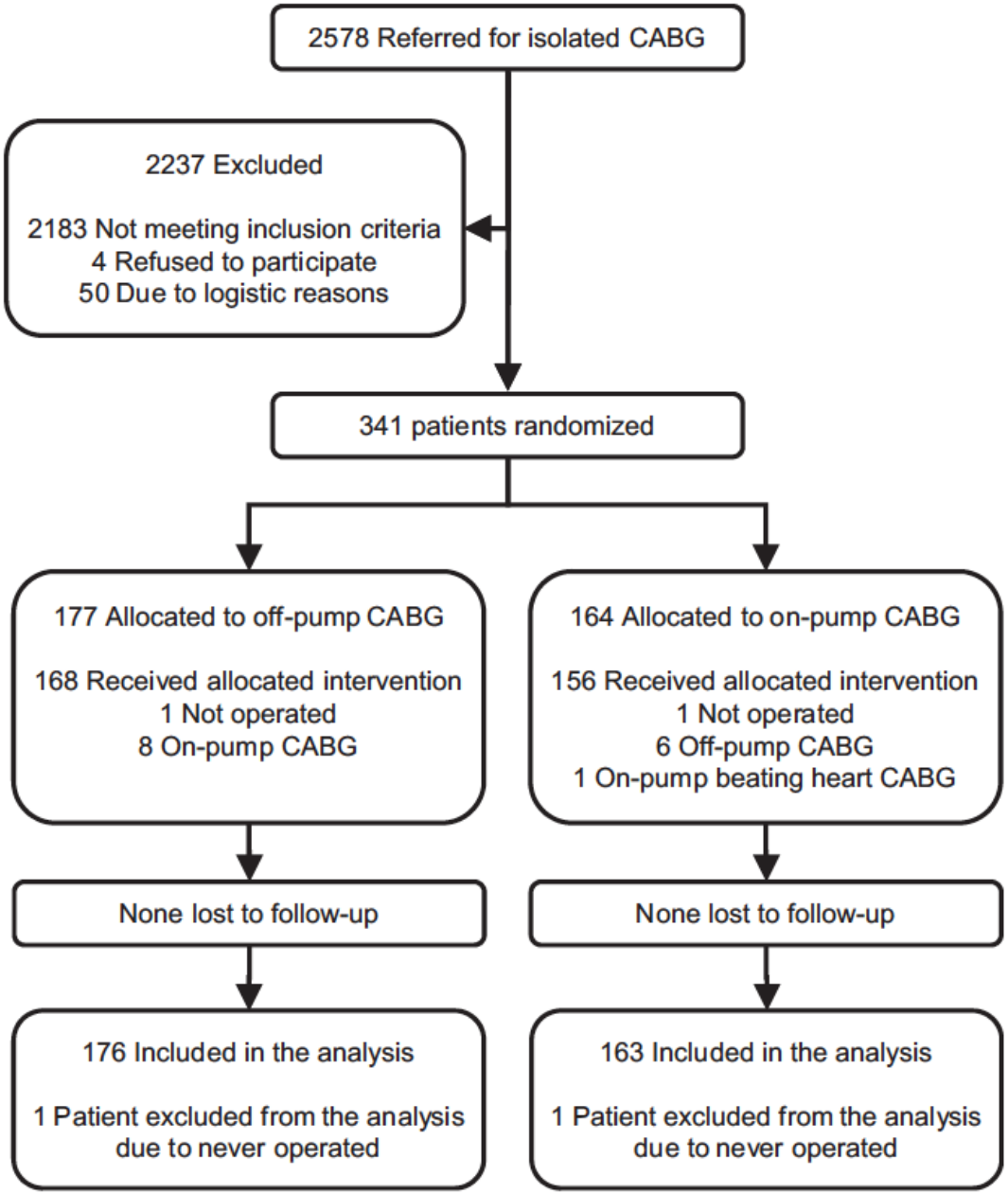


Figure 1 Enrolment, randomisation, and follow-up of patients in the Best Bypass Surgery Trial. CABG, coronary artery bypass grafting.

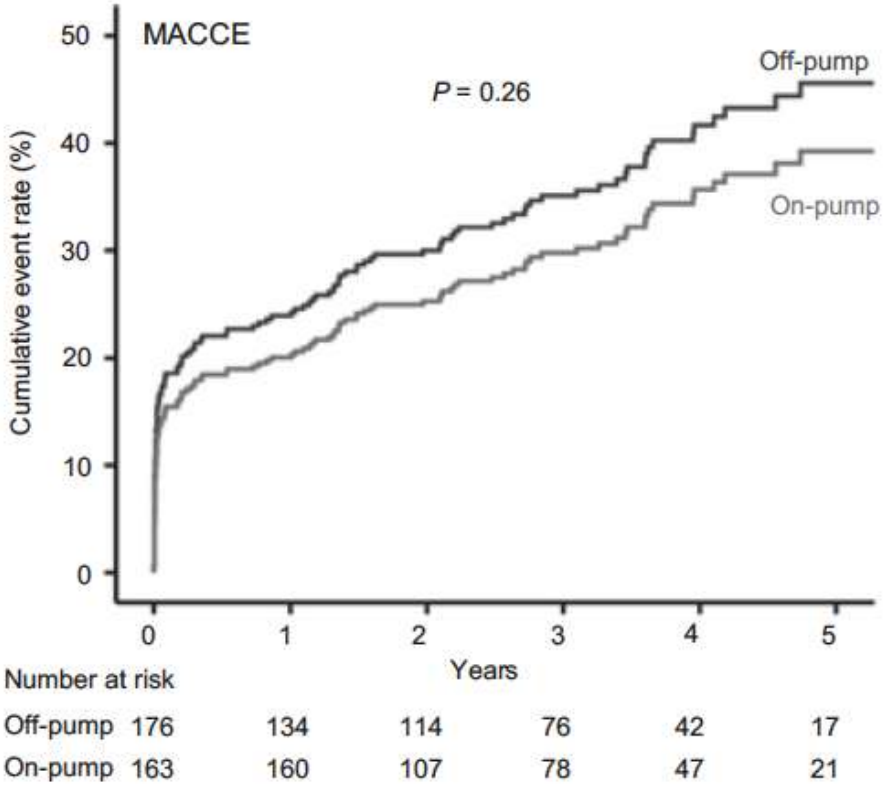
Table 3 Primary composite outcome measure and the individual components of the primary outcome measure—intention-to-treat analyses

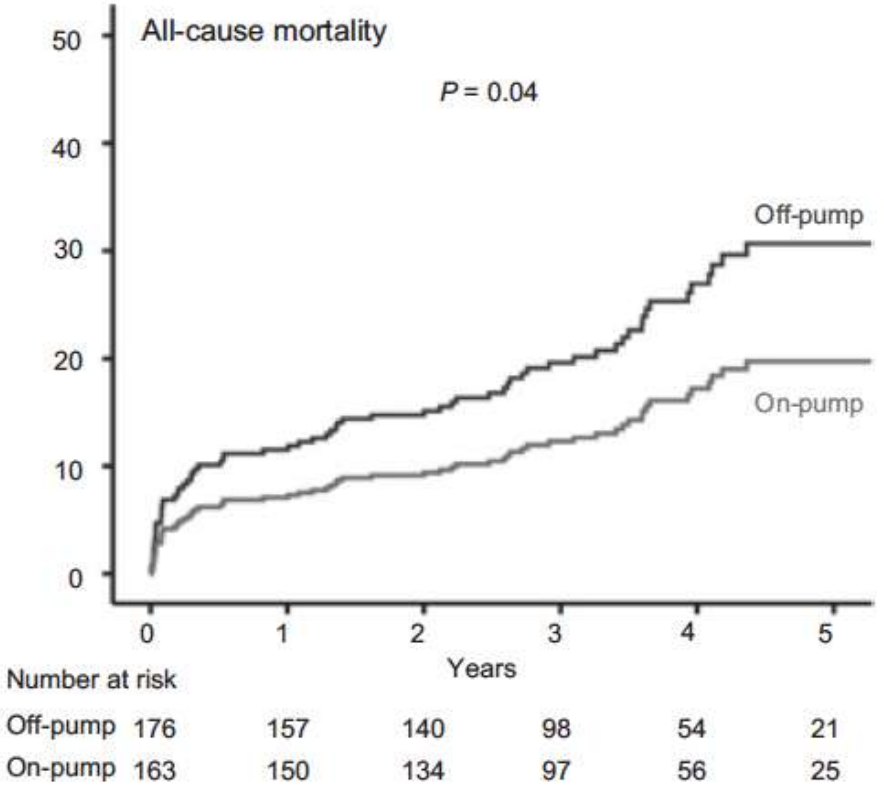
Variable	Off-pump (N = 176)	On-pump (N = 163)	HR (95% CI)	p Value
MACCE	69 (40)	54 (33)	1.22 (0.86 to 1.75)	0.26
All-cause mortality	43 (24)	25 (15)	1.66 (1.02 to 2.73)	0.04
Myocardial infarction	13 (7.4)	23 (14)	0.53 (0.27 to 1.04)	0.06
Cardiac arrest*	5 (2.8)	3 (1.8)	1.59 (0.38 to 6.65)	0.52
LCOS	7 (4.0)	10 (6.1)	0.65 (0.25 to 1.70)	0.37
Stroke	16 (9.0)	11 (6.7)	1.43 (0.66 to 3.08)	0.36
Coronary reintervention	9 (5.1)	10 (6.1)	0.87 (0.35 to 2.14)	0.76

Table 5 Secondary outcome measures

Variable	Off-pump (N = 176)	On-pump (N = 163)	HR (95% CI)	p Value
Hyperdynamic shock	1 (0.6)	0 (0)	NA	NA
Atrial fibrillation	80 (45)	73 (45)	1.06 (0.77 to 1.46)	0.71
Need for pacing	15 (9)	15 (9)	0.94 (0.46 to 1.93)	0.87
Renal complications	32 (18)	29 (18)	1.03 (0.63 to 1.71)	0.90
Pneumonia	38 (22)	28 (17)	1.31 (0.81 to 2.14)	0.27
Intubation more than 24 h	10 (6)	11 (7)	0.84 (0.36 to 1.98)	0.69

Values are numbers of outcomes (percentages).


MACCE
P = 0.26
Off-pump
On-pump
Cumulative event rate (%)
50
40
30
20
10
0
0
1
2
3
4
5
Years
Number at risk
Off-pump 176 134 114 76 42 17
On-pump 163 160 107 78 47 21


All-cause mortality
P = 0.04
Off-pump
On-pump
50
40
30
20
10
0
0
1
2
3
4
5
Years
Number at risk
Off-pump 176 157 140 98 54 21
On-pump 163 150 134 97 56 25

Does off-pump coronary artery bypass surgery have a beneficial effect on mortality in patients with left ventricular dysfunction?

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Abstract

A best evidence topic was written according to a structured protocol. The question addressed was whether off-pump coronary artery bypass surgery (OPCAB) offered any beneficial effect on mortality when compared with on-pump coronary artery bypass surgery (ONCAB) in patients with left ventricular dysfunction (LVD). A total of 491 papers were found using the reported searches of which 17 represented the best evidence. The authors, date, journal, study type, outcome measures and results are tabulated. The 17 studies (only containing patients with LVD) comprised of one prospective randomized trial, one meta-analysis and 15 retrospective studies. The prospective trial associated the OPCAB technique with significantly lower in-hospital mortality. By comprising of seven studies and 1512 patients, the meta-analysis showed no significant difference in terms of operative mortality. Of the retrospective studies, all 15 compared short-term mortality (<30-day) of which four showed significantly lower mortality in the OPCAB group. Nine of the studies compared mid-term mortality (30 days to 5 years) with no significant difference detected and three of the studies compared long-term mortality (>5 years) with no significant difference detected. We conclude that there is limited evidence to associate the OPCAB technique with improved short-term mortality. The majority of the studies suffered from significant limitations such as containing data from operations carried out prior to the year 2000, a period when off-pump surgery was in its infancy. They frequently contained major differences in baseline characteristics with no specific inclusion/exclusion criteria, description of handling of patients converted from off-pump to bypass or reporting of myocardial viability and concomitant mitral regurgitation. Nine studies reported completeness of revascularization of which eight associated the OPCAB group with a poorer degree of revascularization making comparisons less valid. The lack of high-quality data indicates that prospective randomized trials are needed. The CRISP Trial ('Coronary artery grafting in high-risk patients randomized to off-pump or on-pump surgery') has recently been halted due to recruitment difficulties. The CORONARY ('Coronary artery bypass surgery off- or on-pump revascularization study') trial is a large international multicentre randomized study that is recruiting well and is likely to provide valuable information in the near future.

Keywords: CABG • Off-pump surgery • Ventricular dysfunction • Outcomes

A Randomized Trial of On-Pump Beating Heart and Conventional Cardioplegic Arrest in Coronary Artery Bypass Surgery Patients With Impaired Left Ventricular Function Using Cardiac Magnetic Resonance Imaging and Biochemical Markers

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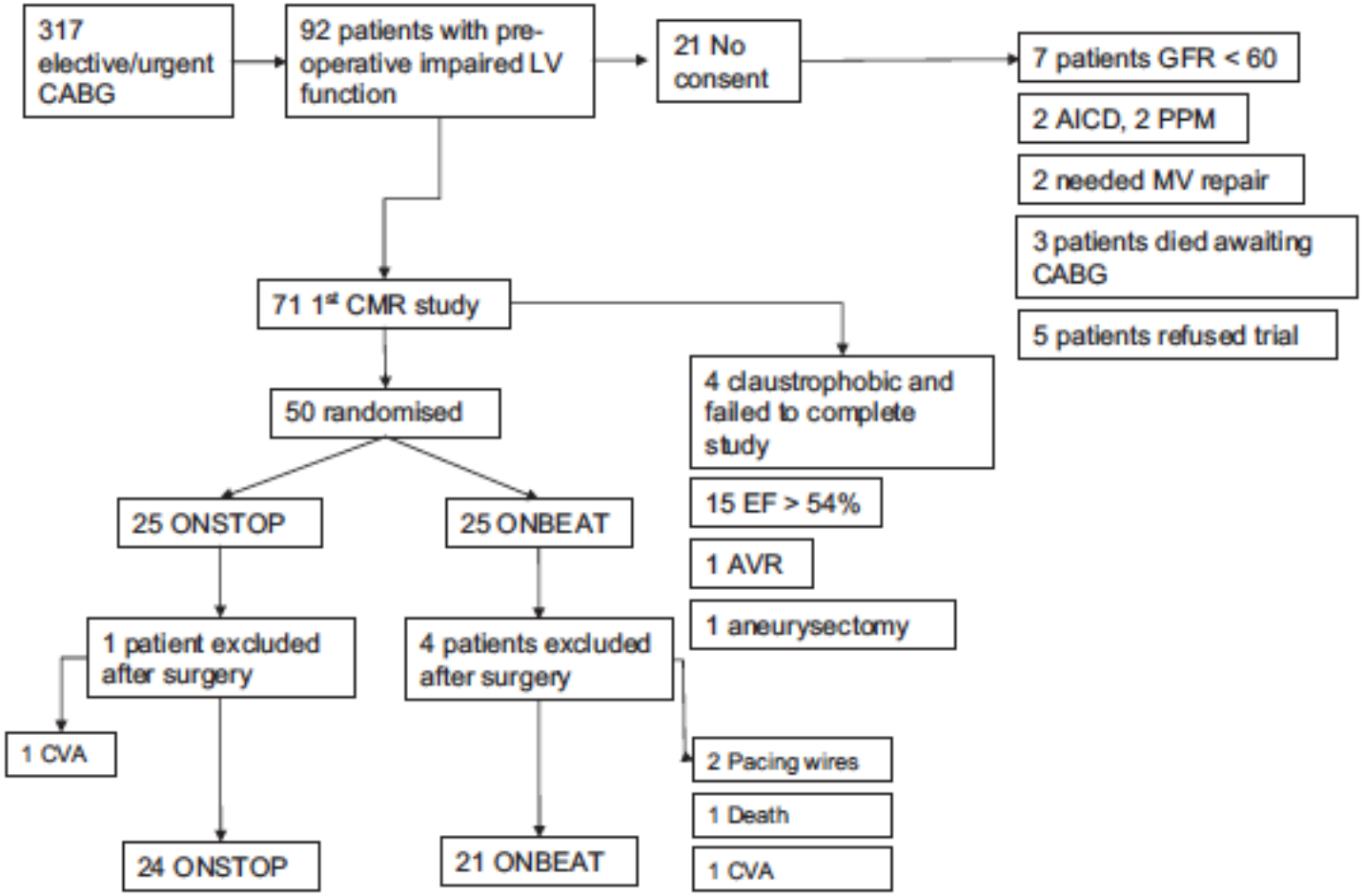
Jane M. Francis, DCRR, DNM; Theodoros D. Karamitsos, MD, PhD;
Zoe Maunsell, MSc, MBiochem; Ly-Mee Yu, MSc; Stefan Neubauer, FRCP, MD;
David P. Taggart, FRCS, PhD*

Background—Beating heart coronary artery bypass grafting (CABG) improves early postoperative cardiac function in patients with normal ventricular function, but its effect in patients with impaired function is uncertain. We compared a novel hybrid technique of on-pump beating heart CABG (ONBEAT) with conventional on-pump CABG (ONSTOP) in patients with impaired ventricular function.

Methods and Results—In a single-center randomized trial, 50 patients with impaired ventricular function were randomly assigned to ONBEAT or ONSTOP. Patients underwent cardiac magnetic resonance imaging for function and delayed hyperenhancement early and later after surgery. Serial assessment of biochemical markers was also undertaken. Preoperative characteristics were well matched; cardiac index was 2.85±0.53 (ONBEAT) and 2.62±0.59 $L \cdot min^{-1} \cdot m^{-2}$ (ONSTOP). Early after surgery, there was a trend toward a greater reduction in end-systolic volume index in ONSTOP patients versus ONBEAT (−9±8 versus −4±11 $mL \cdot m^{-2}$; $P=0.06$). The changes were sustained and significant at 6 months (−14±18 versus −2±19 $mL \cdot m^{-2}$; $P=0.04$). Furthermore, the incidence of new hyperenhancement at 6 days was higher in ONBEAT patients ($P=0.05$), with 6 of 17 (35%) sustaining 8.2±5.2 g of new hyperenhancement each versus 2 of 23 (9%) in the ONSTOP group, each with 9.8±9.0 g ($P=0.86$). Finally, median area under the curve for troponin was higher in ONBEAT at 461 (interquartile range, 226 to 1141) μg/L versus 160 (interquartile range, 98 to 357) μg/L for ONSTOP ($P=0.002$).

Conclusions—The incidence of new irreversible myocardial injury was significantly higher in ONBEAT than in ONSTOP patients. Furthermore, at 6 months, only ONSTOP patients demonstrated an improvement in ventricular geometry. The most likely mechanism is inadequate coronary perfusion to distal myocardial territories in patients with severe proximal coronary disease. (***Circulation***. 2008;118:2130-2138.)


317 elective/urgent CABG
92 patients with pre-operative impaired LV function
21 No consent
7 patients GFR < 60
2 AICD, 2 PPM
2 needed MV repair
3 patients died awaiting CABG
5 patients refused trial
71 1st CMR study
4 claustrophobic and failed to complete study
50 randomised
15 EF > 54%
1 AVR
1 aneurysectomy
25 ONSTOP
25 ONBEAT
1 patient excluded after surgery
4 patients excluded after surgery
1 CVA
2 Pacing wires
1 Death
1 CVA
24 ONSTOP
21 ONBEAT

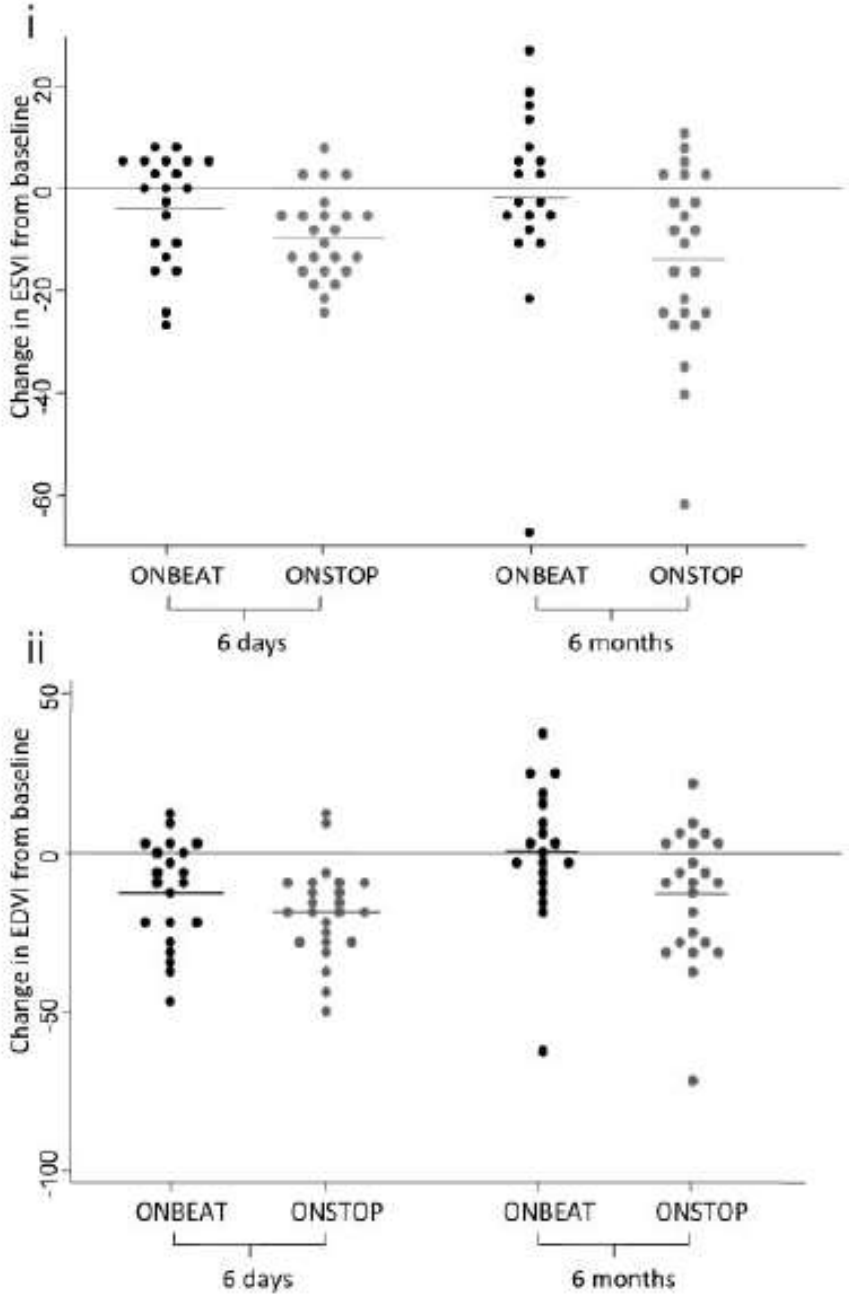


Figure 3. Individual change in ESVI and EDVI at 6 days and 6 months after surgery, ONBEAT vs ONSTOP.

The Effects of Levosimendan in Cardiac Surgery Patients with Poor Left Ventricular Function

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Stefanie Cromheecke, MD*

Philippe J. Van der Linden, MD, PhD†

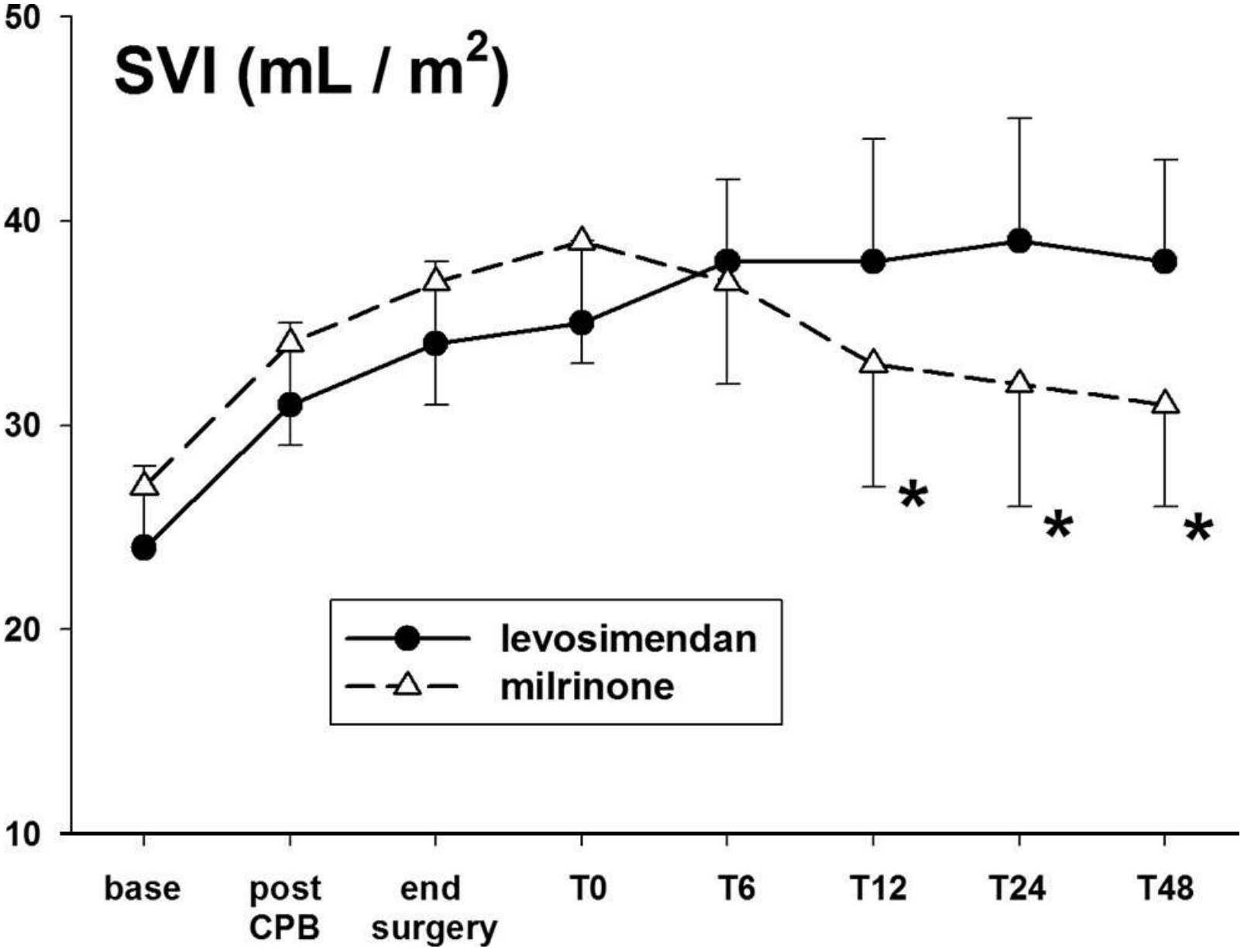
BACKGROUND: Patients with poor left ventricular function often require inotropic drug support immediately after cardiopulmonary bypass. Levosimendan improves cardiac function by a novel mechanism of action compared to currently available drugs. We hypothesized that, in patients with severely compromised ventricular function, the use of levosimendan would be associated with better postoperative cardiac function than with inotropic drugs that increase myocardial oxygen consumption.

METHODS: Thirty patients with a preoperative ejection fraction ≤30% scheduled for elective cardiac surgery with cardiopulmonary bypass were randomized to two different inotropic protocols: milrinone 0.5 $mg \cdot kg^{-1} \cdot min^{-1}$ or levosimendan 0.1 $mg \cdot kg^{-1} \cdot min^{-1}$, started immediately after the release of the aortic crossclamp. The treatment was masked to the observers. All patients received dobutamine 5 $mg \cdot kg^{-1} \cdot min^{-1}$.

RESULTS: Stroke volume was similar between groups initially after surgery, but it declined 12 h after surgery in the milrinone group but not in the levosimendan group ($P < 0.05$ between groups) despite similar filling pressures. Total dose, duration of inotropic drug administration and norepinephrine dose were lower in the levosimendan group than in the milrinone group ($P < 0.05$). The duration of tracheal intubation was shorter in the former group compared with the milrinone group ($P = 0008$). Three patients in the milrinone group but none in the levosimendan group died within 30 days of surgery.

CONCLUSION: In cardiac surgery patients with a low preoperative ejection fraction, stroke volume was better maintained with the combination of dobutamine with levosimendan than with the combination of dobutamine with milrinone.

(Anesth Analg 2007;104:766–73)


SVI (mL / m2)
50
40
30
20
10
levosimendan
milrinone
*
*
*
base
post CPB
end surgery
T0
T6
T12
T24
T48

Original Article

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19(2) 154–159

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SAGE

Levosimendan vs. intra-aortic balloon pump in high-risk cardiac surgery

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Abstract

The purpose of our study was to compare the efficiency of levosimendan and preventive intra-aortic balloon pump in high-risk cardiac patients (left ventricular ejection fraction <35%) operated under cardiopulmonary bypass. In 20 patients, intra-aortic balloon pump was started 16–18 h before surgery; another 20 had a levosimendan infusion starting after induction of anesthesia with an initial bolus of 12 $\mu g \cdot kg^{-1}$ for 10 min, followed by 0.1 $\mu g \cdot kg^{-1} \cdot min^{-1}$ for 24 h. Postoperative complications, hemodynamics, and markers of cardiac damage were analyzed. In the levosimendan group, cardiac index was significantly higher 5 min after cardiopulmonary bypass, at the end of the operation, 2 and 4 h after perfusion, compared to the intra-aortic balloon pump group. The level of troponin I in the levosimendan group was significantly lower at 6 h after the operation. Intensive care unit stay was significantly shorter in the levosimendan group. It was concluded that the use of levosimendan in high-risk cardiac patients is as effective as intra-aortic balloon pump, in terms of maintaining stable hemodynamic during and after operations under cardiopulmonary bypass. The lower level of troponin I at 6 h postoperatively suggests cardioprotective properties of levosimendan, but requires further investigation.

Table 2. Postoperative findings and outcome

Variable	IABP	Levosimendan	*p* Value
Ventilation time (h)	8.47 ± 4.1	9.7 ± 7.2	NS
ICU stay (days)	4.5 ± 1.7	3.2 ± 2.1	0.03
Mortality	0	0	NS
Blood loss in 1st 24 h (mL·kg^{-1})	5.73 ± 3.4	5.3 ± 2.7	NS
Reoperation for bleeding	0	0	NS
Need for inotropic support	7/20 (35%)	6/20 (30%)	NS
Postoperative dialysis	0	0	NS
Mediastinitis	1/20 (5%)	2/20 (10%)	NS

IABP = intra-aortic balloon pump, ICU = intensive care unit, NS = not significant.

Table 4. Markers of myocardial damage

Marker	Group	Baseline	End of Operation	6 h after the operation	POD 1	POD 2
cTnI	IABP	0.02 ± 0.01	2.19 ± 2.05	6.77 ± 5.86	3.98 ± 3.94	1.35 ± 1.47
($ng \cdot mL^{-1}$)	Levo	0.025 ± 0.01	1.43 ± 1.1	2.74 ± 2.01*	4.67 ± 2.3	3.05 ± 2.3
CK-MB	IABP	19.4 ± 11.2	63.1 ± 25.4	58.0 ± 23.5	85.8 ± 58.8	63.0 ± 34.4
($U \cdot L^{-1}$)	Levo	18.3 ± 15.0	67.6 ± 30.3	70.3 ± 34.2	66.0 ± 21.8	60.0 ± 24.6

*$p < 0.05$ between groups. CK-MB = creatine kinase MB-isoenzyme, cTnI = cardiac troponin I, IABP = intra-aortic balloon pump, Levo = levosimendan, POD = postoperative day.

Levosimendan Facilitates Weaning From Cardiopulmonary Bypass in Patients Undergoing Coronary Artery Bypass Grafting With Impaired Left Ventricular Function

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Departments of Anesthesiology and Intensive Care, Cardiothoracic Surgery, and Cardiology, Helsinki University Central Hospital, Helsinki, Departments of Anesthesiology and Cardiovascular Surgery, Turku University Hospital, Turku, and Orion Pharma, Cardiology Unit, Clinical Research and Development, Espoo, Finland

Background. Levosimendan is a compound with vasodilatory and inotropic properties. Experimental data suggest effective reversal of stunning and cardioprotective properties.

Methods. This prospective, randomized, placebo-controlled, double-blind study included 60 patients with 3-vessel coronary disease and left ventricular ejection fraction (LVEF) of less than 0.50. Levosimendan administration (12 μg/kg bolus, followed by an infusion of 0.2 μg/kg/min) was started immediately after induction anesthesia. Predefined strict hemodynamic criteria were used to assess the success of weaning. If weaning was not successful, CPB was reinstituted and an epinephrine infusion was started. If the second weaning attempt failed, intraaortic balloon pumping (IABP) was instituted.

Results. The groups had comparable demographics. The mean (standard deviation) preoperative LVEF was 0.36 (0.8) in both groups. The baseline cardiac index was 1.8 (0.3) L/min/m^2 in the levosimendan group and 1.9 (0.4) L/min/m^2 in the placebo group. The mean duration of CPB to primary weaning attempt was 104 (25) minutes in the levosimendan and 109 (22) minutes in the placebo group. Primary weaning was successful in 22 patients (73%) in the levosimendan group and in 10 (33%) in the placebo group ($p = 0.002$). The odds ratio for failure in primary weaning was 0.182 (95% confidence interval, 0.060 to 0.552). Four patients in the placebo group failed the second weaning and underwent IABP compared with none in the levosimendan group ($p = 0.112$).

Conclusions. Levosimendan significantly enhanced primary weaning from CPB compared with placebo in patients undergoing 3-vessel on-pump coronary artery bypass grafting. The need for additional inotropic or mechanical therapy was decreased.

(Ann Thorac Surg 2009;87:448–54)

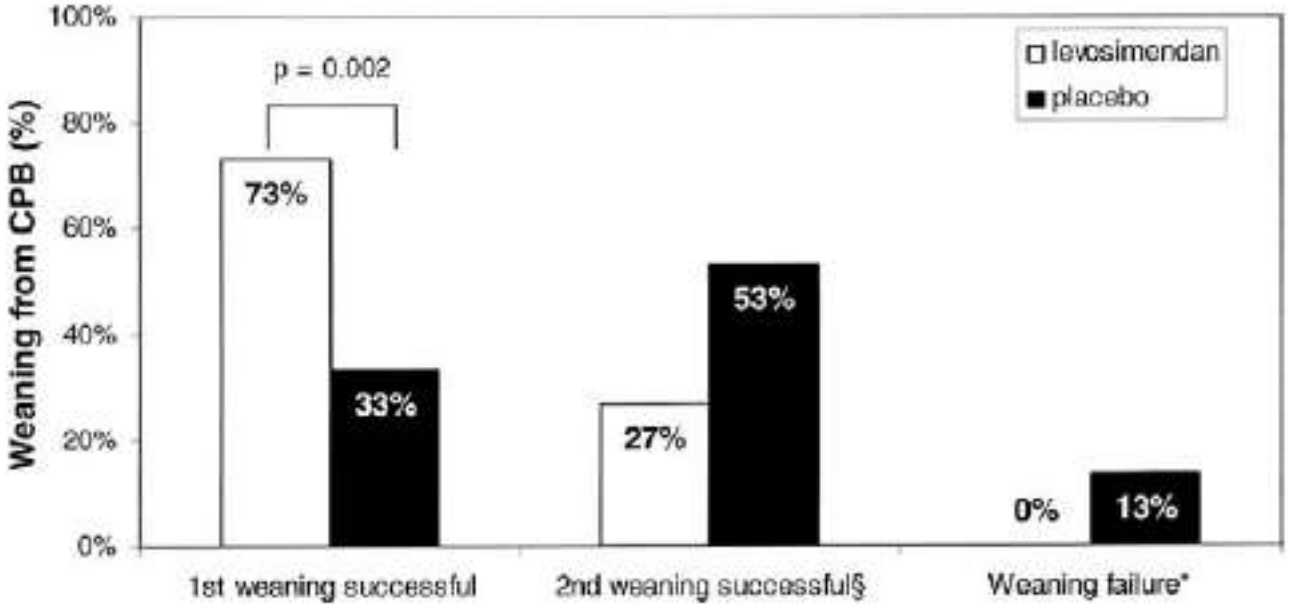

*Fig 1. Weaning from cardiopulmonary bypass (CPB). First weaning attempt with levosimendan and placebo. Epinephrine added to second weaning attempt. §Two levosimendan patients were weaned in primary attempt although failed to meet primary endpoint hemodynamic criteria. *Weaning failure leads to use of intra-aortic balloon pump.*

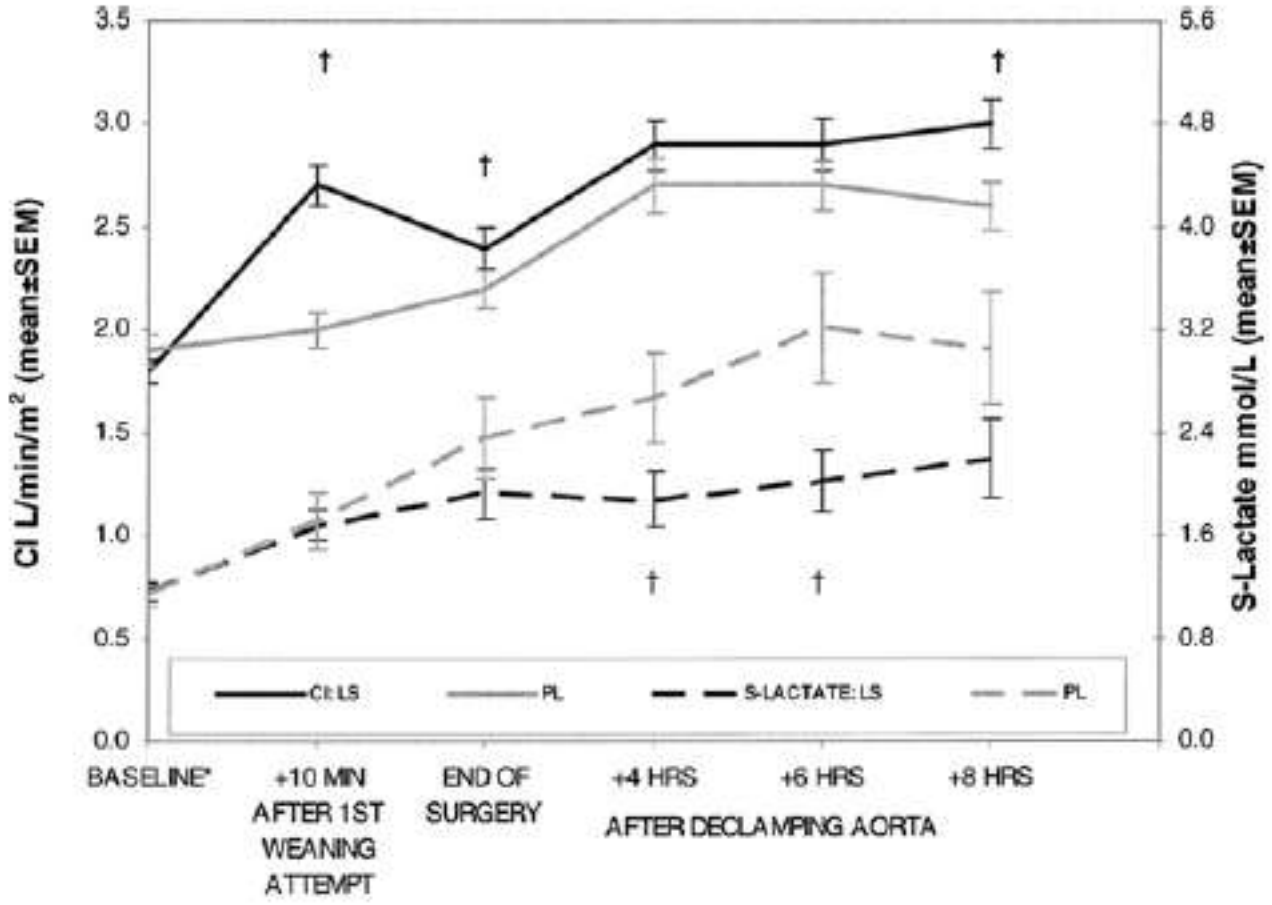

Fig 2. Cardiac index (CI) and lactate values in levosimendan (black lines) and placebo (gray lines) groups. Baseline denotes after induction of anesthesia. (†Denotes $p < 0.05$ between levosimendan and placebo.)

Table 3. Use of Rescue Inotropic Medications Within 6 Hours After Declamping Aorta

Drug	Levosimendan (n = 30)	Placebo (n = 30)
Epinephrine		
Patients, No. (%)	15 (50.0)	24 (80.0)
Cumulative dose, median (range), mg	2.2 (0.3–5.2)	1.8 (0.0–3.1)
Milrinone		
No. (%)	2 (6.7)	5 (16.7)
Cumulative dose, median (range), mg	7.6 (4.5 - 10.7)	6.9 (2.0–9.2)

Levosimendan reduces heart failure after cardiac surgery: A prospective, randomized, placebo-controlled trial*

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Objective: To investigate whether levosimendan diminishes the incidence of heart failure after cardiac surgery.

Design: Prospective, randomized, placebo-controlled clinical study.

Setting: Cardiac surgery operating room and postanesthesia care unit in a university hospital.

Patients: Two hundred patients assigned to undergo heart valve or combined heart valve and coronary artery bypass grafting surgery.

Interventions: Patients were randomized to receive a 24-hr infusion of placebo or levosimendan administered as a 24 μg/kg bolus over 30-mins and thereafter at a dose of 0.2 μg/kg/min.

Measurements and Main Results: Heart failure was defined as cardiac index <2.0 L/min/m^2 or failure to wean from cardiopulmonary bypass necessitating inotrope administration for at least 2 hrs postoperatively. Heart failure was less frequent in the levosimendan compared to the placebo group: 15 patients (15%) in the levosimendan and 59 patients (58%) in the placebo group experienced heart failure postoperatively (risk ratio 0.26; 95% confidence interval 0.16–0.43; $p < .001$). Accordingly, a rescue inotrope (adrenaline) was needed less frequently in the levosimendan compared to the placebo group (risk ratio 0.11; 95% confidence interval 0.01–0.89), $p = .005$. Intra-aortic balloon pump was utilized in one patient (1%) in the levosimendan and in nine patients (9%) in the placebo group (risk ratio 0.11; 95% confidence interval 0.01–0.87), $p = .018$. The hospital and the 6-month mortality were comparable between groups. There were no significant differences in major organ failures postoperatively. Eighty-three patients were hypotensive and needed noradrenaline in the levosimendan compared to 52 patients in the placebo group, $p < .001$. The cardiac enzymes (creatine kinase MB isoenzyme mass) indicating myocardial damage were lower in the levosimendan group on the first postoperative day, $p = .011$.

Conclusions: In the present study, levosimendan infusion reduced the incidence of heart failure in cardiac surgery patients but was associated with arterial hypotension and increased requirement of vasopressor agents postoperatively. Improved mortality or morbidity was not demonstrated. (Crit Care Med 2011; 39:2263–2270)

KEY WORDS: cardiac surgery; heart failure; heart valve surgery; hypotension; inotropes; levosimendan

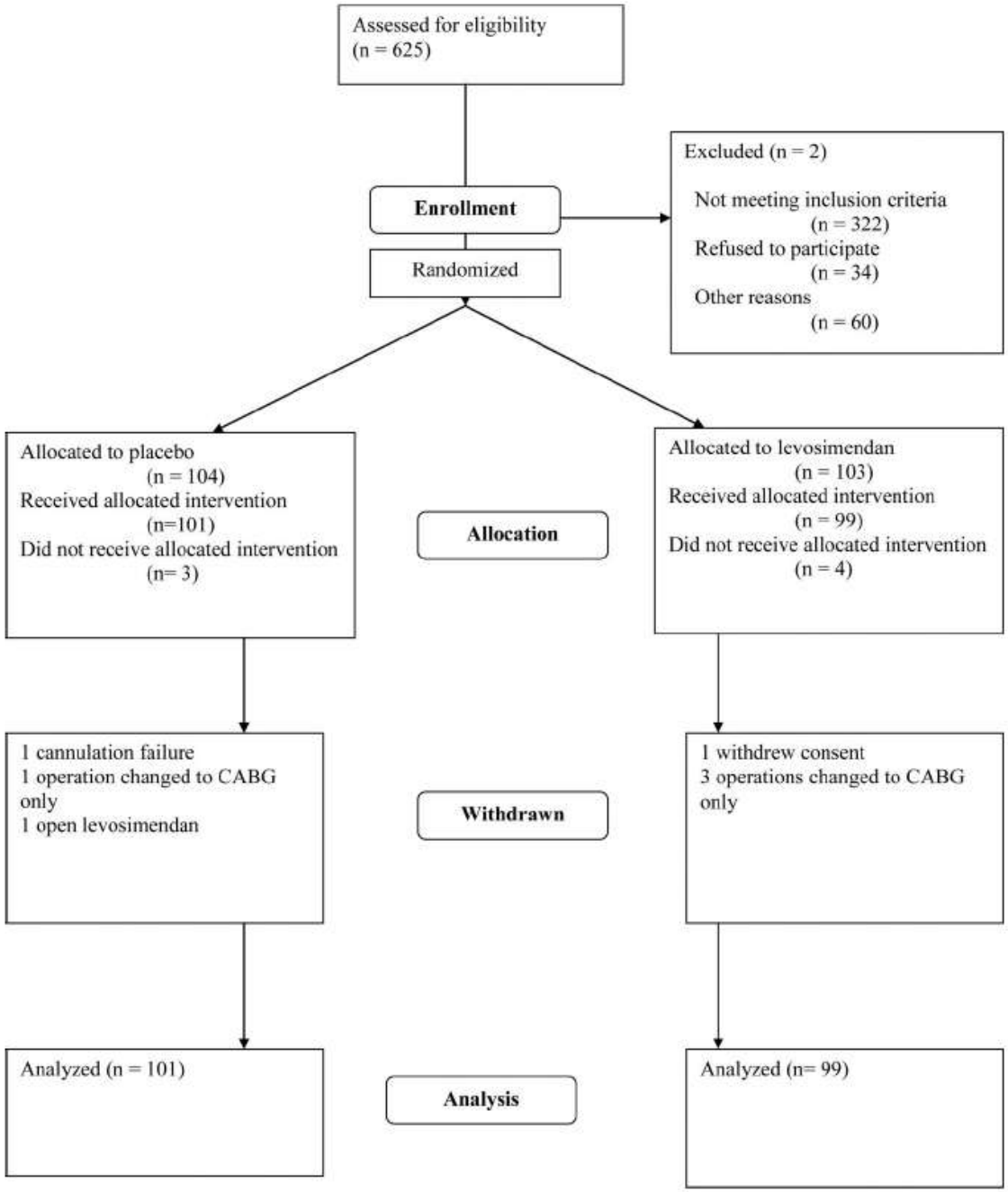

Figure 1. Trial profile. CABG, coronary artery bypass grafting.

Table 3. Fluid balance during 24 hrs perioperatively

Fluids	Placebo (n = 101)	Levosimendan (n = 99)	*p*
Crystalloids (L)	8.0 (4.0−18.2)	8.0 (5.0−17.0)	.124
Colloids (L)	2.5 (0.5−5.0)	2.3 (1.0−5.5)	.978
Fresh Frozen Plasma (L)	0 (0–2.2)	0 (0–2.0)	.976
Red cells (L, 1 unit = 0.25 L)	0.7 (0–5.9)	1.0 (0–6.3)	.855

Values are median (minimum-maximum).

Table 4. Primary outcome data, postoperative heart failure, and associated inotrope and vasopressor administration

Primary Outcome and Vasoactive Therapy	Placebo (n = 101)	Levosimendan (n = 99)	p^a
Heart Failure[b]	59	15	<.001
Dobutamine			
Periop	59	15	<.001
PACU	61	18	<.001
Adrenaline			
Periop	11	1	.005
PACU	9	1	.019
Milrinone			
Periop	5	1	.212
PACU	8	0	.007
Noradrenaline[c]			
Periop	43	76	<.001
PACU	52	81	<.001
Intra-Aortic Balloon Pump (Intensive Care Unit)	9	1	.018

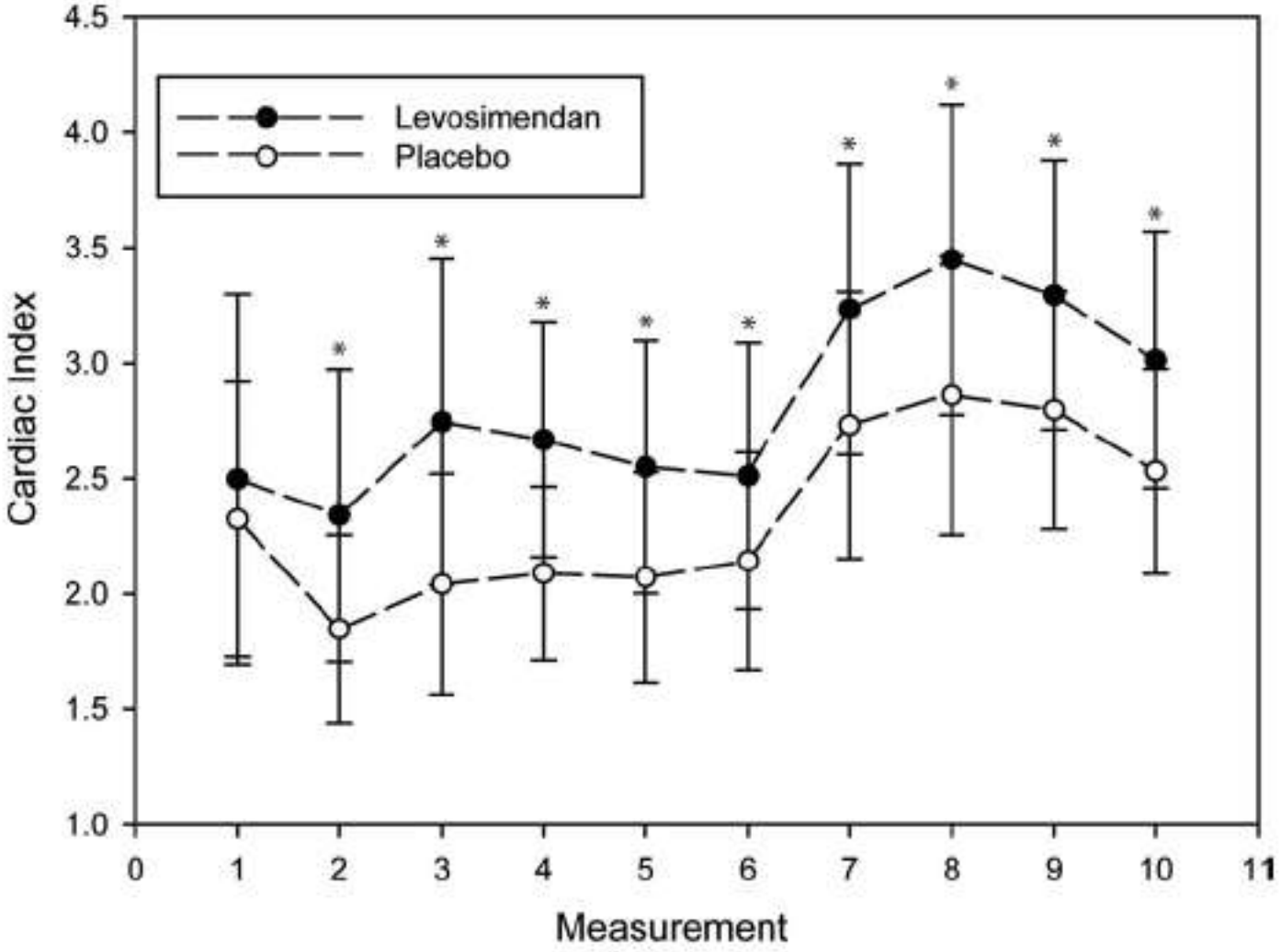
Levosimendan
Placebo
Cardiac Index
Measurement
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0
1
2
3
4
5
6
7
8
9
10
11
*

Table 5. Mortality and major organ morbidity

Mortality and Morbidity	Placebo (n = 101)	Levosimendan (n = 99)	*p*
Hospital Mortality	6	7	.124
30-day Mortality	10	10	.978
6-mo Mortality	12	12	.976
Postoperative acute myocardial infarction[a]	19	17	.855
Atrial fibrillation postoperatively	70	74	.433
Renal insufficiency[b]	8	8	1.0
Hepatic insufficiency[c]	3	2	1.0
Respiratory insufficiency[d] (>12h/>24h)	29/18	23/14	.423/.565
Central nervous system Disorder	16	12	.688
Prolonged intensive care unit stay/readmission[e]	36/10	40/10	.560/1.0
Length of stay, days (SD)	17 (26)	16 (12)	.622
Prolonged length of stay[f], n	88	81	.333
CK-MBm (μg/L)	38 (492)	29 (479)	.011
Cardiac troponin T (μg/L)	0.81 (18.1)	0.80 (18.0)	.739

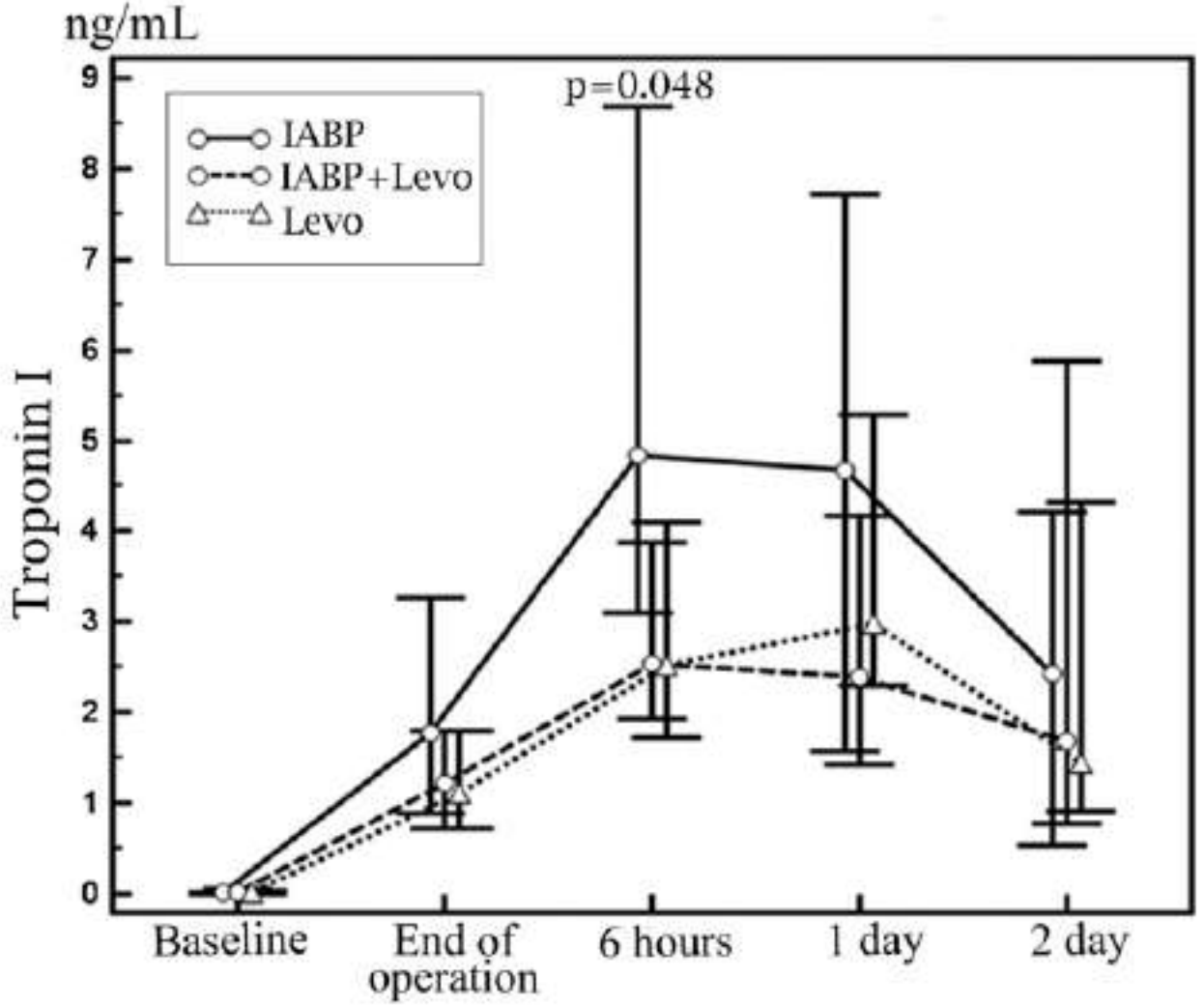

Fig 1. Higher troponin I in the intra-aortic balloon pump (IABP) group compared with levosimendan (Levo) group 6 hours after cardiopulmonary bypass. Values are presented as median and 95% confidence interval (error bars).

Ciddi Sol Ventrikül Disfonksiyonuna Bağlı Kalp Yetersizliği Olan Kalp Cerrahisi Hastalarında Preoperatif Levosimendan Kullanımı

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Tablo 1. Demografik, peroperatif ve takip parametreleri

	(n=10)
Ortalama yaş	55.2 ± 11.9
Unstable angina (%)	30
NYHA	3.2±0.4
Diabetes Mellitus (%)	60
Euroscore	6.5±2.7
Kardiyopulmoner baypas süresi (dakika)	81±21
Kardiyak arrest süresi (dakika)	51±20
Entübe kalma süresi (saat)	7.4±3.9
Postoperatif drenaj (ml)	600±368
Yoğun bakımda kalış süresi (saat)*	37±15
Postoperatif aritmi (%)	0
Hastanede kalış süresi (gün)	8.5±3.5
Postoperatif yüksek doz inotropik destek (%)	30
IABP kullanımı (%)	0
Ortalama takip süresi (ay)	11.6±5.7
1 aylık mortalite	0
1 yıllık mortalite	0
EF1 (%) **	27,5±3,1
EF2 (%) **	37,1±5,4
EF3 (%) **	40,3±10,7

***IABP:** İntraaortikc balon pompa
****EF1:** Preoperatif sol ventrikül ejeksiyon fraksiyonu, **EF2:** Postoperatif 1. gün sol ventrikül ejeksiyon fraksiyonu, **EF3:** Postoperatif 1. ay sol ventrikül ejeksiyon fraksiyonu (EF1 vs. EF2; p=0.01)

- Preoperatif Levosimendan 46 hasta
  - EF < %30
  - Ameliyattan 4 saat önce
- Propensity skor ile eşleştirme ve lojistik regresyon yapılmış 92 hasta

- Outcome analizi

	Levosimendan (n=46)	Kontrol (n=46)	P değeri
Kadın cinsiyet (%)	11	17	0.55
Yaş	59.5∓9.8	60.1∓8	0.75
KKY (%)	41.3	34.8	0.67
Diyabet (%)	43.5	32.6	0.39
Hipertansiyon (%)	71.7	54.3	0.13
KOAH (%)	89.1	82.6	0.55
PAH (%)	8.7	6.5	1.00
SVH (%)	2.2	4.3	1.00

	Levosimendan (n=46)	Kontrol (n=46)	P değeri
Preop clopidogrel (%)	10.9	*13*	1.00
Preop inotrop (%)	6.5	2.2	0.62
Preop Hct (%)	41∓4.6	40.2∓4.8	0.49
Preop kreatinin (mg/dL)	1.08∓0.41	1.02∓0.34	0.42
EF (%)	28.1∓3.8	26.4∓4.4	0.11
EuroSCORE	6.37∓2.49	6.52∓3.30	0.80
Redo (%)	4.3	0	0.50

	Levosimendan (n=46)	Kontrol (n=46)	P değeri
CABG	24	22	
CABG+ Mitral Kapak Tamiri	13	13	0.86
CABG+Diğer	9	11	

	Levosimendan (n=46)	Kontrol (n=46)	P değeri
CPB süresi (dak)	89.1∓26.3	88.3∓32.51	0.90
X-clamp süresi (dak)	57.5∓25.0	54.7∓22.5	0.57
Kan transfüzyonu (ünite/hasta)	1.09∓1.8	0.68∓1.16	0.19
TDP transfüzyonu (ünite/hasta)	1.35∓3.3	1.1∓1.6	0.63
Trombosit transfüz. (ünite/hasta)	0∓0	0.26∓1.02	0.09
Toplam drenaj (ml)	802∓566	733∓480	0.55
Postoperatif kreatinin	0.95∓0.49	1.03∓0.73	0.56
Postoperatif Hct	28.3∓3.1	29.3∓5.8	0.36

	Levosimendan (n=46)	Kontrol (n=46)	P değeri
Mortalite	0∓0	0.88∓0.28	0.04
Entübasyon süresi (saat)	9.0∓6.2	7.9∓5.2	0.39
YB kalış süresi (saat)	51.5∓70.3	29.8∓25.6	0.06
Hastane kalış süresi (gün)	10.4∓8.8	9.6∓15.8	0.78
Postop. AF %	71.7	80.4%	0.46
Postop. IABP %	6.5	2.2%	0.62
Postop. Vazopressör %	62.5	37.5%	0.12
ARY %	2.2%	0%	1.00
Stroke %	2.2%	0%	1.00
Enfeksiyon %	4.3%	2.2%	1.00

Pharmacological Criteria for Ventricular Assist Device Insertion Following Postcardiotomy Shock: Experience with the Abiomed BVS System

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J CARD SURG
1999;14:288-293

TABLE 1
Hospital Mortality Versus Inotrope Level Upon Separation from CPB

Inotrope Level	Number of Patients	Number of Mortalities
None	796 (23)	16 (2.0)
Low	1593 (46)	48 (3.0)
Moderate	606 (17.5)	45 (7.5)
One-High	277 (8)	58 (21)
Two-High	138 (4)	58 (42)
Three-High	52 (1.5)	42 (80)

Numbers within parentheses represent total percentage of patients.

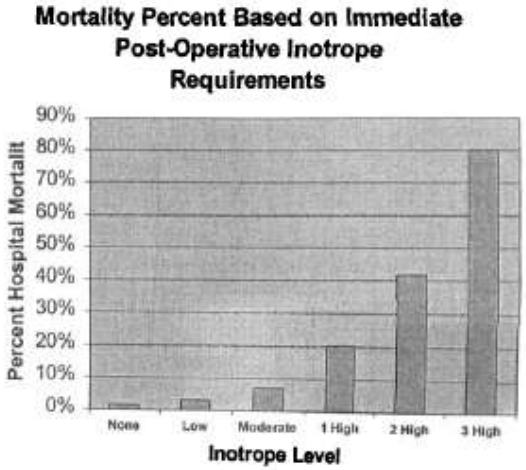

Figure 1. *Mortality percent based on immediate post-operative inotrope requirements.*

Timely Use of a CentriMag Heart Assist Device Improves Survival in Postcardiotomy Cardiogenic Shock

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Center for Cardiac Support, Texas Heart Institute at St. Luke's Episcopal Hospital, Houston, Texas

J CARD SURG
2011;26:548-552

TABLE 1
Preimplantation Patient Characteristics

Variable	All Patients (n = 22)	CentriMag Immediate Implantation (n = 10)	CentriMag Delayed Implantation (n = 12)
Age (years)	65 ± 12	62 ± 10	67 ± 14
Weight (kg)	88 ± 24	88 ± 24	86 ± 20
Body surface area (m^2)	1.80 ± 0.35	1.89 ± 0.14	1.72 ± 0.46
Gender [cases (%)]			
Men	13 (59)	6 (60)	7 (58)
Women	9 (41)	4 (40)	5 (42)
Coronary artery disease [cases (%)]	17 (77)	9 (90)	8 (67)
Left main disease [cases (%)]	5 (23)	3 (30)	2 (17)
Acute myocardial infarction [cases (%)]	13 (59)	8 (80)	5 (42)
LVEF (%)	40 ± 12	39 ± 9	41 ± 15
Hypertension (%)	18 (82)	9 (90)	9 (75)
Pulmonary hypertension* (%)	17 (77)	8 (80)	9 (75)
Diabetes mellitus (%)	8 (36)	5 (50)	3 (25)
Creatinine (mg/dL)	1.6 ± 0.6	1.5 ± 0.5	1.6 ± 0.6
Intra-aortic balloon pump support [cases (%)]	9 (41)	4 (40)	5 (42)
EuroSCORE	13.1 ± 4.6	12.6 ± 4.3	13.6 ± 5.0

Results are presented as mean ± standard deviation (SD) or number (%) of patients. LVEF = left ventricular ejection fraction.
*Pulmonary hypertension is defined as pulmonary artery pressure > 30 mmHg.

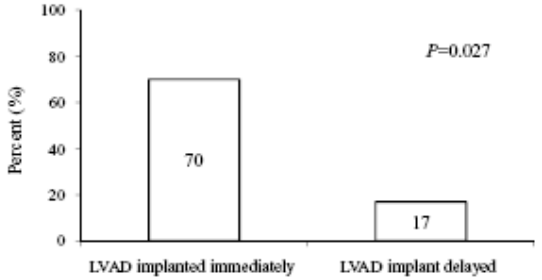
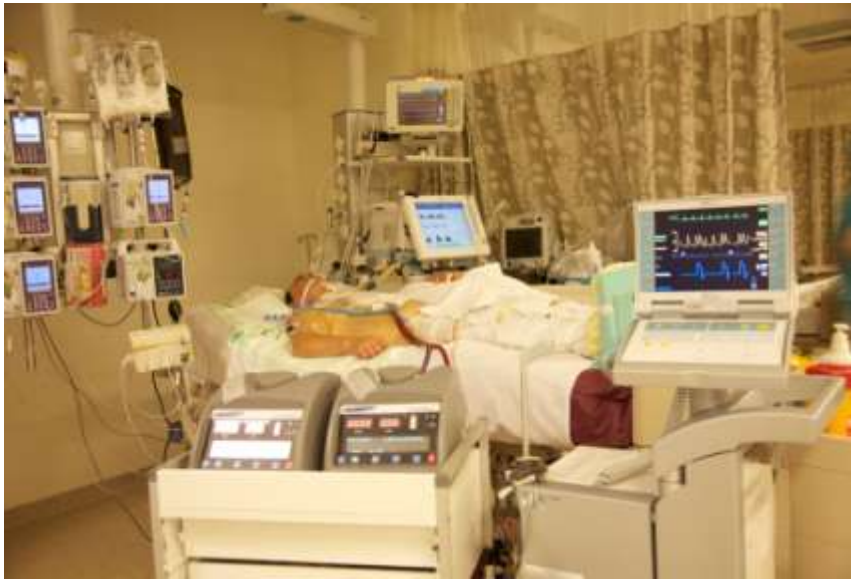
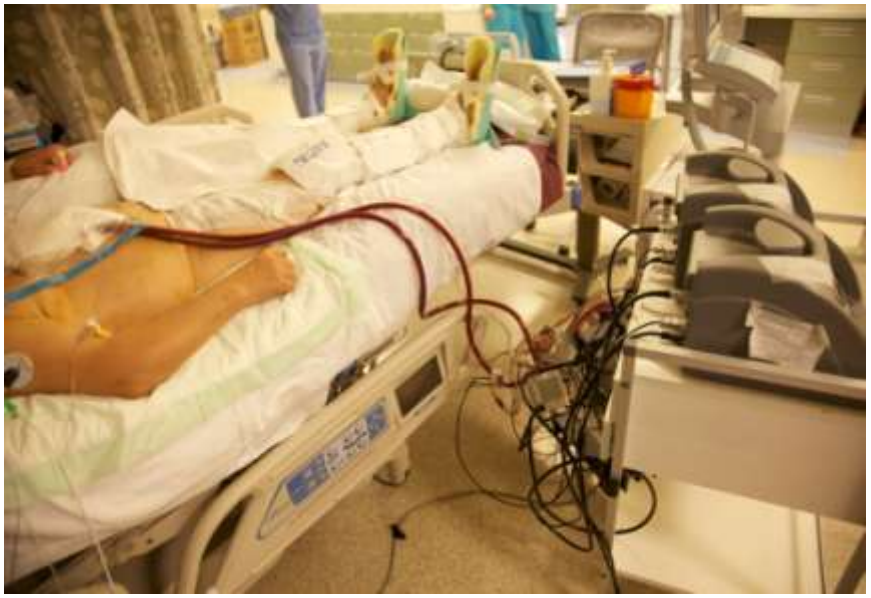


Figure 3. *Survival at 30-day follow-up was significantly better (p = 0.027) in patients who had the CentriMag LVAD implanted immediately after CPB than in patients who had a delayed LVAD implantation.*





Onbirinci Emir

- **“Thou shall not operate on the day of a patient's death”**
- **“Hastayı ölüm gününde ameliyat etme”**