Perioperative risk factors in obese patients for bariatric surgery: a Singapore experience

Iyer U S, Koh K F, Chia N C H, Macachor J, Cheng A

ABSTRACT

Introduction: Morbid obesity and obstructive sleep apnoea (OSA) are increasingly encountered in anaesthetic practice today. Difficult intubation may be seen more frequently in our practice. This high-risk group may also be more prone to complications in the postoperative period.

Methods: We reviewed a consecutive series of patients who had undergone laparoscopic gastric banding at our institution from 2001 to 2006. The incidence of difficult intubation, early postoperative complications and its attendant risk factors were studied.

Results: Severe OSA and neck circumference greater than 44 cm were factors associated with difficult intubation in morbidly obese patients who presented for bariatric surgery. Asthma and increasing age may be associated risk factors for adverse events in the postoperative period.

Conclusion: It is important to anticipate and prepare for a difficult intubation scenario in patients with severe OSA and a larger neck circumference. Close monitoring is recommended for patients with respiratory comorbidities and advanced age.

Keywords: bariatric surgery, difficult postoperative complications, morbid obesity, obstructive intubation, sleep apnoea

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Department of Anaesthesia, Khoo Teck Puat Hospital, 90 Yishun Central, Singapore 768828

Iyer US MBBS, MD, MMed
Consultant

Koh KF, MMed
Senior Consultant and Head
Deputy Chairman, Medical Board

Chia NCH, MBBS, MMed
Consultant

Macachor J, DPBA
Medical Officer

Department of Surgery

Cheng A, FRCSE, FRACS, FAMS
Senior Consultant

Correspondence to:
Dr Uma Shridhar Iyer
Tel: (65) 9756 4458
Fax: (65) 6602 3648
Email: uma_shridhar@rediffmail.com

INTRODUCTION

Anaesthesia for the morbidly obese patient is challenging. With the incidence of obesity rising rapidly and almost assuming pandemic proportions, the dire implication for the healthcare provider is clear. An estimated 315 million people worldwide are obese.[1] It is second only to smoking as the leading preventable cause of premature death.[2] Comorbidities like hypertension and diabetes mellitus are also more often seen in obese patients.[2] Surgical techniques are increasingly being used for weight loss. As a fast-growing pandemic, this high-risk group is now frequently encountered in our anaesthetic practice. Obesity in Asian patients may be associated with more obesity-related diseases at a lower body mass index (BMI) than their Caucasian counterparts. This has led the Ministry of Health, Singapore to redefine overweight and obesity as a BMI greater than 23 and 27.5, respectively as opposed to the figures of 25 and 30, as previously proposed by the World Health Organization (WHO).[3] WHO, the International Association for the Study of Obesity and the Obesity Task Force have since adopted the Singapore figures for defining obesity. Severe obesity is defined as a BMI > 37 or a BMI ≥ 32 if associated comorbidities exist (defined by the 2005 Asia Pacific consensus).[4]

This shift in definition of obesity and severe obesity increases the number of patients meeting the required criteria for surgical intervention as part of a weight management programme. Among the surgical options available, laparoscopic gastric banding is considered to be one of the safer options.[5] This technique has evolved from the old non-adjustable gastric bands to the current adjustable gastric bands and other techniques.

As the incidence of obesity increases and more weight reduction surgeries are being performed, anaesthetists also come across this difficult group of patients more frequently. The perioperative care of these patients is complex due to obesity and its associated conditions. Factors associated with difficult intubation include obesity, large neck circumference, high Mallampati score and obstructive sleep apnoea (OSA).[6-8] Obesity is also associated with a higher incidence of postoperative complications, as shown by Patel et al.[9] OSA has been increasingly diagnosed in patients in recent years, often coexisting in patients with obesity.[10] OSA alters the upper airway anatomy by reducing the available oropharyngeal space, leading to obstruction and difficulties in securing an airway by conventional or non-conventional techniques.[11]

We reviewed a consecutive series of patients who had undergone laparoscopic gastric banding in our institution from 2001 to 2006 in order to study the incidence of difficult intubation, early postoperative complications and its attendant risk factors.

METHODS

After obtaining the approval of the Domain Specific Review Board, we reviewed the paper-based anaesthetic records and case notes of patients who underwent laparoscopic gastric banding in our hospital from January 1, 2001 to December 31, 2006. A total of 301 patients underwent surgery during the study period. However, complete case notes were successfully retrieved for only 267 patients, and these were included in the study. We also accessed the computer-based hospital's anonymous incident reporting system data adverse events pertaining to patients who had undergone bariatric surgery.

The demographic data of all patients were obtained. Clinical correlates that were deemed useful were BMI, preexisting comorbid diseases, smoking status, presence or absence of OSA and its severity, such as the apnoea-hypopnoea index, neck circumference, Mallampati (Samsoon and Young modification)[12] score, thyromental distance, technique of anaesthesia for airway control, number of attempts for successful endotracheal intubation and grading of laryngoscopic view (Cormack-Lehane score), postoperative complications in the first 24 hours post surgery, choice of postoperative monitoring and length of hospital stay, were also obtained.

Ancillary devices that were used to assist endotracheal intubation were also recorded. These could range from a stylet to a bougie or a normal Macintosh blade to an alternate laryngoscope like a short-handle laryngoscope or McCoy laryngoscope. Data pertaining to airway assessment, Mallampati score, technique of anaesthesia for airway control, number of attempts for securing the airway and the grading of the laryngoscopic view was retrieved from the anaesthetic chart. Data on OSA and neck circumference was obtained from the sleep study reports. All patients who underwent workup for bariatric surgery underwent a sleep study and measurement of neck circumference as part of the surgical protocol, and hence, this data was accessible with accuracy. Difficult intubation was defined as a situation that required three or more attempts for successful endotracheal intubation.[13] The modified ramp position was adopted for all patients during intubation. Factors that were studied for difficult intubation were age, gender, BMI, severity of OSA, neck circumference greater or less than 44 cm and the Mallampati score.

Table I. Patient characteristics (n = 267).

Characteristic	No. (%)
Gender	
Male	96 (36.0)
Female	171 (64.0)
Mean age ± SD (yrs)	35.7 ± 9.2
Mean BMI ± SD (kg/m^2)	42.0 ± 7.2
OSA	
None	91 (34.1)
Mild	53 (19.9)
Moderate	34 (12.7)
Severe (AHI ≥ 30)	89 (33.3)
CPAP for OSA	98 (36.7)
Neck circumference > 44 cm	100 (37.5)
Comorbidities	158 (59.2)
Asthma	54 (20.2)
Smokers	54 (20.2)

SD: standard deviation; CPAP: continuous positive airway pressure; AHI: apnoea-hypopnoea index; OSA: obstructive sleep apnoea;

Data on postoperative events were retrieved from the postoperative records. All patients were closely monitored during the first 24 hours. Oxygen was administered in the recovery period until the patients were fully awake, and further need for oxygen supplementation was then reviewed. Postoperative events such as delayed emergence, desaturation, bronchospasm, nausea, vomiting, dysphagia, unplanned intensive care unit (ICU) admission in the first 24 hours post surgery, cardiovascular events like arrhythmias and chest pain were also reviewed. Delayed emergence was defined as a time requirement of more than 30 minutes for eye opening and obeying of simple commands in the recovery area. Desaturation was defined as a fall in oxygen saturation on the pulse oximeter to less than 92%, prompting oxygen supplementation. Bronchospasm that was confirmed on auscultation, coughing episodes causing distress to the patients and desaturation were classified as adverse respiratory events in the recovery period. Similarly, complaints of nausea or vomiting, chest pain, breathlessness and palpitations were documented in the recovery period.

Numerical data was presented as mean or percentage, where appropriate. Univariate analysis, followed by multivariate logistics regression analysis, was performed for factors associated with difficult intubation, such as age, gender, BMI, severity of OSA, neck circumference greater or less than 44 cm and Mallampati score. Likewise, factors that were studied for postoperative complications included age, gender, BMI, severity of OSA, neck circumference, comorbidities and smoking history. A p-value < 0.05 was statistically significant. Odds ratio (OR) and 95% confidence interval (CI) were then calculated for factors that were considered significant.

Table II. Differences between patients with and without difficult intubation.

Factor	No difficult intubation	Difficult intubation	p-value
Mean age ± SD (yrs)	35.37 ± 9.29	40.11 ± 7.62	0.036
Male:Female	85:164	11:7	0.021
Mean BMI ± SD (kg/m^2)	41.82 ± 6.65	45.04 ± 12.64	0.068
Neck circumference (< 44 cm: ≥ 44 cm)	160:89	7:11	0.032
Mallampati score			0.322
1	107	7	
2	116	8	
3	24	2	
4	2	1	
Non-severe OSA:severe OSA	172:77	6:12	0.002

SD: standard deviation; BMI: body mass index; OSA: obstructive sleep apnoea

The Statistical Package for the Social Sciences version 13 (SPSS Inc, Chicago, IL, USA) was used for data analysis.

All patients required general anaesthesia with endotracheal intubation, which was facilitated by succinylcholine in 77.9% of patients, atracurium in 17.9% and rocuronium in 3.4% of patients. Elective awake fibreoptic bronchoscopic intubation technique, as indicated by cervical spine pathology, was performed in two patients. Laryngoscope view was graded as 1 or 2 in 98% of patients, with or without external laryngeal pressure. Grade 3 laryngoscopic view was noted in three patients.

18 (6.7%) patients required three or more attempts at endotracheal intubation. Difficult intubation was not anticipated in nine out of the 18 patients. Intubation was eventually achieved with the aid of one or more of the following adjuncts: stylet, bougie, long-blade Macintosh scope and McCoy laryngoscope, either singly or in combination. No failed intubation or laryngeal mask airway rescue was recorded. No trauma or critical hypoxaemia, defined as desaturation < 85%, was recorded.

The distribution of patients in the two groups showed a predeliction toward younger, female patients with a lower BMI in the group without difficult intubation (Table II). Correlation was tested for severe OSA and neck circumference only. There was significant correlation between severe OSA (Spearman correlation 0.2, p = 0.002), neck circumference > 44 cm (Spearman correlation 0.13, p = 0.03) and difficult intubation. Only severe OSA (OR 4.46, 95% CI 1.6–12.3, p = 0.004), was significantly associated with difficult intubation among other factors such as BMI, age, Mallampati score, neck circumference, when entered in logistic regression analysis.

158 (58.17%) patients had comorbidities, of whom 54 (20.2%) had asthma. Other comorbidities were diabetes mellitus, hypertension, ischaemic heart disease, osteoarthritis and gout. 54 (20.2%) patients had a significant smoking history. 54 (20.2%) patients had early postoperative complications such as respiratory distress, nausea and atypical chest pain. No mortality was noted (in the first 24 hours) during the study period. The commonest complication was desaturation, which was most likely due to atelectasis in this patient population. It was easily overcome by the administration of supplemental oxygen. None of these patients required institution of therapeutic continuous positive airway pressure (CPAP). Patients who were already on CPAP therapy preoperatively for OSA were electively set on CPAP on the night of the surgery. In one patient, atypical chest pain was another complication that led to prolonged hospital stay. The pain was likely due to band position or pneumoperitoneum, as a cardiac cause was eventually ruled out. No record of delayed emergence was noted.

Patients from the recovery room were either discharged to the general ward or to a planned high-dependency unit, according to the discretion of the attending anaesthetist. 59.5% of patients were electively admitted to the high-dependency unit, usually for severe OSA. There were no unplanned ICU admissions. The mean BMI of patients who were discharged to the general ward was 38.8 ± 5.4, while that of patients who were monitored in the high-dependency unit/ICU was 44.73 ± 7.49. The median length of stay was one day, which was similar in patients with or without complications.

Using multivariate logistic regression analysis, the factors associated with postoperative complications were increasing age (OR 1.04, 95% CI 1.01–1.08, p = 0.05), asthma (OR 2.94, 95% CI 1.5–5.8, p = 0.002) and a BMI > 50 (OR 2.64, 95% CI 1.14–6.12, p = 0.02) (Table III). The postoperative complications involved mild exacerbations of bronchial asthma and desaturation in the recovery suite, which were conservatively managed with oxygen and bronchodilators.

DISCUSSION

Bariatric surgery was first performed in our hospital in 2001, and since then, we have had the largest series of bariatric surgery cases. We have developed protocols for

Table III. Differences between patients with and without early postoperative complications.

Factor	No complication	Complication	p-value
Mean age ± SD (yrs)	35.02 ± 9.18	38.33 ± 9.13	0.018
Male:Female	78:135	18:36	0.65
Mean BMI ± SD (kg/m^2)	41.64 ± 7.11	43.62 ± 7.48	0.073
Non-severe:severe OSA	145:68	33:21	0.33
No comorbidities: comorbidities	93:120	16:38	0.061
No Asthma: asthma	178:35	35:19	0.002
Non-smokers:smokers	173:40	40:14	0.24

SD: standard deviation; BMI: body mass index; OSA: obstructive sleep apnoea

the perioperative management of this high-risk group, which include enrolment in a multidisciplinary weight-management programme, pre-anaesthetic screening for comorbid conditions and airway difficulties, as well as elective ICU booking, perioperative use of mask CPAP and intraoperative anaesthetic management protocol.

The overall incidence of difficult intubation was high in our study (6.7%), but intubation was nonetheless successful in all our patients. In another local study by Butler and Dhara, the authors studied the incidence of difficult laryngoscopy in mixed surgical patients in Singapore and found that 8.2% of all patients had difficult laryngoscopy, which was reduced to 1.6% when cricoid pressure or external laryngeal pressure was applied.[14] However, this study referred to the incidence of difficult laryngoscopy in all patients, unlike our study, which exclusively looked at patients with obesity.

Our department policy for intraoperative management during bariatric surgery recommends strict preoxygenation for three minutes in the ramp position, followed by a rapid sequence intubation technique with succinylcholine if the patient is considered to be at risk for difficult intubation and aspiration. One of the greatest concerns would be the ability to mask-ventilate these patients after they are paralysed. Unfortunately, the details of difficulty in mask ventilation were not always available in the case notes. After gaining more experience and confidence, we began attempting laryngoscopy and intubation with non-depolarising agents. Obesity does not necessarily put these patients at a higher risk for aspiration, as opposed to their leaner counterparts.[15] In fact, the use of rapid sequence technique, and therefore, cricoid pressure, has been postulated to worsen the laryngoscopic view and contribute to difficulty in intubation.[16] All patients who met the criteria of difficult intubation were intubated with succinylcholine, except for one who received atracurium. Hence, application of cricoid pressure may have contributed to the increase in the incidence of difficult intubation.

Although it has been shown in previous studies that OSA is more prevalent in patients with obesity,[10] the association of obesity with difficult intubation has been a subject of considerable controversy.[6-8] Brodsky et al reported that neither BMI nor OSA predicts difficult intubation,[6] but a larger neck circumference and a high Mallampati score were positive predictors in their study.[6] Morbid obesity is known to be one of the risk factors for the development of OSA. Certain anatomical features in OSA compromise airway dimensions and have been suspected of causing difficult airway access. Siyam and Benhamou studied patients with OSA and found a higher incidence of difficult intubation in patients with OSA as compared to the control population.[7] However, they did not find an increasing risk of difficult intubation with an increasing severity of OSA. Hiremath et al studied patients with difficult intubation and found a significant association between OSA and difficult intubation.[11] A review of the literature did reveal studies on either OSA or morbid obesity with relation to difficult intubation, but in our study, we attempted to look at both of these factors together. This study is unique as it focused on the interactions between the various factors that may cause difficult intubation in the morbidly obese patients undergoing laparoscopic banding.

On univariate analysis, both severe OSA and neck circumference were noted to be associated with difficult intubation. However, on employing multivariate logistic regression analysis, only severe OSA was found to be associated with difficult intubation. This may be explained by an association between severe OSA and neck circumference in previous studies as well as in our data. The presence of severe OSA puts this high risk group of patients at an additional risk for difficult intubation due to changes in the upper airway, namely increased fatty tissue around the neck and increased peripharyngeal tissue. With a reduced space for displacement of structures during laryngoscopy, visualisation of the larynx and vocal cords is thus impaired. While obesity in itself does not predispose one to difficult intubation, the higher

incidence of OSA in these patients should raise the alarm for potentially difficult laryngoscopy. In evaluated and diagnosed patients, sleep studies or other screening tools for OSA could thus serve as red flags in alerting the anaesthesiologist to the possibility of a difficult airway.

The immediate availability of adjuncts like stylets, bougies, short-handle laryngoscopes and McCoy laryngoscopes has helped to achieve a high degree of success with endotracheal intubation among our patients. We strongly recommend the availability of such adjuncts (as well as video laryngoscopes) before intubation. In addition, it may not be mandatory to carry out rapid sequence intubation with succinylcholine in these patients, as our experience has shown. Difficult mask ventilation, especially after muscle paralysis, may be overcome by using two hands for mask ventilation, with a trained assistant or ventilator delivering the positive pressure. Careful positioning, the availability of appropriate equipment and extra help are effective in reducing the incidence of difficult or failed intubation.

Our postoperative practice is to extubate the trachea in a semi-upright position so as to avoid complications like airway obstruction, basal atelectasis or negative pressure pulmonary oedema. We routinely employ anti-emetic prophylaxis, with a combination of dexamethasone and ondansetron. Prophylactic perioperative antibiotics and low-molecular-weight heparin is standard practice. Morbidly obese patients and patients with severe OSA require ICU booking.[17]

The commonly encountered complications in the postoperative period are nausea, vomiting, desaturation, haemodynamic instability, aspiration, infection and deep vein thrombosis. Karunakar et al reported that BMI is predictive of complications like blood loss, wound infection and deep vein thrombosis after operative acetabular fractures.[18] In another paper, Brandt et al reported that severe obesity does not adversely affect perioperative mortality and morbidity in coronary artery bypass surgery.[19] In another study on obese patients presenting for spine surgery, Patel et al reported BMI as an independent predictor of significant postoperative complications, and that the probability of minor complications increased with age.[9] Pang retrospectively studied 118 patients who underwent surgery for OSA and found an increased incidence of desaturation in patients with severe OSA, for which the author recommended the use of CPAP in the immediate postoperative period to reduce the incidence.[20] Siyam et al also noted a corresponding increase in respiratory complications in OSA patients, with 97% of these patients requiring respiratory support.[7] In a study by Ahmad et al, where the recovery profiles of obese patients with OSA were compared to obese patients without OSA, it was observed that the incidence of desaturation in the recovery area did not differ between the two groups.[21] Similarly, we did not find any correlation between OSA and the development of complications in the early postoperative period, which concur with the results published by Ahmad et al.

Expectedly, we noted more frequent complications in patients with asthma due to the natural history of the disease. Patients with obesity already have a poor oxygen reserve, which makes them even more vulnerable to the respiratory hazards associated with asthma in the postoperative period. We also noted frequent occurrences of respiratory complications, which were dealt with by nebulisation of bronchodilators, institution of supplemental oxygen or CPAP for patients who were already on it preoperatively. We also observed that older patients were more prone to respiratory complications, with the risk increasing by 9% every year. Surprisingly, the incidence of complications, be it respiratory or otherwise, were not encountered more frequently in smokers as compared to non-smokers. Obesity alone did not seem to pose a risk for development of postoperative complications. Atypical chest pain was noted in five patients, which proved innocuous and was probably secondary to the band position. Any cardiac aetiology to this chest pain was ruled out; it was hence labeled as atypical chest pain.[22]

No life-threatening complications were noted. This may be due to the close monitoring of this high-risk group and the adherence to protocols for perioperative management. The low incidence of nausea and vomiting may be attributed to a strict antiemetic regime practised in this group of patients. We had no reports of aspiration, infection or deep vein thrombosis. However, we restricted data collection in this study to the first 24 hours postoperatively and thus could not account for any infection or deep vein thrombosis occurring subsequently.

This experience has influenced our decision for ICU admissions postoperatively for this group of patients. Perhaps older patients and asthmatics should be managed in facilities with close monitoring, such as a prolonged stay in post-anaesthesia care unit, high-dependency or ICU care postoperatively. Our practice of using prophylactic antiemetics and anticoagulants has led to a very low incidence of nausea, vomiting and deep vein thrombosis. We prefer to extubate obese patients when they are awake and in a propped-up position, in concurrence with the literature and physiology so as to minimise airway obstruction and atelectasis.

There are limitations to the study. As this was a retrospective study, standardisation and accuracy

may be compromised. We could not retrieve data from all the patients who underwent surgery during the study period owing to the displacement of case notes. Preoperative assessment, namely airway assessment, was mostly performed by rotating medical officers or trainee registrars and not by a dedicated team, which may influence its consistency. Among the various definitions of difficult intubation, we chose three or more attempts at intubation, as it was the only data that could be secured with reasonable accuracy from our anaesthetic charts. Another argument could be the accuracy of the definition of attempts, as initial attempts at intubation could well have been performed by a trainee of limited experience before a more senior and trained anaesthetist took over. However, this reflects the real-life scenario of a teaching hospital. The incidence of postoperative complications may also be underreported, as some minor events may not have been documented. Thus, we worked on the assumption that unrecorded events may not have significant consequences. We accessed the records of the anonymous hospital reporting system records to look for reports of any adverse events in order to maximise the recovery of data pertaining to postoperative complications.

In conclusion, severe OSA and a neck circumference > 44 cm are factors associated with difficult intubation in morbidly obese patients presenting for bariatric surgery. It is important to suspect OSA in this high-risk group of patients and confirm the diagnosis of OSA with a polysomnograph test, when suspected. In the presence of severe OSA, whether based on clinical suspicion or polysomnograph, it is important to anticipate a difficult airway and prepare for such a scenario with an array of adjuncts for maintaining airway patency and as aids to intubation, along with expertise, skilled assistance and familiarity with the difficult airway algorithm. With improved understanding of the pathophysiology of morbidly obese patients, careful anticipation and appropriate prophylactic intervention strategies, surgery in such patients can be undertaken safely with minimal adverse events. Asthma and increasing age may be associated risk factors for adverse events in the postoperative period. Therefore, these patients could benefit from sites that provide heightened postoperative monitoring.

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