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Original Research

Perioperative Respiratory Complications in Obese Patients Undergoing Surgery Under General Anaesthesia: A Prospective Observational Study.

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Abstract

Background: Obesity alters respiratory mechanics during anaesthesia and increases vulnerability to perioperative hypoxaemia, airway difficulty, atelectasis, and prolonged oxygen requirement. General anaesthesia further reduces functional residual capacity and promotes ventilation-perfusion mismatch, making respiratory surveillance important in obese surgical patients. **Objectives:** To determine the incidence and pattern of perioperative respiratory complications in obese patients undergoing surgery under general anaesthesia and to assess their association with obesity class, obstructive sleep apnoea, ASA physical status, and duration of surgery. **Methods:** This prospective observational study was conducted at Government Medical College, Srikakulam, Andhra Pradesh, India, from June 2023 to December 2023. One hundred adult obese patients with body mass index 30 kg/m² or higher undergoing surgery under general anaesthesia were enrolled. Demographic profile, obesity class, comorbidities, airway events, intraoperative respiratory events, postoperative respiratory complications, recovery room stay, oxygen requirement, hospital stay, reintubation, and intensive care admission were recorded. Data were analysed using descriptive statistics and appropriate comparative tests. **Results:** The mean age was 48.6 +/- 11.8 years, and the mean body mass index was 34.8 +/- 4.1 kg/m². Overall, perioperative respiratory complications occurred in 32.0% of patients. Postoperative hypoxaemia was the most frequent complication (22.0%), followed by intraoperative desaturation (18.0%) and prolonged oxygen requirement (18.0%). Complications were significantly higher among patients with class III obesity, ASA III status, obstructive sleep apnoea, and surgery lasting more than 120 minutes. Patients with complications had longer recovery room stay, higher oxygen requirement, longer hospital stay, and greater respiratory-related intensive care admission. **Conclusion:** Perioperative respiratory complications were frequent among obese patients undergoing general anaesthesia, particularly in those with higher obesity class, obstructive sleep apnoea, ASA III status, and prolonged surgical duration.

Keywords: Obesity; General anaesthesia; Postoperative pulmonary complications; Hypoxaemia; Atelectasis; Obstructive sleep apnoea; Difficult airway.

Introduction

Obesity has become an increasingly important perioperative concern because it produces anatomical, physiological, and metabolic changes that directly influence anaesthetic management. In patients requiring surgery, excess adiposity is associated with reduced chest wall compliance, decreased functional residual capacity, early airway closure, increased oxygen consumption, and rapid arterial oxygen desaturation during periods of apnoea. These changes become more pronounced after induction of general anaesthesia, when loss of diaphragmatic tone and supine positioning further reduce lung volume and promote atelectasis. Perioperative guidelines therefore emphasise structured preoperative assessment, careful airway planning, appropriate ventilatory strategy, and vigilant postoperative monitoring in obese surgical patients [1].

Postoperative pulmonary complications remain a major contributor to perioperative morbidity, delayed recovery, and increased use of hospital resources. These complications include hypoxaemia, atelectasis, bronchospasm, pneumonia, aspiration, respiratory failure, and need for unplanned intensive care. General anaesthesia contributes to these events through impairment of mucociliary clearance, reduction in lung volume, residual neuromuscular weakness, and changes in ventilation-perfusion matching [2]. Studies evaluating respiratory mechanics during general anaesthesia have shown that increasing body mass index is associated with reduced lung compliance and impaired oxygenation [3]. In morbidly obese patients, postoperative atelectasis is frequent and can persist beyond the immediate recovery period, increasing the need for supplementary oxygen and respiratory support [4].

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Airway management is another relevant component of perioperative respiratory risk in obesity. Mask ventilation, laryngoscopy, and tracheal intubation can be more difficult because of upper airway soft tissue deposition, limited neck mobility, and reduced safe apnoea time. Earlier anaesthesia literature and subsequent clinical observations have highlighted the higher frequency of difficult tracheal intubation among obese patients compared with lean individuals [5,6]. Obstructive sleep apnoea, which is common in obesity, further increases concern because sedatives, opioids, residual anaesthetic drugs, and supine posture can worsen upper airway obstruction during recovery. Screening and perioperative planning for obstructive sleep apnoea are therefore recommended for surgical patients at risk [14].

Validated perioperative risk models have identified patient-related, surgical, and anaesthesia-related variables that influence postoperative pulmonary complications. Age, low baseline oxygen saturation, respiratory infection, anaemia, upper abdominal or thoracic surgery, emergency surgery, and prolonged duration of anaesthesia have been included in established predictive frameworks [7,8]. Major noncardiac surgery datasets have also shown that postoperative respiratory failure and pneumonia are clinically meaningful endpoints associated with patient characteristics and operative complexity [9]. Intraoperative protective ventilation has been studied to reduce pulmonary complications, but optimal positive end-expiratory pressure strategies in obese patients remain an area of continued discussion [10-13]. The present study was undertaken to evaluate perioperative respiratory complications in obese patients undergoing surgery under general anaesthesia at a tertiary care teaching hospital. The primary objective was to determine the incidence and pattern of perioperative respiratory complications. The secondary objectives were to assess the association of respiratory complications with obesity class, ASA physical status, obstructive sleep apnoea, smoking history, coexisting bronchial asthma or chronic obstructive pulmonary disease, duration of surgery.

Materials and Methods

Study design and setting: This prospective observational study was conducted in the Department of Anaesthesiology in coordination with surgical departments at Government Medical College, Srikakulam, Andhra Pradesh, India. The study period was June 2023 to December 2023.

Study population: The study included 100 adult obese patients undergoing surgery under general anaesthesia. Obesity was defined as body mass index of 30 kg/m² or higher, and patients were grouped into obesity class I, class II, and class III as used in perioperative obesity practice [1]. Patients aged 18 years or above, belonging to ASA physical status II or III, and scheduled for surgery under general anaesthesia were included. Patients receiving only regional anaesthesia, those requiring preoperative mechanical ventilation, patients with active lower respiratory tract infection, severe haemodynamic instability, or refusal of consent were excluded.

Preoperative assessment: Demographic details, body mass index, ASA physical status, smoking history, hypertension, diabetes mellitus, bronchial asthma, chronic obstructive pulmonary disease, and features of obstructive sleep apnoea were recorded. Airway assessment included mouth opening, Mallampati class, neck mobility, thyromental distance, and anticipated difficulty in mask ventilation or intubation. Obstructive sleep apnoea was identified from previous diagnosis, treatment history, or suggestive symptoms such as loud snoring, witnessed apnoea, and excessive daytime sleepiness [14].

Anaesthetic management and monitoring: All patients were managed according to institutional anaesthesia practice. Monitoring included electrocardiography, noninvasive blood pressure, pulse oximetry, capnography, temperature, and airway pressure. General anaesthesia was induced with appropriate intravenous agents and neuromuscular blocker. Airway management was performed using either endotracheal tube or supraglottic airway device. Mechanical ventilation was adjusted using oxygen-air mixture, tidal volume based on ideal or predicted body weight, respiratory rate, and positive end-expiratory pressure when clinically indicated. Intraoperative desaturation, bronchospasm, high airway pressure, difficult mask ventilation, difficult intubation, and suspected aspiration were recorded.

Outcome measures: The primary outcome was any perioperative respiratory complication. Complications included intraoperative oxygen desaturation, difficult mask ventilation, bronchospasm, high airway pressure, suspected aspiration, postoperative hypoxaemia, atelectasis, prolonged oxygen requirement, reintubation, postoperative pneumonia, and respiratory-related ICU admission. Postoperative hypoxaemia was assessed by pulse oximetry in recovery and ward areas. Atelectasis and pneumonia were diagnosed clinically and radiologically when indicated, following broad definitions used in postoperative pulmonary complication research [2,7,8]. Secondary outcomes included recovery room stay, oxygen requirement, hospital stay, reintubation, ICU admission, and mortality.

Statistical analysis: Continuous variables were expressed as mean $\pm$ standard deviation. Categorical variables were expressed as frequency and percentage. Chi-square test or Fisher exact test was used for categorical comparisons. Independent sample t-test was used for continuous outcome variables. A p-value less than 0.05 was considered statistically significant.

Ethical considerations

Necessary Permissions were obtained before starting the study. Written informed consent was obtained from all participants before enrolment.

Results

A total of 100 obese patients undergoing surgery under general anaesthesia were included in the study. The mean age of the study population was 48.6 $\pm$ 11.8 years. Males constituted 58.0% of the participants, while females constituted 42.0%. The mean body mass index was 34.8 $\pm$ 4.1 kg/m². Most patients belonged to obesity class I, followed by class II and class III obesity. Hypertension and diabetes mellitus were the most common associated comorbidities. The baseline demographic and clinical characteristics are shown in Table 1.

Table 1. Baseline demographic and clinical characteristics of the study participants

Variable	Category / Value	Frequency	Percentage
Total sample size	--	100	100.0
Age, years	Mean $\pm$ SD	48.6 $\pm$ 11.8	--
Age group	18-40 years	24	24.0
	41-60 years	56	56.0
	>60 years	20	20.0
Sex	Male	58	58.0
	Female	42	42.0
BMI, kg/m ²	Mean $\pm$ SD	34.8 $\pm$ 4.1	--
Obesity class	Class I, BMI 30.0-34.9 kg/m ²	52	52.0
	Class II, BMI 35.0-39.9 kg/m ²	32	32.0
	Class III, BMI $\geq$ 40 kg/m ²	16	16.0
ASA physical status	ASA II	64	64.0
	ASA III	36	36.0
Hypertension	Present	42	42.0
Diabetes mellitus	Present	36	36.0
Smoking history	Present	22	22.0
Obstructive sleep apnoea	Present	28	28.0
Bronchial asthma/COPD	Present	12	12.0

Most patients underwent abdominal surgeries, followed by orthopaedic and gynaecological procedures. The mean duration of surgery was 96.4 +/- 34.7 minutes. Endotracheal intubation was used in 82.0% of patients, while supraglottic airway devices were used in 18.0%. The perioperative surgical and anaesthetic profile is shown in Table 2.

Table 2. Surgical and anaesthetic profile of the study participants

Variable	Category / Value	Frequency	Percentage
Type of surgery	Abdominal surgery	38	38.0
	Orthopaedic surgery	26	26.0
	Gynaecological surgery	18	18.0
	Urological/other surgery	18	18.0
Duration of surgery	Mean +/- SD	96.4 +/- 34.7 minutes	--
Duration category	<=60 minutes	24	24.0
	61-120 minutes	48	48.0
	>120 minutes	28	28.0
Airway device used	Endotracheal tube	82	82.0
	Supraglottic airway device	18	18.0
Difficult mask ventilation	Present	10	10.0
Difficult intubation	Present	8	8.0
High intraoperative airway pressure	Present	14	14.0

Perioperative respiratory complications were observed in 32 patients, giving an overall incidence of 32.0%. The most common complication was postoperative hypoxaemia, observed in 22.0% of patients, followed by intraoperative desaturation in 18.0% and requirement of prolonged postoperative oxygen support in 18.0%. Atelectasis was observed in 12.0% of patients. Reintubation and postoperative pneumonia were less frequent. The distribution of respiratory complications is shown in Table 3.

Table 3. Pattern of perioperative respiratory complications

Respiratory complication	Frequency	Percentage
Any perioperative respiratory complication	32	32.0
Intraoperative oxygen desaturation	18	18.0
Difficult mask ventilation	10	10.0
Bronchospasm	6	6.0
High airway pressure	14	14.0
Suspected aspiration	1	1.0
Postoperative hypoxaemia	22	22.0
Postoperative atelectasis	12	12.0
Prolonged oxygen requirement	18	18.0
Reintubation	2	2.0
Postoperative pneumonia	3	3.0
Postoperative ICU admission due to respiratory cause	5	5.0

The incidence of perioperative respiratory complications increased with increasing obesity class. Respiratory complications were observed in 23.1% of patients with class I obesity, 31.3% of patients with class II obesity, and 62.5% of patients with class III obesity. This association was statistically significant. Patients with obstructive sleep apnoea, ASA III status, and longer duration of surgery also showed a significantly higher frequency of respiratory complications. The association between selected clinical variables and respiratory complications is presented in Table 4.

Table 4. Association of selected variables with perioperative respiratory complications

Variable	Category	Respiratory complications present	Respiratory complications absent	p-value
Obesity class	Class I	12 (23.1%)	40 (76.9%)	0.013
	Class II	10 (31.3%)	22 (68.7%)	
	Class III	10 (62.5%)	6 (37.5%)	
ASA physical status	ASA II	15 (23.4%)	49 (76.6%)	0.015
	ASA III	17 (47.2%)	19 (52.8%)	
Obstructive sleep apnoea	Present	14 (50.0%)	14 (50.0%)	0.017
	Absent	18 (25.0%)	54 (75.0%)	
Duration of surgery	<=60 minutes	3 (12.5%)	21 (87.5%)	0.012
	61-120 minutes	15 (31.3%)	33 (68.7%)	
	>120 minutes	14 (50.0%)	14 (50.0%)	
Smoking history	Present	10 (45.5%)	12 (54.5%)	0.132
	Absent	22 (28.2%)	56 (71.8%)	
Bronchial asthma/COPD	Present	6 (50.0%)	6 (50.0%)	0.154
	Absent	26 (29.5%)	62 (70.5%)	

Patients who developed perioperative respiratory complications had a longer postoperative recovery time compared with those without complications. The mean postoperative hospital stay was also significantly higher among patients with respiratory complications. Respiratory-related ICU admission was required in five patients, and two patients required postoperative reintubation. No mortality was observed in the study population. Postoperative outcome measures are shown in Table 5.

Table 5. Postoperative outcome according to respiratory complication status

Outcome variable	Complication group (n=32)	No complication group (n=68)	p-value
Recovery room stay, hours	5.8 +/- 2.1	3.6 +/- 1.4	<0.001
Postoperative oxygen requirement, hours	14.6 +/- 6.8	5.2 +/- 3.1	<0.001
Length of hospital stay, days	4.8 +/- 1.9	3.2 +/- 1.3	<0.001
ICU admission	5 (15.6%)	0 (0.0%)	0.003
Reintubation	2 (6.3%)	0 (0.0%)	0.041
Mortality	0 (0.0%)	0 (0.0%)	--

Overall, the study showed that perioperative respiratory complications were common among obese patients undergoing surgery under

general anaesthesia. Higher obesity class, obstructive sleep apnoea, ASA III physical status, and prolonged surgical duration were significantly associated with increased risk of respiratory complications.

Discussion

The present prospective observational study evaluated perioperative respiratory complications among 100 obese patients undergoing surgery under general anaesthesia. The overall incidence of any perioperative respiratory complication was 32.0%. Postoperative hypoxaemia was the most frequent event, followed by intraoperative desaturation and prolonged postoperative oxygen requirement. These findings are clinically relevant because obese patients have lower pulmonary reserve, faster desaturation after induction, and greater tendency for dependent airway closure during anaesthesia. The pattern observed in this study is consistent with descriptions of postoperative pulmonary complications as a broad spectrum ranging from transient hypoxaemia to pneumonia and respiratory failure [2,7,8].

Increasing obesity class showed a clear association with respiratory complications. Complications were present in 23.1% of class I, 31.3% of class II, and 62.5% of class III obese patients. This gradient supports the physiological basis that higher body mass worsens respiratory mechanics during general anaesthesia. Pelosi et al. showed that body mass influences lung volumes, compliance, and gas exchange, while Eichenberger et al. demonstrated persistent postoperative atelectasis in morbidly obese patients [3,4]. Therefore, the higher frequency of hypoxaemia and atelectasis in this cohort reflects reduced functional residual capacity, small airway closure, and incomplete alveolar recruitment after extubation.

Airway-related events were also important. Difficult mask ventilation was recorded in 10.0% of patients, difficult intubation in 8.0%, and high intraoperative airway pressure in 14.0%. These findings indicate the combined technical and physiological challenges encountered during anaesthesia in obesity. Earlier reports noted a higher rate of difficult tracheal intubation among obese patients, and bariatric anaesthesia literature stresses positioning, preoxygenation, appropriate airway equipment, and experienced assistance [5,6]. In the present study, airway events formed part of the broader respiratory risk profile rather than isolated procedural problems.

Obstructive sleep apnoea was significantly associated with respiratory complications, with events occurring in 50.0% of patients with obstructive sleep apnoea compared with 25.0% of those without it. This finding agrees with sleep apnoea guidelines and meta-analytic evidence showing increased postoperative adverse events among patients at high risk for obstructive sleep apnoea [13,14]. Residual anaesthetic effects, opioids, supine recovery, and reduced pharyngeal tone can aggravate upper airway obstruction after extubation. The observed increase in oxygen requirement and recovery room stay supports postoperative pulse oximetry, cautious opioid use, head-up positioning, and early airway support when required.

Duration of surgery and ASA physical status also showed significant associations with respiratory complications. Patients undergoing procedures lasting more than 120 minutes had a complication rate of 50.0%, while ASA III patients had a rate of 47.2%. These findings correspond with established risk models in which patient burden, operative complexity, and anaesthesia exposure influence pulmonary outcomes [7-9]. Intraoperative ventilation remains a modifiable factor. Trials of protective ventilation and positive end-expiratory pressure have shown benefits for pulmonary function in selected patients, although high PEEP with recruitment manoeuvres did not reduce postoperative pulmonary complications in obese patients in the PROBESE trial [10-12].

Limitations

This study was conducted at a single tertiary care centre with a sample size of 100 patients, limiting wider external generalisation. Obstructive sleep apnoea was identified from clinical history or previous diagnosis rather than formal polysomnography. Long-term pulmonary outcomes after discharge were not assessed. Ventilation settings and analgesic regimens were recorded according to routine practice, without protocol-based randomisation or intervention.

Conclusion

In this prospective observational study, perioperative respiratory complications were observed in nearly one-third of obese patients undergoing surgery under general anaesthesia. Postoperative hypoxaemia, intraoperative desaturation, prolonged oxygen requirement, and atelectasis were the most frequent events. Higher obesity class, obstructive sleep apnoea, ASA III status, and longer surgical duration were significantly associated with increased complication rates. Patients with complications required longer recovery room observation, greater oxygen support, longer hospital stay, and more frequent respiratory-related ICU admission. These findings emphasise careful preoperative risk assessment, planned airway management, individualised ventilation, cautious extubation, and structured postoperative respiratory monitoring as practical measures to improve perioperative safety in obese surgical patients within routine clinical practice.

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