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Study Of The Prevention Of Post-Operative Shivering After Sevoflurane Anaesthesia Following Preoperative Use Of Pethidine, Buprenorphine And Butorphanol Intravenously In Small Doses And Comparison Of Their Effects

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Abstract:
A significant number of patients, undergoing Sevoflurane and or Propofol anaesthesia, may develop shivering and hypoxemia, in the immediate post-operative period. However in majority of patients this is relieved spontaneously after some time in fit and healthy patients - no serious problem is posed. As post-anaesthetic shivering increase metabolic rate, oxygen (O_2) demand and carbon-di-oxide (CO_2) production, it may become hazardous in compromised patient population.
Several physical and pharmacological approaches to treatment and prevention of post-anaesthetic shivering have been studied. Pethidine in a low dose has been found to be the most effective and consistent drug in stopping post-anaesthetic shivering. Confusing reports are found in the literature regarding the role of other opioids e.g. Fentanyl in treating post-anaesthetic shivering.
*Hence, this prospective, randomized, double blind study was conducted in **90** ASA-I patients undergoing operation under general anaesthesia, lasting not more than 1 hour. The patients were divided into 3 groups, – Group-I received Pethidine, Group-II received Buprenorphine and Group-III received Butorphanol. Identical anaesthetic technique was employed for all the patients, namely induction with propofol and maintaining anaesthesia with sevoflurane upto 3vol% using Mapleson-A circuit for spontaneous ventilation. Ambient temperature of operation theatre (OT) and recovery room and temperature of intravenous (IV) fluid were maintained around 30^oC. Heart rate, core temperature, oxygen saturation and end-tidal CO_2 (E_TCO_2) were recorded intra-operatively and post-operatively from time to time. Arterial blood gases of shivered patients were done.*
After proper statistical analysis of the data obtained following observations were found:
1) *No correlation could be established between incidence of shivering and the age or body weight of the patient.*
2) *Overall incidence of shivering 14.44%.*
3) *No statistical significant difference was obtained in the change of intra-operative and post-operative heart rate as well as intra-operative and post-operative core body temperature.*
4) *Median value of post-operative arterial oxygen saturation was 99% in all three groups and median value of post-operative E_TCO_2 was 35mm of Hg in all three groups. There changes could not present any statistical significance. So hypoxia was not statistically significant.*

Keywords: *Shivering, Sevoflurane, Pethidine, Butorphanol, Buprenorphine, Propofol, Post-operative.*

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I. Introduction

To note the efficacy of Pethidine (Meperidine), Buprenorphine and Butorphanol in prevention of post-operative shivering and hypoxia when used as premedicant drug after Sevoflurane anaesthesia. [1]

The sophistication and refinement of anaesthetic techniques and drugs have revolutionised the transition, an uncomplicated course from anaesthesia to full recovery of consciousness. However, there may present some complications like hypotension, hypoxemia, nausea, vomiting, pain which have received due attention to prevent mortality and morbidity of patients. Shivering, a major complication has been neglected because of comparative little difficulty posed by it. Post-anaesthetic shivering is a common phenomenon in patients recovering from anaesthesia, incidence being 5 – 65% in different studies. [2-4]

Shivering is defined as rhythmic contraction of muscle groups with irregular intermittent periods of relaxation. It can also be defined as involuntary muscular activity, either generalised or localised to the neck, throat or jaw muscles after the patient gained consciousness. [3]

Patients report that shivering is remarkably uncomfortable than surgical pain. Moreover, shivering may aggravate postoperative pain simply by stretching surgical incisions. Shivering can double or even triple oxygen consumption and carbon-di-oxide production, although the increases are typically much smaller. These large increases in metabolic requirements may predispose to difficulties in patients with existing intrapulmonary shunts, fixed cardiac output or limited respiratory reserve. Morbid cardiac outcomes associated with mild peri-operative hypothermia may be associated with marked increase in plasma catecholamine. Shivering also occasionally impedes monitoring techniques, increases intraocular and intracranial pressure. It is especially disturbing to mother during labour and delivery. 4

The occurrence of shivering after general anaesthesia has been recognised for many years and variably described as 'pentothal shakes', 'halothane shakes' 'shivering', 'post-operative spasticity' and 'spontaneous post-anaesthetic tremor'. Post-anaesthetic shivering can follow after cyclopropane, ether, halothane, thiopentone, sevoflurane or any other combination of these; but it is most common after halothane than sevoflurane. It has been found to be common in American Society of Anaesthesiologists (ASA)-I patients than in other ASA categories.[5]

Several physical and pharmacological approaches to prevention of shivering have been studied. Use of complex humidifiers for inspired anaesthetics and other such physical methods- like using surgical drapes, blankets or plastic bags as well as application of radiant heat, warm air circulating mattress have been found to be effective. But these would be not enough to prevent post-anaesthetic shivering. Although methylphenidate (Ritalin) was first reported to be uniformly effective in stopping post-anaesthetic shivering, Pethidine was shown to be most effective and consistent drug for this purpose in a few numbers of studies.[6]

Pethidine (μ agonist) decreases the shivering threshold almost twice as much as vasoconstriction threshold and it is clearly more effective than equi-analgesic concentrations of other (μ agonist) opioids. Butorphanol (*k*- agonist) is five to eight times more potent than morphine. Buprenorphine a partial μ-receptor agonist is 33times more potent than morphine. No study comparing the effectiveness of the opioids i.e. Pethidine, Buprenorphine and Butorphanol used as premedication to control post-operative shivering and hypoxemia is found in the literature to our knowledge.

II. Materials And Methods

The study included **90 cases** of ASA-I category between age group of 30- 45 years (except those as enumerated below) and scheduled for short surgical procedures lasting not more than 1 hour.

The surgical procedures are included like fibroadenoma of breast, implant removal (orthopaedic), Bartholin cyst remove, eversion of sac, wound debridement under general anaesthesia.

Following patients were **excluded** from the study.

1. Patients on prolonged intake of narcotics
2. Patients who had received a narcotic or sedative for pre-operative pain or delirium.
3. Patients with febrile illness in last one week.
4. Those requiring transfusion of blood or any blood product intra-operatively.

All the patients were randomly divided into 3 groups according to the different drugs they received, the details of which are as follows:

Group I (Pethidine Group):

30 patients in this group received Injection pethidine 50 mg intravenously (IV) 15 minutes before surgery.

Group II (Buprenorphine Group):

In this group 30 patients received Injection Buprenorphine 0.15 mg IV 15 minutes before surgery.

Group III (Butorphanol Group):

30 patients in this group received Injection Butorphanol 1 mg IV 15 minutes before surgery.

Each drug was taken in a 2 ml syringe in equal volume and was given by one senior anaesthetist who was ignorant about its content. None of the patients received diazepam or any other drugs before or during surgery. On reaching the operation theatre (OT) non-invasive monitors - for monitoring vital signs were connected to the patients and a peripheral venous access was secured. At induction of anaesthesia all the patients received the sleep dose of Propofol. Anaesthesia was maintained with 66% N_2O in O_2 with Sevoflurane (1.5 to 3vol %) on spontaneous ventilation, using the face mask and Mapleson-A circuit. Administration of IV fluid intra-operatively was kept to a minimum volume and its temperature was kept around 30°C. Temperature of OT and post-anaesthesia recovery room (PACU) were kept around 30°C.

PARAMETERS:

Intra-operative (intra-op) and post-operative (post-op) (30 minutes) monitoring of the patient was done using Datex Cardiocap II (5-channel monitor) and following parameters were noted:

1. Electro-cardiography (ECG):

A continuous trace of ECG was observed for the rate and rhythm of the heart.

2. Temperature (Temp):

Core temperature of the patient was measured by using nasopharyngeal probe which was displayed in the same monitor and noted every 5 minutes. Measurement of core body temperature had shown to be reasonably accurate using nasopharyngeal probe and precise in relation to tympanic membrane and has been recommended for intra-operative use.

3. Oxygen Saturation (S_PO_2):

Pulse oximeter probe was used and oxygen saturation continuously monitored.

4. End-tidal CO_2 (E_TCO_2):

Capnography probe was attached between mask and the circuit and continuous monitoring was done.

5. Grading of shivering (SHIV):

Unbiased observers in the recovery room who was blind to the test groups assessed shivering. It was graded according to a grading scale and was noted every 5 minutes.

Grade	Clinical Signs
0	No shivering
1	Piloerection and/or peripheral cyanosis but without visible muscular activity.
2	Visible muscular activity confined to one muscular group.
3	Visible muscular activity confined to more than one group of muscle.
4	Gross muscular activity involving entire body.

If shivering become prolonged (> 5 minutes) and distressing (> Grade 1) Pethidine 25 mg IV bolus was given as rescue drug.

6. Arterial blood gas (ABG) analysis:

It was undertaken if any of the patient shivered during the study period.

Apart from these, other parameters e.g. respiration rate and blood pressure were measured from time to time. During the recovery from anaesthesia all the patients were given 30% O_2 by using ventimask - is the practice at our Institute.

ETHICAL JUSTIFICATION:

Premedication is routinely used before any kind of planned surgical procedure. Analgesic is mandatory in all surgical procedure. As there is a chance of sevoflurane induced shivering - each patient should receive drug which can prevent shivering because shivering can cause hypoxia, hypercarbia which may cause deleterious effect to patient. So, I use the drugs, which are analgesics as well as they have known antishivering action.

Informed consent was taken for all patients undergoing this study. Pethidine 25mg IV bolus was administered as a rescuer drug to any patient who had a distressful post-operative shivering.

III. Statistical Analysis

For statistical analysis data were entered into a Microsoft excel spreadsheet and then analyzed by SPSS 24.0. andGraphPad Prism version 5. One-way analysis of variance (one-way ANOVA) was a technique used to compare means of three or more samples for numerical data (using the F distribution). A chi-squared test ($\chi 2$ test) was any statistical hypothesis test wherein the sampling distribution of the test statistic is a chi-squared distribution when the null hypothesis is true. Without other qualification, 'chi-squared test' often is used as short for Pearson's chi-squared test. Unpaired proportions were compared by Chi-square test or Fischer's exact test, as appropriatep-value ≤ 0.05 was considered for statistically significant.

IV. Result And Analysis

In group-I the mean age (mean± s.d.) of patients was 36.5667 ± 4.1079 years. In group-II the mean age (mean± s.d.) of patients was 37.8667 ± 5.0291 years. In group III the mean age (mean± s.d.) of patients was 38.1667 ± 5.0657 years. Difference of mean age in three groups was not statistically significant (p=0.3870).

In group-I the mean weight (mean± s.d.) of patients was 51.3000 ± 6.6288 kg. In group-II the mean weight (mean± s.d.) of patients was 50.4000 ± 8.5484 kg. In group III the mean weight (mean± s.d.) of patients was 51.0667 ± 7.1483 kg. Difference of mean weight in three groups was not statistically significant (p=0.8899).

In group-I the mean HR at starting (mean± s.d.) of patients was 86.0667 ± 12.0543.In group-II the mean HR at start (mean± s.d.) of patients was 90.2000 ± 10.4927.In group III the mean HR at start (mean± s.d.) of patients was 85.3000 ± 16.2781.Difference of mean HR at start in three groups was not statistically significant (p=0.3057).In group-I the mean HR at 5 min (mean± s.d.) of patients was 85.0667 ± 10.6316.In group-II the mean HR at 5 min (mean± s.d.) of patients was 90.9000 ± 9.0186.In group III the mean HR at 5 min (mean± s.d.) of patients was 83.2667 ± 13.7162.Difference of mean HR at 5 min in three groups was statistically significant (p=0.0275).In group-I the mean HR at 10 min (mean± s.d.) of patients was 76.9667 ± 10.4732.In group-II the mean HR at 10 min (mean± s.d.) of patients was 94.2000 ± 9.6111. In group III the mean HR at 10 min (mean± s.d.) of patients was 81.5667 ± 12.5167.Difference of mean HR at 10 min in three groups was statistically significant (p<0.0001).In group-I the mean HR at 20 min (mean± s.d.) of patients was 77.5667 ± 12.9340.In group-II the mean HR at 20 min (mean± s.d.) of patients was 87.5333 ± 8.5731.In group III the mean HR at 20 min (mean± s.d.) of patients was 82.9333 ± 14.2222.Difference of mean HR at 20 min in three groups was statistically significant (p=0.0084).In group-I the mean HR at 30 min (mean± s.d.) of patients was 78.9333 ± 9.5950.In group-II the mean HR at 30 min (mean± s.d.) of patients was 88.4667 ± 8.6452.In group III the mean HR at 30 min (mean± s.d.) of patients was 85.7333 ± 14.4507.Difference of mean HR at 30 min in three groups was statistically significant (p=0.0044).

Difference of mean post-op HR at 5 min in three groups was not statistically significant (p=0.1953).Difference of mean post-op HR at 10 min in three groups was not statistically significant (p=0.1855).Difference of mean post-op HR at 15 min in three groups was not statistically significant (p=0.1461).Difference of mean post-op HR at 20 min in three groups was not statistically significant (p=0.2719).Difference of mean post-op HR at 25 min in three groups was not statistically significant (p=0.1472).The mean post-op HR at 30 min of patients was higher in group-II (mean± s.d.) 85.4000 ± 4.5833. Difference of mean post-op HR at 30 min in three groups was statistically significant (p=0.0236).

Difference of mean core temp start in three groups was not statistically significant (p=0.4056).Difference of mean core temp at 5 min in three groups was not statistically significant (p=0.1903).Difference of mean core temp at 10 min in three groups was not statistically significant (p=0.1140).Difference of mean core temp at 15 min in three groups was not statistically significant (p=0.9636).Difference of mean core temp at 20 min in three groups was not statistically significant (p=0.9904).Difference of mean core temp at 30 min in three groups was not statistically significant (p=0.2906).

Difference of mean core temp post-op 5 in three groups was not statistically significant (p=0.3985).Difference of mean core temp post-op 10 in three groups was not statistically significant (p=0.9435).Difference of mean core temp post-op 15 in three groups was not statistically significant (p=0.9317).Difference of mean core temp post-op 20 in three groups was not statistically significant (p=0.2577).Difference of mean core temp post-op 25 in three groups was not statistically significant (p=0.6994).Difference of mean core temp post-op 30 in three groups was not statistically significant (p=0.5114).

In group-I 4(13.3%) patients had SHIV. In group-II 6(20.0%) patients had SHIV. In group-III, 3(10.0%) patients had SHIV. Association of SHIV in three groups was not statistically significant (p=0.5329).

Difference of mean oxygen saturation starting in three groups was not statistically significant (p=0.1433).The mean oxygen saturation at 5 min of patients was higher in group-II (mean± s.d.) 98.2667 ± .8277.Difference of mean oxygen saturation at 5 min in three groups was statistically significant (p=0.0215).The mean oxygen saturation at 10 min of patients was higher in group-II (mean± s.d.) 98.1333 ± .7761.Difference of mean oxygen saturation at 10 min in three groups was statistically significant (p=0.0065).The mean oxygen saturation at 15 min of patients was higher in group-II (mean± s.d.) 98.3000 ± 1.1788.Difference of mean oxygen saturation at 15 min in three groups was statistically significant (p=0.0291).The mean oxygen saturation at 20 min of patients was higher in group-II (mean± s.d.) 98.4333 ± .7739.Difference of mean oxygen saturation at 20 min in three groups was statistically significant (p=0.0463).Difference of mean oxygen saturation at 30 min in three groups was not statistically significant (p=0.8823).

Difference of mean post-op oxygen saturation at 5 min in three groups was not statistically significant (p=0.1595).Difference of mean post-op oxygen saturation at 10 min in three groups was not statistically significant (p=0.4498).Difference of mean post-op oxygen saturation at 15 min in three groups was not statistically significant (p=0.9471).Difference of mean post-op oxygen saturation at 20 min in three groups was

not statistically significant (p=0.3844).Difference of mean post-op oxygen saturation at 30 min in three groups was not statistically significant (p=0.1480).

In group-I the mean post-op oxygen saturation (mean± s.d.) of patients was 99.0000 ± .0000.In group-II the mean post-op oxygen saturation (mean± s.d.) of patients was 98.9286 ± .3780.In group III the mean post-op oxygen saturation (mean± s.d.) of patients was 99.0000 ± .0000.Difference of mean post-op oxygen saturation in three groups was not statistically significant (p=0.3528).

In group-I the mean post-op end-tidal CO_2starting (mean± s.d.) of patients was 34.7333 ± .9444.In group-II the mean post-op end- tidalCO_2starting (mean± s.d.) of patients was 34.7333 ± .9444.In group III the mean post-op end- tidal CO_2starting (mean± s.d.) of patients was 34.7333 ± .9444.Difference of mean post-op end-tidalCO_2starting in three groups was not statistically significant (p=1.0000).

In group-I the mean post op end-tidalCO_2 (mean± s.d.) of patients was 34.7000 ± 1.0875. In group-II the mean post op end-tidalCO_2 (mean± s.d.) of patients was 34.7000 ± 1.0875. In group III the mean post-op end-tidal CO_2 (mean± s.d.) of patients was 34.7000 ± 1.0875. Difference of mean post-op end-tidalCO_2in three groups was not statistically significant (p=1.0000).

In group-I the mean post-op end-tidalCO_2 (mean± s.d.) of patients was 34.8667 ± .9371. In group-II the mean post-op end-tidalCO_2 (mean± s.d.) of patients was 34.8667 ± .9371. In group III, the mean post-op end-tidal CO_2 (mean± s.d.) of patients was 34.8667 ± .9371. Difference of mean post-op end-tidalCO_2in three groups was not statistically significant (p=1.0000).

Difference of mean intra-op HR at start Non-SHIV vs. SHIV was not statistically significant (p=0.8666).Difference of mean HR at 5 minNon-SHIV vs. SHIV was not statistically significant (p=0.6890).Difference of mean HR at 10 min Non-SHIV vs. SHIV was not statistically significant (p=0.6191).Difference of mean HR at 15 minNon-SHIV vs. SHIV was not statistically significant (p=0.8808).Difference of mean HR at 20minNon-SHIV vs. SHIV was not statistically significant (p=0.9033).Difference of mean HR at 30minNon-SHIV vs. SHIV was not statistically significant (p=0.9178).
Difference of mean post-op HR at 5 minNon-SHIV vs. SHIV was not statistically significant (p=0.8666).In SHIV positive, the mean post-op HR at 10 min (mean± s.d.) of patients was 91.6923 ± 15.7236.Difference of mean post-op HR at 10 min Non-SHIV vs. SHIV was statistically significant (p=0.0106).In SHIV positive, the mean post-op HR at 15 min (mean± s.d.) of patients was 90.0000 ± 12.1929.Difference of mean post-op HR at 15 min Non-SHIV vs. SHIV was statistically significant (p=0.0102).Difference of mean post-op HR at 20 min Non-SHIV vs. SHIV was not statistically significant (p=0.1760).Difference of mean post-op HR at 25 min Non-SHIV vs. SHIV was not statistically significant (p=0.6571).Difference of mean post-op HR at 30 min Non-SHIV vs. SHIV was not statistically significant (p=0.9266).
Difference of mean core temp at start Non-SHIV vs. SHIV was not statistically significant (p=0.1498). Difference of mean core temp at 5 min Non-SHIV vs. SHIV was not statistically significant (p=0.3946). Difference of mean core temp at 10 min Non-SHIV vs. SHIV was not statistically significant (p=0.2293). Difference of mean core temp at 15 min Non-SHIV vs. SHIV was not statistically significant (p=0.7071). In SHIV positive, the mean core temp at 20 min (mean± s.d.) of patients was 35.2077 ± 1.1449.Difference of mean core temp at 20 min Non-SHIV vs. SHIV was statistically significant (p=0.0525). In SHIV positive, the mean core temp at 30 min (mean± s.d.) of patients was 35.1846 ± 1.0148.Difference of mean core temp at 30 min Non-SHIV vs. SHIV was statistically significant (p=0.0560).
Difference of mean core temp post-op at 5 min Non-SHIV vs. SHIV was not statistically significant (p=0.3548).Difference of mean core temp post-op at 10 min Non-SHIV vs. SHIV was not statistically significant (p=0.1855).Difference of mean core temp post-op at 15 min Non-SHIV vs. SHIV was not statistically significant (p=0.5871).Difference of mean core temp post-op at 20 min Non-SHIV vs. SHIV was not statistically significant (p=0.1047).In SHIV positive, the mean core temp post-op at 25 min (mean± s.d.) of patients was 35.9923 ±.7053.Difference of mean core temp post-op at 25 min Non-SHIV vs. SHIV was statistically significant (p=0.0356).In SHIV positive, the mean core temp post-op at 30 min (mean± s.d.) of patients was 36.1769 ± .5918.Difference of mean core temp post-op at 30 min Non-SHIV vs. SHIV was statistically significant (p=0.0498).
Difference of mean oxygen saturation at starting Non-SHIV vs. SHIV was not statistically significant (p=0.1830).Difference of mean oxygen saturation at 5 min Non-SHIV vs. SHIV was not statistically significant (p=0.8505).Difference of mean oxygen saturation at 10 min vs. SHIV was not statistically significant (p=0.2239).Difference of mean oxygen saturation at 15 min Non-SHIV vs. SHIV was not statistically significant (p=0.1241).Difference of mean oxygen saturation at 20 min Non-SHIV vs. SHIV was not statistically significant (p=0.2125).In SHIV positive, the mean oxygen saturation at 30 min (mean± s.d.) of patients was 98.4935 ± .7186.Difference of mean oxygen saturation at 30 min Non-SHIV vs. SHIV was statistically significant (p=0.0138).

InSHIV positive, the mean post-op oxygen saturation at 5 min (mean± s.d.) of patients was 97.4615 ± 97.4615.Difference of mean post-op oxygen saturation at 5 min Non-SHIV vs. SHIV was statistically significant (p<0.0001).InSHIV positive, the mean post-op oxygen saturation at 10 min (mean± s.d.) of patients was 97.0000 ± .8165.Difference of mean post-op oxygen saturation at 10 min Non-SHIV vs. SHIV was statistically significant (p<0.0001).In SHIV positive, the mean post-op oxygen saturation at 15 min (mean± s.d.) of patients was 98.4615 ± .6602.Difference of mean post-op oxygen saturation at 15 min Non-SHIV vs. SHIV was statistically significant (p=0.0019).Difference of mean post-op oxygen saturation at 20 min Non-SHIV vs. SHIV was not statistically significant (p=0.7200).Difference of mean post-op oxygen saturation at 30 min Non-SHIV vs. SHIV was not statistically significant (p=0.4338).

Difference of mean post-op end- tidal CO_2 at start Non-SHIV vs. SHIV was not statistically significant (p=0.8819).Difference of mean post-op end- tidal CO_2 at 5 min Non-SHIV vs. SHIV was not statistically significant (p=0.1002).Difference of mean post-op end- tidal CO_2 at 10 min Non-SHIV vs. SHIV was not statistically significant (p=0.3130).Difference of mean post-op end- tidal CO_2 at 15 min Non-SHIV vs. SHIV was not statistically significant (p=0.0914).Difference of mean post-op end- tidal CO_2 at 20 min Non-SHIV vs. SHIV was not statistically significant (p=0.7462).Difference of mean post-op end- tidal CO_2 at 30 min Non-SHIV vs. SHIV was not statistically significant (p=0.2930).

DISCUSSION:

The incidence of shivering after anaesthesia with volatile anaesthetics is 40–60%, but the understanding of the physiological mechanism behind this phenomenon is still unclear.

Normally thermogenic shivering is triggered when body temperature goes below the hypothalamic thermostatic set-point. The conventional explanation for spontaneous post-operative shivering is lowering of this set-point by anaesthetic drugs and exposure to cold operating rooms. As the concentration of anaesthetic decreases in the brain following surgery the hypothalamic set- point begins to return to its normal setting. Disparity between near normal set- point and relatively low body temperature stimulates cold sensation, vasoconstriction and shivering. [5]

Drug therapy may offer a simple cost-effective solution in treating shivering. Perhaps opioids offer maximum hope for simple therapy, although its action remains a mystery. These that are effective are so in low doses, suggesting specificity of action, but why some should be active when other similar agents are not is unexplained. However, most authors agree that prevention of post- anaesthetic shivering is desirable and use of drugs to treat established shivering has been questioned. [6]

The aim of the present study was to establish the efficacy of Pethidine, Buprenorphine and Butorphanol in preventing shivering and hypoxia when used as premedicant drug after Sevoflurane anaesthesia. 90 patients of ASA-I between age-group 30-45 years and scheduled for short surgical procedures lasting not more than 1 hour were selected. All patients received sleep dose of Propofol and maintaining anaesthesia with 66% N_2O in O_2 and Sevoflurane of 3 vol%. Pethidine was used as the rescue drug.

Demographic parameter

All the 90 patients were randomly divided into three groups and each group given either pethidine, Buprenorphine or Butorphanol in a standard dosage as a premedicant.

In the present study all the patients were comparable in relation to their age and body weight in each of the three groups. There was no statistically significant difference in these parameters among the patients who ultimately shivers and who did not.

Controversy exists as to the relationship of post-anaesthetic shivering with age. There are few reports which suggest that relatively younger patients are more prone to development of post-anaesthetic shivering. One study established that shivering is the rule in elderly patients because age per se impairs normal thermoregulatory control. [7]

Crossley while reviewing the incidence of post-anaesthetic shivering in a district general hospital over a 6 month period, had reported that patients who did not receive a volatile agent did not shiver subsequently, and post- anaesthetic shivering was predominant in fit, healthy, young males subjected to anaesthetic techniques involving spontaneous ventilation and volatile agents. In the present study also all the patients were of ASA-I and received volatile agent i.e. sevoflurane while maintaining anaesthesia. Age and body weight did not correlate well with incidence of shivering.[8]

Incidence of Shivering

Post-operative shivering was present 13 out of total 90 patients with an incidence of 14.44%. In Group-I 13%of patients shivered and Group III only 10% patients shivered. Maximum 20% patients shivered in Group II. However Grade 2 shivering (visible muscular activity confined to one muscle group) was more prevalent in group-II. The difference in incidence was not statistically significant among three groups.

Rescue drug pethidine 25 mg IV bolus was administered to 4 patients who had shivered more than grade I. In all these cases it could attenuate post- anaesthetic shivering by 5 minutes and there was no recurrence within the study period of 30 minutes. None of these patients experienced any adverse reaction to pethidine.

Duration of Anaesthesia and Shivering

Controversy exists as to whether post-anaesthetic shivering is related to duration of anaesthesia or not. Cohen observed that incidence of shivering increased in relation to increased duration, up to a plateau at 40 minutes. Goldobserved post-operative shivering to be more frequent when operation time exceeded 30 minutes. One study found this critical duration to be more than 1 hour. One study found that shivering and feeling of intense cold was the most distressing memory of anaesthesia even after short surgical procedures. However, one study could not find any relation between the two. This observation has been supported by one and Hold craft also. The duration of anaesthesia in the present study was mostly confined to 30 minutes (except 5 cases where it extended up to 45 minutes).

Core Temperature Response

Many authors have reported incidence of shivering in relation to fall in core temperature. There are many proponents of the theory that post- anaesthetic shivering is related to fall in core body temperature
Contrary to this there have been many reports which could not correlate temperature fall and shivering one study found no co-relation between a fall in body temperature below normal range, and the incidence of shivering. A study did not find any statistically significant difference in mean core temperature between patients who subsequently shivered and those who did not, and the incidence was not significantly greater in patients with a core temperature less than 36°C an arrival to recovery room. A study had suggested that intensity of shivering as recorded by shivering grade was correlated to axillary temperature. He noted an interesting phenomenon also – 14.6% of his patients had a lower axillary temperature after 30 minutes in recovery room than they had an entry (despite routine measures to pressure body temperature), while 17.9% had the same temperature and 32% were warmer. However, there was no relationship between warming or cooling and the onset of shivering, or between warming or cooling shivering grade. [4-8]

In the present study intra-operative and post-operative core body temperature was comparable in all the three groups. Even core body temperature post- operatively in patients who shivered and who did not, were comparable and no statistically significant difference was obtained.

It should be remembered that a normal core temperature does not necessarily exclude any previous or on-going peripheral heat loss. The theoretical concept of core temperature is that there is a central core of the body within which temperature varies minimally. This central core is surrounded by peripheral tissue that interfaces with the environment through temperature gradients. When the energy expenditure associated with the intensity of shivering is considered in terms of an increase in metabolic rate, it has been found that the central mechanisms for the onset of shivering (hypothalamic centres) are approximately three times as powerful as peripheral thermal stimuli. In view of this finding it is considered that the central body temperature measurements are of greater significance than peripheral skin temperature measurements. Benzinger had shown that in human's tympanic membrane temperature closely approximates temperature of the blood supplying the hypothalamus and recommended tympanic membrane temperature as the most reliable core temperature in clinical practice. However, measurements of body temperature using nasopharynx, oesophagus and bladder are recommended for intra-operative use as providing the best continuation of accuracy and precision, rather than subjecting the tympanic membrane to possible trauma while monitoring temperature intra-operatively.

Shivering is usually considered to be a means of rapid acute thermo-genesis in man. If shivering patients are not in need of acute thermo-genesis because they are not hypothermic, the question then is why are they shivering? Unfortunately, there is no measurement of hypothalamic temperature 'set- point' of these patients to compare them with core temperature. Patients who shiver may need acute shivering thermo-genesis in response to difference between their 'set-point' and core temperature. Patients with a lesser difference between 'set-point' and core temperature may have slowly rewarmed themselves without shivering by conserving heat by the mechanism of peripheral vasoconstriction. Heat loss during anaesthesia occurs not only because of low environmental temperature and humidity but also because of the infusion of cold fluids, ventilation with cold gases, exposure of body cavities, the absence of muscle movement and subcutaneous vasodilatation. The most alarming heat loss occurred at the end of the anaesthesia. There seems a little point in maintaining normothermia during anaesthesia, if heat loss occurs maximally during transfer of the patient to the recovery area. [9]

Heat loss under anaesthesia occurs primarily by radiation and convection; evaporation and conduction have minimal effect. So, post-operative shivering may be a response to heat loss, rather than to fall in core temperature. Hence, minimizing heat loss by radiation with space blanket contributed the reduction in shivering.[10]

Heart Rate Response:

All the three groups of patients showed a similar trend in heart rate response post-operatively for 30minutes. This parameter at identical time interval between the shiverers and non-shiverers is not significantly different is the present study. However, it has been noted in the present study that heart rate is increased significantly during initial 20 minutes of post-operative period as compared to end of anaesthesia in the patients who shivered.

Prys Robertshas noted that increased cardiac output in response to shivering was predominantly associated with increased heart rate.

Oxygen saturation Response and Arterial P_aO_2

Post-operative oxygen saturation in the patients in all the three groups was comparable and median value of 99% was obtained in each of the three groups.

However, oxygen saturation differed highly significant in the shiverers from the non-shiverers till 10minutes post-operatively (post-op) and significant for 5 minutes thereafter. But median value was never below 97% at any time interval.

Amongst the 13 patients who shivered in the present study range of P_aO_2 was 84-100mmHg, but majority of them had a P_aO_2 level of more than 90mmHg. This shows that oxygen consumption and arterial P_aO_2 are not well correlated as was noted by a study. They noted that values of O_2 consumption remained surprisingly close to basal level during early stages of recovery from anaesthesia, making it clear that awakening does not of itself cause an appreciable increase in metabolism. They put forward few possible causes of slight hypothermia, which is characteristics of post-operative period (irrespective of post-anaesthetic shivering), namely high venous admixture, excessive desaturation of mixed venous blood and reduction of alveolar (P_AO_2)as a result of alveolar hypoventilation. [10]

The results of the present study shows disagreement with these of one study who found that SaO_2, measured with an ear oximeter, was about 10% lower in shivering patients. In this view of the demonstration by Lim that shivering causes peripheral vasoconstriction, it is possible that the use of ear oximetry may not have been suitable for this type of study.

The observations made by one study the lowered PaO_2 in shivering patients breathing room air did not improve significantly after cessation of improve shivering. Similarly, when $\mathbf{F_iO_2}$ was 1.0 no improvement in mean PaO_2 was seen after visible shivering had seized.

One study did not notice any change in ventilation frequency or SpO_2 during shivering episodes. They attributed this to provision of supplemental oxygen during post-operative period, as has been done in the present study. In spite of this, significant difference in SaO_2 was noticed for 15 minutes in the present study between shiverers and non-shiverers.

End-tidal CO_2

In my study, anaesthesia was given by Mapleson A circuit. Intubation was not done. End-tidal CO_2 probe was attached between mask and the circuit and continuous monitoring was done.

Median value of post-operative End-tidal CO_2 was found 35mm of Hg in all three groups and statistically not significant.

Crossley had analysed retrospectively more than 2500 patients after general anaesthesia and indicated that the incidence of post-anaesthetic shivering was increased fourfold if any anticholinergic premedication had been used. In a further study, they noticed a significantly greater incidence of post-anaesthestic shivering in patients who received any of the anticholinergic. Premedications (hyoscine and glycopyrrolate) compared with the control (metoclopramide) group. In our study no anticholinergic premedication was used in any of the patients. We used narcotic opioids in our study. But there was no significant difference in the incidence of shivering among the 3 groups.[8-10]

The present study included post-operative monitoring for 30 minutes only. A larger duration would have been more result oriented. There was always an inevitable chance of subjective error in assessing grades of shivering. ABG analysis was done in patients who shivered and that too, when shivering had ceased, because of the technical difficulty in sampling. Lastly, we propose to extend this study to patients undergoing prolonged surgery with intubation and monitor the effect of duration of surgery.

In my study, Butorphanol establishes less incidence of shivering. Now a days, Butorphanol is strictly used in our hospital only in ASA-I patients. On the other hand, it is not popular for its unwanted side effects. So, though it plays a better role than pethidine to prevent shivering but its limitation restricts the use of drug only some limited place.

V. Conclusion

Total incidence of post-operative Sevoflurane-induced shivering was14.44%.Among the patients who shivered there was a significant increase in heart rate and fall in oxygen saturation during early post-operative period as compared to end of anaesthesia. Fall of core body temperature was significant at 5minutes and 30minutes post-operatively. Significant hypoxemia and hypercarbia was not noted in the patients who had post-anaesthetic shivering. Though statistically no correlation could be established between incidence of shivering and the drugs used as premedicants but clinically Butorphanol establishes less incidence of shivering than Pethidine and Buprenorphine.

References

[1]. Holdcraft A, Hall GM. Heat loss during anaesthesia. Brit J Anaesth 1978; 50: 157-164.
[2]. Gold JE. Post-operative spasticity and shivering. Anaesthesia 1984; 39: 35-38.
[3]. Claybon LE, Hiesch RA. Meperidine arrests to post-anesthetic shivering. Anesthesiology 1980; 53: S180.
[4]. Macintyre PE, Pavlin EG, Dwersteg JF. Effect of meperidine on oxygen consumption, CO_2production, and respiratory gas exchange in post anaesthetic shivering. AnesthAnalg 1987; 66: 751-755.
[5]. Birzis L. Hemingway A: Efferent at brain discharge during shivering. J. Neurophysiology 1957; 20: 156-66.
[6]. Vogelsang J, Hayes SR. Butorphanoltartarate relieves post-anesthetic shivering more effectively than meperidine. J. Post AnaesthNurs 1992 Apr; 7(2): 94-100.
[7]. Meperidine, Buprenorphine, Butorphanol in Huldman JG, LimliedLE(Eds). Goodman and Gilman; The pharmacological basis of therapeutics. 10th Edition: New York; Macgow Hill: 592-594 & 601.
[8]. Horn E-P, Werner C, Sessler DI,Steinfath M, Schulte am Esch J.Late intra-operative administration of clonidine prevents post-anesthetic shivering after total intravenous or volatile anesthesia. AnesthAnalg 1997; 84: 613-7.
[9]. Baxendale BR, Mahajan RP, Crossley AWA. Anticholinergic premedication influences the incidence of post-operative shivering. Brit J. Anaesth 1994; 72: 291-294
[10]. Collins KJ, Dore C, and Exton- Smith AN, Fox RH, Mac Donald IC, Woodword DM: Accidental hypothermia and impaired temperature homeostasis in the elderly.
BMJ 1997; 1: 353-6.

Table: Distribution of mean HRin Three Groups

Interval	**Groups**	Number	Mean	SD	Minimum	Maximum	Median	p-value
HR Start	GROUP - I	30	86.0667	12.0543	64.0000	114.0000	84.5000	0.3057
	GROUP - II	30	90.2000	10.4927	65.0000	112.0000	89.5000	
	GROUP - III	30	85.3000	16.2781	55.0000	120.0000	86.0000	
HR At 5 min	GROUP - I	30	85.0667	10.6316	60.0000	103.0000	88.0000	0.0275
	GROUP - II	30	90.9000	9.0186	74.0000	106.0000	92.0000	
	GROUP - III	30	83.2667	13.7162	61.0000	110.0000	84.0000	
HR At 10mn	GROUP - I	30	76.9667	10.4732	58.0000	94.0000	76.0000	<0.0001
	GROUP - II	30	94.2000	9.6111	76.0000	110.0000	95.0000	
	GROUP - III	30	81.5667	12.5167	54.0000	104.0000	83.5000	
HR At 15 min	GROUP - I	30	76.6000	13.7329	58.0000	110.0000	71.0000	0.0002
	GROUP - II	30	90.7000	9.1393	74.0000	106.0000	91.0000	
	GROUP - III	30	81.4667	14.6422	52.0000	108.0000	77.5000	
HR At 20min	GROUP - I	30	77.5667	12.9340	56.0000	108.0000	76.0000	0.0084
	GROUP - II	30	87.5333	8.5731	68.0000	100.0000	90.0000	
	GROUP - III	30	82.9333	14.2222	54.0000	110.0000	82.0000	
HR At 30min	GROUP - I	30	78.9333	9.5950	60.0000	97.0000	78.0000	0.0044
	GROUP - II	30	88.4667	8.6452	68.0000	100.0000	91.0000	
	GROUP - III	30	85.7333	14.4507	66.0000	106.0000	90.0000	
Post-OP HR at 5min	GROUP - I	30	82.9000	9.8308	64.0000	101.0000	80.0000	0.1953
	GROUP - II	30	87.3000	7.5756	76.0000	102.0000	87.5000	
	GROUP - III	30	83.0000	13.6836	52.0000	110.0000	88.0000	
Post-OP HR at10min	GROUP - I	30	85.2667	8.3126	70.0000	106.0000	84.0000	0.1855
	GROUP - II	30	87.6667	9.5279	74.0000	110.0000	89.0000	
	GROUP - III	30	83.0000	11.2004	52.0000	100.0000	86.0000	
Post-OP HR at 15min	GROUP - I	30	83.6000	7.5274	70.0000	100.0000	80.0000	0.1461
	GROUP - II	30	86.8333	7.3816	72.0000	100.0000	86.5000	
	GROUP - III	30	82.6667	10.3768	56.0000	100.0000	87.0000	
Post-OP HR at 20min	GROUP - I	30	83.9333	7.3996	72.0000	100.0000	82.0000	0.2719
	GROUP - II	30	85.2667	7.1724	72.0000	100.0000	84.0000	
	GROUP - III	30	81.7333	10.5141	56.0000	100.0000	83.0000	
Post-OP HR At 25min	GROUP - I	30	82.1333	6.3828	72.0000	100.0000	82.0000	0.1472
	GROUP - II	30	83.9333	6.6329	68.0000	96.0000	84.0000	
	GROUP - III	30	80.0667	9.3438	56.0000	100.0000	82.0000	
Post-OP HR At 30min	GROUP - I	30	82.8000	7.3831	72.0000	110.0000	82.0000	0.0236
	GROUP - II	30	85.4000	4.5833	76.0000	92.0000	84.0000	
	GROUP - III	30	80.5333	7.8069	60.0000	96.0000	82.0000	

Table: Distribution of mean CoreTemp in Three Groups

Interval	Groups	Number	Mean	SD	Minimum	Maximum	Median	p-value
Core Temp start	GROUP - I	30	35.7667	.6042	34.4000	36.5000	35.9500	0.4056
	GROUP - II	30	35.8600	.7079	34.2000	37.3000	35.7000	
	GROUP - III	30	35.6467	.5124	34.4000	36.6000	35.5000	
Core Temp at 5min	GROUP - I	30	35.8000	.5252	34.9000	36.9000	35.8000	0.1903
	GROUP - II	30	35.7933	.5508	34.8000	36.9000	35.8000	
	GROUP - III	30	35.5800	.5041	34.2000	36.2000	35.7500	
Core Temp at 10min	GROUP - I	30	35.7233	.6678	34.6000	37.0000	35.8000	0.1140
	GROUP - II	30	35.5133	.4569	34.8000	36.4000	35.4000	
	GROUP - III	30	35.3700	.7883	32.3000	36.2000	35.6000	
Core Temp at 15min	GROUP - I	30	35.5867	.6268	34.6000	36.9000	35.7000	0.9636
	GROUP - II	30	35.5600	.5691	34.3000	36.5000	35.6000	
	GROUP - III	30	35.5433	.6652	32.8000	36.3000	35.7000	
Core Temp at 20min	GROUP - I	30	35.5333	.6144	34.5000	36.8000	35.6000	0.9904
	GROUP - II	30	35.5500	.5111	34.4000	36.3000	35.7000	
	GROUP - III	30	35.5267	.8424	32.1000	36.8000	35.7500	
Core Temp at 30min	GROUP - I	30	35.6400	.5969	34.6000	36.7000	35.8000	0.2906
	GROUP - II	30	35.4000	.5092	34.7000	36.3000	35.4000	
	GROUP - III	30	35.4400	.7559	32.4000	36.5000	35.7000	
Core Temp Post-op 5min	GROUP - I	30	35.9500	.7157	35.0000	37.2000	36.0000	0.3985
	GROUP - II	30	36.0233	.6207	34.8000	37.0000	36.0000	
	GROUP - III	30	36.1600	.4492	35.0000	37.0000	36.2500	
Core Temp Post-op 10min	GROUP - I	30	36.1233	.7352	35.0000	37.4000	36.2000	0.9435
	GROUP - II	30	36.1367	.5786	34.8000	37.0000	36.2000	
	GROUP - III	30	36.1733	.4025	35.3000	37.0000	36.3000	
Core Temp Post-op 15min	GROUP - I	30	36.1800	.7708	35.2000	37.6000	36.0000	0.9317
	GROUP - II	30	36.2300	.5522	34.6000	37.0000	36.2500	
	GROUP - III	30	36.1800	.4010	35.6000	36.9000	36.2500	
Core Temp Post-op 20min	GROUP - I	30	36.2000	.8000	34.8000	37.6000	36.2000	0.2577
	GROUP - II	30	36.3000	.5801	35.0000	37.0000	36.4000	
	GROUP - III	30	36.4633	.4222	35.6000	37.0000	36.7000	
Core Temp Post-op 25min	GROUP - I	30	36.3033	.7801	34.6000	37.5000	36.4000	0.6994
	GROUP - II	30	36.2367	.5196	35.0000	37.0000	36.2000	
	GROUP - III	30	36.3633	.3577	35.8000	37.0000	36.4000	
Core Temp Post-op 30min	GROUP - I	30	36.4900	.5448	35.0000	37.5000	36.5000	0.5114
	GROUP - II	30	36.3500	.4883	35.2000	37.0000	36.4000	
	GROUP - III	30	36.4000	.3677	35.8000	37.0000	36.4000	

Table: Distribution of Mean Oxygen Saturation in Three Groups

Interval	Groups	Number	Mean	SD	Minimum	Maximum	Median	p-value
Oxygen Saturation Starting	GROUP - I	30	97.7667	1.3047	94.0000	99.0000	98.0000	0.1433
	GROUP - II	30	98.3333	.9589	96.0000	100.0000	99.0000	
	GROUP - III	30	97.8000	1.3995	94.0000	99.0000	98.0000	
Oxygen Saturation at 5min	GROUP - I	30	97.6000	1.1326	95.0000	99.0000	98.0000	0.0215
	GROUP - II	30	98.2667	.8277	97.0000	100.0000	98.0000	
	GROUP - III	30	97.6000	1.1626	95.0000	99.0000	98.0000	
Oxygen Saturation at 10min	GROUP - I	30	97.1000	1.4937	94.0000	99.0000	97.0000	0.0065
	GROUP - II	30	98.1333	.7761	97.0000	99.0000	98.0000	
	GROUP - III	30	97.6667	1.2954	95.0000	99.0000	98.0000	
Oxygen Saturation at 15min	GROUP - I	30	97.4000	1.6103	92.0000	99.0000	98.0000	0.0291
	GROUP - II	30	98.3000	1.1788	95.0000	99.0000	99.0000	
	GROUP - III	30	98.1000	1.2134	95.0000	99.0000	98.5000	
Oxygen Saturation at 20min	GROUP - I	30	97.7333	1.5742	94.0000	99.0000	98.0000	0.0463
	GROUP - II	30	98.4333	.7739	97.0000	99.0000	99.0000	
	GROUP - III	30	98.2333	.7739	97.0000	99.0000	98.0000	
Oxygen Saturation at 30min	GROUP - I	30	98.4333	.7739	97.0000	99.0000	99.0000	0.8823
	GROUP - II	30	98.3333	1.0283	95.0000	99.0000	99.0000	
	GROUP - III	30	98.4333	.8584	96.0000	99.0000	99.0000	
Post-OP Oxygen Saturation at 5min	GROUP - I	30	98.3333	1.0283	96.0000	99.0000	99.0000	0.1595
	GROUP - II	30	98.6000	.8550	96.0000	99.0000	99.0000	
	GROUP - III	30	98.7333	.4498	98.0000	99.0000	99.0000	
Post-OP Oxygen Saturation at 10min	GROUP - I	30	98.3667	1.0981	96.0000	99.0000	99.0000	0.4498
	GROUP - II	30	98.5000	.9738	96.0000	99.0000	99.0000	
	GROUP - III	30	98.6667	.6065	97.0000	99.0000	99.0000	
Post-OP Oxygen	GROUP - I	30	98.8000	.4842	97.0000	99.0000	99.0000	0.9471
	GROUP - II	30	98.8000	.4842	97.0000	99.0000	99.0000	

Saturation at 15min	GROUP - III	30	98.8333	.3790	98.0000	99.0000	99.0000	
Post-OP Oxygen Saturation at 20min	GROUP - I	30	98.9667	.1826	98.0000	99.0000	99.0000	0.3844
	GROUP - II	30	98.9333	.2537	98.0000	99.0000	99.0000	
	GROUP - III	30	96.0000	16.4317	9.0000	99.0000	99.0000	
Post-OP Oxygen Saturation at 30min	GROUP - I	30	99.0000	.0000	99.0000	99.0000	99.0000	0.1480
	GROUP - II	30	98.8667	.4342	97.0000	99.0000	98.8667	
	GROUP - III	30	98.9667	.1826	98.0000	99.0000	98.9667	

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