

## Featured Abstracts – Coronary Outcomes

Friday, June 21, 2002, 8:00 a.m. – 10:00 a.m.

### 1 COGNITIVE DYSFUNCTION AFTER CARDIAC REVASCLARIZATION: FOLLOW-UP AT ONE YEAR

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**OBJECTIVE:** To assess cognitive impairment in patients undergoing cardiac revascularization (comparison of off-pump and on-pump techniques).

**METHODS:** 110 consecutive patients undergoing elective cardiac surgery were prospectively evaluated using a standard battery of neuropsychometric tests. The patients were divided into 3 groups: Group A - Patients undergoing Off-Pump CABG, Group B - Patients undergoing On-Pump CABG, Group C - Patients undergoing Valvular surgery + CABG. Patients performed these tests pre-operatively, at day 6 post-op and at 1 year post-op. For a variety of reasons, 17 patients did not do all the tests pre-operatively or at day 6. A further 8 patients did not do the tests at 1 year. Cognitive impairment was defined as a decrease in 20% in comprehensive test scores.

**RESULTS:** At 6 days post-op, 32.2% of patients (10/31) in Group A, 87.09% (27/31) in Group B, and all patients (31/31) in Group C had cognitive impairment. At 1 year, 6.89% patients (2/29) in Group A, 44.82% (13/29) in Group B and all patients (27/27) in Group C had cognitive impairment. Using one-way analysis of variance, the three groups were compared for cognitive impairment. Group A had less impairment than Group B at both time points post-operatively ( $p < 0.05$ ). There was no statistically significant difference in patient age, gender, LV function and number of grafts between the patients in Group A and Group B.

**CONCLUSIONS:** Off-Pump cardiac revascularization results in lesser incidence of cognitive impairment in the immediate post-operative period and at 1 year. Avoiding cardiopulmonary bypass may play an important role in this phenomenon.

### 3 MULTIVESSEL OFF-PUMP CORONARY ARTERY BYPASS: ANALYSIS OF 3908 CASES

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**OBJECTIVE:** Advancement in tissue stabilizers and intracoronary shunts has increased interest in off pump coronary surgery (OPCAB) all over the world. We analysed our results of OPCAB during the last five years and compared them with conventional coronary artery surgery (CCAB) on pump.

**METHODS:** A total of 3908 patients underwent OPCAB between January 1997 and December 2001. During the same period 7086 patients underwent CCAB.

**RESULTS:** The hospital mortality was 1.2% (47/3908) in OPCAB group and 1.8 % (127/7086) 0.8( 0.7 and 3.2 (in CCAB group ( $p = 0.022$ ). The average no of grafts were 2.9 ( $p < 0.7$  in OPCAB and CCAB( 0.7 and 2.3 (.001) and arterial grafts were 2.1 groups respectively ( $p < 6$  hrs,  $p( 4$  vs 25(.001). The intubation time (18 <74,  $p(49$  vs 598(.001), blood loss (347<.001), atrial fibrillation (10.7 % vs 18.9 %,  $p < .001$ ), re-exploration for bleeding (0.6% vs 2.8%,  $p < .001$ ) and prolonged ventilation (3.8 % vs 6.7%,  $p < .001$ ) were significantly less in OPCAB group than CCAB group. The incidence of perioperative MI (1.6% vs 1.8%,  $p = 0.473$ ) and stroke (0.8% vs 1.2 %,  $p = 0.058$ ) were not statistically significant 8 hrs) and hospital stay (5±6 hr vs 34(in two groups. The average ICU stay (22 2 vs 8 ± 3,  $p < .001$ ) were significantly less in OPCAB group.

**CONCLUSIONS:** Off pump coronary artery bypass is a safe and effective procedure for patients with multivessel coronary disease. It is associated with less morbidity than coronary artery bypass on pump.

### 2 PROSPECTIVE RANDOMIZED TRIAL OF ON-PUMP VS. OFF-PUMP CORONARY SURGERY COMPARING CLINICAL OUTCOMES, NEUROPSYCHOLOGICAL FUNCTION AND BIOCHEMICAL MARKERS

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**OBJECTIVE:** We compared graft patency, biochemical markers and neuropsychological function in patients with three vessel disease undergoing off-pump coronary surgery (OPCAB) to those with cardiopulmonary bypass (CPB).

**METHODS:** 104 patients were recruited to a prospective, randomised study in a single institution. Exclusion criteria included single vessel disease, age >80, recent infarct or cerebrovascular event (CVA), ejection fraction <30%. Patients were followed up at 3 months with coronary angiography to assess graft patency.

**RESULTS:** 54 patients were randomised to OPCAB, 49 to CPB. Pre-operative variables were similar in both groups. The average number of grafts per patient was 3.4 in the CPB group, and 3.1 in the OPCAB group ( $p = 0.02$ ). In the OPCAB group, mean blood usage was 245 mls compared to 467mls in the CPB group ( $p = 0.006$ ). Length of post-operative stay was 7.3 days in the OPCAB group compared with 9.7 days in the CPB group ( $p = 0.02$ ). Adverse events at discharge were similar in both groups. Troponin T (TnT) and I (TnI) levels were measured at 0, 6, 12, 24, 48 and 72hrs post-operatively. For TnT, the area under the curve was significantly higher in the CPB group, ( $p = 0.005$ ). Preliminary data ( $n = 71$ ) at 3 months showed graft patency was 88.9% in the OPCAB group, and 95.1% in the CPB group ( $p = 0.09$ ). Adverse events at 3 months were similar in both groups.

**CONCLUSIONS:** OPCAB appears to be safe and effective when compared to conventional coronary surgery, with similar graft patency and clinical outcomes.

### 4 ELIMINATION OF STERNOTOMY AND CARDIOPULMONARY BYPASS (CPB) REDUCE MORTALITY AND MORBIDITY IN REOPERATIVE CORONARY BYPASS GRAFTING (CABG)

Valavanur A. Subramanian, John C. McCabe, James D. Fonger, Nilesh U. Patel, Mark W. Connolly, Didier F. Loulmet

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**OBJECTIVE:** Reoperative CABG increases operative mortality and morbidity compared to primary CABG. This study analyzes the influence of two operative strategies, sternotomy OPCAB and sternal sparing MIDCAB, on the clinical outcome of patients undergoing reoperative CABG.

**METHODS:** From April 94 to December 2001, 499 patients underwent Reoperative CABG, 100 with CPB and 399 without CPB (53 sternotomy, 346 sternal sparing MIDCAB). There were 167 anterior, 104 lateral, and 75 transabdominal MIDCAB procedures (51 multi-incision operations). Preoperative risks and postoperative complications were analyzed using a multivariate logistical regression method and risk adjusted mortality using the New York State Cardiac Surgery Reporting System Model.

**RESULTS:** Revascularization without CPB (OPCAB and MIDCAB) had significantly higher incidence of CHF, COPD, severe PVD, preop IABP, bad LV (EF <30) than the CPB group with no difference between the MIDCAB and OPCAB groups. Risk Adjusted mortality and postoperative renal failure were significantly less in MIDCAB compared to OPCAB and CPB group. The grafts per patient were less in MIDCAB 1.3±0.6 9 (260 single, 79 double and 7 triple) compared to OPCAB (2.2±0.9) and CPB group (2.9±1.0). Freedom from all complications was greater in MIDCAB and OPCAB compared to the CPB group. During the follow up of a mean of 23.5 ±5 months, event free survival (reintervention, MI, death, reoperation) was 93% in the MIDCAB group despite less number of grafts per patient.

	MIDCAB	OPCAB	CPB	p value
Risk adj. Mortality	0.76%	2.27%	3.28%	<0.0001
Renal Failure	0.3%	3.8%	5.0%	0.05
Freedom from Complications	91.3%	92.5%	70.5%	<0.001

**CONCLUSIONS:** In reoperative coronary artery bypass graft patients, a sternal sparing MIDCAB grafting strategy offers the best in-hospital and mid-term clinical results.

#### 5 TOTAL ARTERIAL OFF-PUMP CORONARY REVASCLARIZATION WITH ONLY ITA AND COMPOSITE RADIAL ARTERY GRAFTS

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**OBJECTIVE:** To avoid cerebral complication and late vein graft failure, total arterial off-pump coronary artery bypass grafting (OPCAB) with ITA and composite radial arterial (RA) grafts has been extensively applied. We evaluated the initial experience of this method by clinical and angiographic study.

**METHODS:** Between October 1998 and February 2002, 208 patients underwent total arterial OPCAB with ITAs and composite RA. Mean age at operation was 65.9 ± 8.6 years. Average number of distal anastomoses was 3.12 ± 0.75. More than 4 distal anastomoses were performed in 57 patients (27%). Bilateral ITAs were used in 66 patients (32%). As in situ grafts, 274 ITAs (1.32/pts) were used. RA was used as Y composite graft in 184 patients (88%), as I composite (extension of ITA) graft in 31 patients, and as K composite (side to side anastomosis) graft in 15 patients. Sequential bypass grafting was performed using RA in 141 patients (68%), and ITA in 4. Postoperative angiography was performed in 195 patients (94%).

**RESULTS:** There was one operative death (0.5%) and one cerebral infarction due to paroxysmal atrial fibrillation. There was no clinical underperfusion syndrome or new IABP insertion. There was one patient whose ITA was too small for RA inflow. Early postoperative angiography revealed 98.7% (224/227) graft patency of ITA and 97.2% patency (381/390) of RA. Flow competition was found in 14 (7.2%) Y composite RA grafts where native right coronary artery stenosis was <75%.

**CONCLUSIONS:** Satisfactory clinical and angiographic results could be achieved with total arterial OPCAB with ITA and composite RA grafts. LITA is enough for total coronary revascularization as a single blood source though decreased perfusion pressure of distal RA may cause low flow perfusion in the right coronary artery branches.

#### 6 EARLY ADAPTATION OF LEFT INTERNAL THORACIC ARTERY AS A BLOOD SOURCE OF Y-COMPOSITE RADIAL ARTERY GRAFT IN OFF-PUMP CORONARY ARTERY BYPASS GRAFTING

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**OBJECTIVE:** Y-composite graft using radial artery (RA) is often used in off-pump coronary artery bypass grafting (OPCAB). However, the early flow reserve of left internal thoracic artery (LITA) as a blood source of Y-composite RA graft has not been delineated.

**METHODS:** In 42 pts who underwent OPCAB using LITA and Y-composite RA graft between June 2000 and February 2002, angiographical size of LITA was examined. In these patients, LITA was used as a blood source of Y-composite RA graft. Mean age was 67 ± 8 years. Average number of distal anastomoses was 3.2 ± 0.7. Only LITA and Y-composite RA graft was used for total coronary revascularization in 34 pts. RA graft was used for revascularization of circumflex alone in 5 pts, right coronary artery system (RCS) alone in 6 pts, and both circumflex and RCS in 23 pts. Average number of distal anastomoses using RA was 1.9 ± 0.7. Flow measurements of proximal LITA was achieved intraoperatively using a transit-time Doppler flow meter. The diameters of LITA before and after the operation were measured on cineangiography using DCAP package (ELK). Intraoperative flow volume was correlated with the diameter ratio of LITA between diameters before and after.

**RESULTS:** The mean flow of LITA was 61 ± 35 ml/min (range 9-196). The mean diameter of LITA before and after the operation were 1.97 ± 0.35mm and 2.77 ± 0.61mm, respectively. The diameter ratio of LITA before and after operation was 1.41 ± 0.27. Intraoperative flow volume was positively correlated with the ratio of LITA diameter ( $r = 0.409, p = 0054$ ).

**CONCLUSIONS:** These results demonstrate the early adaptation of LITA as a blood source of Y-composite RA graft in OPCAB, and rationale of LITA use as a single blood source for total coronary revascularization.

#### 7 LESS INVASIVE CARDIA ANESTHESIA - AN ULTRAFAS TRACK PROCEDURE AVOIDING THORACIC EPIDURAL ANALGESIA

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**OBJECTIVE:** A new „less invasive“ technique avoiding thoracic epidural analgesia has been tested for suitability as a routine procedure for cardiac anesthesia. Early postoperative extubation is an important step in this fast track procedure

**METHODS:** Consecutive patients (n = 305, age 35 - 82 years, mean 63, M/F ratio = 3.3) were subjected to general anesthesia using ultra-short acting opiates and then underwent coronary surgery (n = 279), valve surgery (n = 9), combined and other procedures (n = 17). The coronary artery bypass grafting was performed in 62% cases off pump. The percentage of patients extubated within 10 minutes after skin closure was the primary endpoint. In addition, we attempted to identify the limiting factors of the procedure tested.

**RESULTS:** Two hundred and seventy-three patients (90%) were extubated within 10 minutes after skin closure. Thirty-two patients (10%) were converted to standard anesthesia. No patient required reintubation. Two patients died. Six myocardial infarctions, no renal failure and 8 neurological disturbances were recorded. The mean hospital stay was 7.2 days (3-45). The patients converted to standard anesthesia showed significantly higher frequency of the following factors: use of extracorporeal circulation, administration of inotropic drugs in the operating room, longer duration of surgical intervention.

**CONCLUSIONS:** Early extubation proved suitable as a routine procedure for the vast majority of patients. With a good postoperative analgetic protocol there is no need for thoracic epidural analgesia. Such avoidance of thoracic epidural analgesia is a further step in minimizing invasiveness in cardiac surgery.

## Featured Abstracts – Heart Failure

Friday, June 21, 2002, 10:15 a.m. – 12:00 noon

### 8 BIVENTRICULAR PACING FOR CONGESTIVE HEART FAILURE: EARLY EXPERIENCE IN EPICARDIAL LEAD PLACEMENT VS. CORONARY SINUS PLACEMENT

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**OBJECTIVE:** Biventricular pacing (BVP) has recently been introduced in the treatment of refractory congestive heart failure. Endocardial lead placement for left ventricular pacing is often technically appalling because of high pacing threshold, lead dislodgement, and long procedure times. An epicardial lead placement has the potential advantage of visually selecting the optimal pacing site, although it requires a thoracotomy.

**METHODS:** BVP was performed in twelve NYHA Class IV congestive heart failure patients (11 male, 1 female). Patient's mean age was 70 (range 41-84). Epicardial leads were placed in three patients through a 3-inch incision via a left fourth or fifth intercostal thoracotomy with oral intubation and general anesthesia. The other nine patients underwent coronary sinus lead placement under conscious sedation.

**RESULTS:** Postoperative NYHA Class status improved from Class IV to Class II in eight patients and to Class III in three patients. In three out of seven patients with mitral regurgitation, the severity of the mitral regurgitation improved. The mean left ventricular ejection fraction improved from  $14 \pm 6.5\%$  to  $20 \pm 11.9\%$  after BVP. All patients who had epicardial lead placement were extubated within 24 hours after surgery. Total procedure time was decreased with epicardial lead placement. There was no difference in pacing threshold or lead dislodgement. There were no complications related to the surgery or laboratory procedure.

**CONCLUSIONS:** Epicardial lead placement through a minithoracotomy for BVP was performed safely with equivalent benefits to endocardial lead placement and with decreased procedure time in NYHA class IV congestive heart failure patients.



## Forum Abstracts – High Risk CABG

Friday, June 21, 2002, 1:30 p.m. – 3:00 p.m.

### 9 SINGLE VESSEL REOPERATIVE CORONARY ARTERY BYPASS GRAFTING: MINIMALLY INVASIVE DIRECT CORONARY ARTERY BYPASS GRAFTING VERSUS CONVENTIONAL PROCEDURE

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**OBJECTIVE:** Redo coronary artery bypass grafting without cardiopulmonary bypass through a small thoracotomy as minimally invasive coronary bypass grafting (MIDCAB) offers several advantages over the conventional procedure. Among these are avoidance of repeated sternotomy, aortic manipulation and cardiopulmonary bypass, minimally manipulation of the patent grafts and reduced dissection of pericardial adhesions. This study was performed to compare early clinical outcomes of reoperative grafting as MIDCAB procedure versus conventional.

**METHODS:** Between February 1997 and December 2001, 28 redo coronary patients underwent the MIDCAB procedure with left internal mammary artery (LITA)-group A. 2 of them were re-redo. LITA has not been used previously and only the left anterior descending coronary artery needed to be revascularized. Group B consisted of 32 consecutive patients from October 1997 to December 2001 who underwent the same procedure using a median sternotomy with cardiopulmonary bypass. There were no major preoperative differences in patient age, gender, NYHA class, ejection fraction and risk stratification between groups.

**RESULTS:** No patients required intraoperative conversion to conventional bypass in group A. There were no significant differences in mortality, myocardial infarctions, postoperative inotropic support, coronary occlusion time (A) and aortic cross clamp time (B). Three cerebrovascular accidents (9.4 %) and four operations (12.5 %) for bleeding occurred in group B. The patients in group A had significant reduction of atrial fibrillation ( $p < 0.001$ ) and transfusions required ( $p < 0.001$ ) also mean operation time, time to extubation, length of intensive and hospital stay was shorter in group A. Actuarial survival at 1, 2 and 4 years are  $85\% \pm 3$ ,  $75\% \pm 3$ ,  $65\% \pm 2$  in group A and  $81\% \pm 4$ ,  $70\% \pm 3$ ,  $59\% \pm 2$  in group B respectively.

**CONCLUSIONS:** Despite the relative greater complexity of performance, minimally invasive direct coronary artery bypass grafting can be performed safely in properly selected redo coronary bypass patients and is a viable alternative with benefit of reduced associated morbidity over conventional procedure.

### 11 LATERAL MIDCAB IS A PROTECTIVE STRATEGY FOR REOPERATIVE CABG FOR CIRCUMFLEX GRAFTING IN PATENTS WITH PATENT INTERNAL THORACIC ARTERY GRAFT

James D. Fonger, John C. McCabe, Nilesh U. Patel, Mark W. Connolly, Didier F. Loulmet, Valavanur A. Subramanian  
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**OBJECTIVE:** During sternal reentry injury to patent IMA graft during reoperative bypass is 5%, which is associated with 40% periop MI, and 9% mortality. Beating heart technique with the use of mechanical stabilizer via a small (3inches) lateral thoracotomy is an attractive alternative method. We report our clinical experience over the last 5 years.

**METHODS:** One hundred and eight patients (85 males) ages 45-85 underwent lateral MIDCAB between November 1996-September 2001. Eighty-three patients had one, 23 had 2 and 2 had 3 prior CABGS. Risk factors were carotid disease (9), aorto-iliac disease (11), PVD (14), COPD (11), chronic renal failure (3), SVG graft instent restenosis (51), EF<30% (20 patients) and calcific ascending aorta (16). Descending thoracic aorta was inflow in 94 patients, RGEA in 11 and lateral thoracodorsal artery in 3. Seventy-four patients had single, 31 double and 3 triple grafts with an average of 1.4 grafts per patient. Conduits were SVG (41), radial (75), both (15) with sequential grafting in 14 patients.

**RESULTS:** Peri-operative mortality was 0.9% (1). Complications were reoperation for bleeding (3), lung torsion requiring lobectomy (1). No patient had periop stroke. Initial eighteen patients had routine postoperative angiogram (< 48 hours) with 100% patency. During the follow up of mean  $23.5 \pm 5$  months, actuarial survival was 96% and the event free survival (reintervention, MI, death, reoperation) was 93%.

**CONCLUSIONS:** Lateral MIDCAB is a safe and protective strategy for revascularization of circumflex grafting in presence of patent IMA graft.

### 10 BEATING HEART REVASULARIZATION IN OCTAGENARIANS: EARLY OUTCOME ANALYSIS

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**OBJECTIVE:** Increasingly, elderly patients with multiple comorbidities are being referred for surgical revascularization. In an effort to reduce the potential morbidity associated with cardiopulmonary bypass in these elderly patients, we have preferentially performed off-pump coronary grafting (OPCAB) in this population.

**METHODS:** Our prospectively updated database was interrogated to identify all octagenarians who underwent OPCAB between 1/1/99 and 7/31/01. Demographic and clinical profiles were obtained, complications were collected and telephone interviews were conducted.

**RESULTS:** One-hundred and thirteen consecutive octagenarians who underwent OPCAB were identified. Mean age was  $83 \pm 2$ . Surgical priority was urgent in 84/113 (74%). Mean LVEF was  $51 \pm 11\%$ . Forty-six percent (52/113) had left main disease, 45/113 (40%) had previous MI and 14/113 (12%) had cerebrovascular disease. We performed  $3.3 \pm 1$  grafts/patient (range 2-6) with 82% (93/113) IMA use. There were 4 strokes (3.5%), 42% incidence of atrial fibrillation and one (0.9%) hospital death. Expected mortality (STS database) was 5.9%. Mean length of stay was  $10.1 \pm 8$  days. There were 3 late deaths. Survival is depicted below.

**CONCLUSIONS:** In our experience with octagenarians, the largest reported to date, multivessel OPCAB is associated with low incidence of gross neurologic deficits and in-hospital mortality and should be considered a safe and viable alternative to conventional grafting in this elderly population.

### 12 VALIDATION OF FOUR DIFFERENT RISK STRATIFICATION SYSTEMS IN PATIENTS UNDERGOING OFF-PUMP CORONARY ARTERY BYPASS (OPCAB) SURGERY: A UK MULTI-CENTRE ANALYSIS OF 2,223 PATIENTS

Sharif Al-Ruzzeh, George Asimakopoulos, Gareth Ambler, Rumana Omar, Ragheb Hasan, Brian Fabri, Ahmed El-Gamel, Tony DeSouza, Vipin Zamvar, Steven Griffin, Daniel Keenan, Uday Trivedi, Mark Pullan, Alex Cale, Michael Cowen, Kenneth Taylor, Mohamed Amrani

The National Heart and Lung Institute, Imperial College of Science, Technology and Medicine, Harefield and Hammersmith Hospitals, the Department of Statistical Science, University College, London, UK

**OBJECTIVE:** Various risk stratification systems have been developed based mainly on patients undergoing cardiac surgery with Cardiopulmonary Bypass (CPB). This report attempts to assess the validity and applicability of the Parsonnet score, the EuroSCORE, the ACC/AHA system and UK CABG Bayes model in patients undergoing Off-Pump Coronary Artery Bypass (OPCAB) surgery in the United Kingdom (UK).

**METHODS:** Data on 2,223 patients who underwent OPCAB in eight UK cardiac surgical centres were collected. Predicted mortality risk scores were calculated using the four systems and compared to the actual observed mortality. Calibration was assessed by Hosmer-Lemeshow (HL) test. Discrimination was assessed by calculating the Receiver-Operating-Characteristic (ROC) curve area.

**RESULTS:** Out of 2,223 patients 30 (1.3%) died in hospital. For the Parsonnet score the HL test was significant ( $P < 0.001$ ) and the ROC area was 0.74. For the EuroSCORE the HL test was also significant ( $P < 0.01$ ) and the ROC area was 0.74. For the ACC/AHA system the HL test was non-significant ( $P = 0.73$ ) and the ROC area was 0.75. For the UK CABG Bayes model the HL test was also non-significant ( $P = 0.87$ ) and the ROC area was 0.81.

**CONCLUSIONS:** This study shows that the UK CABG Bayes model is well calibrated and provides good discrimination when applied to OPCAB patients in the UK. Amongst the other three systems, the ACC/AHA system is also well calibrated but its discrimination power was less than that of the UK CABG Bayes model. These data suggest that the UK CABG Bayes model is an appropriate risk stratification system to use for patients undergoing OPCAB in the UK.

**13 OBESITY DOES NOT INCREASE POST-OPERATIVE MORBIDITY FOLLOWING ENDOSCOPICALLY – ASSISTED CORONARY ARTERY BYPASS GRAFTING**

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**OBJECTIVE:** Obesity has been shown to be an independent risk factor for adverse outcomes and prolonged hospitalization following conventional CAB (coronary artery bypass). For this reason and because of increased technical challenges, obese patients have been considered relative contraindications for minimally invasive bypass. The purpose of this study was to determine if in fact severe or morbid obesity is an independent risk factor for patients undergoing minimally invasive CAB.

**METHODS:** Outcomes data of 350 consecutive endoscopic, atraumatic CAB procedures performed at our institution over a four-year period were reviewed with respect to body mass index (BMI). All operations consisted of thoracoscopic left or right internal mammary artery (IMA) harvesting followed by off-pump grafting of the left anterior descending (with/without diagonal coronary artery) or right coronary artery via a four-centimeter thoracotomy. Patients were divided into two groups: BMI 18-34 (no to mild obesity) and BMI > 34 (severe to morbid obesity).

**RESULTS:** Although the BMI > 34 group had a higher incidence of hypertension, diabetes, and hypercholesterolemia, there was no statistical difference in operative risk between the two groups. Thirty-day mortality, conversion to sternotomy, transfusion rate, wound, pulmonary, neurological and myocardial complications were not significantly different between groups. Although the BMI > 34 patients required longer IMA harvest times and total operating times, ICU length of stay was not significantly different between groups. Hospital length of stay was shorter in the BMI > 34 group when compared to the BMI 18-34 group (p = 0.025), (TABLE).

Variable	Total	BMI 18 - 34	BMI > 34	p value
n (%)	350 (100)	243 (69.4)	107 (30.6)	
30 day mort.	2 (0.57%)	1 (0.41)	1 (0.93)	0.864
Convert to sternotomy	9 (2.57%)	5 (2.06)	4 (3.74)	0.584
Transfusion	30 (8.57%)	23 (9.47)	7 (6.54)	0.487
Wound complic	6 (1.71%)	5 (2.06)	1 (0.93)	0.764
Pulm. complic	33 (9.42%)	21 (8.64)	12 (11.21)	0.578
Infarction	8 (2.28%)	6 (2.47)	2 (1.87)	0.966
ICU LOS (hrs)	5.23 ± 4.33	5.86 ± 4.95	4.67 ± 3.88	0.481
Hosp LOS (days)	2.34 ± 1.19	2.65 ± 1.07	2.15 ± 1.03	0.025

**CONCLUSIONS:** Despite increased technical difficulty, obesity is not an independent risk factor for patients undergoing minimally invasive coronary artery bypass. In fact, coronary artery bypass operations that avoid both cardiopulmonary bypass and a sternotomy may provide added benefit for the obese patient.

**14 OFF-PUMP REVASULARIZATION IN PATIENTS WITH SEVERE LEFT VENTRICULAR DYSFUNCTION: CAN AND SHOULD IT BE DONE?**

Daniel Goldstein, Ravendra Karanam, Brandon Luk, Frederick Sardari, Paul Burns, Thomas Prendergast, P. Garland, Craig Saunders  
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**OBJECTIVE:** Despite the widespread use of beating heart revascularization, reluctance exists in submitting patients with severe left ventricular dysfunction to off pump coronary artery bypass grafting (OPCAB) for fear of hemodynamic instability and increased morbidity and mortality. We analyze our experience with OPCAB in this high-risk population.

**METHODS:** Our prospectively updated database was interrogated to identify all patients with LVEF < = 30% who underwent OPCAB between 1/1/99 and 7/30/01. Demographic and clinical profiles were obtained, complications were collected and telephone interviews were conducted.

**RESULTS:** One-hundred consecutive patients with LVEF < = 30% underwent OPCAB during the study period. Follow up was 100%. Mean age was 67±10. Mean LVEF was 26% (range 15-30%). Sixty-four percent (64/100) were in heart failure at the time of surgery and 51% (51/100) had previous MI. We performed 3.5±1 grafts/patient with 81% IMA use. Balloon pump support was placed preoperatively in 19% (19/100) and intraoperatively in 5% (5/100). In-hospital mortality was 3% (3/100). Expected mortality (STS database) was 5.2%. Atrial fibrillation occurred in 21% (21/100), stroke in 1% (1/100) and renal failure in 3% (3/100). Mean length of stay was 8.8±5 days. There were 14 late deaths. Survival is depicted below.

**CONCLUSIONS:** For patients with severely depressed left ventricular function, OPCAB is technically feasible, particularly with liberal use of balloon support. Our experience, the largest reported to date, suggests that a standardized approach results in low morbidity and mortality figures and is our procedure of choice for this high-risk population.

**15 IS THERE ADVANTAGE OF OPCAB OVER ON-PUMP CABG IN PATIENTS WITH LEFT VENTRICULAR DYSFUNCTION?**

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**OBJECTIVE:** The purpose of this study was to assess if there was any benefit of one technique of CABG over another (OPCAB Vs On-Pump CABG) in patients with poor left ventricular function in a single institution.

**METHODS:** Data on preoperative risks, operative and postoperative outcomes were collected retrospectively on all patients undergoing surgical revascularization between January 1st 1998 and January 31st 2002.

**RESULTS:** A total of 95 patients (39 off-pump/ 56 on-pump) with EF < = 35% were analyzed. Patient's characteristics and outcomes are summarized:

	Off-pump	On-pump	p-value
EF (%)	29.2 ± 5.8	28.6 ± 5.8	0.98
Parsonnet score	9.6 ± 7.9	10.2 ± 7.8	0.52
Blood transfusion (U)	1.9 ± 2.8	3.3 ± 3.8	<0.05
Ventilatory support (h)	16.2 ± 20.7	20.8 ± 29.7	<0.05
ICU LOS (h)	45.9 ± 48.9	52.0 ± 62.3	0.16
Post operative LOS (d)	9.5 ± 8.8	10.6 ± 10.6	0.53
Anastomoses / Pts.	2.9 ± 0.8	3.9 ± 0.8	<0.01
IABP (%)	7.7	7.1	0.99
Mortality (%)	2.6	10.7	0.23

**CONCLUSIONS:** We noted less need for blood transfusions and shorter ventilatory time in the OPCAB group. Despite a lower operative mortality, this did not reach statistical significance. In patients with poor left ventricular function it is possible to perform surgical coronary revascularization with a low morbidity.

**16 POSTOPERATIVE RENAL INSUFFICIENCY REQUIRING HEMOFILTRATION IN PATIENTS UNDERGOING CABG IN THE ERA OF BEATING HEART SURGERY - INCIDENCE AND RISK FACTOR ANALYSIS IN 10,759 ADULT PATIENTS**

Jan Bucerius, Jan F. Gummert, Nicolas Doll, Volkmar Falk, Dierk V. Schmitt, Thomas Walther, Friedrich Wilhelm Mohr

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**OBJECTIVE:** Despite refinements in perioperative patient management renal insufficiency requiring hemofiltration and/or -dialysis is still a common complication after coronary artery bypass grafting associated with impaired patient outcome and increased costs.

**METHODS:** Prospective data on 10,759 patients undergoing CABG with and without CPB (Conventional-CABG, n = 8917; OPCAB, n = 765; MIDCAB, n = 1077) between April 1996 and August 2001 were subjected to univariate and multivariate logistic regression analysis. Postoperative hemofiltration was defined as any postoperative renal insufficiency requiring first time hemofiltration and/or -dialysis during postoperative stay.

**RESULTS:** Overall incidence of postoperative hemofiltration was 3.8% (Conventional-CABG 4.3%; OPCAB 1.8%; MIDCAB 1.4%). 35 out of 44 selected pre- and intraoperative patient- and treatment related variables had a high association with postoperative hemofiltration. 9 of these (diabetes, OR: 1.4; preoperative renal disease, OR: 3.1; preoperative cardiogenic shock, OR: 1.9; preoperative NYHA gt; = 3, OR: 1.5; urgent operation, OR: 1.5; intraoperative hemofiltration, OR: 1.9; intraoperative low output, OR: 1.7; perfusion time gt; 2hrs, OR: 1.7) were independent predictors. No significant association has been found between both beating heart approaches (OPCAB; MIDCAB) and postoperative hemofiltration.

**CONCLUSIONS:** It is of utmost importance to identify perioperative risk factors associated with postoperative hemofiltration and/or -dialysis. Patients with preoperative non-dialysis dependent renal insufficiency are at a high risk for a postoperative decline in renal function requiring hemofiltration and/or -dialysis. Impact of beating heart approaches seems to be less influential with regard to the incidence of postoperative hemofiltration after CABG.



## Forum Abstracts – Facilitated Anastomosis

Friday, June 21, 2002, 3:30 p.m. – 4:30 p.m.

### 17 CLINICAL AND SIX-MONTH ANGIOGRAPHIC EVALUATION OF CORONARY ARTERIAL GRAFT INTERRUPTED ANASTOMOSES USING COALESCENT U-CLIP™ ANASTOMOTIC DEVICE – A PROSPECTIVE CLINICAL STUDY

Michael P. Caskey, Merick S. Kirshner, Edwin L. Alderman, Sonna Lea Hunsley, R.N., Michael A. Daniel

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**OBJECTIVE:** Interrupted suture technique avoids "purse string" and puckering effects frequent seen with continuous suture techniques and should represent the standard of care in the creation of high quality vascular anastomoses. This clinical study evaluated the safety and effectiveness of a self-closing surgical clip (Coalescent Surgical U-CLIP™) designed to facilitate this interrupted technique. LIMA to LAD coronary bypass grafting was studied.

**METHODS:** Eighteen patients meeting inclusion criteria were enrolled (October, 2000 and September, 2001), into this prospective study. Anastomoses were performed using an OPCAB beating heart technique in 17 cases (94%) with one MIDCAB procedure. Six-month follow-up has been completed on 16 (89%) patients to-date with 15 angiograms (83%) at a mean of 180 days (168-191 days). Qualitative and quantitative angiographic assessment was performed by an independent core laboratory.

**RESULTS:** The U-CLIP was used for 18 LIMA to LAD interrupted anastomoses without the requirement for knot tying or suture management with no device-related morbidity or mortality. Mean LIMA to LAD anastomosis time was 8.6 minutes (5-14 minutes). All anastomoses were FitzGibbon Grade A. Quantitative analysis showed mean LIMA diameters proximal to the anastomosis of 2.1mm, at the anastomosis of 2.1mm and immediately distal to anastomosis of 1.8mm. The average ratio of anastomosis to LAD diameter was 1.19 (0.93 to 1.93). Anastomotic stenosis as a percentage of average LIMA/LAD diameter was -6% comparing favorably with the 23-24% reported in the POEM study.

**CONCLUSIONS:** The interrupted technique, facilitated by a self-closing anastomotic clip, yields favorable 6-month follow-up and angiographic results when compared with other published studies.

### 19 EFFECT OF SUTURE TECHNIQUE ON ANASTOMOSIS MECHANICS AND TRANSIT-TIME FLOW INCIDENCES

Marc W. Gerdisch, Thomas J. Hinkamp, Stephen D. Ainsworth

Central DuPage Hospital, Winfield, Illinois, USA, Alexian Brothers Medical Center, Elk Grove Village, Illinois, USA, Coalescent Surgical, Sunnyvale, CA, USA

**OBJECTIVE:** Experiments were conducted to investigate the mechanics of coronary end to side anastomoses created with both running and interrupted techniques. Indices of blood flow across anastomoses and anastomotic compliance were evaluated.

**METHODS:** Both internal thoracic arteries in six male calves were harvested, and end to side anastomoses were created on the left anterior descending artery using either running polypropylene suture or the U-CLIP® Anastomotic Device (Coalescent Surgical, Inc., Sunnyvale, CA) for the interrupted anastomoses. Intravascular ultrasound (IVUS) provided dynamic images used to calculate anastomotic compliance, and transit-time flow tracings (TTFM) were analyzed for pulsatility index (PI), normalized mean flow, peak flow, and fast Fourier transformations.

**RESULTS:** Anastomotic compliance was significantly greater in the interrupted anastomoses when compared with running suture ( $P < 0.05$ ). There was also a significant difference in the pulsatility index, with the average PI in the interrupted anastomoses 40% lower than the running anastomoses (Interrupted = 4.75; Running = 7.76;  $P < 0.05$ ). There was no significant difference in the normalized mean flow, however the normalized peak flow was 35% lower on average in the interrupted anastomoses (222 ml/min) when compared to the running anastomoses (340 ml/min;  $P < 0.01$ ).

**CONCLUSIONS:** The results of this preliminary study suggest that the interrupted technique creates a compliant anastomosis that changes shape with varying pressure and flow. This dynamic situation significantly alters the flow waveform by dampening the amplitude of the systolic peak during normal coronary function, possibly reducing shear stress and turbulence, which are associated with chronic intimal hyperplasia.

### 18 PATENCY CONTROL OF SUTURELESS PROXIMAL ANASTOMOSES FOR CABG USING MULTIDETECTOR ROW CARDIAC CT (MDCT)

Markus Dietrich, Sven Martens, Christopher Herzog, Mirko Doss, Gerhard Wimmer-Greinecker, Anton Moritz

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**OBJECTIVE:** Proximal anastomoses of saphenous vein grafts to the aorta are usually performed with a running suture. The Symmetry™ aortic connector creates automated proximal anastomoses using a nitinol implant. To evaluate the patency and anastomotic quality compared to conventional vein grafts, a prospective randomized trial using multidetector row cardiac CT (MDCT) was carried out.

**METHODS:** 31 elective CABG patients were randomly assigned to automated (group I, 19 patients) or handsewn proximal anastomoses (group II, 12 patients). An MDCT scan was performed on postoperative day 5. Graft patency and narrowing of the vein lumen at the anastomotic site were evaluated.

**RESULTS:** In group I, 30 sutureless anastomoses were performed (1.6 / patient), in group II, 20 proximal anastomoses were handsewn (1.7 / patient). MDCT scan revealed 100% patency in both groups, without relevant narrowing (>50%) of the vein lumen at the anastomotic site.

**CONCLUSIONS:** Feasibility of proximal anastomoses using the Symmetry device has already been reported. Patency control has been performed using invasive angiography by other groups. MDCT scan as a noninvasive method provides reliable data about graft patency and local anastomotic quality, even if nitinol is implanted.

### 20 SHORT-OCCLUSIVE SUTURELESS CORONARY ANASTOMOSIS USING ADHESIVE

Marc P. Buijsrogge, Cees W.J. Verlaan, Paul F. Gründeman, Cornelius Borst

Heart Lung Center Utrecht, University Medical Center Utrecht, Utrecht, Netherlands

**OBJECTIVE:** We revisited a sutureless coronary anastomosis technique by means of a preglued side-to-side ITA-LAD kissing vessel wall apposition using octylcyanoacrylate, which, following the arteriotomy, was converted into an end-to-side anastomosis. The feasibility, patency and vascular wall healing of this facilitated coronary anastomosis technique was studied in porcine off-pump CABG.

**METHODS:** In 8 pigs (80 kg), 8 low flow RITA-to-LAD anastomoses (pro-thrombotic condition) and 8 high flow control LITA-LAD anastomoses ( $< 15$  mL/min and about 50 mL/min, respectively) were evaluated intra-operatively and at 35 days. Anastomoses were examined by flow measurement, angiography and histology.

**RESULTS:** All anastomoses (but one) were hemostatic after average construction time of 5 minutes. One pig died at day 19 due to saddle type pulmonary embolism unrelated to graft failure. Fourteen anastomoses were fully patent at 35 days (FitzGibbon Grade A) with angiographic classical end-to-side anastomosis configuration. Histology showed mild repair intimal hyperplasia without aneurysm formation or medial necrosis.

	Anastomosis construction time (min)	Coronary occlusion time (min)	Hyperemic response index (peak/baseline flow) - intra-op	Hyperemic response index - 35 days	Patency	Medial necrosis
Low flow (n = 7)	5.2 ± 1.2	1.5 ± 0.3	5.2 ± 1.2	5.6 ± 1.8	7/7	0/7
High flow (n = 7)	5.5 ± 1.1	1.7 ± 0.2	2.7 ± 0.6	4.2 ± 1.1	7/7	0/7

**CONCLUSIONS:** In the pig, the sutureless-adhesive coronary anastomosis technique competed with classic coronary anastomosis construction time and revealed a favorable healing response, even in pro-thrombotic low bypass graft flow conditions.

## 21 THORACOSCOPIC USE OF A PROXIMAL ANASTOMOTIC DEVICE FOR CORONARY SURGERY

David F. Torchiana, Jennifer K. White, James Titus, Arvind K. Agnihotri  
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**OBJECTIVE:** Objective: Endoscopic coronary bypass surgery has focused on single vessel bypass and the distal anastomoses. Most surgical patients have multi-vessel coronary disease and require one or more proximal aortic anastomosis as part of their revascularization. The thoracoscopic use of a proximal anastomotic mechanical device (Symmetry<sup>®</sup>, St. Jude Medical Inc.) and a new method of cardioplegia delivery were investigated.

**METHODS:** A robotic system (Zeus<sup>®</sup>, Computer Motion Inc.) was used to endoscopically mobilize the internal mammary arteries in six anesthetized canines. The aortic fat pad was removed and human saphenous vein was anastomosed to the ascending aorta using the connector system through a 12-mm port. The venous valves were lysed with a valvulotome, allowing administration of cardioplegia into the aortic root via the vein after cross-clamping. The veno-coronary anastomoses were performed last. The grafts were assessed for patency, blood flow, and hemostasis.

**RESULTS:** All anastomoses were non-bleeding with adequate blood flow. Angiographic patency was confirmed in two animals. The device properly deployed in all but one animal in which there was low aortic root pressure. Cardioplegia delivery was effective and eliminated the use of an endoaortic clamp.

**CONCLUSIONS:** Thoracoscopic use of a proximal anastomotic device in this study resulted in reliable, non-bleeding anastomoses. A simple new method of cardioplegia delivery via the saphenous vein graft eliminated problems associated with transluminal balloon occlusion of the aorta and may be a useful technique.

## 22 PROXIMAL ANASTOMOTIC CONNECTIONS USING A NEW, INTEGRATED COUPLING SYSTEM

Valavanur A. Subramanian, Ji Zhang

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**OBJECTIVE:** Automated coupling devices, designed to facilitate the connection between bypass grafts and the aorta have recently been introduced. While several devices have shown feasibility in creating a sutureless anastomosis to the aorta, they have proven to be cumbersome and time consuming, requiring multiple preparation and loading steps. As a result, they increase total time required to complete the proximal connection. These devices also require the proximal anastomosis to be completed prior to the distal. Recently, our group sought to determine the feasibility of an automated proximal coupler designed to streamline the procedure.

**METHODS:** Six sheep, 50 to 65 kg, underwent off-pump CABG surgery using the Linx<sup>™</sup> Proximal Anastomosis Device (Ventrica, Inc. Fremont, CA). Saphenous vein grafts were harvested and distal anastomoses were performed to the left circumflex artery in the conventional manner with a traditional, running 7-0 polypropylene suture. A small portion (2 cm) of the proximal vein graft was mounted on the device and deployed into a pressurized, unclamped aorta. The time required to prepare the graft vessel, along with the time required to deploy and connect it with the aorta, was measured. Hemostasis was assessed.

**RESULTS:** Our experiments revealed that the Linx<sup>™</sup> Device is a feasible alternative to currently available devices and provides a quick and easy method for forming a hemostatic connection between aorta and saphenous vein, without radial stent-like forces applied to the graft. Total vessel preparation, deployment and connection times averaged less than two minutes. Aortic connection and transfer of the graft could be accomplished with the single insertion of the deployment system. Hemostasis was achieved instantly and without additional sutures. This study also verified that proximal connections done with the Linx<sup>™</sup> Device may be done before or after distal connections are made. Requirement of only a small portion of vein graft (2 cm) for loading step is an added advantage of this device.

**CONCLUSIONS:** The Linx<sup>™</sup> Proximal Anastomosis Device is a feasible alternative to devices currently available for off-pump CABG surgery and may provide significant advantages over other designs in ease-of-use, time required, and flexibility in placement order between proximal and distal connections.

