Lung Cancer 90 (2015) 15–21

Contents lists available at ScienceDirect

Lung Cancer

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

Distance from accessible specialist care and other determinants of advanced or unknown stage at diagnosis of people with non-small cell lung cancer: A data linkage study

Elizabeth Tracey[a,*], Brian McCaughan[b], Tim Badgery-Parker[a], Jane Young[a], Bruce Armstrong[a]

[a] University of Sydney, Sydney, NSW, Australia
[b] Royal Prince Alfred Hospital, Sydney, NSW, Australia

ARTICLE INFO

Article history:
Received 19 March 2015
Received in revised form 28 July 2015
Accepted 29 July 2015

Keywords:
Lung neoplasms
Cancer registry
Advanced stage
Unknown stage
Access to treatment
Distance to treatment facility
Multinomial logistic regression

ABSTRACT

Background: Access to specialist services may influence stage at cancer diagnosis and whether cancer is ever adequately staged. We investigated associations of distance to the nearest accessible specialist hospital (NASH) with likelihood of advanced or unknown stage cancer at diagnosis in Australian non-small cell lung cancer (NSCLC) patients.
Methods: Cancer registry records for 22,260 consecutively diagnosed NSCLC patients, 11,147 with linked records of hospital admissions, were analysed. Distances from patients' homes to the NASH were measured using geographical coordinates. Multinomial logistic regression analysis examined associations of distance from the NASH, type of hospital of treatment and other characteristics of NSCLC patients with advanced and unknown cancer stage.
Results: Odds of advanced stage and unknown stage NSCLC were higher in people who lived 40–99 km, OR 1.18 (95%CI 1.07–1.31) advanced stage and 1.18 (1.04–1.33) unknown stage, and 100 km+ from the NASH, OR 1.17 (1.08–1.27) advanced stage and OR 1.38 (1.25–1.52) unknown stage (reference group patients living 0–39 km from the NASH). For hospitalised patients likelihoods of advanced stage and unknown stage NSCLC were also significantly higher in patients treated in general hospitals than in those treated in specialist hospitals. When both distance and hospital type were considered, patients who lived 100 km+ from the NASH had low odds of unknown stage cancer if admitted to a specialist hospital, OR 0.63 (95%CI 0.47–0.85), but a high odds of unknown stage if admitted to a general hospital, OR 2.13 (1.78–2.54). These associations were independent of age, sex, socioeconomic status, comorbidity, period and method of diagnosis, and histopathological subtype.
Conclusions: People living remotely from accessible specialist services are at greatest risk of advanced stage or unknown stage disease if diagnosed with NSCLC. This risk is greater again if the patient is treated in a general hospital. Barriers to referral for specialist care require investigation.

1. Introduction

Determining cancer stage at diagnosis is important in ensuring that patients are given stage appropriate care [1]. Most lung cancer patients present with late stage disease; [2] and the proportion of patients for whom stage is unknown, at least to cancer registries, tends to be higher for lung cancer than for many other common cancers [3,4].

UK studies have shown that the greater the distance non-small-cell lung cancer (NCSLC) patients lived from a cancer centre the more likely they were to have disseminated disease at diagnosis [5–7] However, not all relevant studies show a relationship between advanced lung cancer and distance to treatment. A number of United States registry based studies found that the odds of presenting with advanced stage lung cancer were higher in urban areas and very remote areas, but lower in suburbs and outer

* Corresponding author at: The University of Sydney, Level 6 Chris O'Brien Lifehouse (C39Z), 119-143 Missenden Road, Camperdown, NSW 2050 M 0400 324 990, Australia.
E-mail addresses: elizabeth.tracey@sydney.edu.au (E. Tracey), brianmccaughan@gmail.com (B. McCaughan), tim.badgeryparker@sydney.edu.au (T. Badgery-Parker), jane.young@sydney.edu.au (J. Young), bruce.armstrong@sydney.edu.au (B. Armstrong).

http://dx.doi.org/10.1016/j.lungcan.2015.07.018
0169-5002/

Table 1
Personal, cancer and treatment characteristics of NSW non-small cell lung cancer patients diagnosed between 2000 and 2008 (n = 22,260).

Characteristics	Total	Localised		Advanced		Unknown		
	22,250	5345		11,740		5175		
Distance from the NASH		*n*	%	*n*	%	*n*	%	
0–39.00 km	12807	3201	59.9	6863	58.5	2743	53	
40.00–99.00 km	3034	677	12.7	1639	14	718	13.9	
100 plus km	6419	1467	27.4	3238	27.6	1714	33.1	$p < 0.0001$
Sex								
Males	14,064	3369	63	7402	63	3293	63.6	
Females	8196	1976	37	4338	37	1882	36.4	$p < 0.0001$
Age at diagnosis								
0–59	4044	870	16.3	2566	21.9	608	11.7	
60–69	5834	1401	26.2	3343	28.5	1090	21.1	
70–79	7889	2009	37.6	3901	33.2	1979	38.2	
80+	4493	1065	19.9	1930	16.4	1498	28.9	$p < 0.0001$
Socioeconomic status								
Lowest SES'	4523	1101	20.6	2332	19.9	1090	21.1	
Second lowest SES'	4103	1016	19	2048	17.4	1039	20.1	
Middle SES'	5042	1230	23	2558	21.8	1254	24.2	
Second highest SES'	4603	1044	19.5	2548	21.7	1011	19.5	
Highest SES'	3989	954	17.8	2254	19.2	781	15.1	$p < 0.0001$
Period of diagnosis								
2000–2004	8942	2269	42.5	4510	38.4	2163	41.8	
2005–2008	13,318	3076	57.5	7230	61.6	3012	58.2	$p < 0.0001$
Histology								
Squamous	4623	1573	29.4	1982	16.9	1068	20.6	
Adenocarcinoma	7301	1694	31.7	4473	38.1	1134	21.9	
Large cell carcinoma	7051	1380	25.8	3808	32.4	1863	36	
Other	3285	698	13.1	1477	12.6	1110	21.4	$p < 0.0001$
Method of diagnosis								
Cytology	3144	422	7.9	1560	13.3	1162	22.5	
Clinical	3383	496	9.3	1433	12.2	1454	28.1	
Histologically verified	15,733	4427	82.8	8747	74.5	2559	49.4	$p < 0.0001$

Cancer codes: ICD0-3 morphology codes: Squamous 80503-80783, Large cell 80353, 83103, 80103-80123,80143-80313, Adenocarcinoma 82303-82313, 82503-82603, 81403, 82113, 83233, 85763, 82463 Other 80003-80053, 88003, 88013, 88023, 88053, 88103, 88113, 88303, 88903, 89203, 90403, 90413, 91203, 91333, 91503, 95403, 88403-89213, 89903-89913, 91203-91333, 95403-95813, 88303, 91503.

metropolitan areas [8,9]. These differences in stage at diagnosis appeared to be due to higher proportions of young patients and black patients in urban locations. However, a limitation of these studies is that they did not differentiate lung cancer by histological subtype.

There are a number of other factors associated with advanced stage. With increasing age a higher proportion of lung cancer is initially seen at local stage [10,11] Advanced stage patients are also more likely not to be histological verified or be first diagnosed at death or autopsy [12]. Furthermore the likelihood of histological verification was found to diminish with increasing deprivation [13,14]. A similar proportion of men and women present with advanced stage at diagnosis [15].

We know of only one study that has examined differences in staged and unstaged lung cancer patients and access to care. Unstaged lung cancer patients relative to staged ones were more likely to be male [4], older [12], poorer, black significantly less likely to have a specific histological types of cancer (squamous, adenocarcinoma and small cell) and to have resided in rural areas with fewer physicians [16].

We investigated whether increasing distance to a specialist centre was associated with advanced or unknown NSCLC stage at diagnosis. In addition to distance, our analysis consider other factors antecedent to and plausibly associated with actual stage at diagnosis and factors subsequent to diagnosis plausibly associated with accuracy and completeness of stage determination and its reporting to the New South Wales (NSW) Central Cancer Registry (CCR).

2. Methods

All patients the NSW CCR registered as diagnosed with NSCLC (ICD-O topography codes C33-C34 excluding morphology codes for small cell cancer, M80413-M80453, M82463) between 2000 and 2008 were potentially eligible for the analysis. CCR records for these patients were linked to matching records in the NSW Admitted Patient Data Collection. This collection records diagnosis and surgical treatment for all separations from NSW public and private hospitals. The combined automated and manual record linkage process had an estimated false positive rate of 0.4 per cent [17].

2.1. Stage

CCR coders record stage at diagnosis from hospital notifications (which report degree of spread at diagnosis coded as 1, localised to tissue of origin, 2, regional spread to adjacent organs and/or regional lymph nodes, 3, distant metastases or 4, unknown). Hospital notifications are supplemented by pathology reports (which are obligatorily provided), outpatient cancer centres' notifications of patients treated with chemotherapy or radiotherapy and doctors' responses to CCR queries. Studies have shown that the "degree of spread" categories used provide broadly similar information to other methods of staging [4,18,19].

2.2. Distance

Distance to the NASH (nearest accessible specialist hospital), a public hospital with a thoracic surgical service, was obtained for