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Variation in surgical resection for lung cancer in relation to survival: Population-based study in England 2004–2006

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ABSTRACT

Background: Compared with some European countries, England has low lung cancer survival and low use of surgical resection for lung cancer. The use of surgical resection varies within England. We assessed the relationship between surgical resection rate and the survival of lung cancer patients in England.

Methods: We extracted data on 77,349 non-small cell lung cancer (NSCLC) patients diagnosed between 2004 and 2006 from the English National Cancer Repository Dataset. We calculated the frequency of surgical resection by age, socio-economic deprivation and geographical area. We used Cox regression to compute mortality hazard ratios according to quintiles of frequency of surgical resection amongst all 77,349 lung cancer patients, and separately for the 6900 patients who underwent surgical resection.

Results: We found large geographical variation in the surgical resection rate for NSCLC in PCT areas (3–18%). A high frequency of resection was strongly inversely associated with overall mortality (HR 0.88, 95% CI 0.86–0.91 for the highest compared to the lowest resection quintile) and only moderately associated with mortality amongst the resected patients (HR 1.15, 95% CI 0.98–1.36). Compared to the highest resection quintile, 5420 deaths could be delayed in the overall NSCLC group, whereas about 146 more deaths could be expected amongst the resected patients.

Conclusion: The differences in the magnitudes of both the hazard ratios and the absolute excess deaths within resected patients and all NSCLC patients suggests that lung cancer survival in England could plausibly increase if a larger proportion of patients underwent surgical resection. Carefully designed research into the possible benefit of increasing resection rates is indicated.

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1. Introduction

Around 40,000 incident cases of lung cancer are diagnosed in the United Kingdom every year, and five-year relative survival

is less than 10%.¹ Lung cancer survival is known to be lower in England than in other countries with similar health care systems² and the mortality difference is largest early in the period of follow-up.³ Surgical resection for lung cancer can

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potentially lead to long-term survival and cure, and it is possible that the low survival in England can in part be ascribed to low resection rates.

Non-small cell lung cancer (NSCLC) comprises over 85% of all lung cancers. In patients with early stage NSCLC, pulmonary resection provides the best form of potentially curative treatment.⁴ The resection rate in England is reportedly around 10%,⁵ whereas elsewhere in Europe and the US resection rates of around 20% to 30% are reported.^{6–8} However, most internationally reported resection rates are quoted as a proportion of those patients with a confirmed tissue diagnosis of NSCLC whereas previous UK data has used the total lung cancer population (including those diagnosed on clinic-radiological grounds only) as the denominator. It has been shown that resection rates are variable by region.^{9,10} Recent data from the English National Lung Cancer Audit showed that 14% of patients with a confirmed NSCLC diagnosis underwent resection, with some hospital trusts having rates of well over 20%.¹¹ [<http://www.ic.nhs.uk/webfiles/Services/NCASP/>] A recent report from one UK hospital reported a resection rate of 25% for NSCLC.¹² The resection rate in NSCLC patients declines above the age of 70 years,¹³ although there is strong evidence that they respond equally as well as younger patients.¹⁴ Higher levels of socio-economic deprivation have been associated with the low use of radical resection for lung cancer.^{15,16}

The present study was designed to explore the association between lung cancer resection and survival in different parts and subgroups of the English population. The ultimate question is whether it is likely that increasing the use of surgical resection would lead to an increase in lung cancer survival. A priori, we hypothesised that resection and survival would be positively associated in the total lung cancer population (resected patients expectedly living longer than non-resected patients), and negatively associated in the resected patient population (higher surgery rates being associated with surgery being carried out on higher risk patients). The relative magnitudes of these opposing associations could help indicate whether an increase in resection would lead to an increase in the overall lung cancer survival.

2. Methods

2.1. Lung cancer patients

We extracted data on 92,952 persons diagnosed with lung cancer (ICD-10 C33-C34) between 2004 and 2006 from the National Cancer Repository Dataset, collated from the regional cancer registries in England and linked with the hospital episode statistics (HES) records.¹⁷ Follow-up for death was until 31st December 2006.

We excluded small cell lung cancer (SCLC) ($n = 11,428$) patients from the analysis of survival in relation to surgical resection because the primary treatment for SCLC is generally chemotherapy. All cancer registrations originating from a death certificate only (DCO) ($n = 4229$) were also excluded. These exclusions left 77,349 patients with NSCLC (47,705) or with unspecified types of lung cancer (29,644) for the analyses.

Patients who had undergone surgical resection were identified from the linked HES data. Radical resections for lung cancer included: lobectomy (66%), total pneumonectomy (13%), partial lobectomy (9%), excision of lung segment (7%), bilobectomy (4%) and seven other, less common procedures (1%).

2.2. Independent variables

We computed the proportion of lung cancer patients resident in each Primary Care Trust (PCT) who underwent surgical resection, and derived the quintiles from the resulting distribution. Each lung cancer patient was thereby assigned to a resection quintile, depending on their PCT of residence. There are currently 152 PCT organisations in England with an average population of 339,000 people (inter-quartile range: 214,000–408,000; full range: 91,000–1284,000).

Patients were assigned to a socio-economic deprivation quintile, based on their postcode of residence at the time of lung cancer diagnosis. Quintiles were based on the income domain of the Index of Multiple Deprivation 2004.¹⁸

Patients were also grouped according to their Government Office Region of residence (East Midlands, East of England, London, North East England, North West England, South East England, South West England, West Midlands and Yorkshire & the Humber).

2.3. Data analysis

The proportions of lung cancer patients who underwent surgical resection in the 152 PCT areas in England were displayed in a ranked bar chart, indicating the five quintiles of the distribution. We also mapped the PCTs with indication of the resection quintile of each area.

We used logistic regression models to assess the effects of age, sex, socio-economic deprivation and Government Office Region on the proportion of patients who underwent resection.

Cox proportional hazards regression was used to analyse the survival of lung cancer patients in relation to resection quintile and other covariates. These analyses were carried out amongst all 77,349 lung cancer patients, and separately for the 6900 resected patients. For quality assurance, we repeated the analyses with restriction to the 47,705 patients with a specified morphology diagnosis.

In separate analyses, we used the Government Office Region of residence as an alternative to the resection quintiles. We computed χ^2 values and p -values for trend by fitting a linear categorical variable.

Finally, we computed the excess deaths in each resection quintile amongst all lung cancer patients, and amongst those who had undergone surgical resection. We computed the expected deaths based on the baseline death rate in the reference quintile (lowest resection rate) and the accumulated person-years in the comparison quintiles. Excess deaths were then calculated by subtracting the observed number of deaths from the expected number. Negative values represent the number of deaths postponed.

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