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RESEARCH ARTICLE

PROSPECTIVE STUDY SHOWING EFFECTS OF GENERAL ANAESTHESIA ON TEMPERATURE CHANGES IN INDIAN ADULTS

Dr. Jaspreet Singh Khanna, Dr. Harinderpal Singh, Dr. Naveen Jindal, Dr. Ravi Jindal, Dr. Gurpreet Singh and Dr. Navjot Kaur

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Abstract

During intraoperative period patients are often unconscious or their autonomic system is partially blocked, and the operation suite is generally air-cooled. There are various other settings in operation theatre causing hypothermia under anaesthesia which can change patient's thermohomeostasis. This study will discuss the factors affecting the temperature changes during general anaesthesia in Indian Adults.

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Introduction:-

Adult human is regarded as homeothermic under normal range of ambient temperature and in the conscious state. During intraoperative period patients are often unconscious or their autonomic system is partially blocked, and the operation suite is generally air-cooled. Apart from these settings there are other perioperative factors such as duration of surgery, extent of body cavity exposure, volume of cold irrigations and infusions, anaesthetic drugs used and their effects on thermoregulatory control, low metabolic rate under anaesthesia and age of patient that can change patient's thermohomeostasis.

Aims and objectives:-

1. To assess the extent of temperature fluctuation in adult Indian patients during anaesthesia and recovery following surgery under general anaesthesia using volatile agents and controlled ventilation.
2. To evaluate the influence of such variants as age of patient, duration of surgery and cold transfusions.
3. To observe any undesirable effects such as delay in recovery.

Materials and Methods:-

Materials:

This study on Perioperative changes will be carried out on one hundred Indian adult patients undergoing general anaesthesia. This will be primarily divided into four equal groups based on their age irrespective of ASA status, undergoing major abdominal surgery lasting for one or more hours for elective surgery. Temperature was monitored at two different sites: Axillary and Nasopharyngeal. The groups were as follows:

- Group-1: 21-30 years of age
- Group-2: 31-40 years of age
- Group-3: 41-50 years of age
- Group-4: 51-60 years of age

Variables studied will be limited to:

Age, Duration of Surgery and Cold Transfusions.

Exclusion criteria:

Febrile patients, hyper and hypothyroid patients, Patients undergoing transplant surgery, Patients undergoing obstetrics and gynaecological procedures, Patients undergoing otorhinolaryngological procedures and Patients with coagulation disorders.

Methods:

Each patient was examined at pre-anaesthetic clinic and explained the procedure. Preoperative evaluation includes checking of nostrils, coagulation disturbances and febrile states. Axillary temperature was monitored with axillary and Nasopharyngeal with nasopharyngeal temperature probe (Mindray, Model: BeneView T8). Premedication was uniform in every patient. Baseline temperature readings were monitored. Ambient operation theatre temperature was maintained throughout the surgery and anaesthesia around 22°C.

Monitoring:

Nasopharyngeal temperature probe was placed in the nasopharynx via the nostril and fixed distance was measured from the angle of mouth to the tragus of ear. Axillary temperature probe was placed in the axilla.

Timing Of Temperature Recording:

1. Before induction.
2. After induction.
3. Half an hour after induction.
4. Then hourly till surgery lasts.
5. After reversal of relaxant and extubation.
6. One hour after end of surgery.
7. Any delay in recovery correlated to temperature was also checked.

Observation And Results:-

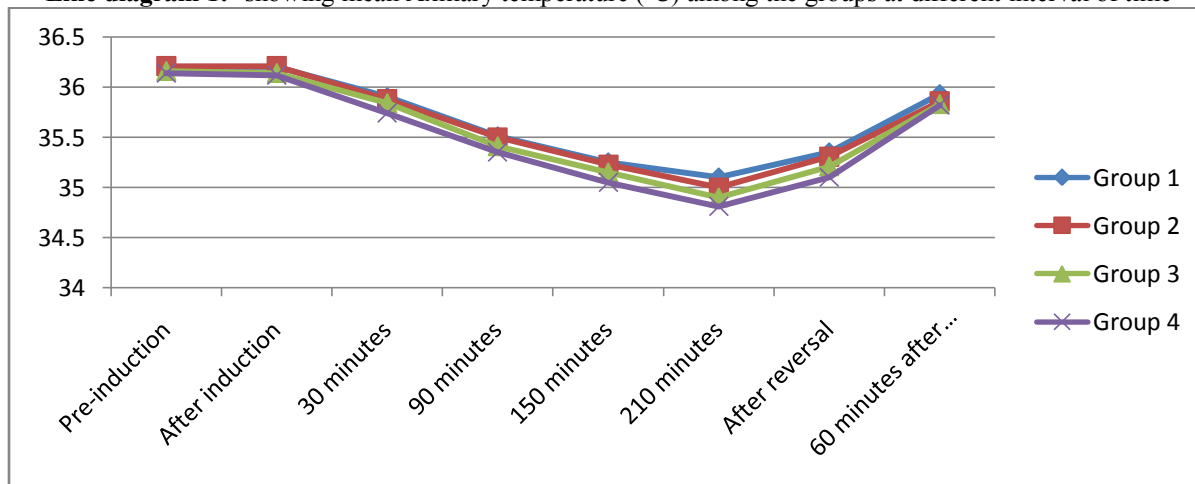
Results on the various parameters observed in this present prospective study showing effects of General Anaesthesia on Temperature changes in Indian adults.

Table 1:- Mean Duration of anaesthesia (minutes) among the groups.

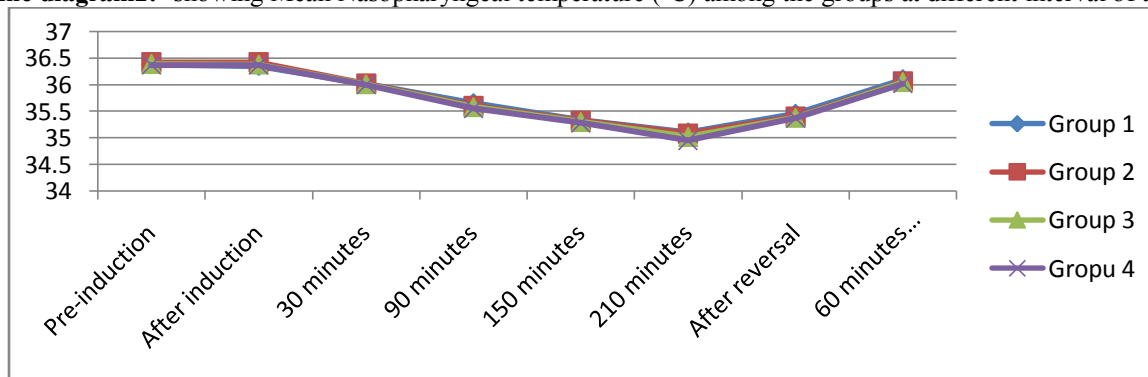
Parameter	Group 1	Group 2	Group 3	Group 4
Mean Duration of anaesthesia (range)	136.63 (70-220)	141.2 (70-240)	137.67 (65-250)	145 (70-255)

Table 2:- Mean Axillary temperature (°C) among the groups.

Parameter	Group 1	Group 2	Group 3	Group 4
Pre-induction	36.2 (36-36.5)	36.21 (36-36.4)	36.16 (35.9-36.5)	36.14 (35.9-36.4)
After induction	36.2 (36-36.5)	36.21 (36-36.5)	36.14 (35.9-36.5)	36.12 (35.9-36.4)
30 minutes	35.9 (35.6-36.2)	35.88 (35.6-36.2)	35.84 (35.4-36.2)	35.74 (35.2-36)
90 minutes	35.51 (35.2-35.8)	35.50 (35.1-35.7)	35.41 (35.1-36)	35.35 (34.9-35.6)
150 minutes	35.25 (34.9-35.6)	35.23 (34.9-35.6)	35.15 (35-35.6)	35.05 (34.7-35.2)
210 minutes	35.10 (34.8-35.4)	35 (34.7-35.3)	34.9 (34.5-35.2)	34.81 (34.4-35)
After reversal	35.35 (34.8-36)	35.31 (34.7-35.9)	35.21 (34.5-35.9)	35.1 (34.5-35.7)
60 minutes after Reversal	35.93 (35.6-36.4)	35.86 (35.6-36.2)	35.83 (35.5-36.1)	35.82 (35.5-36.1)

Line diagram 1:- showing mean Axillary temperature ($^{\circ}\text{C}$) among the groups at different interval of time**Table 3:-** Mean nasopharyngeal temperature ($^{\circ}\text{C}$) among the groups.

Parameter	Group 1	Group 2	Group 3	Group 4
Pre-induction	36.38 (36.1-36.8)	36.42 (36.2-36.7)	36.39 (36.2-36.8)	36.37 (36.1-36.7)
After induction	36.35 (36.1-36.8)	36.42 (36.2-36.7)	36.38 (36.2-36.8)	36.37 (36.1-36.7)
30 minutes	36.02 (35.7-36.4)	36.02 (35.8-36.4)	36.01 (35.7-36.4)	36 (35.5-36.4)
90 minutes	35.65 (35.4-36.2)	35.6 (35.3-36.1)	35.58 (35.2-36.1)	35.55 (35.2-36.1)
150 minutes	35.33 (34.9-35.6)	35.32 (34.8-35.6)	35.30 (34.7-35.7)	35.28 (34.5-35.8)
210 minutes	35.1 (34.7-35.4)	35.08 (34.7-35.3)	35.02 (34.5-35.2)	34.95 (34.3-35.2)
After reversal	35.45 (34.7-36.1)	35.4 (34.7-36)	35.38 (34.6-36)	35.37 (34.6-35.9)
60 minutes after reversal	36.1 (35.8-36.5)	36.06 (35.8-36.5)	36.05 (35.8-36.4)	36.02 (35.7-36.3)

Line diagram2:- showing Mean Nasopharyngeal temperature ($^{\circ}\text{C}$) among the groups at different interval of time**Table 4:-** Mean volume of crystalloids and colloids (ml) among the groups.

	Group 1	Group 2	Group 3	Group 4
Crystalloids	1474.65 (800-3300)	1405.33 (800-3500)	1417 (800-3300)	1488.67 (800-3000)

Colloids	500 (500-500)	665.85 (500-1000)	607 (500-1000)	500 (500-500)
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Table 5:- Incidence of undesirable effects among the groups.

SIDE EFFECTS	Group 1	Group 2	Group 3	Group 4
Delayed Recovery	0	0	1	4

Discussion:-

The present clinical study was aimed to observe the effects of General Anaesthesia on Temperature changes in Indian adults. Besides, evaluating the temperature changes under general anaesthesia we also observed the effects of duration of anaesthesia, cold transfusions and undesirable effects.

In this study, one hundred patients were selected between the age group of 21-60 years, undergoing elective surgery under general anaesthesia. The study group was divided into four groups of twenty five each based on their age. The various parameters studied were: age, duration of anaesthesia and recovery room temperature.

It was found that the fall in temperature at both the sites was greater with the increasing age and it was significantly higher in group 4, axillary temperature (p-value: <0.001) and nasopharyngeal temperature (p-value- <0.001). Similar results were found in a study conducted by Kongsayreepong et al¹. In their study they showed increasing age to be a significant risk factor for core hypothermia. Another study by Ozaki et al had reported similar results². Frank et al had also shown in their study that age is a significant risk factor for perioperative hypothermia during general anaesthesia³. Study on preoperative risk factor of intraoperative hypothermia in major surgery under general anaesthesia conducted by Kasai et al had also shown that increase in age was a major preoperative risk factor for intraoperative hypothermia during major surgery⁴. Vaghan et al⁵ showed the advanced age as a significant predisposing factor for perioperative hypothermia.

As a predictor of core hypothermia this study also showed that the duration of anaesthesia was a significant factor regarding the fall in temperature at both the sites: axillary (p-value- <0.001) and nasopharyngeal (p-value- <0.001). This result was in corroboration with the study done by Kongsayreepong et al¹ as mentioned above. This study explained that duration of anaesthesia longer than 2 hours was a significant predictor of core hypothermia.

The fall in axillary temperature (p-value- <0.001) and nasopharyngeal temperature (p-value- <0.001) was highly significant with the general anaesthesia.

Nearly all patients in the study become hypothermic, typically by 1-2°C. This fall in temperature is attributed to the fact that general anaesthesia reduces the vasoconstriction threshold well below the core temperature, thus inhibiting centrally mediated thermoregulatory constriction. Also anaesthetic agents cause direct peripheral vasodilation. This vasodilation allows core heat to flow down the temperature gradient into the peripheral tissues and this redistribution is the primary cause of hypothermia during the initial phase of general anaesthesia.

Our study showed that the fall in first 30 minutes in mean axillary temperature was 0.29°C and that of mean nasopharyngeal temperature was 0.34°C. The higher fall in core temperature signifies the core temperature to be a reliable predictor of hypothermia. Study conducted by Cork et al⁶ signified the fact that nasopharynx corresponds the core temperature while precision of axillary temperature was lesser. Benzinger et al⁷ had also signified similar observations.

The similar fall in temperature and effect of general anaesthetic agents was shown in the study 'Isoflurane-induced vasodilation: minimally increases cutaneous heat loss' conducted by Sessler and McGuire et al⁸. In another study conducted by Kurz et al also refers the same^{9,10}. This fact was also shown by the study conducted by Vaughan et al⁵. Matsukawa et al¹¹ has also shown similar results in their study on heat flow and distribution during induction of general anaesthesia.

In our study the fall in temperature at both sites had a significant correlation with amount of crystalloids and colloids infused, axillary (p-value- <0.001) and nasopharyngeal (p-value- <0.001) i.e. more the amount of fluids infused higher was the fall of core temperature. This finding was in corroboration with the results of study conducted by

Tausk et al¹². Study done by Kongsayreepong et al¹ showed similar results in temperature changes with the volume of crystalloids.

Incidence of delayed recovery was highest in group 4 but the overall incidence of delayed recovery was not significant. This high number of delayed recovery in group 4 can be attributed to the age in this group as compared to other groups.

Summary And Conclusion:-

The present clinical study was aimed at observing the perioperative temperature changes in Indian adults under general anaesthesia.

The following conclusions have been drawn from this study -

1. The fall in temperature at both the sites was greater with increasing age.
2. Duration of anaesthesia was a significant predictor of core hypothermia.
3. There was significant fall in temperature at both the sites with general anaesthesia. All the patients in the study became hypothermic by 1-2°C.
4. Amount of fluid transfused had a direct effect on fall in temperature at all the three sites.
5. Delayed recovery was observed more in older age group.

Concluding thereby the fall in temperature at both the sites was seen with general anaesthesia; these were influenced by increased age, increased duration of anaesthesia and the amount of fluid transfused. Delayed recovery and hypothermia were more significant with increased age. We have observed hypothermia in patients undergoing surgeries in general anaesthesia so strict temperature monitoring should be carried out and institute appropriate measures to prevent hypothermia such as forced air warmer and warm fluid transfusions.

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