Original Article

Conscious off Pump Coronary Artery Bypass Surgery—an Audit of Our First 151 Cases

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Purpose: An audit of our first 151 cases of conscious off pump coronary artery bypass (COPCAB) surgery with epidural anesthesia as sole anesthetic.

Methods: Patients underwent conscious off pump coronary artery bypass (OPCAB) surgery using high thoracic epidural anesthesia. The epidural catheter was inserted on the day before the surgery.

Results: There were 118 male and 33 female patients. The incision was via midsternotomy except in 3 patients. Single graft was performed in 25 patients, double in 61, triple in 46, quadruple in 19. Twenty-nine patients developed pneumothorax. Three patients required conversion to general anesthesia. In one patient cardiopulmonary bypass (CPB) was instituted. There was no mortality in the group.

Conclusion: Our experience shows that conscious OPCAB surgery can be performed safely in selected patients. (Ann Thorac Cardiovasc Surg 2005; 11: 93–7)

Key words: high thoracic epidural anesthesia (TEA), off pump coronary artery bypass (OPCAB) surgery, conscious patients

Introduction

Beating heart surgery has gained popularity now and is an accepted mode of therapy in many units. Endotracheal intubation and mechanical ventilation may not be necessary in patients undergoing off pump coronary artery bypass (OPCAB) surgery. Following reports of conscious OPCAB (COPCAB) performed with thoracic epidural anesthesia (TEA),[1] we have evaluated the technique to identify the feasibility and problems. Potential benefits may include patient satisfaction and shorter intensive care duration reducing the dependency in the intensive care unit. These potential benefits must be weighed against problems such as surgical difficulty, respiratory insufficiency and urgent need for securing airway, in addition to potential problems due to TEA *per se*.

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Materials and Methods

This audit refers to our first 151 patients who underwent COPCAB under TEA between October 2001 and April 2004. Contraindications included patient refusal, infection at the local site of epidural catheterization, continued use of anti platelet medicines such as clopidogrel or aspirin, bleeding disorders, past surgery of the cervical and upper thoracic spine. There were 118 male and 33 female patients in our series. Midline sternotomy was performed in 148 patients and left anterior small thoracotomy in 3 for minimally invasive direct coronary artery bypass (CAB). Twenty-one patients underwent repeat CAB graft surgery. Other co-morbid conditions are shown in Table 1. All patients continued to take their usual medications including aspirin except for other antiplatelet medications. The preoperative medications are listed in Table 2. If heparin infusion was being administered, it was ceased for 6 hours before performing the epidural catheterization and activated partial thromboplastin time (APTT) was checked. Epidural catheterization was car-

Table 1. The demographic data and co-morbidities

Male/female	118/33
Weight (kgs)	56±12.3
Age (years)	54±9.4
Midline	148
Thoraco	3
Redo	21
Obese	31
PVD	22
DM	79
HTN	58
CVA	17
Renal failure	6
COPD	46
UA	9
AWMI	6

1) Midline = Median sternotomy
2) Thoraco = Left anterior thoracotomy
3) Redo = Repeat coronary artery surgery
4) Obese = Obesity
5) PVD = Peripheral vascular disease
6) DM = Diabetes mellitus
7) HTN = Hypertension
8) CVA = Past cerebrovascular accident
9) COPD = Chronic obstructive pulmonary disease
10) UA = Unstable angina
11) AWMI = Anterior wall myocardial infarction less than 2 months

Table 2. The preoperative medications (Total num-ber of patients-151)

Drug	N	%
Beta blockers	49	32.5
ACE inhibitors	26	17.2
Calcium channel blockers	29	19.2
Oral hypoglycemic agents	46	30.5
Insulin	42	27.8
Bronchodilators	19	12.6
Aspirin	36	23.8
Amiodarone	12	7.9
Digoxin	4	2.6
Furosamide	18	11.9

ACE inhibitors = Angiotensin converting enzyme inhibitors

ried out only if APTT was normal. If the patients were receiving low molecular weight heparin, it was stopped 12 hours before the scheduled time of epidural catheterization, and infusion of heparin was started. Infusion of heparin was stopped 6 hours prior to the procedure. The airway was assessed using the combination of Mallampati classifications combined with presence of receding chin, a short neck, protruding maxillary incisors or short thyromental distance.

Epidural anesthesia

TEA was used for all patients. The epidural catheter was inserted on the evening before surgery. The aim of the block was to produce anesthesia from the neck to the upper abdomen. An informed consent was obtained from all the patients for TEA after the risks & benefits were explained to them. A 16 gauge epidural catheter (Perifix, B Braun, Melsungen AG, Germany) was inserted through a Tuohy needle between C7 to T2 with the patient in the sitting position using a midline technique. The space was identified by loss of resistance and the catheter was inserted leaving 3-4 cms of the catheter indwelling.

On the day of surgery, the patients were pre-medicated with fentanyl 3 mcg/kg and midazolam 50 mcg/kg intra muscularly thirty minutes before surgery. Invasive monitoring included femoral arterial line and a central venous line or pulmonary artery catheter inserted under local anesthesia. 3 ml of 2% xylocaine with 1:200,000 epinephrine was administered as an epidural test dose. Epidural anesthesia was accomplished with 8-10 ml of 0.5% bupivacaine with further 3-5 ml of 0.25% bupivacaine if the block was inadequate. A naso-pharyngeal airway suitable to the patient's nasal passage was passed to maintain a patent airway. Through the naso-pharyngeal airway a 10 French naso-gastric tube was inserted. A facemask was used to supply supplemental oxygen at 5 L/min. End tidal carbon dioxide was monitored via the facemask.

Surgical technique

The surgical incision is made after checking the zone of analgesia. The sternotomy is made during the inspiratory phase of the respiration, taking care to avert injury to the pleura. If the pleura is opened unintentionally during sternotomy, we prefer to repair the pleural breach in addition to inserting an underwater seal drain. The left internal mammary artery (LIMA) is dissected at the same time radial artery is harvested by another surgeon. Whenever the saphenous vein was harvested, local anesthetic was infiltrated if required. All patients were anticoagulated with 2mg/kg of heparin and activated clotting time of 300 seconds or more was achieved. The epicardial stabilizer used for performing the distal anastomosis the Octopus®3 (Medtronic Inc, Minneapolis, MN55432-5604, USA). Dopamine was administered at the rate of 5-10 mcgs/kg/minute, to treat hypotension which was defined as reduc-

Table 3. The changes in mean hemodynamic parameters in the perioperative period

	Basal	TEA	Incise	LAD	Diag/OM	PDA	Transfer	postop
HR	72±12	76±6.8	68±7.9	64±11.7	79±8.9	92±6.3	68±4.7	70±2.3
MAP	90±12.1	82±3.9	80±5.7	79±7.8	69±12.4	71±10.1	89±7.6	92±3.2
PCWP	19±2.4	16±3.2	17±2.3	21±5.6	20±7.6	15±2.9	14±4.9	13±3.9
CVP	9±2.1	12±1.3	7±2.3	9±6.4	13±7.0	13±3.7	10±3.2	10±4.5
$ETCO_2$	30±10.8	28±10.8	26±6.7	34±12.2	32±11.9	27±11.8	25±4.7	23±12.9
SPO_2	100	100	99±0.8	100	100	100	100	100

Variables:
1) HR = Heart rate in beats per minute
2) MAP = Mean arterial pressure in mm Hg (expressed as mean)
3) PCWP = Pulmonary capillary wedge pressure in mm Hg (expressed as mean)
4) CVP= Central venous pressure
5) $ETCO_2$ = End tidal carbon dioxide in mm Hg
6) SPO_2 = Oxygen saturation in %

X-axis:
1) Basal = Basal values
2) TEA = Injection of full dose of epidural analgesics
3) Incise = Incision
4) LAD = Left anterior descending artery grafting
5) Diag/OM = Diagonal/obtuse marginal artery grafting
6) PDA = Posterior descending artery/Posterior left ventricular artery grafting
7) Transfer = Pre transfer to the intensive care unit
8) postop = Half an hour after transfer to intensive care

tion in mean arterial pressure more than 25% below baseline values. If hemodynamic stability was compromised, the heart was returned to the pericardial cradle and surgery recommenced after recovery of stable hemodynamics. Protamine sulfate was used to reverse the anticoagulation. The epidural catheter was left *in-situ* for 2-3 days. Postoperative analgesia was achieved by epidural administration of buprenorphine (1 to 2 mcg/kg) at 12 hourly intervals. Prior to removal of the epidural catheter APTT was checked. In the postoperative period, we conducted electrocardiography and estimation of cardiac enzymes twice daily, which helped detect myocardial ischemia or infarction. All the patients surveyed were satisfied with the technique. Values are expressed as mean ± standard deviation (SD).

Results

Out of a total of 151 patients, 148 underwent COPCAB. We were specifically requested by 14 patients to perform COPCAB on them. The patient profile is outlined in the Table 1. Two patients had probable difficulty in endotracheal intubation as indicated by the preoperative airway assessment, and thus were not given epidural anesthesia. Nine patients were receiving either infusion of heparin or injection of low molecular weight heparin, in these patients heparin was stopped prior to epidural catheterization. Four patients, who were receiving low molecular weight heparin, were started on infusion of heparin 12 hours ahead of schedule of epidural catheterization and were managed similar to the patients who were on heparin infusion. The patients were lightly sedated during the surgery. Diaphragmatic respiration was adequate; but one patient required assisted respiration for about 20 minutes to treat diaphragmatic paresis.

Twenty-nine patients developed pneumothorax during the operation. We used $ETCO_2$ and SaO_2 to guide the tolerance of the collapsed lung. Pneumothorax posed a technical difficulty to the operating surgeon during grafting because of the penduluft movement of the mediastinum especially in the minimally invasive direct coronary artery bypass (MIDCAB). The LIMA was used in 146 patients out of 151. One MIDCAB patient received an 'H' graft from LIMA to LAD by an interposition of the saphenous vein graft. The radial artery was used as a LIMA-radial 'Y' graft in 91 patients and as a free graft in

32 patients and the saphenous vein graft was used in 31 patients. Sixty-four patients had systemic hypotension during the grafting of the obtuse marginal (OM) artery, which was normalized by a dopamine infusion of 5 mcg/Kg/min or restoring the heart to the pericardial cradle. Thirty-seven patients became restless whenever the mean arterial pressure decreased during grafting. The hemodynamic changes noted are depicted in Table 3. One patient developed ST segment elevation followed by ventricular fibrillation during the OM grafting. Although sinus rhythm was restored with internal defibrillation, we initiated general anesthesia and mechanical ventilation and commenced CPB. Two patients developed coughing during OM grafting. In both these patients anesthesia was converted to general anesthesia with mechanical ventilation.

The duration of surgery was 174±18.4 minutes, the anastomosis time was 9.8±2.6 minutes, and the number of grafts per patient was 2.4±0.6. Blood loss in 48 hours was 267±106.5 ml. One patient required ventilatory assistance in the postoperative period because of persistent hypercapnea possibly related to opioid administration. Three patients developed perioperative myocardial ischemia, one developed inferior myocardial infarction on the day after surgery and the other two developed antero lateral ischemia on the 4th day; and did not require any further interventions.

The mean stay in the intensive care unit was 10.9±4.2 hours and the mean stay in the hospital was 3.9±3.2 days. There was no in hospital mortality. When surveyed about their experience, patients were satisfied with anesthesia. Twenty-eight patients could recall the conversations carried out on the operating table, but had no complaints about it. Fifty-four patients recalled transfer to the operating room and were unable to recall any events there after.

Discussion

Minimally invasive direct CAB surgery and OPCAB have been performed in conscious patients[1,3,4] with acceptable results. The advantages of general anesthesia are that it provides good control on ventilation, hemodynamics and allows transesophageal echocardiography. Although general anesthesia is considered safe, the use of TEA as a sole anesthetic requires evaluation. In certain situations where general anesthesia and orotracheal intubation may be relatively difficult, this technique may serve as an alternative one.[2] Our audit shows that it is a viable alternative to general anesthesia in a select group of patients.

We identified several advantages of the conscious technique. Patient satisfaction was high. Of note, patients who had previous cardiac surgery could compare the two techniques and they expressed preference for the conscious technique especially during the emergence and extubation phases. The use of TEA has advantages including excellent analgesia, dilation of coronary arteries and hemodynamic stability.[5,6] Though TEA can and is usually employed as an adjunct to general anesthesia, of interest, we found that patients frequently became irritable when the mean arterial level fell and improved with restoration of a stable hemodynamic state. The conscious patient therefore presents as an optimal “cerebral monitor” for brain hypoperfusion.

The disadvantage of this technique is the additional responsibility on meaning pneumothorax (in a spontaneously breathing patient), inability to perform transesophageal echocardiography, neurologic problems due to extradural hematoma. Some authors have expressed fears that by the use of TEA, the patient is exposed to risks, which he may not have faced under general anesthesia.[7] The main difficulties that we encountered relate to the management of pneumothorax and coughing (presumably from diaphragmatic irritation). There is a learning curve for the surgeon to deal with pneumothorax that can be overcome. Patency of the airway may be compromised in some of the patients due to the tongue falling backwards, when they are asleep, the nasopharyngeal airway helps in maintaining patent airway. While earlier in our practice we used nasopharyngeal airways in all patients, now we do only when necessary. In the initial stages we used to regularly insert a nasogastric tube, which we have dispensed with recently, because gastric distension is seen rarely in these patients. Coughing during grafting is troublesome and perhaps best treated by conversion to general anesthesia. Accordingly it is important to select patients who are unlikely to have a difficult airway, as access during surgery to the airway is less optimal than before it. We did not encounter any problems with urgent intubation. The use of TEA in cardiac surgery remains controversial despite a growing worldwide experience without neurological complications. The use of TEA is inherent in our technique and practitioners contemplating our technique must be comfortable with the risks and benefits associated with TEA use in cardiac surgery.[7,8]

Conclusion

COPCAB surgery can be safely performed in a select

group of patients.

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