ISSN- O: 2458 - 868X, ISSN–P: 2458 – 8687
Index Copernicus Value: 68 . 16
PubMed - National Library of Medicine - ID: 101731606

International Journal of Medical Science and Innovative Research (IJMSIR)
IJMSIR : A Medical Publication Hub
Available Online at: www.ijmsir.com
Volume – 4, Issue – 4, August - 2019, Page No. : 65 - 75

Comparative Evaluation of Oxygen Saturation Using Conventional Versus Specially Designed Surgical Drape In Ophthalmic Surgery

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Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Aims: The present study was conducted on 200 patients of ASA grade I-III of either sex scheduled for cataract surgery under local anaesthesia (peribulbar block and retrobulbar block), selected in a randomized single blinded manner.

Materials and Methods: Pulseoximetry reading of O_2 saturation were recorded in patients Preoperatively after patients have received usual medications; After local anaesthesia (peribulbar and retrobulbar block); After patients's head was covered with ophthalmic drape; During surgery (at, 3, 6, 9, 12, 15 mins. And then at duration of 5 mins. Interval); Postoperatively for 3 mins. After surgery.

Patients comprised of 5 group

1. Control group or Group C- patients were allowed to breathe room air under the ophthalmic drape throughout the whole surgical procedure.
2. Group I – 2 L O_2/min. insufflated in ambient air under the drape.
3. Group II- Patients received 2 L O_2/min. through nasalcatheter.
4. Group III – patients received 2 L O_2/min. through nasal prongs.
5. Group IV – A specially designed drape was used allowing the patients to breathe freely the room air.

Results: Mean SpO2 marginally increases just after putting the drapes. The mean SpO2 decreases during the course of surgery when conventional drapes are used, O_2 supplementation in any form is able to increase mean SPO2, a flow of 2 L/min of O2 via nasal prongs appears to be a grood method. The specially designed drapes used by us also appear to be a good and reliable alternative to the conventional drapes in which SPO2 is well maintained throughout the course of surgery without supplementation of extra oxygen.

Conclusion: We recommend these specially designed drapes to be routinely used for all types of eye surgery done under LA.

Keywords: cataract, pulse oximetry, surgical drape

Introduction

Patients undergoing cataract surgery generally belong to geriatric age group. So, they represent a high risk group for hypoxia because of their age and coexisting pulmonary, cardiac or neurological diseases. It is obvious

that premedication, surgical draping, possible use of intraoperative sedatives and the concomitant diseases may predispose the patients to the risk of hypoxemia during ophthalmic surgery. There are even reports of respiratory arrest following retrobulbar block due to brain-stem anaesthesia.1,2

The report of the Joint Working Party on Anaesthesia in Ophthalmic Surgery by the Royal College of Anaesthetists and College of Ophthalmologists recommend that all patients under local anaesthesia should have careful monitoring including pulseoximetry, ECG, noninvasive blood pressure measurement and maintenance of verbal contact with the patients. Various studies have been conducted by which it has been proved that the ophthalmic drapes during cataract surgery create a semiclosed environment for CO2. So, there occurs rebreathing of CO2 which is exhaled in spontaneously breathing patients under the drapes. There is hypercapnia as evidenced by studies of PCO2 & PtCO2 values during cataract surgery under local anaesthesia when patients head is covered under drape (Schlager Andreas. Luger J Thomas, 1999).

Again, hypercapnia and hypoxemia are closely related.As we know, if concentration of N2 or other inert gases remain constant, the concentration of CO2 in alveolar gas only increases at the expense ofoxygen which must be displaced. Thus PAO2 and ultimately PaO2 decreases. Thus hypercapnia ultimately leads to hypoxemia. Hypercapniaresults into increased PaCO2 values which results in increased choroidal blood flow and IOP which can complicate the operation and aggravate the outcome. In sedated patients, early sympathetic nervous system reactivity to hypoxemia may be reduced and the effects of hypoxemia may be expressed only as bradycardia with severe hypotension and ultimately circulatory collapse. H. Palve and T. Ali Melkkila in 1991 also observed that some patients lying in quiet surrounding without disturbing sounds fell asleep which may be associated with moderate hypoxemia in elderly and obese patients. So, cataract surgery patients are in danger of hypoxemia even before transfer to operating room. The aim of O2 supplemntation is to increase pulmonary O2 reserve by raising the O2 fraction within FRC. Then, in the event of a decrease in CVS function (e.g. arrhythmia, hypotension), O2 transport is already optimal and there is time for the surgeon to safe guard the operative site before intervention in the airway becomes mandatory.

J.E. Risdall and I.F. Geraghty (1997) in their study concluded that oxygen supplementation should be provided for all patients having ophthalmic surgery under LA which can be achieved with good patient acceptability and clinical reliability using low flows of oxygen through securely positioned nasal cannulae.

G. Michelson, B. Naujoks in 1991 in there study found that O2 administration by a nasal probe improves respiration in cataract surgery after retrobulbar naesthesia. In their sudy, Palve et al (1991) have concluded that pulseoximetry is a convenient and clinically adequate method to assess the oxygenation of patients for cataract surgery under local anaesthesia and that spontaneously breathing fully covered patients are difficult to be monitored in any other way.

In view of above reported studies and lack of reports of monitoring in Indian patients undergoing cataract surgery under local anaesthesia, it was decided to undertake the present work of monitoring of O2 saturation during cataract surgery under LA in our department. In the present study we also compared the four methods to increase the oxygen content of the inspired air of the patients undergoing cataract surgery under local

anaesthesia without making any intervention in the course of operation.

Material and Method

The present study was conducted on 200 patients of ASA grade I-III of either sex scheduled for cataract surgery under local anaesthesia (peribulbar block and retrobulbar block), selected in a randomized single blinded manner.

In the morning (8 am) of the day of surgery patients received tab acetazolamide 500mg. Tab chlorpheniramine 25 mg, injection gentamycine 80 mg., injection TT 0.5 ml i.e. which is routinely given in our institution by the ophthalmologists. Xylocaine sensitivity test was also done in every patients..

Patients comprised of 5 groups

Control group or Group C- patients were allowed to breathe room air under the ophthalmic drape throughout the whole surgical procedure.

Study groups-Group I – 2 L O_2/min. insufflated in ambient air under the drape.

Group II- Patients received 2 L O_2/min. through nasalcatheter.

Group III – patients received 2 L O_2/min. through nasal prongs.

Group IV – A specially designed drape with a knitted window over the patient's nose was used allowing the patients to breathe freely the room air. A sterile cotton drape measuring 63 cm x 53cm having a circular aperture for eye to be operated (5 cm x 4 cm) and a knitted window (10 cm x 9 cm) with holes about 1/2x ½ cm was placed over patients head in a way that the knitted window was adjusted over patients nose.

Discussion

The present study has been done on 200 patients of ASA grade I-III of either sex scheduled for cataract surgery under LA. Patients were selected in a randomized single blinded manner. All the patients were thoroughly examined and necessary investigations were done. History of smoking if any was noted. Patients comprised of 5 groups (Group C, GroupI, II, III & IV) of 40 patients each. Group C patients were allowed to breathe roomair under ophthalmic drape and acted as control group. GroupI patients received 2 L of O_2/min which was insufflated in the ambient air under the drape. Group II patients received 2 L of O_2/min through nasal catheter. Group III patients received 2 L of O_2/min through nasal prong, whereas Group IV patients were not given anyoxygen and were allowed to breathe freely room air after draping themwith a specially designed drape which had a knitted window which covered the patients nose.

The history of smoking was obtained from all the patients. None of the female patients gave history of smoking. The mean pulse rate and BP of all the patients in all the group remained stable throughout the surgery except total 3 patients (one each of in Group C, Group I and Group IV) had bradycardia (pulse < 50 /min) during the course of surgery and were treated with i.v. atropine 0.6 mg. 1 patient who did not respond to i.e. atropine was advised ECG and later on was diagnosed as complete heart block.

In group IV patients, the mean SPO_2 recorded before the block was 95.075 ± 0.62. The mean SPO_2 recorded slightly lower in group IV patients was because of few patients in this particular group had a very low SPO_2 (93-94%) which could have been because of some lung pathology. Because of small number of total patients (n= 40) studied in various groups, these 3 patients were able to affect the mean SPO_2, level in this particular group. The respiratory rate of all the patients in all groups was closely monitored. There was no significant variation in respiratory rate in any of the patients in all the groups during the couse of surgery.

We have recorded and compared the saturation of oxygen at various stages of the cataract surgery in our set up. The comparison has been done from mean initial SPO_2 of all the patients. In the control group, SPO_2 marginally decreased after instituting the retrobular or peribulbar blocks and this decrease was found to be statistically just significant ($p < 0.05$), whereas, there was marginal decrease in saturation of O_2 in group I patients and practically no change in Group II and III patients after institution of block which was also found to be statistically insignificant. But, the Group IV patients, it was interesting to note that the saturation of O_2 increased after the block and this increase was also found to be statistically highly significant. This could have been because of anxiety. This increase was possibly because in this Group of patients, the mean initial SPO_2 was little lower as compared to other patients of various groups where the initial mean SPO_2 was already on higher side. When mean SPO_2 in various groups was compared from the initial mean SPO2 levels, after putting the drapes and after insufflations of O_2 by different methods in Group I, II and III it was interesting to note that after a period of 5 mins., the mean SPO_2 levels slightly increased in control group of patients where no oxygen was supplemented. This was found to be statistically just significant ($P < 0.05$). Similarly a rise in SPO_2 was seen in group I, II and III patients which was found tob e highly significant statistically. Similar rise was also seen in Group IV patients which was found to be highly significant on statistical analysis. Palve H. and Ali Melkkila T. (1991) have also reported a rise in O_2 saturation after draping the patients. It is evident that a rise in O_2 saturation occurs upto a period of 5 mins., after application of drapes in all the patients irrespective of O_2 insufflation. However, rise in satutation occurs much more when O_2 is insufflated. This could have been because of the anxiety in the patients, the level of which is usually more in the initial period because of variety of reasons (lying on operation table, putting the drapes, manipulating the eye and entirely a changed unacclamatised environment).

The mean SP O_2 recorded during the course of surgery was 95.91± 1.68% in control group when compared with mean initial SPO_2 (98.45 ± 1.3%) it was found tobe little lower from mean initial values. On statistical analysis, this decrease was found to be veryhighly significant. It is evident that after initial period of 5 mins thereis a substantial decrease in saturation of oxygen in control group of patients in whom O_2 was not supplemented in any form. This may owe to rebreathing of CO, accumulated under the drape by the patients which ultimately lead to hypoxia and fall in oxygen saturation. The other workers, Palve H. et al (1991), Michelson G & Naujoks B (1991), Risdall J.E. and Geraghty I.F. (1997) also reported an identical decrease in saturation of O_2 after covering the patients which drapes without supplementation of O_2 during the period of surgery.

In group I patients, in whom O_2 2L/min was trickled underneath the drape, the saturation of O_2 marginally increased but on statistical analysis this decrease was again foundto be highly significant ($P < 0.001$). Similarly, in GroupIIand III patients, in whom O_2 2L/min. was given with nasal catheterand nasal prongs respectively, also showed a rise in O_2 saturation and this rise was again found to be very highly significant ($P < 0.0001$).

The Group IV patient did not show a fall in saturation of O_2 after putting the drapes as compared to the patients of control group. This could have been because of practically no rebreathing underneath the drapes in Group IV patients because of special design of the drape i.e. a knitted window through of special design of the drape i.e. a

knitted window through which patient could breathe freely from the atmosphere. As the initial mean saturation of O_2 was very low in group I"V" patients, a little rise in saturation of O_2 because of wider difference appeared to be very highly significant on statistical analysis. A larger series will be required to further substantiate our finding.

It is evident that the saturation of O_2 remains on lower isde throughout the course of surgery when conventional method of draping the patient is used for cataract surgery.Supplementing O_2 in any form raises the saturation of O_2 during the course of surgery. The newly designed drape by us is also good and there is nofall in saturation of O_2 in this group of patients. On the contrary, there is a little rise in saturation of O_2 when these drapes are use

When mean SP O_2 was observed in the immediate postoperative period after a period of 3 mins, there was a rise in saturation of O_2 in the control group of patients after removal ofdrapes and their saturation of oxygen reached almost equal to the pre-blockvalues. Similarly, in Group I patients, the saturation of O2 reached to its pre-block value and there was no significant difference in the values of saturation which was also substantiated on statistical analysis. But, Group II, III and IV patients showed a little rise in saturation of O_2 upto a period of 3 mins in the postoperative period (3 mins) and on statistical analysis, this difference when compared from mean initial preblock values of saturation were found to be statistically highly significant. Other workers Schlager Andreas and Luger J Thomas (2000) have reported that saturation of O_2 comes to near baseline values in postoperative period. In our series, some of the patients specially in Group II, III and IV had higher SPO_2 levels as compared to base values. This is very difficult to explain but could have been because of pain and anxiety in some of the patients of these groups and also because these patients (in Group II and III) were given O_2 theroughout the course of surgery and it is likely that the desaturation could not have been achieved after a period of 3 mins in the postoperative period.

Conclusion

In the present study, 200 patients in ASA grade I-III of either sex undergoing cataract surgery under local anaesthesia were studied. Patients comprised of 5 groups (Group C, Group I, II, III and IV) of 40 patients each. Group C patients acted as control and were allowed in breathe room air under the conventional ophthalmic drape. Group 1 patients received 2L of O2/min. which was insufflated in ambient air under the drape. Group II patients received 2L of O2/min through nasal catheter and Group III patients also received 2L of O2 /min through nasal prongs. Group IV patients were allowed to breathe freely room air after draping them with a specially designed drape by us which had a knitted window which covered the patient's nose. These patients did not receive extra oxygen in any form.

O2 saturation of all the patients in various groups was seen before and after the block and thereafter monitored throughout the course of surgery (with the help of pulseoximeter). It was also monitored in the postoperative period up to a period of 3 mins.

From the present study, it is concluded that:

1. The mean age of the patients coming for cataract surgery in our institution is 60.615 ± 10.66 years.
2. The sex wise distribution of the patients was found to be even except for a particular period, which recorded very high ratio (72.3%) of males as compared to females.
3. That smoking is very common in male patients coming for cataract surgery in our area.

4. The mean pulse rate, BP and respiratory rate usually remains stable during cataract surgery done under LA but occasionally bradycardia my be precipitated in some patients. Hence we recommend a continuous monitoring of pulse and O2 saturation of the patients undergoing cataract surgery under LA.
5. The normal mean SPO2 of patients with a mean age of 61.615 ± 10.66 years coming for cataract surgery was 97.4 ± 1.64% and represents the normal mean SPO2 of the population in and around Jabalpur.
6. The mean SPO2 marginally increases just after putting the drapes because of sympathetic stimulation, which occurs as a result of variety of factors.
7. The mean SPO2 decreases during the course of surgery when conventional drapes are used, probably because of CO2 retention and rebreathing under the drapes leading to decrease in partial pressure of O2.
8. O2 supplementation in any form is able to increase mean SPO2 which we recommend to be used routinely during cataract surgery when performed with conventional drapes.
9. A flow of 2 L/min of O2 via nasal prongs appears to be a grood method. It not only raises SPO2 but appears to be much more compliant for the patients.
10. The specially designed drapes by us also appear to be a good and reliable alternative to the conventional drapes in which SPO2 is well maintained throughout the course of surgery without supplementation of extra oxygen.
11. We recommend these specially designed drapes to be routinely used for all types of eye surgery done under LA.

Legends Tables and Figures

Table 1: Age wise distribution

Age range (yrs.)	Group C (n=40)	Group I (n=40)	Group II (n=40)	Group III (n=40)	Group (n=40)
30-39	1	0	3	2	2
40-49	5	6	2	2	5
50-59	13	5	4	9	6
60-69	14	21	14	16	18
70-79	7	8	15	10	6
80 &> 80	0	0	2	1	2
Mean ± SD	58.425 ± 9.84	60.775± 9.231	60.575 ± 10.74	604.0 ± 11.00	59.275 11.921

Most of the patients included in the study belonged to age group of 60-70 yr

Table 2: Weight Wise Distribution

Weight (kg)	Group C (n=40)	Group I (n=40)	Group II (n=40)	Group III (n=40)	Group IV (n=40)
30-39	1	5	7	3	2
40-49	12	13	18	15	12
50-59	18	17	10	14	20
60-69	9	5	5	8	6
Mean ± SD	52.55 ± 6.64	49.125 ± 8.16	60.575 ± 10.74	50.975 ± 8.55	59.275 ± 11.921

Most of the patients belonged to wt group of 50-59 kg

Table 3 : Sex wise (%) distribution

	Male	Female
Group C	29(72.5%)	11(27.5%)
Group I	18(45%)	22(55%)
Group II	22(55%)	18(45%)
Group III	22(55%)	18(45%)
Group IV	23(57.5%)	17(42.5%)

Table 4: Distribution of male patients with relation to smoking

	Smoker	Non smoker
Group C	20(68.9%)	9
Group I	14(77.77%)	4
Group II	17(77.2%)	5
Group III	18(81.8%)	4
Group IV	17(73.9%)	6

No female patient had given the history of smoking. No patients had given history of passive smoking

Table 5: Initial mean pulse rate of patients in various groups

Groups	Mean pulse rate (Mean ± SD) per minute
Group C	77.95 ± 11.16
Group I	83.9 ± 16.59
Group II	83.775 ± 18.47
Group III	76.157 ± 14.54
Group IV	77.1 ± 11.55

Pulse rate was also recorded along with SPO2 during the whole course of surgery and post operatively. There was no significant variation of pulse rate inany of the groups during the course of surgery.

Three patients (one each in group C, group I and Group IV) were treated with i.v. atropine 0.6 mg as there was bradycardia during the course of surgery (pulse < 50/min). Later on, one of the patients was diagnosed as having complete heart block.

Table 6: Initial mean BP of patients in various groups (Mean ± SD)

Groups	Systolic (mm Hg)	Diastolic (mm Hg)
Group C	124.8 ± 13.74	76.8 ± 7.88
Group I	119.2 ± 11.45	72.15 ± 7.79
Group II	122.0 ± 11.39	75.15 ± 9.19
Group III	115.3 ± 11.33	67.9 ± 7.58
Group IV	121.7 ± 19.08	75.4 ± 10.24

Two patients in Group IV were found to be hypertensive. They were not on any anti-hypertensive drug. They were given i.v. mannitol by ophthalmologists to drcrease the I.O.P.

Table 7: Mean Age of all patients in the study and initial mean SPO2 of all patients in the study (before block)

Mean age of patie (n=200)	Initial Mean SPO2 of patients (before block) Mean ± SD
60.615 ± 10.66	97.4 ± 1.64

Table 8: Mean SPO2 of patients in various groups before block

Groups	Mean ± SD
Group C	98.45±1.31
Group I	98.15 ± 0.92
Group II	97.73± 1.43
Group III	97.60±1.29
Group IV	95.075±0.62

Table – 9: Mean SPO2 of patients of various groups after block

Groups	Mean ± SD
Group C	97.875±1.32
Group I	97.975±0.99
Group II	97.67±1.18
Group III	97.6±1.24
Group IV	97.9±1.31

Table – 10: Mean SPO2 of patients in various groups (5 mins after starting O2 supplementation)

Groups	Mean SPO2(Mean±SD)
Group I	99.25±0.63
Group II	99.7±0.52
Group III	99.575±0.52

Table – 11: Mean SPO2 of patients of group C and group IV after draping (Mean ± SD)

Group	Mean SPO2±SD
Group C	99.15±0.769
Group IV	98.6±1.215

In group C patient's head was covered with conventional drape whereas, in Group IV the specially designed drape with knitted window over the nose was used.

Table – 12: Mean SPO2 of patients in various groups during surgery with range of SPO2during surgery (Mean ± SD)

Group	Mean SPO2 during surgery (Mean±SD)	Range of SPO2 during surgery(Mean±SD)	
		Minimum	Maximum
Group C	95.91±1.68	95.4±2.42	99.1±1.057
Group I	98.76±0.79	98.4±0.98	99.525±0.5
Group II	99.078±0.79	99.03±0.697	99.925±0.2
Group III	99.32±0.49	98.975±0.73	99.875±0.3
Group IV	97.05±1.41	95.975±1.702	98.175±1.3

The owest mean SPO2 during surgery was recorded in Group C and the highest mean SPO2 during surgery was recorded in Group III.

Table 13: Range of respiratory rate of patients in various groups (Mean ± SD)

Group	Minimum	Maximum
Group C	19.8±3.02	22.7±3.24
Group I	22.35±2.52	23.85±3.28
Group II	22.05±2.46	23.05±2.511
Group III	21.4±2.57	23.15±2.35
Group IV	20.33±2.485	22.05±3.23

There was no significant variation of respiratory rate in any of the groups during the course of surgery.

Table 14: Mean postoperative SPO2 of patients in various groups (3 mins. After completion of surgery)

Group	(Mean ± SD)
Group C	98.5±1.22
Group I	98.25±0.78
Group II	98.725±0.15
Group III	99.85±0.36
Group IV	97.33±1.35

Table – 15: Comparison of Mean SPO2 of patients in various group recorded before block and afterblock (Mean ± SD)

Group	Before block	After block	p value	
Group C	98.45±1.31	97.875±1.32	<0.05	Significant
Group I	98.15±0.92	97.975±0.99	>0.05	Non Significant
Group II	97.73±1.43	97.67±1.18	>0.05	Non Significant
Group III	97.6±1.29	97.6±1.24	>0.05	Non Significant
Group IV	95.075±0.62	97.9±1.31	<0.001	Highly Significant

There was decrease in mean SPO2 of patients of group C after block. Whereas in study group IV there was increase in mean SPO2 value after block than initial value of before block from 95.075 ± 0.62 to 97.9 ± 1.31% and statistically found tob e highly significant

Table – 16: Comparison of Mean SPO2 in various groups before block and mean SPO2 after draping and after 5 mins of starting of O2, (Mean ±SD)

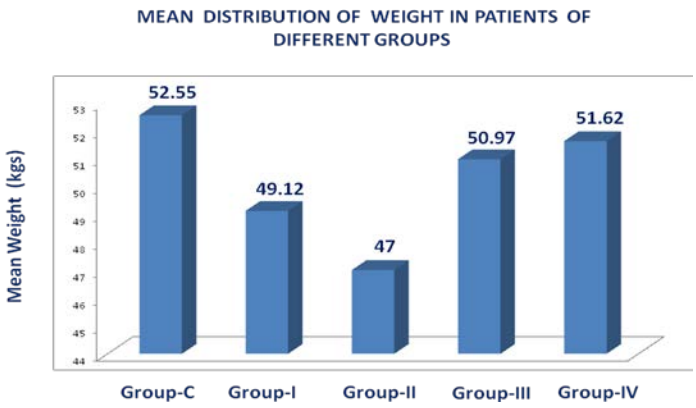
Group	Before block	Mean SPO2		p value	
Group C	98.45±1.31	99.15± 0.769	After draping	<0.05	Significant
Group I	98.15±0.92	99.25± 0.63	5 mins After starting Of O2	<0.001	Highly Significant
Group II	97.73±1.43	99.7± 0.52		<0.001	Highly Significant
Group III	97.6±1.29	99.575± 0.52		<0.001	Highly Significant
Group IV	95.075±0.62	98.6± 1.215	After draping	<0.001	Highly Significant

Table – 17 : Comparison mean SPO2 of patients in various groups before block with mean SPO2 recorded during surgery (Mean ± SD)

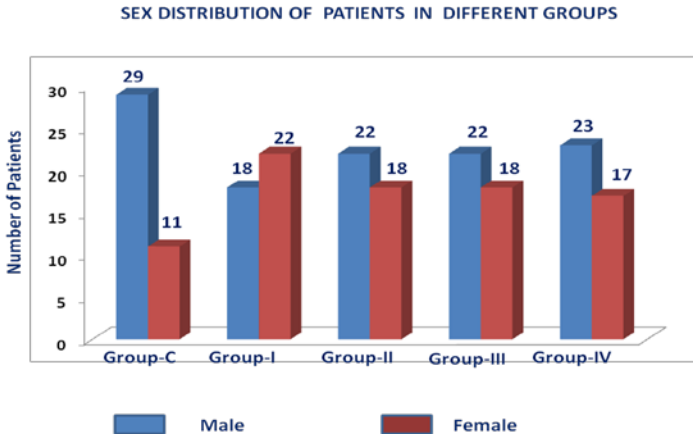
Group	Before block	During surgery	p value	Significance
Group C	98.45± 1.31	95.91± 1.68	<0.0001	Highly Significant
Group I	98.15± 0.92	98.76± 0.79	<0.001	Highly Significant
Group II	97.73± 1.43	99.078± 0.79	<0.0001	Highly Significant
Group III	97.6± 1.29	99.32± 0.49	<0.0001	Highly Significant
Group IV	95.075± 0.62	97.05± 1.40	<0.0001	Highly Significant

Statistically the results of comparison are found to be highly significant in group I and very highly significant in Group II and III. In study group IV also there is increase in mean SPO2 value during surgery from initial value of 95.075 ± 0.62 to 98.05 ± 1.40% and foundto be statistically very highly significant.

Graph 1



Graph 2



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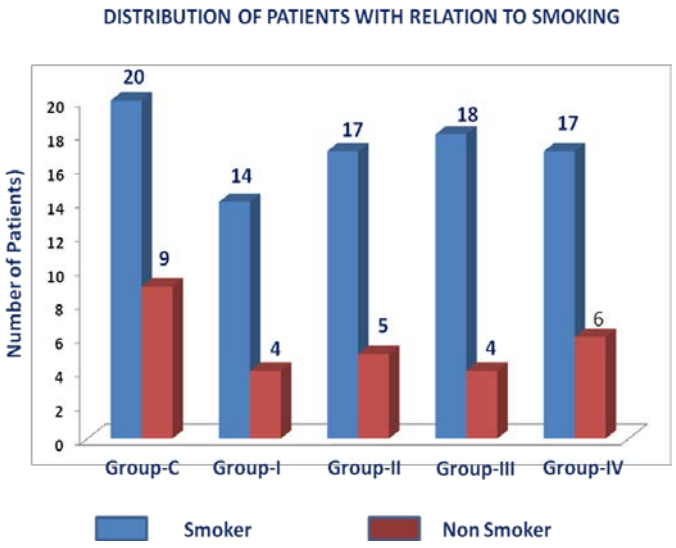

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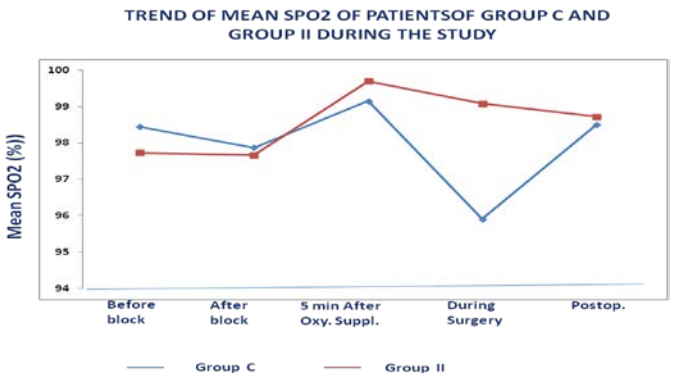

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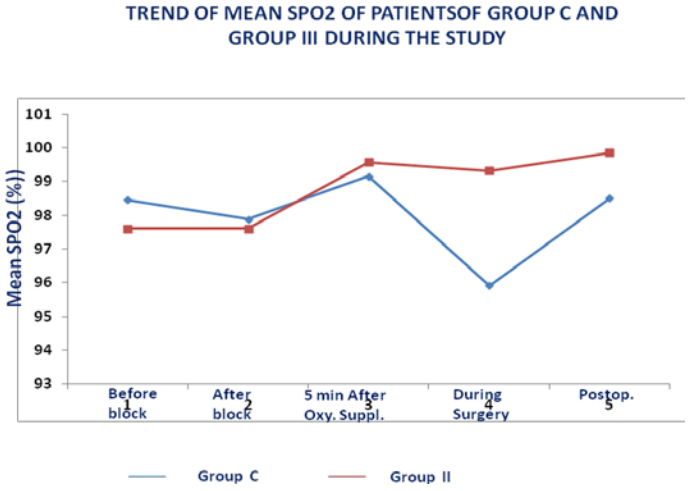

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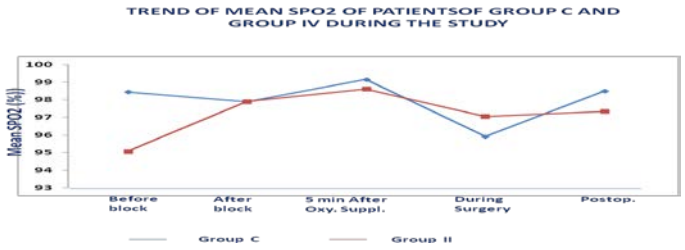

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