Original Research Article

Awareness and sweating among patients undergoing elective cardiac surgery under hypothermic cardiopulmonary bypass

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Abstract

Background: The risk of awareness during cardiac surgery under general anaesthesia is higher than in other surgeries under general anaesthesia. Unintended awareness during a surgery causes various complications like insomnia, anxiety, depression, nightmares and post-operative stress. Rewarming of the body core towards the end of cardiopulmonary bypass (CPB) causes facial sweating that may be considered a sign of sympathetic response. The objective of this study was to investigate the rate and also the association of awareness and sweating among patients undergoing elective cardiac surgery under hypothermic CPB. **Methods:** 50 patients undergoing elective cardiac surgery under hypothermic CPB were enrolled in the study. For measuring awareness post operatively, as the temperature reached to 34°C, audiotapes with a few absurd phrases were played in the patient's language till temperature reached 37°C. Simultaneously, the patient was observed for any associated sweating in the forehead and in the rest of the face where the score was noted as nil, mild, moderate or profuse. **Results:** Among 50 patients, 8% were female and 92% were male. CPB time was in range of 51-80 minutes (42%). Around 56% patients, CPB temperature was in range of 32.1-34°C. 66% patients underwent coronary artery bypass graft surgery. 49 patients reported memory of waking up in the postoperative ICU while 1 had intraoperative recall (2% incidence of awareness). 27 patients had no sweating, 11 had mild, 6 had moderate and 6 had profuse sweating. **Conclusion:** Study showed incidence of awareness and sweating are 2% and 46% respectively. Also, the study did not find any association between sweating score and duration of CPB.

Keywords: Awareness; Anaesthesia, Cardiopulmonary Bypass; Elective cardiac surgery; Sweating.

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INTRODUCTION

The incidence of awareness reported in patients undergoing general anaesthesia is 0.1-0.2%.[1] Awareness is defined as the recall of the intraoperative events during the postoperative period, It occurs due to the imbalance in the required and administered amount of anaesthesia.[2] Awareness occurs when a patient becomes conscious during a surgical procedure under general anaesthesia and recalls events like pain, somatic sensations, noise, speech etc.[3] Awareness is a prevalent problem linked with general anaesthesia and can lead to a wide range of complications that includes insomnia, anxiety, depression, nightmares, and post-operative stress disorder.[4,5] The risk of awareness during cardiac surgery is higher than other anesthetic subspecialties.[6] The reported incidence of unintended awareness in cardiac practice ranges from less than 1% to over 20%, depending on the definition of awareness, the size of the study and the method of detection.[7] Hence,

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cardiac anesthesia was associated with a two-to tenfold higher risk of unintended awareness than that reported for the general population. Causes of unintended awareness during cardiac anesthesia may include altered pharmacokinetics during cardiopulmonary bypass (CPB) including hemodilution, changes in acid-base status, drug sequestration and hemodynamic instability needing reduction in minimum alveolar concentration (MAC) of volatile gases.[8] Further, during hypothermic CPB, the body's core temperature is regulated by convectional heat exchange in the extracorporeal circuit. Rewarming of the body core towards the end of CPB commonly causes facial sweating that may be considered a sign of sympathetic response to inadequate anesthesia in keeping with the assumption that anaesthetic agents are eliminated more quickly as patients rewarm. Facial sweating during rewarming on CPB is typical of a thermoregulatory response. Absence of sweating in patients may be due to pharmacokinetic or pharmacodynamic differences in the response to anaesthesia.[9] The depth of anesthesia is commonly assessed in clinical practice by the patient's clinical signs, and symptoms such as tachycardia, hypertension, sweating, or movements which can predict inadequate anaesthesia. Anaesthetic agents elevate the core temperature threshold that triggers intraoperative sweating and depresses the thresholds for vasoconstriction and shivering. Sweating on rewarming at the end of CPB could be a marker of light anaesthetic plane, closely associated with active cutaneous vasodilation, which can be identified by a sudden increase in skin temperature.[10] A previous cross-sectional survey conducted by Rashad Siddiqi et al.[11] in Pakistan reported an overall frequency of awareness as 5% in patients who received propofol infusion during CPB compared to the patients who did not administer with propofol. Also, Stone et al.[12] demonstrated changes in temperatures measured at various standard monitoring sites during profound hypothermic CPB conducted for repair of cerebral aneurysms. The rate and the association of sweating and awareness at the end of cardiopulmonary has not been documented from developing countries, especially India. The present study is aimed to investigate the incidence of sweating and awareness and the association between the two during rewarming among patients undergoing elective cardiac surgery under hypothermic cardiopulmonary bypass.

MATERIALS AND METHODS

Ethics: This observational study was conducted in the Tertiary Care Hospital after the Institutional human ethics committee approval. The present study was conducted from July 2014 to August 2014.

Study design: Fifty patients undergoing elective cardiac surgery under hypothermic cardiopulmonary bypass were recruited. Informed written consent was obtained from all the participants. The inclusion criterion was patients age 18-70 years, from both sexes having no history of other diseases. Exclusion criteria were patients with hearing loss, psychiatric illness, neurological deficit, speech impairment and re-exploration cases.

Methodology: All patients were premedicated with tablet diazepam 10 mg at night and in the morning of the Day of surgery. In addition, coronary artery bypass graft (CABG) patients were also given atenolol based on the left ventricular function. If the ejection fraction was more than 25% and less than 25% these patients were given 50 mg and 25 mg atenolol respectively. On arrival in the operation room routine monitoring for cardiovascular anaesthesia was instituted. Standard base line parameters heart rate, automated non-invasive arterial blood pressure, pulse oximetry, five lead ECG with ST analysis were monitored before induction. All patients were preoxygenated with 100 % oxygen for 3 minutes and anaesthesia was induced with intravenous administration of morphine sulphate 0.15mg/kg + midazolam hydrochloride 0.05mg/kg and 3 mg/kg of thiopentone sodium. Skeletal muscle paralysis was achieved with a bolus of pancuronium bromide (0.15mg/kg) and tracheal intubation was accomplished with appropriate sized endotracheal tube. The standard baseline parameters that were measured post induction were end tidal carbon dioxide; invasive arterial blood pressure, central venous line, nasopharyngeal temperature probe, and agent to monitor and measure the end tidal isoflurane (maintained at 1.2%) and urinary catheter. Anaesthesia was maintained with a mixture of humidified oxygen nitrous oxide (2:1) and a volatile agent isoflurane at 1.2%. Boluses of morphine sulphate 0.15mg/kg and midazolam hydrochloride 0.05mg/kg were repeated pre-bypass and also during rewarming. All patients were mechanically ventilated using a semi closed circle absorber and a hanging bellows-in bottle type of anaesthesia ventilator (ascending type). A bolus of vecuronium bromide 0.08mg/kg was given during rewarming. An end tidal carbon dioxide of 28 - 35mmHg and pulse oximeter saturation greater than 97% was maintained at all times. Patients were heparinised at a dose of 400 units/kg body weight. Activated clotting time (ACT) was confirmed to be more than 400 seconds. Aorta was cannulated, de-aired and connected to the cardiopulmonary bypass machine. Venous cannula / cannulae were connected to the venous reservoir. Vents were prepared as required. After confirming ACT, line pressures, no air bubbles in the arterial side and measuring the urine output, patient was put on cardiopulmonary bypass (CPB) as and when the surgeon was ready. Immediately after the commencement of CPB, the venous return, the line pressures, the efficacy of cardiotomy suckers and the temperature to which the

patient had to be cooled was reconfirmed with the surgeon and the perfusionist. During CPB the following parameters were monitored at the commencement and every thirty minutes while on bypass. Pupillary size, arterial blood gases (ABG) and arterial pressure (maintained between 50 to 90 mmHg), packed cell volume (maintained above 30%), potassium (maintained between 4 and 5 mEq/L), ACT (more than 400 seconds), urine output and blood sugar in diabetics. Cardioplegia was repeated every 20 minutes as required. Rewarming was started depending on the progress in surgery as per surgical requirements. As and when the rewarming was started, IV anesthetics like morphine sulphate 0.15mg/kg, midazolam hydrochloride 0.05mg/kg and nondepolarizing muscle relaxant vecuronium bromide 0.08mg/kg were administered. When the temperature reached 34°C audiotapes with a few absurd phrases (Table 1) were played in the patient's own language till the temperature reached 37°C. Simultaneously, the patient was observed for any associated sweating in the forehead and rest of the face. The sweating score was noted as nil, mild, moderate or profuse as given in Table 2. Patient was weaned off CPB when the following criteria were satisfied. Normal arterial blood gases and serum potassium, PCV (> 25%), snuggers on the venous line were off, nasopharyngeal temperature was 37°C, ventilator was on and the lungs were inflating and all bleeding points checked monitors recalibrated, pleural space emptied, fibrillator off, urine output satisfactory and the availability of blood confirmed, ECG pattern remaining same as compared to pre-bypass period, pulse and wires availability confirmed and inotropes and vasodilators kept ready. Anticoagulation was reversed with protamine in the post bypass period. Chest was closed after securing hemostasis. Patient was monitored in the intensive care unit and electively ventilated overnight following which patient was extubated when the standard extubation criteria were satisfied. All the patients were interviewed after 48 hours postoperatively, regarding memory of intraoperative events and the following questionnaire was put forward as given in Table 3. Similarly, Postoperatively the same audiotapes as given in Table 1 was replayed for the patient and was asked whether he/she had any recall of the same. A review of anesthetist's charts and perfusionists chart helped to record dosage of drugs employed to maintain anesthesia, cardiopulmonary bypass time and aortic cross clamp time. Additional information like patients age, weight nasopharyngeal temperature throughout the procedure and amounts of fluids and vasopressors administered during the procedures were also recorded.

STATISTICAL ANALYSIS: Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. Categorical outcomes were compared between study groups using Chi square test /Fisher's Exact test as applicable. A p value >0.05 was considered significant. All statistics were performed using the SPSS statistical package (version 22.0).

Table 1: Pre-recorded phrases in the audiotape

No.	Phrases
1	Roses are blue
2	The sun rises in the west
3	Cats have six legs
4	Trees grow under the earth
5	Milk is black in colour
6	Sugar is bitter to taste

Table 2: Sweating Score

Type of Sweating	Score	Characteristics
Nil	0	No Sweating
Mild	1	Moist on Touch
Moderate	2	Visible Droplets
Profuse	3	Large Droplets (Trickling down the forehead and face)

Table 3: Questions asked after 48 hours of Post-operation

No.	Questions
1.	What was the very last thing you remembered before going to sleep?
2.	During the operation, did you notice any sounds, tactile sensations,visual perceptions, pain, paralysis, anxiety, panic, helplessness, andpowerlessness?
3.	Did you feel anything in your mouth or throat?
4.	Did you alert anytime?
5.	What was the first thing you remembered after the surgery?

OBSERVATIONS AND RESULTS

A total of fifty patients who underwent elective cardiac surgery under hypothermic cardiopulmonary bypass were included in the study. Table 4 represents the baseline parameters among all patients undergoing elective cardiac surgery. Among 50 patients, 8% (n =4) were female patients and the rest 92% (n =46) were male patients. The most common (42%), CPB time was in range of 51-80 minutes. Similarly, around 56%, CPB temperature among patients was in range of 32.1 to 34°C. Majority of patients (66%) underwent coronary artery bypass graft surgery (Table 5).

Incidence of awareness: All of them completed the postoperative interview. The last memory before surgery of 43 patients was lying on the operating table prior to induction of anaesthesia, and that of the other seven patients was lying in the premedication room before going to the operation room: The memory soon after surgery reported by 49 patients was waking up in the postoperative ICU while one patient had intraoperative recall, which resulted in the 2% of incidence of awareness in our study (Figure 1). This patient who had recall described a feeling "as if a banana was pushed into his mouth and down his throat". He wanted to speak but couldn't speak. He also recalled one phrase played in the audiotapes during rewarming "sugar is bitter to taste", (incidentally he happens to be the owner of a large sweet shop in the city!). He gives no recall of pain at any time; neither did he recollect any operating room sounds or conversation. Therefore, out of 50 patients, only one patient had awareness with recall and had no evidence of sweating.

Incidence of sweating: 27 patients had no sweating followed by 11, 6, and 6 patients had mild, moderate and profuse sweating respectively. The overall incidence of sweating was 46% (Figure 2). The number of patients coming under long cardiopulmonary bypass time (>90 min) are 16 and short cardiopulmonary bypass time (<90 min) are 34 irrespective of their sweating score. When compared statistically using Chi Square test, there was no correlation found between the different sweating scores and their cardiopulmonary bypass time (P >0.5), statistically not significant (Table 6).

Table 4: Baseline parameters of patients undergoing elective cardiac surgery (N =50)

Parameter	n (%)
Age (years) [Mean ± S.D]	49.5 ± 11.23 (ranged 20 to 68)
Upto 30	4 (8%)
31- 40	6 (12%)
41 - 50	15 (30%)
51 and above	25 (50%)
Gender	
Male	46 (92%)
Female	4 (8%)
Weight (kg) [Mean ± S.D]	63.22 ± 11.23 (ranged 39 to 98)
Upto 50	8 (16%)
51 - 60	9 (18%)
61 -70	20 (40%)
71 and above	13 (26%)
Aortic cross clamp time (Min)	39.96 ± 22.25(ranged 12 to 131)
CPB (time)	77.78 ± 26.23(ranged 38 to 148)
Upto 50	8 (16%)
51 to 80	21(42%)
81 to 110	14 (28%)
110 min and above	7 (14%)
CPB temperature (°C)	30.99 ± 2.01 (ranged 26.1 to 34)
26.1 to 29	15 (30%)
30 to 32	7 (14%)
32.1 to 34	28 (56%)

Table 5: Summary of type of surgery among all patients (N=50)

Type of surgery	n (%)
CABG	33 (66%)
Valve repair replacement	11 (22%)
CABG+ valvular procedure	2 (4%)
Atrial septal repair	3 (6%)
TAPVC repair	1 (2%)

Table 6: Comparison of sweating score and their cardiopulmonary by pastime (N=50)

Parameter	Bypass		Chi square	*P* value
	Long (>90 min)	Short (≤ 90 min)		
Sweated (Score ≥ 1) (n=23)	8 (34.78%)	15 (65.22%)	0.152	0.697
Not Sweated (Score =0) (n=27)	8 (29.63%)	19 (70.37%)		

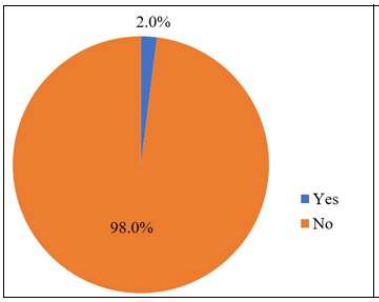

Figure 1

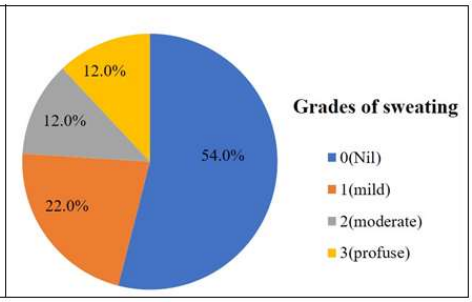

Figure 2

Figure 1: Pie chart showing the distribution of awareness among patients (N=50)
Figure 2: Pie chart showing the grades of sweating in the study population (N=50)

DISCUSSION

The present observational study demonstrated an incidence of 2% awareness during cardiac anaesthesia. Only one patient out of total 50 patients showed the awareness, interestingly, this one patient showed no evidence of sweating during the period of rewarming. However, due to smaller number of patients with recall precludes drawing any definite conclusion on the relationship between awareness and sweating was not possible. Several clinical studies reported wide range from 0.13-7% to 17% intraoperative unpleasant dreams and awareness and because of different anaesthetic technique and methods of monitoring and defining awareness.[13-14] Also, studies have documented the several predisposing factors that affect the incidence of awareness are young age, smoking, female gender, severe obesity.[15,16] Traditionally cardiac surgery is associated with a higher incidence of awareness compared with other specialties (1.14% to 23%).[17] This may be related to anaesthetic technique used in cardiac surgery. Also, earlier study used to incorporate, large doses of opioids in order to minimize the hemodynamic changes after induction, endotracheal intubation, and sternotomy.[18] However, problem associated with opioids are their uncertainty in maintaining the unconsciousness.[19] Therefore, we have used a balanced anaesthetic technique with opioid, benzodiazepines and volatile agents to maintain anaesthesia. Benzodiazepines are given for their amnesic actions as guidelines suggests premedicating the patient with amnesic drugs assist in reducing the awareness. Also, we used hypnosis to detect awareness because hypnosis is associated with confabulation and pseudo memories and instead of being more reliable than non-hypnotic awareness it may actually be less reliable in assessing memory during anaesthesia. Cardiopulmonary bypass alters the pharmacokinetics and pharmacodynamics of drugs. Almost all the physiological processes involved in drug absorption, distribution, metabolism and elimination are affected because of abnormal physiologic conditions including hemodilution, hypotension, hypothermia and non-pulsatile blood flow. In addition, the oxygenator and tubing may bind large amount of drugs. These factors combined with a desire to avoid the negative inotropic effects of volatile and intravenous anaesthetics that possess cardiac depressant actions may contribute to the return of consciousness during cardiopulmonary bypass.[20]

CONCLUSION

The present observational study showed the incidence of awareness and sweating are 2% and 46% respectively in patients who underwent elective cardiac surgery under hypothermic cardiopulmonary bypass. Also, the study did not find any association between the sweating score and the duration of cardiopulmonary bypass. Due to sample constraints the association between sweating with awareness cannot be established.

LIMITATIONS

One of the limitations of our study was small sample size, which was not large enough to reveal significant association between sweating with awareness in patients undergoing elective cardiac surgery under hypothermic cardiopulmonary bypass.

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