Effect of Applying Perioperative Oxygen Therapy Guidelines on Postoperative Health Outcomes

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Abstract

Background, Pulmonary complications are most common complications in postoperative period leading to increased mortality rate. The incidence of postoperative hypoxemia is particularly high in surgical patients. **Aim,** was to evaluate the effect of applying perioperative oxygen therapy guidelines on postoperative outcomes. **Methodology,** Quasi–experimental study with a purposive sample of 90 surgical patients from both gender who were admitted to surgical ward at Mansoura University Hospital was enrolled in this study. Patients were assigned to control and intervention group. Data were collected using three tools: An interviewing questionnaire sheet, National Early Warning Score (NEWS), and ASEPSIS. **Results,** there was a significant decrease in postoperative hypoxemia, improved wound healing with decreased wound infection rate in the study group compared to control group according to the NEWS and ASEPSIS Scale (p-value ≤ 0.05). **Conclusion**, the study concluded that application of postoperative O_2 therapy guidelines have a significant effect in reducing postoperative hypoxemia, improved wound healing with decreased wound infection rate. **Recommendations**, standardized O_2 therapy guidelines should be applied at surgical words for nurses in order to help in decreasing the rate of postoperative hypoxemia.

Key words: Guidelines, Health Outcomes, O_2 therapy, Perioperative, Postoperative

Introduction

Oxygen is essential for energy production in all body tissues which makes up approximately 65 % of human body mass. Oxygen therapy is listed by WHO as one of an essential drugs, which administrated at concentrations greater than that in the environmental air for treating or preventing hypoxia and its subsequent complications (**Aloushan et al., 2019).** Pulmonary complications commonly occurs in postoperative period leading to increase mortality rate (**Lumb., 2016)**. The rate of postoperative hypoxemia is predominantly show high levels in surgical patients, reaching about 50% **(Futier, Paugam-Burtz, Constantin, Pereira & Jaber., 2013)**. Morbidity is also increased by postoperative pulmonary complications (PPCs) and prolonged length of hospital stay (LOS) by 13–17 days **(Serpa Neto et al., 2015)**.

Decrease in oxygen saturation also impaired mental concentration, muscular coordination, renal function, speech and visual perception and causing nausea and vomiting. A 25% decrease in the arterial blood oxygen saturation diminishes memory performance and induces emotional lability and prolong recovery period (**Ferrando et al., 2020 &**

Kumpaitiene et al., 2018). In addition, maintaining oxygen saturation within normal levels improve tissue oxygenation which help in wound healing and decrease surgical site infection significantly. So**,** if the SaO_2 fall below 94%, it is important to identify and treat the cause rather than correcting the hypoxemia. So, close observation and appropriate intervention is recommended (**Hedenstierna, Perchiazzi, Meyhoff & Larsson,. 2017)**.

According to British Thoracic Society Oxygen Guidelines, oxygen has its own toxicity hence should be used only when indicated in health care and emergency setting and must be prescribed including dose, duration, delivery device, target arterial oxygen saturation range (SaO2), and monitoring process and oxygen order must be involved in a treatment chart before administration **(O'Driscoll., 2017)**. So, administration of supplemental O_2 therapy is a significant intervention for appropriate management of postoperative pulmonary complications that resulting in hypoxemia (**Desalu et al., 2019).**

Nursing staff have a vital role in confirming appropriate oxygenation for postoperative patients based on international standardized guidelines, and recognize how O_2 is supplied to body cells and which methods and delivery devices work accurately to deliver O_2 to the lungs. Additionally, they must recognize the hazards of hyperoxia and effect of O_2 therapy in different cases **(Siela & Kidd., 2017),** and implementing safe practice to improve patient's safety **(Tregunno, Ginsburg, Clarke, & Norton. 2014).**

Significance of the study

Worldwide, more than 230 million major operations performed annually, postoperative complications occurs in up to 63% of major surgery, 50% of those complications are postoperative hypoxemia. Significance of a physiological target of O_2 saturation range is recognized by guideline group which guide staff to administer O_2 therapy correctly with proper concentration to manage hypoxemia without the risks of hyperoxaemia. This is a significant background knowledge which impacts how a health-care think of and use oxygen. Ideally, O_2 therapy should be given under strict observation as other medications, including correct dose, duration, and route of administration to prevent complications and get the maximum benefits from its use (**Yang, Teng, Lee & Rose., 2015).**

Aim of the study:

The aim of this study was to evaluate the effectiveness of applying perioperative oxygen therapy guidelines on postoperative health outcomes.

Research hypothesis:

Surgical patients who receive postoperative O_2 therapy based on international guidelines experience better postoperative health outcomes than those who do not receive such intervention.

Operational definition:

Health outcome: Decreasing postoperative complications (hypoxemia, hypercapnia, nausea and vomiting, impaired consciousness and SSIs)

Subjects and methods:

Research Design: A quasi experimental design was utilized in the present study.

Research Setting: Study was conducted at Surgical Words of Mansoura university hospital

Subjects: A purposive sample of 90 adult surgical patients, randomly distributed into two matched groups (45 each): Study group submitted to O_2 therapy based on standardized guidelines, and the control group who had only the routine prioperative care. Sample size was determined statistically using power analysis using epidemiological information (EPI info) after taking into consideration the total number of abdominal surgery patient admitted to surgical word during year 2018/2019. Based on data from literature **(Yang, Teng, Lee & Rose., 2015),** since level of significance of 5%, alpha error 5% (= confidence level=95%) Beta error 20% (study power= 80%).

Based on the above formula, the sample size required is 84 patients and increased to 90 patient for dropout.

Inclusion criteria: Adult patients, of both sexes, age from 20 to 60 years, undergoing abdominal surgery, willing to participate in the study, cooperative, Able to communicate verbally.

Exclusion criteria: Complicated surgical patients and those with low hemoglobin levels

Tools: Three tools were used:

Tool I: patients' interviewing questionnaire, developed by the researchers and including three parts:

Part 1: Patient's Demographic Data, it will include patient's age, gender, marital status, educational level and occupation.

Part 2: Health Relevant Data, including patient's history, chief complain, medical diagnosis, date of diagnosis.

Part 3: Postoperative data, including name of surgical procedure, duration of anesthesia, postoperative complications, and time used to initiate nursing intervention (minutes), recovery duration

Tool II: National Early Warning Score (NEWS) (Royal College of Physicians., 2017).

NEWS developed by Royal College of Physicians and obtained by nursing staff at the surgical wards, and includes physiologic parameters of the patients (blood pressure, body temperature, heart rate, respiratory rate, air or oxygen, level of consciousness, blood oxygen saturation) for early recognition of hypoxic patients, to make early diagnosis more accurately in the postoperative period and provides immediate intervention to patients with worsening clinical status **(Royal College of Physicians., 2017).**

Scoring system

Physiological parameter	Score 3	2	1	0	1	2	3
Respiration rate (per minute)	≤8		9–11	12–20		21–24	≥25
SpO_2 Scale 1 (%)	≤91	92–93	94–95	≥96			
SpO_2 Scale 2 (%)	≤83	84–85	86–87	88–92 ≥93 on air	93–94 on oxygen	95–96 on oxygen	≥97 on oxygen
Air or oxygen?		Oxygen		Air			
Systolic blood pressure (mmHg)	≤90	91–100	101–110	111–219			≥220
Pulse (per minute)	≤40		41–50	51–90	91–110	111–130	≥131
Consciousness				Alert			CVPU
Temperature (°C)	≤35.0		35.1–36.0	36.1–38.0	38.1–39.0	≥39.1	

Chart 2: NEWS thresholds and triggers

NEW score	Clinical risk	Response
Aggregate score 0–4	Low	Ward-based response
Red score Score of 3 in any individual parameter	Low–medium	Urgent ward-based response*
Aggregate score 5–6	Medium	Key threshold for urgent response*
Aggregate score 7 or more	High	Urgent or emergency response**

* Response by a clinician or team with competence in the assessment and treatment of acutely ill patients and in recognising when the escalation of care to a critical care team is appropriate.
**The response team must also include staff with critical care skills, including airway management.

NEWS values are measured in time intervals every 12 hours if **sum score 0**, every 6 hours with **low scores**, every1 hour with **medium scores** and continuously with **high scores**.

Tool III: ASEPSIS (Wilson and others., 1986)

It is a standard, sensitive, and significantly more specific scale of wound infection and complications. Wound was evaluated on 4 major characteristics (serous exudate, erythema, purulent exudate, and separation of deep tissues). additional treatment (drainage, debridement, antibiotics) and duration of inpatient stay also evaluated. The sum of daily wound evaluations for 5 postoperative days (while the patient was in the hospital) in addition to treatment score represent the total ASEPSIS score to grade surgical wound sites prior to discharge **(Wilson and others 1986).**

Scoring system

Wound healing measured to the nearest 10% of its length and assigned a numerical score. Serous exudate and erythema were scored from 0 to 5 (0 = no part of wound was affected, 5 = more than 80% of the wound was affected). Purulent exudate and separation of deep tissues were scored from 0 to 10 (0 = no part of wound was affected, 10=more than 80% of the wound was affected). Scores were summed daily; the range of possible scores was 0 to 30. An additional one-time score was assigned based on the presence/absence of additional treatment (antibiotics, drainage, and/or debridement of the wound), isolation of bacteria, and hospital stay 14 days or more. The total score indicated the severity of infection (0-10 = satisfactory healing, 11-20 = disturbance of healing, 21-30 = minor wound infection, 31-40 = moderate wound infection, > 40 = severe wound infection).

Validity and Reliability:

Study tools were tested for content validity by a panel of seven experts in the field of the study including three members in the medical surgical nursing, Faculty of Nursing, two anesthesiologists and two surgery specialist Faculty of medicine Mansoura University.

Reliability was done using Cronbach's alpha on a sample of 10% (9 patients) of the studied subjects. It was 0.86 for tool I, 0.819 for tool II, and 0.95 for tool III which represents a highly reliable tool.

Pilot study:

It was carried out on 10% (9 patients) of the studied subjects to test the probability, applicability, and timeframe for tools application and excluded from main sample.

Fieldwork:

Field work started from the beginning of April 2020 to May 2021. The study goes through four phases: assessment, planning, implementation and evaluation phases.

Assessment phase: During this phase, the purpose of the study were explained and necessary demographic data were obtained using tool I (part 1 and 2). The time needed for each patient was assessed (from 20 - 30 min).

Planning phase: During this phase, goals and expected outcome criteria were being formulated based on priorities during implementing slandered O_2 therapy guidelines as the following:

Maintaining stability of patients' target O_2 saturation level, declining length of stay, and complication.

Implementation phase:

- One day before surgery, patients who were eligible for the study informed about the study intervention and their consent was obtained.
- Selected patients were randomly assigned to two equal groups (45 each), and applying the proposed intervention

- The preoperative data were collected using tool I (part 1 and 2) and recorded during this visit.
- Patients' O_2 saturation was measured and O_2 therapy was initiated if needed
- **Postoperative Period:** patient was followed in the PACU (post anesthetic care unite), and surgical word and the data regarding the intraoperative period (surgical procedure, duration of anesthesia, and complications related to anesthesia) were obtained from the patient's chart and the doctor who performed anesthesia to the patient using tool I (part 3), tool II and tool III.
- Applying the proposed intervention (O_2 therapy based on standardized guidelines) for the study group as follows:

Good practice points (O'Driscoll BR et al,. 2017)

✓ O_2 therapy should be started using suitable device and flow rate.

✓ SaO_2 range of 94–98% for acutely ill patients excluding patients at risk of hypercapnic respiratory failure when a target saturation range of 88–92% should be used. ✓ patients can be managed with suitable O_2 device:

- High-concentration reservoir mask at 15 L/min is ideal for delivering high oxygen concentration until pulse oximetry monitoring has been established.
- Nasal cannula should be used rather than simple face masks for patients in need for medium concentration oxygen therapy with flow rate between 2 and 6 L/min to attain target saturation.
- Venturi mask recommended for those requiring precise control of FiO2, which deliver a constant FiO_2 with a greater flow than a simple face mask.

✓ O_2 saturation should be noted before starting oxygen therapy.

✓ Target O_2 saturation should be documented on the observation chart (NEWS).

✓ Gradual weaning and discontinuation prior to cessation of O_2 therapy:

- 2 L/min via nasal cannula for stable patients.
- 1 L/min or occasionally 0.5 L/ min via nasal cannula Patients susceptible to hypercapnic respiratory failure

✓ O_2 therapy should be stopped once a patient is clinically stable after two consecutive measurements

✓ O_2 therapy prescription should remain active for any deterioration in O_2 saturation.

✓ Adjust the target range for those with chronic cardiopulmonary disorders with O_2 saturations < 94% when stable.

✓ O_2 saturation on air should be checked for 5 min after cessation of O_2 therapy, if stable recheck 1 hour after.

✓ If the O_2 saturation and physiological 'track and trigger' score (NEWS) is satisfactory for 1 hr, safely discontinued O_2 therapy.

✓ Monitoring SaO_2 and physiology regularly according to patient's condition.

✓ If the saturation falls below the target range after cessation of O_2 therapy, resume O_2 therapy with low concentration that sustained the target range and monitor for 5 min.

✓ If a patient needs more O_2 concentration than before to sustain the target saturation range, clinical review should be performed to establish the cause.

- ✓ O_2 prescription chart should be maintained. intervention for the study group.

3) Evaluation phase: Estimating the influence of the proposed intervention on patients' physiological parameters using tool II and wound healing using tool III and post-operative complications using tool I part 3

Ethical Considerations:

Ethical approval was gained from ethics committee, Faculty of Nursing, Mansoura University. Approval to carry out this study was obtained from the administrator of Mansoura University Hospital after explaining the aim of study. Privacy and confidentiality was respected and assured

Statistical analysis:

After collection of the data, it was analyzed using the statistical package of social science "SPSS" software. Descriptive statistics were expressed as numbers and percentages (%) for qualitative data, mean ± standard deviation (X±SD) for quantitative variables. Quantitative continuous data were compared using the non- parametric Mann-Whitney test. Qualitative categorical variables were compared using chi-square test. A p value of less than 0.05 was considered statistically significant.

Results

Table (1): Show demographic characteristics of the studied sample. Regarding age, (42.2%) of the study group and (33.3%) control group in age group 40 to 49 years. In relation to gender (84.8) of the study group and (69%) control group were males. (71.1%) and (66.6%) of study and control groups were married. Illiteracy more prevailing among study (42.2%) and control (33.3%) groups. (60.0%) and (48.9%) of study and control groups were manual worker

Table (2): Represent health relevant data of the studied sample, it is clear that (37.8%) of study and (33.3%) of control group free from chronic disease. DM, hypertension and chest disease more prevailing among studied groups. In relation to hemoglobin level both study and control group appears within normal range (14.9±2.51 and 15.1±1.9 respectively) and the same with hematocrit with mean 46.1±3.95 for study group and 44.2 ± 2.3 for control

Table (3): Demonstrates Postoperative News scoring, it is clear that 95.6 of study group and 84.4 of control group suffering low risk (0-4) 12 hr post-operative but at the end of 1^{st} hr. 8.8% of control group falls in medium risk category (5-6) and increased to 13.3 by the end of 2^{nd} hr. whereas only 6.6 of study group falls in medium risk category (5-6) and decreased by the end of second hour to reach 4.5. By the end of 6^{th} and 12^{th} hr. post-operative 11.2% of control group compared to 4.5% of study group falls in medium risk category (5-6). Also 4.5% of control group falls in high clinical risk (score ≥ 7) category by the end of 1^{st} and 2^{nd} hr. and increased to 8.8% by the end of 6^{th} hr. and then decreased to 4.4 b the end of 12^{th} hr. compared to 0.0% of study group. Representing statistical significant difference between studied groups.

Table (4): Representing comparison between the study and control group in relation to mean NEWS score, it is obvious that the mean NEWS score decrease to 2.5 ± 1.3 by the end of 6th hr and 1.5 ± 1.0 by the end of 12th hr post-operative compared to control group (3.4 ± 2.1 and 3.8 ± 3.1 respectively). Representing statistical significant difference (0.000*) between studied groups

Table (5): Representing interventions performed by nursing staff in post-operative period. There was a significant difference between the study and control groups in regard to the mean number of applications performed by nurses (saturation, heart rate, blood pressure, level of consciousness, pain follow-up, drug administration) (p<0.001*). as "is helpful in early recognition and management of patients with worsening status"

Table (6): Demonstrate data regarding the recovery period of the studied groups, it is clear that only (24.5%) of the study group suffering postoperative complications compared to (48.9%) of control group, respiratory distress more prevailing among control group (40.9%) compared to study group (27.3%). In relation to time of intervention, there were significant differences between the study and control groups with respect to the time of intervention to manage complications (0.001*). Mean recovery duration decreased in study group compared to control group, expressing statistical significant difference.

Figure (1): Representing ASEPSIS Scoring system, it is obvious that (62.2%) of study group reach satisfactory wound healing compared to (46.6%) in control group. expressing statistical significant difference (0.000*).

Table (1): Demographic characteristics of the studied groups (n= 90).

Demographic data	Groups				P-Value
	Study group (45)		**Control group (45)**		
	NO	**%**	**NO**	**%**	
Age					**0.111**
• 20-29	**8**	**17.8**	**11**	**24.5**	
• 30-39	**14**	**31.1**	**10**	**22.2**	
• 40-49	**19**	**42.2**	**15**	**33.3**	
• 50-60	**4**	**8.9**	**8**	**17.8**	
Gender					
• Male	**38**	**84.4**	**31**	**69**	**0.274**
• female	**7**	**15.6**	**14**	**31**	
Marital status					
• Single	**3**	**5.5**	**2**	**3.4**	
• Married	**32**	**71.1**	**30**	**66.6**	
• Widow	**11**	**23.4**	**27**	**30.0**	**0.492**
Level of education					
• Illiterate	**19**	**42.2**	**15**	**33.3**	
• Read and write	**8**	**14.5**	**11**	**24.5**	
• Secondary school	**11**	**24.5**	**8**	**17.7**	
• University	**9**	**18.9**	**11**	**13.8**	**0.234**
Occupation					
• Manual work	**27**	**60.0**	**22**	**48.9**	
• Employee	**10**	**22.2**	**13**	**28.9**	**0.117**
• House wife	**4**	**10.0**	**7**	**14.5**	
• Retired	**4**	**7.8**	**4**	**7.7**	
Mean age	**42±11.5**		**41±9.9**		

*Count [%] and p value (X_2) through **Chi-square test.***

Table (2): Percentage distribution of the studied groups according to Health Relevant Data.

Health Relevant data	Groups Study group (45) NO	%	Control group (45) NO	%	P-Value
Past medical history					
none	**17**	**37.8**	**15**	**33.3**	
DM	**7**	**15.6**	**8**	**17.8**	
Hypertension	**6**	**13.3**	**7**	**15.6**	**0.274**
Chest disease	**8**	**17.8**	**6**	**13.3**	
Heart disease	**3**	**6.7**	**4**	**8.9**	
Renal disease	**4**	**8.8**	**5**	**11.1**	
Smoking					
Yes	**15**	**33.3**	**20**	**44.4**	**0.226**
No	**30**	**66.7**	**25**	**55.6**	
Preoperative hemoglobin	**14.9 ± 2.51**		**15.1 ± 1.9**		**0.372**
Preoperative hematocrit	**46.1 ± 3.95**		**44.2 ± 2.3**		**0.319**

Table (3): comparison between studied groups in relation to Postoperative News scoring.

Time	NEWS Categories	Groups Study group (45) NO	%	Control group (45) NO	%	P-Value
1st hour	**0-4**	42	93.4	39	86.7	
	5-6	3	6.6	4	8.8	**0.027***
	≥ 7	0	0.0	2	4.5	
2nd hour	**0-4**	43	95.5	37	82.3	
	5-6	2	4.5	6	13.3	**0.028***
	≥ 7	0	0.0	2	4.5	
3rd hour	**0-4**	43	95.5	38	84.6	
	5-6	2	4.5	4	8.8	**0.019***
	≥ 7	0	0.0	3	6.6	
4th hour	**0-4**	43	95.6	41	77.8	
	5-6	2	4.4	3	13.3	**0.015***
	≥ 7	0	0.0	1	6.6	
5th hour	**0-4**	43	95.6	38	84.6	
	5-6	2	4.4	3	6.6	**0.012***
	≥ 7	0	0.0	4	8.8	
6th hour	**0-4**	43	95.6	36	80.0	
	5-6	2	4.4	5	11.2	**0.011***
	≥ 7	0	0.0	4	8.8	
12th hour	**0-4**	43	95.6	38	84.4	
	5-6	2	4.4	5	11.2	**0.05***
	≥ 7	0	0.0	2	4.4	

Table (4): Comparison between the study and control group with relation to mean NEWSscore(N=90).

Timing	Study group (45)	Control group (45)	P-Value
	Mean ± SD		
1st hour	3.2 ± 2.2	4.4 ± 2.6	**0.001***
6th hour	2.5 ± 1.3	3.4 ± 2.1	**0.002***
12th hour	1.5 ± 1.0	3.8 ± 3.1	**0.000***
P-Value	**0.001***	**0.04***	

p* : mean Whitney test p** : mean Wilcoxon test

Table (5): Interventions performed by nurses in post-operative period.

Nurses intervention	Groups Study group (45) Mean ± SD	 Control group (45) Mean ± SD	P-Value
Saturation monitoring	15.05 ± 4.58	6.23 ± 1.25	**0.001***
Heart rate monitoring	15.05 ± 4.58	6.23 ± 1.25	**0.001***
Respiration monitoring	15.05 ± 4.58	6.23 ± 1.25	**0.001***
Body temperature monitoring	15.05 ± 4.58	6.23 ± 1.25	**0.001***
Consciousness monitoring	15.05 ± 4.58	6.23 ± 1.25	**0.001***
Fluid balance monitoring	15.05 ± 4.58	6.23 ± 1.25	**0.001***
Pain monitoring	15.05 ± 4.58	6.23 ± 1.25	**0.001***
Fluid monitoring	15.05 ± 4.58	6.23 ± 1.25	**0.001***
Positioning	2.03 ± 1.12	1.29 ± 1.21	**0.001***
Drug administration	3.04 ± 1.55	1.32 ± 0.56	**0.001***
Calling for physician	2.01 ± 1.25	1.88 ± 0.85	**0.001***
Wound healing monitoring	4.08 ± 2.38	2.91 ± 1.23	**0.001***

Independent sample t test, ** mean, stander deviation

Table (6): Data regarding the recovery period of the studied groups.

Data	Groups Study group (45) NO	 %	 Control group (45) NO	 %	P-Value
Complications					
• **Present**	11	24.5	22	48.9	**0.046***
• **Absent**	34	75.5	23	51.1	
Developing complications					**0.032***
• **Respiratory distress Hypotension**	3	27.3	9	40.9	
• **Nausea and vomiting**	1	9.1	3	13.6	
• **Impaired consciousness**	2	18.2	2	9.1	
• **Unexplained confusion and agitation**	3	27.2	5	22.7	
	2	18.2	3	13.7	
Time of intervention (minutes)					
• **Untreated**	0	0.0	10	45.4	
• **0 to 10 minutes**	9	81.8	6	27.3	
• **11 minutes and above**	2	18.2	6	27.3	**0.001***
Recovery duration (minutes) Mean ± SD	**32.46 ± 15.65** **Range = 18 - 55**		**45.33 ± 18.32** **Range = 28 - 95**		**0.026***

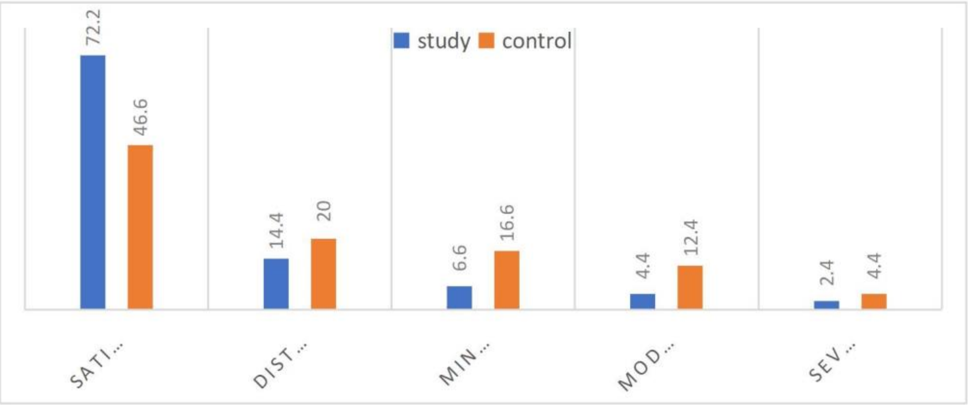

Figure (1): ASEPSIS Scoring system for wound healing

Discussion

Postoperative pulmonary complications have been recently approved to be the main cause of postoperative morbidity and mortality. So, optimizing respiratory support is an important activity through perioperative period, especially for those have a risk to develop pulmonary complications **(Futier, Paugam-Burtz, Constantin, Pereira & Jaber., 2013).**

The ability to anticipate and to provide early treatment to potentially modifiable adverse clinical events such as postoperative hypoxemia is of critical importance to prevent subsequent complications (**Barth et al., 2016)**.

Demographic characteristics of the studied sample representing that most of both groups were males, married, in age group 40 to 49 years. Illiteracy more prevailing among them. Regarding health relevant data most of the studied sample were smokers, have chronic disease, hemoglobin level appears within normal range and the same with hematocrit.

Restoration of a normal alveolarto-arterial oxygen after major surgery may take long time, and episodes of hypoxaemia. The normal activity of most respiratory muscle is altered, including the airway and abdominal muscles and diaphragm, which resulting from anaesthetic agents, analgesics (opioids) and pain **(Miskovic and Lumb., 2017).**

Results from the present study regarding postoperative News scoring demonstrated that, by the end of 1^{st} hr. some patients in control group falls in medium risk category (5-6) and increased by the end of 2nd hr. whereas in study group medium risk category (5-6) improved by the end of 2^{nd} hr postoperative. By the end of 6^{th} and 12^{th} hr. post-operative significant number of control group falls in medium risk (5-6) and high clinical risk (score ≥ 7) category compared to study group. This may be due to application of O_2 therapy Guidelines with continuous assessment for early detection and management of any complications.

In the same line with our results study by **Barth et al., (2016)** confirmed that guideline intended to offer concise instructions on how to provide health care services and to direct and maintain safe and competent nursing practice. The same results documented by **Lumb, Bradshaw, Gamlin and Heard., 2015)** they stated that**,** providing supplemental oxygen in right way based on standardized guidelines increases arterial and tissue oxygenation which increased significantly during and immediately after surgery because plasticity in the respiratory control mechanisms during surgery needs time to return to normal. Applying O_2 therapy guidelines postoperatively with continuous assessment help in identifying patients at risk and enable optimal management.

Also A Cochrane review by **Pedersen, Møller & Hovhannisyan., (2019)** regarding pulse oximetry monitoring intra and postoperative presented that, using pulse oximetry to monitor patients' O_2 levels help in decreasing the occurrence of perioperative hypoxaemia 1.5 to 3-fold**. Antoniou et al., (2015)** emphasize that O_2 therapy increases PAO_2 which offset the effects of hypoperfusion. Also, they highlighted that approach of 'exact control of arterial oxygenation' in which O_2 is provided to a definite target, preventing potential hyper and hypoxemic complications and improving health outcomes.

Piryani et al., (2019) confirmed that provision of safe and effective oxygen therapy depending on effective patient's assessment and recognition of post-operative hypoxemia, which can be lifesaving, particularly if the right concentration is not administered and properly monitored, hence the need for blood gas analysis. According to **Lemma and Weldetsadik,. (2015); & Adeniyi et al., (2021)** O_2 prescription should be to a target saturation range rather than a fixed dose, especially for those at risk of hypercapnia to achieve a target saturation of 88–92% or 94–98%. Pulse oximetry is an effective method for arterial oxygen saturation measurement which determine definitely when O_2 therapy is needed and aim for appropriate target during oxygen administration**.**

Study by **Ikeda-Miyagawa, Kihara & Matsuda., (2015).** shown that increased respiratory rate and heart rate are common indicators of cyanosis in hypoxaemic patients than other physical finding, and should be measured cautiously, to help deliberately increasing oxygen delivery for surgical patients to decrease organ failure, hospital stay and mortality.

Ponikowski et al., (2015) clarifies that, arterial blood gases should be measured continuously even with normal SpO_2 especially for those on O_2 therapy. It is recommended that oximetry measurements in postoperative period which measures hemoglobin oxygen saturation, because administering oxygen to the non-hypoxemic patient has possibly adverse effects include pulmonary toxicity, coronary vasoconstriction, decreased COP, free radical generation and delay the recognition of physiological deterioration.

The same results reported by **Schmid et al., (2015)** emphasized that receiving titrated O_2 therapy rather than high-concentration oxygen significantly decrease mortality rate. So, keeping a target O_2 saturation is very important when administering O_2 therapy to optimizing O_2 delivery to tissues. Also **de Jonge et al., (2019)** documented that high concentrations of oxygen of approximately 70-100% may cause damage to the alveolar membrane when used for more than 48hours. The signs and symptoms of oxygen toxicity are not easy to notice, hence the use of arterial blood gas analysis and pulse oximeters is very important

Delivery system, flow rate and O_2 saturation should be documented on monitoring chart, with close observation for signs of improvement or deterioration, observing O_2 saturation, respiratory rate and skin color for peripheral cyanosis, and work of breathing **(Bayliss., 2016).** Any unexpected fall in O_2 saturation or requirement for repeatedly increase FiO_2 necessitate urgent reassessment by health care staff and blood gases monitoring **(O'Driscoll, Smith, Linaker & Myers., 2016).**

In relation to interventions performed by nurses in post-operative period when applying O_2 therapy Guidelines our results represents that, increased mean number of applications performed by nurses (oxygen flow rate, device saturation, heart rate, blood pressure, level of consciousness, pain follow-up, drug administration, positioning,….etc). that is helpful in early recognizing the patients with worsening status". These results attributed to adherence to O_2 therapy standardized guidelines which guide nursing actions based on best evidence.

The same results documented by **Desalu et al., (2014)** who emphasized that proper documentation of oxygen flow rate, source, delivery device, and frequency by nursing staff minimize the risk of O_2 toxicity and hypercapnic respiratory failure. Another study by **Gunathilake, Lowe, Wills, Knight, Braude., (2014)** Confirmed that proper O_2 delivery was improved as prescription rates increased and the number of patients at risk of experienced oxygen desaturation decreased following a multicomponent nursing intervention based on O_2 therapy guidelines.

According to **Baron et al,. (2015)** it essential to remember that O_2 therapy is one of numerous approaches that can be used to improve tissue oxygenation for postoperative patients. Nursing intervention regarding O_2 therapy including positioning the patient in upright position improve patients saturation level, by improving ventilation and perfusion at the bases of the lung. In pathological conditions, the pulmonary blood vessels also maximizes PaO2 by confirming that the well-ventilated spaces of the lung obtaining the most of pulmonary blood flow, a process called V/ Q matching.

Study by **Mattishent et al,. (2019).** Confirmed that O_2 saturation is considered 'the fifth vital sign', and should be monitored and documented including delivery device and flow rate by qualified nurses specially for acutely ill and breathless cases, and for those with unexplained confusion and agitation as this may be a sign of hypoxemia and/or hypercapnia. **Green &Shah,. (2016)** added that the most suitable delivery system to reach and maintain the target saturation should be used according to patient's condition, if resting saturation below the target saturation range FiO_2 should be increased and vice versa

Based on **British Thoracic Society Emergency Oxygen Guideline,** preliminary clinical assessment and successive monitoring of post-operative patients should contain the use of a recognized physiological 'track and trigger' system, such as the NEWS including all physiological parameters which indicate the presence of hypoxemia and the need for supplementary oxygen **O'Driscoll, et al. (2017)**. Also **Ferrando et al,. (2020)** indicated that for postoperative patients who are at risk of hypercapnia respiratory failure, it is recommended to use NEWS chart, which alert health care staff if SaO_2 is below or above the target range, in addition to symptoms and signs of carbon dioxide retention as drowsiness, flapping tremor, confusion and coma.

Regarding the recovery period of the studied groups, it is clear that control group suffering more postoperative complications including respiratory distress, hypotension, nausea and vomiting, impaired consciousness, unexplained confusion and agitation

These results agreed by **Beasley et al,. (2015)** who stated that in postoperative period body organs are vulnerable to the risk of hypoxic tissue injuries due to sudden exposure to low SaO_2 levels which affects mainly brain tissues and mental functioning. So, keeping the SaO_2 above 90% is recommended. Another study by **O'driscoll, et al,. (2017)** clarifies that hypoxemia can occurs as a result of poor gas exchange in certain area in the lung or defects in gas exchange during serious pulmonary disease, where hypoxic vasoconstriction unable to compensate for this mismatch. O_2 therapy is the most effective and easiest intervention to treat This type of hypoxemia.

In addition **Hovaguimian et al,. (2013).** Conformed that maintaining O_2 saturation within normal range is recommended to decrease the occurrence of postoperative nausea and vomiting by preventing intestinal ischemia and decreasing serotonin and dopamine release. In the same context **Staehr-Rye et al,. (2017); Ferrando et al,. (2020)** discussed that rapid severe hypoxemia causing brain damage, and abrupt decrease in urine flow and renal function, so guidelines recommend a target range of 94–98% for all adult patients and necessitate clinical assessment.

In relation to time of intervention our study results documented that there were significant differences between the study and control groups with respect to the time of nursing intervention to manage postoperative related complications.

In this respect **Kord et al, (2015)** suggested that guidelines on oxygen therapy nursing care can identify and minimize the weaknesses and provide the optimal level of care. Insufficient knowledge on oxygen therapy should be addressed through specialized training programs and establishing standard care principles base on standardized guidelines. So, nurses have been recognized as an important members of health care team, and their performance is essential to improve patient's safety in the healthcare system which has been focused on implementing safe practices; to achieving a high level of safety in healthcare organizations **(Tregunno, Ginsburg, Clarke, & Norton. 2014).**

This result in the same line with **Kord et al, (2015) & Lema, Tsadik & Beza, (2017)** presence of practice gap associated with: insufficient knowledge of nurses about oxygen therapy, absence of proper oxygen therapy protocols, increased workload, and inadequate supervision on adherence to oxygen therapy standards and lack of continuous educational courses related to oxygen therapy resulting in inadequate nursing practice.

In this regard**, Bizzarro et al, (2014)** stated that, decreased number of staff nurse and monitoring by skillful professionals, decreased work motivation, insufficient knowledge and training courses regarding O_2 therapy resulting in poor nursing performance. Therefore, important step to achieving desired outcomes is the presence of nurses those have adequate knowledgw, professional skills and experience..

Our results also show that mean recovery duration decreased in study group compared to control group. These results in accordance with results documented by **Pighin et al,. (2012)** who show that a 15% decrease in oxygen saturation impaired mental concentration and muscular coordination, which impairs speech and visual perception. A 25% decrease in the arterial blood oxygen saturation diminishes memory performance and induces emotional lability and major motor impairments. In the same line study by **Kumpaitiene et al,. (2018)** reported that episodes of decreased oxygen saturation was detected in postoperative patients which affect patients level of consciousness and prolong recovery period

According to ASEPSIS Scoring system, the majority of study group reach satisfactory wound healing compared to control group. Our results goes in the same line with results of **Allegranzi et al,. (2016)** reported possible advantage of oxygen therapy for avoidance of postoperative wound infection. Another study by **Meyhoff, Fonnes, Wetterslev, Jorgensen, Rasmussen,. (2017).** Confirmed that oxygen therapy reducing postoperative complications and suggested to improve health outcomes significant decrease in the rate of surgical site infection. **Hedenstierna, Perchiazzi, Meyhoff & Larsson,. (2017).** Clarifies that oxygen therapy help increased tissue PO_2 within surgical wounds which enhance neutrophil killing capacity resulting in reduced wound infection rates.

Conclusion

Surgical patients who receive postoperative O_2 therapy based on international guidelines experience better postoperative health outcomes than those who do not receive such intervention.

Recommendations

It is recommended that standardized O_2 therapy guidelines should be applied for better postoperative health outcomes. further studies was needed on large probability sample

Reference

Adeniyi BO, Akinwalere OO, Ekwughe FC, Ogunmodede AF, Kareem AO, Olakanye OD, Erhabor G & Abejegah C (2021). Assessment of knowledge and practice of oxygen therapy among doctors and nurses: A survey from Ondo State, Southwest Nigeria. J Pan Afr Thorac Soc 2(3); 161-166, doi: 10.25259/JPATS_4_2021

Allegranzi B, Zayed B, Bischoff P, Kubilay NZ, de Jonge S, de Vries F, Gomes S, Gans S, Wallert E, Wu X, Abbas M, Dellinger B, Egger M, Gastmeier P, Guirao X, Ren J, Pittet D, Solomkin J and WHO Guidelines Development Group (2016). New WHO recommendations on intraoperative and postoperative measures for surgical site infection prevention: an evidence-based global perspective. Lancet Infect Dis. 2016;16(12):e288–303. doi: 10.1016/S1473-3099(16)30402-9

Aloushan AF, Almoaiqel FA, Alghamdi RN, Alnahari FI, Aldosari AF, Masud N & Aljerian N. (2019). Assessment of knowledge, attitude and practice regarding oxygen therapy at emergency departments in Riyadh in 2017: A cross-sectional study. World J

Emerg Med 2019;10:88-93. doi: 10.5847/wjem.j.1920-8642.2019.02.004

Antoniou SA, Antoniou GA, Koch OO, Ko hler G, Pointner R, Granderath FA. (2015). Laparoscopic versus open obesity surgery: ameta-analysis of pulmonary complications. Dig Surg2015;32: 98–107. Antoniou SA, Antoniou GA, Koch OO, Ko hler G, Pointner R, Granderath FA. (2015). Laparoscopic versus open obesity surgery: ameta-analysis of pulmonary complications. Dig Surg2015;32: 98–107

Baron DM, Hochrieser H, Posch M, Metnitz B, Rhodes A, Moreno R P, Pearse R M & Metnitz P. (2015) Preoperative anemia is associated with poor clinical outcome in noncardiac surgery patients.Br J Anaesth 2014;113: 416–23103. Clevenger B, Richards T. Pre-operative anaemia. Anaesthesia 2015;70: 20–8. doi: 10.1093/bja/aeu098. Epub 2014 May 14.

Barth, J., Misra, S., Aakre, K., Langlois, M., Watine, J., Twomey, P.,& Oosterhuis, W. (2016). Why are clinical practice guidelines not followed? Clin Chem Lab Med. 54 (7). 1133–1139. Available at: https://www.eflm.eu/.../Why%20are%20clinical%20practice%20guid.

Bayliss, J. (2016). Oxygen Policy (adult). *NHS Trust*.V2.4-12. **Available at:** http://www.eastcheshire.nhs.uk/About-The-Trust/policies/O/Oxygen%20Policy%20%20Adult%20ECT2581.pdf

Beasley R, Chien J, Douglas J, Eastlake L, Farah C, King G, Moore R, Pilcher J, Richards M, Smith S & Walters H (2015). Thoracic society of Australia and New Zealand oxygen guidelines for acute oxygen use in adults: 'Swimming between the flags'. Respirology 2015;20:1182-91. doi: 10.1111/resp.12620.

de Jonge S, Egger M, Latif A, Loke YK, Berenholtz S, Boermeester M, Allegranzi B & Solomkin J (2019). Effectiveness of 80% vs 30-35% fraction of inspired oxygen in patients undergoing surgery: an updated systematic review and meta-analysis. Br J Anaesth. 2019;122(3):325–34. doi: 10.1016/j.bja.2018.11.024.

Desalu OO, Aladesanmi AO, Ojuawo OB, Opeyemi CM, Ibraheem RM, Suleiman ZA, Oyedepo O, Adesina K, Oloyede T, Sanya E and Oxygen Study Group (2019). Development and validation of a questionnaire to assess the doctors and nurses knowledge of acute oxygen therapy. PLoS One 2019;14:e0211198. doi: 10.1371/journal.pone.0211198. eCollection 2019

Desalu OO, Oyedepo OO, Ojuawo OB, Ibraheem M, Aladesanmi AO, Suleiman ZA, Opeyemi C M, Adesina K T, Sanya E O & Salami A K (2019) Acute oxygen therapy on hospital wards in Low Middle-Income Country: Experience from a referral centre in Ilorin, Nigeria. West Afr J Med 2019;36:122-8.

Ferrando C, Aldecoa C, Unzueta C, Belda FJ, Librero J, Tusman G. (2020). Effects of oxygen on postsurgical infections during an individualized perioperative openlung ventilatory strategy: a randomised controlled trial. Br J Anaesth. 2020;124(1):110–20. DOI: 10.1016/j.bja.2019.10.009

Ferrando C, Aldecoa C, Unzueta C, Belda FJ, Librero J, Tusman G, Sipmann F, Peiró S, Pozo N, Brunelli A, Garutti I, Gallego C, Rodríguez A, García J, DíazCambronero O, Balust J, Redondo F, Matta M, Gallego-Ligorit L, Hernández J, Martínez P, Pérez A, Leal S, Alday E, Monedero P, González R, Mazzirani G, Aguilar G, López-Baamonde M, Felipe M, Mugarra A, Torrente J, Valencia L, Varón V, Sánchez S, Rodríguez B, Martín A, India I, Azparren G, Molina R, Villar J, Soro M and iPROVE-O2 Network (2020). Effects of oxygen on post-surgical infections during an individualized perioperative open-lung ventilatory strategy: a randomised controlled trial. Br J Anaesth. 2020;124(1):110–20. doi: 10.1016/j.bja.2019.10.009.

Futier E, Paugam-Burtz C, Constantin J, Pereira B and Jaber S. (2013). The OPERA trial -comparison of early nasal high flow oxygen therapy with standard care for prevention of postoperative hypoxemia after abdominal surgery: study protocol for a multicenter randomized controlled trial. Trials Journal. 14 (1):341 http://www.trialsjournal.com/content/ 14/1/341

Gunathilake R, Lowe D, Wills J, Knight A, Braude P. (2014). Implementation of a multicomponent intervention to optimize patient safety through improved oxygen prescription in a rural hospital. Aust J Rural Health 2014;22:328-33. doi: 10.1111/ajr.12115.

Hedenstierna G, Perchiazzi G, Meyhoff CS, Larsson A. (2017). Who can make sense of the WHO guidelines to prevent surgical site infection? Anesthesiology. 2017;126(5):771–3. DOI:10.1097/ALN.0000000000001604

Hovaguimian F, Lysakowski C, Elia N and Tramèr M. (2013). Effect of intraoperative high inspired oxygen fraction on surgical site infection, postoperative nausea and vomiting, and pulmonary function: systematic review and meta-analysis of randomized controlled trials. Anesthesiology 2013;119:303–16. doi: 10.1097/ALN.0b013e31829aaff4.

Ikeda-Miyagawa Y, Kihara T, Matsuda R. (2015). Case of negative pressure pulmonary edema after administration of sugam-madex under general anesthesia with laryngeal mask air-way.Masui2014;63: 1362–577.Lee CZ, Kao LT, Lin HC, Wei PL. Comparison of clinical out-come between laparoscopic and open right hemicolectomy:a nationwide study.World J Surg Oncol2015;13: 25078.

Kumpaitiene B, Svagzdiene M, Drigotiene I, Sirvinskas E, Sepetiene R, Zakelis R and Benetis R. (2018) Correlation among decreased regional cerebral oxygen saturation, blood levels of brain injury biomarkers, and cognitive disorder. Journal of International Medical Research 2018, Vol. 46(9) 3621–3629. doi: 10.1177/0300060518776545

Lemma G, Weldetsadik A. (2015)

Assessment of Nurse's Knowledge, Attitude and Practice about Oxygen Therapy at Emergency Departments of One Federal and Three Regional Hospitals in Addis Ababa, Ethiopia, Doctoral Dissertation, Thesis.

Liao P, Wong J, Singh M, Wong D, Islam S, Andrawes M, Shapiro C & Chung F. Shapiro C, White D, Chung F (2017) Postoperative Oxygen Therapy in Patients With OSA: A Randomized Controlled Trial. CHEST,151(3):597-611. doi: 10.1016/j.chest.2016.12.005

Lumb AB & Thomas C. (2016). Anaesthesia. In: AB. LumbNunn's Applied Respiratory Physiology, 8th Edn. London: Elsevier, 2016;291– 318

Lumb AB, Bradshaw K, Gamlin FMC, Heard J. (2015) The effect of coughing at extubation on oxygenation in the postanaesthesia care unit.Anaesthesia 2015;70: 416–20. doi: 10.1111/anae.12924

Maity A, Saha D, Swaika S, Maulik SG, Choudhury B, Sutradhar M. (2012) Detection of hypoxia in the early postoperative period. Anesth Essays Res. 2012;6(1): 34–7. doi: 10.4103/0259-1162.103369

Mattishent K, Thavarajah M, Sinha A, Peel A, Egger M, Solomkin J, de Jonge S, Latif A, Berenholtz S, Allegranzi B & Loke Y (2019). Safety of 80% vs 30-35% fraction of inspired oxygen in patients undergoing surgery: a systematic review and meta-analysis. Br J Anaesth. 2019;122(3): 311–24. doi: 10.1016/j.bja.2018.11.026.

Meyhoff CS, Fonnes S, Wetterslev J, Jorgensen LN, Rasmussen LS. (2017). WHO Guidelines to prevent surgical site infections. Lancet Infect Dis. 2017;17(3): 261–2. doi: 10.1016/S1473-3099(17)30079-8

Miskovic A and Lumb A. B. (2017). Postoperative pulmonary complications. British Journal of Anaesthesia, 118 (3): 317–34. doi: 10.1093/bja/aex002. doi: 10.1093/bja/aex002.

O'Driscoll BR, Howard L S, Earis J, Mak V, British Thoracic Society Emergency Oxygen Guideline Group and BTS Emergency Oxygen Guideline Development Group. (2017). British Thoracic Society Emergency Oxygen Guideline Development Group. Thorax 2017;72:i1–i90. doi:10.1136/thoraxjnl-2016-209729. doi: 10.1136/thoraxjnl-2016-209729.

O'Driscoll BR, Howard LS, Earis J and and Mak V. (2017). British Thoracic Society Guideline for oxygen use in adults in healthcare and emergency settings . BMJ Open Resp Res 2017;4: e000170. doi:10.1136/ bmjresp-2016-000170

O'driscoll BR, Howard LS, Earis J, Mak V. (2017). BTS guideline for oxygen use in adults in healthcare and emergency settings. Thorax 2017;72 Suppl 1:ii1-90.

O'Driscoll, B., Bakerly, N., Caress, A., Roberts, J., Gaston, M., Newton, M., Yorke, J. (2016). A study of attitudes, beliefs and organizational barriers related to safe emergency oxygen therapy for patients with COPD (chronic obstructive pulmonary disease) in clinical practice and research. *BMJ Open Resp Res*. 3 (1). 1-11. **Available at**: Doi: 10.1136/bmjresp-2015-000102.

Parke R, McGuinness S, Dixon R and Jull A.(2013). Open-label, phase II study of routine high-flow nasal oxygen therapy in cardiac surgical patients. Br J Anaesth 2013;111:925– 31. DOI: 10.1093/bja/aet262

Pedersen T, Møller AM, Hovhannisyan K, Møller A, Smith A, Lewis S. (2019). Pulse oximetry for perioperative monitoring. Cochrane Database Syst Rev 2019;(4):CD002013. DOI: 10.1002/14651858.CD002013.pub3

Pighin S, Bonini N, Savadori L, Hadjichristidis C, Antonetti T & Schena T. (2012). Decision making under hypoxia: Oxygen depletion increases risk seeking for losses but not for gains. Judgment and Decision Making Journal, 7(4)

Piryani R, Piryani S, Khatri P, Dhakal PR, Khan MA, Shahi A. (2019). Survey to assess the knowledge of postgraduate residents about acute oxygen therapy. EC Emerg Med Crit care 2019;3:93-102.

Ponikowski P, Voors AA, Anker SD. (2015). ESC Guidelines forthe diagnosis and treatment of acute and chronic heart fail-ure.Eur Heart J2016;37: 2129–20087.Association of Anaesthetists of Great Britain and Ireland. Peri-operative management of the obese surgical patient2015.Anaesthesia2015;70: 859–76

Royal College of Physicians National Early Warning Score (NEWS)2: Standardizing the assessment of acute-illness severity in the NHS. Updated report of a working party London: RCP, 2017.

Schmid M, Sood A & CampbellL. (2015). Impact of smoking onperioperative outcomes after major surgery.Am J Surg 2015;210: 221–9

Serpa Neto A, Hemmes SN, Barbas CS. (2015). Protective versus conventional ventilation for surgery. A systematic re-view and individual patient data meta-analysis. Anesthesiology 2015;123: 66–78

Siddiqui N, Arzola C, Teresi J, Fox G, Guerina L, Friedman Z. (2013) Predictors of desaturation in the postoperative anesthesia care unit: an observational study. J Clin Anesth. 25(8):612–7.

Siela, D., & Kidd, M. (2017). Oxygen Requirements for Acutely and Critically Ill Patients.Critical Care Nurse. 37 (4). 58-70.Available at: https://criticalcarenews.wordpress.com/2017/08/01/oxygen-requirementsfor- acutely-and-critically-ill-patients.

Staehr-Rye AK, Meyhoff CS, Scheffenbichler FT, Vidal Melo MF, Gatke MR, Walsh JL. (2017). High intraoperative inspiratory oxygen fraction and risk of major respiratory complications. Br J Anaesth. 2017;119(1):140–9.

Yang CK, Teng A, Lee DY, Rose K. (2015). Pulmonary complications after major abdominal surgery: national surgical qualityimprovement program analysis.J Surg Res2015;198: 441–9