CHAPTER 8

Routine postoperative monitoring after bariatric surgery in morbidly obese patients with severe obstructive sleep apnoea: ICU admission is not necessary

Amin B. Goucham, Usha K. Coblijn, Helga B. Hart – Sweet, Nico de Vries, Sjoerd M. Lagarde, Bart A. van Wagensveld

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Abstract

Background and study aim: Obstructive sleep apnoea (OSA) occurs in 70–80% of bariatric surgery patients. Patients with severe OSA (apnoea-hypopnea-index (AHI) > 30/hr) are postoperatively admitted to an Intensive Care Unit (ICU) for continuous monitoring, to prevent complications. The aim of this study was to assess the necessity of routine postoperative monitoring at an ICU of severe OSA patients after bariatric surgery, attempting to prevent and detect cardiorespiratory complications.

Methods: Patients undergoing bariatric surgery from November 2010 until July 2013 were entered into a database. Minimal follow up was one month. Poly(somno)graphy (P(S)G), was routinely performed. Patients with severe OSA were admitted to the ICU for the first postoperative night. Oxygen saturation was continuously measured. The database was reviewed regarding patient characteristics, CPAP use, re-intubations, desaturations (saturation <90% and severe <85%) and complications.

Results: Severe OSA was present in 151 of the 794 patients and all 151 were admitted to the ICU. Thirty who underwent revisional surgery were excluded. Forty seven percent was male, median age 51 years (27.0–68.0) and median body mass index (BMI) 46.6 (kg/m²) (34.0–77.6). No deaths, re-intubations or cardiopulmonary complications occurred. Eighty-two (67.8%) patients used continuous positive airway pressure (CPAP). Twenty-one (17.4%) patients experienced desaturations with a median of 2.0 (1–8). Six patients (5.0%) had one episode of severe desaturation.

Conclusion: Patients with severe OSA and adequate CPAP use are at low risk of cardiopulmonary complications after (laparoscopic) bariatric surgery. Routine admission to an ICU might be superfluous. However, continuous digital oximetry remains essential.
Introduction

Obesity is a major health problem with serious medical, psychological and socio-economic consequences all over the world \[13\]. Obstructive sleep apnoea (OSA) is an important comorbidity that improves dramatically after bariatric surgery \[4\]. However, OSA is considered a risk factor for postoperative events after general anaesthesia. Desaturation (10.7 vs 5.6%) can be regarded as one of the first symptoms of such a negative adverse event like respiratory failure (2.0 vs 0.7%), cardiac events (3.8 vs 1.7%), intensive care unit (ICU) transfer (5.1 vs 1.6%) stroke and mortality (adjusted hazard ratio: 2.0) \[5\].

OSA is a disease characterized by recurrent airway collapse. In obese patients, it is thought that an important part of the pathophysiology is caused by the local fatty tissue deposition in the neck which results in reduction of the lumen of the upper airway \[14\]. Due to the subsequent restricted airflow, patients can become hypoxic which can lead to cardiac arrest and other ischemic complications \[8\]. The prevalence of OSA in the bariatric population ranges from 71% to 91% \[15\]. The apnoea/hypopnea index (AHI) represents the combined number of apnoea’s and hypopneas that occur per hour of sleep. An AHI of 5–15 was graded as mild, 15–30 as moderate, and ≥30 as severe OSA. Of those with OSA, 33.1% are diagnosed with severe OSA \[10\].

Bariatric surgery is the only long term effective treatment for weight loss \[2\]. Ten years after bariatric surgery, weight loss (25% of total weight for gastric bypass) was still apparent, whereas patients receiving conservative treatment regain their baseline weight. There is also a significant reduction in obesity related comorbidities such as type 2 diabetes \[12\].

In many institutions, patients with severe OSA are admitted at the ICU, medium care unit or under intensive monitoring at the general surgical ward after bariatric surgery \[14\]. The growing demand for bariatric surgery, however, creates an increasing logistical strain on costly critical care resources. Evidence justifying postoperative ICU admission is scarce. Several studies show that routine ICU admission is not required, and continuous monitoring by means of pulse oximetry or capnography alone may be sufficient \[13\]. The American Society of Anaesthesiologists has put forth recommendations for the perioperative care of patients with OSA. These recommendations are, however, not evidence-based since research is scarce \[15\]. To minimize cardiopulmonary complications continuous positive

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airway pressure (CPAP) is frequently used peri-operatively. CPAP reduces hypoxemia and should decrease postoperative hypoxic complications \(^{(18)}\). Still, many institutes don’t use protocols regarding this issue and therefore an evidence-based approach is in order \(^{(19)}\). This study aimed to assess the necessity of routine postoperative monitoring at an ICU of severe OSA patients after bariatric surgery, attempting to prevent and detect cardiorespiratory complications.

**Methods**

From November 2010 until July 2013, 794 morbidly obese patients underwent bariatric surgery and were entered into a consecutive database. Patients underwent laparoscopic Roux-en-Y gastric bypass (LRYGB), laparoscopic adjustable gastric banding (LAGB) or laparoscopic sleeve gastrectomy (LSG). Thirty of the 151 patients who had severe OSA and were admitted at the ICU were excluded due to previous bariatric surgery were excluded from analysis to avoid potential bias.

Data collection for this study was approved by the institution’s ethics committee. Patients were considered eligible when the International Federation for the Surgery of Obesity (IFSO) criteria for bariatric surgery were met \(^{(20)}\). A body mass index (BMI) of 40 kg/m\(^2\) or more, or between 35 kg/m\(^2\) and 40 kg/m\(^2\) together with significant co-morbidity (for example, type II diabetes, high blood pressure or OSA). One patient with a BMI of 34.0 kg/m\(^2\) was accepted due to severe comorbid disease (including severe OSA), that would benefit of weight loss.

Preoperative screening in all patients consisted of psychological evaluation, physical examination including assessment of the upper airway, and additional tests such as laboratory tests or imaging if necessary. All patients underwent esophagogastroduodenoscopy including testing for Helicobacter pylori. Due to the very high prevalence of OSA in morbidly obese patients, pre-operative screening for OSA was routinely performed by means of poly(somno)graphy (P(S)G). The severity of OSA was determined according to the AHI. Manual scoring was used to determine AHI.

Patients with moderate OSA (AHI >15) were prescribed continuous positive airway pressure (CPAP) and patients with severe OSA (AHI > 30/hr) were additionally admitted to the ICU for 24 hours postoperative observation.

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Patients with moderate OSA (AHI >15) were prescribed continuous positive airway pressure (CPAP) and patients with severe OSA (AHI > 30/hr) were additionally admitted to the ICU for 24 hours postoperative observation.
Patients were treated for OSA with CPAP at home prior to surgery and the treatment was continued postoperatively. Supplemental oxygen with a maximum of five litres was administered per nasal cannula when necessary and oxygen saturation was continuously measured using pulse oximetry. Oxygen (O₂) saturation levels were monitored and an alarm sounded when saturation levels dropped below 88%. Desaturation was defined as <90% and severe desaturation as <85%. All desaturations were automatically collected by the electronic patient records and subsequently reviewed. CPAP compliance was regarded as proper use when its usage was witnessed and documented in patient’s chart by the nursing staff.

As thrombosis prophylaxis, nadroparine 0.6 ml daily was prescribed, starting one day prior to surgery until discharge. For postoperative analgesia paracetamol 1000 mg three times daily was prescribed and if necessary diclofenac 50 mg three times daily. If not sufficient morphine 10 mg subcutaneously up to six times in 24 hours was administered. Patient controlled analgesia was never used. In the post anaesthesia care unit (PACU) morphine is titrated until a tolerable level of pain is achieved, usually less than four on a Visual Analogue Scale (zero is no pain and ten is the worst possible pain).

The database was retrospectively reviewed to investigate patient demographics, co-morbidities, CPAP compliance, re-intubations, desaturations and severe desaturations, complications and mortality.

Statistical analysis was performed using SPSS version 18.0 (SPSS, Inc., Chicago IL). A histogram was used to test whether the data was normally distributed, if normal distributed the analysis of continuous variables was carried out using the independent sample T-test, otherwise the Mann-Whitney U was used. Logistic regression analysis was used to calculate the odds ratio and confidence interval for predictive variables. Baseline variables which were categorical were analysed with the Chi-square test. A p-value smaller than 0.05 was considered significant. The rule of three was used to approximate the rate of major complications or fatal events in the absence of observed events.
Results:

One hundred and fifty-one (19%) of the 794 analysed patients had severe OSA and were admitted to the ICU for the first postoperative night according to protocol. Thirty (19.9%) patients were excluded from the analysis because they underwent revisiional procedures. Hundred and ten patients underwent LRYGB (90.9%), three underwent LAGB (2.5%) and eight underwent LSG (6.6%). Of 121 patients analysed, patient characteristics are shown in Table 1. Median hospital stay was 2.2 nights (1-9). All patients were observed in the ICU for 1 night except for 1 patient who was observed for 2 nights because she did not use her CPAP mask postoperatively and developed hypercapnia which was subsequently treated with CPAP. This patient was 62 years with an AHI of 66 and a BMI of 49.5 with an extensive medical history of frequent hospital and IC admissions for impending respiratory failure due to chronic obstructive pulmonary disease.

Twenty-one (17.4%) patients experienced one or more desaturations (O₂ below 90%). Median number of desaturations below 90% O₂ during ICU admission was 2.0 (1-8). Six patients (5.0%) had one episode of severe desaturation (O₂ below 85%). One female patient experienced one episode with six severe desaturations which was treated with CPAP. This patient was 27 years with an AHI of 34, a BMI of 61.3 and no comorbidities. A BMI of 60 kg/m² and higher was significantly associated with desaturations <85% Table 2. Eighty-two (67.8%) patients were CPAP compliant. All non-compliant patients (32.2%) received oxygen per nasal cannula. There was no association between desaturations and the use of CPAP Table 2. Median O₂ supplementation was three litres (range 0-5). No significant association between desaturations and increased AHI could be demonstrated Table 2. The 30-day complication rate was 9.1% Table 3. Two anastomotic leaks occurred. No in-hospital deaths, re-intubations, cardiopulmonary complications or wound infections occurred.

<table>
<thead>
<tr>
<th>Number of patients:</th>
<th>121</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (%)</td>
<td>47</td>
</tr>
<tr>
<td>Median BMI (kg/m²)</td>
<td>46.6 (34.0 - 77.6)</td>
</tr>
<tr>
<td>Median age (years)</td>
<td>51.0 (27.0-68.0)</td>
</tr>
<tr>
<td>Median AHI (per hour)</td>
<td>50.0 (10.0-149.0)</td>
</tr>
<tr>
<td>CPAP compliance</td>
<td>67.8%</td>
</tr>
</tbody>
</table>

BMI = Body Mass Index, AHI = Apnoea Hypopnea Index, CPAP = Continuous Positive Airway Pressure
Table 2: Predictive variables

<table>
<thead>
<tr>
<th>Desaturation</th>
<th>Variable</th>
<th>Odds ratio</th>
<th>95% Confidence Interval</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 90% O₂</td>
<td>CPAP use (Y/N)</td>
<td>0.980</td>
<td>0.868 - 1.105</td>
<td>0.980</td>
</tr>
<tr>
<td>&lt; 90% O₂</td>
<td>AHI ≥ 30</td>
<td>1.010</td>
<td>0.991 - 1.029</td>
<td>0.327</td>
</tr>
<tr>
<td>&lt; 85% O₂</td>
<td>BMI ≥ 60</td>
<td>8.720</td>
<td>1.346 - 56.512</td>
<td>0.023</td>
</tr>
</tbody>
</table>

CPAP = Continuous Positive Airway Pressure, AHI = Apnea Hypopnea Index, BMI= Body Mass Index

Table 3: 30 days complications

<table>
<thead>
<tr>
<th>Complication</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bleeding</td>
<td>3</td>
</tr>
<tr>
<td>Marginal ulcer</td>
<td>1</td>
</tr>
<tr>
<td>Internal herniation</td>
<td>1</td>
</tr>
<tr>
<td>Dysphagia</td>
<td>1</td>
</tr>
<tr>
<td>Anatomotic leakage</td>
<td>2</td>
</tr>
<tr>
<td>UTI or pneumonia</td>
<td>3</td>
</tr>
</tbody>
</table>

UTI: urinary tract infection

Discussion

This study found that in patients with severe OSA who were monitored at the ICU, no OSA depended adverse events occurred. No relation between a high AHI and desaturations could be established. No cardiopulmonary complications occurred in the patients admitted to the ICU. No major interventions were required for desaturations or even for the severe ones. Subsequently the complication rate was below the 2.5%, comparable with patients without OSA as found by a prospective, observational cohort study by the Longitudinal Assessment of Bariatric Surgery Consortium. They found that the estimated percentage of patients with postoperative complications (deep-vein thrombosis or venous thromboembolism; re-intervention by percutaneous, endoscopic, or operative technique; or failure to be discharged from the hospital within 30 days after surgery) ranges from approximately 3% among patients who did not have a history of OSA to 5% among patients who had a history of OSA (22).

The present studies strength compared to previously published studies is that PSG was performed in all patients who underwent bariatric surgery, unless previously assessed with a known AHI. Therefore, no selection bias based on OSA presence occurs. In a previous
In an effort to eliminate as much confounding factors as possible all patients who had previous bariatric surgery were excluded as an increased risk of postoperative complications in revisional surgery exists. In addition to severe sleep apnoea, a BMI > 60 kg/m² is also associated with transfers to the ICU. In this study of Helling et al. no association between pulmonary comorbidity (both OSA and ICU transfers for other pulmonary comorbidities) and complications was found. However, it was shown that a BMI above 60 kg/m² combined with severe OSA is significantly associated with desaturations <85%. However, only seven patients were available for analysis and no interventions were necessary.

In this study routine P(S)G was part of the screening prior to bariatric surgery identifying all patients with (severe) OSA. The presence of a high AHI (>30 hrs.) as predictor for ICU admittance was assessed but no significant association between desaturations <90% and AHI could be found. Presumably because compliant CPAP use effectively lowers the AHI.

All CPAP-dependent patients were instructed to bring their appliance to the hospital when admitted for surgery. No association between desaturations and CPAP use was found. It is hypothesized that this is caused by low patient compliance. Of most patients using CPAP, compliance was not preoperatively determined. A retrospective cohort study showed a CPAP compliance of only 59.5%. Many patients consider the use of CPAP uncomfortable. The mask is pulled off during the night unnoticed or it may dislocate during sleep causing air to escape. Another explanation could be that oxygen therapy of less than five litres was sufficient for the treatment of hypoxemia. A recent meta-analysis comparing oxygen therapy and CPAP showed that both oxygen therapy and CPAP improved saturation equally in non-surgical patients. Because of the above-mentioned limitations, it is not possible to determine the effect of CPAP on the amount or the severity of desaturations.
According to protocol patients are instructed to use their CPAP appliance during ICU admission, but non-usage was tolerated if the oxygen saturation level, continuously measured, was sufficient. Literature concerning the risk of OSA or CPAP usage on the development of anastomotic leakage lacks ambiguity. Although Fernandez et al. discovered that OSA is a risk factor for the development of anastomotic leakage, diagnostics of OSA is not described, nor treatment of patients with OSA. Vasquez and Hoddinott hypothesized that if patients are not used to breathing with their CPAP device, air might be forced inside the gastrointestinal tract causing bowel distension and pressure on the newly formed, vulnerable anastomosis. However, other studies state that the risk of anastomotic leakage is not increased in patients who use a CPAP mask. With regard to the sleeve gastrectomy and positive airway pressure no literature could be identified. The present study is too small to conclude if positive airway pressure could be used as the pylorus is preserved and a consequently higher pressure on the sleeve’s staple line is created compared to gastric bypass surgery. In this study 67.8% of the patients at the ICU were postoperatively treated with CPAP. In the patient group treated with CPAP, as well in the one treated only with nasal oxygen, one leakage at the side of the gastrojejunostomy occurred. Since CPAP use is characterized by poor and difficult compliance due to intolerability of the facial mask in many patients and desaturations still occur, continuous pulse oximetry remains indicated. However, admission at the ICU can be debated if necessary or too cautious as this study shows a low risk on OSA related complications and unnecessary ICU admissions are costly.

Postoperative use of opioids might cause respiratory depression leading to desaturations. Due to the retrospective nature of this study it was not possible to quantify the use of morphine. Patient controlled analgesia was never used and morphine was administered with reserve. Shearer et al monitored CPAP-dependent patients using continuous pulse oximetry in a non-ICU setting. CPAP was only used if nasal oxygen was not sufficient. Two out of 192 patients were in need of CPAP due to low oxygen saturation. No patients were admitted to the ICU for additional respiratory support. Although the present study is not sufficient to conclude the standard administration of a standard amount of oxygen to severe OSA patients for the first postoperative night, it could be considered. One of the other limitations in extrapolating our data is in the type of care patients receive in the ICU since this is different from the care at a general surgical ward. Benefits of an ICU compared to the non-ICU setting. CPAP was only used if nasal oxygen was not sufficient. Two out of 192 patients were in need of CPAP due to low oxygen saturation. No patients were admitted to the ICU for additional respiratory support. Although the present study is not sufficient to conclude the standard administration of a standard amount of oxygen to severe OSA patients for the first postoperative night, it could be considered. One of the other limitations in extrapolating our data is in the type of care patients receive in the ICU since this is different from the care at a general surgical ward. Benefits of an ICU compared to the non-ICU setting. CPAP was only used if nasal oxygen was not sufficient. Two out of 192 patients were in need of CPAP due to low oxygen saturation. No patients were admitted to the ICU for additional respiratory support. Although the present study is not sufficient to conclude the standard administration of a standard amount of oxygen to severe OSA patients for the first postoperative night, it could be considered. One of the other limitations in extrapolating our data is in the type of care patients receive in the ICU since this is different from the care at a general surgical ward. Benefits of an ICU compared to the
general surgical ward are a noisier environment, and one responsible nursing individual who may wake patients before the desaturation becomes severe compared to one nurse on four or eight patients. Minor interventions e.g. an increase of oxygen flow till five litres, were not documented. A prospective study to assess the role of minor interventions and the influence of standard administration of oxygen to severe OSA patients in a monitored floor setting is needed.

**Conclusion**

These results show that patients with severe OSA who use CPAP adequately are at a very low risk of cardiac and pulmonary complications after laparoscopic bariatric surgery. The lack of major interventions needed for desaturations suggests that routine admission to an ICU might be superfluous and can be regarded as not necessary. However, continuous digital oximetry combined with monitoring remains essential, especially as adequate CPAP compliance is difficult to guarantee.
ICU monitoring with OSA

References


