Short communications

Early postoperative change of double-lumen to single-lumen tube after thoracoabdominal aortic surgery

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Introduction

Double-lumen tube (DLT) and one-lung ventilation are necessary to facilitate thoracoabdominal aortic aneurysm (TAAA) surgery. Early postoperative change of DLT to a single-lumen tube (SLT) may facilitate bronchial toilet and avoid DLT malposition. However, persistent lung bleeding, impaired oxygenation and airway swelling may impede safe airway management. No evidence exists about optimal tube exchange timing, but current ACCF/AHA guidelines discourage routine exchange at the end of TAAA repairs (Class III). Our study aim was to determine feasibility and safety of immediate postoperative change of DLT to SLT following TAAA surgery.

Methods

With IRB approval for this retrospective single-center observational study, records of all patients undergoing TAAA repair at our institution between April 2008 and May 2010 were reviewed. Data are mean ± SD.

Results

Hundred-thirteen consecutive patients were analyzed, none was excluded. Mean age was 64 ± 12 years, male sex 46%, BMI 25 ± 4 kg/m2, logistic EUROscore 24 ± 15%. Aneurysms were symptomatic and ruptured in 29% and 12%, respectively. Eighteen % of patients were operated emergently or urgent. Surgery included the aortic arch in 9%, and was a redo surgery in 12%. Mean duration of surgery and of cardio-pulmonary bypass time was 461 ± 114 and 192 ± 66 minutes, respectively.

A DLT was used in 107/113 patients. DLT was changed to a SLT immediately at the end of surgery in 96% in the OR by the attending cardiac anesthesiologist. No critical events occurred during tube exchange. Results from arterial blood gas analyses before and after tube exchange did not differ. No tube exchange was done in 4 patients (4%) due to persistent lung bleeding (n = 2), and intraoperative mortality (n = 2). Airway management is summarized in Tables 1 and 2.

Conclusions

After TAAA-surgery, immediate postoperative change of DLT to SLT is feasible and safe. However, careful airway evaluation by an experienced anesthesiologist is mandatory. Current guidelines should be adapted with regard to this aspect of TAAA anesthesia.

Table 1

Airway management	
Patients with DLT, n(%)	107 (95)
Size of DLT: 35/37/39/41 , n (%)	5/28/47/27 (5/26/44/25)
Type of DLT: left/right, n (%)	100/7 (93/7)
Immediate postop. tube exchange, n (%)	103 (96)
Laryngoscopy for exchange, n (%)	100 (98)
Airway exchange catheter, n (%)	11 (11)
Failed exchange intubation, n (%)	0 (0)
SaO2 nadir during exchange, %	99±1.2 (100; 93-100)

Table 2

Outcomes	
Duration of intubation, days	2.5±3.2
Length of ICU stay, days	5.8±9.8 (range: 1-45)
Length of IMC stay, days	2.4±2.2 (range: 0-10)
Pulmonary complications (overall), %	30
Persistent postop lung bleeding, %	3
ARDS, %	5
Pneumonia, %	7
Pleural effusion, %	11
Pneumothorax, %	3
Pulmonary embolism, %	3
Tracheostomy, %	10

Procedural sedation with dexmedetomidine for transcatheter aortic valve implantation

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Introduction

Transfemoral Aortic Valve Implantation (TF-AVI) in patients with severe aortic valve stenosis can be performed under sedation and local anesthesia. Different sedatives and opioids are used by various groups (e.g., propofol, midazolam, piritramide, fentanyl, remifentanil, and ketamine). Dexmedetomidine (DEX) is a centrally acting alpha-2 adrenergic agonist used for intensive care and procedural sedation. So far, no report about its use for conscious sedation in TF-AVI exists. We report our first experience with the use of DEX for sedation in TF-AVI patients.

Methods

With written informed consent to be included into a prospective TAVI registry database, and IRB approval, patients with severe symptomatic aortic valve stenosis undergoing TF-

AVI receive local anesthesia and sedation as per clinical routine. Starting from July 2011, patients were sedated with DEX (loading dose, 0.5 mcg/kg over 20 minutes, followed by infusion of 0.3–0.7 mcg/kg/min) to achieve a sedation level correlating to a Ramsay Scale of 3 or 4 at the discretion of the attending anesthesiologist. Results of DEX group were compared to the LA group from our registry without DEX treatment. Data are mean ± SD. Groups were compared by Students t-test and chi-square test (alpha set at 5%).

Result

The first consecutive 120 patients undergoing procedural sedation with DEX for TF-AVI were analyzed. Results were compared to the other 226 LA cases from the registry without DEX treatment. No patient was excluded from the analysis. Patient's baseline characteristics are shown in Table 1. Mean DEX induction dose was 53 ± 42 micrograms, cumulative dose 122 ± 66 micrograms. Anesthesia management and outcomes are summarized in Table 2.

Conclusions

Procedural sedation with DEX for transfemoral aortic valve implantation (TF-AVI) is feasible and safe. Procedural outcomes do not differ between sedation regimes with DEX and alternatives. After TF-AVI with DEX-sedation, 95% of patients are fit for a step-down unit immediately at the end of the procedure.

Table 1: Patients baseline characteristics.

	DEX (n=120)	No DEX (n=226)	p-value
Age, years	82±5.8	83±4.4	n.s.
Male, n, (%)	27 (44)	84 (36)	n.s.
BMI, kg*m^2	26.2±5.1	26.1±4.9	n.s.
AVA, cm^2	0.6±0.28	0.6±0.33	n.s.
LVEF, %	52±15	53±15	n.s.
Log Euroscore, %	24±14	23±14	n.s.

Table 2: Management and outcomes.

Sedation	% (n)	Vaso-pressor	Convers LA → GA	Mortality intra-proc.	Extubat. post-proc.	ICU post-proc.
DEX	35% (120)	63% (75)	5% (6)	1% (1)	95% (114)	8% (10)
No DEX	65% (226)	65% (146)	7% (16)	1.3% (3)	96% (217)	8.4% (19)
p-value	-	n.s.	n.s.	n.s.	n.s.	n.s.

Remote ischemic preconditioning influences the protein expression of Connexin 43 in the rat heart in vivo

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Background and goal

Remote ischemic preconditioning (RIPC) protects the heart from ischemia and reperfusion injury (I/R). The underlying molecular mechanisms are unclear. Connexin 43 (Cx43) mediates cardioprotection during ischemic preconditioning (IPC) [1]. In the present study we investigated the influence of RIPC on the expression of Cx43 after ischemia and reperfusion in the rat heart in vivo.

Materials and Methods

Animals were treated in compliance with institutional and national guidelines. Anesthetized Wistar rats were thoracotomized and a snare occluder was passed around a major branch of the left coronary artery. In total we performed two experimental series. Series 1: Animals were randomized into 4 groups (n = 6 each): 1) I/R (35 min regional myocardial ischemia followed by 2 h reperfusion), 2) RIPC (4 cycles of 5 minutes bilateral hind limb ischemia and reperfusion), 3) RIPC + I/R and 4) Sham (surgical procedure without ischemia). Subsequently the myocardium was divided into area at risk (AAR) and area not at risk (non AAR). Expression of Cx43-mRNA was detected by qPCR. Proteins were fractionated into membranous and mi-

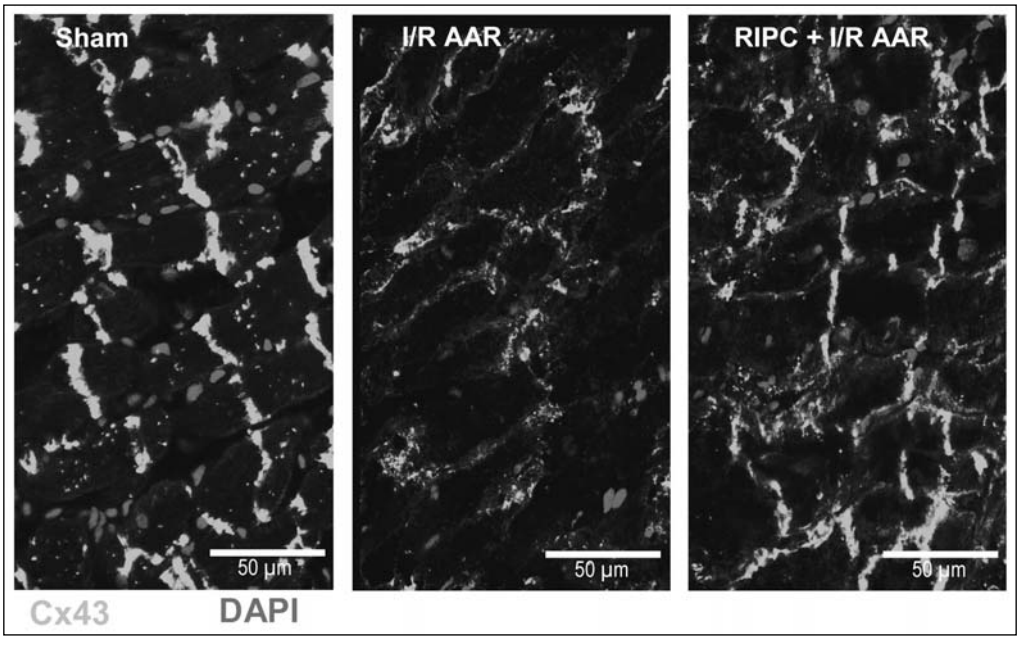

Figure 1: Immunohistochemistry: In Sham animals the Cx43 signal (red) is predominately localized at the intercalated discs (left). I/R leads to a loss of the Cx43 signal at the intercalated discs, Cx43 is translocated to the lateral membranes (middle). In the RIPC + I/R group the Cx43 signal at the intercalated discs is partly sustained (right).

tochondrial protein fractions and expression of Cx43 was measured by Western Blot analysis. Localization of Cx43 was visualized by immunohistochemistry. Series 2: Animals were randomized into 2 groups (each n = 6): I/R and RIPC + I/R. Infarct size was measured by TTC staining. Statistical analysis: Student's t-test or One-way ANOVA with Tukey post hoc test. Data are Mean ± SD, $p < 0.05$ was considered significant.

Results

RIPC reduced the infarct size (I/R: 73 ± 5% vs. RIPC I/R: 34 ± 14%, $p < 0.05$). Expression of Cx43-mRNA was unchanged between groups. I/R caused a strong decrease of relative Cx43 protein expression in the membranous and the mitochondrial fraction of the AAR. In contrast, this decrease was partly abolished in the RIPC + I/R group ($p < 0.05$ vs. I/R). Immunohistochemistry showed that the Cx43 signal was lost at the intercalated discs in the I/R group. The Cx43 signal at the intercalated discs was partly sustained in the RIPC + I/R group (Figure 1).

Conclusion

The results demonstrate that RIPC reduces the decrease of Cx43 caused by ischemia/reperfusion in the rat heart in vivo. RIPC seems to influence Cx43 expression on a posttranscriptional level. Preservation of Cx43 protein expression especially at the intercalated discs after RIPC might protect the rat heart in vivo.

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Active patient warming can reduce postoperative complications after interventional aortic valve replacement

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Introduction

Clinical studies have demonstrated that regulation of body temperature is impaired during general anesthesia with more than 60 % of patients potentially suffering from unintended perioperative hypothermia unless active temperature management is performed (1). It has been shown that perioperative hypothermia may have a negative impact on postoperative outcome (1,2). High requirements have to be met by such a warming system during valve surgery because any negative influence on imaging quality has to be avoided. Due to the relatively short intervention time, most clinics do not use any active warming system. We suppose that use of the LMA PerfecTemp™ warming system may improve postoperative outcome in patients undergoing interventional valve replacement.

Objective

The study aimed to investigate whether use of the LMA PerfecTemp™ warming system during interventional aortic valve replacement can prevent hypothermia and whether this would be associated with a reduction in postoperative complications.

Methods

After approval by the local ethics commission, 40 patients undergoing elective interventional transfemoral aortic valve replacement were included in this study. Patients were randomized into 2 groups, one group using LMA PerfecTemp™ warming system, while the control group remained without any active warming. Body temperature was measured intravesical at the time of anesthesia induction and at the end of surgical intervention. Primary endpoint was the temperature at the end of intervention. Secondary endpoints were post-interventional complication rates and intensive care unit (ITS) and hospital length of stay. The data are presented as median (25th percentile – 75th percentile).

Results

Each group consisted of 20 patients. There were no significant differences in basic characteristics (age, BMI, duration of surgery) and temperature at start of anesthesia induction between intervention group and control group (37.3°C; 36.6-37.6°C vs. 37.1°C; 36.8-37.4°C; p = 0.41) (Table 1). At the end of intervention there was a significant difference in body temperature between the groups (36.9°C; 36.5-37.2°C in the intervention group vs. 36.3°C; 35.9-36.9°C in the control group; p = 0.02) (Figure 1). Absolute body temperature decline between both groups was statistically significant (intervention group vs. control group (0.4°C; 0.1-0.6°C vs. 0.6°C; 0.4-1.1°C; p < 0,01) (Figure 2). There was no significant difference in ITS and hospital length of stay, however, ventilation time was prolonged in the

Table 1: Basic patient characteristics.

	Interventionsgruppe (n=20)			Kontrollgruppe (n=20)			p-Wert
	Median	Perzentile 25	Perzentile 75	Median	Perzentile 25	Perzentile 75	
Alter (Jahre)	82,5	74,8	85,0	81,0	70,8	87,5	0,758
BMI (kg/m²)	26,4	22,3	30,4	27,0	25,7	31,4	0,369
Interventionsdauer (h)	62,5	55,0	90,0	77,5	65,0	98,8	0,242
Krankenhausbehandlungsdauer(d)	11,0	7,0	14,3	11,0	7,0	14,0	0,940

Table 2: Postoperative outcome

		Interventionsgruppe (n=20)		Kontrollgruppe (n=20)		p-Wert
		Häufigkeit	Prozent	Häufigkeit	Prozent	
Komplikationen postop.	Ja	15	75,0	19	95,0	0,077
	Nein	5	25,0	1	5,0	
Infektionen postop.	Ja	8	40,0	14	70,0	0,057
	Nein	12	60,0	6	30,0	
Nachbeatmung postop.	Ja	5	25,0	11	55,0	0,053
	Nein	15	75,0	9	45,0	
Delir postop.	Ja	0		4	20,0	**0.035**
	Nein	20	100,0	16	80,0	

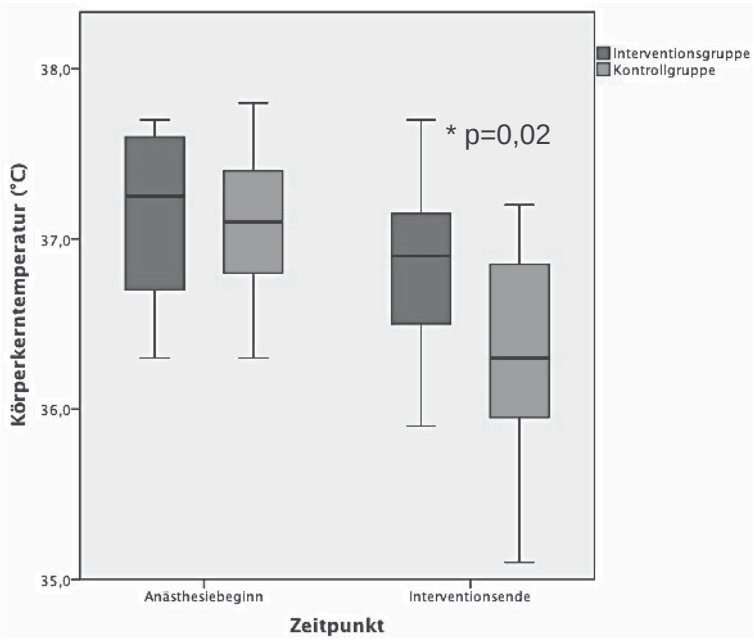

Figure 1

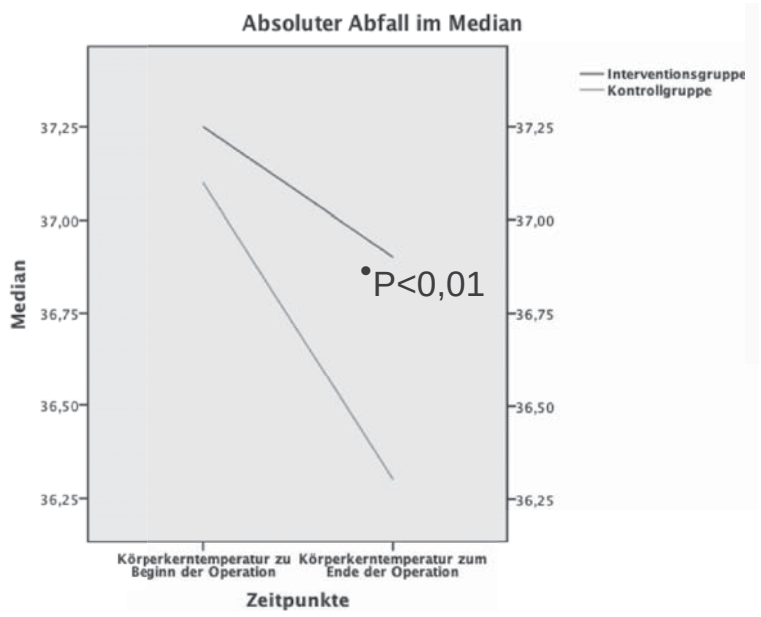

Figure 2

control group (15h; 0-164h vs. 0h; 0-23 h; p = 0.05), without reaching statistical significance (Table 2). We were able to demonstrate a trend towards higher post-interventional infection rates in the control group as compared to the intervention group (intervention group vs. control group: 8/20 vs. 14/20; p = 0,06). Prevalence of post-interventional delirium was significantly increased in the control group (0/20 (0%) vs. 4/20 (10%); p = 0.04) (Table 2). Follow-up at 6 months revealed a median survival rate of 90% in the intervention group and 70% in the control group (p = 0.11).

Conclusion

The most important result of this study was a reduction in the prevalence of delirium in patients with active warming during interventional transfemoral aortic valve replacement to prevent post-interventional hypothermia. Despite the relatively short anesthesia time, there was a clear temperature loss in patients without any active warming. Larger studies could possibly show that active warming not only prevents hypothermia but may also have a positive impact on postoperative complications and duration of ventilation and may as well promote long-term patient survival.

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Real-Time 3D TEE – A tool for experts only? A multi-center comparison for mitral valve evaluation

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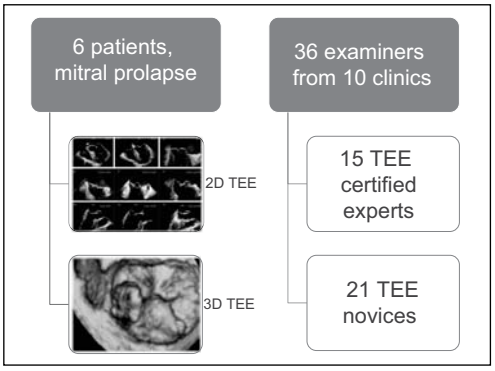
Study



Starting Situation

- Introduction of Real-Time 3D TEE Sept. 2007
- Studies have demonstrated advantages of 3D TEE versus 2D TEE in the evaluation of mitral valves.

Previous studies:
- Only 1-2 examiners
- Only experts
  Reproducibility is not demonstrated.

Hypotheses

1) 3D TEE is superior to 2D TEE in the diagnosis of prolapse
2) TEE novices profit from 3D TEE due to easy orientation

Results

Score for comparison of both study groups, experts vs. novices:

	experts	novices	Δ exp. vs. novices	p
prolapse 2D TE	28.3 [27.6,29.0]	23.0 [22.2,23.8]	14.8% [11.9,17.8]	<0.001
prolapse 3D TE	30.2 [29.2,31.2]	29.7 [29.0,30.5]	1.4% [-1.9,4.6]	0.410

Data are mean values with corresponding 95% confidence intervals.
Percentages represent the relative proportion of maximum score of 36 points.

Measure of reproducibility: Multi-Rater Kappa-Coefficient (κ)

	experts	novices
prolapse 2D TE	κ=0.58	κ=0.53
prolapse 3D TE	κ=0.65	κ=0.66

Limitation of the Study

We have only compared the results, however, we have not compared acquisition of the TEE loops!

Conclusion

- Results of 2D and of 3D TEE are reproducible.
- Results of 3D TEE are more reliably reproducible than 2D TEE.
- Expert examiners provide significantly better evaluations of mitral prolapses using 2D TEE method.
- Novices can outweigh this deficit by using 3D TEE images.

Highlighting within the cardio-thoracic area the input of palliative care in existential distress situations

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Background

In an acute life threatening situation the physician may not identify or take into consideration the full subjective perception of the event and the existential distress for the patient and family.

Objective

The challenge in an acute situation is to secure all the necessary emergency measures without neglecting to take into account the subjective needs of the patient and his family. The aim of this study was to highlight the difficulties but also the opportunities that may arise during a life-threatening journey.

Method

Documentation of 2 clinical cases:
- the acute medical problem
- the treatment options
- the final outcomes that were achieved.

Cases

Case n° 1:
53 year old lady with instable angina pectoris awaiting emergency coronary bypass operation after an unsuccessful stenting attempt. Her main personal concern was to inform her husband that the dinner was in the oven on his return home. The lady had a total intravenous anaesthetic with Sufentanil and Midazolam as an induction dose which normally would induce a retrograde amnesia. Many months later she recognized the anaesthetist in an accidental meeting in a crowded lift. She recognized his eyes despite the fact that he was in full surgical attire at the moment of their first and unique meeting. The fact that the anaesthetist took a few minutes to listen to her before the operation was paramount for her in regaining self-confidence and accept the surgical treatment with inner peace into a safe outcome.

Case n° 2:
57 year old lady with a background of COPD, heavy smoker, short history of increasing breathlessness, neck pain and unsteadiness on her feet. She had respiratory arrest shortly after hospital admission, successful resuscitation, intubation and ventilation. She was diagnosed with an invasive neuro-endocrine tumour in the right thoracic area compressing the trachea and invading the spine. A decision was made to involve Specialist Palliative Care because it was recognized in ICU as an end of life situation. Long and intense meetings were held with her husband and 7 children (aged from 14 to 32 years) while within the extended family circle there were major family events occurring (birth and death). A collective decision was made to allow the lady to die in the presence of her immediate family after stopping the assisted ventilation. After 50 minutes of spontaneous breathing under the cover of intravenous medication the lady died. The family used this last day of her life to accompany her in her dying process and to journey alongside her with all their different personal coping strategies. At the same time it was necessary for the health care professionals to make their own transitions.

Conclusion

These two cases show how unexpected skills within existing resources could help to improve the outcome for the patient in the first case and for the patient, her family and the involved health care professionals in the second case. While recognizing the importance of acute medicine in the cardio-thoracic area the input of palliative care should always be considered.

Protection against coagulopathy and inflammation during extracorporeal circulation and hypothermia – short-acting P2Y12 blockade as novel pharmacological strategy

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Abstract

Extracorporeal circulation (ECC) and hypothermia are routinely employed in cardiac surgery to establish stable circulatory parameters and to increase the ischemia tolerance of organs. However, ECC and hypothermia cause activation, interaction, and dysfunction of platelets and leukocytes possibly followed by a devastating coagulopathy and inflammation (1). The platelet ADP receptor P_2Y_{12} plays a crucial role in platelet activation. Taking into account that ECC and hypothermia incrase ADP levels (2,3), we hypothesize that ADP plays a key role in activation processes during ECC.

Recent data of our working group (4) indicate that during *in vitro* and *in vivo* hypothermic ECC (pig model) the short-acting P_2Y_{12} blocker cangrelor ($t½ < 5$ min) inhibits activation and aggregation of platelets, proinflammatory platelet-granulocyte binding, and platelet loss. Due to cangrelor's short half-life, its platelet-inhibiting action can be very well controlled, which potentially reduces bleeding complications.

These data highlight that ADP is a key player in actication processes during ECC. As a consequence short-acting blockade of the platelet ADP receptor P_2Y_{12} has the potential to reduce complications associated with ECC and hypothermia. Further studies should follow to evaluate the potential of this new pharmacological strategy under clinical conditions.

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Dynamic indices of mitral valve function using perioperative three-dimensional transesophageal echocardiography

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Introduction

More than 2 million people or 1.7 % of the United States population suffer from moderate to severe mitral regurgitation (MR) [1]. Non-functional, organic (usually degenerative) MR is the most common reason for mitral valve (MV) surgery and the criteria for surgical correction are relatively well established. The decision on when and how to intervene on functional (usually ischemic) MR remains controversial [2] and is complicated by the degree of ventricular remodeling. Complex repairs have proven promising for select patients [3]. While MV repair is most often preferred over MV replacement, 7 to 10% of all patients undergoing repair will require re-operation within 10 years [1]. There is a clear need for improved understanding of mitral valve anatomy in order to decide when and how to best intervene on a dysfunctional mitral valve.

Two-dimensional transesophageal echocardiography (TEE) represents a standard modality for evaluation of the MV during repair surgery [4]. Three-dimensional (3D) TEE has improved the description of complex MV anatomy, but quantitative analysis has mostly been limited to static approaches of one single frame. Tracking of dynamic changes using 3D imaging permits novel assessment of morphologic and functional characteristics of the MV over time.

Hypothesis

Here we sought to quantitatively compare the dynamic and 3D MV characteristics obtained from intraoperative 3D-TEE examinations in four different groups: Normal MVs, degenerative MVs prior to repair, degenerative MVs following mitral ring annuloplasty, and functional regurgitant MVs. We hypothesized that the mechanistic characteristics of the MV apparatus would be reflected in a distinctly different dynamic profile of the separate categories when comparing the following dynamic and 3D parameters: 3D annulus area, annular displacement distance, annular displacement velocity, and annular area fraction.

Methods

Following Institutional Review Board approval, we retrospectively analyzed 80 datasets of cardiac surgery patients who underwent a comprehensive intraoperative TEE exam with 3D-TEE images of the MV. 20 patients had degenerative MR and were analyzed prior to and following MV repair. 20 patients had functional MR (FMR), and 20 patients had no MV disease. Analysis of the MV was performed using 3D MV quantification software (Fig. 1, 4D MV assessment™ 2.0, TomTec Imaging Systems, Unterschleissheim, Germany).

Results

Baseline characteristics of the studied patients are outlined in table 1 and a summary of the measurements of MV indices is depicted in table 2. Figure 2 summarizes the primary outcome variables: MV annulus area was enlarged in degenerative and FMR when compared to normal and repaired valves. Annular displacement distance was decreased in FMR and repaired compared to normal and degenerative valves. Annular displacement velocity was decreased in FMR compared to normal and to degenerative MVs. Annular displacement velocity was al-

Table 1: Characteristics of patients (n=20 per group) studied. Mean values. Age in years. Fem (female gender), AFib (atrial fibrillation), CAD (coronary artery disease), EF (ejection fraction) in %. MR (grade of mitral regurgitation: 0=none, 1=trace, 2=mild, 3=moderate, 4=severe), NYHA New York Heart Association functional classification).

	NOR	DEG/REP	FMR
Age	57	62	64
Fem	35	50	45
AFib	0	35	15
CAD	90	10	70
EF	52	59	23
MR	0.5	3.8	3.6
NYHA	2.8	2.4	3.2

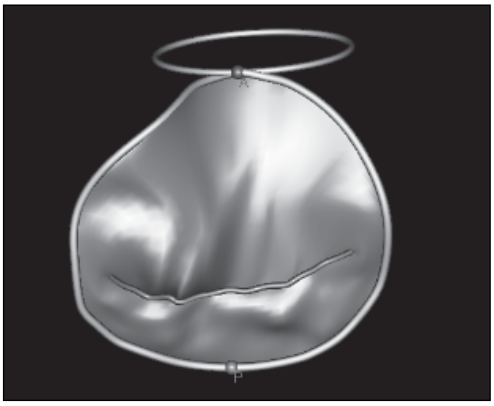

Figure 1: Image of a 3D reconstruction of a MV.

Table 2: Summary of automated measurements of MV indices. Abbreviations: AP (anteroposterior), AL (anterolateral), PM (posteromedial), AAO (aorto-mitral angle).

	Normal MV	Degenerative MR	Repaired MV	Functional MR
AP diameter (cm)	3.1	4.1	2.8	3.8
AL-PM diameter (cm)	3.4	4.3	3.4	4.2
Sphericity Index	0.9	0.9	0.8	0.9
Non-planar angle (°)	143.1	144.7	157.9	145.1
Annulus circumference 3D (cm)	10.9	13.8	10.3	13.5
Annulus area 2D (cm^2)	8.4	13.9	7.8	13.2
Tenting volume (cm^3)	1.8	1.1	1.4	4.8
Tenting height (mm)	6.5	6.3	6.3	10.6
Commissural diameter (cm)	3.3	4.0	3.3	4.1
Anterior leaflet area (cm^2)	6.0	8.0	4.9	9.1
Posterior leaflet area (cm^2)	4.0	9.2	5.1	7.0
Anterior closure line length 2D (cm)	3.0	3.8	3.1	4.0
Anterior closure line length 3D (cm)	3.0	3.9	3.1	4.1
Posterior closure line length 2D (cm)	3.0	3.8	3.0	4.0
Posterior closure line length 3D (cm)	3.0	4.1	3.1	4.1
Angle AAO-AP (°)	121.1	123.3	131.0	131.1
Tenting volume fraction (%)	38.3	67.9	34.3	23.1

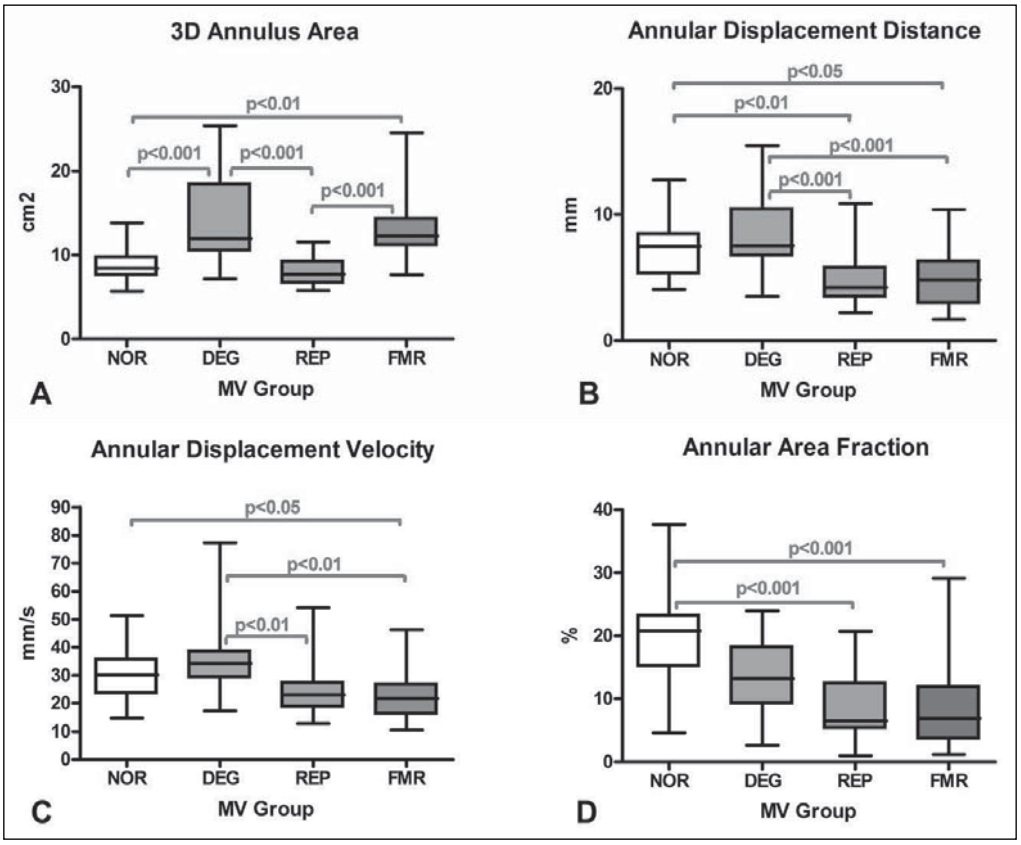

Figure 2: 3D and dynamic changes of mitral valve (MV) anatomy in normal MVs (NOR), degenerative regurgitant MVs (DEG), repaired MVs (REP), and functional regurgitant MVs (FMR) using 3D tracking software (statistical analysis of results using Kruskal-Wallis test followed by Dunn's multiple comparison test). ***A:*** *Annulus area was enlarged in DEG compared to NOR and REP and also enlarged in FMR compared to NOR and REP.* ***B:*** *Annular displacement distance was decreased in REP compared to NOR and DEG and also decreased in FMR compared to NOR and DEG.* ***C:*** *Annular displacement velocity was decreased in REP compared to DEG and also decreased in FMR compared to NOR and DEG.* ***D:*** *Annular Area Fraction was decreased in both FMR and REP compared to NOR.*

so reduced in repaired compared to degenerative MVs. Annular Area Fraction was decreased in FMR and repaired compared to normal MVs.

Discussion

This study demonstrates that normal, functional regurgitant, degenerative, and repaired MVs have distinctly different dynamic indices of MV anatomy and function as reliably determined by quantitative 3D-TEE tracking. Future studies should aim at comparing dynamic 3D-TEE quantification with other imaging modalities and assess its potential impact on surgical repair technique and patient outcomes.

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Volatile Sedatives provide spontaneous breathing in children following congenital heart surgery

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Background

Anxiolysis, analgesia, minimal impairment of organ functions and control of depth of sedation are the general goals of postoperative sedation. Especially in pediatric critical care following congenital heart surgery early spontaneous breathing is essential. Spontaneous breathing is even more important in children with Fontan circulation and with restrictive right-ventricular physiology, e.g. after tetralogy of Fallot repair.

Sedation with common sedative drugs, e.g. midazolame, ketamine and gamma-hydroxy-butyric-acid, usually in combination with opioids, frequently leads to rapid development of drug tolerance and need of excessive drug doses. Thus, spontaneous breathing is often impaired. Propofol is easy to control and wide-spread in adult postoperative care, but not licensed for long-term sedation in children younger than 16 years of age. Furthermore propofol is also not suitable for long-term sedation in children as it provides the risk of causing the potentially lethal propofol infusion syndrome.

Long-term sedation with volatile anesthetics is also not licensed for use in children, however it has advantages compared to common sedatives: sedation depth is easy to control and development of drug tolerance and bradypnoea are less distinctive. The known disadvantages of volatile anesthetics are vasodilation and therefore hypotension, accumulation of fluoride and environmental impact.

Volatile anesthetics are applied via a syringe pump connected to a special device in the inspiratory tube of the respirator, the tidal gas concentration is measured through a sample taken from the exspiratory tube. Common volatile anesthetics used for postoperative sedation are isoflurane and sevoflurane. Relevant differences between the two gases exist in metabolism and cost, pharmacokinetic aspects are of minor importance for postoperative sedation.

Patients and methods

We retrospectively analyzed four cases of pediatric patients undergoing congenital cardiac surgery, regarding to spontaneous breathing rates and doses of sedatives. The only volatile sedative drug we used was isoflurane because of its lower impairment of organ functions and also lower costs.

Results

Four cases of children following congenital heart surgery: 1. Pulmonary valve insufficiency and sepsis with long-term mechanical ventilation after VSD repair and transannular patch, 2. Difficult sedation and impaired mechanical ventilation after Norwood procedure with postoperative low cardiac output and ECMO therapy, 3. Difficult sedation and restrictive RV physiology following tetralogy of Fallot repair and 4. Conduit-thrombosis after Fontan operation with surgical reintervention and sepsis. In all patients common sedatives were given in high doses and in combination with other sedatives and opioids. After start of volatile sedation common sedatives were withdrawn completely in three of four cases, in one case only clonidine was continued. Doses of opioids were lowered in one case, raised in two cases and unchanged in one case. Spontaneous breathing was established in each of the four cases and was followed by successful extubation. We discovered no side effects of volatile sedation.

Discussion

In two of four cases (pulmonary valve insufficiency and tetralogy of Fallot repair) the restrictive right ventricle required spontaneous breathing to reduce for afterload reduction for the right ventricle. In one case (Fontan operation) lung perfusion and thus preload of the single ventricle was dependent on spontaneous breathing. In the case following Norwood procedure early spontaneous breathing was not essential, but mechanical ventilation was heavily impaired by rapid development of drug tolerance.

In each case spontaneous breathing and successful extubation were possible after establishing volatile sedation, despite opioids were being continued and in two cases the dose was even raised. We concluded that the combination of volatile sedative drugs with opioids causes less impairment of breathing than intravenous sedatives do, especially in high doses.

Despite successful use of volatile sedatives and missing side effects in these four cases, long-term use of volatile sedation is not sufficiently examined.

Conclusion

Spontaneous breathing is essential in congenital cardiac critical care, however sometimes difficult to manage with common sedatives. Volatile sedatives have shown to be able to provide early spontaneous breathing and early weaning from mechanical ventilation. Sedation with volatile anesthetics is not licensed for long-term sedation in children and therefore has to be rated as a rescue-trial. Side effects, especially regarding to neurological and renal impairment, need to be investigated in further studies.

Mitral valve replacement (valve in ring/valve in valve) in re-do mitral surgery using transapical access: Initial experience

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Introduction and Hypothesis

Transapical Aortic Valve Replacement (TAVR) has been performed in recent years with good results (1). The usage of this approach can be extended further for mitral valve replacement in patients undergoing re-do surgery in high risk patients. We hypothesized that this procedure can be utilized in patients with similar success in high risk mitral re-do surgical patients.

Methods

After local ethical committee approval this study was performed in hybrid operating room. 16 patients with mean Logistic Euroscore of 14,6 were selected for this procedure. Patient demographics are shown in Table 1. Two patients had a combined procedure of valve in valve in mitral and aortic position. Patients underwent general anesthesia and the valve was implanted without usage of cardiopulmonary by-pass in beating heart technique using Edwards SAPIEN XT (Edwards Lifesciences, California, USA) valve. Rapid ventricular pacing was used during implantation and valve was deployed under fluoroscopic and echocardiographic guidance. Successful implantation was assessed by echocardiographic parameters using pre and postoperative data. Wilcoxon test for paired samples was used for statistical purpose.

Results

In 9 patients valve in valve whereas in 7 patients valve in ring was implanted. 1 patient with preoperative ejection fraction of 15% underwent cardiopulmonary resuscitation during implantation and could not be revived even after initiation of cardiopulmonary bypass. The post and preoperative ejection fraction and valve gradients were recorded and tabulated. No paravalvular leak was detected and an increase in valve area was seen in either group. 10 Patients could be fast tracked with a mean post anesthesia care unit stay for 90min before transferring to high dependency unit. Average length of stay in ICU was 7,5 days in the ICU group. Average length of hospital stay was 18 days in the ICU group.

Conclusions

Our results have shown satisfactory outcome in patients undergoing re-do mitral surgery in high-risk group. Both methods (valve in ring and valve in valve) have promising results although a larger patient population is required to establish the safety and efficacy of the procedure for long term results.

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Safety of thoracic peridural anesthesia in adult cardiac surgery – Results of a retrospective analysis of 2398 patients

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Introduction

Thoracic peridural anesthesia (PDA) in cardiac surgery is attributed a range of potential advantages, e. g. optimized postoperative analgesia, reduced ventilation time, improved postoperative lung function, reduced stress reaction and cardio-protective effects. On the other hand, PDA is associated with the risk of epidural bleeding with ensuing hematoma and persistent neurological damage as well as risk of epidural abscess. There are only few studies available, with small patient numbers, and the available data are heterogenous.

Objective

It was our aim to evaluate safety of PDA in cardiac surgery patients with anticoagulation and use of extracorporeal circulation.

Methods

- retrospective analysis
- study period: 1997 until 2010
- N = 2398, cardiac surgery patients: male 74.8% (n= 1793), female 25.2% (n=605)
- median age: 65.9 ± 9.6 years

- elective planned surgeries with full heparinization (400 IE/kg KG; activated clotting time > 400s) with use of heart lung machine:
  - coronary bypass surgeries 71% (n = 1698),
  - cardiac valve surgeries 14% (n = 335),
  - combinated surgeries 12% (n = 286),
  - others 3% (n = 79).

Anesthesia protocol

All patients included in this study underwent perioperative peridural catheter (PDC) placement at C7/T1 or T1/T2 awake and in sitting posture, using pending drop method and combination anesthesia with intubation narcosis.

Basic narcosis was maintained by intravenous disoprivan infusion (4-6 mg/kg/h) and ropivacain-sufentanil infusion via PDC at a dose of 5 ml/h ropivacain 0.2 % with 0.5 –1 µg/ml sufentanil.

In the postoperative period, patient-controlled analgesia (PCA) was performed via continuous ropivacain-sufentanil infusion until third postoperative day. Furthermore, the patient could administer himself via a PCA pump 2ml boli, as needed, with a blocking interval of 20 minutes. In addition, all patients were given oral doses of paracetamol every 6 to 8 hours.

During the entire period of PDA and PCA administration, a standardized protocol sheet record was taken care of by our Acute Pain Service during their daily pain consultations.

Results

In the 2398 patients registered, we did not observe any epidural hematoma, any persistent neurologic damage nor any epidural abscess.

Complications

- *Perforation of Dura mater 1.1% (n = 27).* In 17 cases (0.7%) a de novo PDC placement was performed at another site after documented puncture failure. In 10 cases (0.4%) leakage of liquor via PDC occurred inspite of unproblematic de novo PDC placement. In these 10 cases, no test dosage was given and PDK was removed postoperatively after control of coagulation. In these 27 cases, no postdural punction headache was documented after primary dura perforation.
- *Accidental high spinal anesthesia: 0.3% (n = 8).* Of these, 4 cases referred to documented preceding perforation of Dura mater. In another 4 cases, it was not possible to clearly document the reason for the signs of total spinal anesthesia.
- *Respiratory complications: 0.04% (n = 1).* We observed respiratory insufficiency after loading dose of PDA in one patient.
- *Vaso-vagal reaction: 0.25% (n = 6).* Vasovagal reaction during PDC placement was noticed in 6 patients.
- *Paresthesia: 0.34% (n = 9%).* Paresthesia during PDC placement was registered in the arms of 9 patients. In these cases, the catheter was retracted by 1 - 2 cm.

In all cases, with the above mentioned complications, surgery was performed as planned. Patients did not present any neurological abnormalities.

Problems during PDC placement

- *Identification of epidural space 0.25% (n = 6).* In 6 extremely obese patients, it was not possible to identify the epidural space at first. In a second attempt, PDC placement was successful.
- *Placement of peridural catheter 1.5% (n = 37).* Problems occurred during placement of peridural catheter in 37 patients. In all cases a further puncture was successful.

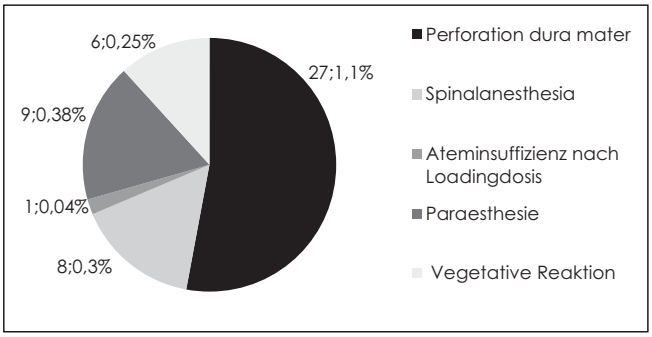

Figure 1: Complications.

- *Failure of peridural catheter placement (primary) 0.3% (n=8).* PDC was non patent, potential kinking of the catheter in the tissue. In seven cases, a new PDC could be placed successfully, in one case PDC placement was discontinued due to bleeding puncture.
- *Bleeding puncture 2.4% (n=57).* Partly, reason for bleeding is not unequivocally documented, sometimes bleeding is only subcutaneous or soft-tissue origin. In all 57 cases, surgery was performed as planned. There were no postoperative epidural hematomas.
- *Discontinuation of peridural catheter placement: 0.3% (n=8),* of these, bleeding puncture in 7 patients and lack of reaction after application of loading dose in one patient. In these cases, total intravenous anesthesia was performed.

Conclusion

This retrospective analysis of thoracic PDA in cardiac surgery patients demonstrates that this method, in compliance with prevailing standards, is a safe anesthesiologic method. There were no severe complications and the surgical interventions could be performed as planned.

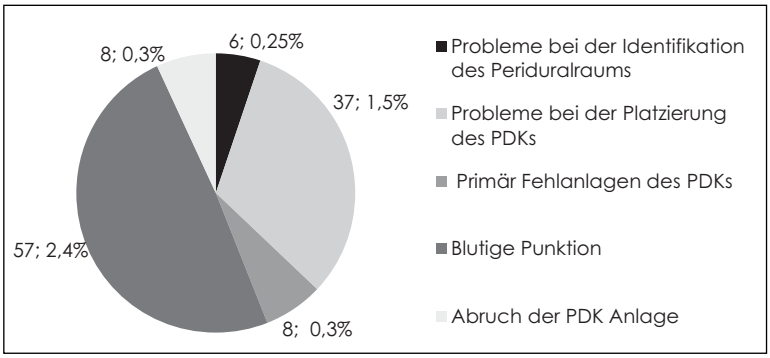

Figure 2: Problems during PDC placement

Growth differentiation factor 15 versus soluble fms-like tyrosine kinase 1 and human placental growth factor: New "troponins" for cardiac surgery-associated acute kidney injury?

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Objective

Early diagnosis of cardiac surgery-associated acute kidney injury (CSA-AKI) is a prerequisite for investigating potential treatments aimed at modulating or reversing the renal insult occurring in this setting. The clinical usefulness and reliability of available markers for this indication is controversial.

Placental growth factor (PlGF) and Soluble – fms-like tyrosine kinase (sFLT-1) are established plasmatic markers for preeclampsia – a clinical syndrome often associated with renal dysfunction (1). Data from a recent pilot study (2) suggest that the ratio between SFLT-1 and PlGF may be used for the early detection of CSA-AKI. Growth differentiation factor 15 (GDF-15) is emerging as a humoral marker for risk stratification in cardiovascular disease (3). The present study aims to further elucidate the role of the sFLT-1/PlGF ratio and GDF-15 for predicting CSA-AKI in patients undergoing cardiac surgery.

Methods

445 consecutive patients scheduled for on-pump cardiac surgery were studied during a prospective observational study. The ratio between plasma sFLT-1 and PlGF as well as plasma levels of GDF-15 (electrochemiluminescence immunoassays "ECLIA" on Elecsys 2010; Roche Diagnostics, Germany) were determined immediately before induction of anesthesia, at the end of surgery, and on the morning of the first to third postoperative day. Patients were grouped according to the Acute kidney injury network (creatinine) criteria.

Results

GDF-15 increased significantly from baseline with a peak on the first postoperative day. Patients fulfilling any AKI criterium had significantly higher GDF-15 levels throughout the observation period (figure 1a.). This effect was especially pronounced in AKI patients needing renal replacement therapy (RRT; Figure 2).

The FLT-1/PlGF ratio showed a moderate increase throughout the observation period. Only minor between group differences could be observed between patients with preserved renal function and AKI patients (figures 1b and 2b).

The AUC for detecting the need for new RRT immediately after surgery (Figure 3) was 0.796 ((0.749 to 0.838), p = 0.0006) for GDF-15 and 0.552 (0.497 to 0.606) for sFLT/PlGF.

Conclusions

The promising findings of our pilot study, that the immediate postoperative sFLT-1/PlGF-ratio can be used to predict CSA-AKI could not be confirmed in this larger patient population. However, these data suggest that the GDF-15 is a promising marker for AKI in patients undergoing cardiac surgery, related to the severity of AKI, and allows rapid detection of severe AKI necessitating RRT in the early postoperative course. Further studies will have to determine the predictive capacity of this peptide for CSA-AKI in comparison with other markers currently investigated as "renal troponins", i.e. neutrophil-gelatinase associated lipocalin and kidney injury molecule -1.

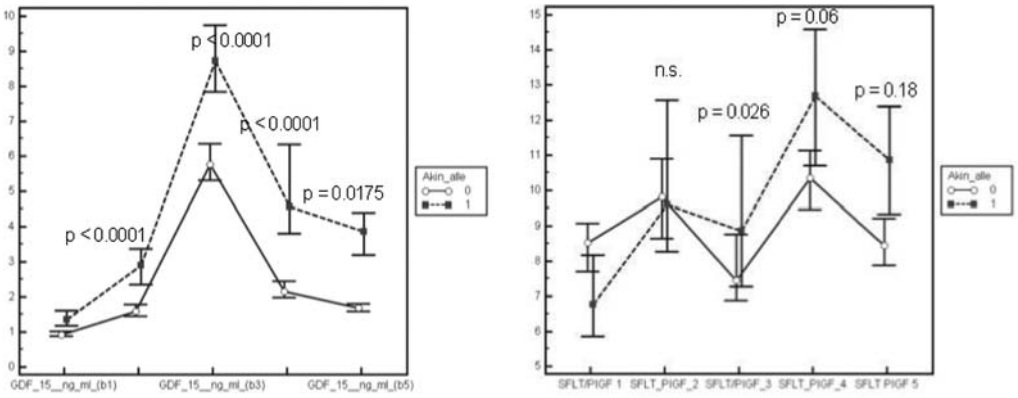

Figure 1: Time course of the GDF-15 and the ratio between sFLT-1 and PIGF in patients undergoing on-pump cardiac surgery with postoperative Acute Kidney Injury (1a: GDF-15; 1b: sFLT-1/PIGF) (red lines) or in patients without postoperative kidney dysfunction (blue lines). Friedman's test followed by Mann-Whitney test. (n.s. = non-significant).

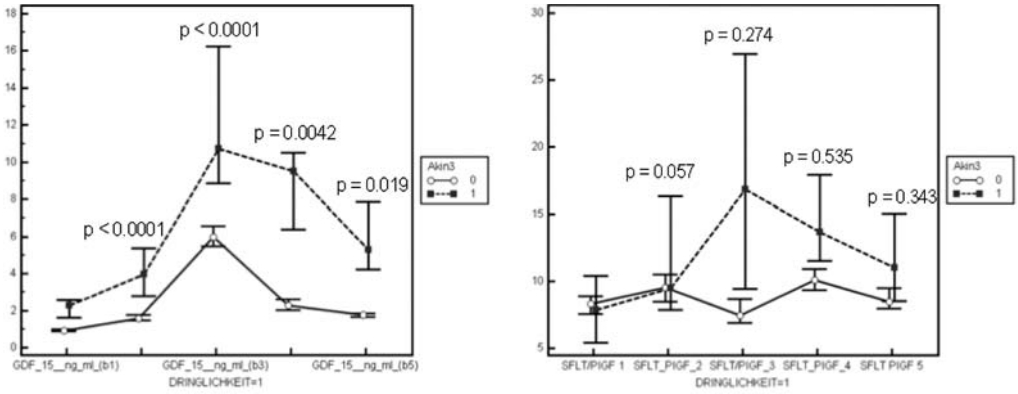

Figure 2: Time course of the GDF-15 and the ratio between sFLT-1 and PIGF in patients undergoing on-pump cardiac surgery with postoperative RRT (2a: GDF-15; 2b: sFLT-1/PIGF) (red lines) or in patients without postoperative RTT (blue lines). Friedman's test followed by Mann-Whitney test.

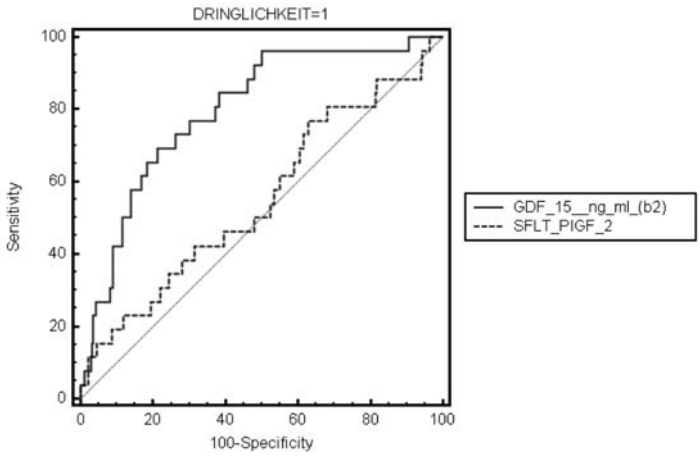

Figure 3:
ROC curves analysis of the immediate postoperative values of GDF-15 and sFLT/PIGF to detect renal failure with the need of RRT (blue line GDF-15, red line sFLT-1/PIGF).

Acknowledgement

Supported by Roche Diagnostics, Mannheim, Germany.

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Preoperative treatment with levosimendan ameliorates cardiac-surgery associated acute kidney injury and high-risk cardiac surgical patients – A matched pairs analysis.

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Background

Levosimendan (LVS), a calcium-sensitizing inotrope capable of ameliorating myocardial ischemia – reperfusion injury [1], is increasingly used in patients undergoing cardiac surgery. The effects of LVS on clinical outcomes are controversial [2,3]. Acute kidney injury (AKI) is a frequent complication in cardiac surgical patients and has been associated with a poor short- and long term prognosis [4]. Few data are available about the effects of perioperative treatment with LVS on the incidence of cardiac surgery associated-AKI (CSA-AKI). With respect to the fact that from April,1st 2009 to December, 31st 2009 almost all patients undergoing cardiac surgery at the University of Lübeck were enrolled in a prospective observational trial analyzing the association between preoperative cerebral oxygen saturation and postoperative organ dysfunction we choose to use this database also to determine the effects of perioperative, and especially of preoperative treatment with LVS on general outcomes and the incidence of the CSA-AKI.

Methods

Following approval of amendment 5 to the primary request (reference number: 07-146) by the local ethical committee we specifically searched for patients treated pre- and/or perioperatively with levosimendan. One patient was omitted from the analysis due to preoperative endstage kidney disease, leaving 51 treated with LVS. Using a matched-pairs approach, non-LVS treated patients with comparable risk factors and surgical procedures patients were derived from the cardiac surgery quality register and used as control group (n = 51). Patients in the LVS group were treated with 12.5 mg levosimendan (without a bolus) applied within 24h. Postoperative renal dysfunction was quantified according to the Acute-Kidney-Injury (AKI) network criteria.

Results

Median age was 68 (57/75) years, median additive Euroscore was 9 (7/11). With the exception of higher preoperative NTproBNP levels, a lower LVEF in the LVS group, and

more patients with a history of myocardial infarction in the control group, baseline demographics, surgical procedures and surgical core parameters were highly comparable between both groups. In 20 patients LVS treatment was started the day before surgery; in the other patients, LVS was either started during surgery or on the ICU.

No significant differences in intra- and postoperative hemodynamics were observed. Patients in the LVS group were more frequently treated with dobutamine and vasopressin and less frequently with PDE-III inhibitors and low dose noradrenaline.

No significant differences were observed in the duration of ICU treatment, hospital length of stay, and major non-renal morbidity. Thirty day and 1-year mortality were 9.8% vs. 17.7% and 19.6 vs. 29.4% (p = n.s.) in the LVS and control group, respectively.

In the total cohort, 45.1% of patients in the LVS and 64.7% of patients in the control group fulfilled any of the AKI criteria (p = 0.07). Duration of renal replacement therapy (RRT) was shorter in the LVS than in the control group (85 (66/177) h vs. 195 (93/383) h; p = 0.05).

Patients treated preoperatively with LVS showed significantly less renal dysfunction (any AKI: LVS: 25%; control: 75% p = 0.004) and a significantly shorter duration of RRT (74 (65/139) h vs. 214 (170/244) h; p = 0.027).

Conclusion

Taking into account the limitations of a retrospective matched control approach, the results of the present study suggest that preoperative treatment with LVS in high risk cardiac surgical patients ameliorates cardiac surgery associated acute kidney injury.

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Intraoperative cerebral tissue oxygenation and postoperative cognitive dysfunction after on- and off-pump coronary artery bypass surgery – a randomized study

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Background

The incidence of postoperative cognitive dysfunction (POCD) after cardiac surgery is up to 65% at hospital discharge. (1) For a long time it was assumed that POCD is caused by impaired cerebral tissue oxygenation (cSO_2) due to the physiological alterations associated with cardiopulmonary by-

pass (CPB). A recent study showed that preoperative cSO_2 and reactivity to O_2-administration predicted outcome after on-pump coronary artery bypass grafting (CABG). (2) Other (non-randomized) studies have shown correlations between the severity and duration of brain tissue desaturation and POCD during on- and off-pump CABG. (3,4)

Objectives

Our study aimed to compare the depth as well as duration of cerebral tissue desaturations during on- and off-pump CABG, and relate this to the incidence of POCD.

Materials & Methods

In this ethical committee approved, clinical trial 60 patients undergoing elective CABG under standardized anesthesia (mean age of 63 [SD 9.4]) were randomized to either the on- or off-pump procedure. Primary endpoint was area under the cSO_2 curve $< 40\%$ of > 600sec.%, calculated as shown in figure 1 with X = 40%. cSO_2 was measured continuously from preinduction of anesthesia until end of surgery with Invos 5100 (Covidien) cerebral oximeters. O_2-reactivity was assessed by calculating the difference between baseline cSO_2 measurement (room air) and cSO_2 after administration of 100% O_2 for 5 minutes. A validated cognitive testing battery (CogState) comprising 4 tests was used to assess cognitive performance preoperatively and 4 days and 3 months after surgery. POCD was defined as a decline in performance of > 2 SD in ≥ 2 tests or a composite z-score of > 2.

Results

In one patient, who was randomized to on-pump surgery, the operating surgeon decided nonetheless to operate off-pump. The data from this patient were thus excluded from the analyses, resulting in 29 on-pump and 30 off-pump procedures. Baseline characteristics were similar in both study groups. There was no difference in major complications, nor duration of ICU and hospital admission. The primary endpoint occurred in only 3 patients, of whom 1 patient developed postoperative stroke. Other commonly used cut-off values for cerebral desaturation showed no difference in AUC (table 1). The incidence of early postoperative cognitive dysfunction (POCD) 4 days postoperatively was the same in on- and off-pump patients. Late POCD (after 3 months) was significantly more prevalent in on-pump operated patients (table 2). Baseline cSO_2 was not predictive of early or late POCD, nor was there any predictive value of O_2-reactivity.

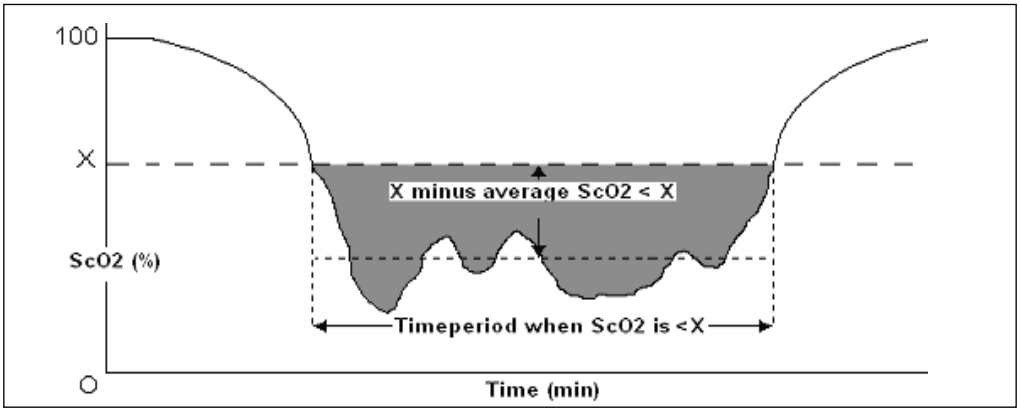

*Figure 1: X = Cut-off value for desaturation. AUC < X% ScO_2 is calculated by [average decrease of ScO_2 below X in %] * [time period when ScO_2 is <X in min].*

Table 1

	On-pump (N=29)	Off-pump (N=30)	p
AUC cSO_2 <60% (%·min)	638 (925) [0 – 3397]	511 (682) [0 – 2178]	0.55
AUC cSO_2 >20% decrease from baseline (%·min)	70.3 (140) [0 – 559.8]	51.7 (118) [0 – 439.2]	0.59

Data are mean (SD) [range]

Table 2

	On-pump (N=29)	**Off-pump (N=30)**	**p**
Early POCD (4 days postoperatively)	12 (41%)	14 (46%)	0.80
Late POCD (3 months postoperatively)	9 (32%)	2 (7%)	0.02

Data are number (%)

Conclusions

This randomized trial showed no difference in the incidence of intraoperative cerebral desaturation and early POCD between patients undergoing on-pump and off-pump CABG. At 3 months postoperatively, the incidence of POCD had declined significantly more in off-pump compared to on-pump patients. Although the incidence of POCD was similar to other published studies, the depth and duration of intraoperative cerebral desaturations was less severe in our study population. This suggests that factors other than cerebral oxygenation play an important pathophysiological role in the development of POCD. Factors such as inflammatory responses to stress, anesthesia and surgery should be considered. (5)

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Inhibition of inflammatory events during extracorporeal circulation: Anti-inflammatory effects of the volatile anesthetic sevoflurane

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Extracorporeal circulation (ECC) is a crucial tool for the execution of cardiac operations. However, ECC also induces a systemic inflammatory response associated with leukocyte activation and potentially life-threatening complications (1). The volatile anesthetic sevoflurane has been reported to exert anti-ischemic and anti-inflammatory effects (2,3). We therefore hypothesize that application of

sevoflurane during ECC may decrease ECC-related inflammatory events.

Recent data of our working group (4) indicate that during in vitro ECC administration of sevoflurane (2 Vol%) decreases expression of the granulocyte receptor Mac-1 (CD11b/CD18) and inhibits ECC-induced release of PMN-elastase. These data highlight that sevoflurane has the potential to decrease ECC-triggered inflammatory complications. This promising finding warrants further investigation to elucidate the exact mechanism of sevoflurane's anti-inflammatory properties and its potential benefit under clinical conditions.

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The use of venoarterial ECMO as a "Bridging to recovery" method for patients with postcardiotomy low cardiac output syndrome in a community hospital

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Objective

After acute myocardial infarction, coronary intervention or extracorporeal circulation undergoing cardiac surgery 0.3 - 1% of all patients may develop a Low Cardiac Output Syndrome (LCOS) .

Extracorporeal membrane oxygenation (ECMO) may be used to bridge such patients when myocardial recovery is expected. A high rate of complications and cumulative survival rates of 24 - 36% have been reported.

We report on 23 patients with femorofemoral ECMO after having undergone extracorporeal circulation.

Methods

From 6/2011 until 6/2012 23 of 646 patients after bypass and intractabile LCOS were treated with ECMO. Nine of them had to be resuscitated before starting ECMO. The median age was 64 $\pm$ 14 years. The SAPS II score at admission was 57, the predicted mortality was 78.8 $\pm$ 18%.

After surgical positioning ECMO was carried out via femoral arterial and venous cannulas. Inotropic agents were reduced as fast as possible and a mean arterial pressure of 55 mmHg was maintained with norepinephrine and fluids.

Table 1: Age, SAPS II-score and predicted mortality are demonstrated as median value ± standard deviation. Duration of ECMO und requirement of transfusion of survivors and non-survivors are demonstrated as median value of the 25% and 75% quartile.

parameter	all patients (23)	survivors (8)	non-survivors (15)
age (years)	64 ± 14	50 ± 12	73 ± 10
SAPS II score (points)	57 ± 21	56 ± 15	66 ± 24
predicted mortality (%)	78,8 ± 18	77,3 ± 4	89,3 ± 12,4
duration of ECMO (h)	96 (45-147)	144 (96-160)	56 (29-107)
packed red cells	33 (20-57)	36 (26-49)	33 (20-59)
fresh frozen blood plasma	30 (18-42)	25 (18-39)	31 (15-41)
packed blood platelets	4 (2-7)	4 (1,5-6)	4 (3-8)

Anticoagulation was performed with unfractionized heparin, following ACT measurement.

Weaning from ECMO was initiated not earlier than 48 h after recovery controlled by TEE and supported with levosimendan.

Results

Eight patients were weaned successfully from ECMO and survived. Three of the survivors and 6 of the non-survivors were resuscitated before starting ECMO.

The median duration (25% and 75% quartile) of ECMO was 96 h (45-147). Survivors were supported for 144 h (96-160), non-survivors for 56 h (29-107).

A median of 33 packed red cells, 30 fresh frozen blood plasma and 4 packed blood platelets were transfused.

No cerebral ischemic attacks were observed. Six patients suffered from MOV.

Renal failure and early extracorporeal continuous renal replacement therapy in survivors were completely reversible. No ischemia of the legs was observed.

One patient suffered a severe complication in the form of thrombosis of the heart and the pulmonary artery.

Conclusion

The use of ECMO for patients with LCOS after extracorporeal circulation undergoing cardiac surgery is a bridging method with acceptable survival and only moderate complications even outside of university hospitals.

Hemodynamic monitoring via hTEE®? – Case reports

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Introduction

Perioperatively impaired tissue oxygenation can compromise the outcome of the patient. A major source of impaired tissue oxygenation is unsatisfactory cardiac output (CO) due to hypovolemia and/or reduced myocardial contractility. This often leads to systemic inflammatory response syndrome (SIRS) which induces further organ dysfunctions. Today, such hemodynamically unstable patients usually undergo extended monitoring to measure CO, e. g. pulmonary artery catheter (PAC) or transpulmonary thermodilution PICCO). However, this often only al-

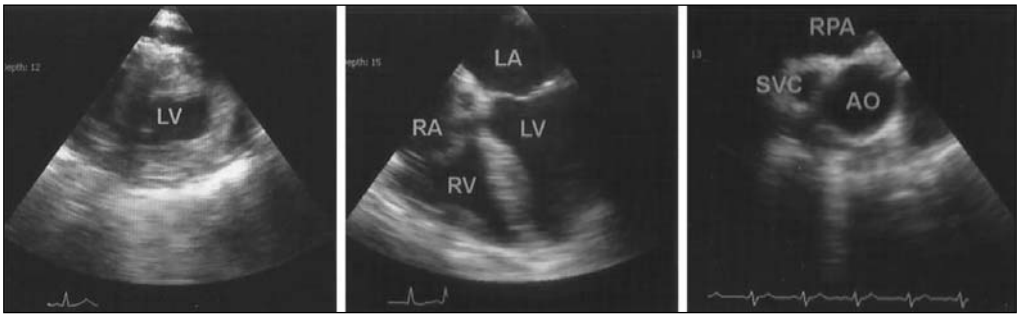

Figure 1: 3 hTEE- images: 1) Transgastric short axis view (left), 2) Mid-esophageal 4-chamber view (middle), 3) Mid-esophageal short axis view of Vena cava superior (right) (with permission of ImaCor®).

Table 1: Case reports.

	Alter (Jahre)	Geschlecht	Indikation	Schall-qualität	Einstell-bare Views	Haupt-hTEE-Befund	Therapie-Änderung	Wie	Status
1	78	W	HI bei Z.n. Perikardtamponade nach Myokardbiopsie mit CPR, bek. pHTN unklarer Genese	Gut	3 von 3	Rechtsherz-Versagen	JA	NO-Versuch	Tod
2	70	M	HI nach Akut-4-fach CABG	Ausreichend	3 von 3	Hypovolämie und Perikarderguss → Tamponade	JA	Volumen → RE-OP	VL
3	85	M	HI nach CABG bei bek. Linksherzinsuffizienz, IABP in situ	Gut	3 von 3	Hypovolämie → Linksherzversagen	JA	Volumen → Levosimendan	VL
4	64	W	HI bei Z.n. Bio-MKE bei MS	Ausreichend	3 von 3	Neue Akinesie inferior sowie eingeschränkte RV-Funktion (V.a. Plegieschaden RCA), zudem Hämatom im RA-Dach mit Kompression der VCS (a.e. ausgehend von einer Blutung im Bereich des Aortenanulus)	JA	Levosimendan, NO, Diskussion RE-OP → unter Therapie Erholung der RV-Funktion, Hämatom im Verlauf nicht progredient Multiplane TEE	ITS
5	78	M	HI nach CABG bei bek. Linksherzinsuffizienz, PAK in situ	Gut	3 von 3	Hypovolämie → eingeschränkte LV- Funktion → TAA-bedingte REA, Ausschluss neue reg. WBS → Hypovolämie	JA	Volumen, Austausch Dobutamin gegen Adrenalin	VL

lows to diagnose impairment of CO. In order to find the source of CO impairment, we now have the possibility to perform a hemodynamic focused transesophageal echocardiography (hTEE) by means of a miniaturized monoplane probe (ClariTEE® Ima-Cor). This probe allows to obtain the 3 major images to make precise distinctions between several cardial pathologies. The probe is inserted orally via the oesophagus and can remain in the patient for up to 72 hours. This also allows continuous monitoring of the patient. Reports of first experiences (Poster presentation at ESCIM 2012, Geisen et al. and Merz et al.) reveal that, in order to perform such a focused examination, a 6-hour training programme may be sufficient for unexperienced practitioners, anesthesists or intensive care specialists in order to be able to use this method successfully. However, it has not yet been determined, whether use of continuous hemodynamic focused transesophageal echocardiography will be beneficial for the patient's postoperative outcome. (Royse et al., Anesth Analg, November 2012; 115: 1007-1028).

Conclusion

In the above mentioned cases, we performed postoperatively, after a cardiac surgery intervention, continuous monitoring via hTEE in hemodynamically instable patients. After a 4 to 6-hours training (including simulator training) even echocardiography novices were able to obtain 3 hTEE images with at least satisfying quality. Furthermore, in each single case hTEE yielded clinically relevant results leading to immediate changes of the previously established therapies. Thus, this method seems to be clinically feasible. Nevertheless there is still a lack of larger studies investigating commonly used clinical methods (e.g. PAK, PICCO) in order to assess influence of hTEE on outcome.

High ACT levels after CPB in paediatric heart surgery do not indicate remaining Heparin in paediatric patients

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Introduction

The exact dose of Protaminchlorid (PCl) to antagonize Heparin after CPB is unknown and point of care testing in children has its weakness. We want to proof, if Activated Clotting Time (ACT) indicates a sufficient antagonization of Heparin by Protamin after Cardiopulmonary bypass (CPB). Therefore, we aimed to investigate the anticoagulation/coagulation course by evaluation the levels of anti-Xa , ACT and Fibrinogen during and after the CPB.

Patients and Methods

A total of 28 children (n = 14 < 5 kg body weight (bw) and n = 14 >5 < 10 kg (bw)) suffering from congenital heart disease who underwent open heart surgery were included. The blood sampling schedule is demonstrated in Fig.1.

Before CPB 400 IE/kg Heparin was administered. No further Heparin beside 2000 IE in pump prime volume was given during CPB procedure until neutralization by Protaminchloride (PCl) after the end of CPB. Heparin neutralization by PCl was performed approx. 100 % based on the applied total i.v. Heparin

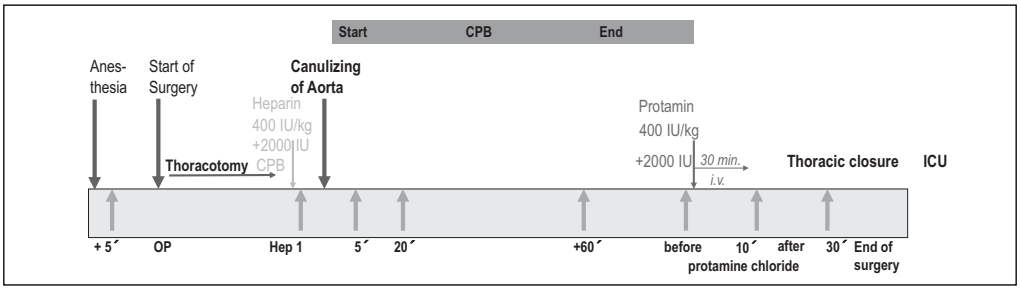


Figure 1: Perioperative heparin treatment and blood sampling schedule.

Table 1: ACT (sec.).

	N	MW	SD	Min	Max	Percentile			p
						25	50 Median	75	
ACT1	28	128,89	16,37	108,00	195,00	119,50	126,50	134,50	,765
ACT2	26	499,12	128,19	334,00	999,00	426,00	458,50	559,00	,000
ACT3	28	737,21	228,95	410,00	999,00	526,50	712,00	999,00	,014
ACT4	28	745,29	193,65	459,00	999,00	578,50	730,50	999,00	,013
ACT5	24	720,29	190,55	507,00	999,00	562,00	644,00	948,50	,001
ACT6	27	582,85	195,28	381,00	999,00	463,00	489,00	684,00	,000
ACT7	28	177,14	28,73	140,00	237,00	156,00	167,50	192,50	,105
ACT8	26	182,00	30,09	136,00	253,00	157,00	180,50	200,00	,469

Table 2: aXa (IU/ml).

	N	MW	SD	Min	Max	Percentile			p
						25	50 Median	75	
aXa1	28	,07	,06	,00	,25	,01	,06	,09	,005
aXa2	27	10,04	1,84	6,30	13,60	8,80	9,80	11,60	,679
aXa3	27	8,32	1,73	6,10	12,60	7,10	8,10	8,80	,004
aXa4	27	8,25	1,92	5,40	12,60	7,00	7,70	9,70	,088
aXa5	24	7,07	1,95	3,70	11,30	5,70	7,15	8,10	,822
aXa6	28	5,70	2,14	1,90	11,60	4,15	5,55	7,40	,193
aXa7	27	,06	,09	,00	,38	,00	,02	,09	,000
aXa8	28	,06	,06	,00	,29	,00	,06	,09	,000

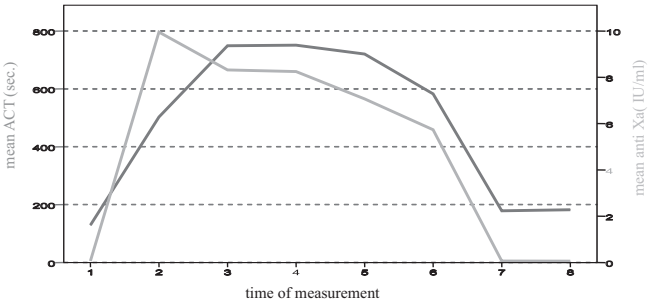
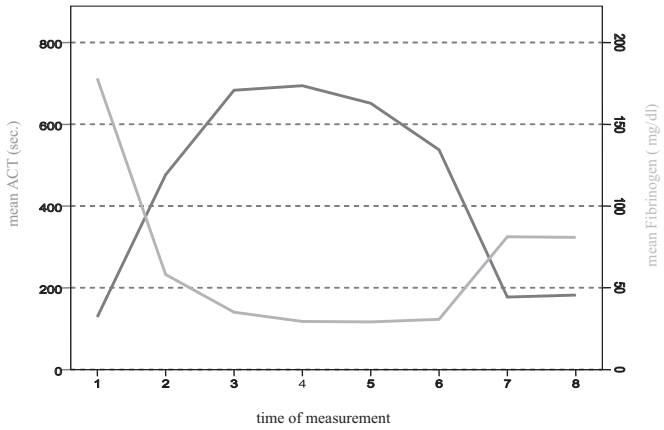


Table 3: Fibrinogen (mg/dl).

	N	MW	SD	Min	Max	Percentile			p
						25	50 Median	75	
Fgn1	28	178,00	45,92	45,00	307,00	158,50	175,50	205,00	,421
Fgn2	7	58,14	22,95	22,00	92,00	39,00	58,00	74,00	,877
Fgn3	17	35,12	26,36	21,00	129,00	24,00	27,00	30,00	,005
Fgn4	15	29,47	11,20	20,00	67,00	24,00	27,00	30,00	,005
Fgn5	14	29,14	10,46	21,00	64,00	24,00	28,00	29,00	,004
Fgn6	19	30,21	11,11	21,00	71,00	22,00	30,00	34,00	,012
Fgn7	28	81,18	27,23	54,00	191,00	67,00	72,00	90,50	,026
Fgn8	28	80,32	26,74	49,00	175,00	65,50	74,00	86,00	,030



and CPB prime volume dose. Neither Platelets, Fresh Frozen Plasma (FFP) nor other anticoagulation factors were administered during and after CPB. Heparin levels were measured by anti Xa assay. ACT and Fibrinogen were also examined and correlated with ACT. All patients underwent modified Ultrafiltration (MUF) after weaning from CPB.

Results

The Heparin course during heart surgery is given in Table 2. After Heparin is antagonized by PCl, there is no relevant amount of Heparin measured but ACT still remains high (Table 1).

The course of Fibrinogen is demonstrated in Table 3. The levels of Fibrinogen measured in mg/dl are low on CPB and increased slightly after MUF but remain low.

Conclusions

High ACT levels after Heparin antagonization with Protaminchlorid after heart surgery do not indicate remaining Heparin in these patients. The level of ACT after CPB and MUF is negatively correlated with the amount of Fibrinogen. Our study shows, that high ACTs after Heparin antagonization indicate low levels of Fibrinogen.