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Original article

Safety of open ventral hernia repair in high-risk patients with metabolic syndrome: a multi-institutional analysis of 39,118 cases

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Abstract

Background: Metabolic syndrome (MetS) entails the simultaneous presence of a constellation of dangerous risk factors including obesity, diabetes, hypertension, and dyslipidemia. The prevalence of MetS in Western society continues to rise and implies an elevated risk for surgical complications and/or poor surgical outcomes within the affected population.

Objective: To assess the risks and outcomes of multi-morbid patients with MetS undergoing open ventral hernia repair.

Setting: Multi-institutional case-control study in the United States.

Methods: The American College of Surgeons National Surgical Quality Improvement Program database was sampled for patients undergoing initial open ventral hernia repair from 2012 through 2014 and then stratified into 2 cohorts based on the presence or absence of MetS. Statistical analyses were performed to evaluate preoperative co-morbidities, intraoperative details, and postoperative morbidity and mortality to identify risk factors for adverse outcomes.

Results: Mean age (61.0 versus 56.0 yr, $P < .001$), body mass index (39.2 versus 31.1, $P < .001$), and prevalence of co-morbidities of multiple organ systems were significantly higher ($P < .001$) in the MetS cohort compared to control. Patients with MetS received higher American Society of Anesthesiologists classifications (81.0% versus 43.1% class 3 or higher, $P < .001$), were more likely to require operation as emergency cases (11.4% versus 7.2%, $P < .001$), required longer operative times (103 versus 87 min, $P < .001$), had longer hospitalizations (3.5 versus 2.4 d, $P < .001$), and had more contaminated wounds (15.9% versus 12.0% class 2 or higher, $P < .001$). Overall, they had more medical (7.5% versus 4.2%, $P < .001$), and surgical complications (9.7% versus 5.4%, $P < .001$), experienced more readmissions (8.3% versus 5.7%, $P < .001$) and reoperations (3.4% versus 2.5%, $P < .001$), and were at higher risk for eventual death (.8% versus .5%, $P = .008$).

Conclusions: The presence of MetS is related to a multitude of unfavorable outcomes and increased mortality after open ventral hernia repair compared with a non-MetS control group. MetS is a useful marker for high operative risk in a population that is generally prone to obesity and its associated diseases. (Surg Obes Relat Dis 2018;14:206–213.)

Keywords: Ventral hernia repair; Secondary procedures; Obesity; Metabolic syndrome; Risk factors; Outcomes

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The prevalence of metabolic syndrome (MetS) has risen to an epidemic status and continues to increase at an alarming rate, most likely due to sedentary lifestyles and

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poor eating habits in Western industrialized nations [1]. According to National Health and Nutrition Education Survey data, an estimated 34% (35.1% of men and 32.6% of women) of the U.S. population meet criteria for a diagnosis of MetS [2]. However, these figures vary depending on the syndrome definition and laboratory cutoff values used to meet diagnostic criteria [3]. The syndrome is defined as the concomitant presentation of multiple cardiovascular risk factors: namely an increased resistance to insulin, obesity, dyslipidemia, and hypertension [4]. The International Diabetes Foundation sought to unify the medical and research communities by generating a consistent definition for MetS, stating a patient must have central obesity—defined by ethnicity-specific values or body mass index (BMI) >30 kg/m^2—plus the presence of, or ongoing treatment for, at least 2 of the following: hypertriglyceridemia, low high-density lipoprotein cholesterol, hypertension, and elevated fasting plasma glucose (see Fig. 1 for specific diagnostic criteria) [5]. Recognition of MetS' importance in current clinical care is fortified by the creation of a unique identifier from the International Classification of Diseases, version 10, to identify and track patients with MetS: E88.81 [6]. MetS is strongly related to multiple adverse outcomes including stroke, myocardial infarction, and death [7].

Preexisting obesity, diabetes, or hypertension are known to elevate risk of surgical complication across a spectrum of procedures [8–11]. In addition, there is a significant correlation between obesity and an increased risk of ventral abdominal hernia with the potential for strangulation or incarceration [12]. The pathogenesis behind this association may be linked to high intraabdominal pressure and decreased wall strength as per the law of Laplace [13]. Despite this knowledge, there is little data in the literature regarding the risks of complications in ventral hernia repair (VHR) in patients with MetS [14–17]. As a result, this study investigates the impact of MetS on morbidity and mortality among patients undergoing VHR using a large multi-institutional national database.

Central obesity	Waist circumference*†—ethnicity specific (see Table 7) plus any two of the following:
Raised triglycerides	≥ 1.7 mmol/l (150 mg/dl) or specific treatment for this lipid abnormality
Reduced HDL-cholesterol	< 1.03 mmol/l (40 mg/dl) in males < 1.29 mmol/l (50 mg/dl) in females or specific treatment for this lipid abnormality
Raised blood pressure	Systolic: ≥ 130 mmHg or Diastolic: ≥ 85 mmHg or treatment of previously diagnosed hypertension
Raised fasting plasma glucose‡	Fasting plasma glucose ≥ 5.6 mmol/l (100 mg/dl) or previously diagnosed Type 2 diabetes If > 5.6 mmol/l or 100 mg/dl, oral glucose tolerance test is strongly recommended but is not necessary to define presence of the syndrome

*For guidelines on how to measure waist circumference accurately, see Table 7.
†If body mass index is > 30 kg/m^2 then central obesity can be assumed, and waist circumference does not need to be measured.
‡In clinical practice, impaired glucose tolerance is also acceptable, but all reports of the prevalence of the metabolic syndrome should use only the fasting plasma glucose and presence of previously diagnosed diabetes to assess this criterion. Prevalences also incorporating the 2-h glucose results can be added as supplementary findings.

Fig. 1. Metabolic syndrome definition (Reprinted with permission of John Wiley and Sons from: Alberti KG, Zimmet P, Shaw J. Metabolic syndrome–a new world-wide definition. A Consensus Statement from the International Diabetes Federation. Diabet Med 2006;23(5):469–480.).

Methods

De-identified patient information is regularly provided to the American College of Surgeons as part of the National Surgical Quality Improvement Program (NSQIP) [18] data sets, including variables such as preoperative co-morbidities, perioperative details, and postoperative follow-up within a 30-day period. This nationwide data set was retrospectively searched for patients with MetS undergoing open VHR between the years 2012 and 2014 [18]. Given the rapid evolution of VHR techniques and mesh materials, this date range was chosen to begin with a time point reflecting contemporary repair techniques and ending with the latest data set available at the time of analysis. The database includes more than 750,000 surgical cases across the United States for 2014 alone and was ideally suited to conduct high-quality retrospective analysis.

Initial selection was performed by screening Current Procedural Terminology (CPT) [19] codes corresponding to primary VHR, including 49560 ("repair initial incisional or ventral hernia; reducible") and 49561 ("repair initial incisional or ventral hernia; incarcerated or strangulated"). The focus of this study was on patients undergoing initial open hernia repair and, thus, those patients undergoing recurrent VHR as specified by CPT codes 49565 ("repair recurrent incisional or ventral hernia; reducible") and 49566 ("repair recurrent incisional or ventral hernia; incarcerated or strangulated") or laparoscopic repair (CPT codes 49652, 49653, 49656, or 49657) were purposely excluded. Identified cases of open VHR were then stratified into 2 cohorts based on the presence or absence of a diagnosis of MetS. MetS was defined as the simultaneous presence of obesity specified as a BMI $\geq$30.0 [20], diabetes, and hypertension requiring medication. Demographic and preoperative variables were collected for each group. Perioperative data included type of hernia, surgical specialty of the operating surgeon, secondary procedures, operative time, and hospitalization length. Cases that included abdominal wall reconstruction in the form of component separation or panniculectomy were detected by CPT codes 15734 ("muscle, myocutaneous, or fasciocutaneous flap; trunk") and 15830 ("excision, excessive skin and subcutaneous