

Schumann R¹, Sigl J², Alyamani O¹, Shikora S⁴, Kelley SD^{2,3}. Tufts Medical Center, Department of Anesthesiology¹, Boston, MA; Respiratory & Monitoring Solutions, Covidien², Boulder, CO; Brigham & Women's Hospital, Department of Anesthesia, Perioperative and Pain Medicine³, and Center for Metabolic Health and Bariatric Surgery, Brigham & Women's Hospital⁴, Boston, MA.

The Impact of Metabolic Syndrome on Postoperative Pulmonary Complications: A Large Bariatric Surgical Database Analysis

Introduction: Morbid obesity is part of, and associated with, a high incidence of the metabolic syndrome. Characteristics of the metabolic syndrome (MetS) include obesity, dyslipidemia, hypertension and glucose intolerance or frank diabetes mellitus. These co-morbid conditions often improve after bariatric surgery¹. The prevalence of metabolic syndrome among patients presenting for bariatric surgery has not been well studied. In addition, it is unclear whether or not the presence of MetS may contribute to postoperative pulmonary outcomes following bariatric surgery. We examined the prevalence of MetS and its possible impact on pulmonary complications in bariatric surgical patients using a large national database.

Methods: Following IRB approval, we analyzed de-identified records from the Bariatric Outcomes Longitudinal Database (BOLD™, Surgical Review Corporation: ASMBS Bariatric Surgery Center of Excellence program) from January 2008 to December 2010. This database collects outcomes from registered member centers of excellence for bariatric surgery.

Data analyzed included procedural information, demographics, ASA physical status, and the presence or absence of MetS. Hypertension, dyslipidemia, and diabetes are each categorized 6-fold in the BOLD™ preoperative encounter form (**TABLE 1**). MetS was considered present when at least a status of ≥ 2 in all 3 co-morbidities existed.

We tested the association of MetS with the following postoperative pulmonary outcomes: atelectasis, pneumonia, pneumothorax, pleural effusion, respiratory failure, ARDS, and a composite of these complications. The Pearson Chi-Square test was used to determine statistically significant associations. A $p < 0.05$ was significant.

Results: In 158,405 primary bariatric procedures (52% gastric bypass; 40% gastric banding; 4% sleeve gastrectomy), the mean (SD) patient age was 45.7 (± 11.8) yr; 78.5% were female; 75.4% had a body mass index (BMI) of 40-60 kg/m²; and 65.3% were ASA 3.

The features of metabolic syndrome were present in 20,158 patients, which constitute 12.7 % of the cohort analyzed. Except for pneumothorax, MetS was significantly associated with all investigated adverse pulmonary outcomes (**TABLE 2**). This finding was pronounced for respiratory failure and ARDS.

Discussion: Our study analyzed the Bariatric Outcomes Longitudinal Database for the prevalence of metabolic syndrome in this vulnerable population and its possible impact on postoperative adverse pulmonary events. We previously reported an overall 0.9 % incidence of composite postoperative pulmonary complications in a large cohort of

bariatric patients². In this analysis of more than 158.000 patients in the BOLD database, metabolic syndrome was present in 12.7 % of patients presenting for weight-loss surgery. The presence of the metabolic syndrome was significantly associated with adverse pulmonary events following bariatric surgery with the exception of pneumothorax. The most severe pulmonary outcomes, ARDS and respiratory failure, had the strongest associations with MetS. It is unclear whether the presence of MetS merely reflects a generally impaired physiological status that explains these findings, or whether the particular combination of the MetS defining co-morbidities is responsible, suggesting MetS as a risk factor. General health status and metabolic tissue impairment may be less important to the development of pneumothorax which is very rare in this population. This complication often has a mechanical component to its etiology in minimally invasive weight loss surgery, which may explain the absence of an association with MetS³. Medical optimization of patients with MetS prior to bariatric surgery appears to be warranted, and this may also apply to weight-loss unrelated procedures. We did not yet further analyze the impact of the surgical procedure type on postoperative pulmonary complications, including in patients with MetS. However, it is conceivable that duration of surgery and the degree of intestinal disruption in bariatric procedures may also play a role. It remains to be determined if and how the recent exponential trend towards sleeve gastrectomy may influence pulmonary and other complications following weight loss surgeries⁴.

References:

1. Adams TD, Davidson LE, Litwin SE, Kolotkin RL, LaMonte MJ, Pendleton RC et al. Health benefits of gastric bypass surgery after 6 years. *JAMA* 2012; 308: 1122- 1131.
2. Schumann R, Sigl J, Alyamani O, Garces-Ambrossi G, Shikora S, Kelley S. Pulmonary Complications Following Bariatric Surgery: A Large National Experience. ASA 2012 annual meeting abstract A309
<http://www.asaabstracts.com/strands/asaabstracts/searchArticle.htm;jsessionid=7C797E4B9D984B9A7CBD48C004D50FCD?index=0&highlight=true&highlightcolor=0&bold=true&italic=false>
3. Mehran A, Brasesco O, De Velasco E, Szomstein S, Rosenthal R. Intra-operative pneumothorax complicating laparoscopic Roux-en-Y gastric bypass. *Obes Surg* 2004; 14: 124 - 128
4. Nguyen NT, Nguyen B, Gebhart A, Hohmann S. Changes in the makeup of bariatric surgery: a national increase in the use of laparoscopic sleeve gastrectomy. *J Am Coll Surg* 2013; 216: 252 -257.

Table 1. BOLD™ preoperative severity status of MetS Co-morbidities

Co-Morbidities	Severity Status					
	0	1	2	3	4	5
Hypertension	No history of hypertension	Borderline, no medication	Diagnosis of hypertension, no medication	Treatment with single medication	Treatment with multiple medications	Poorly controlled by medications, organ damage or dysfunction
Diabetes	No symptoms or evidence of diabetes	Elevated fasting glucose	Diabetes, controlled with oral medication	Diabetes, controlled with insulin	Diabetes, controlled with insulin and oral medication	Diabetes, with severe complications (retinopathy, neuropathy, renal failure, blindness)
Dyslipidemia	Not present	Present, no treatment required	Controlled with lifestyle change, including Step 1 or Step 2 diet	Controlled with a single medication	Controlled with multiple medications	Not controlled

Patients meeting at least a status 2 in all 3 co-morbid conditions were considered to have metabolic syndrome.

Table 2: Association of MetS with adverse pulmonary events and relative proportion of MetS vs Non-MetS patients.

Pulmonary Complications	Presence of Metabolic Syndrome			Significance (p)
	No	Yes		
Atelectasis (n = 589)	No	12.7%	(20,058/157,816)	0.002
	Yes	17.0%	(100/589)	
Pneumonia (n = 412)	No	12.7%	(20,073/157,993)	< 0.001
	Yes	20.6%	(85/412)	
Pleural effusion (n = 233)	No	12.7%	(20,117/158,172)	0.026
	Yes	17.6%	(41/233)	
Respiratory failure (n = 275)	No	12.7%	(20,059/158,130)	< 0.001
	Yes	36.0%	(99/275)	
ARDS (n = 65)	No	12.7%	(20,142/158,340)	0.004
	Yes	24.6%	(16/65)	
Pneumothorax (n = 28)	No	12.7%	(20,156/158,377)	0.375
	Yes	7.1%	(2/28)	
Composite outcome (n = 1444)	No	12.6%	(19,848/156,961)	< 0.001
	Yes	21.5%	(310/1,444)	

Incidence of metabolic syndrome in patients with or without the respective pulmonary complication. Because the number of patients with pulmonary complications is much smaller than the number with MetS, the incidence of MetS in the comparison groups (those without pulmonary complications) remains relatively constant at 12.7%.