

## **Effect of Fenoldopam and Dopexamine on peri-operative renal function following CABG - a prospective randomised case control study**

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### **Background**

Peri-operative acute renal failure following coronary artery bypass grafting affects the outcome [1]. Fenoldopam a new DA-1 receptor analog has been shown to increase renal blood flow when used in low doses [2]. We hypothesised that use of Fenoldopam may preserve the renal function following coronary artery bypass grafting and have compared this with dopexamine, another dopamine analog.

### **Methods**

We examined the effects of Fenoldopam and dopexamine on hemodynamic parameters, Creatinine clearance, urine output in 30 consecutive patients with good left ventricular function coming forward for either elective or urgent CABG. Patients were randomly assigned to receive continuous infusions of Fenoldopam (F) 0.2ug/kg/min (n=10), Dopexamine (DX) 2ug/kg/min (n=10) and placebo (normal saline-NS) (n=10) for the first 24 hours following CABG. Haemodynamic parameters were measured in the peri-operative period. Urine output, fluid balance, requirement for inotropes were measured for the first 24 hours. Creatinine was measured pre op and on post op days 0,1,2 and 4. Creatinine clearance was calculated using the Cockcroft –Gault equation. Chi square test was used for categorical data and independent students t test and ANOVA were used for comparing outcomes between groups.

### **Results**

The three groups were comparable for pre operative variables. There was a significant increase in heart rate following commencement of infusion in DX and F groups (p=0.04 and 0.017), however it was not associated with a rise in blood pressure. The bypass and cross clamp times were not significantly different between groups. The 24-hour urine output and fluid requirement was not different between groups (p=0.76). The change in serum creatinine levels and creatinine clearance between groups was not significantly different although in the DX group the creatinine clearance decreased and came back to about pre op levels before discharge. The need for metaraminol for the F group during CPB was significantly higher (average dose was 4.8mg, 1.8mg, 2.5mg in F, NS, DX groups). One patient in the NS group had elevated creatinine but none of the patients required hemofiltration.

### **Conclusions**

Routine administration of low dose dopexamine and Fenoldopam infusions in patients undergoing first time coronary artery bypass surgery would not alter the rise in serum creatinine levels and does not alter the incidence of renal impairment. However Fenoldopam has similar effects like other Dopamine analogs in increasing heart rate. Patients on Fenoldopam needed more vasoconstrictors suggesting the significant vasodilatory effect of the drug. Further studies are needed to quantify the hemodynamic effects of Fenoldopam.

### **References**

1. Eagle KA, Guyton RA *et al.* ACC/AHA 2004 Guideline Update for Coronary Artery Bypass Graft Surgery. *Circulation* 2004. e341-e438.
2. Mathur VS, Swan SK, Lambrecht LJ, Anjum S, Fellmann J, McGuire D, Epstein M, Luther RR. The effects of Fenoldopam, a selective dopamine receptor agonist, on systemic and renal hemodynamics in normotensive subjects. *Crit Care Med* 1999. 27(9):1832-7.

## National survey of antibiotic prophylaxis in cardiac surgery

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The objective was to characterise national and regional patterns of antibiotic prophylaxis in adult cardiac surgery across UK and Ireland.

### Methods

Information was sought from 39 adult cardiac centres.

### Results

Response rate was 82%. Single agent prophylaxis is used in 38% of centres. 68% centres prescribed antibiotics for 24 hours. 90% centres administered one dose at induction. However in 2 centres another dose of antibiotics is administered before skin closure and in 1 centre gentamicin 80 mg is administered pre CPB. 4 institutions use a different protocol for valvular surgery. In 70% centres the protocol has not changed in the last 6 to 10 years. For re-sternotomy, 59% centres administered the same antibiotic as the initial operation.

### Discussion

Despite the large number of prospective, randomised, controlled clinical studies, no single regimen has emerged successful in preventing postoperative infections. According to the 1999 American College of Cardiology guidelines, a 24-hour duration is as efficacious as a prolonged regime. We compared our main results with two previous national surveys performed in Great Britain in 1993[1] and in Canada in 2002[2].

Survey	Parry, Britain 1993	Paradiso-Hardy, Canada 2002	Our Survey, Britain 2005
Single agent	32%	97%	38%
Duration	89% reported at <48 hours	43% for 24 hours 82% for 48 hours	68% for 24 hours 21% for 48 hours
Different Protocol for valves	17%	12%	12%

**Table 1**

The Canadian survey revealed a practice of supplementing a dose intraoperatively if surgery lasted > 4 hours in 60% centres. In our survey 2 centres (6%) supplemented another dose towards the end of surgery irrespective of duration of surgery.

### Conclusion

Our results are strikingly similar to the 1993 survey and surprisingly different with respect to the Canadian survey in 2002. In our opinion a consensus needs to be reached and clear guidelines need to be published on antibiotic prophylaxis in cardiac surgery in UK.

### References

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2. Paradiso-Hardy FL. A national survey of antimicrobial prophylaxis in adult cardiac surgery across Canada. *Can J Infect Dis* 2002; 13(1): 21-27

## A National Audit of Temperature Management in Cardiac Surgery

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There has been much debate in recent literature about the optimum cardiopulmonary bypass temperature [1]. There is a wide variety in practise between hospitals and individual surgeons.

### Methods

A total of 298 questionnaires asking about temperature management were sent by post to all ACTA linkmen in the United Kingdom for circulation to each consultant cardiothoracic anaesthetist in the hospital.

### Results

We had returns from 79% of hospitals and received a total of 148 replies from individual cardiac anaesthetists (48%). The majority (96%) measured temperature in the nasopharynx. The commonest site for a second temperature measurement was the skin surface (26%) with a small number of respondents measuring temperature in additional sites. The temperatures that patients are cooled to are shown in table 1 by percentage.

The maximum temperature, if set, on the cardiopulmonary bypass arterial inflow blood during rewarming varied widely from 36 degrees to 40 degrees. The target rewarming temperature of the patient was most commonly 37-37.9 degrees (60%) with 91% of the respondents measuring this temperature in the nasopharynx.

**Table 1**

	<28 C	28-31.9 C	>32 C
<b>CABG</b>	<b>1</b>	<b>12</b>	<b>87</b>
<b>Valve surgery</b>	<b>2</b>	<b>57</b>	<b>41</b>
<b>Root Surgery</b>	<b>54</b>	<b>38</b>	<b>8</b>

### Discussion

Even though nasopharyngeal temperature has been shown to be 3-4 degrees lower than jugular bulb and arterial inflow temperatures on rewarming [2] it remains the standard site for temperature measurement. There is more variation in cooling temperatures for valve and root surgery than CABG surgery perhaps reflecting the increasing levels of off pump work. It is claimed that periods of hyperthermia may be responsible for neuropsychological dysfunction [1] however 4% of respondents rewarm patients to over 38 degrees and 61% to over 37 degrees.

In summary there is a larger variation in national practise for cooling and rewarming cardiac patients, reflecting the lack of conclusive evidence for temperature management either way in cardiac surgery

### References

- 1 Shaaban A, Harmer M, Kirkham F. *Cardiopulmonary bypass temperature and brain function* 2005; **60**:365-372
- 2 Grocott HP, Newman MF, Croughwell ND, White WD, Lowry E, Reves JG. Continuous jugular venous versus nasopharyngeal temperature monitoring during hypothermic cardiopulmonary bypass for cardiac surgery. *Journal of Clinical Anesthesia* 1997; **9**: 312-6.

## **A national audit of the use of muscle relaxants in cardiac anaesthesia**

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Residual neuromuscular blockade contributes to post-operative morbidity and mortality, and is more prevalent with long-acting non-depolarising muscle relaxants (NDMRs) such as pancuronium [1]. With increasingly short times between the end of surgery and extubation, residual neuromuscular blockade in cardiac patients is known to occur, particularly when long-acting NDMRs are used [2,3]. To examine and attempt to influence clinical practice in this respect, we performed an audit of muscle relaxant use in the United Kingdom between 2002 and 2004.

### **Method**

Postal questionnaires were sent to 310 consultant cardiac anaesthetists in the UK in 2002. We asked which NDMRs are preferred for 'fast-track' (FT) and 'non-fast-track' (NFT) cases, and what methods are used to assess neuromuscular function. The results of this survey were published [4], and also circulated by post to the same 310 anaesthetists during 2003 together with evidence regarding residual neuromuscular blockade in these patients. The survey was repeated in 2004, and the results compared with those obtained in 2002.

### **Results**

The response rates were 73% in 2002 and 61% in 2004; 50% of the original group of 310 answered both questionnaires, resulting in a matched responder group of 155. There has been a significant move away from pancuronium to shorter acting NDMRs in the matched group during the two-year period, both for FT anaesthesia (from 45% to 37%,  $P=0.024$ ) and NFT anaesthesia (from 64% to 54%,  $P=0.007$ ). There has also been a significant increase in assessment of neuromuscular function before extubation (as part of a protocol), from 19% to 34% ( $P=0.0015$ ). However, there has been no change in *objective* measurement of neuromuscular function before extubation or in theatre.

### **Discussion**

During the audit period there has been a significant move away from longer-acting NDMRs, and a significant increase in monitoring of neuromuscular function before extubation. However, the number of individuals monitoring neuromuscular function at any time in theatre or ITU remains low, despite guidelines [5] that this is best practice.

### **References**

- 1 Berg H, Roed J, Viby-Mogensen J, et al. Residual neuromuscular blockade is a risk factor for postoperative pulmonary complications. A prospective, randomised, and blinded study of postoperative pulmonary complications after atracurium, vecuronium and pancuronium. *Acta Anaesthesiol Scand* 1997; 41:1095-103.
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- 3 Van Oldenbeek C, Knowles P, Harper NJN. Residual neuromuscular block caused by pancuronium after cardiac surgery. *British Journal of Anaesthesia* 1999; 83: 338-339
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## Intraoperative transoesophageal echocardiography: a prospective review of impact on surgical management

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Intraoperative transoesophageal echocardiography (ITOE) has been shown to have a significant impact on the surgical management of cardiac surgical patients [1]. We audited the ITOE service at our hospital to assess its impact on the surgical management of our cardiac surgery patients.

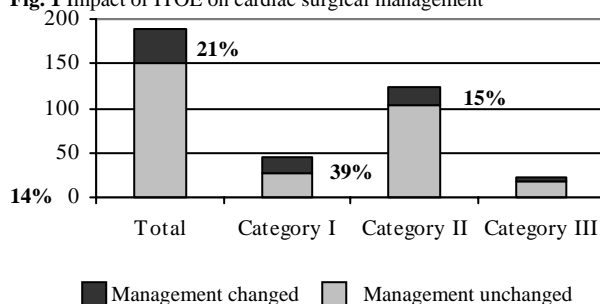
### Methods

From February to April 2005, all ITOE reports were reviewed. The listed surgical procedure and the category indication [2] for the ITOE were recorded. If the ITOE written report stated that the ITOE findings directly impacted upon clinical decision making in the operating theatre, the echocardiogram images were reviewed to confirm their impact.

### Results

Over the three month period under review, 189 ITOE examinations were performed. Written reports were found for 174 (92%) examinations. 23% were for ASCA category I indication (frequently useful eg. mitral repair, unstable haemodynamics); 65% for category II (may be useful eg. CABG); 12% for category III (infrequently useful). Surgical management was altered in 21% of cases. The proportion of ITOE's altering surgical management increased with increasing ASCA recommended ITOE indication. Pre-cardiopulmonary bypass (CPB) examinations altered management in 13% of cases and directly changed the listed surgical procedure in 10%. Post-CPB findings changed surgical management in 8% of cases.

Fig. 1 Impact of ITOE on cardiac surgical management



### Discussion

The large impact (21%) ITOE has on surgical management reinforces its use in the cardiac surgical patient. Due to the significant level of impact for category II and III indications, we recommend routine use of ITOE in these cases. The high incidence of significant new findings may reflect varying standards of preoperative investigation due to lack of resources in referring hospitals. The complexity of workload and the small numbers may also contribute.

### References

1. Click RL et al *Intraoperative transesophageal echocardiography: 5-year prospective review of impact on surgical management* Mayo Clin Proc 2000; **75**: 241-7
2. Thys DM et al. *Practice guidelines for perioperative transesophageal echocardiography* Anesthesiology 1996; **84**: 986-1006

## **Factors Predicting Length of Intensive Care Stay and Impact of Intensive Care Stay on Long-Term Survival Following Coronary Artery Bypass Surgery**

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Despite the increased costs for patients with a more protracted ICU stay, their long-term survival is largely unknown. This study aims to identify pre-operative risk factors that are associated with longer ventilation and ICU stay and to assess the effect of ICU stay on long term survival

### **Methods**

A cohort of consecutive patients undergoing first time coronary artery bypass grafting(CABG) between Jan-1994 and Jan-1996 were studied. Patients were censored for survival to Feb-2005. Factors predicting length-of-stay on the intensive care unit were analysed using univariate analysis. Correlation between length of ICU stay and long-term survival was analysed using Cox regression.

### **Results**

1180 patients were analysed. Mean duration of ventilation was 7.3hrs(Range 0.8-634hours). Length of ICU stays varied widely (mean 2.36 days, median 2.00days, range 2 hours-65days). Age(P<0.001), BMI(P<0.01), diabetes(P<0.001), operative priority(P<0.001), length of cardiopulmonary bypass(P<0.001), left ventricular function(P<0.001) and pre-operative intra-aortic balloon pump(P<0.001) were independent predictors of length of intensive care stay. EuroScore was an independent predictor of duration of ICU stay(P<0.001), but not length of ventilation(P<0.27). The EuroScore significantly correlated with both 30-day mortality and long-term survival(P<0.001). Overall survival was 74.0% at time of censoring. Patients with ICU stay less than 1 day had an 82% 10-year survival, 2-3 days 73% 10-year survival and >7 days a 27% 10 year survival.

### **Conclusion**

This study shows that prolonged ICU stay significantly impairs long term survival. We also found that the Euroscore not only predicts 30-day mortality but also ICU stay and long term prognosis.

**The effects of high thoracic epidural on glycaemic control and insulin requirement after on-pump coronary artery bypass surgery.**

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**Introduction**

Hyperglycaemia and insulin resistance are common after cardiac surgery even in patients without diabetes <sup>1</sup> Glycaemic control with intensive insulin therapy has been associated with better outcome. Thoracic epidural blockade can abolish the stress response, but has not been shown to improve postoperative glycaemic control <sup>2</sup>.

**Methods**

We studied retrospectively two patient groups who had undergone on-pump coronary artery bypass surgery during the calendar year 2004. 50 patients had a high thoracic epidural catheter sited immediately prior to surgery and were given a postoperative infusion of 0.15% bupivacaine with 2 µg.ml<sup>-1</sup> of fentanyl. 50 patients had conventional moderate dose fentanyl anaesthesia with postoperative morphine analgesia. Blood glucose level and insulin infusion rate was recorded every 3 hours for 24 hours postoperatively.

**Results are shown in the Table**

13 patients were excluded from each group because they were either on adrenaline infusion or were diabetic.

	Epidural group	Fentanyl group
Insulin required	14(37.8%)	33(89.1%)
No insulin	23(62.1%)	4(10.8%)
Mean blood glucose (SD)[95% CI]	7.71(0.82) [7.47-7.94]	8.33(1.23) [7.98-8.68]

Blood glucose levels were slightly significantly, lower in the epidural group. The number of patients requiring no insulin was significantly greater in the Epidural group with 23 patients as compared to Fentanyl group 4 patients; p=0.000007360438 (Fisher's exact test).

**Conclusion:**

High thoracic epidural helps to provide better glycaemic control postoperatively in cardiac surgical with most patients requiring no insulin and avoiding the risk of hypoglycaemia, which is a feature in patients managed by aggressive insulin regimes. Larger studies are needed to determine if this beneficial effect leads to lower morbidity.

**References:**

1. Van den Berghe et al. Intensive insulin therapy in critically ill patients. N Engl J Med 2001; 345(19):1359-1367
2. Moore C et al. Hormonal effects of thoracic extradural analgesia for cardiac surgery. BJA 1995; 75:387-393

## The use of biocompatible surface modifying additive (SMA) circuits does not alter the plasma IL-8, IL-6 or IL-10 response within an isolated cardiopulmonary bypass (CPB) circuit

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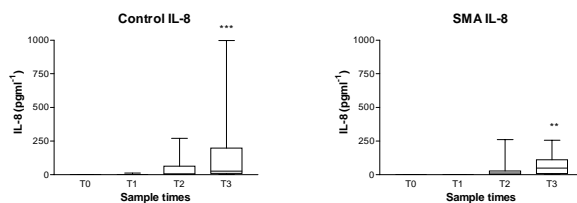
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Although SMA (biocompatible) circuits for cardiac surgery are compared with conventional circuits are associated with reduced blood loss, no *in-vivo* significant between group difference in plasma proinflammatory cytokines was observed.<sup>1</sup> Since surgical factors contribute to the peri-operative proinflammatory cytokine response we investigated the effect of SMA CPB surface technology on cytokines, in an *in-vitro* model where surgical factors are excluded.

### Methods

Two 250 ml bags of blood (SAGM anticoagulant) were collected from ten healthy volunteers, to which heparin 1050 u. alone was added. Separate bags were simultaneously added to each of two CPB circuits, identical apart from their surface treatment, one being SMA treated while the other was non-SMA. Samples were obtained as follows: T0 = at blood donation before heparinisation; T1, T2 and T3 = after 30, 60 and 90 min of identically managed isolated CPB respectively. IL-8, IL-6 and IL-10 were measured by ELISA assay.



**Figure 1.** IL-8 concentration in control and SMA circuits. Within group comparison with base line (T0) was with Friedman and Wilcoxon's Tests (\*\* P < 0.01; \*\*\* P < 0.001).

### Results

As before,<sup>2</sup> IL-8 increased within the isolated CPB system but not IL-10. Now, we report that IL-6 was not significantly elevated. There was no between group difference in cytokine concentrations.

### Discussion

This isolated CPB investigation, confirms patient studies where SMA circuits did not reduce plasma proinflammatory cytokines.<sup>1</sup>

### References

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## Metabolic acidosis during cardiopulmonary bypass: the effect of changing the priming solution from Ringer's to Hartman's.

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Previously, we noted that priming cardiopulmonary bypass (CPB) circuit with Hartman's solution resulted in a mild lactataemia that lasted into the first postoperative day.<sup>1</sup> As a result, we changed our priming solution to Ringer's. Subsequently, metabolic acidosis that develops during CPB became more pronounced and we identified this change to be associated with a decrement in the strong ion difference.<sup>2</sup> Consequently, we then reverted to using a Hartman's prime and the aim of this study was to audit the effect of this change on metabolic acidosis.

### Methods

Blood gas analyser results for all patients undergoing heart surgery for the same month in 2002 and 2003 were retrospectively examined. Arterial blood results from five minutes after starting and immediately before weaning from CPB were identified. Approximately, halfway between these time points, the priming solution was changed from Ringer's to Hartman's solution.

### Results

Even after correction for change in arterial carbon dioxide tension (PaCO<sub>2</sub>) and the amount of fluid administered, Hartman's solution was associated with a lower hydrogen ion concentration (H<sup>+</sup>) at the end of CPB than when Ringer's solution was used (p<0.001). Results are presented in Table 1 as mean and standard deviation (SD).

**Table 1**

Year	2002 n = 66 Ringer's		2003 n = 63 Hartman's	
	Mean	SD	Mean	SD
H <sup>+</sup> start (mmol l <sup>-1</sup> )	38	4	38	5
H <sup>+</sup> end (mmol l <sup>-1</sup> )	41	7	36	6
PaCO <sub>2</sub> start (kPa)	5.6	0.8	5.6	0.7
PaCO <sub>2</sub> end (kPa)	4.8	0.7	4.6	0.9
HCO <sub>3</sub> <sup>-</sup> start (mmol l <sup>-1</sup> )	26.6	2.8	26.7	3.2
HCO <sub>3</sub> <sup>-</sup> end (mmol l <sup>-1</sup> )	21.1	2.5	23.6	2.8
Base Excess start	1.8	2.7	2.1	3.2
Base Excess end	-3.5	3.0	-0.1	2.9
Fluid added (ml)	1902	1497	1598	1669

### Discussion

Using Hartman's solution for CPB promotes an alkalosis whereas Ringers solution results in an metabolic acidosis. This difference between the solutions is most likely mediated by their effects on strong ion difference.<sup>2</sup> Whether the type of solution used for CPB has any effect on outcome from heart surgery remains unresolved.

### References

1. Millar SA, Alston RP, Souter MJ, Andrews PJD. Aerobic, anaerobic and combination estimates of cerebral hypoperfusion during and after cardiac surgery *Br J Anaesth* 1999;**81**:936-9
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## **ACHIEVEMENT OF NORMAL BODY TEMPERATURE POST CARDIAC SURGERY**

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Hypothermia is commonly seen in patients admitted to ITU following surgery on cardiopulmonary bypass. Hypothermia causes many deleterious effects like increased stress response, catecholamine release, increased duration of ventilation, hospital /ITU stay and morbidity and mortality (1,2). We audited our practice looking at temperatures of patients on admission to the unit and after four hours (standards being 34°C or greater on admission to the ITU and 36°C or greater after four hours in the ITU). We also looked at influence of hypothermia on duration of ventilation and hospital /ITU stay. Exclusions were procedures performed without cardiopulmonary bypass, heart and lung transplants and ventricular assist devices.

### **Methods**

The audit included all patients having coronary artery bypass graft (CABG) and/or valve repair or replacement surgery (103 patients). The following information was collected: length of ITU stay; length of hospital stay; temperature on arrival in ITU; temperature after four hours in ITU; type of surgery; surgical risk (additive and logistic Euroscore).

Patient temperature was measured using a nasopharyngeal probe.

### **Results**

Compliance with standard one was 92%. Of the 103 patients in the study, eight were admitted to the ITU with a temperature lower than 34°C.

Compliance with standard two was 67% (60 out of 90 patients).

### **Discussion**

Patients entering the ITU with a temperature of less than 34°C had a longer hospital and ITU stay but the differences were not statistically significant. EuroScore values show that surgical risk for patients either meeting or failing the standard was similar.

Patients who failed to reach 36°C also had a longer hospital and ITU stay. The difference in ITU stay was not significant. The difference in mean hospital stay between patients meeting or failing the standard was significant. This study also reiterates the fact that 'sicker patients are indeed colder'.

### **References**

1 Steve R Insler, Michael S O'Connor, Marvin J Levinthal, David R Nelson, Norman J Starr. *Association between postoperative hypothermia and adverse outcome after coronary artery bypass surgery* Ann Thorac Surg 2000;70:175-81

2 Frank S M, Fleischer LA, Breslow MJ et al. *Perioperative maintenance of normothermia reduces the incidence of morbid cardiac events* JAMA 1997;277:1127-34

## **A national survey of the management of accidental carotid artery puncture during central venous catheter placement prior to cardiopulmonary bypass**

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Central venous cannulation is a commonly performed procedure in the hospital patient population. This procedure has significant morbidity and mortality. Accidental carotid artery puncture has a reported incidence of 2 to 8% and inadvertent dilatation and cannulation of the carotid artery is a potentially life threatening complication [1]. We are not aware of any current data regarding the incidence of this complication in the cardiac surgical population. We are also unaware of any published guidelines detailing the best management of this problem. We designed a questionnaire to assess the incidence of this complication and to ascertain whether there is any consensus regarding its management.

### **Methods**

We conducted a survey of ACTA members using the internet. A questionnaire was e-mailed to each member using the ACTA mailing list. The list contained 268 valid addresses. Each address was e-mailed a maximum of three times depending on response.

### **Results**

We received one hundred and twenty three replies giving a response rate of 46%. 89% of respondents were consultants (n = 110). 99% of respondents had placed more than one hundred central venous catheters. 12% (n = 15) reported having cannulated the carotid artery with a Swan Ganz Sheath. No respondents would cancel a case if they punctured the carotid artery with an 18g needle / cannula. 100% of respondents would apply pressure to a punctured carotid artery. When managing the accidental insertion of a Swan Ganz sheath into a carotid artery 18% would request surgical removal of the sheath under direct vision. 28% would remove the sheath, apply pressure and cancel the surgical procedure. 33% would remove the sheath, apply pressure to the artery, resite the cannula and proceed to surgery. 86% of respondents do not routinely use ultrasound to guide placement of central venous catheters.

### **Discussion**

We are not aware of any published data regarding this complication and its management in cardiac patients about to undergo cardiopulmonary bypass. Our survey targeted ACTA members who are likely to perform a proportionately large number of central venous cannulations. The results indicate that there is considerable difference of opinion as to the management of this complication. We have shown that cannulation of the carotid artery with a large bore cannula has a relatively high incidence. We have also shown that the routine use of ultrasound guidance is uncommon. Although each individual case will involve a number of considerations, this survey indicates that further study of this problem is warranted and that a set of guidelines may facilitate decision making when confronted with this potentially serious complication of central venous catheter placement.

### **References**

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