



## Weekday of gastrectomy for cancer in relation to mortality and oncological outcomes – A Dutch population-based cohort study

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### Abstract

**Background:** Some studies demonstrate that high-complex surgeries performed later in the week are associated with higher postoperative mortality and worse long-term survival. The aim of this cohort study was to determine whether weekday influences outcomes in patients undergoing gastrectomy for cancer.

**Methods:** All patients who underwent a curative gastrectomy for cancer (2006–2014) were selected from the nationwide population-based Netherlands Cancer Registry. Weekday was analyzed as categorized (Monday–Tuesday versus Wednesday–Friday) and discrete variable (Monday–Friday). The influence of weekday on postoperative 30- and 90-day mortality, and oncological outcomes (lymph node yield, radicality rate and overall survival) was assessed with multivariable logistic and Cox regression analyses.

**Results:** A total of 3.776 patients were included with a median overall survival of 26.7 months [range 0–120]. The 30- and 90-day mortality were 5% and 8% respectively, median lymph node yield was 13 [range 0–87], and radicality rate was 87%. In multivariable analysis, no influence of weekday was found on postoperative mortality ( $p > 0.05$ ), on R0 resection rates ( $p > 0.05$ ), nor on overall survival (Monday–Friday, HR 1.03, 95%CI 1.01–1.04,  $p = 0.111$ ; Wednesday–Friday vs. Monday–Tuesday, HR 1.05, 95%CI 0.96–1.14,  $p = 0.307$ ). The lymph node yield was significantly lower later in the week compared to earlier (Monday–Friday, OR 0.94, 95%CI 0.89–0.99,  $p = 0.013$ ; Wednesday–Friday vs. Monday–Tuesday OR 0.83, 95%CI 0.71–0.96,  $p = 0.010$ ), which was most apparent in recent years of surgery.

**Conclusion:** Gastric cancer surgery can be performed safely throughout the week regarding postoperative mortality, radicality and overall survival. A point of concern is a reduced lymph node yield later in the week.

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**Keywords:** Day of week; Gastric cancer; Hospital mortality; Timing of surgery; Prognosis; Survival

### Introduction

Gastric cancer is one of the leading causes of cancer death worldwide, accounting for more than 700.000 cancer-related deaths.<sup>1</sup> Incidence and prognosis differ between regions in the world.<sup>1,2</sup> In Europe, only a limited amount of patients are eligible for curative treatment,<sup>3</sup> which consists of gastrectomy with or without perioperative chemotherapy,<sup>4</sup> since most patients have incurable disease or are not fit for treatment. Unfortunately, the prognosis after treatment with curative intent remains poor with 5-year survival rates of 23–36%.<sup>4</sup> Therefore, it is important to

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identify factors to improve the outcomes of gastric cancer care.

Gastrectomy and the postoperative care are qualified as high-complex, and require a dedicated, experienced and multidisciplinary team. For gastric cancer an adequate oncologic resection is crucial for the prognosis,<sup>5</sup> and early recognition of complications reduces postoperative mortality.<sup>6</sup> Therefore, gastrectomies have been centralized in the Netherlands in recent years,<sup>7</sup> which has been demonstrated to improve the outcomes of surgery in countries such as England and Denmark.<sup>8,9</sup>

Some studies argue that high-complex surgical procedures should only be performed early in the week, as surgical teams might be more focused and it prevents early postoperative care to be performed during weekend hours with reduced staffing.<sup>10,11</sup> These studies demonstrated that major surgical procedures performed later in the week are associated with higher postoperative mortality and worse long-term survival. For gastrectomy however, this effect has not yet been investigated.

Since an effect of weekday potentially has great impact on clinical practice, the aim of this study was to determine whether weekday influences postoperative mortality, and oncological outcomes in patients undergoing gastrectomy for cancer.

## Methods

### *Study design*

The Netherlands Cancer Registry (NCR) was used to select patients' data for this nationwide population-based cohort study. The NCR is maintained by the Netherlands Comprehensive Cancer Organisation (IKNL) and records all cancer diagnoses in the Netherlands since 1989 with a completeness that exceeds 95% and high quality.<sup>12,13</sup> The main source of information is the national pathology archive (PALGA), which sends weekly notifications of all cancer cases. Once a year, the registry is linked with the national hospital discharge register. Hospital records are reviewed by specially trained data managers to collect the data. The privacy committee of the NCR approved this study.

### *Patient selection and patient-specific information*

All patients who underwent a curative gastrectomy (pT1–4aN0–3M0) for histologically proven adenocarcinoma of the stomach or esophagogastric junction between 2006 and 2014 were identified and included in this study. Exclusion criteria consisted of gastrectomy during the weekend.

On the basis of the data collection of the NCR, patient-specific information was retrieved and included age, gender, malignancy history, tumor differentiation, neoadjuvant therapy, surgical type, surgical approach, radicality, (y)

pTN-stage, adjuvant therapy, referral, year of surgery, and weekday of surgery.

Patients were treated according to Dutch national guidelines.<sup>14</sup> The use of perioperative chemotherapy consisted of a regimen similar or comparable to the MAGIC-trial.<sup>4</sup> The surgical type consisted of a partial gastrectomy if a resection margin of at least 6 cm could be achieved, otherwise a total gastrectomy was performed.<sup>14</sup> Both open and laparoscopic surgery approach was performed. The (y)pTN-stage was classified according to the TNM classification of the International Union Against Cancer (UICC) and translated to the 7th edition.<sup>15</sup> After diagnosis, patients had their surgery in the same hospital or were referred to an operating hospital.

### *Statistical analysis and outcome measures*

Normally distributed variables are presented as mean ( $\pm$  standard deviation (SD)) and variables with a skewed distribution as medians with ranges. Categorical data are presented as frequencies with percentages. Missing baseline data were considered at random, except tumor differentiation, and handled using multiple imputation with the iterative Markov chain Monte Carlo method (20 iterations).

The weekday of surgery variable was analyzed in 2 ways, based on previous studies.<sup>10,16</sup> First, surgery early in the week (Monday–Tuesday) was compared with surgery late in the week (Wednesday–Friday). Second, weekday of surgery was analyzed as discrete variable to evaluate the linear trend (Monday–Friday).

The effect of weekday on postoperative mortality (30-day and 90-day mortality) and on short-term oncologic outcomes ( $\geq 15$  lymph nodes and irradical resection (R1–2)) was evaluated using univariable and multivariable logistic regression, providing odds ratios (ORs) with 95% confidence intervals (CIs). The cutoff value of 15 lymph nodes was chosen according to previous studies,<sup>17</sup> and since it is regarded as a surgical quality indicator in the Netherlands and international guidelines.<sup>3,15</sup> Subsequently, the effect of weekday on overall survival was calculated using a multivariable Cox proportional hazards model, providing hazard ratios (HRs) along with 95% CIs. Overall survival was calculated in months from the day of surgery until death or end of follow-up at December 31st, 2015. Kaplan–Meier survival curves were constructed for gastrectomy early and late in the week and compared with the log-rank test.

Multivariable logistic regression and Cox proportional hazards model were adjusted for age, gender, malignancy history, tumor differentiation, neoadjuvant therapy, surgical type, surgical approach, radicality, (y)pTN-stage, referral, and year of surgery. In the multivariable Cox proportional hazards model adjuvant therapy was considered as a potential confounding variable as well. To evaluate the proportional hazard assumption, log minus log survival plots were constructed and the assumption was met. Kaplan–Meier survival curves were constructed for

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