Trends in the Pattern of Care for Lung Cancer and Their Correlation With New Clinical Evidence: Experiences in a University-Affiliated Medical Center

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Trends in the Pattern of Care for Lung Cancer and Their Correlation With New Clinical Evidence: Experiences in a University-Affiliated Medical Center

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The authors surveyed the pattern of care (POC) of lung cancer (LC) using data on 4565 patients from the cancer registry of their university-affiliated hospital institution for the period of 1991 to 2002. New clinical evidence was retrieved from the citations used in the level 1 recommendations in guidelines and textbooks. Using this evidence, indexes (1-6) were chosen, including stage I to II non–small-cell LC (NSCLC): no adjuvant radiotherapy (ART; I); stage III NSCLC: equivocal ART (II), neoadjuvant chemotherapy (C/T; III), and chemoradiotherapy (CRT; IV); stage 4 NSCLC: C/T (V) and limited-stage small-cell LC: CRT (VI). Odds ratios of these index events in the postevidence period versus preevidence period were calculated to show trends in the POC. Trends in the POC were consistent with new clinical evidence with statistical significance. The age and gender adjustment odds ratio was 2.22 to 7.06 for beneficial indexes (3-6) and 0.12 to 0.4 for detrimental indexes (1-2). (Am J Med Qual 2006;21:408-414)

Keywords: clinical practice patterns; evidence-based medicine; information dissemination; lung cancer

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Lung cancer is the leading cause of global cancer-related death.[1] Treatment of lung cancer has been evolving, and there is wide variation in treatment regionally; this variation may influence treatment outcomes.[2,3] One reason for the differences in the pattern of care may be the dissemination of recommendations or new evidence-based treatments, but there is little relevant literature regarding this.[4] In this article, we report on our institution's experience with the pattern of care for lung cancer patients for the period from 1991 to 2002 and focus on its temporal relationship with new treatment guidelines.

MATERIAL AND METHODS

Pattern of Care

Our university-affiliated hospital is a 1500-bed tertiary medical center. Its cancer registry was established in 1966. According to this registry, 5315 patients were coded as lung cancer patients who visited and received their primary treatment in our hospital from 1991 to 2002. The disease extent was unknown for 146 of these patients, and another 604 patients had a histological diagnosis irrelevant to non–small-cell lung cancer (NSCLC)[5] or small-cell lung cancer (SCLC) or were diagnosed clinically without cytological or histological diagnosis. The remaining 4565 patients constituted our study group. The median age was 65 years (range, 15-95), and 65% (n = 2593) were male. Data regarding clinical stage and treatment pattern was taken from our cancer registry. The Surveillance Epidemiology and End Results (SEER) staging system was used in our cancer registry.[6] Its correlation with the American Joint Committee on Cancer staging[7] is shown in Table 1. The SEER staging distributions

Table 1

Correlations Between SEER and AJCC Staging

SEER Staging	AJCC Staging (TNM)	AJCC Overall Staging, NSCLC	Overall Staging, SCLC
2	T1N0M0	I	LS
3	T2N0M0	I	LS
	T3N0M0	II	LS
	T4N0M0	IIIb	LS
4	T1N1M0	II	LS
	T1N2M0	IIIa	LS
5	T2N1M0	II	LS
	T2N2M0, T3N1-2M0	IIIa	LS
	T4N1-2M0	IIIb	LS
7	T1-4N3N0	IIIb	LS
	T1-4N0-3M1	IV	ES

SEER = Surveillance Epidemiology and End Results; AJCC = American Joint Committee on Cancer; TNM = tumor, node, metastases; NSCLC = non–small-cell lung cancer; SCLC: small-cell lung cancer; LS: late stage; ES: end stage.

were 28% (n = 1262) stage II to III patients, 15% (n = 684) stage IV to V patients, and 57% stage VII patients. Date of initial therapy, types of therapy (ie, operation, radiotherapy [RT], chemotherapy [C/T]), and intent of therapy (ie, curative, palliative, no therapy) were coded.

Evidence

To evaluate the dissemination of evidence-based treatment to clinical practice, important guidelines and textbooks were reviewed.[5, 8-11] The references that were cited for category 1/level 1 evidence in these guidelines were reviewed and retrieved (Table 2).[12-30]

Index Events

As shown in Table 2, 6 indexes were finally chosen for the present study. Adjuvant C/T for NSCLC was not chosen because there was new evidence and recommendations,[31] and it was seldom used in our institution in the past. Concurrent chemoradiotherapy for NSCLC was not chosen because one of its references used an unusual RT protocol (ie, 56Gy/28 fraction with split course),[17] and the other reference was an abstract only.[18] Hyperfractionation RT for both SCLC and NSCLC was not chosen because it was not widely used clinically. The C/T regimen for both SCLC and NSCLC was not chosen because the outcome was possibly similar. Prophylactic cranial irradiation was not chosen because it was not easy to define its denominators (ie, those patients with clinical complete remission) retrospectively. With regard to the potential bias in retrospective staging, SEER staging and surrogate indexes were used. The 6 final potential surrogate indexes are shown in Table 3. The cutoff point for the preevidence versus postevidence period was 2 years after the latest cited references (reference 13 was not used because it was from 2002).

Statistical Analysis

A χ^2 test was used to test for trends in gender, age, stage, and treatment distribution. Logistic regression (and Fisher exact test for those with few events) was used to estimate the odds ratio (OR) and statistical significance of surrogate events among patients in the preevidence period versus the postevidence period for each index.

RESULTS

Trends in Patient Characteristics

For NSCLC, the percentage of aged (≥65 years old at diagnosis) and female patients increased during the study period (test for trend: $P \leq .001$ for both). For SCLC, the pattern was similar ($P = .006$ and .008, respectively).

Trends in Staging and Therapy

For NSCLC, the proportion of SEER stage 7 seemed to increase gradually (test for trend: $P = .007$), and the treatment strategy was more aggressive in recent years. The proportion of patients receiving radical treatment (ie, radical operation or radiotherapy) increased in this period (test for trend: $P = .001$), and the proportion of patients receiving treatment (ie, any kind of surgery, RT, C/T) also increased in this period (test for trend: $P \leq .001$). Similar trends were noted for SCLC with less obvious statistical significance ($P = .37$, .001, and .17, respectively). The overall treatment pattern by year is shown in Figure 1.

Index 1

Adjuvant RT for operated early-stage NSCLC patients was seen less frequently in the postevidence period (0.5%) as compared to the preevidence period (4%). The OR (95% confidence interval [CI] and P value) of an index 1 event was

Table 2

Literature That Formed the Basis of Important Guidelines and Index Used in the Present Study

Disease/Stage	Treatment and Its Role	Sources	References Used (Year of Publication)	Index
NSCLC (I/II)	Adjuvant RT: no	NCI, EBO	12 (1998)	1
NSCLC (I/II/III)	Adjuvant C/T: no	EBO	13 (2002)	x
NSCLC (III)	Adjuvant RT: equivocal	NCI, EBO	12 (1998)	2
NSCLC (III)	Neoadjuvant C/T: yes	EBO	14 (1998)	3
NSCLC (III)	CRT: yes	NCCN, EBO	15 (1990), 16 (1991), 13 (2002)	4
NSCLC (III)	Concurrent CRT: yes	NCCN	17 (1999), 18 (2003)	x
NSCLC (III)	Hyperfractioned RT: yes	NCI: level 1 EBO: insufficient evidence	19 (1997)	x
NSCLC (IV)	C/T: yes	NCCN, EBO	20 (1993), 21 (1994), 13 (2002)	5
NSCLC (IV)	C/T regimen	NCI	22 (1991), 23 (2002)	x
SCLC (LS)	CRT: yes	NCCN	24 (1992), 25 (1992)	6
SCLC (LS)	Hyperfractionated RT: yes	NCI	26 (1999)	x
SCLC (ES)	C/T regimen: unclear	NCI	27 (1991), 28 (1999), 29 (2002)	x
SCLC	PCI	NCCN, NCI	30 (1999)	x

NSCLC = non–small-cell lung cancer; RT = radiotherapy; NCI = National Cancer Institute[9,10]; EBO = evidence-based oncology[11]; C/T = chemotherapy; NCCN = National Comprehensive Cancer Network[5,8]; CRT = chemoradiotherapy; LS = late stage; SCLC = small-cell lung cancer; ES = end stage; PCI = prophylactic cranial irradiation.

Table 3

Surrogate Indexes

Index	Original	Surrogate Nominator	Surrogate Denominator
1	Adjuvant RT for early (AJCC stage I-II) NSCLC	SEER stage 2-3 NSCLC receiving curative operation and curative RT	SEER stage 2-3 NSCLC receiving curative operation
2	Adjuvant RT for locally advanced (AJCC stage III) NSCLC	SEER stage 4-5 NSCLC receiving curative operation and curative RT	SEER stage 4-5 NSCLC receiving curative operation
3	Neoadjuvant C/T for locally advanced (AJCC stage III) NSCLC	SEER stage 4-5 NSCLC receiving C/T and curative operation	SEER stage 4-5 NSCLC receiving curative operation
4	Definitive CRT for locally advanced (AJCC stage III) NSCLC	SEER stage 4-5 NSCLC without curative operation but received curative RT and C/T	SEER stage 4-5 NSCLC without curative operation but received curative RT
5	C/T for advanced (AJCC stage IV) NSCLC	SEER stage 7 NSCLC receiving C/T	SEER stage 7 NSCLC
6	CRT for LS-SCLC	SEER stage 2-5 SCLC receiving curative RT and C/T	SEER stage 2-5 SCLC receiving C/T

RT = radiotherapy; AJCC = American Joint Committee on Cancer; NSCLC = non–small-cell lung cancer; SEER: Surveillance Epidemiology and End Results; C/T = chemotherapy; CRT = chemoradiotherapy; LS-SCLC = limited-stage small-cell lung cancer.

0.12 (CI, 0.016-0.93; P = .04). After adjusting for age and gender, the OR was 0.12 (CI, 0.016-0.95; P = .04).

Index 2

Adjuvant RT for operated locally advanced NSCLC patients was seen less frequently in the postevidence period (16%) as compared to the preevidence period (33%). The OR of an index 2 event was 0.4 (CI, 0.12-0.72; P = .003). After adjusting for age and gender, the OR was 0.4 (0.12-0.72; P = .0025).

Index 3

Neoadjuvant C/T for operated locally advanced NSCLC patients was seen more frequently in the postevidence period (26%) as compared to the preevidence period (13%). The OR of an index 3

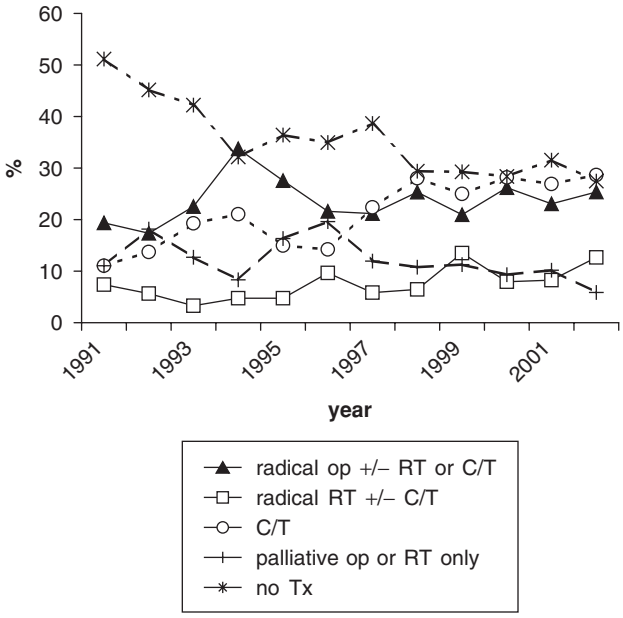

Figure 1. Treatment pattern by year. RT = radiotherapy; C/T = chemotherapy; palliation: palliative radiotherapy or operation only.

event was 2.6 (CI, 1.47-4.63; P = .0011). After adjusting for age and gender, the OR was 2.67 (CI, 1.49-4.79; P = .0009).

Index 4

Definitive chemoradiotherapy for nonoperated locally advanced NSCLC patients was seen more frequently in the postevidence period (70%) as compared to the preevidence period (11%). The OR of an index 4 event was 5.83 (CI, 1.36-24.94; P = .017). After adjusting for age and gender, the OR was 7.06 (CI, 1.5-33.23; P = .013).

Index 5

C/T for advanced-stage NSCLC patients was seen more frequently in the postevidence period (40%) as compared to the preevidence period (24%). The OR of an index 5 event was 2.01 (CI, 1.68-2.51; P < .0001). After adjusting for age and gender, the OR was 2.22 (CI, 1.8-2.73; P < .0001).

Index 6

Radical RT for localized SCLC patients receiving C/T was seen more frequently in the postevidence period as compared to the preevidence period. This proportion was 28% (26/93) in the postevidence period as compared to 0% (0/11) in the preevidence period (Fisher exact test, 1 side P = .035).

The overall temporal trends in the pattern of care are summarized in Table 4.

DISCUSSION

There was wide variation in the pattern of care for lung cancer.[3,32] This may have been due to many factors, such as regional, demographic (ie, age, race, martial status, education, socioeconomic status), patient (ie, performance, comorbidity), disease (ie, stage, pathology), treatment provider (ie, hospital, physician), and cost.[2,3,32-38] However, it seemed that there was scant literature focused on the temporal trends and the impact of new clinical evidence, which we tried to elucidate in the present study.

The present study focused on our institution's pattern of care. Although there were some demographic changes (ie, more aging and female patients in recent years) during the study period, the trends had the same statistical significance after taking these factors into account.

There also were changes in disease factors (ie, more advanced-stage diseases in recent years) and treatment factors (ie, treatment strategy was more aggressive in recent years) during the study period. However, since our indexes were stage and treatment specific, these changes likely had little impact on our results.

New practice guidelines do not always lead to changes in the pattern of care immediately, as reported by Ford et al.[4] However, that survey was conducted in 1987. After extensive search in PubMed using the keywords *clinical practice patterns*, *compliance*, *evidence-based medicine*, *information dissemination*, *quality*, *quality of care*, *guideline*, *pattern of care*, *implementation*, and *performance*, few relevant recent reports were found.[39] Kedikoglou et al reported that all indicators improved substantially in the second part of their prospective study,[40] but this study focused on diagnostic procedure rather than treatment. Most of the relevant studies were cross-sectional. For example, Langer et al reported that current practice in the United States generally matches evidence-based literature, but this study was based on sampling data from patients with good performance status receiving RT in 1998 and 1999.[41] Lee et al reported there were cumulative delays in the overall investigation and management of lung cancer patients, which

Table 4

Temporal Trends in the Pattern of Care

Index	Content	Intervention Effect	Preevidence Period (%)	Postevidence Period, %	OR (95% CI)	*P* Value
1	Adjuvant RT for early NSCLC	Harmful	1991-1999 (4)	2000-2002 (0.5)	0.12 (0.016-0.95)	.04
2	Adjuvant RT for locally advanced NSCLC	Equivocal	1991-1999 (33)	2000-2002 (16)	0.4 (0.12-0.72)	.0025
3	Neoadjuvant C/T for locally advanced NSCLC	Beneficial	1991-1999 (13)	2000-2002 (26)	2.67 (1.49-4.79)	.0009
4	Definitive CRT for locally advanced NSCLC	Beneficial	1991-1992 (11)	1993-2002 (70)	7.06 (1.5-33.2)	.013
5	C/T for advanced NSCLC	Beneficial	1991-1995 (24)	1996-2002 (40)	2.22 (1.8-2.73)	<.0001
6	CRT for LS-SCLC	Beneficial	1991-1993 (0)	1994-2002 (28)	—	.035

OR = age- and gender-adjusted odds ratio; CI = confidence interval; RT = radiotherapy; NSCLC = non–small-cell lung cancer; C/T = chemotherapy; CRT = chemoradiotherapy; LS-SCLC = limited-stage small-cell lung cancer.

were not covered by the British Thoracic Society guidelines, but this study focused on timeliness rather than adoption of recommended therapy.[42] There also are ongoing implementation programs, but the results of clinical impact have not been reported as yet.[43] In the present study, the longitudinal trends in the pattern of care were consistent with new clinical evidence for all 6 treatment-related indexes chosen.

Although these trends were consistent, the absolute percentage of patients who received recommended therapy still was not very high for those beneficial indexes (3-6). Similar findings were presented in recent reports. For example, in 2004, Potosky et al reported that only 52% of NSCLC patients received recommended therapy and only 41% of stage IV NSCLC patients received C/T, which was comparable to our present study (40%).[36] In 2005, Teshima reported that only 56% of nonsurgery group NSCLC patients received C/T in addition to RT, even in academic institutions, which also was comparable to our present study (70%).[44]

These regional, demographic, patient-related, disease-related, treatment provider, and cost factors discussed above may influence the low proportion of patients receiving recommended therapy as presented in recent reports.[37,45] Among these, the age effect was one of the most frequently reported factors. As discussed in the above-mentioned studies,[36,44,45] there was a consistent decline in the use of recommended therapy with increasing age at diagnosis, which was also found in our study. For beneficial indexes (3-5), the adjusted ORs (*P* value) were 0.46 (.012), 0.62 (.42), and 0.37 (<.001), respectively.

Performance status (PS) was another possible explanation. Decreased PS was associated with decreased use of chemotherapy.[34] It also was correlated with the definition of recommended therapy. For indexes 4 to 6, these optimal therapies were recommended only for patients with good PS, which, with this disease, is a minority of patients.[9,10,46] Because PS was not coded in our cancer registry in the past, this would result in our estimation's being lower than it actually was. The low percentage of index 3 may also be due partly to its still being somewhat controversial.[47] Finally, this quality problem may not be unique and may be commonly seen in other acute and chronic conditions, as recently discussed by Mainz and Bartels.[48]

Since the approval of the Law of Cancer Prevention and Management in Taiwan in 2003, a national unit (ie, Taiwan Cancer DataBase) was set up and is responsible for the maintenance of a new comprehensive cancer registry (including pretreatment PS). Clinical indicators were gradually developed to centrally audit institutional performance and quality improvement.[49] In response to this national requirement, more comprehensive combined conference and cancer registry data acquisition were adopted in our institution since 2005. Although the final impact on clinical outcome is pending, we feel that the process of patient management was somehow changed, and we believe that all these strategies will further improve the quality of care for our lung cancer patients.

CONCLUSION

From 1991 to 2002, trends in the pattern of care for lung cancer patients in this university-affiliated hospital were consistent with new clinical evidence, but the absolute usage of new clinical evidence was

still low. Old age at diagnosis may partly explain this result. Cooperation with the ongoing national project (ie, Taiwan Cancer DataBase) may further improve the use of new clinical evidence.

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