Cancer Epidemiology 57 (2018) 13–23

Contents lists available at ScienceDirect

Cancer Epidemiology

journal homepage: www.elsevier.com/locate/canep

Variation in geographical treatment intensity affects survival of non-small cell lung cancer patients in England

Daniela Tataru[a,*,1], Katie Spencer[b,1], Andrew Bates[c], Andrzej Wieczorek[d], Ruth H. Jack[a], Michael D. Peake[a,e,f], Michael J. Lind[d,g], Margreet Lüchtenborg[a,h]

[a] National Cancer Registration and Analysis Service, Public Health England, Wellington House, London, UK
[b] Faculty of Medicine and Health, Leeds Institute of Cancer & Pathology, University of Leeds, UK
[c] University Hospital Southampton NHS Foundation Trust, Southampton, UK
[d] Hull and East Yorkshire NHS Trust, Hull, UK
[e] Institute for Lung Health, University of Leicester, Leicester, UK
[f] Centre for Cancer Outcomes, University College London Hospitals, London, UK
[g] Hull York Medical School, University of Hull, UK
[h] Department of Cancer Epidemiology, Population and Global Health, Division of Cancer Studies, Faculty of Life Sciences & Medicine, King's College London, London, UK

ARTICLE INFO

Keywords:
Non-small cell lung cancer
Curative treatment
Surgical resection
Radical radiotherapy
Geographical variation
England

ABSTRACT

Objectives: We aimed to determine the geographical variation in the proportion of non-small cell lung cancer (NSCLC) patients undergoing curative treatment and assess the relationship between treatment access rates and survival outcomes.
Methods: We extracted cancer registration data on 144,357 lung cancer (excluding small cell tumours) patients diagnosed between 2009 and 2013. Surgical and radiotherapy treatment intensity quintiles were based on patients' Clinical Commissioning Group (CCG) of residence. We used logistic regression to assess the effect of travel time and case-mix on treatment use and Cox regression to analyse survival in relation to treatment intensity.
Results: There was wide variation in the use of curative treatment across CCGs, with the proportion undergoing surgery ranging from 8.9% to 20.2%, and 0.4% to 16.4% for radical radiotherapy. The odds of undergoing surgery decreased with socioeconomic deprivation (OR 0.91, 95% CI 0.85-0.97), whereas the opposite was observed for radiotherapy (OR 1.16, 95% CI 1.08–1.25). There was an overall effect of travel time to thoracic surgery centre on the odds of undergoing surgery (OR 0.81, 95% CI 0.76-0.87 for travel time > 55 min vs ≤15 min) which was amplified by the effect of deprivation. No clear association was observed for radiotherapy. Higher mortality rates were observed for the lower resection and radiotherapy quintiles (HR 1.08, 95% CI 1.04–1.12 and HR 1.06, 95% CI 1.02–1.10 for lowest vs. highest resection and radiotherapy quintile).
Conclusion: There was wide geographical variation in the use of curative treatment and a higher frequency of treatment was associated with better survival.

1. Introduction

Lung cancer is one of the three most common cancers in England with 37,637 newly diagnosed cases in 2015. It is also the commonest cause of death from cancer with 28,586 deaths annually, representing 21% of all cancer deaths [1]. Although survival rates for lung cancer have been improving in England in recent years [2], they remain poor compared with many other cancers. In addition, survival rates in England are worse than those reported from a number of other countries with equivalent expenditure on healthcare [3,4].

Almost 90% of all lung cancers diagnosed in England have non-small cell histology or are diagnosed on clinical grounds without tissue confirmation [5]. Fit, early stage non-small cell lung cancer (NSCLC) patients can be offered potentially curative treatment, either with surgical resection or radiotherapy, often combined with adjuvant chemotherapy. Wide variation in usage of surgical resection for NSCLC patients across England and a clear association between resection rate and survival has previously been demonstrated [6]. Such variation has

* Corresponding author: National Cancer Registration and Analysis Service, Public Health England, Wellington House, 133-155 Waterloo Road, London, SE1 8UG, UK.

E-mail addresses: daniela.tataru@phe.gov.uk (D. Tataru), margreet.luchtenborg@phe.gov.uk (M. Lüchtenborg).

[1] These authors contributed equally to this work.

https://doi.org/10.1016/j.canep.2018.09.001
Received 22 March 2018; Received in revised form 5 September 2018; Accepted 8 September 2018

also been demonstrated in other European countries [7,8]. This may in part be attributable to patient and disease-related factors with performance status, comorbidity, age (with associated increasing frailty and patient choice) and disease stage all justifiably impacting upon the clinical decision-making process [9–11]. Differing interpretation of the clinical evidence supporting cancer treatment decisions may, however, result in varying practice [12] and previous small-scale studies have demonstrated wide variation in Multi-Disciplinary Team (MDT) recommendations for identical presentations [13]. As such, variation in quality and access to stage specific treatments may, in part, underpin the relatively poor outcomes seen for NSCLC in the UK [4]. Analyses which focus upon surgery alone will, however, have a limited scope in a population often unfit for such an approach. In this often co-morbid population of NSCLC patients, radical radiotherapy is frequently more appropriate. Moreover, where surgical resection is not possible, radical radiotherapy can offer potential cure. As such, in order to assess effectiveness of curative treatment for NSCLC at the population level both treatment modalities should be considered. A priori, one could hypothesize that CCGs with high surgical resection rates would have low radical radiotherapy rates and vice versa, due to case-mix factors or historical local treatment preferences favouring one treatment over the other. Alternatively, one could hypothesize that CCGs that had high surgical resection rates also had high radical radiotherapy rates owing to a general appetite for curative treatment.

This study aimed to determine the proportion of NSCLC patients in England undergoing potentially curative treatment and its geographical variation. We aimed to assess the impact of patient and tumour characteristics, and distance to nearest treatment centre on treatment rates and determine the relationship between rates of access to curative treatment and population level survival outcomes.

2. Methods

2.1. Study population

Data on 168,634 lung cancers (International Classification of Diseases [version 10] (ICD10) codes C33 to C34) diagnosed in England between 1 April 2009 and 31 December 2013 were extracted from the National Cancer Registration Dataset [AV2013], held by the National Cancer Registration and Analysis Service at Public Health England. We excluded 18,492 cancers with small cell histology (ICD-O-2 classification morphology codes 8041–8045), 3865 cancers identified from death certificates only (DCO), and 113 cases without a recorded National Health Service (NHS) number. Only the first lung cancer recorded for each patient was included, which affected 1,689 patients with multiple primary lung cancers. The analyses focussed on adult lung cancer patients only, and excluded 43 patients under the age of 15 and over 100. Finally, we excluded 75 patients with unknown vital status. The final data set thus included 144,357 adult NSCLC patients, of whom 68% had a histological and/or cytological confirmation.

2.2. Patient and tumour characteristics

Information on patient demographics and tumour characteristics (including stage, anatomical topography and morphology) were extracted from the core cancer registration data. Information on death was obtained from the Office for National Statistics (ONS).

Socioeconomic deprivation (SED) is based on the income domain of the Indices of Deprivation (version 2015) [14]. Lower Super Output Areas (LSOAs, geographic areas of a consistent size that cover a population of approximately 1500 persons) were grouped into five SED quintiles, each containing 20% of the population of England. The least deprived quintile was labelled 1 and the most deprived 5. Patients were assigned to a socioeconomic deprivation quintile based on their postcode of residence at the time of diagnosis.

Performance status at diagnosis was available through patient level linkage with the National Lung Cancer Audit data [15].

Comorbidity information was obtained from linked in-patient Hospital Episode Statistics (HES 2015) records [16]. Diagnoses (excluding cancer, for which information was retrieved from cancer registration records) from hospital admissions 27 months to 3 months prior to the lung cancer diagnosis were used to calculate the weighted Charlson comorbidity scores (CCS) [17]. The resulting scores were grouped into four categories of increasing severity (CCS 0, 1, 2, 3+). A small proportion of patients (0.9%) did not have a linked HES record and were assumed to have a CCS of 0.

2.3. Treatment

Information on surgical resection was retrieved from linked in-patient and day-case HES records. The cancer registration records were linked to HES records using a matching algorithm based on patient's NHS number, date of birth, sex and postcode at diagnosis. Surgical procedures recorded in the HES dataset are coded using the Office of Population, Censuses and Surveys Classification of Surgical Operations and Procedures (4th revision, OPCS-4) [18]. Types of surgical resections were included as previously defined [19]: lobectomy or bilobectomy (68%), partial lobectomy or wedge resection (16%), pneumonectomy (12%), sleeve resection (1%), and other less common procedures (other or unspecified excisions of (or lesions of) trachea, carina, lung, and chest wall, 4%). Surgical procedures from one month before to six months after the date of diagnosis were included. If patients had more than one recorded surgical procedure, the most extensive procedure was used in the analysis.

Information on radiotherapy treatments was retrieved from the linked summary records in the national Radiotherapy Dataset (RTDS). The RTDS contains information on all episodes of radiotherapy delivered, but does not consistently capture the treatment intent, whether it be radical, adjuvant or palliative. In addition, disease coding varies between centres, for example, total attendances are captured in some centres rather than intended fractionation patterns, and radiation dose is not always recorded. We considered all episodes starting within six months from date of diagnosis for which a treatment site code for lung cancer (ICD 10 C33-C34) or unspecified respiratory tract cancer (C78, C80, D38, D02) was recorded in the RTDS. When information on the total radiation dose used was missing, the radiotherapy treatment intent was derived using criteria based on clinical guidelines. Thus, radical treatment was defined as: patients with at least one radiotherapy treatment summary record with either 15 or more attendances (with or without recorded dose); 3, 5 or 8 attendances with a dose higher than 50 Gy (stereotactic ablative radiotherapy, SABR); or 3, 5 or 8 attendances without a dose but with stage I or II (reflecting TNM stage I through IIA (N0)) treated at a radiotherapy centre known to have performed SABR during the study period. The identification of SABR treatment was validated within two treating centres. In addition, patients with two radiotherapy episodes delivered to the chest within 2 weeks of each other and which together summed up to more than 15 attendances were classified as having had radical radiotherapy treatment. Lung cancer patients without a linked RTDS record were deemed to have received no radiotherapy treatment. If a patient underwent surgical resection and adjuvant radiotherapy, this was considered as primary surgical treatment in the analyses.

To study geographical variation in treatment activity, we calculated the proportion of patients undergoing potentially curative treatment (surgical resection or radical radiotherapy) in each of the 211 CCGs. Because the two treatment modalities pertain to distinct groups of lung cancer patients, separate treatment intensity quintiles were created for surgical resection and radical radiotherapy, where Q1 is the quintile with the lowest and Q5 is the quintile with the highest treatment intensity. Patients were allocated to one of these quintiles based on their residential postcode at diagnosis linked to a CCG.

Travel time was calculated for all patients from their residential