Research

PREOPERATIVE PSOAS MUSCLE SIZE PREDICTS POSTOPERATIVE DELIRIUM IN OLDER ADULTS UNDERGOING SURGERY: A PILOT COHORT STUDY

To the Editor: Individuals aged 65 and older account for more than 30% of surgical procedures in the United States and undergo operations at a rate twice that of the general population.[1] Postoperative delirium is an increasingly recognized postoperative occurrence in these individuals, resulting in prolonged length of stay (LOS), functional decline, and greater mortality.[2] Given that delirium may be preventable in more than one-third of cases with proper intervention, attention has been focused on identification of frail individuals before surgery who are at greater risk of delirium.[3] Functional status can be used as a surrogate for frailty,[4] although comprehensive geriatric assessment has not become part of standard preoperative protocols. Trunk muscle size, as defined by total psoas area (TPA) on computed tomography (CT), is a novel objective marker of surgical frailty[5] and has been shown to correspond to functional status.[6] The objective of this study was to examine the relationship between TPA and postoperative delirium in older adults planning to undergo elective general surgical procedures, controlling for other delirium risk factors identifiable in a comprehensive geriatric assessment.

This was an observational cohort study of a subsample of individuals from the larger Vulnerable Elders Surgical Pathways and outcomes Assessment (VESPA) study at the University of Michigan from 2007 to 2011.[6] Inclusion criteria were aged 70 and older, CT within 90 days before elective surgery, and a LOS of longer than 1 day (n = 142). TPA was calculated at the L4 vertebral level using validated analytic morphomic methods.[5] In this study, TPA was defined as the sum of normal- (31–100 Hounsfield Units (HU)) and low-density muscle (0–30 HU). Individuals with a low TPA were defined as falling within the lowest tertile of the sex-standardized study population. Retrospective medical record review was used to assess for the incidence of delirium or acute confusional state in the postoperative period, modified from a previously described methodology.[7] Multivariate logistic regression was used to estimate the association between TPA and development of any signs or symptoms of postoperative delirium, controlling for extent of surgery and known delirium risk factors. The following factors were adjusted for: age (per 5-year increase), surgical complexity determined according to relative value units, comorbidity using the Charlson Comorbidity Index,[8] degree of preoperative functional impairment (having difficulty in 0–5 activities of daily living (bathing, walking, shopping, light housework, managing finances) modified from a previous study[9]), and cognitive impairment (documented dementia, cognitive impairment, positive preoperative Mini-Cog[10]). A significance level of $\alpha = 0.05$ was used. As a sensitivity analysis, influential observations were identified using Pregibon influence statistics. All statistical analysis was performed using Stata version 13 (StataCorp LP, College Station, TX).

Of the 142 individuals in the analytical sample, 22 (15.5%) developed documented signs or symptoms of postoperative delirium during their hospitalization. Individuals who developed delirium had a median LOS of 12.2 days, vs 8 days for those who did not ($P = .001$) and were more likely to be discharged to destinations other than home (45.5% vs 21.6%) ($P = .02$).

Postoperative signs and symptoms of delirium were associated with low TPA (vs normal or high TPA, odds ratio (OR) = 3.51, 95% confidence interval (CI) = 1.37–8.95) and older age (OR = 1.12, 95% CI = 1.02–1.21 per year increase). In the multivariate model controlling for age, comorbidity, surgical complexity, cognitive impairment, and preoperative functional status, the effect of low TPA remained substantial, although confidence intervals included 1 (OR = 2.63, 95% CI = 0.94–7.39, $P = .07$), a loss of statistical significance that was sensitive to a single highly influential and outlying case (dbeta = 2.35) who had a middle-tertile TPA but high functional impairment. After removal of this individuals, low psoas muscle area (OR = 3.12, 95% CI = 1.02–9.56, $P = .046$) was substantively and statistically independent of age and the other risk factors, with an area under the receiver operating characteristic curve of 0.8077. Individuals with TPA in the lowest tertile of the study population had a 27% risk of delirium during their during hospitalization, compared with a 10% risk for those in the highest tertile (Figure 1).

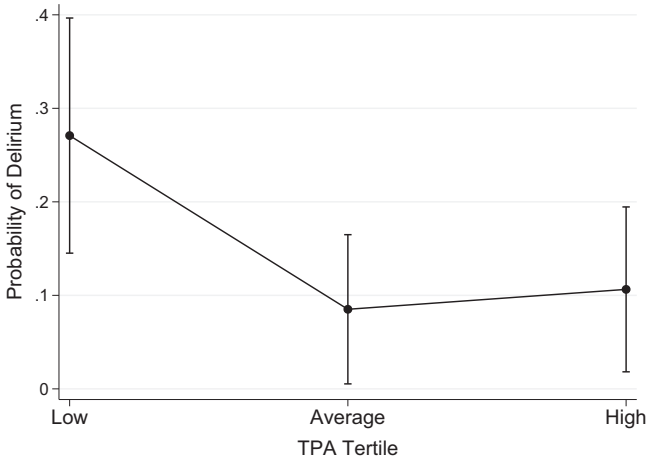

Figure 1. Probability of delirium according to tertile of total psoas area (TPA). Predicted risk of developing delirium based on TPA after controlling for other risk factors. Risk of delirium was 2.7 times as greater in individuals in the lowest tertile of TPA (27%) as in those in the tertile (10%).

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The addition of trunk muscle size to existing risk factors resulted in more-robust prediction of risk of delirium. Trunk muscle size is an innovative, objective metric that can potentially be used to identify vulnerable individuals and to guide antideliriogenic interventions, behavioral and pharmacological, after hospital admission. With a larger sample and further developments to increase availability of automated morphometric measures preoperatively (e.g., in the electronic medical record), this research indicates that psoas muscle size may be a new tool to identify at-risk individuals and prevent the development of postoperative delirium.

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REFERENCES

1. Weiss AJ, Elixhauser A, Andrews RM. Characteristics of Operating Room Procedures in U.S. Hospitals, 2011: Statistical Brief #170. Healthcare Cost and Utilization Project (HCUP) Statistical Briefs. Rockville, MD: Agency for Healthcare Research and Quality, 2006.
2. Robinson TN, Raeburn CD, Tran ZV et al. Postoperative delirium in the elderly: Risk factors and outcomes. Ann Surg 2009;249:173–178.
3. American Geriatrics Society Expert Panel on Postoperative Delirium in Older Adults. American Geriatrics Society abstracted clinical practice guideline for postoperative delirium in older adults. J Am Geriatr Soc 2015;63:142–150.
4. Malani PN. Functional status assessment in the preoperative evaluation of older adults. JAMA 2009;302:1582–1583.
5. Englesbe MJ, Lee JS, He K et al. Analytic morphomics, core muscle size, and surgical outcomes. Ann Surg 2012;256:255–261.
6. Miller AL, Min LC, Diehl KM et al. Analytic morphomics corresponds to functional status in older patients. J Surg Res 2014;192:19–26.
7. Inouye SK, Leo-Summers L, Zhang Y et al. A chart-based method for identification of delirium: Validation compared with interviewer ratings using the Confusion Assessment Method. J Am Geriatr Soc 2005;53:312–318.
8. Charlson ME, Pompei P, Ales KL et al. A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. J Chronic Dis 1987;40:373–383.
9. Saliba D, Orlando M, Wenger NS et al. Identifying a short functional disability screen for older persons. J Gerontol A Biol Sci Med Sci 2000;55A:M750–M756.
10. Borson S, Scanlan J, Brush M et al. The Mini-Cog: A cognitive 'vital signs' measure for dementia screening in multi-lingual elderly. Int J Geriatr Psychiatry 2000;15:1021–1027.