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Analytic morphomics corresponds to functional status in older patients

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ABSTRACT

Background: Older patients account for nearly half of the United States surgical volume, and age alone is insufficient to predict surgical fitness. Various metrics exist for risk stratification, but little work has been done to describe the association between measures. We aimed to determine whether analytic morphomics, a novel objective risk assessment tool, correlates with functional measures currently recommended in the preoperative evaluation of older patients.

Materials and methods: We retrospectively identified 184 elective general surgery patients aged >70 y with both a preoperative computed tomography scan and Vulnerable Elderly Surgical Pathways and outcomes Assessment within 90 d of surgery. We used analytic morphomics to calculate trunk muscle size (or total psoas area [TPA]) and univariate logistic regression to assess the relationship between TPA and domains of geriatric function mobility, basic and instrumental activities of daily living (ADLs), and cognitive ability.

Results: Greater TPA was inversely correlated with impaired mobility (odds ratio [OR] = 0.46, 95% confidence interval [CI] 0.25–0.85, $P = 0.013$). Greater TPA was associated with decreased odds of deficit in any basic ADLs (OR = 0.36 per standard deviation unit increase in TPA, 95% CI 0.15–0.87, $P < 0.03$) and any instrumental ADLs (OR = 0.53, 95% CI 0.34–0.81; $P < 0.005$). Finally, patients with larger TPA were less likely to have cognitive difficulty assessed by Mini-Cog scale (OR = 0.55, 95% CI 0.35–0.86, $P < 0.01$). Controlling for age did not change results.

Conclusions: Older surgical candidates with greater trunk muscle size, or greater TPA, are less likely to have physical impairment, cognitive difficulty, or decreased ability to perform daily self-care. Further research linking these assessments to clinical outcomes is needed.

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1. Introduction

Advances in surgical technology, increased life expectancy, and high demand have resulted in surgeons performing more operations on patients of advanced age [1–3]. Patients aged ≥65 y undergo surgical procedures at a rate two to three times that of the general population and account for almost 40% of operations performed in the United States [1,4]. Given the heterogeneous presentation of these older patients [5], it has become evident that age alone is insufficient to risk-stratify these patients for surgery [6]. Some variation in apparent physical fitness is appreciable by history and physical examination, but there exists a need for objective, time-efficient measures of physical fitness in the preoperative setting. Our recent work described the use of existing preoperative cross-sectional imaging to define surgical risk and has identified central sarcopenia as a strong marker of poor surgical outcomes in the general population [7]. In response, we have become interested in potential approaches to identify remediable surgical risk in older patients with the goal of optimizing high-risk patients for surgical procedures. The potential clinical application would be to optimize sarcopenic patients for surgery by prescribing physical exercise to increase muscle mass.

However, surgeons must appreciate a complex milieu of risk among older patients, especially those in the upper end of this age rage (i.e., aged ≥70). Older patients are more likely to have complex risk factors such as functional impairment and cognitive decline, which also impact surgical course [5,8–12]. This marked variation in preoperative functional capacity has prompted a strong recommendation to use geriatric assessment before surgery, for example in recent guidelines on the preoperative care of the older surgical patient written by the American College of Surgeons [5,6,13]. The landscape of tests includes not only physical screens, such as ability to perform self-care [14,15] and observed gait speed [16], but also assessment of cognitive ability [17,18]. Great enthusiasm has been shown for identifying various domains of risk, yet little work has been performed to describe the association between the various metrics in the older patient population [19–21]. We also do not fully understand how sarcopenia relates to the geriatric screening tests, and how they might overlap in these complex patients [22,23].

Therefore, we proposed this cross-sectional study of the relationship between central sarcopenia and risk factors identifiable by a comprehensive geriatric assessment in older patients planning to undergo elective general surgical procedures in the Vulnerable Elderly Surgical Pathways and outcomes Assessment (VESPA) study [18]. We aimed to determine the extent to which radiographic quantification of trunk muscle size is correlated with risk stratification measures currently used to assess fitness in older patients. We hypothesized that muscle size would be associated most closely with measures of physical function in older patients. However, because decline in cognition can precede or concur with diminished physical and functional capacity [24,25], we also anticipated correlation between trunk muscle size and self-care and/or cognitive measures.

2. Methods

2.1. Study design

We conducted an observational cross-sectional study of a subsample of patients in the VESPA study. The original VESPA study was a quality improvement intervention developed in 2008 as a collaborative effort between the Departments of Surgery and Medicine at the University of Michigan Health System (UMHS), an academic, tertiary-referral center [18]. Briefly, the VESPA initiative implemented a brief geriatric assessment that could be administered by surgery physician assistants as part of a preoperative evaluation for patients aged ≥70 y with planned general surgery. In 2012, we formally evaluated the VESPA effort from 2008–11, obtained approval by appropriate Institutional Review Boards at UMHS as human research, and described cross-sectional relationships between the risk factors [18]. Relevant to this study, the VESPA evaluation measured functional status (through performance of activities of daily living (ADLs), 6 basic ADLs and 8 instrumental ADLs, mobility (through a timed up and go test (3-m walk), gait evaluation (normal or unsteady), and any self-reported falls within the past year) and cognitive status (using a clock composition test and three-item recall) [14–17].

2.2. Data

Among the 736 patients in the VESPA study, we retrospectively identified an analytic sample who also received a preoperative computed tomography (CT) scan of the thoracolumbar area within the UMHS health system within 90 d before their elective general surgery. The CT scan had to include the psoas muscle at L4. We did not exclude any CT scans based on clinical indication. No additional CT scans, other than those already clinically indicated and performed, were conducted for this study.

2.3. Measures (dependent variables)

The original VESPA study collected functional status as a series of self-reported questions regarding difficulty with ADLs. The questions modified the basic ADLs and instrumental ADLs items from the original severity scales [14,15] to dichotomous responses, difficulty *versus* no difficulty, for each task. VESPA allowed for either self- or proxy-reporting. The surgery physician's assistant performed both the interview and the physical examination to evaluate gait, balance, and cognition.

One challenge for the present analysis was to describe how total psoas area (TPA) relates to the many VESPA items in broad domains. Although some VESPA measures are physical (e.g., gait speed) and others are cognitive (e.g., the Mini-cog), ADLs require both cognitive and physical abilities. Therefore, we considered the individual VESPA items as three types: self-care (ADLs), mobility, and cognitive (Fig. 1). Of the three domains, mobility measures depend more highly on physical reserve, and therefore we expected the mobility deficits to be strongly and inversely correlated with TPA (i.e., increased muscle size would be associated with decreased difficulty in mobility).