Prophylactic Tracheostomy in a Morbid Obesity Patient Undergoing Gastric Bypass: A Case and Review of the Literature

B Whitson, A Tewari, K MacDonald, M Evasovich, T Kellogg, S Ikramuddin

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Abstract

We present a case of a morbidly obese patient with respiratory insufficiency who received a prophylactic tracheostomy one day prior to undergoing Roux-en-Y gastro-intestinal bypass surgery. The patient had an uneventful hospital course and was discharged to a ventilator weaning facility. We discuss the predictors of a prolonged ventilator course and the indications for prophylactic tracheostomy and a review of the literature.

INTRODUCTION

Morbid obesity has become an epidemic with over 98,000 people undergoing surgery from weight loss in 2003.[1] Unfortunately, this all to prevalent disease causes a decrease in life expectancy compared to the non-obese [2,3,4]. The degree of elevation of a patients body mass index (BMI) is directly correlated with an increased mortality.[5,6,7,8,9,10]

Not only do obese patients die earlier, they are plagued by co-morbid medical conditions such as hypertension, diabetes, obstructive sleep apnea, coronary artery disease and many others at an increased rate.[1, 3, 4, 11] Additionally, the combination of an elevated BMI with multiple medical co-morbidities increases the patient's risk of death.[5,6,7, 9, 10] For those patients with extremely high BMI's and multiple co-morbidities, bariatric surgery may be the only effective means of improving their risk of mortality. Bariatric surgery has been shown to have a relative risk reduction in the 5-year mortality rate for the morbidly obese of 89%.[8]

In addition to the co-morbidities which plague this patient population, the morbidly obese are at increased risk of peri-operative pulmonary complications when surgical weight loss procedures are performed. This is mostly attributed to body habitus.[12] As many as 10% of morbidly obese patients can have an extended time on a ventilator.[13] The super-obese are at even greater risk with 14% to 29% of patients developing pulmonary complications.[12, 14] As a direct result of these pulmonary complications, prolonged ventilator times and subsequent tracheostomy are not uncommon in the super-obese patient populations. We present the case of a prophylactic tracheostomy in a morbidly obese patient with poor pulmonary function undergoing Roux-en-Y gastro-intestinal bypass (RYGIB).

CASE REPORT

A 52-year old woman with a BMI of 76 kg/m^2 and multiple associated co-morbidities (history of pulmonary emboli, restrictive airway disease requiring home oxygen (2 to 4 L), type 2 diabetes mellitus, hypertension, chronic low back pain, osteoarthritis, and depression) causing her to be bedridden and nursing home dependent presented for evaluation. With a history of multiple lower extremity orthopedic procedures, three prior abdominal operations, and multiple medications (consisting of inhalers, steroids, oral hypoglycemics, a neuroleptic, antidepressant, and multiple antihypertensives), a careful assessment and discussion of the risk and benefits of surgical management for obesity occurred. Due to her extremely high BMI, an open RYGIB was offered.

A routine psychological evaluation did not reveal any contraindications to surgery. Pre-operative evaluation, risk assessment, and consultation with pulmonary, endocrinology and cardiology occurred. Due to body habitus, a dobutamine stress echocardiogram was felt to provide the best data and was interpreted as normal with mild to moderate cardiomegaly on x-ray. Arterial blood gas on room air

demonstrated pH 7.43, $PaCO_2$ 58, PaO_2 48, HCO3 38 and pulmonary function tests revealed a restrictive process (FVC 42%, FEV1 43%), consistent with the patient's history of chronic pulmonary emboli. Bilateral lower extremity venous duplex ultrasound and ventilation-perfusion scan did not demonstrate deep venous thromboses or ventilation-perfusion mismatches, respectively. Pre-operative laboratories showed a normocytic, normochromic anemia, hyponatremia, hypokalemia, hypochloremia, a normal hemoglobin A1c, mild renal insufficiency and elevated cholesterol and triglycerides.

After extensive discussions, a prophylactic inferior vena caval filter was placed by interventional radiology. In the anticipation of a slow ventilator wean post-operatively, a prophylactic open tracheostomy was performed by otolaryngology. The anticipation of an extended ventilator wean and pulmonary complications was due to the patient having an extremely high BMI (76 kg/m^2), a restrictive airway process with hypercarbia and hypoxia, a history of pulmonary emboli, and limited mobility.

For the tracheostomy, a Bivona (Smiths Medical, Inc) 8mm tracheotomy cannula was utilized. One day post tracheostomy, an open RYGIB was performed with a 260 cm Roux limb, a 150 cm biliopancreatic limb and a 100 cm common channel. The patient was started on a liquid diet on post-operative day four. On post-operative day five, the ventilator had been successfully weaned to trach-dome oxygen only. Transfer to the surgical ward occurred, off ventilator, with intermittent need for suctioning. Two days later, the patient was transferred to a transitional care rehabilitation facility for intensive respiratory and physical therapies. At discharge, the tracheostomy was used for secretion management, intermittent positive airway pressure and supplementary oxygen administration.

The patient did well post-operatively and through physical and occupational therapies was beginning to gain mobility. Due to her deconditioned status pre-operatively, extended sitting, standing, and minimal ambulation were not trivial. At follow-up approximately 2 week post-discharge, her respiratory status was subjectively improved and ventilator support continued to not be necessary. Six weeks post-operatively, the patient had lost 22 pounds and had a BMI of 71kg/m^2. Approximately six months post-operatively, the patient died from acute urosepsis at an outside facility.

DISCUSSION

Similar to Joe in Charles Dickens' The Pickwick Papers, respiratory difficulties have plagued the obese. This patient suffered from chronic hypoxia from obstructive apnea in addition to her other co-morbid conditions. A tracheostomy, when performed correctly, is a safe and effective means of securing airways for ventilation and oxygenation. Recent advances have allowed for bedside percutaneous tracheostomy, in addition to the standard open flap variety. Tracheostomy in obese patients with obstructive apnea results in improved quality of life and hypertension.[15, 16] Nevertheless, weight loss results in a more profound improvement in obstructive apnea.

Over the years, indications for tracheostomy have changed only minimally. The basic tenets of the indications are the prolonged need for mechanical ventilation (whether due to metabolic disorder, infection, or disease process) or for definitive airway control (Table 1).[17,18,19,20,21,22,23,24]

Figure 1

Table 1: Indications for tracheostomy

Indication	Typically Present in Morbidly Obese
Chronic respiratory insufficiency	Yes
Airway obstruction	Yes
Central hypoventilation syndrome	Yes
Congenital abnormalities	No
Head and Neck Malignancy	No
Trauma – Neck / laryngeal / chest (flail)	No
Angioedema	No
Infection – acute / chronic	Possibly (pneumonia)
Foreign body	No
Subglottic stenosis	No
Need to increase mobility	Yes (particularly in super-obese)
Need to feed orally	Yes
Impaired cough reflex	No
Increased secretions	Yes (post-operatively)
Ciliary dysfunction	No
Obstructive Sleep Apnea – not candidate for uvulopalatopharyngoplasty (obese, small mandible, nonvisualized endolarynx)	Yes

In general, tracheostomy are safe to perform with minimal complications, when performed in a controlled setting with experienced surgeons.[19, 22,24] If the surgeon is well trained, percutaneous, open or defatting tracheostomy can be performed safely.[18] Tracheostomy are indicated when there is a prolonged ventilator wean or for need for long term pulmonary toilet with secretion management issues.[18]Additionally, the need for continuous positive airway pressure, when the patient suffers from an obstructive nasopharyngeal process, is an indication for tracheostomy.[25] These type of processes are all readily apparent in the morbidly and super obese patient populations which typically have short necks with redundant pharyngeal tissue, obstructive respiratory processes, hypoventilation

syndromes, and other metabolic abnormalities.

Although the indications for tracheostomy have remained relatively unchanged, the predictors of prolonged ventilation continue to change. Various mathematical models, indexes, and physiologic factors have been developed in order to attempt to predict who will have a prolonged course (Table 2).[17, 26,27,28,29,30] Currently, the trend is toward evaluation of overall illness severity coupled with 3-day and 7-day ventilator weaning trials.[26] In the acute trauma setting, guidelines for tracheostomy are well delineated.[31] This is not the case in the morbidly obese patient and clinical acumen needs to be applied.

Figure 2

Table 2: Predictors of prolonged ventilator wean

Predictors of prolonged ventilator wean
Increasing Apache II score
Failing Spontaneous Breathing Trial (SBT)
Maximum Inspiratory Pressure (PI_{max})
Weaning Index
Age + BUN + Gender
$P_aCO_2 > 40$
$P_aO_2 < 60$ on $FiO_2 > 40\%$
$P_aO_2/FiO_2 > 200$ (150)
Abdominal distension
Unstable hemodynamics
"Metabolic Change"
Trend of decreasing albumin over ICU admission
Cause of respiratory failure
Increased fluid balance
Sepsis score
Lung injury score < 1
Organ system failure index

There is a correlation with an elevated APACHE II score and severity of illness with an inability to wean from mechanical ventilation.[26] Those patients who have poor gas exchange, inadequate tidal volumes, or airway disease are more likely to need prolonged mechanical ventilation.[27] Similarly, hemodynamic insufficiency, a decreased mental status, fatigue or dyspnea are also associated with an inability to wean from ventilators.[27] Those patients who have elevated lung injury scores (>1) have a higher likelihood of having a ventilator course longer than 15 days.[28] Measured parameters, such as a failed spontaneous breathing trial[29] or a trend of decreasing albumin (indicative of a declining metabolic status) over an intensive care unit stay[30] are correlated with an extended need for mechanical ventilation and failure if extubated.

In the obese patient, airway management and tracheostomy have been more difficult. Due to a stout neck, standard cannulas are often not of adequate length, leading some to fashion their own custom cannulas.[32,33,34] The use of the Bivona tracheotomy cannula have allowed for patients with even very large necks to have a tracheostomy placed. Some practitioners have even utilized the Combitube™ as a bridge to tracheostomy in emergent intubation of the obese.[35] Different methods for "defatting"[36], neck lipectomy[37] or permanent tracheostomies[38] have been described in the literature for obese patients. Despite potential difficulties, some authors advocate percutaneous tracheostomy in morbidly obese patients.[39,40,41,42]

It has been reported that weight gain can cause obstructive apnea in patients with previous tracheotomy.[43] Conversely, weight loss surgery can improve respiratory difficulties in the morbidly obese.[44, 45] In morbidly obese patients with a history of respiratory insufficiency treated with tracheostomy, weight reduction surgery has improved the pulmonary status to the point that the tracheostomy is no longer needed.[25, 46]

The morbidly obese patient who undergoes surgery is at increased for pulmonary complications. Respiratory failure in this population is reported to be 2% to 7.7%.[14, 47, 48] The association of atelectasis and pneumonia with post-operative bariatric surgery approaches 30%.[14] This is not universal however. Some high volume centers report post-operative pneumonia rates of 0.14% for laparoscopic bariatric surgery and 0.33% for open approaches.[49]

There is a strong correlation between increasing BMI and increase pulmonary complications.[12, 14] For those with low BMI's the respiratory complications are reported to be 8%. This rate jumps to 14% for an elevated BMI.[12] The super-obese can need mechanical ventilation beyond 12 hours after surgery completion up to 10% of the time.[13]

Of the morbidly obese, 8% can have a hypoventiation syndrome. This can manifest as a PaO_2 <55 mmHg and a PCO_2 >47.[50] Those who are morbidly obese have a decreased pulmonary reserve and are predisposed to respiratory failure.[51] An increased intra-abdominal pressure can contribute to this hypoventilation effect.[52] For the morbidly obese, severe hypoventilation and associated hypoxia occurs in 31%. These changes often lead to a decrease in mentation, prolonged mechanical ventilation, an increase intensive care unit time, and increase transitional care unit time. In those

patients with the hypoventilation syndrome, 18 month mortality can be as high as 23%, compared to 9% in those without hypoventilation syndrome.[53] Older data from another institution has reported that mortality increases from 0.2% to 2.4% when respiratory insufficiency in present.[54] Clearly this is ominous for the morbidly obese patient. Due to this increased mortality, some centers have employed extreme measures to treat hypoxemia in select settings through the use of extracorporeal membranous oxygenation (ECMO).[55]

Bariatric surgery can improve the pulmonary function in morbidly obese patients. Post bariatric surgery weight loss can improve apnea, cardiac function, oxygenation and ventilation, and tidal volumes.[44, 54, 56,57,58] Perhaps early, or prophylactic tracheostomy would allow for improved pulmonary mechanics, earlier mobilization and better transitioning off of mechanical support.

Predicting who will benefit from tracheostomy pre-operatively can be challenging. In this case, our patient had components of chronic respiratory insufficiency with restrictive and obstructive disease, hypoventilation, and arguably obstructive anatomy. This patient: 1) was facing a large upper abdominal operation, 2) had a pre-operative $Pa0_2 < 55$ and $PaC0_2 > 47$, 3) had a very high BMI, and 4) had baseline respiratory insufficiency and confounding co-morbidities. In this case, the accumulation of risk factors that predicted a very difficult airway and prolonged ventilation warranted prophylactic and therapeutic intervention. One could make the argument for an attempted wean with an endotracheal tube followed by a tracheostomy if failure to wean occurs. However, the authors feel that the application of a prophylactic tracheostomy in this type of morbidly obese patient with multiple co-morbidities is more advantageous.

The prophylactic tracheostomy in this patient high risk patient population is also therapeutic. The procedure allows for definitive control of an otherwise difficult airway. The tracheostomy allows for: improved patient comfort, lessened intensive care unit (ICU) sedation, the availability of easy suctioning, in and out of the ICU, ease of ventilator weaning with the application of intermittent ventilation support not requiring reintubation and the addition of continuous positive airway pressure to aid in the common apnea background. In the morbidly obese patient with a prophylactic tracheostomy who undergoes RYGIB, the general overall health, including metabolic abnormalities, weight loss and mobility, is expected to improve allowing for safe weaning from ventilatory support and eventual tracheostomy tube removal. Although strict indications and national guidelines are not formulated, perhaps for those morbidly obese patients who have a hypoventilation syndrome ($Pa0_2 < 55$ and $PaC0_2 > 47$)[50], obstructive apnea, severely decrease mobility, redundant pharyngeal tissue, confounding metabolic co-morbidities and extremely elevated BMI, a prophylactic tracheostomy should be considered before bariatric surgery.

We present here a case of prophylactic tracheostomy in a morbidly obese patient undergoing RYGIB with baseline pulmonary insufficiency, hypoxia, and asthma. Peri-operative airway control through prophylactic tracheostomy should be considered in morbidly obese patients undergoing weight loss surgery with significant pulmonary disease and an anticipated difficult airway. Weight reduction following surgery results in improved mobility and baseline respiratory status, and ultimately safe removal of the tracheostomy tube.

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CORRESPONDENCE TO

Bryan A. Whitson, MD University of Minnesota Department of Surgery MMC 195, 420 Delaware St. SE Minneapolis, MN 55455 Ph: 612-624-0693 Fax: 612-625-9657 E-mail: bwhit@umn.edu

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Author Information

Bryan A. Whitson, M.D.
Department of Surgery, University of Minnesota

Anand Tewari, M.D.
Department of Anesthesiology, University Health Systems of Eastern Carolina

Kenneth G. MacDonald, Jr., M.D.
Department of Surgery, Brody School of Medicine, Eastern Carolinas University

Maria Evasovich, M.D.
Department of Surgery, University of Minnesota

Todd A. Kellogg, M.D.
Department of Surgery, University of Minnesota

Sayeed Ikramuddin, M.D.
Department of Surgery, University of Minnesota