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COMPARISON OF ARTERIAL OXYGENATION AFTER PREOXYGENATION WITH CPAP AND WITHOUT CPAP

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ABSTRACT **Background and Aims:** Preoxygenation and continuous positive airway pressure (CPAP) improve arterial oxygenation. we evaluated the effects of preoxygenation with CPAP or without CPAP by assessing the partial pressure of arterial oxygen (PaO2).

Materials and methods: Sixty patients requiring general anaesthesia were randomly divided into two groups. Group A patients (n = 30) were preoxygenated with 100% oxygen at a rate of 10 L/min for 3 min. In Group B (n = 30), 100% oxygen was administered at a rate of 10 L/min for 3 min with CPAP of 10 cm of H2O. PaO2 and PaCO2 were measured before and after the preoxygenation.

Results: In our study, there was statistically significant raise of mean PaO2 in CPAP group compared to control group (P < 0.0001).

Conclusion: preoxygenation with CPAP improves arterial oxygenation

KEYWORDS : preoxygenation, CPAP, arterial oxygen

INTRODUCTION

Functional residual capacity (FRC) is reduced by almost 1 L by moving from upright to supine position; induction of anesthesia further decreases the FRC by approximately 0.5 L[1]. This reduces the FRC from approximately 3.5 to 2 L, a value close to Residual volume.

The use of 100% oxygen during pre-oxygenation and induction of anaesthesia results in the development of atelectasis in dependent lung regions within minutes of anaesthetic induction.[2,3]

Application of continuous positive airway pressure (CPAP) during pre-oxygenation[4] increases the duration of apnoea before the development of significant arterial desaturation by preventing atelectasis, decreasing intrapulmonary shunt and increasing arterial oxygen[5].

MATERIALS AND METHODS:

This study was a prospective randomized double blinded study conducted during the period from June 2018 to November 2018 after obtaining the Institutional Ethical Committee clearance and informed consent from patients.

sixty patients of ASA physical status I and II of either sex, between the ages of 18 to 60 years posted for elective surgery requiring endotracheal anaesthesia were assigned into two groups.

Group A (control)
preoxygenated with 100% oxygen at a rate of 10 L/min for 3 min

Group B (CPAP) preoxygenated with 100% oxygen at a rate of 10 L/min with CPAP of 10 cm H2O for 3 min Exclusion criteria included chronic obstructive pulmonary disease, cardiac illness, obesity, pregnancy and anticipated difficult airway.

Pre- anaesthetic evaluation was done on the day before the surgery included history, general physical examination and routine investigations. Patients were randomly allocated to either Group A or Group B.

Baseline vital parameters were recorded and an IV line (18G) was started. All patients received a generalized anesthesia protocol and were premedicated with intravenous glycopyrrolate 0.2 mg and midazolam 1 mg.

Under strict aseptic precautions, the radial artery was cannulated after local infiltration with 2% lignocaine and a sample of arterial blood gas (ABG1) was taken with the patient breathing room air.

A circle system with carbon dioxide absorber was used for the preoxygenation in both the groups. circle system was flushed with 100% oxygen before connected to the patient. In both the groups, patients were asked to perform tidal volume breathing. A flow of 10 L/min of oxygen was used to preoxygenate the patients. The patients in Group A were preoxygenated for 3 min with 100% oxygen using a tight-fitting face mask without application of CPAP. In Group B, the patients were preoxygenated with 100% oxygen using a tight-fitting face mask for 3 min with the application of CPAP. The CPAP of 10 cm of H2O was ensured by adjusting the adjustable pressure limiting (APL) valve.

A sample of arterial blood was obtained after 3 min of pre-oxygenation to measure the level of PaO2 (ABG2). Patients in both the groups were induced by standard induction techniques. The patients were monitored for hemodynamic instability and desaturation throughout the study period. We also assessed the patient's tolerance of the tight-fitting face mask.

Data are expressed as mean ± standard deviation. Paired students' t' test was used for evaluation of demographic data and partial pressure of arterial oxygen. P < 0.05 was considered statistically significant. All statistical analyses were done using SPSS version 20.0 statistical software

RESULTS:

In our study the demographic characteristics age, weight, height and gender of the patients were found to be comparable in both groups.

Baseline PaO2 and PaCO2 (ABG1) were comparable between groups. The PaO2 measured following 3 min pre-oxygenation (ABG2) was 451.25 ± 74.60 mmHg in the group A and 552.38 ± 88.35 mmHg in the group B (CPAP). This difference was considered to be extremely statistically significant (P < 0.0001). [Table 1], [Figure 1].

However, the PaCO2 in the two groups at this point was comparable. Oxygen saturation was comparable in both the groups after preoxygenation.

TABLE 1

Arterial blood gas values (mean)	Group A(control) mmHg	Group B (CPAP) mmHg	P value
Base line PaO2	94.31± 4.60	94.29± 4.30	0.9862
Base line PaCO2	37.24± 7.30	36.85± 4.10	0.7995
PaO2 following pre-oxygenation	451.25 ± 74.60	552.38 ± 88.35	< 0.0001
PaCO2 following pre-oxygenation	36.56± 5.20	36.11± 3.60	0.6982

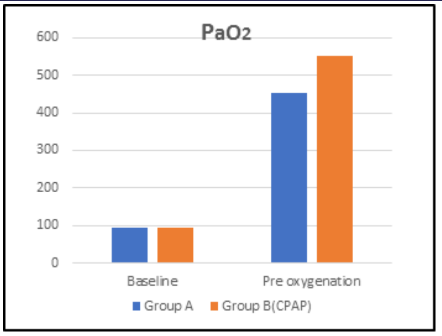

Figure 1

DISCUSSION:

During apnoea, oxygenation depends on the oxygen reserves available in the body. The principal stores of oxygen in an individual breathing air are in the lungs[6]. Breathing 100% oxygen causes a nearly three-fold increase in oxygen stores, most of this additional oxygen is accommodated in the alveolar gas. However, breathing 100% oxygen also results in near-complete denitrogenation of the alveoli. While breathing room air, the low solubility of nitrogen in the blood causes the unabsorbed nitrogen to act as a pneumatic splint and prevent atelectasis from developing.

During general anaesthesia, up to 85–90% of patients develop atelectasis in dependent lung regions within 5 min of anaesthetic induction[7]. This results in a decrease in functional residual capacity (FRC) which in turn causes a reduction in the oxygen stores in the body. In addition, it also increases the intrapulmonary shunt which will hasten desaturation to hypoxic levels[8].

The development of atelectasis is a consistent finding with the use of 100% oxygen for pre-oxygenation before induction of anaesthesia[9,10]. comparison of breathing 100%, 80%, and 60% O2 during induction demonstrated ubiquitous atelectasis with 100%, less with 80%, and even less with 60% O2 however, the trade-off for less atelectasis was a shorter safety margin before occurrence of O2 desaturation[12].

Application of CPAP helps in recruiting collapsed alveoli[11], which in turn helps in reducing ventilation–perfusion mismatch and the rate of desaturation. The advantage of using CPAP had been proven by the observation that a low inspired oxygen (0.5) with CPAP of 5 cmH2O resulted in improved arterial oxygenation than a high inspired fraction of oxygen (1.0) without CPAP[13].

In our study, patients preoxygenated with 100% oxygen with CPAP of 10 cm H2O had higher arterial oxygen tension than patients preoxygenated without CPAP (552.38 ± 88.35mmHg vs.451.25 ± 74.60 mmHg). similar results were obtained by Melveetil S. Sreejit et al. Application of CPAP 10 cm H2O permitted the use of 100% inspired O2 without formation of significant degrees of atelectasis[14].

In our study, there is no significant effects on the heart rate and blood pressure due to application of CPAP. An earlier study using a CPAP of 10 cm H2O has not reported any adverse effects on systolic and diastolic blood pressure[15].

CONCLUSION:

To conclude, pre-oxygenation with 100% oxygen at a rate of 10 L/min with CPAP of 10 cm H2O for 3 min prior to the induction of anaesthesia is a safe and simple technique, well-tolerated by patients, provides higher arterial oxygen tensions compared to pre-oxygenation with 100% oxygen without CPAP.

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