Journal of Cardiovascular Disease Research

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

A PROSPECTIVE STUDY OF PREDICTIVE FACTORS REDUCING ARTERIAL OXYGENATION DURING ONE LUNG ANAESTHESIA

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Abstract:

Introduction: The risk of developing hypoxaemia remains a major concern when the use of one-lung anaesthesia (OLA) is considered for thoracic surgery) Several factors such as hypoxic pulmonary vasoconstriction (HPV), lung collapse and gravity are known to ameliorate the decrease in arterial oxygen tension (PaO2) which occurs during OLA. However, the factors which determine whether an individual patient will develop clinically important arterial oxygen desaturation during OLA have remained unclear.

Materials and Methods: A cross-sectional study was conducted among 68 patients who came for lung or non-lung surgery in the Department of Anaesthesia, Govt General and Chest Hospital, Erragadda, Hyderabad during a period of two years. All the ASA grade I and II patients who needed One Lung Anaesthesia (OLA) during the study period either for lung or non-lung surgery were included in this study. The exclusion criteria were patients less than 15 years, presence of cardiovascular disease, anticipated difficult intubation and inability to isolate the lungs properly after double lumen tube insertion. On the patient arrival in the operating room peripheral and central intravenous cannulations and percutaneous arterial line insertion were done under local anaesthesia. Blood samples for preoperative PaO2, PaO2 during two lung ventilation (TLV), PaO2 at 10 mins and 25 mins. After starting OLA were taken and assessed.

Results: Total number of patients in this study were 68. Out of this 44 (64.7%) were males and 24 (35.29%) were females. Patients undergone right thoracotomy was 26 (38.23%) and left thoracotomy was 42 (61.76%). Among the 68 patients 48 (70.59%) underwent lung surgery, while 20 (29.41%) underwent non-lung surgery. Mean PaO2 at different stages of surgery is described in Table No. 1. Table No. 2 shows that there is a significant increase in the PaO2 at 25 minutes in patients who had their left lung collapsed during surgery. Under the same conditions, PaO2 with the right lung collapsed shows a drop. In Table No. 3 non-smokers showed a lower

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PaO2 at 25 minutes of one lung ventilation when compared to smokers. The females in the study showed a significantly higher PaO2 at 25 minutes of one lung ventilation.

Conclusion: Our study was an attempt to show that it is possible to predict preoperatively the patient who is likely to suffer from hypoxaemia during OLA. The ability to predict the subsequent arterial oxygenation allows the anaesthetists/surgeons to assess and rationalize risk/benefits regarding the use of OLA during thoracic surgery and permits more controlled intraoperative management of oxygenation.

Key Words: hypoxaemia, One Lung Anaesthesia, PaO2, arterial oxygen tension.

INTRODUCTION

The risk of developing hypoxaemia remains a major concern when the use of one-lung anaesthesia (OLA) is considered for thoracic surgery) Several factors such as hypoxic pulmonary vasoconstriction (HPV), lung collapse and gravity are known to ameliorate the decrease in arterial oxygen tension (PaO2) which occurs during OLA.[1] However, the factors which determine whether an individual patient will develop clinically important arterial oxygen desaturation during OLA have remained unclear.[2]

It has previously been demonstrated that it is possible to predict the PaO2 during OLA when continuous positive airway pressure (CPAP) is administered to the non-ventilated (non-dependent) lung) This study was designed to see if a formula could be developed which would predict the PaO2 during OLA without CPAP; then to use this formula prospectively to determine its potential to identify those patients most likely to require abandonment of OLA due to unacceptably low PaO2 values (defined as an arterial oxygen saturation <85%).[3]

During OLA when there is arterial desaturation, various measures can be initiated to increase the oxygenation. These measures are increasing the FiO2, non-dependent lung CPAP and dependent lung PEEP.[4] To carry out this, we need an additional oxygen source and circuit in the case of CPAP and a retard valve for PEEP. CPAP is not desirable in all the patients prophylactically, as it may interfere with the surgery. Therefore, if we can predict which patients will have the need for these measures it will enable us to be prepared to use them before hypoxaemia occurs without having to use it for all patients as routine. This study was an attempt to find out the predictive factors for decreasing PaO2 and to find out if it was possible to predict which patient will have a clinically important decrease of PaO2 during OLA for thoracic surgery based on these factors.[5]

Objectives of the study are to find out the potential factors that reduce arterial oxygenation (PaO2) during One Lung Anaesthesia (OLA) and to find out the possibility of predicting the PaO2 during One Lung Anaesthesia (OLA) based on these potential factors.

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MATERIALS AND METHODS

Study design: A cross-sectional study

Study location: Department of Anaesthesia, Govt General and Chest Hospital, Erragadda, Hyderabad.

Study duration: January 2021 to December 2022 (two years).

Sample size: 68 patients

A cross-sectional study was conducted among 68 patients who came for lung or non-lung surgery in the Department of Anaesthesia, Govt General and Chest Hospital, Erragadda, Hyderabad during a period of two years from January 2020 to December 2022.

All the ASA grade I and II patients who needed One Lung Anaesthesia (OLA) during the study period either for lung or non-lung surgery were included in this study.

The exclusion criteria were patients less than 15 years, presence of cardiovascular disease, anticipated difficult intubation and inability to isolate the lungs properly after double lumen tube insertion. On the patient arrival in the operating room peripheral and central intravenous cannulations and percutaneous arterial line insertion were done under local anaesthesia. Blood samples for preoperative PaO2, PaO2 during two lung ventilation (TLV), PaO2 at 10 mins and 25 mins. After starting OLA were taken and assessed. Alteration in PaO2 related to side, smoking and gender was measured by mean ± SD. The data were analysed by multiple linear regression to assess the independent contribution of each of these 9 predictors with OLA PaO2 at 25 mins.

RESULTS

Total number of patients in this study were 68. Out of this 44 (64.7%) were males and 24 (35.29%) were females. Patients undergone right thoracotomy was 26 (38.23%) and left thoracotomy was 42 (61.76%). Among the 68 patients 48 (70.59%) underwent lung surgery, while 20 (29.41%) underwent non-lung surgery. Mean PaO2 at different stages of surgery is described in Table No. 1. Table No. 2 shows that there is a significant increase in the PaO2 at 25 minutes in patients who had their left lung collapsed during surgery. Under the same conditions, PaO2 with the right lung collapsed shows a drop. In Table No. 3 non-smokers showed a lower PaO2 at 25 minutes of one lung ventilation when compared to smokers. The females in the study showed a significantly higher PaO2 at 25 minutes of one lung ventilation.

PAO2 level	Mean	SD	Minimum	Maximum
Pre-op PaO2	90.3	11.15	70.54	111.10
TLV PaO2	150.67	46.38	62.16	265.17
OLV PaO2 10	110.17	41.65	45.29	215.70

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mins				
OLV PaO2 25 mins	100.10	42.65	57.27	198.20

Table 1: Arterial Oxygenation Saturation at Different Stages of Surgical Procedure

Variable	No of patients	Pre-OP Pao2	PaO2 at 25 mins
Right side	26	91.7±10.15	86.50 ± 16.00
Left side	42	91.16±20.12	108.52 ± 39.00

Table 2: PaO2 Levels and the Side of Thoracotomy

Variable	No of patients	Pre-OP Pao2	PaO2 at 25 mins
Smoker	22	89.75±12.30	98.42±32.17
Non smoker	46	94.12±7.27	86.17±16.12

Table 3: PaO2 Levels and Smoking

Variable	No of patients	Pre-OP Pao2	PaO2 at 25 mins
Males	44	90.65±10.13	94.32±27.21
Females	22	91.40±32.17	110.65±42.10

Table 4: PaO2 Levels and Sex

S.No	Factors	Unstandardised regr. coeffic	P Value
1	Pre-op PaO2	-.90	0.13
2	Side of Surgery	34.83	0.01
3	Sex	31.65	0.04
4	Lung Surgery	-14.25	0.41
5	Weight	-1.27	0.10
6	Age	.27	0.64
7	Smoking/Non	-36.00	0.03
8	FEVI	30.70	0.25
9	Vital Capacity	-10.25	0.66

Table 5: **Predictive Factors in Altering PaO2 Levels-Multiple Linear Regression**

DISCUSSION

It has been generally appreciated that the side of surgery affects the PaO2 during OLA. The left lung receives 10% less perfusion than the right lung. In addition, the dependent lung receives 10% more than its usual blood flow.[6] So it seems feasible that patients having left thoracotomy with the left lung collapsed will have better oxygenation than when the right lung is collapsed. Based on the data of this study, a patient having left thoracotomy had a significantly higher PaO2 at 25 minutes than the patient with right-sided thoracotomy.[7] Therefore, the side of the operation

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 05, 2023

is a statistically significant factor in predicting the PaO2 during OLA. Slingers et al also got similar results with regard to the side of the operation. The females (n=24) in our study had a much higher PaO2 than the males at 25 minutes (Mean increases 16.6 mmHg).[8]

This result is statistically significant in this study. Therefore, this would be one of the variables in the predictive equation. We do not have any explanation for this phenomenon. This may be due to having fewer numbers of females during the study period and larger number will be required to present this evidence as conclusive. The mean pre-operative PaO2 in smoker was 89.75 mmHg and non-smoker was 94.12 mmHg and PaO2 at 25 minutes also showed a higher PaO2 in smokers (Table No.5).[9]

This study has shown a significant negative correlation in the smokers. Even though we expect smokers to have a lower PaO2, they had higher PaO2 than the non-smokers. All smokers in this study had stopped smoking for at least two weeks prior to surgery and had bronchodilator therapy and physiotherapy when indicated. Cessation of smoking is considered to reverse the airway abnormalities in smokers. It has been shown that bronchodilators improves not only air flow obstruction and lung mechanism, but also gas exchange abnormalities.[10]

CONCLUSION

Our study was an attempt to show that it is possible to predict preoperatively the patient who is likely to suffer from hypoxaemia during OLA. The ability to predict the subsequent arterial oxygenation allows the anaesthetists/surgeons to assess and rationalize risk/benefits regarding the use of OLA during thoracic surgery and permits more controlled intraoperative management of oxygenation.

REFERENCES

1. *Knudson RJ, Lebovitz MD, Holberg CJ, Burrows L*. Changes in the normal maximal expiratory flow-volume curve with growth and aging. Am Rev Respir Dis 1983: 127: 725–34.
2. S.A.S. Users' Guide: Statistics Version 5. Cary, Ind, Statistical Analysis System Institute, 1985: 433.
3. *Kerlinger FN, Pedhazure EJ*. Multiple regression in behavioural research. New York, NY, Holt, 1973: 282–5.
4. *Weinreich AI, Silvay G, Lumb PD*. Continuous ketamine infusion for one-lung anaesthesia. Can Anaesth Soc J 1980; 27: 485–90.
5. *Read RC, Friday CD, Eason CN*. Prospective study of the Robertshaw endobronchial catheter in thoracic surgery. Ann Thorac Surg 1977; 24: 156–61.
6. *Tarhan S, Lungborg RO*. Effects of increased expiratory pressure on blood gas tensions and pulmonary shunting during thoracotomy with the use of the Carlens catheter. Can Anaesth Soc J 1970; 17: 4–11.

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7. *Kerr JH, Crampton Smith A, Prys-Roberts C, Meloche R, Foex P*. Observations during endobronchial anaesthesia II: oxygenation. Br J Anaesth 1974; 46: 84–92.
8. *Severinghaus JW, Naifeh KH*. Accuracy of response of six pulse oximeters to profound hypoxia. Anesthesiology 1987; 67: 551–8.
9. *Desiderio DP, Wong C, Shah NK*. A clinical evaluation of pulse oximetry during thoracic surgery. Journal of Cardiothoracic Anesthesia 1990; 4: 30–4.
10. *Katz JA, Lavern RG, Fairley HB, Thomas AN*. Pulmonary oxygen exchange during endobronchial anesthesia: effects of tidal volume and PEEP. Anesthesiology 1982; 56: 164–70.