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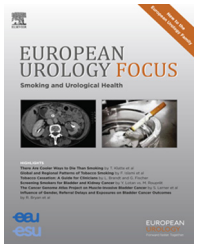

Kidney Cancer

Postoperative 30-day Mortality Rates for Kidney Cancer Are Dependent on Hospital Surgical Volume: Results from a Norwegian Population-based Study

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Abstract

Background: To improve cancer care in Norway, the government introduced surgical volume requirements for hospitals in 2015. To treat kidney cancer (KC) in Norway, the lower limit is 20 surgical procedures per year.
Objectives: To compare the impact of hospital volume on outcome with regard to 30-d mortality (TDM) following KC surgery.
Design, setting, and participants: We identified all KC patients from the Cancer Registry of Norway diagnosed during 2008–2013 whose surgical treatment involved partial or radical nephrectomy. Hospitals were divided into three volume groups: low (LVH), intermediate (IVH), and high (HVH) volume.
Outcome measurements and statistical analysis: Relationships with outcome were analysed using multivariate logistic regression.
Results and limitations: In total, 3273 patients were identified. The TDM rate was 0.89% overall, 0.73% for localised KC, and 2.6% for metastatic KC. The mean (median, interquartile range) numbers of procedures for LVH, IVH and HVH were 5.2 /yr (3, 1.3–8.7), 27 /yr (26, 23–30) and 53 /yr (53, 48–58), with TDM rates of 2.2%, 0.83%, and 0.39%, respectively ($p = 0.001$). In a multivariate logistic regression model, tumour stage, age, and hospital volume remained independent TDM predictors. The odds ratio for TDM was 4.98 (confidence interval 1.72–14.4) for LVH compared to HVH ($p = 0.003$). Study limitations include a lack of data for surgical complications and other possible confounders.
Conclusions: TDM is associated with age, stage, and hospital volume. The study supports the new regulation for hospital volume introduced in Norway.
Patient summary: The risk of dying within 30 d following kidney cancer surgery is low. Advanced disease and older age are risk factors for higher mortality. In this study, we also showed that more patients die within 30 d in hospitals performing fewer operations per year than in hospitals performing many operations.

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1. Introduction

Surgical treatment is still the mainstay of treatment for kidney cancer (KC). Therefore, perioperative mortality is an important quality indicator for patient outcomes [1]. In the literature, contemporary perioperative mortality (both 30-d mortality [TDM] and in-hospital mortality [IHM]) is reported as 0.5–1.5% for localised KC and 2–4% for metastatic (M+) KC [2–7]. For several surgical treatments for other malignancies and for benign conditions, hospital volume is an important factor that significantly affects outcomes [8–10]. However, studies evaluating the impact of hospital volume on outcomes for KC surgery are sparse. Furthermore, there is no generally accepted definition of a low- or high-volume hospital.

Acknowledging that surgical volume is most likely associated with improved patient outcomes, the Norwegian health authorities introduced requirements in 2015 for hospitals that should continue to perform cancer surgery [11]. In addition to general requirements for hospitals to have multidisciplinary teams, 24-h intensive care units, and documented adherence to guidelines, specific volume demands for hospitals and surgeons were established. For KC, hospitals must perform at least 20 surgical procedures per year to remain operative.

Against the background of these new hospital volume requirements, we investigated the relationship between hospital volume and TDM in a national population-based setting. We used other well-recognised (age, stage) [3,12] and potential (surgical procedure, gender) [6,12] prognostic factors as covariates in the study. The study aim was to establish updated Norwegian population-based TDM rates for KC surgery.

2. Patients and methods

2.1. Data source

Since 1953, Norwegian clinicians and pathologists have been required by law to report all new cases of cancer to the population-based Cancer Registry of Norway (CRN). Data for all clinical and pathologic cancers and operation codes used for all types of patient-doctor contact are transferred to the CRN from the national data systems for public health care, and checked against clinical and pathologic report forms. In the case of missing report forms, reminders are sent to the various departments. The CRN is further connected to the Norwegian Population Registry. The registry database contains information on >1 700 000 cancer cases up to 2015, and has completeness of close to 100% [13]. Inclusion in the CRN is mandatory. Thus, in accordance with national regulations, our study did not require informed consent from patients for data extraction from the CRN. The registry does not include data for benign kidney tumours.

2.2. Data extraction, exclusions, and quality assurance

Using the CRN, data sets for all 4465 KC patients (ICD-10 code C64) diagnosed during the 6-yr period from 2008 to 2013 were extracted from the primary database. The data sets consist of demographic, tumour-related, treatment-related, and follow-up variables. A subset of data (~80%) for hospital stay and surgical conversions was available and consisted of all patients for 2010–2013, but data were missing in part for the two first study years.

All CRN data used in the study were manually quality assured from the registry sources by one author (K.M.H.), including re-evaluation of all histopathology reports. During this process, 16 patients (0.36%) were excluded because of a diagnosis other than renal cell carcinoma (RCC). Then data sets for 4449 patients were transferred to an anonymous database for subsequent analyses. Of these, 3313 patients aged ≥18 yr and treated with partial (PN) or radical nephrectomy (RN) remained within the data set.

We excluded patients treated at hospitals performing fewer than four procedures in 6 yr (average of ≤0.5 /yr) on the assumption that these hospitals do not treat KC on a regular basis. In this step, 40 patients were excluded. Hence, the final study population consisted of 3273 patients. Figure 1 shows the details for inclusion and exclusion of patients.

2.3. Definitions used for analyses

Localised KC was defined as disease without distant metastases (M0) at diagnosis or within 4 mo thereafter [14]. Metastatic KC was defined as M+ disease. For tumour staging, the 2009 version of the TNM classification was used.

TDM was defined as death from any cause within 30 d following surgery. IHM was defined as death during the primary hospital stay for surgical treatment.

Open operations were classified as those that started as open procedures and those converted from minimally invasive to open procedures during surgery. Similarly, those classified as RN were operations that started as RN and PN procedures converted to RN during surgery.

Minimally invasive methods (MIMs) included pure laparoscopy, hand-assisted laparoscopy, and robotic-assisted laparoscopy. Ablative treatments involving cryotherapy or radiofrequency treatment were not included in the data.

Hospitals performing KC surgery were divided into three groups according to their mean annual surgical volume: low-volume hospitals (LVH) performed <20 KC operations per year, intermediate-volume hospitals (IVH) performed 20–39 KC operations per year, and high-volume hospitals (HVH) performed ≥40 KC operations per year. The LVH upper limit was defined according to the 2015 Norwegian regulation [11], while the HVH lower limit was arbitrarily based on the presumed volume at the major academic hospitals in Norway.

2.4. Statistical analysis

Standard descriptive statistics were used. Mean values are presented as mean ± standard error of the mean, with median and interquartile range (IQR) used to indicate variation within groups. Because the proportion of TDM is low, we applied bootstrapping with 1000 resamples for TDM rates and associated confidence intervals (CIs). Using this method, we could simulate TDM rates for 1000 cohorts of 3273 patients (ie, 3 273 000 patients).

The specific tests used for comparisons between different groups are indicated. A TDM curve was calculated using the Kaplan-Meier method.

Multiple logistic regression models were established without preselection of the variables. A p value of <0.05 was considered statistically significant. Calculations were performed using SPSS version 23.0.

3. Results

3.1. Patient characteristics

In this surgically treated cohort of patients, 69% underwent RN and 31% PN. In both groups, approximately the same

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