

SCA13

ISOFLURANE AND PROPOFOL SYNERGY IN ATTENUATING POST-ISCHEMIC MYOCARDIAL INJURY IN PATIENTS UNDERGOING CORONARY ARTERY BYPASS GRAFT SURGERY

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**Objective:** Either isoflurane preconditioning or high dose propofol treatment has been shown to attenuate myocardial ischemia-reperfusion injury in patients undergoing coronary artery bypass grafting (CABG) surgery. We hypothesized that joint isoflurane preconditioning and propofol treatment should confer synergistic protective effects in attenuating myocardial injury in patients undergoing CABG surgery using cardiopulmonary bypass (CPB).

**Methods:** sixty patients selected for CABG surgery were randomly assigned to one of the four groups (n=15 each). After the induction, anesthesia was maintained either with fentanyl and midazolam in control group (Control); or with propofol at 100 microgram/kg/mim before and during CPB followed by propofol 60 microgram/kg/mim 15 min after aortic declamping (group-P); or an inspired concentration of isoflurane 1%-1.5% throughout the surgery (Group-I) or an inspired concentration of isoflurane 1%-1.5% before CPB and switched to propofol at 100 microgram/kg/mim during CPB followed by propofol 60 microgram/kg/mim 15 min after aortic declamping (Group-IP).

**Results:** The duration of aortic cross-clamping and CPB as well as patient characteristics did not differ statistically. Plasma malondialdehyde, a marker of oxidative stress, was significantly lower at 8 h after CPB, and troponin I was lower at 24 h after CPB in group-P and group-I compared with control group ( $P < 0.05$ ). These levels of plasma malondialdehyde and troponin I were further reduced in group-IP at the corresponding time points compared with group P or I ( $P < 0.05$ ). In addition, time to extubation and the duration of intensive care unit stay were shorter in group-IP than in groups P and I ( $P < 0.05$ ) or control group ( $P < 0.01$ ).

**Conclusion:** The joint isoflurane and propofol anesthesia regimen conferred synergistic protective effects in attenuating myocardial injury in patients undergoing CABG surgery using CPB.

SCA14

## ANTICOAGULATION FOR A FONTAN PROCEDURE IN A CHILD WITH HITT USING UNFRACTIONATED HEPARIN AND TIROFIBAN

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Heparin-induced thrombocytopenia with thrombosis (HITT) is a serious disorder that greatly impacts the anesthetic and surgical plans for cardiac procedures requiring cardiopulmonary bypass (CPB). Although rare in the pediatric population, HITT is increasingly recognized as a problem in congenital heart surgery (1). Since unfractionated heparin alone is contraindicated in HITT, alternative methods of anticoagulation must be used. The most common methods described in adult case series have been the use of direct thrombin inhibitors (2) and heparin following antiplatelet therapy (3). There is little experience with these techniques in congenital heart surgery.

We describe a case where tirofiban/heparin was used successfully for anticoagulation for bypass in a child. The patient was a 3 year-old child with a history of hypoplastic left heart syndrome whose second stage repair was complicated by HITT (4). When the patient returned for his Fontan procedure, thirty months following the acute episode of HITT, PF4 antibodies remained detectable. Since our previous experience with direct thrombin inhibitors led us to believe that measurement of anticoagulation with hirudin or bivalirudin would be problematic, we chose to proceed with anticoagulation with heparin after platelet inhibition with the glycoprotein IIb/IIIa receptor antagonist tirofiban.

Tirofiban was given as a bolus dose of 10mcg/kg and an infusion of 0.15mcg/kg/min. Inhibition of platelet aggregation was confirmed by closure time assays utilizing epinephrine and ADP activation (PFA-100, Dade Behring, Inc, Deerfield, Ill). Unfractionated porcine heparin 350 units/kg was administered 10min following the tirofiban load. Celite-ACTs ranged from 574 to 823 sec during the 67 minute bypass period. The tirofiban infusion was terminated 45 minutes prior to the end of bypass. After weaning from bypass, heparin was reversed with protamine. ACT after protamine was 128 seconds. Although the surgical field appeared wet initially, hemostasis became acceptable after less than 30 minutes without further therapy. No significant postoperative bleeding was noted, and the patient did not receive any hemostatic blood products. The closure time the morning of post-op day one was normal.

Although the optimal strategy for anticoagulating pediatric HITT patients for cardiopulmonary bypass is unclear, tirofiban/heparin appears to be efficacious and is easy to administer and monitor. (1)Thromb Haemost 2004;91:719-24 (2) J Cardiac Surg 2006;21:286-8 (3) J Thorac Cardiovasc Surg 2001;122:1254-5 (4)Anesth Analg 2005;101:74-6

## SCA15

## EFFECTS OF COUMADIN DERIVATIVES ON THROMBIN GENERATION

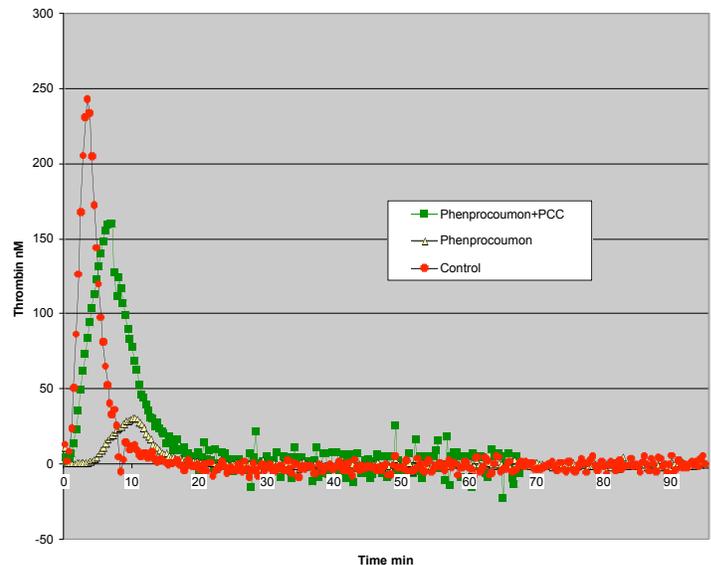
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**Introduction:** Anticoagulant effects of coumadin and its derivatives are conventionally monitored with prothrombin time (PT), a tissue factor activated clotting test. Because only small amount of thrombin is required for clot formation, coumadin anticoagulation may not be fully appreciated with clotting tests. We therefore evaluated endogenous thrombin generation in rats which received oral phenprocoumon. We also evaluated the usefulness of prothrombin complex concentrate for acute reversal of anticoagulation.

**Methods:** Six female rats (190-220 g, Charles River Wiga, Germany) received a single oral dose of phenprocoumon, 2.5 mg. After 15.75 hours, three rats received intravenous prothrombin complex concentrate (PCC, 50 U/kg)(Beriplex P/N, ZLB Behring, Germany), and the others received isotonic saline. Plasma samples were taken at 16 hours, and processed for prothrombin time, and thrombin generation assay (Thrombinoscope, Biodis, France).

**Results:** Phenprocoumon-treated rats had delayed and reduced thrombin generation. PCC restored the onset and peak of thrombin generation toward normal (Figure). PT at baseline was 14.7 sec. In phenprocoumon-treated animal, PT was increased to 50.4 sec, but it was restored to 16.4 sec after PCC treatment.

**Discussion:** PCC restores endogenous thrombin generation, which correlates well with PT results. Thrombin generation assay may be more suitable test in monitoring anticoagulant effects of coumadin derivatives, and therapeutic responses to PCC. For acute reversal of coumadin derivatives, PCC is useful.



SCA16

## OFF PUMP LEFT VENTRICULAR ASSIST DEVICE IMPLANTATION IS SAFE AND EFFECTIVE - INITIAL EXPERIENCE WITH THE FIRST TWENTY CASES IN A SINGLE CENTER STUDY

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**Introduction** Left ventricular assist devices (LVAD) were approved as a bridge to transplantation therapy in 1998, and in 2001, the device received FDA approval for long term implantation in patients with advanced heart failure who were ineligible for cardiac transplantation (destination therapy). This cardiac procedure is associated with a high risk of bleeding coupled with blood product resuscitation which may be related to increase morbidity and mortality. Significant perioperative hemorrhage contributes to other major complications including right side heart failure, acute lung injury, multi organ failure, embolism (due to delay in anticoagulation), infection and the need for surgical re-exploration. The disturbances in the homeostatic system which these patients have are multifactorial and are related to the effect of anesthesia and surgical trauma, end stage heart failure, the LVAD device itself causing consumption coagulopathy, the effect of the cardiopulmonary bypass machine during the procedure and the need for full anticoagulation. The effect of cardiopulmonary bypass can result in severe platelet dysfunction, thrombocytopenia, and the deficiencies in coagulation factors.

**Method and Results** At the Ohio State University Medical Center, in the last two years the surgical team implanted 20 LVAD off pumps. The mean age of the patients was 45 years old, the mean left ventricular end diastolic diameter was 6.9 cm<sup>2</sup>, and the mean ejection fraction was 15%. Eighteen cases were successful in implantation of the LVAD pump. Four cases were redo procedures.

Two cases failed in the redo group. Of the failed cases, one was due to the surgeon entering the right atrium during sternotomy, and the second case was a congenital patient with a previous Mustard operation who did not tolerate the partial occlusion of the pulmonary artery. Both patients had successful implants with CPB. The anesthetic technique includes the mentoring of arterial line and swan ganzs catheter and TEE. The anticoagulation protocol is to administer heparin to keep the ACT above 250 msec. During the case the hemodynamic instability was managed by the attending anesthesiologist. We use the TEE to guide the DeBakey into the heart. Inotropic support was used to support the RV according to the treating anesthesiologists decision. The mean total of blood products (RBCs, FFP, platelets, and cryoprecipitate) used in the operating room and up to 48 hours post-operatively was 15 units and the median total of blood products was 7 units. Four patients also required the administration of recombinant factor VII to reduce post operative chest tube drainage; two require multiple doses and two required only one dose. Only one patient went back for surgical exploration. In addition, no patients required unplanned right ventricular assist device placement. **Discussion** The implantation of LVAD can be done off pump safely and effectively with a much lower rate for surgical re-exploration secondary to surgical bleeding from the historic control in the same institution and from what is found in the literature. The anesthetic team is an integral part in the success of management in these high risk patients in the peri-operative period.

## SCA17

## TIGHT GLYCEMIC CONTROL WITH CONTINUOUS INSULIN INFUSION DURING CARDIOPULMONARY BYPASS

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**Background** The use of continuous insulin infusions in critically ill patients is of known benefit(1). However the use of insulin infusions during operative procedures, specifically cardiac surgery utilizing cardiopulmonary bypass (CPB), remains limited. There are concerns regarding the risk of hypoglycemia both during surgery and in the post operative period(2). We evaluated three different insulin protocols for the ability to achieve tight glucose control and for the incidence of perioperative hypoglycemia.

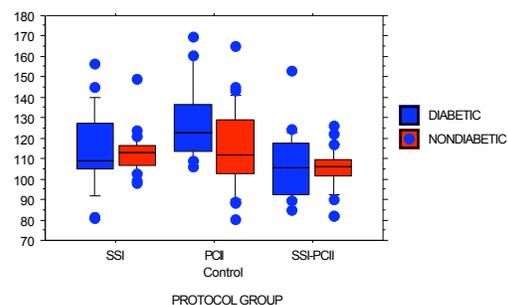
**Methods** After obtaining approval from our institutions IRB, 141 consecutive diabetic and nondiabetic patients scheduled for cardiac surgery with CPB were randomized to one of three groups: (1)control group utilizing the Portland Continuous Infusion Protocol, v2001, (PCII), (2)Sliding Scale Insulin (SSI) group, or (3)Sliding Scale Insulin plus Portland Continuous Infusion Protocol (SSI-PCII) group. Blood glucose levels were measured from arterial line samples at the start of the case and then every 30 minutes to include the initial two hours in the ICU. Patients in each of the three groups received an initial intravenous insulin R bolus as dictated by our institutions moderate insulin sliding scale. The control group (PCII) was then started on the Portland Continuous Insulin Infusion Protocol with target blood glucose of 101-150 mg/dl. The SSI group continued with our hospitals moderate insulin sliding scale with a target of 70-110 mg/dl. The SSI-PCII group was placed on the Portland Continuous Infusion Protocol and additional insulin was administered based upon our

hospitals moderate insulin sliding scale with each subsequent glucose measurement with a target of 70-110 mg/dl. Protocol group parametric variables were compared by unpaired T-test or ANOVA, while non-parametric or categorical variables were analyzed by Chi-square testing.

**Results** Average intraoperative blood glucose levels were significantly lower in the SSI-PCII group compared to the control group ( $P = 0.0005$ ) and SSI group ( $P = 0.015$ ). There was no difference in the incidence of hypoglycemia ( $BG < 60$  mg/dl). The 10 to 90 percentile ranges demonstrated improved glucose control with the SSI and SSI-PCII protocols. Unpaired T-testing of the deviations from the 70-110 mg/dl range was significantly lower for the SSI-PCII ( $6 \pm 8$  mg/dL, mean  $\pm$  S.D.  $P = 0.0006$ ) vs. the PCII group ( $15 \pm 16$  mg/dL). **Conclusions** We have demonstrated that an aggressive insulin protocol with a blood glucose target of 70-110 mg/dl results in improved glucose control and does not increase the incidence of hypoglycemia.

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**Figure 1.** Effect of Protocol on Average Intraoperative Blood Glucose Levels in Non-diabetic (blue boxes) and Diabetic (red boxes) Patients. Lines within boxes indicate means while boxes encompass the 25<sup>th</sup>-75<sup>th</sup> percentile. Whiskers indicate the 10-90 percentile range while individual points are outliers.



## SCA18

## HEPARIN CONCENTRATION MONITORING AND HIGHER HEPARIN DOSING IS NOT ASSOCIATED WITH REDUCTIONS IN BLEEDING AND TRANSFUSION REQUIREMENTS IN A BLINDED RANDOMIZED TRIAL OF CARDIAC SURGICAL PATIENTS REQUIRING CARDIOPULMONARY BYPASS

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**Introduction:** Recently, the conventional approach to anticoagulation management in patients undergoing cardiopulmonary bypass (CPB) for cardiac surgery has been challenged as being inferior to the Hepcon device regarding suppression of thrombin formation and hemostasis.<sup>(1,2)</sup> Neither higher heparin dosing or Hepcon monitoring has been clearly identified as responsible for achieving optimal anticoagulation and reduced blood loss and transfusion.<sup>(3)</sup> Hepcon-based anticoagulation monitoring has been associated with greater total heparin administration. The aim of this study was to evaluate the contribution of heparin dosing regimens and monitoring techniques in patients undergoing cardiac surgery and CPB regarding bleeding and transfusion requirements in a previously unreported blinded fashion.

**Methods:** Following IRB approval, 270 patients scheduled for elective cardiac surgery requiring CPB were planned for enrollment. Management of anticoagulation for CPB was randomly assigned according to designated regimens: Control (C) received 300 u/kg of heparin with additional administration to maintain celite activated clotting time (ACT) > 480 s; High heparin (HH) received 450 u/kg with additional administration to maintain ACT > 600 s; Heparin concentration (HC) received heparin according to Hepcon heparin dose response and additional administration to maintain a heparin concentration at least 4 u/ml. All three groups had heparin neutralized by protamine administration. All perioperative personnel except for perfusionist were blinded to the anticoagulation regimen. Study investigators

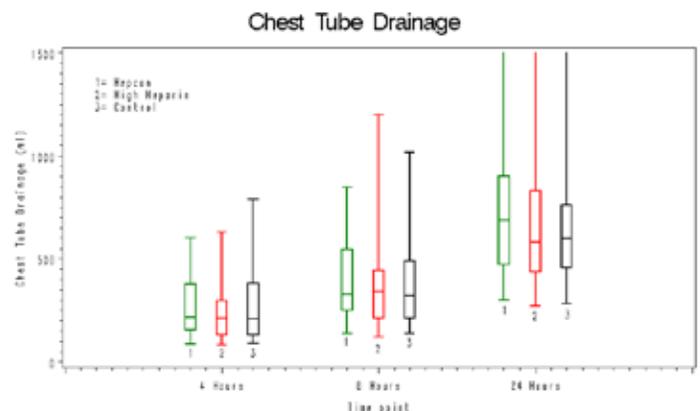
(cardiac anesthesiologists) were substituted for the patients anesthesiologist to manage anticoagulation from the point of heparin administration until complete neutralization without any involvement in transfusion-related decisions. Algorithm for transfusion of blood products was employed for diagnosis and treatment of microvascular bleeding. Comparisons across dosing groups were performed using the Kruskal-Wallis test for continuous variables and Fischers Exact test for categorical variables.

**Results:** Total heparin (u) administered was significantly greater in HH ( $59334 \pm 18669$  u) and HC ( $62436 \pm 15101$  u) regimens compared to control ( $44428 \pm 14556$  u;  $p < 0.001$ ). There were no differences in chest tube drainage at 4, 8, and 24 hours between the regimens (fig). Intraoperative and 24 hour-intensive care unit transfusion requirements did not differ among the regimens.

**Discussion:** Higher heparin dosing or heparin concentration monitoring was not associated with significant differences in bleeding or transfusion requirements compared to conventional dosing and ACT monitoring. Blinding of this study may have contributed to the difference in results compared to prior unblinded studies.<sup>(2,3)</sup>

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SCA19

DECREASING VENTILATOR ASSOCIATED PNEUMONIA IN HIGH RISK CARDIAC SURGICAL ICU PATIENTS

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**INTRODUCTION** Ventilator Associated Pneumonia (VAP) is the 2nd most common hospital-acquired infection in intensive care units (ICUs).(1) Incidence of VAP is significantly higher in Surgical ICUs compared to Medical ICUs.(2) VAP is a leading cause of mortality in ICUs with rates ranging from 20-70%. (3-4) VAP adds \$40,000 to health-care costs on average.(5) Cardiac surgical patients appear to be at an increased risk of nosocomial infections (hospital acquired infections) due to surgical incisions, invasive lines, and intubation.(6) One European study showed that VAP is the main cause of postoperative infection in patients undergoing major heart surgery.(7)

**METHODS:** A multidisciplinary team led by Cardiac Intensivists in a 40 bed Cardiovascular and Thoracic Intensive Care Unit (CVICU) of a tertiary hospital systematically approached reduction of VAP in post cardiac surgical patients. Based on national guidelines multiprong strategy was developed . High VAP rate was identified in July 2003. As it was multidisciplinary, it took multiple revision and buy in before consistent application of therapies took place. First phase was education for all members of CVICU care team highlighting the importance of reducing VAP. Ventilator weaning protocol was revised ,sedation protocol was developed with emphasis on fast track extubation. Consistent application of ventilator bundle done with daily goal sheet rounding. Oral Cleansing and Suctioning System used,with regularly scheduled oral care . Closed In-Line suctioning system used for ventilator circuits. Insulin protocol developed, aggressive control of blood glucose was initiated and maintained. Hand hygiene compliance increased . Reduction in inappropriate transfusion

**RESULTS:** VAP was defined according to the NNIS system. Rate of VAP per 1000 ventilator days was calculated. Incidence of VAP in cardiac surgical patients in the CVICU was measured systematically from month to month for the period of time July 2003- June 2004 ( initiation of process)and July 2004 -June 2005 ( full implementation) by the infection control department. The incidence of VAP from July 2003- June 2004 was 50. It decreased to 11 in July 2004-June 2005. There was greater than 75% reduction of VAP. Additionally health care costs avoidance was more than 1.5 million dollars

**CONCLUSION** A multidisciplinary team approach, led by Cardiac Intensivists, who consistently applied evidence-based treatment modalities were able to reduce VAP in a high risk, cardiac surgical patient population. With cost saving of app. 1.5 million dollars.

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SCA20

## DOES INHALED MILRINONE REDUCE THE SEVERITY OF PULMONARY HYPERTENSION IN CARDIAC SURGERY?

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Two studies have shown that inhaled milrinone (iM) administered after cardiac surgery reduces systolic pulmonary artery pressure without systemic hypotension (1,2). However the investigators were not blind to the group allocated to iM. Furthermore, in an animal model, the administration of iM before cardiopulmonary bypass (CPB) has been associated with prevention of the pulmonary reperfusion syndrome (3). Our hypothesis is that iM is safe and superior to placebo in reducing the severity of pulmonary hypertension and the effect persists after CPB.

**Method:** Following approval from our research and ethic committee and Health Canada, 21 patients with pulmonary hypertension undergoing cardiac surgery and requiring CPB were randomized to iM (5 mg) or placebo administered through a nebuliser following the induction of anesthesia but before CPB. Hemodynamic profiles were obtained before CPB, after the induction of anesthesia, 0, 10 and 20 minutes after nebulisation and after CPB during chest closure. The use of vasoactive agents was standardized. ANOVA was used to measure hemodynamic changes over time.  $P < 0.05$  considered for significance.

**Results:** The mean age was  $70 \pm 6.3$  yo, there were 13 females and 8 males with a NYHA:  $2.9 \pm 0.4$  and a Parsonnet score:  $32 \pm 9$ . The procedures were mitral valve repair or replacement ( $n=5$ ), aortic valve replacement ( $n=3$ ), complex surgery (13) defined by a combination of revascularization, valve or other procedures ( $n=8$ ) or multiple valve surgery ( $n=5$ ) and 5 of these patients had reoperation. The mean systolic pulmonary artery pressure before the induction of anesthesia was  $61 \pm 14$  mmHg. The mean duration of CPB was  $121 \pm 30$  min. Eleven patients received iM and 10

placebo. No difference was observed between iM and placebo in terms of systolic and mean arterial blood pressure however in the iM group the mean systolic pulmonary artery pressure was  $66 \pm 20$  mmHg before the induction of anesthesia and  $46 \pm 12$  mmHg after chest closure but did not change in the placebo group ( $p < 0.001$ ). A total of 3 deaths occurred, 2 in the placebo and one in the iM group. There were no significance difference in outcome in patients with iM but intravenous milrinone and adrenaline were required only in 2 patients in the iM compared to 5 in the placebo group to wean from CPB.

**Conclusion:** Inhaled milrinone administered before CPB is safe and reduces post-CPB pulmonary artery pressure.

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SCA21

SAFETY & UTILITY OF INTRAOPERATIVE TRANSESOPHAGEAL ECHOCARDIOGRAPHY – A SINGLE CENTER CASE SERIES OF 32,408 CARDIAC SURGICAL PATIENTS

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**OBJECTIVE:** To evaluate the safety of intraoperative transesophageal echocardiography (TEE) and to assess its overall utility in real-time use during cardiac surgery.

**METHODS:** Study is a retrospective analysis of cardiac surgical patients operated between January 1993 to June 2006 at the Escorts Heart Institute & Research Centre, New Delhi. During this time frame a total of 51,509 cardiac surgical procedures were performed. Intraoperative transesophageal echocardiography was performed on 32,408 patients (62.9%). Of which, CABG was performed on 16,984 patients (On pump 7610, Off pump 9374), isolated valve procedures on 4,886 patients, CABG combined with valvular surgery 2,128, adult congenital heart surgery in 2,040 and 6,370 underwent miscellaneous procedures i.e. aortic pathology, pericardial diseases, cardiac masses, LV aneurysm repair etc.

**RESULTS:** Prebypass imaging yielded unsuspected findings that either helped or modified the surgical plan in 1764 of 16,984 CABGs (10.38%) and in 596 of 4,886 (12.19%) isolated valve procedures, 486 of 2,128 (22.8%) CABGs combined with valvular surgery, 202 of 2,040 (9.90%) congenital heart repairs. Postbypass TEE identified the need for graft revision in 226 patients (1.33%), intra-aortic balloon pump (IABP) requirement in 1264 patients (7.4%) and associated valve repair/replacement in 562 (3.30%) in the isolated CABG group. Whereas, for isolated valve procedures the postbypass utility was in 432 (8.84%) patients and for CABGs combined with valvular surgery it was 354 (16.63%),

it was useful in 198 (9.70%) congenital heart repairs. For the entire series, 16.66% of patients benefited from prebypass and 8.02% from postbypass use of TEE. The overall incidences of TEE-associated morbidity and mortality in the entire series was 0.61% and 0% respectively.

**CONCLUSION:** Intraoperative TEE is a valuable diagnostic modality for formulating the surgical plan and assessing the immediate results of surgery. Present study demonstrates the significant impact of real time intraoperative TEE on the clinical management of patients undergoing cardiac surgical procedures. It is safe and the results are reliable in the hands of trained anesthesiologists.

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SCA22 (Moved to Poster Discussion III)

## 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.

SCA23

TRANSFUSION OF OLDER BLOOD IS ASSOCIATED WITH HIGHER LONG-TERM MORTALITY FOLLOWING CABG SURGERY

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**Introduction** Each year more than two million units of blood are transfused in the setting of cardiovascular surgery<sup>1</sup>. Detrimental changes to red blood cells stored for a prolonged period of time are well documented. We previously reported an independent association between increased age of transfused blood and thirty-day mortality following coronary artery bypass graft (CABG) surgery<sup>2</sup>. Therefore, we tested the hypothesis that increased age of transfused blood is also associated with long term mortality in 30 day survivors of coronary artery bypass graft surgery.

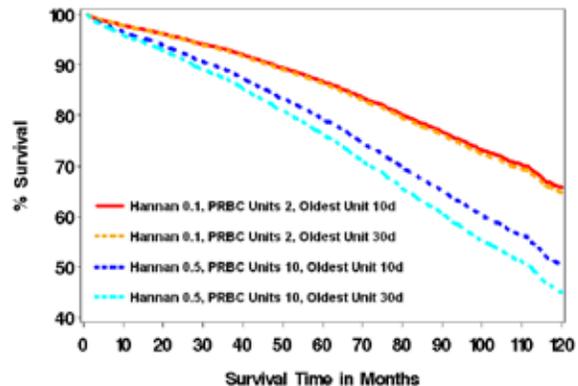
**Methods** Following approval by the local institutional review board, the Duke cardiac surgery and transfusion databases were searched for primary, non-emergent, CABG surgery procedures. Exclusions included off-pump procedures, those not involving transfusion and patients that died within thirty days of surgery. The primary endpoint was long-term survival. A multivariable Cox proportional hazards analysis was performed to assess the relationship between survival (days to death or last follow up), the age of the oldest PRBC unit transfused, the number of packed red blood cell (PRBC) units transfused and the severity of comorbid disease (quantified using the Hannan preoperative risk score)<sup>3</sup>, including interactions between and among these terms.

**Results** Of the 8743 primary, non-emergent CABG surgeries between 1993 and 2002, 3914 were included in the analysis. There

was a statistically significant association between age of the oldest PRBC unit transfused and long-term survival, in interaction with the number of PRBC transfusions received and the severity of comorbid disease (p=0.02). Patients with numerous transfusions and more comorbid disease had the highest mortality risk in association with older blood (figure 1).

**Discussion** We report an association between receiving older blood and decreased long-term survival after coronary artery bypass graft surgery this relationship was most evident in patients with more comorbid disease (higher Hannan score) who received numerous PRBC transfusions. Notably, this analysis was restricted to 30 day survivors of CABG surgery from a larger cohort in which we previously demonstrated an association of older blood transfusion with 30 day mortality risk<sup>2</sup>. While the reasons for these associations are not well understood, they suggest the need for prospective randomized studies to further assess the safe length of blood storage.

- 1 Anesthesiology 1998; 88: 327-33
- 2 Anesth Analg 2005; 100: SCA7
- 3 JAMA 1990; 264: 2768-74



SCA24

## LEVOSIMENDAN ENHANCES WEANING FROM CARDIOPULMONARY BYPASS (CPB) IN PATIENTS WITH COMPROMISED HEART FUNCTION AFTER CORONARY ARTERY BYPASS GRAFT (CABG) SURGERY

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**Introduction** Levosimendan, a compound with both vasodilatory and inotropic properties, is not associated with increased myocardial oxygen consumption (1). Experimental data suggests preconditioning effects of levosimendan (2). Therefore it may have potential in facilitating weaning from CPB in patients with compromised systolic function. We studied the efficacy of perioperatively administered levosimendan in patients undergoing on-pump CABG likely to require postoperative inotropic support and also at risk of myocardial ischemia. The primary focus was on weaning from CPB. Patients and methods Sixty patients with three-vessel coronary disease and left ventricular ejection fraction (LVEF) <50% were included in this prospective, randomized, placebo-controlled, double-blind study. The administration of the study drug (levosimendan 12 µg/kg bolus in 10 minutes followed by an infusion of 0.2 µg/kg/min for the following 23 hours and 50 minutes) or placebo was started immediately after induction of intravenous anesthesia. Anesthesia, hemodynamic treatment and weaning from CPB were standardized. No additional inotropic medications were allowed after induction of anesthesia. Weaning from CPB was successful if, at 10 minutes after weaning, CI≥2.2 L/m<sup>2</sup>/min, SVO<sub>2</sub>≥70%, CVP≤12 mmHg and PCWP≤16 mmHg. If weaning was not successful, CPB was reinstated and epinephrine infusion (0.1 µg/kg/min) was started. If the second weaning attempt failed, an intra-aortic balloon pump (IABP) was instituted.

**Results** The groups were comparable in regard to demographics, preoperative LVEF [36 (8) % in both groups, mean (SD)] and baseline CI [1.8 (0.3) and 1.9 (0.4) L/min/m<sup>2</sup>] in the levosimendan

and the placebo groups, respectively. The mean time from the start of CPB to primary weaning attempt was similar in both groups: 104 (25) min in the levosimendan and 109 (22) min in the placebo group. Primary weaning was successful in 22 patients (73%) in the levosimendan group and in 10 patients (33%) in the placebo group (p=0.002; odds ratio (OR) for failure in primary weaning 0.182, 95% CI 0.060-0.552). Further, four patients in the placebo group needed an IABP after the second weaning failure compared to none in the levosimendan group (p=0.112).

**Conclusion** Our results show that levosimendan significantly enhances primary weaning from CPB compared to placebo in patients undergoing three-vessel on-pump CABG. Consequently, need for additional inotropic or mechanical therapy was decreased.

## References

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2. Kersten JR, Montgomery MW, Pagel PS, Warltier DC. Levosimendan, a new positive inotropic drug, decreases myocardial infarct size via activation of K(ATP) channels. *Anesth Analg* 2000;90:5-11.