

## Free oral sessions

### Oral session I – ‘What about safety?’

O-01

#### Preoperative cerebral oxygen saturation is associated with time to extubation during fast-track cardiac anaesthesia

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**Introduction:** Fast-track cardiac anaesthesia programmes have been linked to a decrease in intensive care unit and hospital lengths of stay and a decrease in mortality and morbidity [1]. It is not known which patients are ideal candidates to undergo early postoperative extubation. The present pilot study was designed to determine pre- and intraoperative factors influencing postoperative ventilation times in a heterogeneous cohort of cardiac surgical patients.

**Method:** Following implementation of a new fast-track protocol at our institution, accompanied by recording pre- and intraoperative factors potentially influencing postoperative time on the respirator, we retrospectively analysed 79 consecutive patients. Successful fast-track was defined as time to extubation within 75 min after admission to ICU [1]. Intraoperatively, depth of anaesthesia had been titrated to achieve a bispectral-index (BIS) of 40 to 50.

**Results:** Sixty patients fulfilled the criterion of successful fast-track (mean 43.9 min (95% CI, 40 to 47 min). 19 patients needed more than 75 min to be weaned from the respirator (135 min (95% CI, 120 to 157 min)). Analysis of pre- and intraoperative factors revealed

that these groups differed only with respect to preoperative cerebral oxygen saturation (ScO<sub>2</sub>) levels (ScO<sub>2</sub>: short ventilation time group: 67.7 ± 5.2%; long ventilation time group: 60.8 ± 7.4%; P=0.001). The correlation between preoperative ScO<sub>2</sub> and time to extubation was: -0.55 (95% CI, -0.68 to -0.37; P<0.0001) Receiver-Operating-Curve analysis of preoperative ScO<sub>2</sub> readings and time to extubation revealed an AUC of 0.83 (95% CI, 0.79 to 0.91; P<0.0001). The best cutoff value to discriminate fast (≤ 75 min) versus not-so-fast (>75 min) extubation was a ScO<sub>2</sub> ≥ 66% (sensitivity 94.7%, specificity 63.3%).

**Conclusions:** Taking into account the limitations of the small sample size and the retrospective design, the results of this pilot study suggests that preoperative ScO<sub>2</sub> is related to time to extubation following cardiac surgery and can thus be used to select ideal candidates for fast-track cardiac anaesthesia programmes.

#### References:

1. Ender J, Borger MA, Scholtz M et al. Cardiac surgery Fast-track treatment in a postanesthetic care unit: six months results of a fast-track concept. *Anesthesiology* 2008; 109 (1): 61-6

O-02

## Non-invasive cerebral oxygenation monitoring during transcatheter aortic valve implantation (TAVI)

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**Introduction:** In patients with high risk cardiac surgery, transcatheter aortic valve implantation (TAVI) could offer a therapeutic solution. In past years, Near Infrared Spectroscopy (NIRS) has been introduced as a useful non-invasive cerebral monitoring technique assessing cerebral oxygenation during cardiac surgery. During valve prosthesis implantation, a transient partial cardiac standstill by rapid ventricular pacing (RVP) is induced to minimize cardiac motion and pulsatile trans-aortic flow. While RVP is advantageous for valve positioning, the combination of rapid heart rate and ventricular hypertrophy can induce a complete loss of cardiac output. In most cases, this haemodynamic deficit is well tolerated, due to the brief duration of RVP. But as far as today, no data are available on cerebral oxygenation during these critical periods of RVP.

**Method:** We report on 10 consecutive pts suffering from severe aortic stenosis. Bilateral ForeSight sensors were applied after induction of anaesthesia. In post-hoc analysis, we were interested to see if any change in cerebral oxygenation (SctO<sub>2</sub> monitoring) occurred during these RVP periods.

**Results:** In all patients, the procedure was technically successfully performed. Mean SctO<sub>2</sub> before RVP was 67% (59-71%) and immediately decreased during RVP to mean 54% (37-70%). This implies a mean decrease in SctO<sub>2</sub> of 13% (1-25%). In 7 patients, RVP resulted in SctO<sub>2</sub> decreases below 55% (m 44%; range 37-52%). These decreases below 55% lasted for mean 20 min (14 sec-87 min).

Systolic blood pressure before RVP was 135 mmHg (95-165 mmHg) and decreased to 74 mmHg (112-42 mmHg) during RVP. In 6 patients, RVP resulted in a decrease in systolic blood pressure below 90 mmHg, immediately countered by vasoactive drugs (adrenaline). In 2 patients, extensive hypotension persisted despite vasoactive support and CPR had to be initiated. In 1 patient, SctO<sub>2</sub> values remained below 55% for 87min. The patient was declared brain dead 48 h later.

**Conclusion:** Transcatheter cardiac interventions, especially those with transient partial cardiac standstill, can induce inadequacy of cerebral perfusion, despite immediate restoration of normal blood pressure.

O-03

## Virtual modelling using real-time activity data informs decision making for efficient critical care utilization post-cardiac surgery

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**Introduction:** Elective postoperative cardiac patients are routinely admitted as Level 3 ITU patients, then stepped down to Level 2 HDU care and eventually discharged to the ward. Delays frequently occur at the interface of different levels of care. We used virtual modelling to test for more efficient ways of providing care in the Cardiac Recovery Unit.

**Method:** Patients who qualified for our established fast track programme were identified. Whilst their care and actual patient journey remained unaltered, we used data on their clinical course and progress to feed a virtual model of alternative critical care unit processes. Three different layouts were evaluated, but all had in common that patients no longer were physically moved between ITU and HDU environments. Instead, 2, 3 and 4 area models were tested using real time data.

The main focus of data collection was on times (admission/step down criteria met/actual discharge/delays), together with a survey of current practices in the UK and an audit of nursing time spent on moving patients between ITU and HDU. All fast track patients were admitted on day 1 to one discreet area "A". As dependency on Level 3 care decreased, nurses were withdrawn from area A to reflect Level 2 standards of 1:2 nurse:patient ratios. The following day all new fast track patients went to an adjacent area "B" and the step down process repeated itself. This was tested with 2, 3 and 4 discreet areas.

**Results:** The majority of UK cardiac units operate a traditional model of care with physically separate ITU and HDU environments. Due to length of stay at Level 2, our 2 area model did not run efficiently. The optimal process with the biggest savings in nursing time and fewest delays in discharge, whilst maintaining acceptable occupancy levels in the expensive critical care infrastructure could be demonstrated using the 4 area model. Should space considerations prevent such a layout, the 3 area model still carries significant advantages over traditional set ups.

**Discussion:** We tested and accepted the hypothesis that it will be more efficient to alter the level of nursing care whilst the patient stays in one place. Virtual Modelling using real time activity data is a rational way of exploring optimal care pathways.

O-04

## Does sleep quality affect the immediate clinical outcome in patients undergoing coronary artery bypass grafting: a clinical biochemical correlation

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**Introduction:** Poor sleep quality is emerging as highly prevalent among patients suffering from cardio-metabolic disturbances. The pathophysiological pathway between poor sleep pattern and outcome from ischaemic heart disease (IHD) is still under research. The role of Endothelin-I (ET-I) in the generation of IHD is well known. However there is lack of information regarding the relationship between this biomarker and in-hospital outcome among the population with poor sleep quality who have to undergo coronary artery bypass grafting.

**Method:** A total of 156 patients were enrolled and divided into two groups based on the Pittsburg Sleep Quality Index (PSQI) of  $\leq 5$  (Group I, n=101) or  $>5$  (Group II, n=55). Blood samples were collected before anaesthesia induction and at 48 h to measure plasma ET-1 and blood sugar levels. The patients were monitored for any intra-operative adverse events and postoperative complications during their hospital stay. Data are presented as mean  $\pm$  SD /median (range) or number %. Continuous variables between groups were estimated by Student's t test for independent samples or Wilcoxon's rank-sum test. Categorical variables were compared using Chi-squared test. The association between ET-1 level and smoking was analysed by using Kruskal-Wallis test. The correlation between ET-1 and PSQI score was tested by using Spearman's rank correlation.  $P < 0.05$  was considered statistically significant.

**Results:** The groups were comparable in demographics and co-morbid conditions. Group II patients had a longer duration of mechanical ventilation ( $14.76 \pm 12.05$  h vs.  $10.10 \pm 8.19$  h,  $P=0.001$ ), ICU stay ( $2.70 \pm 1.45$  dys vs.  $2.08 \pm 1.45$  dys,  $P=0.0016$ ) and hospital stay ( $7.83 \pm 1.73$  dys vs.  $5.98 \pm 1.73$  dys,  $P=0.0001$  respectively). A high number of patients from Group II required inotrope ( $P<0.05$ ) and intra-aortic balloon pump support ( $12.72\%$  vs.  $0$ ,  $P=0.0001$ ) compared with Group I. The overall postoperative complication rate was significantly higher among Group II patients ( $22$  ( $40\%$ ) vs.  $5$  ( $4.95\%$ ),  $P=0.0001$ ) except for the rates of infection and neurological complications which were similar in the two groups. The postoperative in-hospital mortality was nil in Group I and  $3.6\%$  in Group II ( $P=0.05$ ).

The pre-operative ET-1 levels, though clinically high in previous smokers ( $8.82 \pm 7.81$  pg mL<sup>-1</sup>,  $5.8 \pm 4.88$  pg mL<sup>-1</sup> and  $6.51 \pm 4.30$  pg mL<sup>-1</sup> respectively) when compared to non-smokers and who smoked during recent past were not statistically significant ( $P=0.64$ ). A similar finding was elicited for the post-operative values. No significant difference was noted in the ET-1 level among the non-alcoholic and alcoholics at both time points ( $6.18 \pm 5.16$  pg mL<sup>-1</sup> vs.  $7.24 \pm 6.53$  pg mL<sup>-1</sup>,  $P=0.64$  and  $4.04 \pm 6.29$  pg mL<sup>-1</sup> vs.  $5.05 \pm 7.67$  pg mL<sup>-1</sup>,  $P=0.6$  respectively). Spearman's correlation test revealed no relationship between ET-1 level and haematocrit ( $r=-0.002$ ,  $P=0.97$ ) or blood sugar value ( $r=0.05$ ,  $P=0.49$ ) among both the groups. We noted a significant difference in ET-1 level among the groups (Group II vs. Group I) both during the pre and postoperative period [ $9.11$  ( $2.67-36.54$ ) vs.  $4.22$  ( $0-11$ );  $P=0.001$  and  $4.2$  ( $0.39-45.23$ ) vs.  $2.1$  ( $0.39-8.44$ );  $P=0.001$ ].

**Conclusion:** Poor sleep quality was associated with a higher incidence of adverse perioperative events in patients undergoing elective coronary artery bypass grafting. There exists a potential link between poor sleep quality and ET-1 in this group of patients.

O-05

## Training opportunities for foundation year doctors in cardiac intensive care

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**Introduction:** Cardiothoracic intensive care (ICU) is an exceedingly complex and specialised field due to the need to care for extremely ill patients in their perioperative period, with advanced age, multiple co-morbidities and requirement for extracorporeal support (CVVH, ECMO) in many. The opportunities to learn physiological concepts and basic practical procedures in these areas are immense for junior doctors at foundation level (FY). However, the environment of these ICUs can be particularly busy, intimidating and daunting, which could arguably be counterproductive for the training of these doctors. The restriction of working hours due to European working time directive [1] further hampers training opportunities. The aim was to determine the general satisfaction of teaching opportunities provided to FY doctors.

**Method:** An anonymized electronic survey of all FY doctors who worked in our 32 beds Cardiothoracic ICU over the last 3 years was carried out.

**Results:** There were a total of 23 doctors over this period, of which 17 responded to the survey. 88% of those surveyed expressed an interest towards furthering their career in acute care specialties of anaesthesia, ICU and medicine. 76.4% felt that the training was relevant to their career goals. 88.2% felt that they were very well supported in their training needs. 92.4% felt that the formal teaching received on ICU was very useful. 88.1% felt that the ward round was a good educational experience. 82% felt that this was one of the best jobs they had ever worked in. 95.1% would definitely recommend this job to their peers.

**Discussion:** From our results we believe that dedicated senior clinical supervision can provide excellent training to very junior doctors in the most complex environment of the cardiothoracic intensive care. This is likely to prepare doctors at the beginning of their career for the extremes of physiology and help at-

tract more interest in the acute medical specialties.

**References:**

1. McIntyre HF, Winfield S, Te HS, Crook D. Implementation of the European Working Time Directive in an NHS trust: impact on patient care and junior doctor welfare. *Clinical Medicine* 2010; 10 (2): 134-7

## Oral session II – Protection & prevention

O-06

### Levosimendan before heart-lung-bypass in CABG patients with severely reduced ejection fraction

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**Introduction:** We investigated if levosimendan started after anaesthesia induction, prior to cardiopulmonary bypass and continued thereafter reduces organ dysfunction within the first four days after surgery in patients with severely decreased left ventricular systolic function.

**Method:** Thirty three patients with left ventricular ejection fraction  $\leq 30\%$  scheduled for elective coronary artery bypass surgery  $\pm$  valve surgery were included in this prospective, randomized, double-blind controlled study. 17 patients received levosimendan (LEVO) as a 24 h infusion at a rate of  $0.1 \mu\text{g kg}^{-1} \text{min}^{-1}$  started without prior bolus immediately after anaesthesia induction as add-on medication to a goal oriented treatment algorithm. 16 patients were a placebo group (PLAC). Sequential organ failure as-

sessments (SOFA) score on postop. day 1 - 4 was the primary endpoint. Secondary endpoints were haemodynamic parameters, need of vasoactive medication, echocardiographic parameters, need for haemodialysis, 30 days and 6 months survival and quality of life 6 months postoperatively. Statistics included t-test, Wilcoxon-Mann-Whitney, Chi-squared and Log-Rank tests. Power analysis (80%,  $\alpha = 5\%$ ) resulted in 78 patients, but after a blinded interim analysis after 24 months the study was interrupted due to futility, as a recalculation of power resulted in a sample size of 472 patients, 236 in each group.

**Results:** No statistically significant differences in SOFA scores, survival, haemodynamic parameters, time to extubation, median time on ICU, need for haemodialysis or quality of life 6 month postop. were found. The need for epinephrine (35% vs. 81%) or nitroglycerine (6% vs. 44%) for more than 24 h was significantly reduced within the LEVO group.

**Discussion:** Requirements for vasoactive medications were significantly lower in the LEVO group. Haemodynamic parameters, myocardial function, organ dysfunction and mortality in patients with severely reduced ejection fraction for CABG surgery did not differ between groups. We could not show any organ protective effects of levosimendan in our patients. Study conclusions are limited by small patient numbers.

**References:**

1. De Hert SG, Lorsomradee S, Cromheecke S, Van der Linden PJ. The effects of levosimendan

in cardiac surgery patients with poor left ventricular function. *Anesth Analg* 2007; 104 (4): 766-73

2. Tritapepe L, De Santis V, Vitale D, Guarracino F, Pellegrini F, Pietropaoli P, Singer M. Levosimendan pre-treatment improves outcomes in patients undergoing coronary artery bypass graft surgery. *Br J Anaesth* 2009; 102 (2): 198-204

O-07

### The effects of maintaining body core temperature with Thermowrap on incidence of new postoperative atrial fibrillation after CABG

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**Introduction:** Atrial fibrillation (AF) after coronary artery bypass grafting (CABG) surgery occurs in around 30% of patients (pts), aetiology being multifactorial. Studies have suggested that temperature during CPB could influence it [1], although it is unknown whether maintaining normothermia throughout the intervention (Thermowrap™) could reduce the incidence of new postoperative AF.

**Method:** We hypothesized that maintaining normothermia all through the intervention would reduce the incidence of AF by 50% (from 30% to 15%). After approval by the Institutional Review Board 256 candidates for elective primary isolated CABG surgery were enrolled, based on sample size estimation ( $\alpha=0.05$ ,  $\text{power}=0.80$ ). Eligible pts, after signing an informed consent, were randomized (1:1 ratio) into a study group (Thermowrap™ unit was set to 37°C before anaesthetic induction until start of CPB and from rewarming to ICU), and a routine care group, (no warming devices). During CPB rectal temperature was allowed to decline to 33°C and rewarmed to 37°C. In ICU convective air warmers to reach rectal 37°C were utilized in all pts. Anaesthetic and CPB techniques were

standardized. Postoperative AF was defined as episodes of AF that lasted  $\geq 5$  minutes and registered by the monitoring system during the ICU stay and by a telemetry system in the surgical ward. Fisher's exact test was used for statistical analysis.

**Results:** The pts were maintained considerably warmer by Thermowrap™, both during surgery and at ICU arrival. There was a 25% reduction in the incidence of AF in pts treated with Thermowrap™, but this did not reach statistical significance (from 34% to 25%,  $p=0.22$ ).

**Conclusions:** This preliminary study suggests that maintaining normothermia during CABG did not reduce the incidence of postoperative AF, although there was a 25% reduction in treated patients. Further, adequately powered studies are needed, and our study could be the starting point for sample size estimation.

#### References:

1. Adams DC, Heyer EJ, Simon AE, Delphin E, Rose EA, Oz MC, McMahon DJ, Sun LS. Incidence of atrial fibrillation after mild or moderate hypothermic cardiopulmonary bypass. *Crit Care Med* 2000; 28 (2): 309-11

O-08

### Relation between the use of levosimendan and a simple risk factor analysis including age, ejection fraction and creatinine levels in patients undergoing open heart surgery

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**Introduction:** Levosimendan has been reported to cause smooth muscle vasodilata-

tion and an increase in renal blood flow. Our goal was to investigate a relation between the use of levosimendan and a simple risk factor analysis including age, ejection fraction and creatinine levels in patients undergoing open heart surgery.

**Method:** In a prospective, randomized study design, 128 patients with a diagnosis of mitral valve insufficiency with or without coronary artery disease and an ejection fraction of 45% undergoing open heart surgery were divided into two groups. The patients in group levosimendan (Group L, n=64) received levosimendan in addition to standard inotropic support whereas, in the control group (Group C, n=64) only standard inotropic support was given. In Group L, a loading dose of levosimendan ( $6 \mu\text{g kg}^{-1}$ ) was administered within 10 minutes after removal of the cross-clamp, followed by an infusion ( $0.1 \mu\text{g kg}^{-1} \text{min}^{-1}$ ). Echocardiographic data were recorded preoperatively and on day 1 postoperatively. Demographic data, plasma creatinine levels on preoperative and postoperative days 1, 3 and 10 were collected. Complications were recorded. Mann-Whitney U test, Pearson's correlation and multivariate logistic regression analysis were performed.

**Results:** In comparing age, height, weight, preoperative ejection fraction, diagnosis, co-existing diseases and use of medications affecting preoperative renal functions, no difference was found between groups ( $P > 0.05$ ). Postoperative plasma creatinine level was lower in Group L on postoperative day 1 and 3 compared to Group C ( $P = 0.0001$ ,  $P = 0.009$ , respectively). Postoperative ejection fractions were similar between groups ( $P = 0.277$ ). Multivariate logistic regression analysis of risk factors for mortality showed that preoperative pulmonary hypertension, preoperative ejection fraction and postoperative creatinine on day 1 are independent risk factors ( $P < 0.05$ ).

**Discussion:** There is a significant relation between mortality and preoperative ejection fraction as well as early postoperative plasma creatinine levels showing that age, ejection fraction and plasma creatinine levels can be

used in simple risk factor analysis in patients with low ejection fraction undergoing open heart surgery. The use of levosimendan in addition to standard inotropic support therapy in open heart surgery causes a significant decrease in plasma creatinine levels in comparison to a control group that received standard inotropic therapy.

O-09

## Transoesophageal echocardiography and aortic arch branches

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**Introduction:** Visualization of the aortic arch and its branches by transoesophageal echocardiography has been technically challenging. This study was undertaken to evaluate feasibility, merits and demerits and to establish techniques useful in visualizing aortic arch branches.

**Method:** Twenty five patients undergoing elective cardiac surgery were included. TOE was done after anaesthetic induction using a commercial 7 Mhz multiplane TOE 2-D transducer (GE, Vivid 5, Norway). The success rate of visualization techniques useful in visualizing the vessels and complications were noted. Techniques used were tracing the vessel by withdrawing and lateral flexion of the probe, and use of colour Doppler sector scan with low velocity scale.

**Results:** Of the 25 cases, we were able to visualize the left subclavian artery in 100% (25 cases), left internal mammary artery (LIMA) and vertebral arteries in 80% (20 cases), left common carotid artery and its branches, 100% (25 cases) and brachiocephalic and its branches in 56% (14 cases). There was difficulty in visualizing the innominate artery because of the presence of the right main stem bronchus and/or the trachea. Right lateral

flexion of the probe enabled us to visualize the vessel. The subclavian artery was identified by its triphasic Doppler flow pattern while the common carotids were identified by the low resistance Doppler flow pattern with systolic and low velocity diastolic flow throughout the cardiac cycle. The Pulse Wave Doppler of the native LIMA showed a high resistance flow pattern with systolic predominance. Post grafting, the Pulse Wave Doppler showed a biphasic pattern with diastolic predominance exhibiting patency of the graft.

**Discussion:** Visualizing the aortic arch branches can help in identifying the extent of dissection of the aorta, assessing the severity of carotid artery stenosis, patency of LIMA grafts, carotid stents and confirmation of subclavian artery cannulation. With visualization of the subclavian artery it would be possible to control the optimal position of the IABP perioperatively. The information obtained with TOE is helpful for diagnosis, monitoring and decision making during aortic surgery.

O-10

### The effects of hypothermic versus normothermic cardiopulmonary bypass on hepatic blood flow

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**Introduction:** The aim was to explore transoesophageal echo (TOE) as a monitoring device for hepatic blood flow and to correlate between the hepatic venous blood flow measurements and the liver function tests during normothermic and hypothermic cardiopulmonary bypass (CPB).

**Method:** Forty patients scheduled for cardiac surgery were randomly divided into 2 groups, 20 patients undergoing normothermic CPB (G1) and 20 patients undergoing hypothermic CPB (G2). Exclusion criteria were

rheumatoid arthritis, pulmonary disease, diabetes mellitus, left ventricular ejection fraction <0.4, alanine aminotransferase (ALT) >50 IU/L, total serum bilirubin level >1.5 mg/dL (25.6  $\mu$ mol/L) or serum creatinine level >1.5 mg/dL (133  $\mu$ mol/L). CPB flow was adjusted to maintain mean arterial blood pressure (MAP) at 55-70 mmHg. The target nasopharyngeal temperature was 35.5 - 37°C for the normothermic group and 28°C for the hypothermic group. AST, ALT, bilirubin and hyaluronic acid levels were measured before, during and 6 hours after the bypass. During these same phases, TOE was used to measure both cardiac index (CI) and middle hepatic vein blood flow. Calculation of blood flow in the hepatic veins: blood flow = VTI (during one cardiac cycle)  $\times$   $\pi$  (D/2)<sup>2</sup> (cross-sectional area of the vessel)  $\times$  HR (heart rate), and during CPB blood flow = VTI  $\times$   $\pi$  (D/2)<sup>2</sup>  $\times$  60. Measurements were repeated three times and the mean was used. Measurement of CI by TOE: SV = VTI during one cardiac cycle  $\times$  AVA (effective aortic valve area), and during CPB CI = flow adjusted in the CPB machine divided by BSA.

**Results:** Twenty four patients had a CABG (8 hypothermic and 16 normothermic) and 16 patients a valve replacement/repair (10 hypothermic and 6 normothermic). There were no significant differences in demographic data, bypass time, AST, ALT or bilirubin levels between the two groups. There was, however, a significant increase (P<0.001), in both groups, in serum hyaluronic acid levels during CPB in relation to the baseline and in CI 6 hours after bypass in relation to pre and intra bypass phases. The middle hepatic venous blood flow was significantly higher amongst G1 patients six hours following the procedure the pre and intra bypass phases, whereas G2 patients showed a significant decrease in middle hepatic venous flow during the bypass followed by a significant increase 6 hours after the procedure compared to baseline.

**Conclusion:** Hepatic venous blood flow is reduced significantly more during hypothermic bypass than during normothermic bypass.



This may cause disturbances in sinusoidal endothelial cell (SEC) function. However, this change may be well tolerated by the healthy liver.

## Oral session III – Patient blood management

O-11

### Peroperative haemoglobin decrease above transfusion threshold in patients undergoing cardiac surgery

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**Introduction:** Previous studies have suggested that more than a 50% peroperative haemoglobin (Hb) decrease while remaining at a Hb level above a transfusion threshold is associated with an adverse outcome [1]. In this study we aimed to assess the relation between peroperative Hb decrease and a composite endpoint consisting of: in-hospital death, stroke and acute kidney failure. Stroke was defined as a new persistent cerebrovascular event leading to neurological deficits. Acute kidney failure was defined as the need for postoperative kidney replacement therapy.

**Method:** In a single centre observational study, we analysed the relation between peroperative Hb decrease and the composite endpoint in 5,778 patients undergoing cardiac surgery. Only patients with a normal preoperative Hb level were included (Hb 12.0-16.0 g/dL in women and 13.0-18.0 g/dL in men).

**Results:** Our cohort consisted of 4629 non-anemic patients undergoing cardiac surgery. Compared to patients who did not have a Hb

decrease of more than 50% and who continued to have a peroperative Hb level above 7 g/dL, patients with a peroperative nadir Hb level below 7 g/dL, but not more than 50% had higher odds for developing the endpoint (adjusted odds ratio (OR) 2.08, 95% confidence interval (CI) 1.04-4.16). However, the relative increase of odds among patients with a peroperative Hb decrease of more than 50%, who remained above 7 g/dL and of patients with a peroperative Hb decrease of more than 50% who reached a peroperative nadir Hb below 7 g/dL were much less pronounced (adjusted OR 1.40, CI 0.52-3.76, and 1.45, CI 0.74-2.83, respectively)

**Conclusion:** Our findings suggest that a peroperative Hb below 7 g/dL is a more important determinant of in-hospital mortality, kidney failure and stroke than a peroperative Hb decrease of more than 50%.

#### Reference:

1. Karkouti K, Wijesundera DN, Yau TM, McCluskey SA, van Rensburg A, Beattie WS. The influence of baseline hemoglobin concentration on tolerance of anemia in cardiac surgery. *Transfusion* 2008; 48 (4): 666-72

O-12

## Thromboelastography in the evaluation of intra-operative coagulation abnormality changes during CPB: Do females and elderly patients respond differently

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**Introduction:** CPB is associated with coagulation abnormalities. In contrast to standard coagulation tests (SCT), TEG<sup>®</sup> measures clot formation, strength, and lysis under physiologic low shear forces. Parameters measured are, R Time (time for initial fibrin formation), K Time (speed to clot strength), Alpha Angle (rapidity of fibrin build-up/cross-linking) and MA or Maximum Amplitude (maximum dynamic properties of fibrin/platelet bonding [ultimate clot strength]). Prolonged R and K time, and smaller Angle and MA are indicative of hypocoagulability. We investigated TEG percent parameter changes [TPPC] with CPB duration, gender and age.

**Method:** Retrospectively, 421 patients were studied; kaolin heparinase TEG<sup>®</sup> R, K, Angle, and MA values were recorded at baseline (b)

[TEG<sup>®</sup> Rb, Kb, Angleb, and MAb] and post-protamine (pp) [TEG<sup>®</sup> Rpp, Kpp, Anglepp, and MApp]. (+ %) or (- %) TPPC were calculated as follows: TEG<sup>®</sup> Rpp or Kpp or Anglepp or MApp (-) TEG<sup>®</sup> Rb or Kb or Angleb or MAb/TEG<sup>®</sup> Rb or Kb or Angleb or MAb x 100. Relation between TPPC and CPB (SET A). Subgroup analysis, TPPC based on gender (SET B; female; n=143, male; n=278), and age comparing (SET C; Group 1 [ < 60 years; n=134] with Group 2 [ > 80 years; n=57]). (P<0.03 was considered significant).

**Results:** SET A), TEG R%Δ became (+) or prolonged at CPB time ≥ 125 min (P=0.01), TEG K%Δ became (+) or prolonged at CPB time ≥ 119 min (P<0.0001), TEG Angle %Δ became (-) or smaller at CPB time ≥ 124 min (P<0.0001), TEG MA%Δ became (-) or smaller at CPB time ≥ 112 min (P<0.0001). SET B), No gender differences in baseline SCT (PT, INR, PTT, and platelet count), age and CPB time [P>0.03], Females had lower body surface area (BSA), haemoglobin (Hgb), and creatinine [P<0.03]. SET B [TEG (Baseline, Gender Based)]: Females with shorter R and K times, and larger Angle and MA values (P<0.0001). SET C), No differences between Gp1 and 2 in SCT and CPB time (P>0.03). Elderly patients had lower BSA, and Hgb (P<0.0001). SET C [TEG (Baseline, Age Based)]: No TEG R, K, and Angle difference between Group 1 and 2 (P>0.20). Elderly patients with larger MA (P<0.01) [Mean ± S.D].

TEG	Females	Males	Younger (Gp1)	Elderly (Gp 2)
R (min)	7.11±2.03	7.81±2.00	7.88±2.08	7.4±2.74
K (min)	1.65±0.44	1.97±0.71	1.94±0.54	1.77±0.92
Angle (°)	66.92±6.16	63.53±7.26	63.86±6.53	65.57±9.05
MA (mm)	66.19±5.99	62.70±6.76	62.41±6.64	65.20±7.55

SET B [Gender Based TPPC]: for females was more than double of males, despite similar CPB times. (P<0.002). SET C [Age Based TPPC], for elderly was two to five times that of younger patients, despite similar CPB times (P<0.001) [Mean ± S.D].

TPPC	Females	Males	Younger (Gp 1)	Elderly (Gp 2)
R%Δ	+18.93±49.3	+2.23±41.26	5.7±37.7	+24.99±58.0
K%Δ	+32.73±49.32	+16.65±46.2	+11.25±42.12	+ 36.42±46.12
Angle%Δ	-5.53±13.59	-1.0±14.4	+0.50±12.74	-5.23±13.86
MA %Δ	-13.23±10.62	-8.2±10.5	-7.41±10.64	-14.63±9.02

**Discussion:** Prolonged CPB is associated with (+) % Δ or prolongation for TEG<sup>®</sup> R and K, and (-) % Δ or smaller Angle and MA. Despite similar CPB times, TPPC are far more pronounced for both females and elderly (≥ 80 years) patients.

O-13

### Cardiopulmonary bypass and coagulation dysfunction: A comparison of on- and off-pump coronary artery bypass grafting surgery

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**Introduction:** Coronary artery bypass grafting (CABG) surgery, when undertaken on-pump with cardiopulmonary bypass (CPB), is associated with greater blood loss and transfusion than when it is undertaken off pump [1]. Rotational thromboelastography (ROTEM) can be used to quantify the dysfunctions of coagulation. By comparing patients undergoing on- and off-pump CABG surgery, the aim of this study was to identify and quantify the dysfunctions in coagulation associated with CPB using ROTEM.

**Method:** Patients provided informed consent. CABG surgery was undertaken on- or off- pump at the surgeon's discretion. Fifteen minutes after protamine administration (dose at the anaesthetist's discretion), a blood sample was taken from the patients' arterial line

and immediately analysed using a ROTEM Delta<sup>®</sup> analyser.

**Results:** INTEM, FIBTEM and HEPTEM results from 34 patients were obtained (20 on-pump, 14 off-pump). Independent sample Student's t-test found a significantly reduced FIBTEM alpha angle, MA 10, HEPTEM MA 10 and HEPTEM MA (P=0.001, P=0.024, P=0.001, and P=0.001) for on-pump compared to off-pump patients. Mann-Whitney U-test for non-parametric data demonstrated reduced INTEM MA and FIBTEM MA for on-pump compared to off-pump patients. (P=0.038, P=0.0001). There was no significant difference in INTEM MA 10 between the two groups (P=0.053).

**Conclusions:** Dysfunction of coagulation associated with CPB in this unit results either from a lack of clottable substrate, most probably platelets or fibrinogen because of haemodilution or consumption, or insufficient protamine administration. However, our study allocated patients to on- or off-pump surgery in a non-randomized manner, which is a limitation of our method.

#### References:

1. Bainbridge, D, Martin J, Cheng D. Off pump coronary artery bypass graft surgery versus conventional coronary artery bypass graft surgery: a systematic review of the literature. *Semin Cardiothorac Vasc Anesth* 2005; 9 (1): 105-11

O-14

## Different strategies of heparin management during cardiopulmonary bypass and its effects on anticoagulation and postoperative haemostasis: A pilot study

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**Introduction:** The anticoagulant heparin, which is administered to prevent thrombin formation during cardiopulmonary bypass (CPB), may inhibit platelet function and fibrin polymerization. Moreover, heparin needs to be antagonized by protamine, which is also associated with disturbances in haemostasis and allergic reactions. Current heparin and protamine dosing strategies are routinely based on the activated clotting time (ACT), but this can lead to heparin and protamine over- or underdosing. In this pilot study we compared ACT-based heparin management with a heparin management system (HMS) for tailor-made heparin and protamine administration, and focused on anticoagulation and postoperative haemostasis.

**Method:** Twelve patients scheduled for heart valve surgery (main study n=48) were randomized prospectively over the study group (HMS) or control group (ACT). Blood samples were collected after insertion of the arterial line, after administration of the heparin bolus, during CPB and after administration of protamine. Statistical significance of the difference between the groups was assessed using an unpaired Student's t-test.

**Results:** There were no preoperative demographic or haemostatic differences between groups. Patients in the HepCon HMS group received a higher heparin bolus (262 mg ±

50 vs. 201 mg ± 39; P<0.05), more heparin during bypass (163 mg ± 72 vs. 100 mg ± 32; P<0.05) and less protamine (258 mg ± 62 vs. 333 mg ± 80; P<0.05), thus lowering the protamine to heparin ratio (0.6 ± 0.1 vs. 1).

Thromboelastometry parameters revealed a more prolonged post-CPB clotting time (CT) for both INTEM (209 sec ± 16 vs. 183 sec ± 25; P<0.05) and HEPTM (206 sec ± 5 vs. 178 sec ± 26; P<0.05) for patients in the ACT group. Although not significant, patients in this group also showed a higher blood loss 3 h (142 ml ± 125 vs. 63 ml ± 40), 6 h (210 ml ± 163 vs. 120 ml ± 73) and 12 h (346 ml ± 185 vs. 215 ml ± 104) postoperative and in total (477 ml ± 191 vs. 317 ml ± 147).

**Conclusion:** These preliminary results show that heparin management by means of the Hepcon HMS lead to an increase in heparin usage and a reduction in protamine usage without increasing the risk of impaired postoperative haemostasis.

O-15

## The effect of HES (130/0.4) as the priming solution on coagulation in cyanotic children undergoing cardiac surgery

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**Introduction:** Children with cyanotic heart disease undergoing cardiac surgery in which cardiopulmonary bypass (CPB) is used, are at increased risk of postoperative bleeding. There is limited data on the use of HES (130/0.4) as a priming solution in children. In this study, we investigated the influence of hydroxyethyl starch (HES) as a priming solution on postoperative haemostasis in cyanotic children undergoing open heart surgery.

**Method:** Following ethical committee approval and their parent informed consent, twenty cyanotic children ( $\text{SaO}_2 < 85\%$ ) between the ages of 6 mo.-10 yr were included in this prospective, randomized study. Lactated Ringer's solution was used in Group I and HES (130/0.4) solution was used in Group II patients as priming solution adding to blood for the cardiopulmonary bypass (CPB) circuit. Demographic and clinical data of the patients were recorded. The amount of i.v. fluid, urine output and the use of diuretic and inotropic agents were measured at the end of the operation and at the postoperative 24<sup>th</sup> and 48<sup>th</sup> hours. The coagulation parameters (INR, aPTT, Hb, Hct, platelet count) and liver function tests (ALT, AST, GGT, ALP) were examined in all patients. The amount of heparin and protamine were recorded. Postoperative blood loss and transfusion requirements were also assessed. Statistical analysis was performed with Mann-Whitney U test, Pearson  $\chi^2$  test and Fisher  $\chi^2$  test. Significance level was set to  $P < 0.05$ .

**Results:** There was no statistically significant difference between Group I and Group II in terms of demographic and clinical data (Table) coagulation parameters, the amount of drainage from chest tubes and the necessity of blood and blood products replacement and liver functional tests.

**Conclusion:** HES (130/0.4) and RL showed similar effects on coagulation variables and blood loss, so that HES is an alternative solution as priming for the cardiopulmonary bypass (CPB) circuit in children with cyanotic heart disease.

**Reference:**

1. Chong Sung K., Kum Suk P, Mi Ja Y, Kyoung Ok K. Effects of intravascular volume therapy using

hydroxyethyl starch (130/0,4) on post-operative bleeding and transfusion requirements in children undergoing cardiac surgery: a randomized clinical trial. *Acta Anaesthesiol Scand* 2006; 50 (1): 108-11

O-16

**Antiplatelet therapy until the day of cardiac surgery increases postoperative bleeding, transfusion requirements and reoperation rates, but has no impact on 30-day mortality**

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**Introduction:** Balancing the benefit and risk of oral antiplatelet therapy (APT) until the day of cardiac surgery can be challenging. The purpose of this study was to evaluate the impact on continued preoperative antiplatelet treatment (clopidogrel, acetylsalicylic acid) on postoperative bleeding, transfusion rates and mortality.

**Method:** Computerized data from the Western Denmark Heart Registry was used to identify all (9,437) adult patients undergoing cardiac surgery in 3 Danish cardiac centres from 2006 to 2010. Patients subjected to all types of surgery other than CABG or CABG plus valve repair/replacement were excluded.

	Group RL	Group HES	P
Blood loss (mL)	286.0±70.11	277.50±88.60	0.79
Urine output (mL)	882.20±632.28	726.10±288.79	0.65
Total fluid (mL)	1505.00±478.88	1368.70±410.83	0.45
Erythrocyte susp (mL)	190.0±111.65	197.50±58.93	0.40

EuroSCORE age and sex	1.338 (1.176 - 1.522)
EuroSCORE preoperative condition	1.266 (1.157 - 1.384)
EuroSCORE cardiac condition	1.291 (1.182- 1.409)
EuroSCORE procedure	0.937 (0.797 - 1.100)
ECC time score (0, 0-120, >120)	2.598 (1.794 - 3.763)
Peroperative aprotinin	1.419 (0.623 - 3.230)
Peroperative fibrinogen	2.957 (0.764 - 11.447)
Preoperative platelet inhibitors	1.356 (0.896 - 2.053)

Table: Adjusted odds-ratio 30-day mortality.

ed, leaving 5,422 patients in the study cohort.

**Results:** APT patients had higher postoperative drainage (1,027 vs. 844 ml), received more red blood cells (552 vs. 328 ml), fresh frozen plasma (372 vs. 173 ml) and platelets (261 vs. 103 ml) (all  $P < 0.0001$ , independent samples t-test) and were more frequently re-operated due to bleeding (6.3% vs. 4.8%,  $P = 0.038$ ). Patients subjected to re-exploration had significantly higher 30-day mortality (7.9% vs. 2.8%,  $P < 0.0001$ ,  $\chi^2$ -test). APT patients also showed a higher mortality (4.6% vs. 2.3%). However, an adjusted odds-ratio revealed that APT had no independent impact on 30-day mortality.

**Conclusion:** Patients who have not discontinued antiplatelet therapy prior to surgery have significantly higher postoperative bleeding and transfusion requirements and are more often subjected to reoperation. Despite this, APT has no independent impact on 30-day mortality.

O-17

### Bleeding risk assessment using multiple electrode aggregometry in patients following coronary artery bypass surgery: A prospective study

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**Introduction:** Bleeding after cardiopulmonary bypass and re-exploration due to excessive bleeding are risk factors for an adverse outcome after coronary artery bypass surgery (CABG). Differentiating between patients who bleed due to surgical issues and those whose excessive chest tube drainage is due to coagulopathy, remains challenging. Individual variability in the response to antiplatelet therapy (APT) has been established by various platelet function assays. Our hypothesis is that multiple electrode whole-blood aggregometry (MEA) can identify patients at risk for excessive bleeding. The aim of our study was to evaluate the impact of APT, assessed by MEA, on bleeding in patients following CABG.

**Method:** We enrolled 211 patients (155 male and 56 female) undergoing isolated CABG in a prospective observational study. Patients were consecutively recruited and divided into 4 groups with respect to their pre-operative APT management. Patients group allocation was made with respect to antiplatelet therapy management administered by the referral cardiologist. Group 1 (n=103) received acetylsalicylic acid 100 mg/day; group 2 (n=82) received clopidogrel 75 mg/day in addition to acetylsalicylic acid 100 mg/day; group 3 (n=13) received clopidogrel 75 mg/day, and group 4 (n=13) did not receive APT prior to surgery. MEA, using the ASPI and the ADP test, was performed prior to surgery. The primary endpoint was chest tube output and the secondary endpoint was perioperative packed red blood cell concentrate (RBCC) administration. Patients were characterized as bleeders if their 24 h chest tube output exceeded the 75<sup>th</sup> percentile of distribution.

**Results:** All groups were comparable in demographics, basic laboratory data, CPB and aortic occlusion times. Significant differences in both the ASPI test (P<0.001) and the ADP test (P=0.038) were observed between patient groups. The proportion of patients characterized as bleeders differed significantly among the groups with respect to preoperatively administered APT (P=0.039). Significant correlations between the ASPI test (r=0.170, P=0.014) and the ADP test (r=-0.206, P=0.003) with 24 h chest tube output were found. Receiver operating curve revealed the ASPI test value <20 area under curve units (AUC) (AUC 0.603, P=0.023) and ADP test <73 AUC (AUC 0.611, P=0.009) as a "bleeder" determinant. 161 patients (76.3%) received RBCC, and there were no significant differences in RBCC administration among the preoperative APT administration groups (P=0.410). Comparison of the ASPI test values between patients with respect to RBCC administration revealed significantly lower values of ASPI test in the group of patients exposed to RBCC (mean, 27.88 vs. 40.32 AUC, P=0.002).

**Discussion:** Our study showed that MEA is a useful method in predicting CABG patients at risk for excessive bleeding. In this study, we did not assess clinical outcome. Prediction of excessive bleeding along with haemostatic interventions on the basis of MEA should be evaluated in the context of the clinical outcome.

O-18

### The effect of circulating fresh blood through a micro-bypass circuit on platelet microparticles

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**Introduction:** Platelet microparticles (PMPs) are vesicles <3 µm diameter shed from the wall of activated platelets. They may be early markers of vascular damage and mediators of haemostasis [1]. Little is known of their behaviour during bypass or which markers to use for their detection, though they increase during CPB, especially in pericardial blood.

**Method:** 150 ml of blood from each of 10 volunteers was mixed with 1000 i.u. heparin and 50 ml of prime (Hartmann's 66%, Gelifusine 33%), and circulated for 70 min at 33°C in a miniature bypass circuit at an equivalent flow rate of 2.4 L min<sup>-1</sup> m<sup>-2</sup>. Samples were taken at the beginning of bypass, and at 35 and 70 min of circulation and centrifuged twice at 2000 x g. Plasma samples were incubated with CD41a, CD42b, CD61 and CD62 fluorescent antibodies. PMPs were defined using flow cytometry by antibody fluorescence and size, using beads of 0.5 to 3 µm diameter. Analysis was by 2-way ANOVA. P<0.05 was considered significant. Data are presented as median [IQR].

Table 1: PMP absolute counts per ml  $\times 10^6$  during circulation

Species	Baseline	35 min	70 min
CD41a	1.94 [1.29-3.44]	2.27 [1.86-3.47]	2.07 [1.60-4.55]
CD42b	0.38 [0.28-0.94]	0.16 [0.15-0.31]	0.19 [0.11-2.46]
CD61	0.81 [0.53-2.00]	1.21 [0.40-2.34]	1.34 [0.38-3.14]
CD62	0.14 [0.10-0.23]	0.12 [0.09-0.14]	0.13 [0.09-0.26]

**Results:** Using our novel multi-antigen method, there were no significant changes in PMP count (Table 1) for any of the antigen markers between any measurement points.

**Discussion:** Changes in PMP numbers in other studies may be a physiological response to surgery rather than a result of CPB.

**Reference:**

1. Lynch SF, Ludlam CA. Plasma microparticles and vascular disorders. *Br J Haematol* 2007; 137 (1): 36-48

## Oral session IV – Transplant & assist

O-19

### Levosimendan or intra-aortic balloon pump? Which is better in high risk cardiac patients operated under cardiopulmonary bypass?

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**Introduction:** The aim was to test the hypothesis that levosimendan (L) is more effective than intra-aortic balloon pump (IABP) support in cardiac surgical patients with low left ventricular ejection fraction (LVEF), to decrease cardiac troponin I (cTnI) levels and improve haemodynamics.

**Method:** Ninety patients with coronary artery disease and LVEF <35% operated on under cardiopulmonary bypass were randomized to 1 of 3 groups. Group A received a prophylactic IABP one day before surgery.

Group B received a prophylactic IABP and L infusion at a dose of  $0.1 \mu\text{g kg}^{-1} \text{min}^{-1}$  (with an initial bolus  $12 \mu\text{g/kg}$  to facilitate drug effect) after anaesthesia induction for 24 hours. Decision to remove IABP was based on haemodynamic and clinical data. Group C received an L infusion at a dose of  $0.1 \mu\text{g kg}^{-1} \text{min}^{-1}$  with an initial bolus ( $12 \mu\text{g/kg}$ ) after anaesthesia induction. Haemodynamic (bolus thermodilution) and rate of complications were analysed. cTnI was measured at baseline, 30 min and 6 h after CPB, on postoperative day (POD) 1 and 2. Comparative analysis of quantitative characteristics was performed using an analysis of variance or the Kruskal-Wallis test. Comparative analysis of qualitative data was performed with the Fisher-Freeman-Halton exact test.  $P < 0.05$  was considered to be significant.

**Results:** The cTnI level in group C 6 h after CPB was lower than in group A (2.52 (1.56;4.71) vs. 4.84 (2.74;10.3) ng/ml,  $P=0.048$ ). The cardiac index in group A was significantly lower than in groups B and C intra- and postoperatively. The ICU stay was significantly shorter in group C (2 (1,3) days)



than in groups A (3 (3;4) days) and B (4 (3;6) (P= 0.001). Postoperative duration of IABP was 32 (24;48) h in group A and 25 (23;45) h in group B. The need for inotropic support, the rate of complications, and mortality among groups did not differ.

**Discussion:** The authors concluded that the use of L in high-risk cardiac patients is as effective as the use of the IABP. The infusion of L after anaesthesia induction in cardiac surgical patients contributes to lower cTnl levels and improved haemodynamics compared with a preoperative IABP.

O-20

### Perioperative period following heart transplantation with left ventricular wall thickness 1.5 cm or more

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**Introduction:** The use of donor hearts with left ventricular hypertrophy (LVH) is controversial. This category of heart recipients has increasing risk of early graft failure. We proposed that heart transplantation (HT) with LVH  $\geq 1.5$  cm may be successfully performed in selective category patients from a transplant list with extended criteria.

**Method:** Ten patients (2 female and 8 male) were included in this study, aged 26-44 (44.1 $\pm$ 2.7) yr with status UNOS 1A (n=4) and 1B (n=6). Donor characteristics included: female (n=1), male (n=9), age 19-49 (39 $\pm$ 3) yr, weight 86 $\pm$ 3 kg, mechanical ventilation 2.1 $\pm$ 0.8 days, b 12.5 $\pm$ 0.5 g/l, total protein 64 $\pm$ 4 g/l, Na<sup>+</sup> 149 $\pm$ 2 mmol/l, troponin 0.79 $\pm$ 0.04 ng/ml, BNP 132 $\pm$ 11 ng/ml, aorta 3.0 $\pm$ 0.1 cm, RV 2.7 $\pm$ 0.2 m, LVEDV 121 $\pm$ 8 ml, LVEF 66 $\pm$ 1%, IVS 1.5-2.0 (1.63 $\pm$ 0.04) cm,

dopamine (max) 4.8 $\pm$ 0.3 mcg kg<sup>-1</sup> min<sup>-1</sup>, dopamine (min) 3.1 $\pm$ 0.5 mcg kg<sup>-1</sup> min<sup>-1</sup>.

**Results:** Time of CPB was 171 $\pm$ 6 min, total ischaemic time 165 $\pm$ 8 min. 7 (70%) of these recipients had left ventricular type of cardiac allograft dysfunction. Inotropic support included: adrenaline 87 $\pm$ 4 ng kg<sup>-1</sup> min<sup>-1</sup> (n=10), dopamine 8.2 $\pm$ 0.4 mcg kg<sup>-1</sup> min<sup>-1</sup> (n=10), levosimendan infusion (n=4). Intra-aortic balloon counterpulsation (3.3 $\pm$ 0.8 days) was used in 5 (50%) recipients with more significant evidence of LV allograft dysfunction. This category of HT recipients with LVH had a longer time of mechanical ventilation (20.3 $\pm$ 0.8 vs. 5.1 $\pm$ 0.3 h) (P<0.05), more frequent use of CRRT (50% vs. 16%) compared with a historical group of HT recipients without LVH. However there were no differences in survival (90% vs. 91.7%) and ICU time (4.8 $\pm$ 0.3 days vs. 4.5 $\pm$ 0.5 days) between HT recipient with and without LVH.

**Conclusion:** Our study showed that HT from donors with LVH  $\geq 1.5$  cm may be performed in patients from an alternative list with acceptable early post-transplant results.

O-21

### Early extubation in the operating room after heart transplantation

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**Introduction:** Early extubation (EE) of adult or paediatric patients undergoing cardiac surgery is a widely used anaesthetic technique. We proposed that EE may be performed immediately after heart transplantation (HT) in selective category patients.

**Method:** This study included 83 patients (9 female (10%) and 74 male (90%)) aged 18-69 (46.4 $\pm$ 1.5) years undergoing HT from

10/2009 to 12/2011. Pre-transplant diagnoses were dilated cardiomyopathy (n=53; 63.8%) and ischaemic cardiomyopathy (n=30; 36.1%) with NYHA functional class III (n=73, 87.9%) and class IV (n=10, 12.1%). UNOS status was 1A (n=6, 7.2%), 1B (n=30, 36.1%) and 2 (n=47, 56.6%). HT was performed in 80 pts, re-HT in 2 pts and heart-kidney transplantation in 1 pt. Anaesthesia consisted of propofol (TCI), fentanyl, rocuronium bromide or cisatracurim bromide. High thoracic epidural analgesia (0.2% ropivacaine) was used for postoperative management in 9 HT recipients. Decision for EE was based on evaluation of the haemodynamic, respiratory and metabolic status at the end of surgery. The criteria were dopamine or dobutamine  $<7.5 \mu\text{g kg}^{-1} \text{min}^{-1}$ , adrenaline  $<50 \text{ ng kg}^{-1} \text{min}^{-1}$ , CVP  $<12 \text{ mm Hg}$ , PAWP  $<15 \text{ mm Hg}$ , CI  $>2.7 \text{ L min}^{-1} \text{ m}^{-2}$ ; PaCO<sub>2</sub>  $<5.3 \text{ kPa}$ , PaO<sub>2</sub>/FIO<sub>2</sub>  $>40 \text{ kPa}$ , BEa  $>4 \text{ mmol/l}$ , lactate  $<7 \text{ mmol/l}$ ; diuresis  $>1 \text{ ml kg}^{-1} \text{ h}^{-1}$ , absence of significant postoperative bleeding and hypo- or hyperthermia.

**Results:** Total ischaemic time was  $158 \pm 10 \text{ min}$  and CPB time  $138 \pm 10 \text{ min}$ . EE was successful in 56 (67.5%) recipients. Extubation time was  $52 \pm 5$  (5–75) min. Duration of anaesthesia and surgery were consequently  $472 \pm 20$  and  $330 \pm 20 \text{ min}$ . Fast-track HT recipients did not require non-invasive ventilation, re-intubation, re-operation and had no neurological, respiratory infection or other severe complications. Length of ICU stay was  $4.6 \pm 0.4$  days and postoperative inotropic support  $6.2 \pm 0.6$  days. Survival in these heart transplant recipients was 100%.

**Conclusion:** This study showed that early extubation after heart transplantation may be performed in a selected category of recipients.

O-22

## Impella® microaxial pump associated with extracorporeal life support in cardiogenic shock patients

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**Introduction:** Extracorporeal life support (ECLS) is used as short-term circulatory support in cardiogenic shock [1]. However, the ECLS circuit needs reinjection with backward flow into the aorta which increases left ventricle (LV) afterload and preload. To facilitate LV ventricle discharge a microaxial impeller can be inserted across the aortic valve [2].

**Method:** Patients who experienced cardiogenic shock and were treated with ECLS and Impella® have been retrospectively studied. Impella® LP 2.5 (Abiomed Lab., USA.) was inserted through the femoral artery in cases of pulmonary oedema, no LV ejection or LV enlargement with sludge on echocardiography. Patients' characteristics, haemodynamics, pump flow rate, inotrope or vasopressor treatment, serum lactate, creatinine, or bilirubin, cardiothoracic ratio (CTR) on chest X ray over the first 4 days after Impella® implantation, and mortality (day 28 and month 6) have been recorded. Analysis of variance, parametric or non-parametric statistic tests were used.

**Results:** Ten patients, age 17 to 65 y, have been studied. 5 were after cardiac arrest. Impella® was inserted within the first 48 h after ECLS implantation. Mean Impella® pump flow was  $2 \text{ L min}^{-1}$  (1.8 to 2.2). Under ECLS and Impella®, mean dobutamine and norepinephrine doses were reduced significantly ( $P=0.004$ ) with complete inotrope weaning in 7 patients. Serum lactate tended to decrease (from  $6.1 \pm 8.0$  to  $2.8 \pm 2.9 \text{ mmol/L}$ ,  $P=0.05$ ) and CTR decreased significantly from  $0.55 \pm 0.07$  to  $0.49 \pm 0.06$  ( $P=0.002$ ). Five

patients survived at day 28, and 3 at month 6.

**Discussion:** These results suggest that Impella® may contribute to a reduced risk of left ventricle overload under ECLS. Reduction of inotrope doses or complete weaning may also facilitate myocardial recovery.

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O-23

## The comparison of centrifugal and rotation pumps in patients undergoing pulmonary endarterectomy

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**Introduction:** We hypothesize that use of a centrifugal pump for long lasting extracorporeal circulation (ECC) may have a positive influence on markers of haemolysis, inflammatory response and renal function as well as on blood loss and postoperative course.

**Method:** After having signed an informed consent, 39 patients elected for pulmonary endarterectomy from September 2010 to December 2011 were recruited into the study in our University Hospital and randomly divided into two groups. In 20 patients, a rotation pump was used during ECC (Group A). A centrifugal pump was used in another 19 patients for the same purpose (Group B). Demographic, laboratory and clinical data

were collected and compared between the groups. Normal data were analysed using two-way analysis of variance (ANOVA) with repeated measures and subsequent Fisher LSD post-hoc comparisons. Groups were compared by the Mann-Whitney U test in the case of non-normal variables. Multiple-comparison (Bonferroni) correction was used to analyse laboratory measurement at different time points. All values are expressed as mean  $\pm$  SEM and median (min - max) for normal and non-normal distributions, respectively.

**Results:** There were no statistically significant differences in demographic data [age ( $63 \pm 9$  vs.  $60 \pm 11$  years), sex (8 females/12 males vs. 6 females/13 males)], length of ECC ( $280 \pm 35$  vs.  $262 \pm 29$  min), maximum free haemoglobin ( $0.11 \pm 0.01$  vs.  $0.11 \pm 0.006$  mg·dl<sup>-1</sup>), postoperative C reactive protein [ $39$  (19 - 58) vs.  $38$  (15 - 51) mg·l<sup>-1</sup>] and procalcitonin [ $1.9$  (1.5 - 2.4) vs.  $2.0$  (1.4 - 2.4)  $\mu$ g·l<sup>-1</sup>]. Similarly creatinine ( $130 \pm 17$  vs.  $127 \pm 10$   $\mu$ mol·l<sup>-1</sup>), blood losses ( $1124 \pm 109$  vs.  $1000 \pm 97$  ml) and length of stay at ICU ( $7.3 \pm 3.7$  vs.  $7.8 \pm 3.2$  days) did not differ between the groups. There were significantly lower levels of Interleukin-6 (IL-6) in Group B [ $436$  (364 - 489) vs.  $510$  (449 - 544) ng·l<sup>-1</sup>,  $P=0.044$ ], measured 24 h after the end of surgery.

**Conclusion:** Our results show that use of a centrifugal pump in long lasting ECC may decrease the intensity of a systemic inflammatory response expressed by dynamics of IL-6. However, these laboratory changes are without impact on major clinical indicators.

## Oral session V – Cardiac protection

O-24

### Comparison of the effects of sevoflurane, desflurane and isoflurane against ischaemia/reperfusion injury in cardiac surgery

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**Introduction:** An increasing number of investigations demonstrate that halogenated anaesthetics protect the myocardium against Ischaemia/reperfusion (I/R) injury by reducing the infarct size and providing a fast recovery of contractile functions during reperfusion. The aim of this study was to compare the effects of sevoflurane, desflurane and isoflurane on I/R injury when applied before and after cardiopulmonary bypass during cardiac surgery.

**Method:** Following ethical committee approval and informed consent, 36 patients aged 25-75 yr who underwent coronary artery bypass grafting surgery were included in this prospective, randomized study. The patients were randomly allocated to three groups to receive volatile anaesthetics, sevoflurane (Group S), desflurane (Group D) and isoflurane (Group I). These three inhalation agents were administered at 1 MAC concentration from anaesthesia induction until the end of the operation, excluding the CPB

period. All patients received a continuous infusion of remifentanyl throughout the operation and midazolam during CPB. Haemodynamic variables (HR, MAP, CVP, CO, CI, PAP, PCWP, SVR, PVR, SV and SI levels), ICU stay and length of hospital stay were recorded. Laboratory parameters (CKMB, TnT, BNP) were obtained at five periods (T1 after induction, T2 on CPB, T3 at the end of operation, T4 24<sup>th</sup> and T5 48<sup>th</sup> h postoperatively) and IL-6 and IL-10 were recorded at T1, T4 and T5. Statistical analysis was performed with Kruskal-Wallis, Mann-Whitney U test, Bonferroni correction test and Dunn Test. Significance level was set to P<0.05.

**Results:** MAP, CVP, PAP, PCWP, SVR, PVR, SV and SI levels were decreased and HR, CO and CI were increased in all groups. The values of CKMB, BNP, TnT and IL-6 were increased after the operation when compared with the basal value, but no significant difference was observed between the three groups. There were no significant differences in IL-10 levels, fluid, blood, blood products and inotropic requirements and length of ICU and hospital stay between the groups. Blood sugar and insulin requirements were increased more in the desflurane group compared to the other groups.

**Conclusion:** Sevoflurane, desflurane and isoflurane have similar haemodynamic effects and biochemistry markers of cellular damage against I/R injury in patients undergoing open heart surgery.

Table: IL-6 levels (pg/ml) (mean±SD)

(pg/ml)	Group S	Group D	Group I	P #
T1	0.28±0.63	0.11±0.05	0.18±0.28	0.600
T4	1.32±0.92*	1.09±0.70*	1.04±0.68*	0.937
T5	0.79±0.38*	0.77±0.64*	0.68±0.51*	0.405

\*P<0.05: when compared to (T1) period within group

**Reference:**

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O-25

### Cardiac protection by glutamine in patients operated under cardiopulmonary bypass

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**Introduction:** The aim of the present study was to investigate the cardioprotective effects of perioperative use of N(2)-L-alanyl-L-glutamine (GLN) in patients with ischaemic heart disease (IHD) operated on under cardiopulmonary bypass (CPB).

**Method:** This was a double-blind, placebo-controlled, randomized study of 50 patients undergoing cardiac surgery with CPB. Exclusion criteria were left ventricular ejection fraction <50%, diabetes mellitus, recent myocardial infarction or emergency surgery. Patients in the study group (n=25) received GLN (20% solution of GLN «Dipeptiven®» Fresenius Kabi, Germany); 0.4 g/kg a day for 24 h after anaesthesia induction). Patients in the control group (n=25) were administered a placebo (0.9% NaCl). Groups were comparable in preoperative status, anaesthetic management, duration of CPB and number of grafts performed. Troponin I (cTnI) was measured at baseline, 30 min and 6 h after CPB, on postoperative day (POD) 1 and 2. Haemodynamic measurements were based on a thermodilution method (before CPB, 5 min, 30 min, 2, 4, 6, 24 h after CPB). Data are presented as the median (interquartile range). Comparative analysis of non-parametric characteristics were performed with the

Mann-Whitney U test.  $P < 0.05$  was considered to be significant.

**Results:** At POD1, the cTnI level was significantly lower in the GLN group relative to the placebo group (1.28 (0.84–2.23) vs. 2.410 (1.06–6.60) ng/mL;  $P = 0.035$ ). 4 h post-CPB, cardiac index was higher in GLN group patients (2.58 (2.34–2.91) vs. 2.03 (1.76–2.32) L min<sup>-1</sup> m<sup>2</sup>;  $P = 0.002$ ); stroke index was also higher in patients receiving GLN (32.8 (27.8–36.0) vs. 26.1 (22.6–31.8) ml/m<sup>2</sup>;  $P = 0.023$ ); systemic vascular resistance index was significantly lower in GLN group compared to the placebo group (1942 (1828–2209) vs. 2456 (2400–3265) dyn s cm<sup>-5</sup> m<sup>2</sup>;  $P = 0.001$ ). No differences were observed in clinical outcome.

**Discussion:** Perioperative administration of GLN during the first 24 h has cardioprotective effect in IHD patients following CPB. This technique significantly decreases cTnI concentration at POD1 and is associated with improved haemodynamics.

O-26

### Helium pre- or postconditioning does not affect troponin release in patients undergoing coronary artery bypass grafting surgery

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**Introduction:** Coronary artery bypass grafting (CABG) surgery inadvertently subjects patients to myocardial ischaemia reperfusion injury. Helium pre- and postconditioning has been shown to induce cardioprotection in animals. We hypothesized that helium also exerts cardioprotection by pre- and postconditioning in patients undergoing CABG surgery.

**Method:** After ethical approval and informed consent, 125 elective CABG patients were included in the study and randomized to 5 groups: helium preconditioning (pre, n=23), helium postconditioning (post, n=24), helium pre- and postconditioning (pre/post, n=24), sevoflurane preconditioning (sev, n=25) or no conditioning (con, n=29). Preconditioning was given 3 x 5 minutes after the start of surgery, but before cardiopulmonary bypass; postconditioning was started 15 min before expected release of aortic cross-clamp, and continued until a few minutes after clamp release. Blood samples for troponin T analysis were collected until 48 hours after surgery. Statistical testing was done by one-way ANOVA or chi-squared test.

**Results:** Groups were well balanced in regard to age,  $P=0.47$ , sex,  $P=0.88$ , EuroSCORE,  $P=0.36$  and BMI,  $P=0.55$ . Duration of bypass and aortic cross clamping were comparable between groups,  $P=0.53$  and  $P=0.51$ , respectively. Median (interquartile range) area-under-the-curve for troponin release was  $11 \text{ ug L}^{-1} \text{ h}^{-1}$  (5, 31) for control, 11 (6, 18) for preconditioning, 11 (8, 15) for postconditioning, 14 (6, 20) for pre- and postconditioning and 12 (8, 24) for sevoflurane preconditioning ( $P=0.13$ , one-way ANOVA after log transformation).

**Conclusions:** Although previous findings in animal experiments showed that helium induced cardioprotection by pre- and postconditioning, this could not be confirmed in humans undergoing CABG surgery.

O-27

## Cardio-protective effects of sevoflurane and propofol in patients undergoing CABG: A study of HSP70 and TnI levels

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**Introduction:** Serum troponin I (TnI) levels correlate with cardiac damage and compromised perfusion during CABG. A protective effect of stress-inducible heat-shock protein 70 (HSP70) on cellular damage has been demonstrated [1]. The aim of our study was to assess and compare the cardio-protective effects of two different anaesthetic agents, sevoflurane and propofol in patients undergoing CABG, by measuring HSP70 and TnI levels.

**Method:** After Ethics Committee approval and informed consent, 24 patients undergoing elective CABG were randomized. Patients were premedicated with 10 mg diazepam before anaesthesia. After standard monitoring, etomidate, midazolam, vecuronium, and fentanyl were used for anaesthesia induction. Anaesthesia was maintained in group S (n=12) with 2-3% sevoflurane before cardiopulmonary bypass (CPB) and 1-2% during CPB in air-O<sub>2</sub>. In group P (n=12) anaesthesia was maintained with a propofol infusion 3-5 mg kg<sup>-1</sup> h<sup>-1</sup> before and after CPB and 3 mg kg<sup>-1</sup> h<sup>-1</sup> during CPB. Vecuronium and remifentanyl were used in both groups during maintenance. Standard cold blood cardioplegia and moderate hypothermia (28°C) were used for cardio-protection. TnI and HSP70 levels were measured; before induction (t1), at the end of operation (t2), 12<sup>th</sup> (t3) and

24<sup>th</sup> h (t4) after operation. Statistical analysis was performed using StatView V5.0.1. Continuous variables are presented as mean  $\pm$  standart deviation. Intergroup and intragroup comparisons were accomplished using t-test and Bonferroni correction.  $P < 0.05 =$  significant.

**Results:** Age, weight, sex, CPB time, number of grafts, operation and anaesthesia duration were similar ( $P > 0.05$ ). Serum Tnl levels and serum HSP70 levels were presented in table 1 ( $P < 0.05$ ).

There were no significant differences in extubation time, ICU discharge time, haemoglobin levels, platelet counts, usage of blood and blood products, total drainage and urine output among the two groups ( $P > 0.05$ ).

**Discussion:** Results of this study show that compared to propofol, anaesthesia maintenance with sevoflurane resulted in lower levels of serum Tnl and higher levels in HSP70 in patients undergoing CABG with CPB. We conclude that sevoflurane based anaesthesia may provide better cardiac protection than propofol.

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O-28

## Sevoflurane profoundly attenuates the inflammatory response upon myocardial reperfusion

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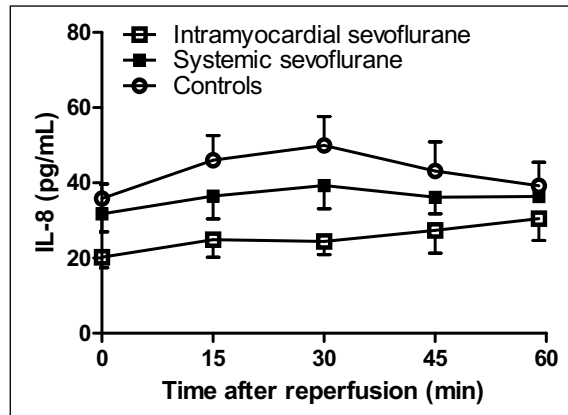
**Introduction:** Myocardial ischaemia/reperfusion (I/R) injury is an inherent consequence of on-pump cardiac surgery. I/R-mediated inflammatory responses are considered key mediators of myocardial dysfunction. Sevoflurane has been shown to quench inflammation. In this study, the hypothesis of attenuating the I/R-related inflammatory responses by selective sevoflurane perfusion was tested.

**Method:** The anaesthetic regimen consisted of a continuous target controlled infusion of propofol, remifentanyl and sufentanil. If necessary, inotropics (dobutamine, norepinephrine, enoximone or a combination) were used. Arterial and myocardial venous blood samples were collected simultaneously at various time points after reperfusion in three patient groups undergoing cardiac surgery. The first eleven patients received warm-blood cardioplegia, enriched with sevoflurane 2%, every fifteen to twenty minutes for two minutes throughout the entire surgical procedure to ensure intramyocardial delivery. Six additional patients received systemic sevoflurane-

Table 1: Serum Tnl levels( $ng.mL^{-1}$ ) and serum HSP70 levels ( $mcg.mL^{-1}$ )

Group	Tnl-t1	Tnl-t2	Tnl-t3	Tnl-t4
P (n=12)	0.086 $\pm$ 0.036	0.210 $\pm$ 0.085	0.282 $\pm$ 0.114	0.144 $\pm$ 0.062
S (n= 12)	0.079 $\pm$ 0.034	0.130 $\pm$ 0.055*	0.186 $\pm$ 0.078*	0.129 $\pm$ 0.052
	HSP70-t1	HSP70-t2	HSP70-t3	HSP70-t4
P (n=12)	0.849 $\pm$ 0.294	1.244 $\pm$ 0.396	1.804 $\pm$ 0.575	1.367 $\pm$ 0.452
S (n=12)	0.820 $\pm$ 0.188	1.885 $\pm$ 0.398#	2.734 $\pm$ 0.577#	1.338 $\pm$ 0.352

\* $P < 0.05$  compared to group P, # $P < 0.05$  compared to group P



enriched perfusion. In detail, 0.5% sevoflurane was administrated systemically via the oxygenator of the CPB for eighty seconds in between two cardioplegia runs. This concentration and time frame was chosen to approximate the same concentration of sevoflurane compared to the intramyocardial delivery group. In addition, ten control patients were included. Cardiac specific release of inflammatory mediators upon reperfusion was studied as well as differences in systemic values by comparing area under the curves of these mediators by paired and unpaired t-test, respectively.

**Results:** Both intramyocardial and systemic delivery of sevoflurane had profound effects on the systemic inflammatory response post-operatively, reflected by a reduction in circu-

lating CRP levels the first day after surgery compared with controls. Administration of *intramyocardial* sevoflurane-enriched blood cardioplegia resulted in a significant systemic attenuation of IL-6, IL-8, IL-16, IL-18 and CXCL10 upon early reperfusion and CCL5 and IL-18 in the late reperfusion phase. Administration of systemic sevoflurane-enriched perfusion resulted also in attenuation of the inflammatory response, although to a lesser extent than the intramyocardial administration.

**Discussion:** Sevoflurane-enriched blood cardioplegia attenuates the systemic inflammatory response profoundly. This effect was most prominent in patients who received sevoflurane intramyocardially, suggesting that the myocardium itself is a major contributor to the postoperative inflammatory response.



## Oral session VI – Risk & non-cardiac surgery

O-29

### Short term haemodynamic consequences of pneumonectomy: An experimental study in pigs

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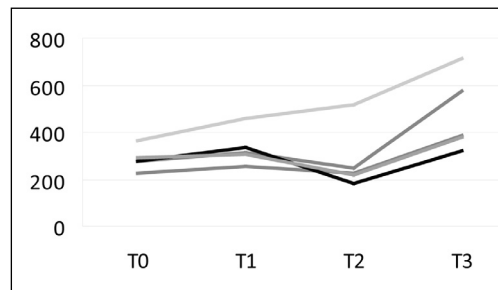
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**Introduction:** The consequences of the changes in pulmonary circulation induced by an acute reduction in the pulmonary vascular bed after pneumonectomy are not well established. We report here the results of an experimental study in pigs.

**Method:** Experiments were performed on commercial female farm-bred piglets (2-3 months after approval by the animal care and use committee of our institution. The animals were anaesthetized with propofol and sufentanil. The animal were mechanically ventilated in air/oxygen (FiO<sub>2</sub> 0.5), keeping end tidal CO<sub>2</sub> pressure between 4.7 and 5.3 kPa and plateau pressure <35 cmH<sub>2</sub>O. Mean arterial pressure (MAP), pulmonary artery pressure (PAP), capillary wedge pressure (PCWP) and cardiac output (CO) (thermodilution catheter) were recorded. Pulmonary vascular resistance (PVR) was calculated using the following formula:  $PVR = (PAP-PCWP)/CO.80$  (dyn s cm<sup>-5</sup>). Left pneumonectomy was performed through the 5<sup>th</sup> intercostal space. A new haemodynamic evaluation was performed on the 2<sup>nd</sup> postoperative day. Measurements were made after induction (T0), after pulmonary exclusion (T1), just after pneumonectomy (T2) and 2 days after (T3). Analysis of variance, parametric or non-parametric statistic tests for repeated measures were used to assess statistical significance (P<0.05).

**Results:** Five piglets, weight 22 to 25 kg, were studied. MAP and COs were not significantly

changed at any time, but pulmonary pressure and systemic and pulmonary vascular resistances increased significantly at day 2 after the pneumonectomy (+62.9%, P=0.001, figure) without oxygenation impairment (Pa<sub>2</sub>/FiO<sub>2</sub> ratio >40).



**Discussion:** Pulmonary pressure and pulmonary vascular resistance increased significantly after pneumonectomy, but only 2 days after the pulmonary resection. These results suggest that pulmonary vasoconstriction was activated that was not effected in the early phase after the pneumonectomy.

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O-30

## Focus assessed transthoracic echocardiography (FATE) in patients acutely admitted with respiratory symptoms

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**Introduction:** Use of transoesophageal echocardiography has for years been mandatory in cardiothoracic anaesthesiology. Transthoracic echocardiography (TTE) has not received the same attention, despite several published protocols of simple focused TTE [1,2]. Several studies have questioned the diagnostic performance of the clinical examination in patients with acute respiratory symptoms [3]. Thus FATE could be integrated as a part of the patient assessment, potentially improving diagnostics. We evaluated the use of a sonographic examination, including FATE, performed within one hour of the primary appraisal in patients acutely admitted with respiratory symptoms.

**Method:** We conducted a prospective cross-sectional, blinded observational study in a medical emergency department. Patients were included if one of the following symptoms or clinical findings was present: respiratory rate >20, saturation <95%, oxygen therapy initiated, dyspnoea, cough or chest pain. Within one hour after the primary evaluation sonographic examination including FATE was done by a physician blinded to patient history and primary appraisal.

**Results:** We identified and screened 342 patients of whom 139 patients fulfilled inclusion criteria. The feasibility of the FATE was 99.3%. In 17 (12%) patients FATE identified an acute life threatening condition missed at

the primary assessment. Of these, 10 had left-sided heart failure with pulmonary oedema, 1 had a pericardial effusion, 1 had massive pleural effusion and 5 had empyema.

**Discussion:** FATE is a fast, highly feasible and non-invasive bedside method. In acute admissions with respiratory symptoms, routine use of FATE may help the clinician to diagnose acute life threatening conditions, which could otherwise be missed. As use of the FATE protocol seems to improve the diagnostic performance in an emergency department, the same could potentially be the case in cardiothoracic anaesthesiology where heart failure, pulmonary oedema, pericardial effusion and pleural effusion are all important daily pathologies.

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O-31

## Transoesophageal echocardiography: Visualizing abdominal aortic branches

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**Introduction:** Transoesophageal echocardiography (TOE) plays a central role in the diagnosis of aortic dissection, allowing a detailed description of its extent and involvement of the aorta and its branches. This study was

conducted to evaluate abdominal aortic branches in aortic surgery with TOE and establish useful techniques to visualize them.

**Method:** After obtaining Ethical Committee approval, eleven patients undergoing elective aortic surgery were studied. TOE was performed after anaesthetic induction using a commercial 7 Mhz multiplane TOE 2-D transducer (GE, Vivid 5, Norway). The success rate of visualization techniques useful in visualizing the vessels and complications were noted. Specific manoeuvres of advancing, anteflexion and lateral flexion of the probe and use of colour Doppler sector scan from the beginning were helpful for visualization of these vessels.

**Results:** Reducing the transducer frequency to 2.5 Mhz and lateral flexion of the probe to minimize the angle of correction increased the success rate of visualization. The coeliac artery (CA) arising at 1 o'clock position was visualized in 82% (9 cases), superior mesenteric artery (SMA) arising at 3 o'clock position in 55% (6 cases) and renal vessels in 36% (4 cases). The CA is the first branch of the descending aorta with a characteristic low resistance Doppler flow pattern continuous throughout the cardiac cycle. SMA had high resistance flow pattern with systolic predominance. Intimal thickening of the aortic wall (3-5mm) was noted in 7 cases.

**Discussion:** Intraoperative visualization of abdominal vessels by TOE is semi-invasive and cost effective. Dissection seen at the level of CA indicates extension into the abdominal aorta which has an impact on the surgical strategy. The visualization of SMA using TOE can be used to diagnose mesenteric ischaemia by assessing the quantum of blood flow. Inferior visualization of the renal vessels was a major limitation. Repeated attempts at visualization increase the success rate. A larger case series is recommended for evaluating the merits and demerits of this method.

O-32

## Liberalized fluid protocol does not increase lung water after lung resection surgery

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**Introduction:** Acute lung injury following lung resection surgery is a serious complication with an incidence of 0.9% - 7% and high mortality rate [1, 2]. Although the pathogenesis is unclear, an increase in pulmonary capillary hydrostatic pressure resulting from lung resection and positive fluid balance have been suggested. This has led to the practice of restrictive fluid therapy in the perioperative period [3]. We hypothesized that with an anaesthetic technique employing protective lung ventilation, fluid therapy directed at normovolaemia will not result in an increase in extravascular lung water in the perioperative period.

**Method:** After IRB approval, all patients scheduled for lung resection surgery were asked to enrol. Exclusion criteria included planned pneumonectomy, ejection fraction <40% or serum creatinine >177 µmol/L. Extravascular lung water index (EVLWI), global end diastolic index (GEDI) and cardiac index (CI) were measured using single-dye technique with PiCCO monitor (Pulsion Medical Systems, Germany) utilizing central venous and brachial artery catheters. Baseline measurements were obtained pre-incision. Following one-lung ventilation, patients were ventilated with 100% oxygen using pressure control ventilation with target tidal volume (Vt) of 4-6 ml/kg, peak airway pressure (P<sub>aw</sub>) <30 cm H<sub>2</sub>O, PEEP 5 cm H<sub>2</sub>O and recruitment manoeuvre. Intraoperative fluids consisted of balanced salt crystalloid solution maintenance of 1.5 ml kg<sup>-1</sup> hr<sup>-1</sup>, deficit volume replacement, and replacement of the insens-

ble loss with 1 ml kg<sup>-1</sup> hr<sup>-1</sup> for open surgery. Blood loss was replaced 1:1 with colloid solution (Hextend) or PRBCs transfusion. The protocol was continued postoperatively until the patient began oral intake. Diuretics were not given routinely. PiCCO measurements were obtained for 3 days postoperatively. Data is presented as mean ± SD. Non-parametric analysis was used to compare variables.

**Results:** Fourteen patients consented to participate. Three patients' surgery was cancelled. The 11 remaining patients were male age 65±6.0 y. 8 patients had a lobectomy, 2 wedge resection and 1 an unplanned pneumonectomy. Open thoracotomy was used in 8 patients and a video assisted approach in 3 patients. One-lung ventilation time was 233 ± 110 min. V was 4.5 ml/kg ± 0.2, with P<sub>aw</sub> of 19.9 ± 4.5 cm H<sub>2</sub>O. Intraoperative crystalloid fluid was 2200 ± 593 ml and Hextend 472 ± 403 ml. On POD 1-3 patients received 1260 ± 796 ml/day of crystalloids in addition to oral intake. Compared to baseline, GEDI was maintained and CI significantly increased on POD 1-3. EVLW showed no change (Table1).

**Conclusion:** The adoption of a liberalized perioperative fluid protocol achieves normovolaemia as shown by GEDI, increased CI, without an increase in lung water.

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O-33

**Postoperative analgesia after thoracic surgery: Is paravertebral block a good rescue technique for epidural analgesia failure?**

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**Introduction:** Thoracic epidural analgesia (TEA) is the “gold standard” analgesia for thoracic surgery [1]. Alternatives are either a paravertebral block (PVB) [2], or patient controlled analgesia with morphine (PCA). We report our experience of PVB as an alternative technique to TEA.

**Method:** Consecutive patients admitted for thoracic surgery were retrospectively analysed. Patients were operated under general anaesthesia and TEA was inserted before anaesthesia induction. A PVB was inserted if possible when TEA was refused by the patient, insertion failed or in case of unexpected thoracotomy during video surgery. The PVB catheter was inserted at the end of surgery. In both techniques, a mixture of ropivacaine and sufentanil was infused continuous-

Table1: Values of EVLWI, GEDI and CI on POD 1-3 compared to baseline value.

	Baseline	POD 1		POD 2		POD 3	
		Value	P	Value	P	Value	P
EVLWI (ml/kg)	11.2	10.5	0.78	11.45	0.75	12.2	0.28
GEDI (ml/m <sup>2</sup> )	815	856	0.46	787	0.46	831	0.37
CI (L min <sup>-1</sup> m <sup>-2</sup> )	2.6	3.95	0.002	3.8	0.001	3.7	0.003

ly to achieve a visual analogue scale (VAS) <4/10 at rest. PCA was added when VAS >4. Analysis of variance, parametric or non-parametric statistic tests were used to assess statistical significance ( $P < 0.05$ )

**Results:** 430 patients, age 25 to 85 y, operated on for pulmonary resection surgery (350 lobectomies) over 3 y were studied. 275 (64%) patients received TEA; 90 (23.9%), PVB and 65 (15.1%) intravenous analgesia (IVA - paracetamol, NSA). PCA was used more frequently in IVA (52.3%) or PVB (34.4%) patients than in the TEA group (10.2%,  $P < 0.01$ ). The incidence of atrial fibrillation and pneumopathy was higher in IVA patients (15.4% vs. 4.7% and 0% for TEA and PVB respectively,  $P < 0.01$ ). Median length of stay was not different between groups (1 day).

**Discussion:** In this observational study, PVB was less effective than TEA for pain control after thoracotomy. Early postoperative complications were less frequent under regional analgesia.

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## Oral session VII – Homeostasis

O-34

### Mannitol increases renal blood flow in patients with acute kidney injury (AKI) after cardiac surgery

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**Introduction:** A recent study has shown that mannitol increases glomerular filtration rate (GFR) after uncomplicated cardiac surgery possibly by a de-swelling effect on tubular cells [1]. Furthermore, experimental studies have shown that renal ischaemia causes an endothelial cell injury and dysfunction followed by endothelial cell oedema [2]. We studied the potential effects of mannitol on

renal perfusion, filtration and oxygenation in early AKI after cardiac surgery.

**Method:** After IRB approval and informed consent from next of kin, eleven sedated and mechanically ventilated post-cardiac surgery patients with >50% increase in serum creatinine were studied. After control measurements, all patients received a bolus dose of mannitol, 1.5 mL/kg, followed by an infusion, 0.5 mL kg<sup>-1</sup> h<sup>-1</sup>, for two 30-min periods. Cardiac output (CO) was measured by a pulmonary artery catheter. Renal blood flow (RBF) and GFR were measured by the renal vein thermodilution technique and by renal extraction of <sup>51</sup>Cr-EDTA. Renal oxygen consumption (RVO<sub>2</sub>) and extraction (RO<sub>2</sub>Ex) were calculated from arterial and renal vein blood samples. ANOVA for repeated measurements, followed by Fisher's PLSD test were used for data analysis (mean ± SEM).

**Results:**

	<b>Control</b>	<b>Mannitol 1</b>	<b>Mannitol 2</b>
MAP (mmHg)	75.7±0.9	75.3±0.9	74.6±1.3
CO (l/min)	6.2±0.5	6.3±0.5	6.3±0.5
RBF (ml/min)	459±45	521±49*	502±47*
GFR (ml/min)	34.6±4.6	41.0±7.3	39.2±5.7
RVO <sub>2</sub> (ml/min)	10.8±1.1	12.1±1.5	11.5±1.3
RO <sub>2</sub> Ex (%)	0.171±0.014	0.172±0.016	0.170±0.017
RVR (mmHg ml <sup>-1</sup> min <sup>-1</sup> )	0.159±0.016	0.132±0.014*	0.135±0.014*
UF (ml/min)	3.54±0.62	6.01±1.09**	5.38±0.99**

ANOVA; \*P<0.05, \*\*P<0.01, mannitol vs. control. RVR: renal vascular resistance. UF: urine flow.

**Conclusion:** Treatment with mannitol in patients with AKI after cardiac surgery improved renal blood flow, with no change in GFR or renal oxygenation. We suggest that mannitol might exert its beneficial effect on renal perfusion by a de-swelling effect on injured endothelial cells.

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O-35

### The effect of hydroxyethyl starch (130/0.4) as the priming solution on renal function in children undergoing cardiac surgery

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**Introduction:** Hydroxyethyl starch (HES) solution is widely used for intravascular volume replacement and as a priming solution in cardiopulmonary bypass (CPB) on adult patients. In children the optimal priming solution for CPB is unclear. This study was conducted to observe the effects of HES as the priming solution on the renal functions in children undergoing cardiac surgery.

**Method:** After ethical committee approval and parent informed consent twenty four patients between 2 and 16 years old were included in this prospective, randomized study. During CPB, Group I received Ringer's Lactate and Group II received HES (130/0, 4) as priming solution. Demographic, clinical and haemodynamic parameters were recorded. Blood samples were collected to analyse

haematocrit, serum electrolytes, creatinine (Cr), blood urea nitrogen,  $\beta$ 2 microglobulin and cystatin C levels. The analyses were performed after induction (T1), before CPB (T2), on the 20th minute of CPB (T3), after CPB (T4), at the end of the operation (T5), on 24th h (T6), and on 48th h postoperatively (T7). Urine samples were analysed for urine electrolytes, albumin and Cr levels at the given time periods. Creatinine clearance, fractional excretion of sodium (FeNa), urine albumin/Cr ratios were calculated. Requirements of inotropes, diuretics, fluids, blood and blood products were recorded, in addition to drainage and urine output. The statistical analysis was performed with Mann-Whitney U test, Friedman two-way analysis, Wilcoxon's signed-rank test and  $\chi^2$  test. Significance level was set to  $P < 0.05$ .

**Results:** No significant difference was observed in the serum and urine electrolyte levels, FeNa, Cr clearance or urine Alb/Cr ratios between the groups. In both groups,  $\beta$ 2 microglobulin levels were decreased after CPB. Cystatin C level decrement was more prominent in the Ringer's Lactate group. In both groups, cystatin C and  $\beta$ 2 microglobulin, levels were in the normal range. There were no differences in the fluid, blood and blood product, inotropes or diuretic requirements between the groups. Urine and drainage output were similar in both groups. Renal dysfunction was not observed in any of the groups.

**Conclusion:** We concluded that usage of HES (130/0.4) did not have negative effects on renal function and it could be used as the CPB priming solution in paediatric patients in cardiac surgery.

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O-36

### Neutrophil gelatinase-associated lipocalin in cardiac surgery associated acute kidney injury: Pilot study in a very high risk population

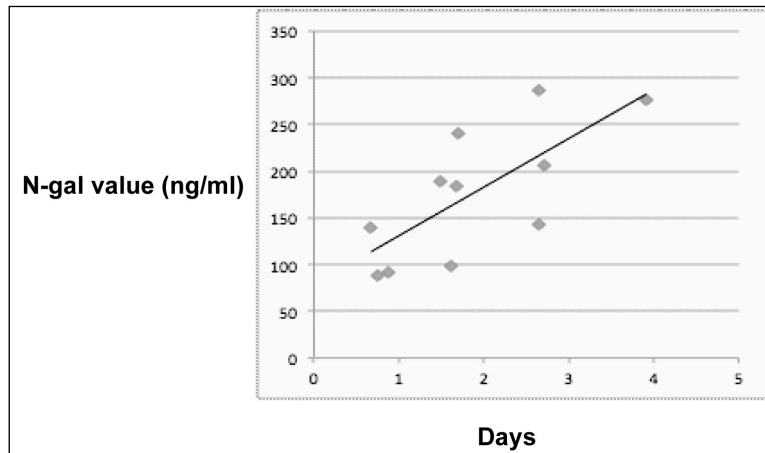
*Erika Dal Checco, Fabio Caramelli, Guido Frascaroli, Antonella Aloisio*  
 UO Dott. Frascaroli, Dep. of cardiothoracic surgery, Policlinico S.Orsola-Malpighi, Bologna, Italy, 2Università degli Studi di Bologna, Bologna, Italy

**Introduction:** Cardiac Surgery Associated-Acute Kidney Injury (CSA-AKI) is a well-known, severe postoperative complication. A well timed treatment may improve its adverse outcome, but it is hampered by the difficulty

Table:  $\beta$ 2 microglobulin levels of the patients (mean  $\pm$ SD)

(ng/ml)	Group I (RL)	Group II (HES)	P #
T1	1395.9 $\pm$ 247.8	1669.9 $\pm$ 401.9	0.06
T2	1467.4 $\pm$ 250.3	1622.4 $\pm$ 406.4	0.590
T3	961.4 $\pm$ 181.1 *	1137.7 $\pm$ 279.9 *	0.089
T4	1224.2 $\pm$ 260.8	1500.2 $\pm$ 301.9	0.020
T5	1208.7 $\pm$ 265.5	1476.7 $\pm$ 381.8	0.068
T6	1285.3 $\pm$ 299.6	1569.4 $\pm$ 936.3	0.713
T7	1267.3 $\pm$ 316.7	1305.8 $\pm$ 293.2 *	0.799

\* $P < 0.05$ ; within group, #  $P < 0.05$ ; between the groups



of making an early diagnosis. A new perspective could open up by new biomarkers, such as Neutrophil Gelatinase-Associated Lipocalin (N-GAL). It has currently been validated in many settings, but in adult cardiac surgery only in CABG patients.

**Method:** A prospective analysis was performed on 11 patients undergoing elective aortic arch replacement. We evaluated the predictive value of N-GAL in surgery with a long CPB time (>120 min'), mild hypothermic circulatory arrest and a large inflammatory response. CSA-AKI was defined according to the RIFLE classification. N-GAL was tested in blood after induction of anaesthesia and 4 h after CPB.

**Results:** Mean preoperative creatinine was  $1.16 \pm 0.34$  mg/dL (mean ACEF score of  $1.2 \pm 0.45$ ). CPB time was  $211.8 \pm 54.3$  min and ACP was  $72 \pm 20.2$  min. Preoperative N-GAL was  $71.7 \pm 28.32$  ng/mL and postoperative N-GAL was  $170 \pm 72.11$  ng/mL with a mean increase of  $2.61 \pm 1.3$  times. The N-GAL correlates with serum creatinine increase on the second postoperative day and the GFR decrease (MDRD equation). 55% pts reached the R and 9% the I of RIFLE classification. Surprisingly the N-GAL and CSA-AKI do not seem to be related to visceral ischaemia time ( $41.7 \pm 8.36$ ). The cut-off level on the ROC curve (99, sensitivity 100% specificity 86%) is quite similar to those previously found in CABG population.

**Conclusions:** N-GAL seems to detect early CSA-AKI (only 4 h after CPB) in complex cardiac surgery with intense inflammatory response.

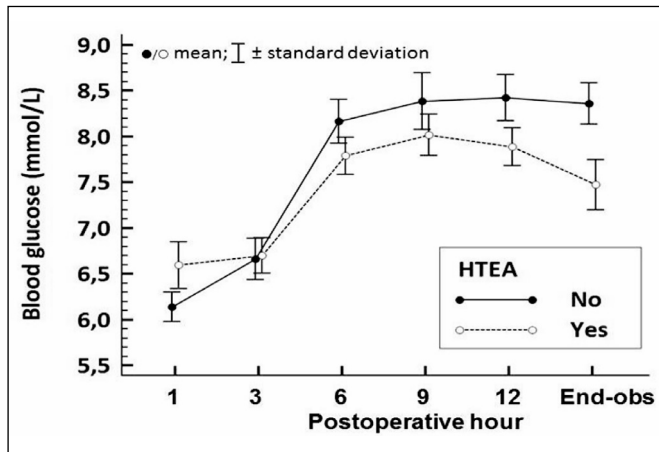
O-37

### High thoracic epidural analgesia reduces the need for insulin, preserves glucose metabolism and attenuates stress hyperglycaemia in cardiac surgery patients

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**Introduction:** Perioperative hyperglycaemia in cardiac surgery patients is associated with increased mortality and morbidity. Blood glucose (BG) control with insulin is essential but stress management has also gained attention. High thoracic epidural analgesia (HTEA) may theoretically be a beneficial supplement to BG control in cardiac surgery patients. The aim of the study was to evaluate the effect of HTEA on the BG level and insulin requirement in low risk patients undergoing cardiac surgery.





**Method:** Forty-two low risk patients scheduled for elective CABG with or without aortic valve replacement were randomized to receive HTEA or not as a supplement to general anaesthesia. Blood glucose and lactate were measured before and after cardiopulmonary bypass and postoperatively at least every 3 h together with administration of insulin. BG target was 5.0-8.5 mmol/l. Postoperative pain was evaluated.

**Results:** The number of patients receiving insulin in the postoperative period was significantly smaller in the HTEA group (2 vs. 9,  $P=0.032$ ,  $\chi^2$ -test) and the average number of insulin units was lower during ICU stay (2.4 vs. 5.4,  $P=0.038$ , t-test). BG levels showed great variation over time ( $P<0.001$ , 2-way ANOVA). No statistically significant difference was found in perioperative BG, but postoperative statistically significant lower BG levels were found in HTEA patients ( $P=0.042$ , 2-way ANOVA). No differences were seen in lactate levels. Patients in the HTEA group had significantly lower pain scores ( $P<0.001$ , 2-way ANOVA).

**Conclusion:** HTEA leads to a lesser degree of "stress hyperglycaemia" in cardiac surgery patients. As difficult or poor glycaemic control is significantly associated with poor outcome, HTEA might be a beneficial supplement to general anaesthesia in cardiac surgery.

O-38

### Predicting acute kidney injury after cardiac surgery with cardiopulmonary bypass using Doppler renal resistive index

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**Introduction:** Acute kidney Injury (AKI) after cardiac surgery is a frequent complication and is associated with a high mortality rate. Usual markers such as serum creatinine (SCr) and urine output detect AKI with delay and new methods are needed for earlier detection. Doppler Renal Resistive Index (RRI) is an early predictor of AKI in septic shock [1]. The aim of this study was to determine if RRI could be a predictor of AKI after cardiac surgery with cardiopulmonary bypass.

**Method:** After IRB approval, 37 patients undergoing elective cardiac surgery and at high risk of AKI determined by a Cleveland score  $\geq 3$  [2] were included. RRI was measured the day before and immediately after surgery. SCr was measured before surgery and from day 1 to 5 in order to calculate glomerular filtration rate (eGFR, MDRD) and serum NGAL was measured at arrival in ICU (H0) and 6 h later (H6). We compared patients with nor-

mal RRI (<0.7) and with increased RRI ( $\geq 0.7$ ). A t-test was used for statistical comparison

**Results:** Age was  $67 \pm 15$  yr, 62% were men. 9 patients developed AKI determine with a RIFLE stage R, I or F. None required renal replacement therapy. Compared to the group RRI < 0.7, postoperative RRI  $\geq 0.7$  was associated with a significant eGFR decrease (Table) and 24 h urine output ( $1.5 \pm 0.6$  L vs.  $2.5 \pm 1.7$ ,  $P=0.027$ ).

**Conclusion:** Doppler RRI value  $\geq 0.7$  immediately after cardiac surgery could select pa-

tients who are at high risk of postoperative AKI and who need an intensive renal protection strategy.

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*Table: Postoperative eGFR (ml/min) and NGAL (ng/ml) in both groups*

	<b>RRI &lt;0.7 N = 14</b>	<b>RRI <math>\geq 0.7</math> N = 23</b>	<b>P</b>
eGFR Preop	70 $\pm$ 25	59 $\pm$ 23	0.16
eGFR D1	77 $\pm$ 29	53 $\pm$ 23	0.001
eGFR D2	81 $\pm$ 29	50 $\pm$ 25	0.02
eGFR D3	82 $\pm$ 29	51 $\pm$ 32	0.02
eGFR D4	85 $\pm$ 26	43 $\pm$ 22	0.0003
eGFR D5	70 $\pm$ 37	55 $\pm$ 26	0.27
NGAL H 0	213 $\pm$ 97	266 $\pm$ 124	0.20
NGAL H6	187 $\pm$ 106	245 $\pm$ 119	0.16

NGAL: Neutrophil Gelatinase-Associated Lipocalin

## Oral session VIII – ‘New insights, new ideas’

O-39

### Gene expression responses in whole blood after intermediate risk cardiac surgery: Associations with multiple organ failure development

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**Introduction:** Serious complications such as the development of multiple organ failure (MOF) after CABG + valve surgery are associated with red blood cell concentrate transfusions (BT). We postulate that fold changes in gene expression (GE) after surgery may reveal GE profiles which are associated with development of postoperative MOF.

**Method:** Using a 2x2 factorial design, 29 cardiac surgery patients from a trial [1] were matched on BT, age and duration on cardiopulmonary bypass of the MOF patients. GE responses in whole blood before and 24 h after cardiac surgery using total RNA were analysed by genome wide expression arrays from 2x2 patient groups: 7 MOF+BT-, 8 MOF-BT-, 6 MOF-BT+ and 8 MOF+BT+ patients. Differences of GE between the MOF and no MOF patients by RT-PCR analyses were confirmed for 5 genes which showed major increases on the array. In total 50 (17 MOF+ and 33 MOF-) matched cardiac surgery patients, GE response profiles were searched with high sensitivity for MOF+.

**Results:** A total of 1.047 genes showed important up- or down-regulation. Thirty genes showed >2 fold change in GE between the MOF-BT- control group and the three other groups on the arrays. Using RT-PCR, MOF+ patients revealed enhanced zinc finger ZD-

HHC19-, matrix metalloproteinase 9 (MMP9)- and interleukin-18 receptor associated protein (IL-18RAP) GE responses as compared to the GE response by patients with MOF-, demonstrated by non-parametric significances ( $P \leq 0.05$ ). A specific profile of combined GE responses of either increased MMP9-, IL-18RAP-, or ZDHHC19- GE could identify all MOF+ patients.

**Conclusion:** The identified 3 genes encoding for proteins seem to reflect both tissue destruction and a compensatory reaction. GE studies on patients at lower and at higher risk for MOF development are needed.

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O-40

### Impact of electro-acupuncture anaesthesia on stress hormone and anti-inflammatory mediator release in cardiopulmonary bypass patients

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**Introduction:** Cardiopulmonary bypass (CPB) induces systemic endocrine and immunological responses that can be modulated by a variety of factors including anaesthetic techniques. The aim was to quantify the impact of electro-acupuncture anaesthesia on stress hormone and anti-inflammatory mediator release after CPB.

**Method:** Patients undergoing elective coronary artery bypass or valve surgery were, after approval of the Ethics Committee, randomly assigned to receive either electroacupuncture anaesthesia (EAA) or opioid anaesthesia (OA). The EAA group received bilateral electroacupuncture at 3 international standardized points until closure of the thorax: Tb 9; St 10; Heart (100) to Trachea (103) ear point with no additional analgesia. The OA group received continuous sufentanil infusion, whereas anaesthetic induction (etomidate, sufentanil, midazolam, rocuronium) and maintenance (sevoflurane, propofol) followed the same standardized protocol in both groups. The levels of epinephrine, norepinephrine, cortisol, C-reactive protein (CRP), interleukin (IL)-6, IL-8 and IL-10 before CPB (T1), 1 h after CPB (T2), 4 h after CPB (T3) and on the first postoperative day (T4) were compared using the non-parametric Mann-Whitney test.

**Results:** Thirty six patients were included (EAA=16; OA=18). The groups were comparable regarding sex, age, NYHA, BMI, EF, ASA. EAA showed significantly higher levels of epinephrine (EAA-median: OA-median ng/l; P-value) at T1 (66:21; P=0.009), T2 (105:15; P=0.001), T3 (351:159; P=0.018), T4 (267:127; P=0.001). Additionally, release of CRP was significantly lower at T4 (54:90; P=0.020) and anti-inflammatory IL-10 was significantly higher in EAA patients on the first postoperative day - T4 (10.4:6.6; P=0.026). In contrast, no significant differences were found in all concentrations of norepinephrine, cortisol and pro-inflammatory cytokines IL-6 and IL-8 after CPB.

**Conclusion:** EAA attenuates the systemic inflammatory response in the postoperative course after CPB by stimulating release of anti-inflammatory cytokines. However the stress response seems to be better controlled by conventional opioid analgesia.

O-41

## Intraoperative epicardial shock wave therapy in coronary artery bypass graft patients improves left ventricular function: A pilot study

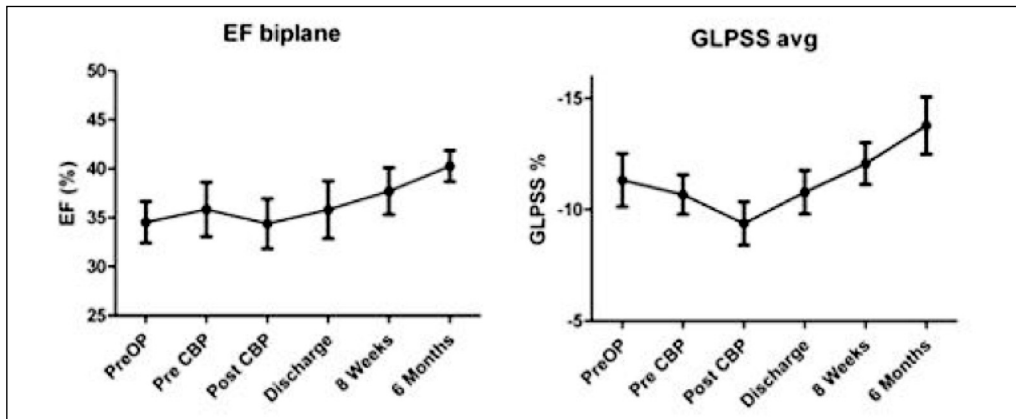
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Michael Hiesmayr*

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**Introduction:** Intraoperative epicardial shock wave therapy (ESWT) is a novel surgical technique in coronary bypass graft (CABG)-patients to stimulate angiogenesis in myocardial infarction regions in the following postoperative months. The aim of the study was to demonstrate that ESWT may improve left ventricular function (LVF) through recovery of infarcted myocardial tissue.

**Method:** ESWT was directly applied during cardiopulmonary bypass (CPB) on the beating heart using a special transducer (300 impulses, 1-2Hz), all infarcted areas being treated. Echo examinations were performed transthoracically prior to surgery, on discharge, after 8 weeks and 6 months respectively and intraoperatively by pre- and post-CPB transoesophageal echo. Global left ventricular function was assessed using global peak systolic strain average (GLPSS avg) and speckle tracking technique, and ejection fraction (EF). In addition regional strain improvement was determined using untreated areas with comparable regional dysfunction as control in each patient at all time points. Statistical analysis was performed using one way Student's t-test with P<0.05 being statistically significant.

**Results:** Ten patients aged 66.9±6.8, were included in our study. Both GLPSS and EF showed a significant improvement from baseline to 6 months after treatment. GLPSS increased from -11.3±1.2 to -13.8± 1.3



( $P < 0.001$ ) and EF from  $34.5 \pm 6.7$  to  $40.4 \pm 4.8$  ( $P < 0.0001$ ).

**Conclusion:** ESWT during CABG surgery leads to significant improvement of LVF within the first 6 months after surgery. Regional

strain showed a non-significant tendency of improvement in treated areas compared with control areas. This problem should be addressed in following studies with appropriate sample size.

## Oral session IX – Microcirculation

O-42

### Evaluation of the mesenteric circulation during on-pump and off-pump coronary artery bypass grafting

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**Introduction:** The aim of the study was to evaluate the mesenteric circulation.

**Method:** The research involved 40 patients who underwent myocardial revascularization. Patients were randomized into 2 groups. In Gp.I (n=23) normothermic cardiopulmonary bypass was used. Gp.II (n=17) were operated off-pump. We used a method of intraluminal tonometry (Pg-aCO<sub>2</sub>, pHi) to evaluate mesenteric perfusion. Laser Doppler flowmetry was used to assess mesenteric mi-

crocirculation (index M). Pg-aCO<sub>2</sub> and index M were registered in the beginning of the primary stage, at the end of the primary stage and at the end of the surgery. pHi was registered before and after the primary stage. We measured body temperature of all patients.

**Results:** In Gp.I by the end of cardiopulmonary bypass Pg-aCO<sub>2</sub> increased from  $-0.2 \pm 0.006$  to  $0.5 \pm 0.004$  kPa ( $P < 0.05$ ). This index continued to increase even after the termination of bypass and by the end of the surgery its rate was  $0.7 \pm 0.01$  ( $P < 0.05$ ). pHi in Gp.I decreased from  $7.41 \pm 0.03$  to  $7.33 \pm 0.08$  ( $P < 0.05$ ). In Gp.II changes of Pg-aCO<sub>2</sub>, pHi were not observed. The changes of tonometry values testified that in Gp.I gut hypoperfusion was observed. Also in Gp.I an increase of lactate levels from  $0.7 \pm 0.01$  to  $1.4 \pm 0.02$  ( $P < 0.05$ ) was noted, principally with cardiopulmonary bypass. In Gp.II an increase of lactate levels was not observed. By the end of surgery a decrease of index M was noted from  $18 \pm 0.5$  to  $12 \pm 0.4$  ( $P < 0.05$ ) in Gp.I and

from  $18 \pm 0.4$  to  $13.5 \pm 0.3$  ( $P < 0.05$ ) in Gp.II). But in Gp.I there was an acute decrease of index from the very beginning of cardiopulmonary bypass (unto  $6.9 \pm 0.6$ ). In Gp.II a decrease of index M was observed by the end of the surgery only and was related to a decrease of body temperature to  $34.5 \pm 0.003$  °C.

**Conclusion:** 1. The most favorable conditions for mesenteric perfusion are created when the operation is performed on a working heart. 2. A decrease of body temperature by the end of the surgery is a very significant factor to the detriment of the microvasculature circulation.

O-43

### Can near-infrared spectroscopy detect critical perfusion in muscle tissue during cardiopulmonary bypass in an animal model?

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**Introduction:** Higher co-morbidity, age and weight of the patients scheduled for today's cardiac surgery question the calculation of blood flow during cardiopulmonary bypass (CPB) [1]. The purpose of this animal study was to investigate if near infrared spectroscopy (NIRS) of regional muscle tissue can be used as an early detector of inadequate blood flow during CPB.

**Method:** Twelve 80 kg pigs were anaesthetized and normothermic CPB was established with a blood flow of 4.8 L/min for one

hour. Thereafter, the pigs were randomized to a blood flow of either 3.8 L/min (Group I) or 2.8 L/min (Group II) for another hour and finally one hour with blood flow of 4.8 L/min. Regional tissue oxygen saturation ( $tSO_2$ ) was measured by placing a NIRS electrode on the skin above a large lower limb muscle. Perfusate from microdialysis of the large muscle, intestinal mucosa and brain were collected every 20 minutes. Systemic oxygen consumption was estimated by measurement of mixed venous saturation, base excess and lactate.

**Results:** PreCPB  $StO_2$  values for group I and group II were 64 (CI; 62, 66) and 74.6 (CI; 67.5, 81.7).  $StO_2$  was unchanged in group I ( $P=0.13$ ) but decreased to very low values in group II ( $P=0.02$ ) during the period of low blood flow. The minimum  $tSO_2$  values during blood flow 3.8 L/min and 2.8 L/min were 49 and 38, respectively. Analysis of microdialysis is still ongoing.

**Discussion:** NIRS on regional muscle tissue seems to be able to detect low and critical values of blood flow during CPB. However, the results have to be confirmed by the results of microdialysis before a conclusion can be reached.

#### Reference:

1. Murphy GS, Hessel II EA 2nd, Groom RC. Optimal perfusion during cardiopulmonary bypass: an Evidence-based approach. *Anesth Analg* 2009; 108 (5): 1394-417

O-44

### Rapid and long-term changes of cerebral and peripheral tissue oxygen saturation during cardiac anaesthesia

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**Introduction:** The aim of the study was to investigate the dynamics of peripheral tissue

and cerebral oxygen saturation and the impact of fast vascular reactions on these parameters during cardiac surgery.

**Method:** Two groups were compared. Gp.1 included 26 CABG patients with normothermic ( $T=36.0^{\circ}\text{C}$ ) cardiopulmonary bypass (CPB). Gp.2 comprised 17 valve replacement patients with mild hypothermic CPB ( $T=32.0^{\circ}\text{C}$ ). Tissue oximeter sensors (FORE-SIGHT, CASMED, USA) were placed on the right forehead and on the upper third of the forearm. We assessed peripheral tissue oxygen saturation ( $\text{StO}_2$ ) and cerebral oxygen saturation ( $\text{SctO}_2$ ). An arterial occlusion test (AOT: 3 min, 240 mmHg) was carried out on the monitored arm to investigate oxygen reserve ( $\text{StO}_{2\text{min}}$ ) and hyperaemic reaction ( $\text{StO}_{2\text{max}}$ ). Student's t-test was used to compare the groups of interest.

**Results:**  $\text{SctO}_2$  and  $\text{StO}_2$  decreased after induction of anaesthesia and before CPB in both groups ( $P<0.05$ ). At the beginning of CPB,  $\text{SctO}_2$  decreased, whereas  $\text{StO}_2$  increased in both groups ( $P<0.05$ ). At the end of CPB,  $\text{StO}_2$  was higher in Gp.2 ( $77\pm 5.9\%$

vs.  $70\pm 6.8\%$ ,  $P<0.02$ ). At the end of surgery,  $\text{SctO}_2$  and  $\text{StO}_2$  were lower than before induction of anaesthesia in both groups ( $P<0.05$ ). During all hypotensive episodes (except the cases of acute left heart failure), a  $\text{SctO}_2$  decrease (from  $70\pm 4.9\%$  to  $64\pm 8.1\%$ ,  $P<0.003$ ) and a  $\text{StO}_2$  increase (from  $69\pm 5.9\%$  to  $77\pm 6.6\%$ ,  $P<0.001$ ) were registered. During hypertensive episodes an inverse relationship was observed, i.e.,  $\text{SctO}_2$  increased (from  $70\pm 5.1\%$  to  $76\pm 5.1\%$ ;  $P<0.01$ ) and  $\text{StO}_2$  decreased (from  $78\pm 5.9\%$  to  $71\pm 6.9\%$ ;  $P<0.02$ ). AOT remained decreased during surgery, whereas hyperaemic reaction didn't change. Only at the end of CPB  $\text{StO}_{2\text{min}}$  was lower in Gp.1 compared to Gp.2 ( $44\pm 8.9\%$  vs.  $55\pm 5.9\%$ ,  $P<0.002$ ).

**Conclusion:** 1. During fast vascular reactions, peripheral tissue and cerebral oxygen saturations changed in an inverse manner to blood arterial pressure (except the cases of acute heart failure). 2. Reserves of oxygen in peripheral tissues decrease throughout surgery and this is more evident during normothermic CPB.

## Oral session X – Congenital & GUCH

O-45

### The prognostic value of plasma B-type natriuretic peptide in children with pulmonary hypertension undergoing congenital heart disease surgery

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**Introduction:** In children undergoing congenital heart disease surgery (CHS) with cardiopulmonary bypass (CPB), the prognostic value of preoperative plasma brain natriuretic peptide (BNP) and lactate levels were investigated in children with pulmonary hypertension (PHT).

**Method:** Fifty five children were enrolled and four children were excluded due to lower body weight, insufficiency of adequate treatment of congestive heart failure and pulmonary hypertension crisis. A division into two groups was made depending on preoperative BNP level and on development of low cardiac output syndrome (LCOS) postoperatively as LCOS (-) ( $n=35$ ) and LCOS (+) ( $n=16$ ). The plasma BNP and lactate levels were collected before operation, 12, 24 and

Table 1: \* $p < 0.05$  statistical significant.

	Preop BNP	12-h BNP	24-h BNP	48-h BNP	p*
All	139 ± 110	483 ± 502	850 ± 1187	915 ± 1199	0.0001
LCOS(-) (n=35)	89 ± 61	264 ± 184	337 ± 232	289 ± 223	0.0001
LCOS(+) (n=16)	247 ± 115	961 ± 638	1972 ± 1618	1332 ± 2223	
	Preop Lactate	12-h Lactate	24-h Lactate	48-h Lactate	P*
All patients	1.4 ± 0.7	1.8 ± 2.3	2.7 ± 2.0	2.4 ± 2.0	0.0001
LCOS(-) (n=35)	1.1 ± 0.6	1.9 ± 0.9	1.7 ± 1.0	1.4 ± 1.0	0.0001
LCOS(+) (n=16)	1.9 ± 0.6	4.1 ± 2.3	4.9 ± 2.0	4.5 ± 1.8	

48 h after operation. The primary end-points were development of LCOS, duration of mechanical ventilation, intensive care unit stay and mortality. Repeated analysis of variance (ANOVA) and Green-Geisser test were used for statistical analysis.

**Results:** The BNP and lactate levels showed significant differences ( $P=0.0001$ ) (Table 1). The preoperative BNP cut-off value of 125.5 pg ml<sup>-1</sup> was found to have the highest sensitivity of 88.9% and specificity of 96.9 % in predicting LCOS in patients with pulmonary hypertension.

**Discussion:** The preoperative BNP value is a prognostic marker for determination of early prognosis in children with PHT undergoing CHS.

O-46

### Effects of caudal analgesia on oxidative stress response in paediatric cardiac surgery

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**Introduction:** In this study we aimed to determine the effects of caudal analgesia in children undergoing congenital cardiac surgery on the oxidative stress response, analgesia status, extubation time and CHIPPS scores.

**Method:** Forty seven children aged between 2-14 yr, undergoing ASD or VSD correction operations were included in the study. Patients randomly divided into two groups; group G: 24 patients received routine general anaesthesia; group C: general anaesthesia with caudal anaesthesia was performed in 23 patients. In group C, 1 ml/kg levobupivacaine 0.25% and morphine 0.1 mg/kg mixture was administered in the caudal epidural space. Perioperative MAP, SpO<sub>2</sub>, HR, ABG (arterial blood gas) values, amount of drug consumption, CPB (cardiopulmonary by-pass) and ACC (aortic cross-clamp) duration, TAS (total antioxidant status), TOS (total oxidant status), OSI (oxidative stress index), glucose values, extubation time, ICU and hospital stay and



CHIPPS (Children's and Infant's Postoperative Pain Scale) scores were recorded. Comparisons between groups were analysed with Mann-Whitney-U test and intra-group comparisons by Wilcoxon matched test. ASA and gender were analysed with Chi-squared test.  $P < 0.05$  was considered significant.

**Results:** No difference was seen between groups in terms of demographic data. Perioperative haemodynamics, ABG values, anaesthesia, CPB and ACC duration did not differ between groups. Preoperative TAS, TOS, OSI and glucose levels showed no difference. After CPB, the TAS value was significantly higher, glucose and TOS values were lower in group C, OSI values did not differ. TAS level was higher in the postoperative period in group C, but not statistically significant ( $P = 0.051$ ), TOS, OSI and glucose values were significantly lower in group C. Extubation time, ICU and hospital stay were significantly lower in group C ( $P < 0.05$ ).

**Conclusion:** In this study, caudal analgesia with general anaesthesia in children undergoing congenital cardiac surgery reduced the stress response, suppressed oxidative stress, shortened the extubation time, length of ICU and hospital stay and reduced the CHIPPS scores.

O-47

### The effect of hypothermic cardiopulmonary bypass on pressure gradient between radial artery and femoral artery in paediatric cardiac surgery

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**Introduction:** Several studies have demonstrated that cardiopulmonary bypass (CPB) may significantly increase the pressure gradient between radial artery and aorta in adult cardiac surgery. We hypothesized that radial

mean arterial pressure accurately reflects femoral mean arterial pressure in paediatric cardiac surgery with CPB.

**Method:** After obtaining ethics committee approval and written consent from the parent(s), 45 children undergoing paediatric cardiac surgery with CPB were studied. Femoral and radial artery catheters were inserted in all patients and simultaneous arterial pressure tracing and measurements were performed from both sites throughout the procedure. Any pressure gradient  $> 5$  mmHg between radial and femoral arterial pressures was recorded as a significant pressure gradient.

**Results:** Patients' mean age and weight values were  $14 \pm 11$  months and  $8.0 \pm 3.0$  kilograms, respectively. The respective mean duration of aortic cross-clamping and CPB were  $54 \pm 22$  minutes and  $76 \pm 25$  minutes. A total of 1816 simultaneous measurements of arterial pressure from radial and femoral arteries were recorded intra-operatively including 520 (29%) systolic arterial pressures (SAP), 520 (29%) diastolic arterial pressures (DAP), and 776 (43%) mean arterial pressures (MAP). The respective number of measurements during pre-CPB, CPB, and post-CPB were 708 (39%), 526 (29%), and 582 (32%). SAP, DAP, and MAP were significantly and strongly correlated throughout the surgery ( $r > 0.937$  and  $P < 0.001$  for all). Bland-Altman plots demonstrated good agreement between the femoral and radial MAPs during pre-CPB, CPB, and post-CPB periods (mean bias  $0.1 \pm 2.4$  mmHg,  $-2.7 \pm 2.3$  mmHg, and  $-1.0 \pm 2.2$  mmHg, respectively). A significant pressure gradient was observed in 150 measurements out of 1816 measurements (8.3%). The respective number of significant gradients during pre-CPB, CPB, and post-CPB were 43 (29%), 42 (28%), and 65 (43%). A significant pressure gradient occurred most frequently between SAP ( $n = 113$ , 75%), followed by MAP ( $n = 28$ , 19%) and DAP ( $n = 9$ , 6%) measurements. These significant gradients were not sustained.

**Conclusion:** Radial MAP measurement provided an accurate estimate of central MAP during the pre-CPB, CPB, and post-CPB peri-

ods of paediatric cardiac surgery in our patients. A significant gradient between radial and femoral MAP measurements occurred in only 3.6% of the measurements and these significant gradients were not sustained.

O-48

## Fast track anaesthesia in paediatric cardiac surgery

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**Introduction:** Fast track anaesthesia is a peri-operative management that aims to facilitate early extubation and therefore early mobilization and alimentionation with decreased length of ICU and hospital stays. An anaesthetic technique for fast tracking should combine a reduction of sympatho-adrenal activation with rapid emergence. Effective pain control is then essential for successful early extubation and mobilization. The aim was to introduce an anaesthetic management suitable for early extubation as a fundamental part of a fast track pathway for uncomplicated cases in paediatric open heart surgery. Complicated operations are currently performed with a technique based on high doses of midazolam and fentanyl.

**Method:** Since January 2011 ten children scheduled for correction of congenital heart disease were prospectively included in the fast track programme. The indications for surgery were: atrial septal defect 3 pts, subaortic stenosis 2 pts, partial atrioventricular canal defect 3 pts, interventricular defect 2 pts. Mean age was 4.5 yr (20 months-11 yr), mean weight 15 kg (8-42 kg). Anaesthetic management was based on propofol administered via TCI Paedfusor system [1] and remifentanyl. Anaesthesia was induced with a target plasma concentration (CPT) of 6 mcg/ml and maintained at a CPT of 3-4 mcg/ml, titrating the concentration of propofol to obtain a BIS value between 40 and 60.

We used remifentanyl at an initial loading dose of 1 mcg kg<sup>-1</sup> in 2 min then 0.15-0.2 mcg kg<sup>-1</sup> min<sup>-1</sup> continuous infusion before, during and post CBP with a supplemental bolus dose of 5 mcg kg<sup>-1</sup> in 2 min given at the start of CBP [2]. Neuromuscular block was obtained with rocuronium at standard dosage. Before discontinuation of the infusion of remifentanyl all patients received a morphine iv. bolus of 100 mcg kg<sup>-1</sup> plus paracetamol 15 mg kg<sup>-1</sup> 30 min followed by morphine PNCA infusion.

**Results:** We obtained haemodynamic stability throughout all phases of the operations. All patients were extubated in the operating room within 15 min from the end of surgery and no one required reintubation. There were no major complications or adverse events.

**Conclusion:** The results of our limited cases series are encouraging. Fast track cardiac anaesthesia combined with a multidisciplinary approach, can improve the efficiency of care and the level of satisfaction of patient and parents in paediatric cardiac surgery.

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1. Absalom A, Amutike D, Lal A, White M, Kenny GN. Accuracy of the 'Paedfusor' in children undergoing cardiac surgery or catheterization. *Br J Anaesth* 2003; 91 (4): 07-13
2. Davis PJ, Wilson AS, Siewers RD, Pigula FA, Landsman IS. The effects of cardiopulmonary bypass on remifentanyl kinetics in children undergoing atrial septal defect repair. *Anesth Analg* 1999; 89 (4): 904-8

O-49

## Is vocal cord dysfunction and inability to suckle after paediatric cardiac surgery sufficiently studied? Experience of an Italian centre

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**Introduction:** Vocal cord dysfunction after paediatric cardiac surgery [1] would be a serious development because of an increased risk of swallowing dysfunction, feeding handicap, aspiration and prolonged hospital stay. We note that the incidents of postoperative wheezing, delayed spontaneous feeding and prolonged nutrition by nasogastric tube (G-tube) are more frequent in neonates.

**Method:** The study was performed in 7 patients operated from September 2009 to Oc-

tober 2011 with a laryngoscopic diagnosis of vocal cord dysfunction. Fiberoptic laryngoscopy was performed with a flexible bronchoscope.

**Results:** All patients were submitted to aortic surgery or ductus arteriosus ligation. TOE was not used. 7/474 (1.5%) children had postoperative vocal cord dysfunction and were symptomatic for wheezing: 4/7 (57%) vocal cord paralysis and 3/7 (43%) vocal cord paresis. Patients were aged 22±20 days (range 5-60) and weighed 3.03±0.61 kg (range 2.1-3.75). No child had a difficult airway and all had prolonged G-tube feeding. At discharge from the hospital 3/7 (47%) had a G-tube. (Patient 1 absent suckle, patient 3-4 insufficient suckle). Of the 4 patients discharged without a nasogastric tube, 2/4 (50%) had inadequate suckle. During the hospital stay 1/7 (14%) did not have a swallowing dysfunction, 2/7 (28%) had absent suckle associated with gastro-oesophageal reflux (GERD) and only these received a specific therapy for GERD. 4/7 (57%) had inadequate suckle. The intubation time was 10±16

Patient	Age (days)	Weight (kg)	Intubation (days)	Suckle	Vocal cord lesion	Hospitalization (days)	Feeding at discharge
1	6	2.6	24	Absent (GERD)	Paralysis	50	G-tube; no suck
2	38	3.55	9	Normal	Paralysis	46	Normal suck
3	60	3.4	3	Inadequate	Paresis	37	G-tube; insufficient suck
4	10	2.6	46	Absent (GERD)	Paresis	30	G-tube; insufficient suck
5	12	3.23	6	Inadequate	Paresis	31	Normal suck
6	14	3.75	3	Inadequate	Paralysis	56	Insufficient suck
7	13	2.1	10	Inadequate	Paralysis	37	Insufficient suck
Mean	22±20	3.03±0.61	14±16			41±10	

days (range 3-46); in 3/7 (43%) it was shorter than 1 week.

**Discussion:** In our centre, dysfunctional swallowing is not studied in neonatal patients. The starting of a programme of monitoring for swallow dysfunction may be a key to reducing the time of hospital stay and morbidities following injury of the recurrent laryngeal nerve. Early gastrostomy may be a way for

better management. Fiberoptic examination is essential for good management of these patients.

**Reference:**

1. Sachdeva R, Hussain A, Moss MM, Schmitz ML, Ray RM, Imamura M, Jaquiss RD. Vocal cord dysfunction and feeding difficulties after pediatric cardiovascular surgery. *J Pediatr* 2007; 151 (3): 312-5

## Oral session XI – Preselected best orals

O-50

### Colour M-mode regurgitant flow propagation velocity: A new transoesophageal echocardiographic method for grading of intraoperative tricuspid regurgitation

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**Introduction:** The aim of this study was to evaluate the reliability of TR colour M-mode regurgitant flow propagation velocity (RFPV), by TOE, in the intraoperative grading of TR. **Method:** We intra-operatively examined 48 patients with central TR (diagnosed by preoperative TTE); mild (n = 16), moderate (n = 17), and severe (n = 15), with colour flow Doppler and M-Mode. TR was evaluated by vena contracta diameter (VCD), regurgitant jet area (RJA), and RFPV. ME-RV inflow-outflow tract view (60°-80°), ME modified bicaval view (90°-110°), and ME-4Ch view (0°-20°) were used.

**Results:** The mean (SD) RFPV for mild, moderate, & severe TR were 31.9 (6.94) cm/sec, 51.2 (6.39) cm/sec, and 70 (5.16) respectively. 36 cm/sec and 65 cm/sec, RFPV were sensitive and specific cut points in differentiating mild and severe TR from other sub-

groups, respectively. Significant correlation was observed between the TOE colour M-Mode RFPV and both VCD ( $r=0.85$ ,  $P<0.01$ ) and RJA ( $r = 0.81$ ,  $P<0.01$ ), respectively.

**Conclusion:** RFPV, assessed by TOE, is a reliable and simple new method for the intraoperative grading of the severity of TR.

O-51

### <sup>1</sup>H NMR-based metabonomics reveals new insights into the pathogenesis of acute lung injury after cardiac surgery

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**Introduction:** Pulmonary dysfunction, with development of acute lung injury (ALI), are common complications in patients undergoing elective coronary artery bypass grafting (CABG) with the use of cardiopulmonary by-

pass (CPB) [1]. The underlying pathological mechanisms are not completely understood and there are no reliable biomarkers that can predict early progression into ALI after CABG. In this study, high-resolution 1H nuclear magnetic resonance (NMR) spectroscopy-based metabolomics has been applied, for the first time to our knowledge, to investigate the metabolic fingerprints in serum of patients undergoing CABG, aiming for a better understanding, and earlier diagnosis of this disease.

**Method:** Fifty patients undergoing CABG with the use of CPB have been recruited for this study. Blood samples were taken at multiple time points before, during and after surgery. Postoperatively, some patients suffered mild or severe ALI, whilst others did not. Serum samples collected 16 hours after surgery were investigated using 1H NMR spectroscopy together with multivariate statistical analyses, such as principal component analysis and partial least-squares discriminant analysis.

**Results:** It was possible to discriminate between patients who progressed into mild (46%) or severe (18%) ALI and patients with no signs of impaired oxygenation. Some significant metabolites involved in sample grouping were identified and could be related to metabolic pathways. Metabolites involved in synthesis and degradation of ketone bodies, oxidative stress, loss of ATP homeostasis, cellular stress and damage, disturbances in lipid metabolism, excessive breakdown of fatty acids, and apoptosis were correlated with mild and especially severe ALI compared to patients that did not develop ALI after surgery. Furthermore, by using a random test-set for validation, it was possible to predict the progression into severe ALI from samples taken 16 hours after CPB surgery. The classification model showed high specificity and sensitivity with no false negatives.

**Conclusion:** The results of this pilot study show the potential of NMR-based metabolomics for identifying putative biomarkers that predict progression into CABG-induced-

ALI, and show the potential of the approach in the early diagnosis of the disease.

**Reference:**

1. Ng CS, Wan S, Yim AP, Arifi AA. Pulmonary dysfunction after cardiac surgery. *Chest* 2002; 121 (4): 1269-77

O-52

### Cerebrospinal fluid markers of brain injury, inflammation and blood-brain barrier dysfunction in cardiac surgery

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**Introduction:** Neurocognitive dysfunction occurs frequently after open-heart surgery. Cerebral microembolization, inflammation, blood-brain barrier (BBB) dysfunction and impaired cerebral oxygenation are considered among possible aetiologies. The relationships between intra-operative microembolic signals (MES) and the release of cerebrospinal fluid (CSF) markers of inflammation, neuronal and glial cell injuries and BBB function were evaluated after cardiac surgery with cardiopulmonary bypass (CPB)

**Method:** After IRB approval and informed consent, ten patients undergoing aortic valve replacement were included. CSF was obtained the day before and 24 hours after surgery for assessment of neuronal damage (neuron-specific enolase [NSE], total-tau [T-tau] and neurofilament light chain protein [NF-L]), glial cell injury (S-100B, glial fibrillary acidic protein [GFAP]), BBB integrity (CSF/serum albumin ratio) and cytokines (IL-6, IL-8). Intra-operative extent and distribution of microemboli were described using the trans-cranial Doppler technique.

**Results:** Intra-operatively,  $354 \pm 79$  MES were detected, 81% after release of the aortic cross-clamp. S-100B and GFAP increased by

	Preoperative	Postoperative	P
CSF S-100B ( $\mu\text{g/L}$ )	0.652 $\pm$ 0.052*	0.882 $\pm$ 0.059	<0.01
CSF GFAP (ng/L)	516 $\pm$ 66.5	646 $\pm$ 82.3	=0.055
CSF NSE ( $\mu\text{g/L}$ )	10.8 $\pm$ 0.7	10.4 $\pm$ 0.7	=0.397
CSF T-tau (ng/L)	235.2 $\pm$ 19.1	241.7 $\pm$ 17.1	=0.641
CSF NF-L (ng/L)	896 $\pm$ 109	982 $\pm$ 97.8	=0.245
CSF-albumin (mg/L)	205 $\pm$ 17.4	232 $\pm$ 23.4	<0.05
Albumin CSF/serum ratio	5.13 $\pm$ 0.48	8.28 $\pm$ 1.22	<0.05
CSF IL-6 (ng/L)	1.89 $\pm$ 0.53	22.8 $\pm$ 6.9	<0.05
CSF IL-8 (ng/L)	39.8 $\pm$ 7.8	139 $\pm$ 18.3	<0.001

35% and 25%, respectively. NSE, T-tau and NF-L, were not significantly affected by the surgery. CSF albumin increased by 13% while serum albumin decreased by 27%. Thus, CSF/serum albumin ratio increased by 61%. There was a 3.5- and 12-fold increase in IL-6 and IL-8, respectively. MES did not correlate to changes in CSF glial injury markers, the CSF/serum albumin ratio or CSF cytokines.

**Conclusions:** Cardiac surgery with CPB causes cerebral inflammation, glial cell injury and BBB dysfunction without biochemical signs of neuronal damage. These changes are not associated with intra-operative microembolization.

O-53

### Effects of levosimendan on renal blood flow, glomerular filtration rate, renal oxygen consumption and oxygenation after cardiac surgery: A randomized controlled study

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**Introduction:** Levosimendan has been shown to improve creatinine clearance in patients with acute heart failure in contrast to dobutamine [1] and in chronic heart failure [2]. However, a detailed analysis of the effects of levosimendan on renal perfusion, glomerular filtration, excretory function and oxygenation in humans, is lacking.

**Method:** After IRB approval and informed consent, thirty patients with normal preoperative serum creatinine were studied after uncomplicated cardiac surgery. Postoperatively they were randomized to receive either placebo or a bolus dose of levosimendan, 12  $\mu\text{g/kg}$ , followed by an infusion, 0.1  $\mu\text{g kg}^{-1} \text{min}^{-1}$ . Cardiac output (CO) was measured by a pulmonary artery catheter. Renal blood flow (RBF) and glomerular filtration rate (GFR) were measured by the renal vein thermodilution technique and by renal extraction

	Baseline		Treatment		
	Placebo	Levo	Placebo	Levo	P
MAP(mmHg)	73.1±1.9	73.1±1.8	71.8±2.2	69.4±2.3	0.133
CO (l/min)	5.6±0.3	6.0±0.2	5.5±0.3	7.2±0.3	<0.001
RBF (ml/min)	822±59	682±43	780±59	730±40	0.027
GFR (ml/min)	70.6±7.0	62.8±4.9	68.2±6.0	74.1±5.1	0.030
RVR (units)	0.080±0.01	0.100±0.01	0.087±0.01	0.086±0.01	0.023
RVO <sub>2</sub> (ml/min)	10.3±0.75	8.9±0.74	11.2±0.81	10.5±0.92	0.128
RO <sub>2</sub> Ex	0.102±0.01	0.097±0.01	0.112±0.01	0.113±0.01	0.210

of 51<sup>Cr</sup>-EDTA. Renal oxygen consumption (RVO<sub>2</sub>) and extraction (RO<sub>2</sub>Ex) were calculated from arterial and renal vein blood samples. Effects of levosimendan vs. placebo were tested with ANOVA for repeated measurements (mean ± SEM).

**Results:** (see table)

**Conclusion:** The levosimendan-induced increase in CO was accompanied with renal vasodilatation and increased RBF. Levosimendan also increased GFR, suggesting a selective dilatation of the pre-glomerular resistance vessels. The renal oxygen demand/supply relationship was not affected by levosimendan as demonstrated by the lack of effect on RO<sub>2</sub>Ex.

**References:**

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O-54

### The effect of high-dose insulin on protein metabolism after cardiac surgery

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**Introduction:** The hyperinsulinaemic-normoglycaemic clamp technique is a precise method of providing insulin and glucose while maintaining normoglycaemia. High-dose insulin has profound effects on glucose and protein metabolism. It has been demonstrated in coronary artery bypass graft (CABG) surgery patients that high-dose insulin causes hypoaminoacidaemia. The aim of this study was to test the hypothesis that hypoaminoacidaemia in the presence of insulin infusion in patients undergoing CABG surgery is the result of suppression of whole body protein breakdown as assessed by L-[1-<sup>13</sup>C]leucine stable isotope kinetics.

**Method:** Approval of our local institution's ethics committee was obtained. Consenting patients were divided randomly into two groups. The control group received a standard iv. insulin protocol with the aim of keeping blood glucose between 6-10 mmol/L. The treatment group received a high dose insulin infusion of 5 mU kg<sup>-1</sup> min<sup>-1</sup> coupled with a variable infusion of dextrose 20% to main-

tain normoglycaemia (4-6 mmol/L). L-[1-<sup>13</sup>C]leucine kinetics were used to assess changes in whole body protein turnover. The preoperative measurements were performed on the morning before the operation. Postoperative studies were conducted 2 hours after surgery. Whole body leucine kinetics between the two groups were analysed using ANOVA for repeated measurements.

**Results:** Sixteen patients were enrolled in the study. Eight received high-dose insulin therapy and eight a standard insulin regimen. Baseline characteristics and surgical data were similar between groups. Mean plasma glucose levels were  $7.5 \pm 0.7$  mmol/L in the treatment group and  $5.0 \pm 0.7$  mmol/L in the control group ( $P < 0.001$ ). Supraphysiologic levels of insulin were achieved in the treatment group compared to the control group ( $3614 \pm 560$  vs.  $56 \pm 39$  pmol/L,  $P < 0.001$ ). The postoperative protein breakdown (leucine rate of appearance, Ra) and protein synthesis decreased in patients receiving high-dose insulin compared to preoperative baseline, but did not change in the control group (see table).

**Discussion:** Achieving supraphysiological levels of insulin while maintaining euglycaemia after CABG surgery decreases whole body protein breakdown and synthesis. This novel technique may have an impact on cardiac and end-organ physiology that may be exploited for potential improvement in CABG outcomes.

O-55

## Efficacy of perioperative pregabalin in acute and chronic postoperative pain after OPCAB: A randomized, double blind placebo controlled trial

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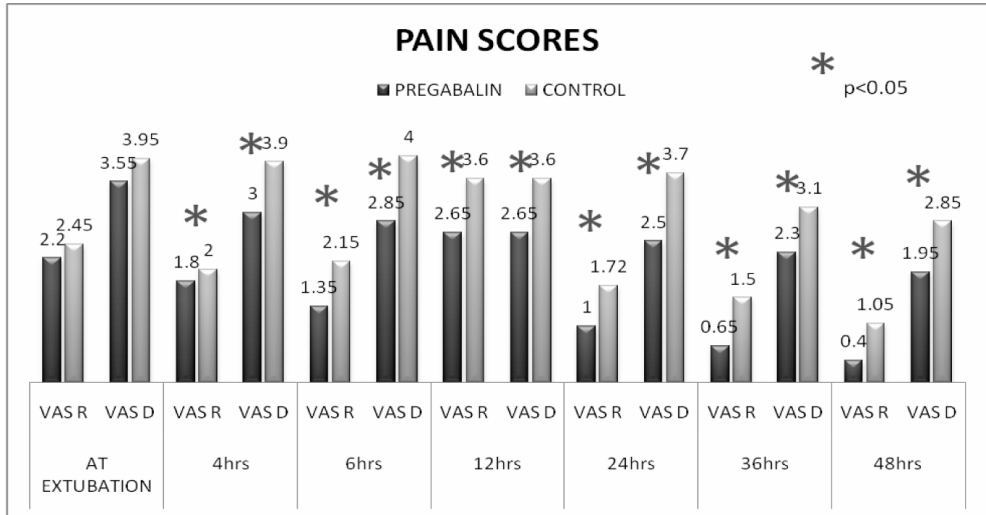
**Introduction:** Use of pregabalin has become a part of a multimodal approach to postoperative pain management. We hypothesized that the use of pregabalin in the perioperative period would reduce postoperative pain, opioid consumption, and chronic pain in off-pump coronary artery bypass grafting surgery (OPCAB).

**Method:** A randomized, prospective, double blind, placebo controlled trial was planned enrolling 40 patients posted for elective OPCAB who were allocated to Group 'A' and Group 'B'. Gp A received Cap. Pregabalin 150 mg 1 h before shifting to the operating room and 75 mg b.d. for 2 postoperative days. Gp B received placebo capsules. VAS numeric score at rest and on deep breathing was used to assess pain at extubation (0), 4, 6, 12, 24, 36 and 48 h from extubation. Rescue analgesia was inj. Tramadol 1mg/kg iv. at VAS>4. VAS scores, rescue analgesic and haemodynamic data were collected for 48 h after surgery. Pain assessment data was collected by telephonic communication at 1 and 3 months. Independent t test and Pear-

Whole body leucine kinetics		Control	Treatment	P- ‡
Ra leucine ( $\mu\text{mol} \cdot \text{kg}^{-1} \text{h}^{-1}$ )	Before surgery	93.5 $\pm$ 17.2	105.3 $\pm$ 8.8	0.003
	After surgery	95.8 $\pm$ 14.8	85.5 $\pm$ 9.9*	
Protein synthesis ( $\mu\text{mol} \cdot \text{kg}^{-1} \text{h}^{-1}$ )	Before surgery	79.2 $\pm$ 14.3	91.1 $\pm$ 7.8	<0.001
	After surgery	81.4 $\pm$ 12.5	69.9 $\pm$ 8.5*	

\* $P < 0.01$ , probability that values change after surgery. †  $P < 0.01$ , probability that values are different between groups. ‡ probability that postoperative changes are different between groups





VAS R: at rest; VAS D: deep breathing

son's chi squared test were used and data analysed by SPSS ver.14 software.

**Results:** All enrolled patients completed the study. VAS scores at rest (VASR) and deep breathing (VASD) were significantly lower in the pregabalin group from 4<sup>th</sup> hour after extubation (Fig). The number of breakthrough episodes were less in the pregabalin group ( $1.05 \pm 0.94$  vs.  $2.5 \pm 1.23$ ,  $P < 0.005$ ). Tramadol consumption in 48 h ( $67 \pm 60.24$  mg vs.  $167 \pm 162.9$  mg,  $P < 0.05$ ), dynamic pain assessed by deep breathing at 4 h from extubation ( $1.2 \pm 0.2$  vs.  $1.9 \pm 0.23$ ,  $P < 0.05$ ) were

significantly lower in Gp A. Pain at 1 and 3 months were comparable in both group.

**Conclusions:** Perioperative pregabalin in off-pump coronary artery bypass grafting surgery significantly reduced postoperative pain score at rest and deep breathing and reduced tramadol consumption by 60%. No untoward effects, such as excessive sedation and prolonged extubation time were observed in the pregabalin group. However, pain at 1 and 3 months after surgery was not significantly different between groups

## Oral session XIII – Intensive care

O-56

### Continuous renal replacement therapy with an adsorbent membrane in postoperative septic cardiac patients: A clinical experience

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**Introduction:** Cardiac surgery patients with renal failure may be seriously compromised by a septic event. In this event CRRT alone may be unable to treat septic shock and CRRT with an adsorbent membrane should be considered. The aim of the study was to evaluate the safety of a new haemofilter membrane oXiris in postoperative cardiac patients, the cardio-respiratory response and changes of IL-6.

**Method:** Twenty five postoperative cardiac patients with renal failure and sepsis/septic shock were enrolled in the study. All patients had preoperative endotoxin >0.6 (EAA Spectral D) and were submitted to high volume haemodiafiltration (50 ml kg<sup>-1</sup> h<sup>-1</sup> – Prismaflex - Gambro®) with a new heparin coated membrane (oXiris TM - Gambro® cut off 25 kD)

without a heparin infusion. At T0 (pre-treatment) and T1 (72 ± 13 h) the main clinical and biochemical data were evaluated. All data are expressed as mean ± SD. Student's t test or Wilcoxon's test was used to evaluate the data changes. P<0.05 was considered significant.

**Results:** All patients but one, survived the treatment and there were no complications related to the CRRT. Table 1 shows the main results of this study.

**Conclusions:** In post cardiac surgery patients with renal failure and sepsis CRRT with a new heparin coated membrane (oXiris TM - Gambro®) is clinically feasible, has a positive effect on haemodynamic, respiratory variables and renal function. An important adsorbing effect on pro-inflammatory cytokines may explain in part these results. The results have to be taken with precaution due to the non-randomized study.

Table 1

	T0	T1	P
SOFA score	13 ± 2	8 ± 2	<0.001
MAP mmHg	63 ± 20	82 ± 16	<0.01
Diuresis ml/24 h	960 ± 580	1290 ± 290	<0.05
Noradrenaline µg kg <sup>-1</sup> min <sup>-1</sup>	0.33 ± 0.2	0.01 ± 0.03	<0.01
IL6 pg/ml	344 ± 57	76 ± 72	<0.05
Procalcitonin ng/ml	46 ± 22	17 ± 35	<0.05

O-57

## Changing risk profile and outcome in patients undergoing cardiac surgery: A 14 years study

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**Introduction:** The severity of patients undergoing cardiac surgery has changed. The aim of this study was to estimate this change using severity scores and to determine alterations in the main predictors of in-hospital mortality.

**Method:** Data of 6768 patients undergoing cardiac surgery in our hospital were prospectively collected between January 1998 and June 2011. These 13.5 years were divided into 3 equal periods. Parsonnet score [1], Tu score [2], additive and logistic EuroSCORE [3] were calculated as described in the original studies. The main end point was hospital mortality. EuroSCORE<sup>37</sup> defined high risk patients. Accuracy of risk scores was assessed by ROC curves analysis.

**Results:** Means of the 4 scores increased with time, but not mortality. The additive and logistic EuroSCORE AUCs were 0.82, did not significantly change during the 3 periods and were significantly higher than the AUCs of Tu and Parsonnet scores (0.77, P=0.0001). Among high risk patients with an additive EuroSCORE >6, LV dysfunction had a declining influence with time, mortality decreased from 18.3 to 10.5% from period I to period

III (P=0.02). The other main declining factor was age, mortality of high risk patients  $\geq$  70 years decreased from 18 to 11% (P=0.03) from period I to period III.

**Conclusion:** Postoperative mortality did not significantly change during the study period. This may be due to improved perioperative care especially for the oldest patients or patients with LV dysfunction.

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3. Tu JV, Jaglal SB, Naylor CD. Multicenter validation of a risk index for mortality, intensive care unit stay, and overall hospital length of stay after cardiac surgery. *Circulation* 1995; 91 (3): 677-84

	Period I	Period II	Period III	P
EuroSCORE	4.8 $\pm$ 3.2	5.2 $\pm$ 3.5	6.3 $\pm$ 3.5	<0.0001
EuroSCORE $\geq$ 7	26 %	39 %	45 %	<0.0001
Log EuroSCORE	6.2 $\pm$ 9.5	8.1 $\pm$ 11.1	9.1 $\pm$ 11.4	<0.0001
Parsonnet	10.0 $\pm$ 8.4	12.1 $\pm$ 9.2	13.1 $\pm$ 9.7	<0.0001
TU score	3.1 $\pm$ 2.4	3.8 $\pm$ 2.6	4.1 $\pm$ 2.6	<0.0001
Mortality (%)	4.0	4.6	4.4	0.57

O-58

## Predictors of high intra-abdominal pressure after cardiac surgery

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**Introduction:** High intra-abdominal pressure (IAP) is associated with severe organ failure, prolonged intensive care unit stay and increased mortality. There are few studies describing changes to IAP in patients undergoing cardiac surgery [1,2]. The aim of this study was to investigate the predictors of high intra-abdominal pressure in patients undergoing cardiac procedures.

**Method:** After hospital scientific committee approval and informed consent; 100 patients who had undergone cardiac surgery with extracorporeal circulation were enrolled (74 M, 26 F). Anaesthesia was induced and maintained with TIVA (propofol, fentanyl and pancuronium). Intra-abdominal pressure was measured with a transvesical technique (via the indwelling urinary cath., 3 way tap, 16-gauge needle, pressure transducer and tubing) at four measurement times (preoperatively, 1<sup>st</sup>, 12<sup>th</sup>, 24<sup>th</sup> h, postoperatively). Patients with high IAP ( $\geq 12$  mmHg, n=49) and those with normal IAP ( $<12$  mmHg, n=51) were compared in terms of pre, intra, and postoperative parameters with Chi-squared or Fisher's exact test. Logistic regression analysis was performed for potential predictors or risk factors associated with  $P<0.05$  from univariate analysis.

**Results:** There were no correlations with preop. diabetes, COPD or chronic renal failure. High IAP was correlated with age and BSA ( $P=0.01$ ), preoperative diagnosis of hypertension ( $P<0.05$ ), atrial fibrillation ( $P<0.01$ ) and high central venous pressure ( $P=0.014$ ); intra-

operatively, with extracorporeal circulation time ( $P<0.01$ ) and cross-clamping time ( $P<0.001$ ), presence of aortic atheroma ( $P=0.025$ ), massive blood transfusion ( $P<0.05$ ); postoperatively with high dose inotropic agents ( $P<0.01$ ), high lactate levels ( $P<0.01$ ), and oliguria ( $P<0.05$ ).

**Conclusion:** Intra-abdominal pressure measurements have a significant diagnostic value, especially in cases of dysfunction of abdominal organs and haemodynamic instability. The introduction of IAP measurements to standard monitoring of patients undergoing cardiac procedures may help in the earlier diagnosis and treatment of postoperative organ failure.

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2. Dabrowski W, Wacinski P, Visconti J. Abdominal perfusion pressure and coronary arterial perfusion pressure in patients undergoing coronary artery bypass graft surgery. *Exp Clin Cardiol* 2009; 14 (3): e84-8

O-59

## Reliability of radial arterial pressure monitoring after cardiac surgery

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**Introduction:** Invasive monitoring allows a continuous measurement of arterial pressure (AP), cardiac output and pulse pressure variation (PPV). However, the pressure signal may be altered by the dynamic characteristics of the fluid-filled tubing. The aim of this study was to evaluate the reliability of inva-

sive radial AP measurement and derived indexes during the early period after cardiac surgery.

**Method:** After IRB approval, 30 patients with a radial artery catheter were admitted to ICU after elective cardiac surgery. A continuous recording of AP during 18 h was started via a double-head pressure transducer (Flotrac, Edwards Lifesciences, Irvine, CA) and 3 fast flushes were performed. The record was examined for episodes of overdamping (Ov) defined as a decrease in systolic (sAP), an increase diastolic (dAP), an unchanged mean pressure (mAP) or attenuation (At) defined as a decrease sAP, dAP and mAP. 3 periods of 10 minutes during the first hour were analysed assuming constant dynamic characteristics, allowing correction of the raw signals and the study of the consequences on sAP, PPV and dP/dt. A paired t-test was used for statistical comparison.

**Results:** During the whole record, the number of episodes of Ov or At ranged from 0 to 15 with a duration of 0 to 6 h. 17 patients had at least 1 episode of Ov and/or At tracing, 10 patients at least 2 episodes, 8 patients at least 5 episodes. 7 episodes lasted more than 20 min and 3 more than 1 h. During the first hour, sAP was overestimated by  $5.0 \pm 1.4$  mmHg ( $P < 0.0001$ ) [range: 0.3-5.9] or by  $4.3 \pm 0.9\%$  [range: 0.4-15.9%], Raw PPV was  $9.5 \pm 7.3$  versus  $10.0 \pm 7.8$  [range from -2.6 to 4.3,  $P = 0.0013$ ]; 5 patients had a raw PPV  $\leq 13$  with a corrected PPV  $> 13$ , 1 patient had a raw PPV  $> 13$  with a corrected PPV  $\leq 13$  ( $P < 0.0001$ ); dP/dt was overestimated by  $134 \pm 47$  mmHg/s ( $P < 0.0001$ ) [range: -13-353].

**Conclusion:** These results showed that after cardiac surgery, frequent artefacts and distortions induced by the fluid-filled tubing could modify the radial artery waveform and lead to inaccurate therapy [1]. More attention should be paid to the quality of the pressure signal.

#### Reference:

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measurement and associated therapeutic interventions. *Anesthesiology* 2011; 115 (5): 973-8

O-60

## The effects of BIPAP in patients undergoing coronary artery bypass graft surgery with or without pleurotomy?

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**Introduction:** The effects of BIPAP (bi-level positive airway pressure) on respiratory functions and on pain intensity were investigated in coronary artery bypass graft (CABG) surgery with or without pleurotomy.

**Method:** In a prospective, open-label, non-randomized study design, 140 patients were divided into Group 1; intact pleurae (n= 70) and Group 2; opened pleurae (n=70) at the end of open heart surgery. BIPAP was administered in an 8 h period after extubation. Primary end-point was prevention of re-intubation. Parameters collected at baseline, 1<sup>st</sup> and 4<sup>th</sup> h after BIPAP included; arterial blood gas values, tidal volume, respiratory and heart rate, visual analogue scale (VAS) scores for pain intensity. All variables were normally distributed. Repeated measure analysis was performed.

**Results:** There were no significant differences in preoperative and intraoperative parameters ( $P > 0.05$ ). There were differences in PaO<sub>2</sub> and SpO<sub>2</sub> levels within the groups (\*) with no significant difference between groups, 1 h and 4 h after BIPAP in comparison to before operation and before BIPAP values on post-operative day 1 (Table 1). VAS scores and reintubation rates (4.3% vs. 5.7 %) were similar ( $P > 0.05$ ).

Table 1

	Group 1 (Opened Pleurae, n=70)				Group 2 (Intact Pleurae, n=70)			
	Preop	Postop			Preop	Postop		
		Pre BIPAP	Post BIPAP			Pre BIPAP	Post BIPAP	
		Day 1	1 h	4 h		Day 1	1 h	4 h
Resp. rate (rate/min)*	23.0 ±1.3	24.5 ±3.2	24.5 ±3.2 <sup>b</sup>	21.7 ±6.9 <sup>c</sup>	24.9 ±2.3	26.8 ±2.6	22.8 ±2.6 <sup>b</sup>	20.4 ±6.9 <sup>c</sup>
PaO <sub>2</sub> (mmHg)	86.29 ±7.5	82.6 ±10.2 <sup>a</sup>	85.7 ±7.3 <sup>b</sup>	86.9 ±8.1 <sup>c</sup>	85.6 ±7.04	80.2 ±11 <sup>a</sup>	87.4 ±10.2 <sup>b</sup>	86.4 ±12.8 <sup>c</sup>
PaCO <sub>2</sub> (mmHg)	38.6 ±3.5	39.0 ±4.2	33.7 ±3.2 <sup>b</sup>	33.9 ±3.1	37.8 ±2.3	38.1 ±2.1	37.9 ±7.2	38.7 ±4.5
SpO <sub>2</sub> (%)	95.9 ±1.82	93.9 ±2.4 <sup>a</sup>	96.13 ±2.6 <sup>b</sup>	96.46 ±3.2 <sup>c</sup>	96 ±1.4	93.9 ±2.5 <sup>a</sup>	97.1 ±2.1 <sup>b</sup>	96.1 ±1.3 <sup>c</sup>

\*P<0.05 statistically significant, a: value before BIPAP on postop. day 1 significantly different from that at baseline within the groups; b: value at 1 h significantly different from that before BIPAP on postop. day 1 within groups; c: value at 4 h significantly different from that at before BIPAP on postop. day 1 within groups; op.: operation; postop.: postoperative, resp.: respiratory

**Conclusion:** The use of BIPAP therapy in the early postoperative period after CABG surgery shows that whether or not the pleural

space was entered, reintubation rates and pain intensity were similar.

## Oral session XIV – Outcome

O-61

### Cognition after coronary artery bypass grafting surgery: A comparison of on- and off-pump

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**Introduction:** In the last two decades, coronary artery bypass grafting (CABG) surgery has increasingly been performed without cardiopulmonary bypass (CPB), that is 'off-pump'. A strong motivation for performing

CABG surgery off-pump was to avoid CPB which has been believed to cause cognitive decline. However, accumulating evidence from systematic reviews and meta-analyses comparing on- and off-pump CABG surgery indicates that CPB may not be the cause of cognitive decline [1]. Several additional randomized controlled trials (RCTs) comparing cognition after on- and off-pump CABG surgery have been published since the last meta-analyses. The aim of this study was to undertake a systematic review of the literature and meta-analysis to compare cognition following on- and off-pump CABG surgery.

**Method:** RCTs comparing continuous measures of cognitive outcome after on- and off-pump CABG surgery were identified by literature searching. Data extraction enabled data from seven psychometric tests (Auditory Verbal Learning Test, Grooved Pegboard, Trail-Making A and B, Digit Symbol, Digit

Span, and Stroop Colour Word Test) to be amalgamated. Data was grouped into early (< six months) and late ( $\geq$  six months) post-operative periods and analysed using Revman 5.

**Results:** A systematic literature search conducted in Medline, Embase, PsychINFO and The Cochrane Library yielded 13 studies totalling 2285 patients that could be included in the meta-analysis. No significant differences were found between on- and off-pump groups in any of the psychometric tests in either early or late postoperative periods.

**Discussion:** To-date, this is the largest meta-analysis comparing cognition following on- and off-pump CABG surgery and the absence of difference is consistent with previous systematic reviews and meta-analyses. The results are highly suggestive that CPB may not be the cause of cognitive decline associated with CABG surgery.

**References:**

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O-62

## Low NT-proBNP response to levosimendan is associated with mortality in coronary surgery for ischaemic cardiomyopathy

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**Introduction:** High N-terminal pro-B-type natriuretic peptide (NT-proBNP) level is a well known indicator of myocardial dysfunction and risk of coronary artery bypass grafting (CABG) [1]. The influence of preoperative levosimendan infusion on NT-proBNP and mortality is being discussed.

**Method:** After the hospital Ethics Committee approval 18 patients (pts, 16 males and 2 females) scheduled for CABG with left ventricular ejection fraction (LVEF) less than 30% and NT-proBNP level higher than 2000 pg ml<sup>-1</sup> were prospectively included. Levosimendan infusion (12.5 mg during 24 hours without a bolus) was started two days before surgery. NT-proBNP level was measured before levosimendan infusion (NT-proBNP-1, inclusion criterion) and before induction of anaesthesia (NT-proBNP-2) by electrochemi-luminescence assay. Data are given as mean  $\pm$  standard deviation. Student's t-test was used. P<0.05 was considered as significant.

**Results:** Six pts died in the postoperative time. The values of NT-proBNP were de-

Parameter	Non-survivors	Survivors	P
LVEF, %	22 $\pm$ 7.3	24 $\pm$ 1.3	0.599
NT-proBNP-1, pg ml <sup>-1</sup>	3060 $\pm$ 806	2570 $\pm$ 503	0.328
NT-proBNP-2, pg ml <sup>-1</sup>	2410 $\pm$ 455	1174 $\pm$ 222	0.008
Decrease of NT-proBNP, %	19 $\pm$ 4.1	54 $\pm$ 2.4	0.001

creased (7-67%) after the levosimendan infusion. Only the degree of decrease of NT-proBNP serum concentration and the level of NT-proBNP-2 were significantly ( $P<0.05$ ) different between survivors and non-survivors (table).

**Discussion:** Depressed response of elevated NT-proBNP level to preoperative levosimendan infusion is associated with mortality after CABG for ischaemic cardiomyopathy. Some alternative methods of preoperative preparation, such as intra-aortic balloon pumping, must be examined for this category of pts.

**Reference:**

1. Elíasdóttir SB, Klemenzson G, Torfason B, Valsøen F. Brain natriuretic peptide is a good predictor for outcome in cardiac surgery. *Acta Anaesthesiol Scand* 2008; 52 (2): 182-7

O-63

## Inotropes in cardiac surgery are independently associated with adverse clinical outcome

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**Introduction:** The aim was to examine the relationship between perioperative use of inotropes and clinical outcome, with specific focus on differences in outcome between use of dobutamine and milrinone.

**Method:** A retrospective cohort study was made of 7,056 consecutive cardiac surgery patients from 3 university-affiliated cardiac centres based on data from the Western Denmark Heart Registry. Multivariate logistic regression analysis and propensity matching based on EuroSCORE parameters, type of surgery, anaesthesia and bypass time was performed to evaluate whether overall inotrope exposure was independently associated with the following outcomes: one year mortality or acute myocardial infarction (AMI), in-hospital stroke or need of renal replacement therapy (CRRT). Subgroup analyses were performed to assess whether dobutamine was associated with higher risk of adverse clinical outcome than milrinone.

**Results:** 2,163 (31%) patients received inotropic therapy, 434 patients (6%) receiving dobutamine and 624 (9%) milrinone exclusively. Overall perioperative use of inotropes was independently associated with increased risk of all clinical outcome parameters compared to non-receivers. There was no difference between milrinone and dobutamine in adverse clinical outcomes.

**Conclusion:** The results of our study indicate that perioperatively the use of inotropes in cardiac surgery is associated with increased risk of adverse outcome. Regarding clinical outcome, dobutamine appears to be as safe as milrinone. The results emphasizes that inotropic therapy in cardiac surgery should always be used with caution.

	Death	AMI	Stroke	CRRT
<b>Overall use of inotropes; OR (95%CI)</b>				
Log.Regr.	3.3(2.6-9.0)	1.8(1.4-2.4)	2.4(1.6-3.6)	4.6(3.1-6.8)
Propensity	3.2(2.3-4.5)	1.8(1.3-2.6)	2.6(1.5-4.5)	5.0(3.0-8.2)
<b>Dobutamine versus Milrinone; OR (95%CI)</b>				
Log.Regr.	0.8(0.4-1.4)	0.6(0.3-1.1)	1.1(0.4-2.8)	1.1(0.5-2.5)
Propensity	0.6(0.3-1.4)	0.4(0.1-1.2)	1.2(0.4-4.0)	0.7(0.3-2.2)

OR: Odds Ratio; CI: Confidence interval; Log.Regr: Logistic regression analysis; Propensity: Propensity score analysis



O-64

## Target controlled propofol and fentanyl infusion during aortic stenosis surgery in elderly patients

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**Introduction:** This study was to assess the effect of propofol and fentanyl target controlled infusion (TCI) on haemodynamic stability and recovery characteristics when used for induction and maintenance of anaesthesia during aortic stenosis surgery in elderly patients.

**Method:** TCI of propofol was performed by syringe pump Graseby 3500 with Astra-Zeneca Diprifusor TCI system. Fentanyl was infused by Graseby 3400 pump controlled by STANPUMP PC software. The fentanyl infusion started 1 min. before the start of propofol infusion. Method was used in 25 NYHA III-IV patients aged 71-82 yr for valve replacement. LVEF was 40-60%, systolic gradient was 70-110 mmHg.

**Results:** Time from start of propofol infusion to intubation was 4.1±0.2 min. The dose of

propofol at the time of intubation was 0.76±0.05 mg/kg, fentanyl- 2.8±0.2 mcg/kg. During induction of anaesthesia, decrease in arterial pressure was faster than the decline in the BIS in all cases. Mean arterial pressure (MAP), BIS data, propofol and fentanyl concentrations are shown in the table.

**Discussion:** Propofol and fentanyl TCI avoids systemic hypotension during anaesthesia.

O-65

## Initial serum creatinine and longterm mortality after cardiac surgery: Are there age or gender related cofactors?

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**Introduction:** Acute kidney injury is a major complication after cardiac surgery. It is an independent risk factor for late postoperative death [1]. We investigated the interaction of age, sex and initial serum creatinine (Inicrea) on long-term mortality after cardiac surgery.

	MAP mmHg	BIS	Propofol.		Fentanyl
			blood conc mcg/ml	effect site conc. mcg/ml	effect site conc. ng/ml
Before induction	105±3	93.1±0.4	0	0	0
Intubation	80±4	54±2	1.2±0.1	1.0±0.1	3.2±0.1
Pre-CPB	87±5	42.2±1.4	1.5±0.1	1.5±0.2	3.7±0.2
CPB	70.4±1.1	42.1±1.2	1.5±0.1	1.5±0.1	1.5±0.1
After CPB	79±2	45.1±1.2	1.5±0.1	1.5±0.2	1.2±0.2
Awakening	81±2	86.2±1.0	0.7±0.1	0.8±0.1	1.0±0.1

Recovery time was 18±2 min. All patients were extubated in the operating room in 45±7 min. Propofol consumption per operation was 865±12 mg, fentanyl 450±15 mcg.

**Method:** 9,490 patients (3,322 female) who underwent cardiac surgery from 1997 to 2008 were included. The follow-up period lasted until 2010. Inicrea was the value recorded before surgery. Identification of a cut-off value was performed on the whole data set, and on four subsets that were obtained by selecting for either sex and age (<60 or >60 years) using the Wilcoxon and log-likelihood test statistics.

**Results:** For patients >60 years of both sexes and women <60 years, a cut-off value of 1.3 mg/dl (115  $\mu$ mol/l) was found. The best cut-off value for men <60 years was 2.0 mg/dl (177  $\mu$ mol/l). Survival functions of the four subgroups are shown in Figure 1.

**Conclusion:** Gender specific differences in the association between Inicrea and outcome should be considered in clinical practice.

**Reference:**

1. Kowalik MM, Lango R, Klaiber K, Musiał-Swiatkiewicz V, Kołaczowska M, Pawlacyk R, Rogowski J. Incidence- and mortality-related risk factors of acute kidney injury requiring hemofiltration treatment in patients undergoing cardiac surgery: a single-center 6-year experience. *J Cardiothorac Vasc Anesth* 2011; 25 (4): 619-24

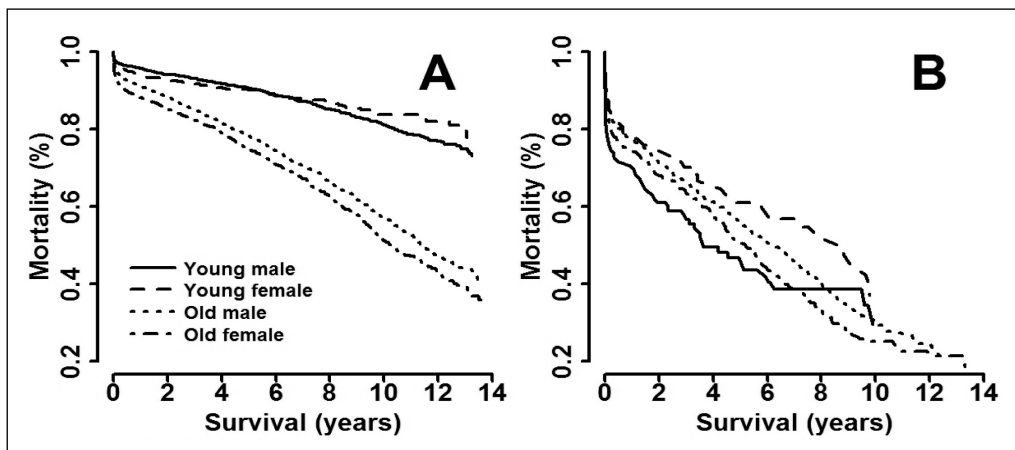


Figure 1: Estimated survival functions, Inicrea below (A) and above (B) cut-off.

## Oral session XV – Thoracic anaesthesia

O-66

### A constant-flow technique for determining the lower inflection point of the pressure-volume curve and volumetric capnography for optimizing oxygenation during one-lung ventilation

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**Introduction:** One method for treating hypoxia during one-lung ventilation (OLV) is the application of PEEP to the dependent lung. The effect of PEEP on oxygenation depends on the relation between the end-expiratory pressure and the lower inflection point (LIP) of the pressure-volume curve [1]. LIP during OLV can be determined with a super-syringe technique. An alternative simpler technique is the constant-flow method [2]. Our goals were to confirm that the constant-flow method works during OLV and that volumetric capnography is useful in optimizing oxygenation.

**Method:** Data were obtained from 20 patients with a wide range of pulmonary hyperinflation during OLV for thoracic surgery who were ventilated with an AVEA (VIASYS Healthcare) critical-care ventilator. During two-lung ventilation (TLV) and OLV an  $\text{FiO}_2$  of 1.0, 8 ml·kg<sup>-1</sup> tidal volume with 10 min<sup>-1</sup> respiratory rate were used. During OLV, ventilation periods of ten minutes, with and without 5 cm H<sub>2</sub>O PEEP were alternated. During each period, arterial blood partial pressure,

volumetric capnographic oxygenation index: OI, dead space, respiratory and haemodynamic values, intrinsic PEEP (PEEPi) and LIP were recorded. PEEPi and LIP were determined using the automatic mode of the ventilator with a continuous flow of 3 L·min<sup>-1</sup>.

**Results:** A significant inverse correlation between the net change in LIP-PEEPi difference and change in PaO<sub>2</sub> during OLV using different PEEP were seen ( $r=0.704$ ,  $P<0.001$ ). A significant negative correlation between the change in OI measured in supine and lateral decubitus positions during TLV and change in PaO<sub>2</sub> during OLV using different PEEP were seen ( $r=-0.55$ ,  $P=0.012$ ).

**Conclusions:** The change in PaO<sub>2</sub> with application of PEEP during OLV is inversely correlated with the net difference between LIP and PEEPi. The constant flow method can thus be used to determine LIP during OLV, with results similar to those reported previously using the super-syringe technique [1]. The change of OI between supine and lateral decubitus positions during TLV can predict the effect of PEEP on oxygenation during OLV. Volumetric capnography can help to optimize oxygenation during OLV.

#### References:

1. Slinger PD, McRae K, Winton T. Relation of the static compliance curve and positive end-expiratory pressure to oxygenation during one lung ventilation. *Anesthesiology* 2001; 95 (5): 1096-102
2. Lu Q, Rouby JJ. Measurement of pressure-volume curves in patients on mechanical ventilation: methods and significance. *Crit Care* 2000; 4 (2): 91-100

O-67

## Usefulness of continuous oxygen flow under apnoeic hyperoxygenation principles to correct intractable hypoxaemia during one lung ventilation in sleeve resection surgery

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**Introduction:** When anatomically appropriate, the advantages of broncho-vascular reconstructive techniques against pneumonectomy, have been now recognized. They are still a challenge for both surgeons and anaesthesiologists because of technical difficulties and the access of more high risk patients. In these cases, hypoxaemia appears more often during one lung ventilation (OLV) and classical manoeuvres to correct it cannot be used, because the bronchus is open during the anastomosis. We describe how we have corrected refractory hypoxaemia, when the bronchus is still open during anastomosis.

**Method:** Eighty sleeve lobectomies (SL) were performed since 2005. In 20 of these patients, impaired lung function (ILF) contraindicated a pneumonectomy. Monitoring of continuous cardiac output and cerebral activity by BIS and Somanetics® (SrO<sub>2</sub> cerebral), were added to anaesthesia management in the patients under bronchoangioplastic procedures or sleeve resections (SR) due to ILF. If hypoxaemia refractory to conventional treatments appeared during OLV, both lungs were hyperoxygenated and hyperventilated with 100% FiO<sub>2</sub> for 10 minutes. After opening the bronchus a thin catheter was placed through the surgical field delivering a flow of 10-15 L/min of O<sub>2</sub> in the spared lobes until the anastomosis was finish.

**Results:** Unresponsive hypoxaemia appeared in 4 of the 20 patients with ILF (mean age 73 y + mean FEV1/DLCO 55%). The application of apnoeic hyperoxygenation + intra-

field O<sub>2</sub> flow, raised PaO<sub>2</sub> to safe values and the surgery could be finished. PaO<sub>2</sub> increased from 6.2 kPa to 8.0 kPa and SaO<sub>2</sub> from 90% to 94% respectively (mean values at FiO<sub>2</sub>=1). Only one patient needed oxygen support after discharge.

**Conclusions:** Continuous oxygen flow to the spared lobe following the principles of apnoeic hyperoxygenated ventilation may correct hypoxaemia, avoiding the need for pulmonary artery clamping or extra equipment requirements. It was free of side effects.

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1. Ku CM, Slinger P, Waddell TK. A novel method of treating hypoxemia during one-lung ventilation for thoracoscopic surgery. *J Cardiothorac Vasc Anesth* 2009; 23 (6): 850-2
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O-69

## Echocardiography assessment of right ventricle function after pulmonary surgery

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**Introduction:** Right ventricular (RV) function has been scarcely studied during pulmonary surgery [1]. Echocardiography, a valuable technique to assess RV function [2], has been used before and after pulmonary resection.

**Method:** Patients who were scheduled for elective pulmonary resection gave informed consent to participate in the study. Transthoracic echocardiography (TTE) (Vivid I, GE) was performed the day before surgery and on postoperative day 2, both during spontaneous ventilation. Left ventricle (LV) ejection fraction, RV dimensions, mitral Doppler inflow (Em, Am and E deceleration time, EDT), mitral annulus motion (Eam and Aam, Sam)

and tricuspid annulus (Eat and Aat, Sat) measured by tissue Doppler (Tdi), and tricuspid annulus systolic motion (TAPSE) were recorded. Derived indices were calculated: Em/Am, Em/Ea, IVA (isovolumic acceleration of tricuspid annulus). LV ejection was assessed by aortic flow (velocity time integral, VTlao). Analysis of variance and parametric statistical test were used to assess statistical significance ( $P < 0.05$ ).

**Results:** Eighteen patients, age from 45 to 79 yr were included. 13 were operated on for partial pulmonary resection (lobectomy,  $n=7$  or smaller resection,  $n=6$ ) and 5 for pneumonectomy. TAPSE was reduced significantly after pneumonectomy (from  $28 \pm 3$  to  $17 \pm 6$  mm,  $P=0.021$ ). LV diastolic function was altered (Em, Em/Am, Em/Ea) more after pneumonectomy than after partial pulmonary resection ( $P < 0.03$ ). LV systolic function was not modified with unchanged VTlao.

**Discussion:** These results suggest that RV systolic function is altered in proportion to the extent of the pulmonary resection; an observation in agreement with the RV dilatation described a few months after surgery [3].

#### References:

1. Amar D, Burt ME, Ronstacher N, Reinsel RA, Ginsberg RJ, Wilson RS. Value of perioperative Doppler echocardiography in patients undergoing major lung resection. *Ann Thor Surg* 1996; 61 (2): 516-20
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O-70

## The novel biomarker Pentraxin 3 may aid risk stratification in the early post-operative period following lung resection

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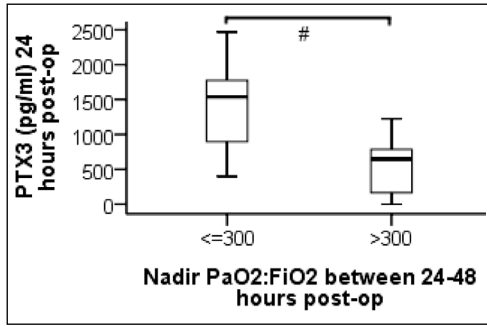
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**Introduction:** Pentraxin 3 (PTX3) is a novel biomarker of acute lung injury (ALI) [1] and may have merit as a prognostic indicator in the early post-operative (post-op) period following lung resection.

**Method:** We collected plasma samples pre-, immediately post- and 24 h post-op from 34 patients undergoing lung resection. PTX3 levels were measured in duplicate by enzyme immunoassay. Arterial blood gas (ABG) data was collected prospectively. Data were assumed to be non-parametric; statistical analysis was carried out using SPSS v19.

**Results:** Immediate post-op PTX3 was unchanged from pre-op levels. Twenty four hours later PTX3 levels had increased significantly (median [IQR], 0 [0-1] pg/ml pre-op to 726 [471-1202] pg/ml at 24 h,  $P < 0.001$  Wilcoxon Signed Ranks). ABG results up to 48 h post-op were only available in 18 patients. Those with a nadir  $\text{PaO}_2:\text{FiO}_2 \leq 40$  kPa (300 mmHg) at 24-48 h post-op ( $n=11$ ) had significantly higher PTX3 levels at 24 h (Fig. 1). A PTX3 level  $\geq 914$  pg/ml at 24 h was 73% sensitive and 86% specific for  $\text{PaO}_2:\text{FiO}_2 \leq 300$  signified by an area under the receiver operating characteristic curve of 0.84 (CI 0.66-1.0,  $P=0.02$ ).

**Discussion:** ALI complicates the post-op course of 5-10% of patients undergoing lung resection and carries a high mortality [2]. PTX3 may have a role as a prognostic indicator / monitor allowing risk stratification in the early post-op period. Patients with elevated PTX3 post-op could then be targeted for increased surveillance and preventative thera-



pies with the aim of averting post-op ALI. Further research is required in a larger cohort in order to evaluate the utility of PTX3 in this context.

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