

Original article

# Effect of body mass index on the outcomes of patients with upper and lower urinary tract cancers treated by radical surgery: Results from a Canadian multicenter collaboration

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## Abstract

**Objective:** To evaluate the effect of body mass index (BMI) on the outcomes of patients with urinary tract carcinoma treated with radical surgery.

**Materials and methods:** Data were collected from 10 Canadian centers on patients who underwent radical cystectomy (RC) (1998–2008) or radical nephroureterectomy (RNU) (1990–2010). Various parameters among subsets of patients (BMI < 25, 25 ≤ BMI < 30, and BMI ≥ 30 kg/m<sup>2</sup>) were analyzed. Kaplan-Meier and multivariate analyses were performed to assess the effect of BMI on overall survival, disease-specific survival, and recurrence-free survival (RFS).

**Results:** Among the 847 RC and 664 RNU patients, there was no difference in histology, stage, grade, and margin status among the 3 patient subsets undergoing either surgery. However, RC patients with lower BMIs (< 25 kg/m<sup>2</sup>) were significantly older ( $P = 0.004$ ), had more nodal metastasis ( $P = 0.03$ ), and trended toward higher stage ( $P = 0.052$ ). RNU patients with lower BMIs (< 25 kg/m<sup>2</sup>) were significantly older ( $P = 0.0004$ ) and fewer received adjuvant chemotherapy ( $P = 0.04$ ) compared with those with BMI ≥ 30 kg/m<sup>2</sup>; however, there was no difference in tumor location ( $P = 0.20$ ), stage ( $P = 0.48$ ), and management of distal ureter among the groups ( $P = 0.30$ ). On multivariate analysis, BMI was not prognostic for overall survival, disease-specific survival, and RFS in the RC group. However,

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BMI  $\geq 30$  kg/m<sup>2</sup> was associated with more bladder cancer recurrences and worse RFS in the RNU group (HR = 1.588; 95% CI: 1.148–2.196;  $P = 0.0052$ ).

**Conclusions:** Increased BMI did not influence survival among RC patients. BMI  $\geq 30$  kg/m<sup>2</sup> is associated with worse bladder cancer recurrences among RNU patients; whether this is related to difficulty in obtaining adequate bladder cuff in patients with obesity requires further evaluation. © 2014 Elsevier Inc. All rights reserved.

**Keywords:** Body mass index; Radical cystectomy; Radical nephroureterectomy

## 1. Introduction

Obesity is a global epidemic that carries with it a significant health and economic burden on countries all over the world. Currently, it is estimated that at least 70% of American adults are either overweight ( $25 \leq$  body mass index [BMI]  $< 30$ ) or obese (BMI  $\geq 30$  kg/m<sup>2</sup>), with trends continuing to rise at an alarming rate. According to recent projections, 86.3% of American adults will be overweight or obese by 2030, whereas all American adults will become overweight or obese by 2048. Health care costs attributable to overweight or obese people are also projected to double every decade, reaching almost \$1 trillion by 2030 [1]. Although such population trends rarely come true and do seem somewhat exaggerated, given the strong association between obesity and various medical disorders such as diabetes and heart disease as well as the growing link between obesity and organ-specific cancers such as cancer of the kidney, prostate, breast, and colon, these projections are nevertheless a cause for great concern [2–6].

In contrast, despite these worrying statistics, there is a paucity of data on the link between obesity and urothelial carcinoma of the upper or lower urinary tract [7]. In addition, although there are several studies reporting an association between higher BMI and higher perioperative complications after radical cystectomy (RC) [8–10], little is known on the effect of obesity, and more specifically the effect of BMI, on the oncological outcomes of patients with upper and lower urinary tract cancers treated by radical surgery. To our knowledge, there are only 3 previous reports examining the effect of obesity on the oncological outcomes after RC [11–13] and only 2 studies evaluating the outcomes after radical nephroureterectomy (RNU) [14,15]. In both patient populations, the results from the studies revealed contradictory conclusions. Because of the limited data and the ongoing debate, we aimed to evaluate the effect of BMI on the oncological outcomes of patients with urothelial carcinoma from a large multi-institutional Canadian collaboration who have been treated by RC or RNU in a universal health care system.

## 2. Patients and methods

Data were retrieved from a retrospectively collected database on patients who underwent RC at 8 Canadian academic centers between the years 1998 and 2008 as well

as from another database on patients who underwent RNU between the years 1990 and 2010 across 10 academic centers [16,17]. A total of 847 RC patients and 664 RNU patients had complete BMI data and form the basis of this report. After approval by the ethics board for each institutional data collection, all variables were then combined into a final database for analysis. For both RC and RNU, the indications for surgery were similar at all participating institutions, with follow-up performed according to institutional guidelines. Indications for RC included clinically documented muscle-invasive disease or recurrent or refractory non-muscle invasive disease following transurethral resection and failed intravesical therapy. For patients undergoing RC, the extent of lymphadenectomy was institution dependent and left to the discretion of the treating surgeon. Indications for RNU included patients with renal, pelvic, or ureteral tumors. For patients who underwent RNU, the performance of lymphadenectomy was institution and physician dependent, with extended lymphadenectomy not being commonly performed. The decision to offer adjuvant or neoadjuvant chemotherapy was both patient dictated and physician dependent. For patients undergoing RC, follow-up was performed every 3 to 6 months for the first 3 years, then less frequently thereafter, and consisted of clinic visits, evaluation of serum creatinine and electrolyte levels, chest x-ray, and abdominal imaging. For patients undergoing RNU, follow-up was more individualized per center but was generally performed every 3 to 6 months during the first year, every 6 months to complete a follow-up of 5 years, and then annually thereafter, and also consisted of office visits, routine blood studies, and urine cytology, in addition to radiologic evaluation of the contralateral upper tract. For both patient populations, bone scans were performed only when clinically indicated. Patients with documented metastatic disease before radical surgery were excluded. Pathologists experienced with genitourinary pathology were involved in evaluating final surgical specimens, with staging and grading performed according to the 2002 American Joint Committee on Cancer classification and the 1998 World Health Organization (WHO) system, respectively. Various clinicopathologic parameters were collected including age, gender, smoking status, perioperative chemotherapy, performance of a lymphadenectomy, time to recurrence, and death. BMI was estimated at the time of radical surgery and was calculated using the standard definition of body weight (kg) divided by the height squared (m<sup>2</sup>). Patients

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