Major respiratory adverse events after laparoscopic gastric banding surgery for morbid obesity

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KEYWORDS
Obesity; Bariatric surgery; Pulmonary complications; Aspiration pneumonia; Chronic cough; Gastro-esophageal reflux

Summary
Background: Laparoscopic adjustable gastric banding surgery has become one of the most common restrictive surgical procedures for treatment of morbid obesity worldwide. Although short-term respiratory complications are well known, long-term data is scarce. We investigated the manifestations of major pulmonary complications showed at least six months after the procedure.

Methods: A retrospective cohort study was conducted at a tertiary university medical center in the five years period of 2006–2010. We included every patient who had had major respiratory complication who needed hospitalization, at least 6 months after laparoscopic adjustable gastric banding procedure. Demographic, pre-operative and post-operative clinical data were collected. We documented respiratory symptoms, results of physical examination, pulmonary function tests, and imaging as well as therapies given and outcome.

Results: Out of 2100 patients who underwent LAGB, thirty subjects, mean age of 45.7 (range 29–64) with an equal number of males and females were included. Mean interval between operation and onset of respiratory symptoms was 51.5 months (range 10–150 months). All had dyspeptic complaints which included: regurgitation, fullness after meals, dysphagia and food aspiration with esophageal dilatation. Major respiratory complications included aspiration pneumonia, chronic cough, and gastro-esophageal reflux. The most common was aspiration pneumonia, followed by chronic cough and gastro-esophageal reflux. All patients were treated with medical therapy, and follow-up was conducted for 6 months post-discharge.

Abbreviations: LAGB, Laparoscopic Adjustable Gastric Banding; GB, Gastric Banding; AP, Aspiration Pneumonia; ILD, Interstitial Lung Disease; CT, Computerized Tomography; ARDS, Acute Respiratory Distress Syndrome; PFT, Pulmonary Function Tests; OSA, Obstructive sleep apnea.
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pneumonia (19) including pulmonary abscess (4) and empyema (2), exacerbation of asthma (3) and hemoptysis (1). Additionally we documented the emergence of chronic diseases such as interstitial lung disease (5) and bronchiectasis (3). One patient developed acute respiratory distress syndrome due to aspiration pneumonia and eventually died in the intensive care unit. The main mode of therapy was deflation of the gastric band. Those who refused to deflate or remove the gastric banding continued to suffer from dyspeptic and respiratory symptoms including recurrent pulmonary abscess.

Conclusion: Although laparoscopic adjustable gastric banding surgery has few short-term risks and is highly effective at achieving weight reduction, we found an increased risk for major respiratory complications in the long-term period. The obesity epidemic and the increased use of surgical techniques to treat obesity will most likely lead to an increase in the incidence of long-term post-operative respiratory complications. This entity is probably under-reported and needs further research into how to reduce its incidence and morbidity.

Introduction

Obesity and morbid obesity have become major health problems and are being recognized as global epidemics. Severe obesity is a biological, psychological and social problem and the co-morbid conditions associated with obesity are life-threatening. Diabetes, arterial hypertension, obstructive sleep apnea, hypoventilation syndrome with respiratory failure, heart and joint problems — all increase in incidence with excessive weight. Primary prevention and the conventional treatment approaches of dietary restriction, exercise programs, and new pharmacological therapies - are almost always ineffective at achieving substantial long-term weight loss in the primary care setting. Therefore, surgical techniques are become increasingly accepted. Bariatric surgeries have been evolving over the past 50 years and since the introduction of laparoscopic bariatric surgery, they have been proven safe and effective with less complications, costs and pain than the existing open techniques. Laparoscopic adjustable gastric banding (LAGB) has become the most widely used surgical procedure for treating morbid obesity in Europe, Australia and South America. While there is now abundant published literature describing the short complications of open and close surgical techniques, reports of long-term complications, and specifically respiratory complications, remain relatively scarce. This lack of data is surprising since follow-up studies have demonstrated a high incidence of late esophageal complications such as esophagitis, esophageal dilatation and esophageal obstruction. Esophageal changes are well known to be associated with pulmonary sequelae, such as recurrent pulmonary infections, hemoptysis, bronchiectasis and fibrosis, but their association with LAGB is still not well described. We sought to investigate late major pulmonary complications after LAGB in order to highlight the association between these two conditions.

Methods

Setup

This study was conducted at the internal medicine division and in the pulmonary clinic of the Soroka University Medical Center, which is the only hospital in southern Israel. The study was approved by the institutional ethics committee (REB number 10376). During the study period there were around 400 LAGB surgical procedures per year. Due to the fact that our hospital is the only medical center in southern Israel and the Negev area — all admissions and all pulmonary complications were documented. Therefore we were able to calculate the incidence of these events.

Data collection

We used electronic documentation from the hospital computerized record system and hard data from the outpatient surgery and pulmonary clinic charts. The results of the radiologic investigations were obtained from the radiology department. Demographic, pre-operative and post-operative clinical data were collected, including weight before and after surgery and any short-term complications. Documentation of respiratory events included — symptoms, results of physical examination, pulmonary function tests, and imaging as well as therapies given and outcome.

Study population

Two-thousands and one hundred patients underwent LAGB between January 2006 and December 2010. Thirty were hospitalized due to major pulmonary acute complications. All had their surgical procedure done at least six months before the acute event.

Definitions

Major pulmonary complications were defined as life threatening events or situations that caused significant respiratory impairment. In order to avoid short term adverse events, we defined long term as complication that emerged at least six months post surgery.

Results

Clinical background

All 30 patients were operated upon in Soroka University Medical Center. Patient’ demographics, co-morbidities and
respiratory symptoms are summarized in Table 1. The mean age was 45.7 (range 29–64) with an equal number of males and females. Past medical history included cardiovascular diseases, diabetes mellitus, hypertension and dyslipidemia, psychiatric disorders and previous abdominal operations.

**Respiratory diseases background**
Most patients (83%) smoked or had a smoking history (mean pack years 34). Two major respiratory diseases were asthma and obstructive sleep apnea.

**Surgery results**
Information about weight reduction showed mean weight reduction of 36% body weight during the follow-up period. There were no short-term post-operative complications. The mean interval between the operation and onset of major respiratory events was 51.5 months.

**Gastrointestinal complains**
All 30 patients had dyspeptic complaints which included: regurgitation, fullness after meals, dysphagia and food aspiration. In all patients these symptoms preceded the emergence of major pulmonary complications.

In the study period 2006–2010 in our center there were 2100 LAGB surgeries done and we documented 30 cases of long-term major respiratory complications. As the only hospital in southern Israel it gives an annual incidence of 1.4% for major complication.

**Major respiratory complications**
Thirty patients presented to the emergency department and were hospitalized with acute respiratory events. We classified the respiratory complications as acute events (asthma attack, hemoptysis, aspiration pneumonia (AP), empyema, pulmonary abscess and respiratory failure) and chronic disabilities such as interstitial lung disease (ILD) and bronchiectasis.

**Acute infectious events**
Nineteen patients developed major acute infectious pulmonary complication. The most frequent incident was AP which complicated the course of 19 patients. The diagnosis of AP was established by typical clinical events of fever with respiratory complaints and chest radiography findings consistent with AP such as consolidations and infiltrates. All of these patients had gastro-intestinal complaints such as aspiration of food and reflux with radiological findings such as esophageal dilatation and air-fluid levels. Several had recurrent events of AP. Four patients had also lung abscess and two — AP with empyema (Figs. 1 and 2). In cases in which there was uncertainty about the diagnosis invasive diagnostic procedures including fine needle aspiration transbronchial biopsy and bronchoalveolar lavage were done (Fig. 1).

**Other acute events**
Three patients were hospitalized due to acute asthma exacerbation. These patients had never been diagnosed with asthma before and their attack was attributed to severe reflux. One patient was referred to the emergency department complaining of recurrent events of coughing with hemoptysis. Other causes of hemoptysis such as pulmonary emboli, tuberculosis, malignancy or an endobronchial process including foreign body were excluded by sputum culture, computerized chest tomography-angiography and bronchoscopy.

**Chronic complications**
Chronic major complications consisted of bronchiectasis (3 patients) and the development of ILD (5 patients). All had combination of symptoms which included cough, sputum production, progressive dyspnea and chest pain.

<table>
<thead>
<tr>
<th>Table 1 Demographics, clinical background, weight reduction, smoking history and spirometric data of the study population (N = 30).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>Age (yrs)</td>
</tr>
<tr>
<td>Males</td>
</tr>
<tr>
<td>BMI before LAGB(kg/m²)</td>
</tr>
<tr>
<td>BMI after LAGB(kg/m²)</td>
</tr>
<tr>
<td>Asthma</td>
</tr>
<tr>
<td>OSA</td>
</tr>
<tr>
<td>Arterial hypertension</td>
</tr>
<tr>
<td>Smoking history — Pack yrs</td>
</tr>
<tr>
<td>Current smokers</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
</tr>
<tr>
<td>CIHDF</td>
</tr>
<tr>
<td>DM type II</td>
</tr>
<tr>
<td>Spirometry — Normal</td>
</tr>
<tr>
<td>Spirometry — Obstructive</td>
</tr>
<tr>
<td>Spirometry — Restrictive</td>
</tr>
</tbody>
</table>

BMI — Body Mass Index.
OSA — Obstructive Sleep Apnea.
CIHDF — Chronic Ischemic Heart Disease.
DM — Diabetes Mellitus.

**Figure 1** Chest CT shows right sided pulmonary abscess.
ILD\(^9\) are a heterogeneous group of lung diseases that comprise more than 200 clinical pathological entities. Clinically the different ILD’s have rather similar presentations with increasing shortness of breath, a restrictive lung function and a widespread shadowing on the chest radiograph. Our patients were diagnosed based on typical clinical complaints, restrictive lung function, and radiologic findings. Radiological CT findings were reticulonodular and ground-glass opacities consistent with diffuse parenchymal lung disease. Autoimmune, infectious and malignant causes were excluded by further evaluation. The radiographic changes of these patients persisted on follow up.

Three patients had bronchiectasis documented on chest CT. The bronchiectasis was located in the upper lobes (one patient had in RUL and the other had in LUL) and was accompanied by other asymptomatic interstitial changes in the same distribution.

**Mortality**

The most serious complication was acute respiratory distress syndrome (ARDS) due to AP. This occurred in a woman who was admitted to the intensive care unit with severe dyspnea, fever and agitation and an oxygen saturation of 81% on ambient air with a P\(O_2\)/F\(O_2\) ratio of 120. On chest CT bilateral infiltrates consistent with ARDS pattern were found. She intubated and bronchoscopy with TBB and BAL that supported the diagnosis of ARDS due to AP. Unfortunately this patient eventually died in the intensive care unit.

**Diagnostic work-up (Table 2)**

**Pulmonary function tests (PFT)**

Only three patients with a history of asthma had spirometry done prior to the operation and the results were consistent with restrictive pattern. Spirometry was performed on eleven patients as part of their respiratory evaluation for post-operative symptoms. Four had a restrictive pattern and three had obstructive flow while the rest showed normal studies. One patient had obstructive flow (without a prior history of obstructive airway disease) which reverted to normal after treatment of his dyspeptic complaints.

**Imaging**

A chest X-ray was part of the evaluation of all patient and twenty patients had a chest CT as well. Radiographic descriptions include: lung infiltrates, ground-glass opacities, reticulonodular pattern, pleural thickening, bronchiectasis, consolidations and nodules. Three patients had a chest CT with a characteristic pattern of diffuse parenchymal lung disease. Three patients had cavitary lesions in the right upper lobe (RUL). Most of the patients had diffuse lung findings. Consolidations were found in all lobes. Sixteen patients had esophageal dilatation and esophageal air-fluid levels on CT (Fig. 3).

**Bronchoscopy**

Half of the patients had further evaluation by invasive procedures. In two patients we performed a transbronchial biopsy (TBB). Cytology was obtained by BAL or FNA. Those procedures ruled out the presence of other etiologies and confirmed inflammation, in some cases with characteristic lipid laden macrophages suggesting aspiration (Fig. 4).

<table>
<thead>
<tr>
<th>Complication</th>
<th>No of patients</th>
<th>Radiological investigation</th>
<th>Biopsy/Cytology/BAL/Cultures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumonia</td>
<td>19</td>
<td>CT — Esophageal dilatation with air-fluid level, airspace consolidation with air-bronchogram</td>
<td>BAL</td>
</tr>
<tr>
<td>Lung abscess</td>
<td>4</td>
<td>CT — Cavitary lesions with air-fluid level</td>
<td>BAL</td>
</tr>
<tr>
<td>Empyema</td>
<td>3</td>
<td>CT — Pleural fluid with adhesions</td>
<td>Pleural fluid culture and cytology</td>
</tr>
<tr>
<td>ARDS</td>
<td>1</td>
<td>CT — Diffuse bilateral ground-glass opacity</td>
<td>BAL</td>
</tr>
<tr>
<td>Asthma</td>
<td>1</td>
<td>CXR — Hyperinflation</td>
<td>None</td>
</tr>
<tr>
<td>Hemoptysis</td>
<td>1</td>
<td>CT — Cavitary lesion with ground-glass</td>
<td>None</td>
</tr>
<tr>
<td>ILD</td>
<td>5</td>
<td>HRCT — Reticulonodular opacity predominant in lung bases</td>
<td>Transbronchial biopsy</td>
</tr>
<tr>
<td>Bronchiectasis</td>
<td>3</td>
<td>CT — Bronchiectasis of upper lobes</td>
<td>Sputum culture</td>
</tr>
</tbody>
</table>

ILD — Interstitial Lung Disease.
ARDS — Acute Respiratory Distress Syndrome.
BAL — Broncho-Alveolar-Lavage.
Treatment and outcome (Table 3)

While in hospital patients were treated with antibiotics to cover aspiration pneumonia. After discharge they were treated conservatively by behavioral and feeding modification. All patients were advised to deflate the band.

The respiratory symptoms resolved in seven patients and significantly improved in three others. Those who refused to deflate or remove the GB continued to suffer from dyspeptic and respiratory symptoms. One patient with a lung abscess due to aspirations who refused to deflate the band had a recurrence. As previously described there was one death from ARDS complicating AP. It is important to emphasize, that chronic radiographic change such as reticulonodular opacities and bronchiectasis were permanent even after deflating the band and resolution of symptoms.

Discussion

This is the largest study available examining the relationship between LAGB and long-term pulmonary complications. Our study shows the predisposition of postoperative LAGB patients to life threatening infectious pulmonary complications even years after the surgery. Recurrent aspiration pneumonia, lung abscess and empyema in relatively young population are unusual and merit special attention. In the ensuing discussion, we examine our findings in light of the currently available studies.

In the literature other papers showed much lower frequencies of late respiratory complications, and interestingly most studies did not describe respiratory complications at all. We found only six other case reports that described late respiratory system complications following LAGB. Two patients were reported by Alamoudi10 one with AP and the other case of pneumonia due to migration of a connecting catheter. A case of thoracic empyema was reported by Krassas et al.11 A case of recurrent AP after LAGB was reported by Hofer et al.12 Zimlichman et al.13 reported a case of lung abscess. Nemni14 reported a case of severe chronic cough after LAGB without radiographic evidence of esophageal dilatation and with no response to medication. Two other cases of chronic cough associated with LAGB were reported by Gentil et al.15 The association between micro-aspiration and pulmonary fibrosis is another issue that warrant particular attention.16,17

In our study there were an equal number of females and males. Mean age of patients was 45.7 and most patients had significant weight reduction during the follow-up period. We did not notice any association between the magnitude of weight reduction and the severity of the respiratory complications. All patients in our series had a history of respiratory diseases or smoking prior to surgery.

All of our patients had dyspeptic complains. These complaints usually preceded the respiratory complaints by a few months or began immediately after the operation. We speculate that GERD complaints are not specific but very sensitive signals of potential pulmonary complication. The restriction of the upper gastric pouch by the band is dynamic (there are many reports of band slippage and penetration) and must be adjusted very often, but this is rarely done. Regurgitation and vomiting are frequently reported. Most of our patients had radiographic signs of esophageal dilatation and stasis although esophagography done by the surgeon around the time of surgery was reported as normal. The discordance between the results of the chest CT scan and the esophagography raises the question of the efficacy of this radiographic procedure after LAGB.

The pulmonary radiographic description of lung complications includes: consolidations, interstitial changes, nodules, bronchiectasis and cavitary lesions. Acute changes
completely resolved with therapy, however bronchiectasis and reticulonodular opacities that were found in radiography of eight of our patients remain.

Limitations — Although this is the largest study published, it lacks the power to enable one to draw firm conclusions about risk factors for pulmonary complications. However, in this series all our patients were either smokers or had respiratory diseases before surgery. It is possible that smokers or patients with other respiratory conditions may benefit from pulmonology close supervision after surgery.

We generally assume that patients with respiratory problems that are associated with morbid obesity (obstructive sleep apnea, hypoventilation syndrome, exercise dyspnea, extra-thoracic restriction and gastroesophageal reflux) will be improved or even cured after LAGB. Nevertheless, our data show that some patients may simply replace one respiratory problem with another after undergoing LAGB.

This study is observational therefore it cannot address the pathophysiology behind these events. However, it has been suggested that gastroesophageal reflux and micro-aspiration is a contributing factor in the development of aspiration pneumonia, and hence a causal relationship could be hypothesized. As all of these complications may be part of obesity alone it is important to investigate and follow obese patients who refused surgery in order to estimate the incidence of these events in the non-treated group.

The risk of mortality from recurrent aspiration pneumonia or lung abscess is a serious consideration. We suggest that patients who have respiratory symptoms after LAGB must be evaluated and followed by a pulmonologist. These patients may not notice or may even hide respiratory complaints as part of their motivation to continue the process of weight reduction. However, according to our experience, band deflation (which is a very simple procedure done by the surgeon at the outpatient clinic) helps to resolve symptoms and may reduce the risk of pneumonia. Therefore, we suggest inquiring specifically about the presence of reflux, cough and events of fever in every follow-up visit. We also recommend deflating the ring whenever recurrent aspiration is suspected.

We followed our patients from six months to four years. Most improved with conservative treatment and band deflation. Nevertheless, chronic changes on radiography and the severity of their respiratory complications put these patients at sufficient risk that lifelong follow up is warranted. Unfortunately, to date there are no guidelines for how to treat and follow patients with late respiratory complications after LAGB.

Obesity is becoming a worldwide epidemic and LAGB has become one of the most common restrictive surgical procedures for treatment of morbid obesity. This procedure has the advantages of a low complications rate and short hospitalization stay. Although short-term respiratory complications are well known, long-term data is scarce. Furthermore, awareness of these complications in the pulmonology community, among family physicians and among surgeons is limited. This study was held in a tertiary center which is the only health care provider in southern Israel. Therefore our data represent also the incidence of late major pulmonary complications after LAGB. As we know that 400 procedures are done each year we calculate the incidence to be quite low. Still the morbidity and mortality associated with these events in relatively young population — merit special consideration.

In conclusion — LAGB has few short-term risks and is highly effective at achieving weight reduction. There is a lack of information about its late pulmonary complications. Our data suggest that LAGB is a risk factor for recurrent AP and lung abscess. The obesity epidemic and the increased use of surgical techniques to treat obesity will most likely lead to an increase in the incidence of long-term post-operative respiratory complications. This entity is probably under-reported and there is a need for a prospective controlled study with more intensive follow-up and further research into how to reduce its incidence and morbidity.

### Conflict of interest

We are here to disclose that we have no conflict of interest related to the subject of this paper.

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**Table 3** Pulmonary complications — Therapy and outcome.

<table>
<thead>
<tr>
<th>Complication</th>
<th>Therapy</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumonia</td>
<td>Antibiotics and deflation of the GB, behavioral and feeding modification</td>
<td>8 — Resolution</td>
</tr>
<tr>
<td>Lung abscess</td>
<td>Antibiotics and deflation of the GB</td>
<td>3 — Recurrence</td>
</tr>
<tr>
<td>Empyema</td>
<td>Pleural drainage, antibiotics and deflation of the GB</td>
<td>Resolution</td>
</tr>
<tr>
<td>ARDS</td>
<td>Mechanical ventilation, antibiotics, supportive</td>
<td>Resolution</td>
</tr>
<tr>
<td>Asthma</td>
<td>Corticosteroids, inhalations, behavioral and feeding modification, PPI</td>
<td>Under control</td>
</tr>
<tr>
<td>Hemoptysis</td>
<td>Antibiotics, inhalations, anti-tussives and deflation of the GB</td>
<td>Resolution</td>
</tr>
<tr>
<td>ILD</td>
<td>Trial of corticosteroids and deflation of the GB</td>
<td>Stable</td>
</tr>
<tr>
<td>Bronchiectasis</td>
<td>None, antibiotics as needed, physiotherapy and removal of the GB</td>
<td>Stable</td>
</tr>
</tbody>
</table>

GB — Gastric Banding.  
ILD — Interstitial Lung Disease.  
ARDS — Acute Respiratory Distress Syndrome.  
PPI — Proton Pump Inhibitor.
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Avital Avriel — contributed to the study design, execution, data collection and analysis, and writing
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Avinoach Eliezer — data collection and writing
Lone S. Avnon — data collection and writing
Heimer D contributed to the data collection and writing
Dan Shteinberg — contributed to the data collection and writing
Nimrod Maimon — contributed to the study design, data analysis, and writing.

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