Gefitinib as First-line Therapy for Advanced or Metastatic Non-small Cell Lung Cancer Patients in Southern Taiwan

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Gefitinib, a selective epidermal growth factor receptor tyrosine kinase inhibitor, is effective in treating patients with non-small cell lung cancer (NSCLC) after unsuccessful chemotherapy. However, survival outcomes and predictors for its effectiveness in chemotherapy-naive NSCLC patients are still not clear. The goal of this study was to investigate the response and survival rates and identify the predictive factors for patients with advanced or metastatic disease receiving gefitinib as first-line therapy. We retrospectively analyzed the response and survival rates of patients with advanced or metastatic NSCLC who had received gefitinib as first-line therapy across six medical institutes in Southern Taiwan between May 2004 and April 2006. The relationship between the response and survival rates to the known predictive factors for gefitinib response and survival was also investigated. A total of 97 patients (65 females and 32 males) were enrolled in this study. Seventy-four patients (76%) had never smoked. Eighty-eight patients (91%) had adenocarcinoma or bronchioloalveolar cell carcinoma. The objective response rate was 56% and the disease control rate (partial response plus stable disease) was 76%. Only poor performance status (Eastern Cooperative Oncology Group score, 3–4) was statistically significantly associated with overall response in this study. The 1-year survival rate was 77%. We suggest that first-line gefitinib monotherapy is promising in some subgroups of Asian patients with NSCLC. Further randomized controlled studies are needed to validate the effectiveness of first-line gefitinib therapy.

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ELSEVIER

Lung cancer is one of the most common malignancies in many countries, including Taiwan. It remains the leading cause of cancer-related deaths in these countries [1,2]. The incidence of lung cancer is increasing annually, particularly among women [3]. Lung cancer is classified according to histological type as either small cell carcinoma or non-small cell lung cancer (NSCLC), the latter accounting for about 85% of all lung cancer cases [4,5], and consists of large cell carcinoma, adenocarcinoma, and squamous cell carcinoma.

Surgery, chemotherapy and radiotherapy are the primary treatment options for patients with NSCLC. Unfortunately, less than 20% of patients are suitable for potentially curative resection at presentation [6,7]. Around 70% of patients have locally advanced or disseminated disease at presentation, are not candidates for surgery [8] and are generally treated with palliative chemotherapy. The prognosis for patients not suitable for surgery remains unsatisfactory. Thus it is necessary to explore new therapeutic modalities to treat this devastating disease.

Gefitinib [Iressa (ZD1839); AstraZeneca Pharmaceuticals, Wilmington, DE, USA] is a selective epidermal growth factor receptor (EGFR) tyrosine kinase inhibitor. After two large-scale phase II studies showing that gefitinib was beneficial in terms of response for patients with locally advanced or metastatic NSCLC who had previously received platinum-based chemotherapy [9,10], gefitinib was approved for the treatment of patients with previously treated advanced NSCLC in Japan, the United States of America and other countries [11]. Unfortunately, two multinational, randomized, double-blind, placebo-controlled phase III studies failed to demonstrate improved tumor response rate or survival rate for gefitinib in combination with standard platinum-based first-line chemotherapeutic regimens [12,13]. In addition, in a large randomized, placebo-controlled trial, gefitinib monotherapy failed to increase survival of chemotherapy-resistant patients [14]. However, in the same study, a statistically significant improvement in overall survival was noted in gefitinib-treated patients over placebo-treated patients with Asian ethnicity. These findings are consistent with the better response rate reported in Japanese patients in one of the phase II studies, the Iressa Dose Evaluation in Advanced Lung Cancer study [9]. In addition to the beneficial effects of gefitinib in chemotherapy-treated NSCLC patients, there have been several small, single-arm studies in Asia showing the effectiveness of gefitinib in chemotherapy-naive NSCLC patients [15–17].

Based on its effectiveness and good safety profile, an increasing number of patients with NSCLC in Taiwan have been using gefitinib as first-line therapy. In this study, we retrospectively analyzed the response and 1-year survival of patients with advanced or metastatic NSCLC who used gefitinib as first-line treatment across six medical institutes in Southern Taiwan. We examined the response and survival rates of these patients and the relationship between these rates and known predictive factors.

Methods

Patients

All stage IIIB or IV NSCLC patients who received gefitinib as their first-line therapy at one of the six institutes in Southern Taiwan between May 2004 and April 2006 were included in this study. Their medical charts, images and image reports were reviewed. Patients were required to meet the following inclusion citeria: cytological or histological diagnosis of NSCLC [stage IIIB (with pleural effusion) or IV disease] and an age >18 years. Patients must also have had measurable lesion(s). Patients who were administered gefitinib for less than 1 month and patients with symptomatic brain metastases were excluded from this study. Clinical data were collected from each institute's registry and included the patient's sex, age, Eastern Cooperative Oncology Group (ECOG) performance status, tumor histology, tumor stage, smoking status, dates of diagnosis, treatment, progression, death and follow-up.

Efficacy assessment

Objective tumor response was assessed by chest X-rays of these patients performed at least 4 weeks after treatment, using the Response Evaluation Criteria in Solid Tumors system [18], which defined responses as complete response, partial response (PR), stable disease (SD) or progressive disease (PD).

Statistical methods

A total of 97 patients met the criteria and were included in this study. Two definitions of response to gefitinib were used in this study: overall response and disease stabilization. The associations between these

and factors such as sex, smoking history, histology, disease stage and performance status were examined with χ^2 tests and odds ratios were calculated using logistic regression to evaluate associations with the response. Logistic regression models, including factors with p values <0.15, were developed to adjust for possible confounding effects and identify the major predictors for the response. For survival status, 1-year survival rates were computed and the Cox proportional-hazards model was used to determine the associations of these factors with mortality. Adjusted hazard ratios were calculated, and these included factors with p values <0.15.

Results

Of these 97 patients, no patient had a complete response. For 54 patients, the best response to gefitinib was PR, corresponding to an objective response rate of 56%. Another 19 patients had SD and the overall disease control rate (PR+SD) was 76%. The characteristics of these patients are summarized in Table 1. For overall response, sex, smoking history, stage and poor performance status seemed to be predictors. However, only poor performance status (ECOG score, 3–4) was statistically significantly associated with overall response [odds ratio: 0.26, 95% confidence interval (CI): 0.09–0.75, $p=0.009$]. For disease stabilization, sex, performance status, smoking history and stage seemed to be predictors, but sex was not statistically related to disease stabilization.

For survival status, the 1-year survival rates and hazard ratios are shown in Table 2. For all 97 patients, the mean follow-up time was 43.2 weeks and the mean 1-year survival rate was 77%. Predictors such as sex, ECOG performance status, smoking status and stage seemed to be associated with survival. The hazard ratio (95% CI) was 2.34 (0.90–6.07) for sex (male *vs*. female); 8.32 (3.10–22.36) for ECOG performance status (0–2 *vs*. 3–4); 3.02 (1.16–7.85) for smoking status (ever smoker *vs*. never smoker) and 7.36 (0.95–55.88) for stage (IIIB *vs*. IV). Patients who showed response or stabilization with gefitinib also had a higher 1-year survival rate compared with patients with PD (94% and 89.7% *vs*. 45.9%, respectively). The HR (95% CI) was 0.06 (0.01–0.26) for patients with PR versus patients with PD and 0.14 (0.05–0.38) for patients with SD versus patients with PD.

Table 1. Characteristics and gefitinib treatment response of the patients*

Characteristics	Patients	Overall response	OR (95% CI)	p	Disease stabilization	OR (95% CI)	p
Total	97 (100)	54 (56)					
Sex							
Female	65 (67)	40 (62)	1		52 (80)	1	
Male	32 (33)	14 (44)	0.49 (0.21–1.15)	0.10	21 (66)	0.48 (0.19–1.23)	0.12
Age (yr)							
<70	40 (41)	20 (50)	1		28 (70)	1	
≥70	57 (59)	34 (60)	1.48 (0.65–3.34)	0.35	45 (79)	1.61 (0.64–4.07)	0.32
ECOG PS							
0–2	77 (74)	48 (62)	1		64 (83)	1	
3–4	20 (26)	6 (30)	0.26 (0.90–0.75)	0.009	9 (45)	0.17 (0.006–0.48)	<0.001
Smoking status							
Never smoker	74 (76)	45 (61)	1		61 (82)	1	
Current/former smoker	23 (24)	9 (39)	0.41 (0.16–1.08)	0.07	12 (52)	0.23 (0.08–0.64)	0.003
Histology							
Adenocarcinoma	88 (91)	51 (58)	1		67 (76)	1	
Non-adenocarcinoma	9 (9)	3 (33)	0.36 (0.09–1.55)	0.16	6 (67)	0.63 (0.14–2.73)	0.53
Stage							
IIIB	24 (25)	15 (63)	1		22 (92)	1	
IV	73 (75)	39 (53)	0.69 (0.27–1.77)	0.44	51 (70)	0.21 (0.05–0.98)	0.03

*Data presented as n (%) or mean (range). OR = odds ratio; CI = confidence interval; ECOG PS = European Cooperative Oncology Group performance status.

Table 2. Overall survival in each subgroup of the patients

Characteristics	*n*	Mean follow up time (wk)	1-year survival rate (%)	HR (95% CI)	*p*
Total	97	43.2	77.34		
Sex					
Female	65	44.0	83.40	1	
Male	32	41.0	66.40	2.34 (0.90–6.07)	0.08
Age (yr)					
<70	40	40.0	76.50	1	
≥70	57	46.0	77.60	0.90 (0.34–2.37)	0.83
ECOG PS					
0–2	77	47.0	90.60	1	
3–4	20	30.0	15.30	8.32 (3.10–22.36)	<0.001
Smoking status					
Never smoker	74	44.0	83.60	1	
Current/former smoker	23	40.0	60.60	3.02 (1.16–7.85)	0.02
Histology					
Adenocarcinoma	88	43.0	76.20	1	
Non-adenocarcinoma	9	43.0	88.90	0.62 (0.08–4.66)	0.62
Stage					
IIIB	24	54.0	100	1	
IV	73	40.0	68.60	7.36 (0.97–55.88)	0.053
Response					
PD	24	36.14	45.90	1	
SD	19	35.38	78	0.45 (0.14–1.42)	0.17
Partial response	54	49.09	94	0.06 (0.01–0.26)	<0.001
Disease stabilization (PD+SD)	73	45.52	89.70	0.14 (0.05–0.38)	<0.001

HR = hazard ratio; CI = confidence interval; ECOG PS = Eastern Cooperative Oncology Group performance status; PD = progressive disease; SD = stable disease.

Table 3. Multivariate models show the adjusted odds ratios for response and disease stabilization and adjusted hazard ratios for survival status

Patient subset	Response OR (95% CI)	*p*	Disease stabilization OR (95% CI)	*p*	Death HR (95% CI)	*p*
Sex (male *vs*. female)	–		–		2.11 (0.80–5.55)	0.13
Smoking (ever *vs*. never)	0.39 (0.14–1.06)	0.07	0.22 (0.07–0.65)	0.007	–	
Histology (non-adenocarcinoma *vs*. adenocarcinoma)	0.26 (0.06–1.16)	0.07	–		–	
Stage (IIIB *vs*. IV)	–		–		5.21 (0.67–40.26)	0.11
ECOG PS	0.24 (0.08–0.72)	0.01	0.16 (0.05–0.49)	0.001	6.46 (2.40–17.43)	<0.001

OR = odd ratios; HR = hazard ratio; CI = confidence interval; ECOG PS = Eastern Cooperative Oncology Group performance status.

The multivariate models that included factors with p value <0.15 are shown in Table 3. For overall response, we found that patients who had ever smoked, had non-adenocarcinoma histology or poor ECOG performance status were less likely to respond to gefitinib, while patients who had ever smoked or those with poor ECOG performance status were less likely to show disease stabilization with gefitinib treatment. For survival, we found that patients who were male or patients with poor ECOG performance status

had poor survival when receiving gefitinib as first-line treatment.

Discussion

In this study, the overall response rate and disease control rate were 56% and 76%, respectively, both of which are higher than those in other reports [19–22], where the response rates ranged from 15.2% to 42%, and the disease control rates ranged from 25.8% to 60%. Gefitinib is effective in treating NSCLC patients with EGFR gene mutations [23–26]. Females, never smokers, adenocarcinoma histology and patients of Asian origin are more likely to have such mutations [26,27]. Although EGFR gene mutations were not determined in this study, the linkage between EGFR gene mutations and female sex, no smoking history, adenocarcinoma and East Asian patients is well-known. This may explain why the response rate and the disease control rate in this study are still less than those reported in the phase II study by Lee et al [15]. They reported better overall response (69%) and disease control (80%) rates for 37 patients with NSCLC (all with adenocarcinoma histology, no smoking history and predominantly female). Because our study was conducted retrospectively by reviewing patients' medical charts between 2004 and 2006, pre-selection bias should be considered for the high response rate and disease control rate.

None of the well-known predictive factors in the literature, such as female sex, smoking status or histology, significantly predicted the overall response or disease stabilization associated with gefitinib in our study. Although patients with these factors still seemed to respond better to gefitinib than patients without these factors in our study, only smoking status was a statistically significant predictor for disease stabilization (PD and SD). The small sample size and selection bias might be reasons why these factors were not statistically significant predictors.

ECOG performance status, originally not considered a predictive factor for overall response or disease stabilization, was thus correlated in this study. Similarly, Hoang et al reported that performance status and another five independent factors were correlated with response rate and survival time for patients with stage IIIB or IV NSCLC receiving third-generation chemotherapy regimens [28]. In addition, in a recent study of chemotherapy-naive patients with advanced or metastatic NSCLC treated with gefitinib in East Asia, the overall response rate and disease stabilization rate for patients with good (ECOG score, 0–2) versus poor performance status (ECOG score, 3–4) were 52% versus 28% and 70% versus 45%, respectively [21]. Thus the correlation between performance status and overall response and disease stabilization in patients with NSCLC treated with gefitinib seems reasonable, although further studies are warranted to validate its significance.

The log-rank test was used to compare the 1-year survival rates in each subgroup. As above, patients who never smoked or patients with better ECOG performance status had a better survival after gefitinib therapy. Although female patients had a better 1-year survival rates than males (83.40% *vs*. 66.40%, $p = 0.08$), statistical significance was not achieved, which could be due to the small sample size of this study. Patients with adenocarcinoma are predicted to show better survival than patients with other types of lung cancer [29]. Unfortunately, we did not achieve similar results to other studies. The 1-year survival rates for patients with adenocarcinoma and non-adenocarcinoma were 76.2% and 88.9%, respectively. Nine patients were diagnosed with non-adenocarcinoma in this study. One of these patients was diagnosed with squamous cell carcinoma, and the other eight patients did not have a definite histological diagnosis because of small specimens, or only had cytological diagnosis. Some of these patients might have had adenocarcinoma. Thus the beneficial effects of adenocarcinoma might not be validated in this study because of the small size of the comparative group or the absence of a comparative group.

Kaplan-Meier survival analysis also demonstrated that patients with PR or SD had significantly better survival than patients with PD. Multivariate analysis showed that only patients with better performance status had better treatment response and survival.

In this multicenter, retrospective analysis, gefitinib showed excellent anti-tumor effects when prescribed as first-line therapy against advanced or metastatic NSCLC. Considering our data and the results from other studies, first-line gefitinib monotherapy offers a promising therapy for some subgroups of Asian patients with NSCLC. Further randomized controlled studies are needed to validate the effectiveness of first-line gefitinib therapy and its cost-effectiveness

compared with traditional first-line chemotherapeutic regimens.

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以 Gefitinib 為第一線藥物治療南台灣晚期非小細胞肺癌病患之經驗

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Gefitinib，為表皮生長激素受體酪胺酸激酶的專一抑制劑，是第一個當非小細胞肺癌病患在接受化學治療失敗之後，被核准可以使用的標靶治療藥物。過去曾有一些較小型的臨床試驗證實 **gefitinib** 對於未曾接受過化學治療的病患也有療效。本研究之目的在探討轉移與晚期非小細胞肺癌患者第一線即使用 **gefitinib** 這一標靶治療藥物時之反應率、病患整體存活率與其預測因子。本文以回溯性方式蒐集南台灣 **6** 家醫院所有在 **2004** 年 **5** 月至 **2006** 年 **4** 月接受 **gefitinib** 為第一線治療之轉移與晚期非小細胞肺癌患者，分析病患對藥物之反應率與病患存活率，及這二者與一些已知可預測因子之相關性。本研究共收納 **97** 位患者，對藥物之反應率為 **56%**，疾病控制率為 **76%**。在本研究中，只有病患之生活功能狀態與病患對於 **gefitinib** 是否產生反應有明顯相關。在本研究中，以 **gefitinib** 為第一線藥物治療轉移與晚期非小細胞肺癌患者，病患可以存活超過一年的機率為 **77%**。我們認為第一線使用單一藥物 **gefitinib** 來治療特定族群之亞洲非小細胞肺癌病患是極具前景的。以控制隨機之臨床試驗進一步來驗證第一線 **gefitinib** 之療效是必須的。

關鍵詞：gefitinib，非小細胞肺癌，標靶治療

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