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Clinical Research

The Underestimated Belly Factor: Waist Circumference Is Linked to Significant Morbidity Following Isolated Coronary Artery Bypass Grafting

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ABSTRACT

Background: Waist circumference (WC) and body mass index (BMI) are clinically used to assess adiposity. The aim of the present study was to evaluate the association of WC with postoperative morbidity and mortality in patients who underwent isolated coronary artery bypass grafting (CABG) in relation to patients' BMI category.

Methods: We analyzed the associations of WC and BMI with short-term postoperative outcomes in a cohort of 7446 patients who underwent isolated CABG. We performed univariate and adjusted analyses on main postoperative outcomes after CABG for WC and BMI.

Results: Adverse events researched included postoperative mortality, intensive care unit and hospital length of stay, cardiovascular and

RÉSUMÉ

Introduction : Dans la pratique clinique, le tour de taille et l'indice de masse corporelle (IMC) sont utilisés pour évaluer l'adiposité. Le but de la présente étude consistait à évaluer le lien entre le tour de taille et la morbidité/mortalité postopératoires chez des patients ayant subi un pontage aorto-coronarien isolé en relation avec leur catégorie d'IMC.

Méthodes : Nous avons analysé le lien entre le tour de taille, l'IMC et les résultats postopératoires à court terme dans une cohorte de 7 446 patients ayant subi un pontage aorto-coronarien isolé. Nous avons réalisé des analyses univariées multivariées avec ajustement sur les principaux résultats postopératoires après un pontage aorto-coronarien, pour le tour de taille et l'IMC.

Obesity has attained epidemic proportions. The prevalence of moderate obesity has more than doubled and severe obesity tripled from 1976 to 2004.[1] Patients with obesity have traditionally been considered at increased risk of adverse events after heart surgery and obesity has been included in most risk stratification models for cardiac surgery.[2] However, several cohort studies have reported that overweight and obesity were not associated with an increased risk of mortality,[3-5] in contrast with severe obesity, which was indeed shown to be associated with increased adverse events and mortality after cardiac surgery.[6-8]

Waist circumference (WC) and body mass index (BMI) are anthropometric measures used to assess adiposity[9] and are recommended clinical features to evaluate increased health hazards associated with obesity.[9,10] In cardiac surgery, BMI is often used to define obesity. Metabolic syndrome (MetS) has been associated with adverse events after coronary artery bypass grafting (CABG) surgery.[11] WC as a marker of central obesity is part of the definition of MetS,[12] however, it has not been studied as an independent risk factor of adverse events after isolated CABG. The aim of this study was to evaluate the association of WC with postoperative morbidity and mortality in patients who underwent isolated CABG in relation to patients' BMI category. We hypothesized that patients with increased abdominal adiposity assessed according to WC were at increased risk of adverse events after isolated CABG at any BMI category.

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See page 333 for disclosure information.

Methods

Patient selection and data collection

Preoperative and operative data were prospectively collected from the Quebec Heart and Lung Institute heart surgery database and data on postoperative events were

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cerebrovascular events, respiratory complications, infectious, hemostasis complications, and renal complications. WC was independently associated with all postoperative outcomes except prolonged intubation and mortality. Overall, patients in the upper WC quartile in each BMI category were at increased risk of adverse events compared with patients in the lower 3 WC quartiles, with a maximal incremental risk of 1.91 (95% confidence interval, 1.23-2.95) among patients with a BMI $\geq$ 35. This association was observed for men and women, across all overweight and obesity categories. Neither WC nor BMI was associated with short-term postoperative mortality.

Conclusions: In our large cohort of patients who underwent isolated CABG, WC was significantly associated with clinical adverse events, independently of BMI. These findings provide further evidence on the added value of measuring WC as a simple and easy to measure anthropometric marker to refine risk assessment beyond BMI among patients who undergo CABG.

Résultats : Les événements indésirables analysés comprenaient la mortalité postopératoire, la durée du séjour à l'hôpital et aux soins intensifs, les manifestations cardiovasculaires et vasculaires cérébrales, les complications respiratoires, les infections, l'hémostasie et les complications rénales. Nous avons établi association indépendante entre le tour de taille et tous les résultats postopératoires, à l'exception de l'intubation prolongée et de la mortalité. D'une manière générale, les patients ayant un tour de taille se situant dans le quartile supérieur dans chacune des catégories d'IMC étaient exposés à un risque accru d'événements indésirables, comparativement à ceux dont le tour de taille se situait dans les trois quartiles inférieurs, le rapport de cote maximal étant de 1,91 (intervalle de confiance à 95 % : 1,23 − 2,95) chez les patients dont l'IMC était $\geq$ 35. Cette association a été observé chez les hommes et chez les femmes, dans toutes les catégories de surpoids et d'obésité. Ni le tour de taille ni l'IMC n'ont été associés à la mortalité postopératoire à court terme.

Conclusions : Dans notre vaste cohorte de patients ayant subi un pontage aorto-coronarien isolé, une association significative a été établi entre le tour de taille et certains événements indésirables cliniques, indépendamment de l'IMC. Ces résultats viennent confirmer l'intérêt du tour de taille en tant que marqueur anthropométrique simple et facile à mesurer pour mieux évaluer le risque, au-delà de l'IMC, chez les patients qui subissent un pontage aorto-coronarien.

collected after surgery. After project approval by the Quebec Heart and Lung Institute ethics committee, we extracted all 8615 patients from the Quebec Heart and Lung Institute heart surgery database who underwent CABG from January 2000 to May 2008 with a BMI $\geq$ 20. Patients with a BMI $\leq$ 20 were excluded because this population is known to be at increased risk of morbidity and mortality after heart surgery.[4,5,13,14] We then excluded 1169 patients who underwent combined valve and CABG. Final analyses were performed on a cohort of 7446 patients.

Study outcomes

Clinically significant outcomes after CABG were studied: (1) postoperative mortality; (2) intensive care unit and hospital length of stay (LOS); (3) cardiovascular and cerebrovascular events; (4) respiratory complications (prolonged mechanical ventilation, reintubation); (5) infectious complications (pneumonia, mediastinitis, blood stream); (6) hemostasis complications (bleeding, pulmonary embolism); and (7) renal complications (renal failure, new postoperative renal replacement therapy; see Supplemental Appendix S1).

Statistical analysis

Continuous variables were expressed as means or medians when skewed and were analyzed using analysis of variance or the Kruskal-Wallis tests where appropriate. Categorical variables were expressed as number of patients and percentage of the studied group and were compared using χ^2 test or Fisher test. To investigate the association of WC and the risk of postoperative adverse events, we first built stepwise logistic regression models including WC and BMI as independent continuous variables and adjusted for confounding factors for each outcome of interest. We used a likelihood ratio test < 0.3 for inclusion and > 0.1 for exclusion in the final model. In a second step, to explore the independent association between BMI, WC, and postoperative outcomes, and because of significant collinearity between WC and BMI, we built logistic regression models using the methods described in the first step but stratified according to BMI class. We used BMI class defined by the National Institute of Health: normal BMI (20.0-24.9); overweight (25.0-29.9), class I obesity (30.0-34.9), and class II and III obesity ($\geq$ 35.0).[10] The class II and III categories were merged together because of the insufficient number of patients in that category. For each BMI category and outcome, we compared patients from the upper sex-specific WC quartile with patients in the 3 lower quartiles, to obtain an estimation of the additional risk of increased WC vs BMI. The 3 lowest quartiles were merged and used as a reference because of the low number of events in some quartiles rendering the adjusted analyses impossible at each quartile level. All models were adjusted for known or suspected risk factors for postoperative adverse events in CABG (age, sex, history of coronary or valvular surgery, peripheral vascular disease, cerebrovascular disease, systemic hypertension, diabetes, renal insufficiency, left ventricular ejection fraction $< 30\%$, chronic obstructive pulmonary disease, surgical priority, and cardiopulmonary bypass time). Odds ratios (ORs), 95% confidence intervals (CIs) and P values were calculated for each included variables in the final model. A P value was considered significant at $P < 0.05$. All statistical analyses were performed using SAS (version 9.4: SAS Institute Inc, Cary, NC).

Results

Baseline characteristics of our population are reported in Table 1 according to BMI category. We observed an increased proportion of women, systemic hypertension, and diabetes in patients with class $\geq$ II obesity. Patients with increased BMI were slightly younger and were less active smokers. Class II and III obesity patients had more chronic obstructive lung