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Original article

Trends in the utilization of imaging for upper tract urothelial carcinoma

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Abstract

Objectives: To evaluate the changes in use of the different imaging modalities for diagnosing upper tract urothelial carcinoma (UTUC) and assess how these changes have affected tumor stage at the time of surgery.

Materials and methods: We assessed the Surveillance, Epidemiology, and End Results (SEER) cancer registry and linked Medicare claims data (1992–2009) for 5377 patients who underwent surgery for UTUC. We utilized International Classification of Disease—Oncology 3 codes to identify UTUC. International Classification of Disease, ninth Revision, Clinical Modification and Current Procedure Terminology codes identified surgical treatment and imaging modalities. We assessed for use of intravenous pyelography, retrograde pyelography (RGP), computed tomography urography (CTU), magnetic resonance urography (MRU), and endoscopy. For each modality, patients were categorized as having received the modality at least once or not at all. Patient characteristics were compared using chi-squared tests. Usage of imaging modalities and tumor stage was trended using Cochran-Armitage tests. We stratified our data into 2 multivariate logistic regression models to determine the effect of imaging modalities on tumor stage: 1992 to 1999 with all modalities except MRU, and 2000 to 2009 with all modalities.

Results: Our patient population was predominantly White males of more than 70 years old. Intravenous pyelography and RGP declined in use (62% and 72% in 1992 vs. 6% and 58% in 2009, respectively) while computed tomography urography, MRU, and endoscopy increased in use (2%, 0%, and 37% in 1992 vs. 44%, 6%, and 66% in 2009, respectively). In both regression analyses, endoscopy was associated with lower-stage tumors. In the 2000 to 2009 model, RGP was associated with lower-stage tumors, and MRU was associated with higher-stage tumors. Finally, our data showed an increasing number of modalities utilized for each patient (1% receiving 4 modalities in 1992 vs. 20% in 2009).

Conclusions: We found trends toward the utilization of newer imaging modalities to diagnose UTUC and more modalities per patient. Endoscopy and RGP were associated with smaller tumors, whereas MRU was associated with larger tumors. Further studies are needed to evaluate the utility of the different modalities in diagnosing UTUC.

Keywords: Upper Tract Urothelial Cancer; Imaging; Diagnosis; Endoscopy; Surgery

1. Introduction

Upper tract urothelial carcinoma (UTUC) is a devastating disease with late-stage presentation, high recurrence rate, and high cancer-specific mortality rates. At the time of diagnosis, 60% of UTUC is invasive, which is more than twice that of urothelial carcinoma found in the lower tract. Patients diagnosed with UTUC have an overall 5-year survival of only 57% [1–3]. The current gold standard for treatment of UTUC is surgical excision with lymph node dissection. However, even after surgery, up to 28% of patients recur within 1 year and nearly 60% of deaths are

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attributable to the disease [3]. The late presentation, high recurrence rate, and high mortality rates suggest a lack of screening and diagnostic modalities to identify and treat UTUC early in its disease course.

Diagnosis of UTUC generally involves a combination of cytology, imaging, and endoscopic biopsy. In the face of a negative cystoscopy, abnormal urine cytology can point to upper tract malignancy, but with limited positive predictive value, particularly in lower-stage disease [4]. As for imaging, UTUC has historically been detected using intravenous pyelography (IVP) and retrograde pyelography (RGP). Today, cross-sectional imaging modalities, such as magnetic resonance urography (MRU) and computerized tomographic urography (CTU), allow urologists to visualize the upper tract and potentially the invasiveness of a tumor into surrounding tissues. Furthermore, recent improvements to endoscopes make ureterorenoscopy an option to directly visualize and take biopsies of lesions in the upper tract.

In this study, we evaluated the changes in use of the different imaging modalities for diagnosing UTUC. Additionally, we assessed how these changes have affected the stage of patients who received definitive surgery. Although prior studies have shown that CTU, MRU, and endoscopy allow for better detection of UTUC compared with IVP and RGP, there are no data in the literature on whether these newer imaging modalities are actually associated with lower-stage tumors at the time of surgery.

2. Materials and methods

2.1. Identification of patient cohort

After receiving Institutional Review Board approval, we assessed the Surveillance, Epidemiology, and End Results (SEER) cancer registry and linked Medicare claims data (1992–2009) for patients who underwent surgical treatment for UTUC. Diagnosis of UTUC was defined as the intersection of the International Classification of Disease—Oncology 3 (ICD-O-3) histology codes for transitional cell carcinoma (8,010; 8,050; 8,120; and 8,130) and the ICD-O-3 diagnosis codes for ureteral and renal pelvis cancer (659 and 669). Surgical treatment for UTUC included open and minimally invasive nephrectomy, ureterectomy, and distal ureterectomy and were identified using Current Procedure Terminology (CPT) codes (50,220; 50,225; 50,230; 50,234; 50,236; 50,240; 50,543; 50,545; 50,546; 50,548; 50,549; 50,650; 50,660; 50,947; 50,948; and 50,949).

We included patients between 66 and 90 years of age who were eligible for Medicare by age only. Exclusion criteria included diagnosis of UTUC on death certificate or at autopsy, malignant histologic subtypes other than urothelial carcinoma, lack of coverage from Medicare A or B for 1 year before diagnosis, and enrollment in managed care for 1 year before diagnosis. Our final cohort included 5377 patients who received surgical treatment for UTUC.

2.2. Demographics and tumor characteristics

SEER data were used to identify patient demographics, including age, sex, and race. Also ascertained were the year of diagnosis, final tumor grade, and final tumor stage. Tumor grades provided by SEER followed a 4-grade system, ranging from well-differentiated (grade I) to undifferentiated or anaplastic (grade IV) [5]. The change in the World Health Organization tumor grade classification system in 2004 had no effect on our data. Patients were dichotomized based on disease stage at the time of surgical treatment: lower-stage disease was defined as Ta, carcinoma in situ, *T1*, or unknown stage; higher-stage disease was defined as *T2* or greater. We classified unknown-stage tumors as lower-stage disease because the tumors were likely too small to ascertain tumor stage.

2.3. Definitions of interventions

Using ICD, ninth Revision, Clinical Modification (ICD-9-CM) and CPT codes, we assessed the types of diagnostics used to evaluate for UTUC before the time of surgical treatment. Included diagnostic modalities were IVP (CPT 74,400; 74,410; and 74,415; and ICD-9 87.73), RGP (CPT 52,005; 74,420; and 74,425; and ICD-9 87.74), CTU (CPT 72,194 and 74,178), MRU (CPT 74,183 and 72,197), and endoscopy (CPT 50,551; 50,553; 50,555; 50,557; 50,559; 50,561; 50,562; 50,570; 50,572; 50,574; 50,575; 50,576; 50,578; 50,580; 50,951; 50,953; 50,955; 50,957; 50,959; 50,961; 50,970; 50,972; 50,974; 50,976; 50,978; 50,980; 52,335; 52,336; 52,337; 52,338; 52,339; 52,344; 52,345; 52,346; 52,351; 52,352; 52,353; 52,354; and 52,355). Endoscopy included all percutaneous and ureterorenoscopic assessment and management.

2.4. Statistical analysis

Chi-squared tests were used to compare demographics, final tumor grade, and final tumor stage. Usage of the different imaging modalities as well as tumor stage was trended over time using Cochran-Armitage tests of trend. Multivariable logistic regression models were fit to determine the effect of diagnostic modalities on tumor stage at surgery. Due to no use of MRU before 2000, we stratified our regression into 2 time-period regression models: (1) 1992 to 1999 with all modalities except MRU and (2) 2000 to 2009 with all modalities. In each regression model, age, sex, race, and year of diagnosis were included as possible confounders. We reported the adjusted odds ratio (OR) for each imaging modality where the reference was lack of that individual imaging modality. Finally, the number of different imaging modalities used on each patient was organized