SCA22 (Moved from Poster Discussion II)
CAN INTRAOPERATIVE TEE EVALUATION FOR MODIFIED BLALOCK-TAUSSIG SHUNT PREDICT THE
POSTOPERATIVE COURSE AND PROGNOSIS?

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Introduction The modified Blalock-Taussig shunt (mBTS) provides and controls the volume of pulmonary blood flow. These functions are useful for encouraging the growth of vascular beds in children with low flow in pulmonary circulation. However, follow-up (F/U) cardiac catheterization after mBTS sometimes reveals stenoses at the site of anastomosis and uneven growth of the pulmonary vascular beds. This may affect the choice of surgical strategy and possibly lead to poor prognosis. This study was conducted to retrospectively investigate whether the intraoperative TEE evaluation for mBTS can preemptively identify the patients in which the aforesaid problems are likely to occur.

Methods The subjects were 14 patients who underwent 17 consecutive mBTSs from March 2005. TEE records and postoperative charts were reviewed in all cases. Pediatric biplane probe was used for all cases except one 3.0 kg neonate who underwent TEE examination with single-plane probe. Flow profiles of the pulmonary veins (PV) were obtained to measure the velocity time integral (VTI) and peak velocity (pV). Changes of the PV flow profiles from pre- to post-mBTS creation were compared with the postoperative course and the results in F/U cardiac catheterization.

Results The patients ranged from 1 month to 6 years in age and from 3.0 kg to 19.2 kg in weight. Four patients received a left mBTS and 13 patients received a right mBTS. Six underwent F/U cardiac catheterization between 6 to 12 months after mBTS. Two with severely blunted flow in the ipsilateral PV to the mBTS required a repeat operation within a day after the mBTS because of the absence of shunt flow. Elevations in VTI and pV in the PV contralateral to the mBTS were observed in 2 patients. One of these patients died on the fourth postoperative day, probably because of shunt occlusion. Stenosis at the anastomosis and poor blood distribution to the contralateral lung were detected in the F/U cardiac catheterization of the other. Another 2 cases with stenosis at the anastomosis showed only small rises of VTI and pV in the ipsilateral PV. Obvious elevations of VTI and pV in the ipsilateral PV were seen in 2 of 3 patients showing well balanced distribution of PBF on F/U cardiac catheterization. There were no complications related to the probe manipulations in this study.

Conclusion In conclusion, intraoperative TEE evaluation for modified Blalock-Taussig shunt can provide prognostic information. A severely blunted ipsilateral PV flow profile and a significantly increased contralateral PV flow profile strongly suggest stenosis at the anastomosis and a potentially poor prognosis related to severe obstruction in the mBTS.

SCA25

CEREBRAL OXYGEN SATURATION DURING 'PULSED' RETROGRADE CEREBRAL PERFUSION

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(BACKGROUND) In our institution, we employ pulsed flow for trans-caval retrograde cerebral perfusion (RCP) during deep hypothermic circulatory arrest (DHCA). By changing the retrograde CPB pump flow, the SVC pressure is varied between 20 mmHg and 40 mmHg at thirty seconds intervals. We conducted a retrospective study to evaluate whether this original pulsed RCP method could maintain cerebral oxygenation during DHCA.

(METHODS) Fifteen patients, aged 46 to 79 (12 males, 3 females), who had either total (n=9) or partial (n=6) aortic arch repair for aneurysm in the supine position were studied retrospectively. After instituting full cardiopulmonary bypass, patients were cooled down to 18 degrees Celsius at either nasopharynx or tympanic membrane before initiating DHCA. A few minutes after DHCA started, the SVC was snared, and retrograde CPB flow through the SVC cannula started. The pump flow was changed between 200 and 800 ml/min to alter the SVC pressure between 20 to 40 mmHg every thirty seconds. Cerebral oxygen saturation (ScO2) was monitored continuously and bilaterally using NIRO 200 (Hamamatsu Photonics, Japan) and the data were transferred to a personal computer for subsequent analysis. ScO2 was averaged every two minutes and the values of three time points (T1: immediately before DHCA start, T2: RCP start, T3: RCP end) were compared in each patient.

(RESULTS) There was an acute decrease of ScO2 (L: mean 17%, p < 0.0001; R: mean 14%, p < 0.0001) during the period of DHCA prior to RCP start (from T1 to T2, mean 281 sec).

The duration of RCP (from T2 to T3) was between 27 to 95 min (mean 56 min, SD 18 min). In this period, ScO2 increased by 6.6% (SD 16.5%) and 4.1% (SD 10.5%) in the left and right side, respectively. From T1 to T3, the ScO2 decreased by 12.3% (SD 8.7%) and 10.2% (SD 8.2%) in the left and right side, respectively. No correlation was found between the duration of RCP and the increase of ScO2 in both sides. Throughout the operation, the ScO2 was lowest at the end of RCP in two patients. In the remaining thirteen patients, the ScO2 was lowest during the period of rewarming after DHCA. Postoperatively, gross neurological deficits, including motor paralysis, convulsion, and loss of meaningful consciousness, were not observed in all of the fifteen patients. A typical pattern of ScO2 change during RCP is shown in the figure.

(IMPLICATION) Although ScO2 decreased slightly during pulsed RCP, the minimum ScO2 values reached during RCP were higher than those reached during rewarming in most of the patients. In addition, no gross neurological deficits were observed postoperatively. These suggest that the pulsed RCP can be performed for as long as 95 min without critically compromising cerebral oxygenation.
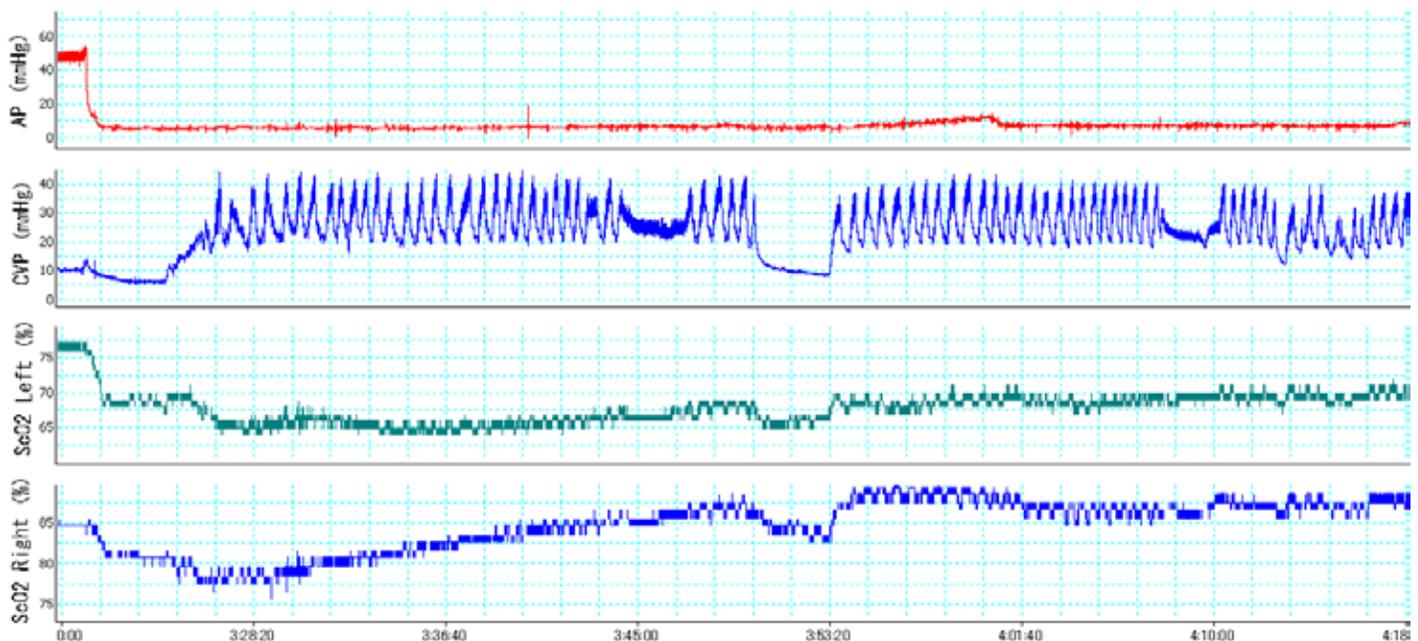
SCA26
FEASIBILITY AND PERFORMANCE OF REAL TIME, THREE-DIMENSIONAL, INTRAOPERATIVE TRANSESOPHAGEAL
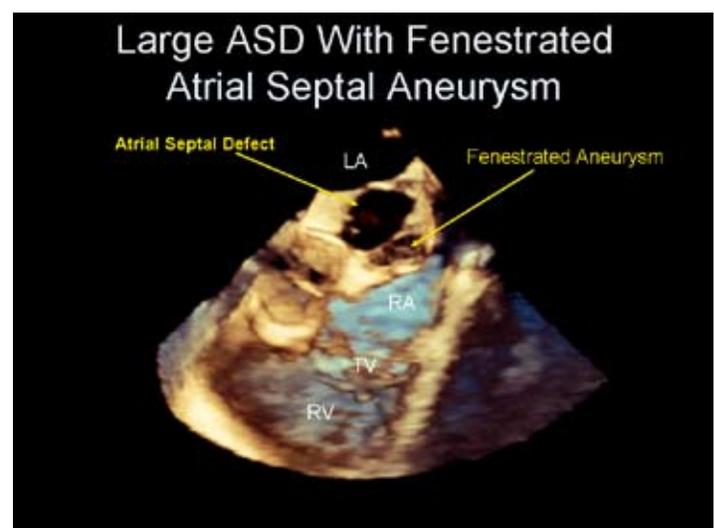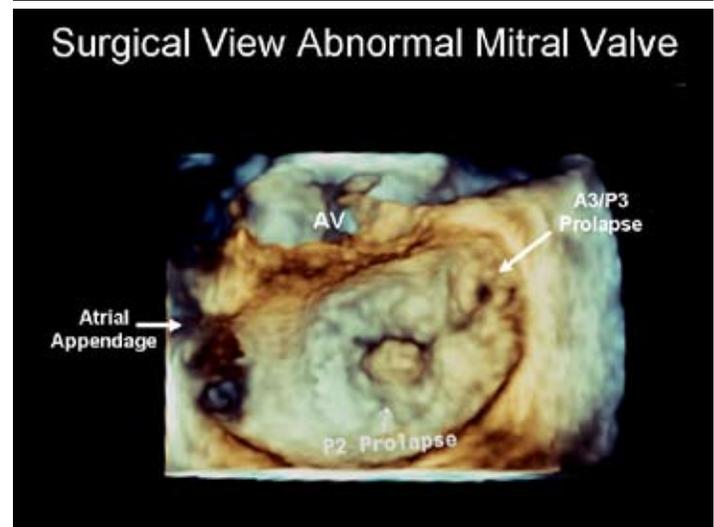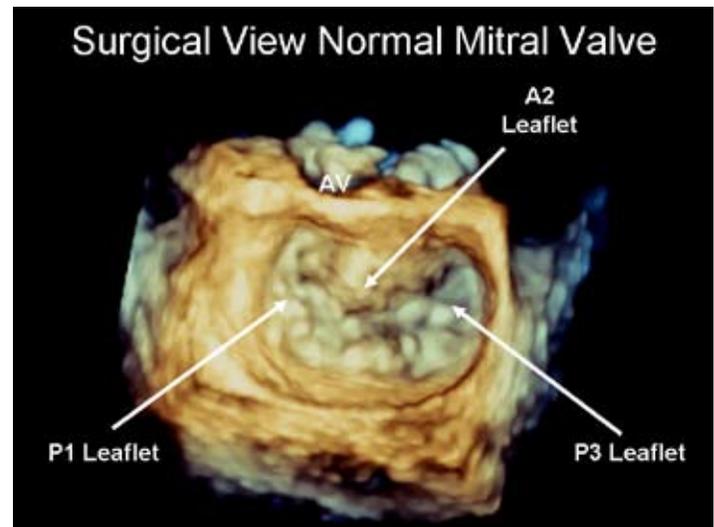ECHOCARDIOGRAPHY USING A MATRIX TRANSDUCER

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Background: Compared with conventional 3-D gated reconstruction, real-time 3-D (RT3-D) using Matrix transducers permits faster acquisition without a dependency on the electrocardiogram or respiratory gating. However, compared to conventional transesophageal probes, the larger dimensions of the Matrix transducers currently available for clinical utilization has limited their utilization to transthoracic or intraoperative epicardial viewing planes. The purpose of this pilot study was to evaluate the feasibility and performance of a newly developed RT3-D TEE Matrix transducer (IE33 system; Philips Medical Systems, Andover, MA) in a cardiac surgical population.

Methods: Limited echocardiographic examinations were performed after the induction of general anesthesia and before sternotomy in 45 patients undergoing a variety of cardiac surgical procedures, to assess the feasibility and image quality of intraoperative RT-3D TEE. Comprehensive intraoperative TEE examinations were performed using standard equipment following the performance of the RT-3D TEE study examinations. The study was approved by the Institutional Review Board and informed consent was obtained from all enrolled subjects.

Results: Insertion of the RT3-D Matrix TEE probe was performed in all enrolled patients without complications. Near-field structures including enface views of the mitral valve apparatus (Figures 1& 2) and atrial pathology (Figure 3) were particularly well-visualized in high-resolution modes (i.e., ZOOM). Acquisition of gated, full-volume echocardiographic data sets permitted RT3-D TEE color-flow Doppler imaging and comprehensive left ventricular global and regional functional analysis.

Conclusion: Intraoperative RT3-D TEE is feasible and provides practical and unique echocardiographic imaging planes for identifying intra-cardiac pathology. Compared to conventional 2-D imaging and gated 3-D reconstruction echocardiographic techniques, RT3-D TEE may permit a more practical and comprehensive echocardiographic evaluation to facilitate perioperative surgical planning.

Surgical View Normal Mitral Valve

Surgical View Abnormal Mitral Valve

Large ASD With Fenestrated Atrial Septal Aneurysm

SCA27
DETECTION OF REGIONAL MYOCARDIAL TISSUE ISCHEMIA USING VISIBLE LIGHT SPECTROSCOPY IN A PIG
MODEL

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Background: Regional changes of myocardial tissue perfusion occur during cardiac surgery. While early treatment can minimize ischemic injury, current methods of ischemia detection have limitations. Visible light spectroscopy (VLS) is a non-invasive method of rapidly determining localized microvascular tissue hemoglobin oxygen saturation (StO2) by direct application of a VLS probe on the tissue; its reliability has been demonstrated in various human tissues. This study tests the ability of VLS spectroscopy to detect localized ischemia by changes in StO2 measurements after coronary artery ligation in a pig model.

Methods: All animal surgeries were performed in compliance with the 1996 National Research Council Guide for the Care and Use of Laboratory Animals. Six (n=6) anesthetized pigs underwent 20 min of proximal occlusion of the left anterior descending artery (LAD) after midline sternotomy. Systemic hemodynamics (heart rate; central venous, mean aortic and pulmonary artery pressure) and oxygen saturation from arterial and mixed venous samples were measured during the protocol. The VLS probe was placed on the epicardial surface to obtain StO2 measurements from the ischemic site and a non-ischemic control region of the left ventricle. Measurements were obtained before LAD occlusion, and during the ischemic period at 1, 5, 10 and 20 minutes. Regional myocardial function was determined by offline analysis of regional wall motion abnormalities and Doppler strain images acquired by epicardial echocardiography.

Results: Systemic hemodynamics, arterial and mixed venous oxygen saturation remained unchanged throughout the protocol. Pre-ischemia StO2 was 69.2% ± 3.58 SE and 72.4% ± 3.58 SE in the ischemic and non-ischemic LV region, respectively. StO2 remained stable in the non-ischemic region, whereas ischemia of the target region was rapidly detected with VLS, resulting in a steep StO2 decrease in the first 5 min of ischemia and a persistent low StO2 thereafter (Figure 1). This change from baseline and compared to the control site was statistically significant by 1 min (p<0.005) using a repeated measures analysis of variance model. Ischemia was confirmed by segmental wall motion abnormalities within the first minute of ischemia (p<0.05) and alterations in the strain and strain rate patterns while echocardiographic parameters remained unchanged in the non-ischemic myocardial region.

Conclusions: Visible light spectroscopy (VLS) provides non-invasive, stable and reproducible measurements of myocardial StO2. Easily obtained and interpreted measurements in myocardium allow for rapid detection of local tissue saturation and the potential for monitoring of myocardial ischemia during cardiac surgery.

StO2 Measurements after LAD Occlusion
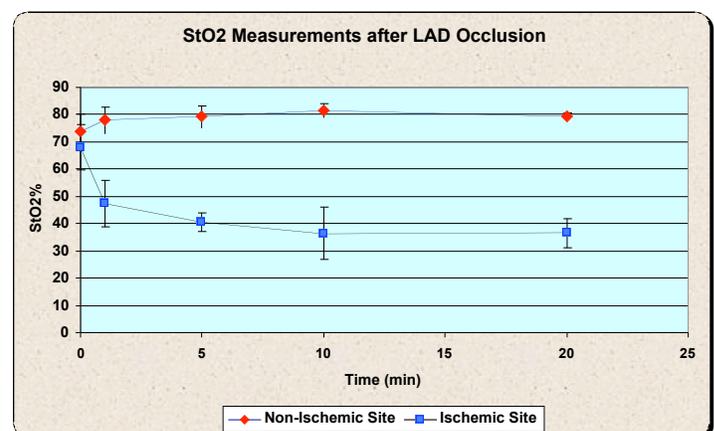
SCA28
PATHOPHYSIOLOGY OF INTRA-AORTIC BALLOON COUNTER PULSATION TO TREAT PRESSURE INDUCED RIGHT
VENTRICULAR FAILURE; SPATIAL GEOMETRY AND SEPTUM FUNCTION DYNAMICS.

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Objective: Experimental direct right coronary perfusion improves right ventricular (RV) dynamics following high afterload RV failure, but is not clinically feasible. This study shows IABP favorably treats RV failure, establishes the helical heart geometry of RV septum structure/function dynamics, and explains how basic muscle/flow physiology defines outcomes.

Methods: Acute RV failure was induced by pulmonary artery banding (PAB) in 8 anesthetized pigs, characterized by tricuspid insufficiency (TR), RV distension, left sided septal bowing and loss of sequential septum function by echo strain analysis. The biventricular effects of combinations of systemic hypertension strategies, with or without intra-aortic balloon pump (IABP) were tested, while measuring tricuspid annular and ventricular size, septal position (eccentricity index (ECI); normal midline position = 1.0), and strain related function of septum spatial architecture.

Results: The aforementioned RV failure pattern (table 1) followed doubling of RV systolic blood pressure (BP), caused profound TR, disrupted the ~80 msec septum contraction sequence of descending and ascending apical loop helical heart segments around the mid-septum line, to impair the septum strain pattern timing. Systemic hypertension by phenylephrine (PE) lowered RV volume and returned midline septum to reduce TR by narrowing the tricuspid annulus, but did not improve septum sequencing or strain. Despite RV success, LV dysfunction from dilation was induced by high aortic afterload. IABP alone marginally changed mean BP without improving RV failure. Conversely, IABP with ½ PE dose augmented aortic diastolic BP, and avoided LV dysfunction by lowering systolic BP. RV failure improved markedly, as TR minimized and septal sequencing and strain patterns normalized to improve biventricular function and augment developed RV pressure.

Conclusion: IABP with minimum vasopressors improves septal perfusion pressure, restores helical heart septum sequential contraction and strain patterns to improve RV failure, while simultaneously avoiding LV dysfunction. These findings imply that treatment of RV failure may require mechanical control of coronary deriving pressure to recover septum dynamics.

StO2 Measurements after LAD Occlusion
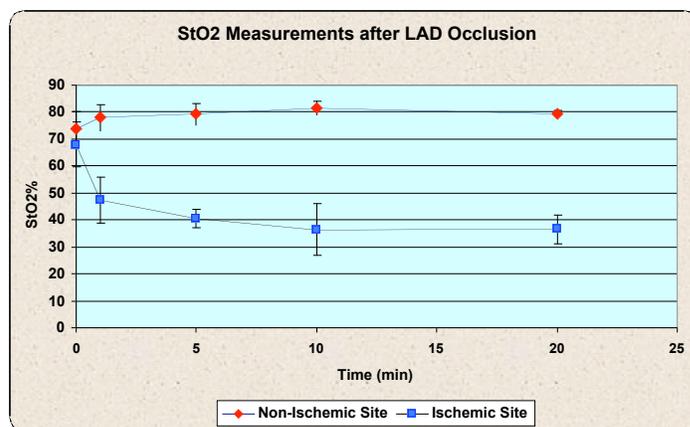
SCA29
NEAR-INFRARED SPECTROSCOPY AS MONITOR OF PERIPHERAL BLOOD FLOW PERFUSION
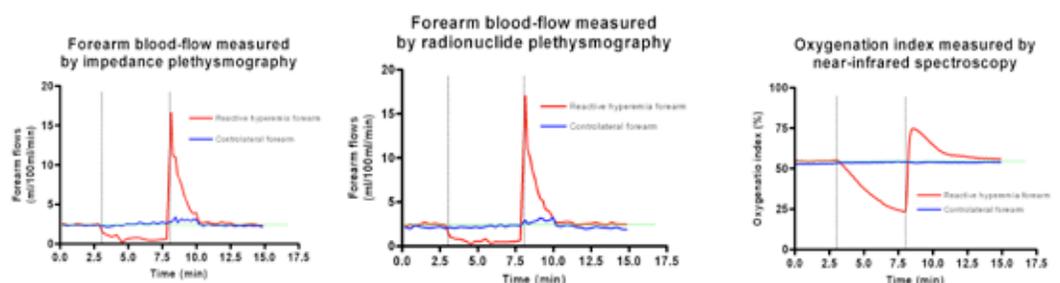
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Introduction: Near-infrared spectroscopy (NIRS) is the only FDA approved monitor of cerebral oxygenation. In addition several reports have suggested that it could be used as a monitor of peripheral perfusion however it has not been studied in patients with cardiac disease and compared with both impedance and radionuclide plethysmography. Using a model of reactive hyperemia after transient arterial occlusion our hypothesis was that the rate of change of forearm tissue saturation using NIRS correlates with strain gauge venous impedance plethysmography and radionuclide plethysmography.

Method: Following approval from the research and ethic committee, 25 subjects referred to the nuclear medicine department were simultaneously evaluated with NIRS and impedance plethysmography. Six baseline flow measurements were performed to evaluate the reproducibility of each method. Twenty-seven serial measurements were then made to evaluate flow variation during forearm reactive hyperemia. Results: Impedance and NIRS methods showed excellent reproducibility with intra-class correlation coefficients of 0.96 and 0.93 respectively (Figure).

Conclusion: We concluded that NIRS technique could be used for the non-invasive evaluation of acute reduction of limb perfusion using a model of reactive hyperemia in patients with underlying cardiac disease.

Forearm blood-flow measured by impedance plethysmography

Forearm blood-flow measured by radionuclide plethysmography

Oxygenation index measured by near-infrared spectroscopy

SCA30
CARDIAC OUTPUT DETERMINATION FROM ARTERIAL PRESSURE WAVEFORM ANALYSIS SHOWED A GOOD
ESTIMATION COMPARED WITH THERMODILUTION METHOD DERIVED WITH PULMONARY ARTERY CATHETER

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Backgrounds: Arterial pressure-based cardiac output measurement (APCO) is based upon arterial waveform analysis and less invasive technique compared with intermittent bolus thermodilution cardiac output (ICO) and continuous cardiac output (CCO) measurements with pulmonary artery catheters (PAC). Also APCO system requires only an arterial line via radial or femoral artery and does not require any manual calibration. In this study we compared the APCO system with PAC routinely used in clinical practice.

Methods: APCO, ICO and CCO data were collected from eighty-five surgical patients (59 cardiac patients and 26 non-cardiac patients) and three medical patients in the OR and ICU from 8 centers in Japan. Patients enrolled in this study required both arterial and pulmonary artery pressure monitoring. The protocol was approved by the institutional review board at the participating hospitals. APCO was calculated with FloTrac system (Edwards Lifesciences, Irvine, CA, USA), and ICO and CCO were obtained with a PAC (Edwards Lifesciences, Irvine, CA, USA) according to clinical need. ICO data were calculated as the average of four bolus measurements in approximately 5 minutes. CCO data were calculated as the average of 6 measurements taken immediately before and after each bolus injection. APCO data were determined by averaging 15 measurements around the mid point of the period of bolus measurements Bland-Altman analysis was used to determine bias and precision in the comparison of the cardiac output (CO) techniques. The bias is defined as the mean of the difference of the COs and the precision is defined as one standard deviation of the difference of the COs. As a subgroup analysis, the bias and precision between the data collected in the OR and in the ICU were calculated. Furthermore, the bias and precision among data of the patients with coronary artery bypass grafting (CABG), valvular surgery and aortic surgery were also calculated.

Results: A total of 457 pairs of measurements were collected from 88 patients between APCO vs. ICO and CCO vs. ICO. Mean age was 62±11 years, and 64.7% of the patients were male. The mean bias between APCO and ICO was -0.15±1.22Lpm and the mean bias between CCO and ICO was 0.39±0.94Lpm. In the OR patients (67patients, 284 data points) the mean bias between APCO and ICO was -0.20±1.27 and the mean bias between CCO and ICO was 0.40±1.02. In the ICU patients (34 patients, 173 data points) the mean bias between APCO and ICO was -0.06±1.11 and the mean bias between CCO and ICO was 0.36±0.79. There was no major difference between the bias and precision for APCO vs. ICO and CCO vs. ICO for the subgroup of patients of CABG, valvular surgery and aortic surgery.

Conclusions:
APCO shows good correlation and minimal bias compared with both ICO and CCO in the patients with various setting and maintains its reliability both in the OR and in the ICU. The use of synthetic graft to large vessels may not affect the large vessel compliance factor of APCO. The less invasive APCO system from arterial pressure monitoring could show us a useful information ofCO.

SCA31

PLAQUE SCORE OF CAROTID ARTERIES AS A PREDICTOR OF ASCENDING AORTIC ATHEROSCLEROSIS IN ELDERLY CORONARY SURGICAL PATIENTS

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INTRODUCTION: Atherosclerosis of the ascending aorta is a major risk factor for postoperative neurologic dysfunction. Transesophageal echocardiography (TEE) has been used to identify atherosclerosis of the thoracic aorta, but allows only limited visualization of the ascending aorta. Plaque score (PS) of the carotid artery is an indicator of systemic atherosclerosis. We examined the plaque score (PS), in combination with TEE, as a predictor of ascending aortic atherosclerosis in elderly patients undergoing coronary artery bypass grafting (CABG).

METHODS: Data were collected prospectively on 151 CABG patients (>60 y) who underwent preoperative B-mode carotid ultrasonography. PS was determined by summing the plaque thickness (>1.1 mm) at each of four divisions of both sides of the carotid arteries and classified into four groups: none, 0; mild, 1.1-5.0; moderate, 5.1-10.0; and severe, >10. TEE was performed to evaluate atherosclerosis in the aortic arch and descending aorta, and to grade the degree of atherosclerosis: normal/mild, <3 mm intimal thickening; moderate, 3-5 mm; or severe, >5 mm. After pericardiotomy, atherosclerosis in the ascending aorta was assessed by epiaortic echocardiography, and atherosclerosis was defined as >3 mm intimal thickening. We compared PS, severity of arch or descending aortic atherosclerosis and risk factors between the atherosclerosis and control groups, and the probability of ascending aortic atherosclerosis was calculated for a combination of risk factors.

RESULTS: There were 42 patients (27.8%) with ascending aortic atherosclerosis. The degree of other thoracic atherosclerosis was higher in the atherosclerosis group (in the aortic arch: 28.5% severe, 33.3% moderate, 38.1% normal/mild vs 8.3%, 29.4%, 62.4%, respectively in controls; in the descending aorta: 26.2%, 40.5%, 33.4% vs 10.1%, 26.6%, 63.3%; p<0.01). PS of the groups were 9.4±4.6 for atherosclerosis and 7.3±5.1 control (p=0.02). The percentage of subjects with ascending aortic atherosclerosis at each group of PS was 12.5% none, 12.5% mild, 35.1% moderate, 34.8% severe. Univariate analysis revealed that PS and 5 other factors were correlated with ascending aortic atherosclerosis: arch and descending atherosclerosis (>5 mm), age (>75 y), male, and smoking. The prevalence of ascending aortic atherosclerosis increased progressively with the number of risk factors present; patients with 5 risk factors had a probability of 0.79.

CONCLUSION: PS of the patients with ascending aortic atherosclerosis was high and is useful to predict ascending aortic atherosclerosis when PS was combined with arch and descending atherosclerosis, as assessed by TEE, age, male and smoking.

SCA32
INFLUENCE OF IABP COUNTERPULSATION ON TRANSESOPHAGEAL ECHOCARDIOGRAPHIC MEASURES OF DIASTOLIC FUNCTION

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Background: Intraaortic balloon pump counterpulsation (IABP), is often used to relieve refractory symptoms of ischemia associated with acute coronary syndrome (ACS). Although IABP is known to optimize systolic cardiac performance, its impact on improving diastolic dysfunction (DD) associated with ACS has not been thoroughly investigated. Therefore, we evaluated the influence of IABP on measures of DD determined by intraoperative transesophageal echocardiography (TEE) in patients undergoing coronary artery bypass grafting (CABG).

Methods: Intraoperative TEE was performed after induction of general anesthesia, in 10 patients undergoing CABG, in whom an IABP was placed preoperatively for refractory ischemia. After full heparinization, the IABP was paused to evaluate cardiac function without IABP support, and compared to values obtained immediately prior on full IABP support (1:1). Transmitral Doppler inflow velocities (E/A), deceleration time (Dt), isovolumic relaxation time (IVRT),pulmonary venous Doppler velocities (S/D),transmitral propagation velocity (Vp) and mitral annular tissue Doppler velocities (e/a), were acquired and analyzed off-line. For statistical analysis Wilcoxon Sign-Rank test was employed. $P<0.05$ was considered significant.

Results: All patients (mean age 65 ± 11 yrs) were hemodynamically stable during the TEE examination. E/A ratios increased from 0.86 without IABP to 1.07 with IABP($p< 0.05$)(Figure 1a). Dt increased from 180ms to 218 ms with IABP ($p<0.05$) (Figure 1b). Trends in IVRT (133ms without IABP vs 102 ms with IABP; $p=0.03$) and S/D ratio (1.66 without IABP vs 1.5 with IABP; $p=0.07$) were not statistically significantly (Figure 1c & d). e/a and Vp also increased significantly with IABP from 0.58 to 0.71; $p< 0.05$ and 34 cm/s to 43 cm/s; $p< 0.05$, respectively suggesting a favorable influence on these less load-dependent measures of diastolic function (Figure 2a & b).

Conclusion: Changes in both load-dependent and load-independent echocardiographic measures of diastolic function associated with IABP counterpulsation are consistent with improved left ventricular relaxation. Thus, in addition to the known favorable influence of IABP on systolic function, IABP may also optimize diastolic function in patients with ACS. Figure 1a) Mitral valve inflow (E/A) ratio. 1b)Deceleration time (Dt) in ms. 1c)Isovolumic relaxation time (IVRT). 1d) Pulmonary vein doppler flow systolic to diastolic (S/D) ratio. Values are Mean ± SD. * $p < 0.05$ Figure 2a) Mitral annular tissue doppler (e/a) ratio. 2b) Transmitral propagation velocity (Vp). Values are Mean ± SD. *$p < 0.05$
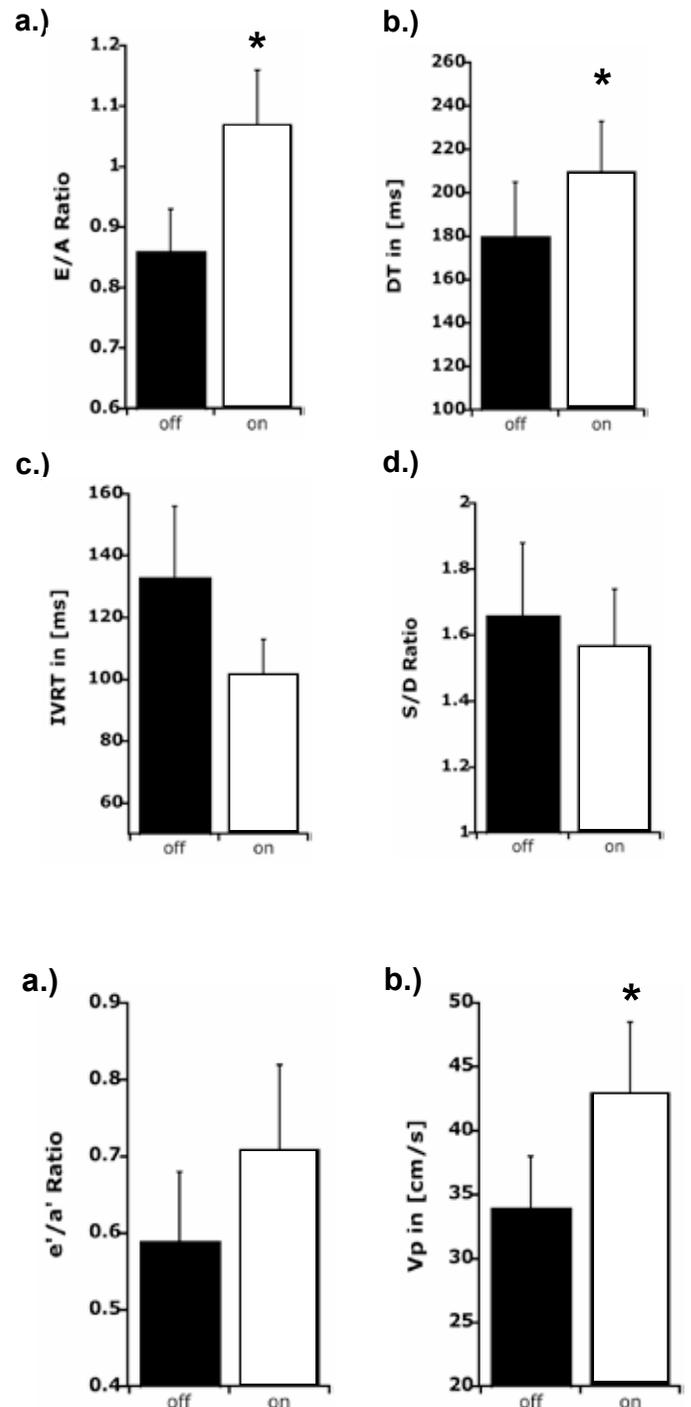
SCA33
ATHEROSCLEROSIS OF THE DESCENDING AORTA DETECTED BY TEE PREDICTS RENAL FAILURE AFTER CARDIAC SURGERY

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Introduction: Acute renal failure (ARF) after cardiac surgery is associated with increased mortality, length of stay, and cost. The risk of acute renal failure ranges from approximately 1.5% to 31% after surgery with cardiopulmonary bypass. In one report, atheroma of the ascending aorta as determined by epiaortic ultrasound predicted renal dysfunction after cardiac operations [1]. In some operating theaters, epiaortic may not be available or utilized. We hypothesized that commonly obtained transesophageal echocardiographic (TEE) information, including the degree of atheroma in the descending aorta, can predict renal dysfunction after cardiac surgery using cardiopulmonary bypass.

Methods: This study was approved by the Internal Review Board at the Wake Forest University School of Medicine. Between November 2004 and June 2005, 269 adult patients undergoing coronary artery bypass grafting (CABG), valve surgery, or combined procedures with cardiopulmonary bypass and the use in intraoperative TEE were retrospectively reviewed. Patients with hemodialysis-dependent (HD) renal failure prior to cardiac surgery were excluded. ARF was defined as an increase in serum creatinine of 0.5 mg/dL and an increase in serum creatinine of 25% from their pre-operative levels. Peak serum creatinine was followed until post-operative day seven. The anesthetic and postoperative management were not controlled. The following demographic factors were recorded: age, gender, race, preoperative Creatinine, intra-aortic balloon pump use, prior heart surgery, history of cerebral vascular disease, peripheral vascular disease, NYHA heart failure classification, ejection fraction, pulmonary rales, COPD, diabetes mellitus, hypertension, previous heart surgery, and surgical priority (elective, urgent, emergent, and salvage). TEE variables recorded include left atrial enlargement, left ventricular enlargement, left ventricular free wall thickness, mitral regurgitation, left ventricular function, descending thoracic atherosclerosis (AS), and the mitral inflow pattern (normal versus diastolic dysfunction pattern).

Results: One patient was excluded from the study for previous HD renal failure. Among 268 patients, 20 (7.5%) developed acute renal insufficiency, 10 (3.8%) of which required hemodialysis. One patient was excluded because of prior requirements for hemodialysis. Univariate independent risk factors for ARF in our study were left ventricular function and severity of AS in the descending aorta.

Conclusion: The severity of atherosclerosis in the descending aorta and the degree of preoperative heart function determined by TEE predicts patients predisposed to acute renal failure after cardiac surgery with cardiopulmonary bypass.

1. Dávila-Román VG, Kouchoukos NT, et al. Atherosclerosis of the ascending aorta is a predictor of renal dysfunction after cardiac operations. J Thorac Cardiovasc Surg 1999;117:111-116.

Table 1: Multivariate Analysis of TEE Variables and Renal Failure

Variables	New Renal Insufficiency (percentage)	OR (CI)	p-value
Left Atrial Size			
Normal-mild (≤ 45 mm)	6.5%	1.65 (0.66-4.14)	0.29
Moderate-severe (> 45 mm)	10.2%		
Left Ventricle Size			
Normal-mild (≤ 58 mm)	7.7%	1.14 (0.25-5.27)	0.86
Moderate-severe (> 58 mm)	8.7%		
Left Ventricle Free Wall Thickness			
Normal-mild (6-14 mm)	8.6%	.686 (0.24-1.98)	0.49
Moderate-severe (≥ 15 mm)	6.1%		
Mitral Regurgitation			
Normal-mild (jet area < 3 cm2, jet length < _ into LA, ≤ 28% of LA Area)	7.0%	1.45 (0.54-4.05)	0.44
Moderate-severe (jet area ≥ 3 cm2, jet length ≥ _ into LA, > 29% of LA Area)	10.0%		
Left Ventricle Function			
Normal-mild (≥ 45% EF)	5.8%	6.46 (2.17-19.2)	<0.01
Moderate-severe (< 45% EF)	28.6%		
Descending Thoracic Aorta Atheroma			
Normal-mild (< 3 mm)	4.2%	4.27 (1.63-11.16)	<0.01
Moderate-severe (≥ 3 mm)	15.7%		
Normal vs. Diastolic Dysfunction			
Normal or normal for age, delayed relaxation	5.8%	2.25 (0.67-7.52)	0.19
Restrictive or Pseudonormalization Pattern	12.1%		

SCA34
ACUTE DIASTOLIC DYSFUNCTION ASSESSED BY TISSUE DOPPLER IN MORBIDLY OBESE PATIENTS UNDERGOING LAPAROSCOPIC GASTRIC BYPASS

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Introduction Cardiovascular disease poses particular challenges to the perioperative care of the morbidly obese (MO). The effects of chronic obesity and volume overload produce ventricular dilatation, increased wall stress and ventricular hypertrophy (1). Prior studies of at risk populations reveal that the physiologic alterations incurred during laparoscopy can compromise cardiac performance (2,3). We hypothesize that MO patients are susceptible to impaired cardiac function during the surgical maneuvers of laparoscopic gastric bypass (LGB). We undertook a combined echocardiographic and hemodynamic study to assess the impact of LGB on cardiac performance.

Methods After IRB approval, 14 patients scheduled for LGB were consented. The anesthetic management was standardized. Echocardiographic and hemodynamic data were collected concurrently at 4 time points: baseline, after insufflation of the abdomen in supine, after insufflation in reverse Trendelenburg (RT) and after desufflation. Diastolic function was assessed by transmitral (TM) and pulmonary venous Doppler velocities and, in a subset of 8 patients, by tissue Doppler imaging (TDI)(Philips IE33). TDI diagnostic criteria for diastolic dysfunction (DD) are: E/e velocity >10 and e velocity <10cm/sec (4). Stroke volume (SV) was calculated from the time velocity integral of the left ventricular outflow tract. After desufflation SV was not obtained due to gastric stapling. Pooled data was compared using a paired t-test.

Results Eleven females and 3 males with a mean age of 42 years and a mean BMI of 50 were enrolled in the study. One female was excluded due to inadequate echocardiographic images. Hypertension was present in 8/13 patients and diabetes mellitus in 4/13. No vasoactive medications were administered during the study. At baseline all patients exhibited normal diastolic function. Abdominal insufflation in supine position induced DD in 4/8 patients (50%) by TDI criteria. Although mean arterial pressure (MAP) remained unchanged, TM E velocity, SV, and cardiac output (CO) decreased significantly (Table). Following placement in RT, DD was present in 3/8 (37.5%) patients and TM E velocity, SV and CO further declined. With release of pneumoperitoneum, all patients returned to normal diastolic functioning.

Discussion These data support our hypothesis that marked impairment of cardiac performance ensues in MO patients undergoing LGB. The relative load independent TDI indices revealed that 50% of patients developed acute DD during abdominal insufflation. These changes were accompanied by marked decreases in SV and CO and returned to baseline values following desufflation. We conclude that MO patients are vulnerable to developing cardiac impairment secondary to the physiologic alterations incurred with pneumoperitoneum and surgical positioning.

References
1   Am J Med Sci. 2001;321:225-236
2   Anesth Analg 1996;83:482-7
3   Obes Surg 2003;13:761-7
4   JAMA 2003;289:194-202

Table: Summary of Echocardiographic and Hemodynamic Data

	Baseline	Insufflation + Supine	Insufflation + Rev. Trend.	Desufflation
MAP (mmHg)	87.5	86.0	81.9	82.2
SV (ml)	74.2	61.2 *	54.8 *	
CO(L/min)	6.03	4.55 *	3.84 ***	_
E (cm/sec)	87.7	77.3	72.2 *	87.4

* = p<0.05 compared to baseline, ** = p<0.05 compared to insufflation + supine, _ = unobtainable

SCA35
CONTINUOUS NON-INVASIVE HEMOGLOBIN MONITORING VIA MULTIWAVELENGTH PULSE CO-OXIMETRY

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New advances in pulse oximetry technology have lead to the development of multi-wavelength pulse CO-oximeters designed to measure multiple physiologic parameters including methemoglobin, carboxyhemoglobin, oxygen saturation, and pulse rate(PR). In addition to these parameters the utilization of multiple wavelengths has led to the development of a prototype pulse CO-oximeter that allows for measurement of continuous hemoglobin concentration (SpHb). This study examines this device's ability to measure continuous SpHb and evaluates the accuracy compared with hemoglobin concentration (Hb) measured in a laboratory CO-oximeter.

Methods: After IRB approval and informed consent 8 patients scheduled to undergo surgery with cardiopulmonary bypass(CPB) were enrolled in this ongoing study. Each patient was monitored with ASA standard monitors and radial artery cannulas. Three prototype SpHb sensors, optically isolated from each other, were attached to a data collection system (Masimo Inc., Irvine, CA). In addition to SpHb, the SpO2, PR and perfusion index (PI) values were recorded. Routine care of these patients was not altered. Data was collected throughout the course of each surgery. SpHb/Hb data pairs were collected at baseline, pre-bypass, start of bypass, pre-separation, post separation, and at completion of the case. Arterial blood samples were analyzed by laboratory CO-oximeter (Radiometer ABL735), and the resulting Hb measurements were compared with the data collected from the corresponding SpHb readings. Regression analysis and bias, precision and ARMS were calculated.

Results: Patients(4 males, 4 females) ranged in age from 10 to 87 years. Mean (SD) SpO2 was 98.6% (3.5%). 139 Hb/SpHb data pairs were collected and analyzed. Hb concentration ranged from 4.4 to 14.1 g/dL (mean =9.4g/dL, SD =2.3g/dL). Regression analysis between Hb and SpHb yielded a correlation coefficient of 0.815 (figure) and the S.E.E = 1.21. Bias, precision and ARMS were 0.45, 1.35 and 1.42 respectively. Excluding all data (n=16) when PI was <0.3%, bias, precision and ARMS were 0.54, 1.23, and 1.35, respectively.

Discussion: This device is the first device developed that can noninvasively continuously measure hemoglobin concentration in addition to the other common hemoglobin species, and therefore provides a significant expansion of existing physiologic monitoring technology. Rapid measurement of hemoglobin would be an extremely useful tool in many clinical scenarios. Patients undergoing CPB present a unique challenge to clinicians and existing monitoring technology. Pulse oximeters have significant accuracy problems due to low peripheral perfusion and significant alteration of the normal plethysmograph waveform during CPB. Data analysis is currently ongoing comparing the device accuracy in healthy subjects to accuracy during CPB. This technology in combination with methemoglobin and carboxyhemoglobin measurements should allow for significant advances in patient care.

Figure:
Correlation between Hb and SpHb in 8 subjects during cardiac surgery. Linear regression is y = 2.0 + 0.74X, r=0.815, S.E.E.=1.21.
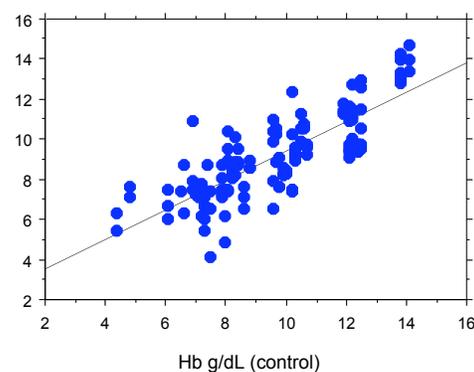
SCA36
RELATIVE IMPORTANCE OF HIGH PULSE PRESSURE AND INTRAOPERATIVE TRANSFUSION ON POSTOPERATIVE STROKE

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Introduction: Increase in pulse pressure (PP) as few as 10 mm Hg is associated with increased risk of stroke in patients undergoing coronary bypass surgery with use of CPB.' Similarly, transfusion of blood products confers added risk for postoperative cerebral complication.2 The combined effect of elevated PP and transfusion on stroke outcome has not been addressed.

Methods: With IRB approval, we conducted a prospective observational study involving 5,436 patients having elective surgery requiring cardiopulmonary bypass. Throughout the index hospitalization, comprehensive data were captured for past medical history, intraoperative and postoperative physiologic and laboratory measures, transfusion requirement, diagnostic testing, and stroke outcomes. Preoperative PP was calculated as the difference of mean systolic and diastolic blood pressure and pulse pressure hypertension (PPH) was defined as pulse pressure > 80 mm Hg. 1 Based on intraoperative transfusion need for red blood cells (RBC), platelets (PLT), and fresh frozen plasma (FFP), two groups were derived: group A (transfusion) and group B (no transfusion). The relationship between stroke and PPH- controlling for the three types of transfusion product- was investigated by stratified analysis and multivariate analysis. Significance was set at P <0.05.

Results: For patients receiving RBC, PLT, and FFP transfusions the incidence of stroke was similar in those with and without PPH (Table 1). In contrast, for patients who did not receive transfusion of RBC and FFP, the incidence of stroke was significantly increased (P=0.026 and P=0.039) in the group with vs. without PPH. Further, for the NO PLT transfusion group, patients with PPH had an associated risk increase in stroke of 92% over patients without PPH (P= 0.0546). After controlling for RBC, FFP, and PLT transfusions, PPH was significantly associated with the risk of stroke- suggesting that blood component therapy confound the associated risk of PPH on postoperative stroke. Nevertheless, the results of multivariate analysis identified PPH, RBC and PLT transfusion as independent predictors of stroke along with Age > 75 years, History of CHF, MI, renal disease, and intraoperative use of inotropes and intra-aortic balloon pump (Table 2).

Conclusions: Our findings confirm that PP as well as RBC and PLT transfusion are independently and strongly associated with postoperative stroke. Whereas blood component therapy combined with PPH markedly increase the incidence of stroke, There appears to be a confounding effect by RBC, PLT, and FFP on the associated risk of PPH on stroke.

Table 1 Impact of Blood Component Therapy and Pulse Pressure on Stroke Outcome in Coronary Bypass Surgery

	Intraoperative Whole blood/Packed Cells = No (N = 2863)			Intraoperative Whole blood/Packed Cells = Yes (N = 1933)		
	Widen PP = No	Widen PP = Yes	P value	Widen PP = No	Widen PP = Yes	P value
Incidence of postoperative stroke – (*n/N*) %	(36/2665) **1.35**	(7/198) **3.54**	0.0260	(35/1749) **2.00**	(5/184) **2.72**	0.4239
Odds Ratio (95% CI)	2.68 (0.99 – 6.20)			1.37 (0.41 – 3.57)		
Summary Statistics	Crude OR: 1.99 (1.07 – 3.70), P=0.0302					
	Cochran-Mantel-Haenszel statistics: General association **P=0.0346**					
	Adjusted OR: **1.92 (1.04 – 3.58)**					
	Breslow-Day Test for Homogeneity of the Odds Ratios: P = 0.2892					
	Intraoperative FFP = No (N = 4309)			Intraoperative FFP = Yes (N = 487)		
	Widen PP = No	Widen PP = Yes	P value	Widen PP = No	Widen PP = Yes	P value
Incidence of postoperative stroke – (*n/N*) %	(58/3965) **1.46**	(10/344) **2.91**	0.0392	(13/449) **2.90**	(2/38) **5.26**	0.3296
Odds Ratio (95% CI)	2.02 (1.02 – 3.98)			1.86 (0.20 – 8.72)		
Summary Statistics	Crude OR: 1.99 (1.07 – 3.70), P=0.0302					
	Cochran-Mantel-Haenszel statistics: General association **P=0.270**					
	Adjusted OR: **1.99 (1.07 – 3.70)**					
	Breslow-Day Test for Homogeneity of the Odds Ratios: P = 0.9260					
	Intraoperative Platelets = No (N = 4383)			Intraoperative Platelets = Yes (N = 413)		
	Widen PP = No	Widen PP = Yes	P value	Widen PP = No	Widen PP = Yes	P value
Incidence of postoperative stroke – (*n/N*) %	(62/4039) **1.54**	(10/344) **2.91**	0.0546	(9/375) **2.40**	(2/38) **5.26**	0.2682
Odds Ratio (95% CI)	1.92 (0.98 – 3.78)			2.26 (0.23 – 11.50)		
Summary Statistics	Crude OR: 1.99 (1.07 – 3.70), P=0.0302					
	Cochran-Mantel-Haenszel statistics: General association **P=0.0296**					
	Adjusted OR: **1.97 (1.06 – 3.66)**					
	Breslow-Day Test for Homogeneity of the Odds Ratios: P = 0.8522					

Table 2. Multivariate Analysis of Postoperative stroke in Coronary Bypass Surgery

Risk Factor	Odds Ratio (95% CI)	P value
PP: every 20 mmHg increment	1.48 (1.15 – 1.90)	0.0021
Intraoperative FFP	2.01 (1.13 – 3.59)	0.0173
History of neurological event	2.19 (1.29 – 3.71)	0.0037
History of COPD	2.53 (1.52 – 4.21)	0.0004
Preoperative ACE inhibitors	1.73 (1.10 – 2.71)	0.0169
Preoperative Calcium channel blockers	1.67 (1.07 – 2.61)	0.0232

Excluded were 5 patients with missing values for at least one of the risk factors in the model, including covariates. The Hosmer-Lemeshow goodness-of-fit chi-square test statistic was 9.30 (P=0.232). The C-index for the model was 0.707.