Non–small cell lung cancer (NSCLC) accounts for some 80% of cases of lung cancer, which remains the leading cause of cancer death in the United States. Patients with NSCLC usually present with stage III or IV disease; because of the prevalence of advanced stage at presentation, end points for clinical studies include survival benefit, relief of symptoms, and quality of life (QOL) as well as tumor response rate. Research has shown that platinum-based chemoradiotherapy (ie, cisplatin) is the best option for stage III NSCLC, and platinum-based chemotherapy is most effective for palliation of stage IV disease.

Despite the efficacy of platinum-based combination therapy for NSCLC, relapse rates remain high, and second-line treatment is an area of intensive research. Recent randomized Phase III trials have proved the efficacy of single-agent docetaxel for second-line chemotherapy in these patients. In TAX 317, docetaxel at 75 mg/m² for stage IV disease increased overall survival, 1-year survival, time to disease progression, and QOL compared with best supportive care. Patients receiving docetaxel had less need for palliative radiotherapy. In TAX 320, docetaxel was compared with vinorelbine or ifosfamide for stage IV disease, with docetaxel given at a dose of...
75 or 100 mg/m²; both doses of docetaxel significantly improved response rates and time to progression, without a deterioration in QOL.³ In fact, TAX 317 and TAX 320 revealed that docetaxel achieved better QOL in many respects, such as weight loss, need for opioid analgesics, and performance status. Docetaxel was declared the standard of care for second-line treatment of NSCLC and was approved by the FDA for this purpose.

In a Phase II trial, docetaxel also showed promising response rates when given as consolidation chemotherapy after concurrent chemoradiotherapy with cisplatin and etoposide in patients with stage IIIb disease.⁴ Because of the success in second-line treatment, randomized Phase III trials have been conducted to evaluate the therapeutic efficacy and safety of docetaxel as first-line therapy for patients with advanced or metastatic NSCLC. In an interview, Frank Fossella, MD, a medical oncologist at M.D. Anderson Cancer Center and lead investigator of the TAX 320 study, explained some of the rationale behind the research on first-line docetaxel. “Intuitively you would say, well, if it’s good for second-line treatment, it must be good for first-line treatment.” Phase II studies had already shown impressive results with new chemotherapy drugs, including the taxanes, used in combination with platinum agents for primary treatment. Phase III trials, such as the Eastern Cooperative Oncology Group (ECOG) 1594 4-arm study, also have supported the use of new agents such as paclitaxel, gemcitabine, and docetaxel in combination with cisplatin or carboplatin, but no particular regimen has yet emerged as superior.⁵

This monograph summarizes the newest efforts to gather data on the use of docetaxel for the first-line treatment of NSCLC.

The TAX 326 Multicenter Trial

Fossella reported a multicenter, multinational study of 2 docetaxel/platinum regimens for advanced NSCLC.⁶

Study Design

Eligible patients had locally advanced, unresectable or recurrent (stage IIIb) NSCLC or metastatic (stage IV) NSCLC not previously treated with chemotherapy.⁶ Recruitment took place at 140 institutions in 29 countries, and 1,218 patients were enrolled; Dr. Fossella called the study “probably the largest” of its type. Patients were required to demonstrate a Karnofsky performance status of ≥70%; 96% had a performance status of ≥80%. Stratification was performed for stage of disease and the patient’s country of origin.

The patients were randomly assigned to receive docetaxel plus cisplatin (DOC/CIS; n=408), docetaxel + carboplatin (DOC/Carbo; n=406), or the control regimen of vinorelbine + cisplatin (VIN/CIS; n=404) in an open-label, parallel-group study.⁶ The dosages and schedules were docetaxel 75 mg/m² I.V. for 1 hour plus cisplatin 75 mg/m² I.V. every 3 weeks; docetaxel 75 mg/m² I.V. for 1 hour plus carboplatin AUC=6 I.V. every 3 weeks; or vinorelbine 25 mg/m² I.V. on days 1, 8, 15, and 22 plus cisplatin 100 mg/m² I.V. on day 1 every 4 weeks.

Treatment response was assessed every 2 cycles, which equated to every 6 weeks in the docetaxel arms and every 8 weeks in the control arm.⁶ Each docetaxel regimen was compared separately with the control treatment. The primary end point was survival. Secondary outcomes included tumor response, time to disease progression, safety of the treatment, and QOL indices, including the Lung Cancer Symptom Scale (LCSS) and the European Quality of Life (EuroQoL) scale.

Comparability of Groups

Few differences were found in baseline comparisons of the study groups. Proportions were identical for stage IV disease (67% each), Karnofsky performance status of 70% to 80% (42% each) and 90% to 100% (58% each), and location
of treatment (Europe/Lebanon/Israel, 48% each; North America, 28% each; Latin America, 15% each; and South Africa/Australia/New Zealand, 8% each). Median age was nearly identical, at 60 years for the DOC/CIS and VIN/CIS groups and 59 years for the DOC/Carbo group. The 2 study groups were 72% male; the control group, 75%.

Clinical disease characteristics were also similar among groups. Histologic subtypes included adenocarcinoma, squamous cell carcinoma, large cell undifferentiated carcinoma, and other types in approximate proportions of 42%, 33%, 12%, and 13%, respectively, for all 3 groups. Liver was involved in 11% to 13% of patients and bone in 16% to 21%. Some patients had already undergone surgery (24% to 30%) and radiotherapy (11% to 14%).

Total cycles of therapy numbered 1,879 and 1,881 in the DOC/CIS and DOC/Carbo groups, respectively; somewhat fewer were completed in the VIN/CIS group, at 1,557. Corresponding median numbers of cycles (ranges) were 5 (1-13), 6 (1-10), and 4 (1-9). Half of the docetaxel patients completed 6 cycles of therapy (DOC/CIS, 49.8%; DOC/Carbo, 51.4%), compared with fewer of the controls (VIN/CIS, 33.6%). Median cumulative doses of each drug component (in mg/m²) were 378/377 for DOC/CIS, 379/1,802 for DOC/Carbo, and 275/353 for VIN/CIS. Median relative dose intensities were 0.97/0.97, 0.97/0.94, and 0.68/0.93, respectively. The lower dose intensity of vinorelbine was due to missed doses.

Survival and Response Rates From TAX 326

**DOC/CIS vs VIN/CIS**

As illustrated in Figure 1, DOC/CIS therapy improved the cumulative probability of overall survival compared with the VIN/CIS regimen (P = 0.044 by adjusted log-rank test). The difference in survival emerged at about 4 months and increased over time to 27 months. Table 1 provides a breakdown of the median, 1-year, and 2-year survival rates, all of which were superior after DOC/CIS therapy to survival rates with VIN/CIS. Median survival was 11.3 months versus 10.1 months; 1-year survival reached 46% as compared with 41%; and 21% were alive at 2 years as compared with 14%. The resulting hazard ratio was 1.183 (95% confidence interval [CI], 1.008-1.388).

The overall response rate by intention to treat (ITT) was 32% for DOC/CIS, as opposed to 25% for VIN/CIS (P = 0.029 by Fisher’s exact test) (Table 2). This difference was explained primarily by the superior partial response rate of DOC/CIS (30%, compared with 23% for VIN/CIS). The complete response rate was 2% for both groups. Other indices of response were generally comparable, with stable disease in 43% and 42%, respectively, and progression noted in 18% versus 21%. Time to progression by ITT did not differ significantly between the groups, with a median of 22.0 weeks for DOC/CIS and 23.0 weeks for VIN/CIS (P = 0.805).

**DOC/Carbo vs VIN/CIS**

In contrast to the DOC/CIS regimen, DOC/Carbo treatment did not significantly improve response rates or survival compared with VIN/CIS. Cumulative probability of survival was not significantly different between the groups (P = 0.66 by adjusted log-rank test). Results for the DOC/Carbo and VIN/CIS regimens were similar for median survival (9.1 vs 10.1 months), 1-year survival (38% vs 42%), and 2-year survival (16% vs 14%). The hazard ratio for survival with DOC/Carbo as compared with VIN/CIS was 1.046 (95% CI, 0.891-1.227).

Table 3 (page 4) details the equivalent findings for the overall response rate by ITT (24% for DOC/Carbo and 25% for VIN/CIS; P = 0.87 by Fisher’s exact test). Partial and complete response rates were virtually identical between groups. Although disease stabilized slightly more often after DOC/Carbo treatment than after VIN/CIS therapy.
(46% vs 42%), progression rates were similar (22% vs 21%). In fact, median time to progression by ITT was marginally shorter with DOC/Carbo than with VIN/CIS (20.0 weeks vs 22.0 weeks), although the difference was not statistically significant ($P=0.235$).

### Toxicity

Table 4 presents the rates of grade 3 or 4 hematologic toxicity for the DOC/CIS, DOC/Carbo, and VIN/CIS groups. Both docetaxel groups were superior to VIN/CIS in avoiding anemia, with rates of only 7% and 10% as compared with 24%, respectively (both comparisons $P<0.01$ by Fisher’s exact test). Approximately 75% of all groups experienced neutropenia. Rates of neutropenia were slightly lower in both docetaxel groups than in the VIN/CIS group, although the differences were not significant. No differences emerged for thrombocytopenia, febrile neutropenia, or infection, with all rates ranging between 3% and 8%. Similar numbers of patients required prophylactic antibiotics or administration of granulocyte colony-stimulating factor.

Table 5 lists the grade 3 or 4 nonhematologic toxicity for the 3 groups. The only significant differences were lower rates of nausea and vomiting in both docetaxel groups than with control. Nausea was reported in 10% of DOC/CIS and 6% of DOC/Carbo patients versus 16% of VIN/CIS recipients. Respective rates for vomiting were 8% and 4% versus 16% (all 4 comparisons $P<0.01$ by Fisher’s exact test). All other measures of toxicity were comparable among groups. The most prevalent adverse effects in all 3 groups were pulmonary complications and asthenia (ranging from 10% to 14%). Only 2% in each group died of treatment-related complications.

### TAX 326 and Quality of Life

Prospective assessments of QOL showed impressive results with the docetaxel regimens. Most comparisons were made in terms of mean changes from baseline for each of the 6 cycles of treatment.

### Table 3. Response Rate (ITT): DOC/Carbo vs VIN/CIS

<table>
<thead>
<tr>
<th>Response</th>
<th>DOC + Carbo (n=406)</th>
<th>VIN + CIS (n=404)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete response</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Partial response</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>Overall response rate</td>
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<td>25</td>
</tr>
<tr>
<td>Fisher’s exact test</td>
<td>$P=0.87$</td>
<td></td>
</tr>
<tr>
<td>Stable disease</td>
<td>46</td>
<td>42</td>
</tr>
<tr>
<td>Disease progression</td>
<td>22</td>
<td>21</td>
</tr>
</tbody>
</table>

Carbo, carboplatin; DOC, docetaxel; VIN, vinorelbine

### Table 4. Grade 3/4 Hematologic Toxicity* Comparing DOC/CIS, DOC/Carbo, and VIN/CIS

<table>
<thead>
<tr>
<th>Adverse event (%)</th>
<th>DOC + CIS (n=406)</th>
<th>DOC + Carbo (n=401)</th>
<th>VIN + CIS (n=396)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anemia</td>
<td>7†</td>
<td>10†</td>
<td>24</td>
</tr>
<tr>
<td>Neutropenia</td>
<td>75</td>
<td>74</td>
<td>79</td>
</tr>
<tr>
<td>Thrombocytopenia</td>
<td>3</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Febrile neutropenia</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Infection</td>
<td>6</td>
<td>8</td>
<td>6</td>
</tr>
</tbody>
</table>

*All events regardless of relationship.
†Fisher’s exact test, $P<0.01$.
Carbo, carboplatin; CIS, cisplatin; DOC, docetaxel; VIN, vinorelbine

### Table 5. Grade 3/4 Nonhematologic Toxicity* Comparing DOC/CIS, DOC/Carbo, and VIN/CIS

<table>
<thead>
<tr>
<th>Adverse event (%)</th>
<th>DOC + CIS (n=406)</th>
<th>DOC + Carbo (n=401)</th>
<th>VIN + CIS (n=396)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonary</td>
<td>10</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>Asthenia</td>
<td>12</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>Nausea</td>
<td>10†</td>
<td>6†</td>
<td>16</td>
</tr>
<tr>
<td>Vomiting</td>
<td>8†</td>
<td>4†</td>
<td>16</td>
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<tr>
<td>Pain</td>
<td>8</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Anorexia</td>
<td>5</td>
<td>3</td>
<td>5</td>
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<tr>
<td>Diarrhea</td>
<td>7</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Neurosensory</td>
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<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Treatment-related death</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

*All events regardless of relationship.
†Fisher’s exact test, $P<0.01$.
Carbo, carboplatin; CIS, cisplatin; DOC, docetaxel; VIN, vinorelbine

### DOC/CIS vs VIN/CIS

The change in global QOL on the LCSS was compared between the DOC/CIS and VIN/CIS groups. DOC/CIS showed a tendency toward an improvement in quality of life, with an increase from baseline with each cycle of treatment, whereas VIN/CIS was associated with a decline ($P=0.064$). Significance was attained on the EuroQoL EQ5D global health status. Figure 2 shows that the response was positive for DOC/CIS during all chemotherapy cycles, indicating improvement; control therapy showed an improvement only in cycle 4. Therefore, DOC/CIS was superior on this measure overall ($P=0.016$).

Docetaxel also decreased pain as measured by the LCSS. In fact, both DOC/CIS and VIN/CIS improved pain scores, but DOC/CIS showed greater increases from baseline ($P=0.033$). A highly significant difference emerged for weight loss during treatment. The proportion of patients who lost ≥10% of their...
body weight was markedly lower with DOC/CIS than with VIN/CIS (7% vs 15%; \( P < 0.001 \) by Fisher’s exact test). Finally, the DOC/CIS regimen significantly improved Karnofsky performance status as compared with VIN/CIS. Figure 3 illustrates the benefit of DOC/CIS on several categories of change in Karnofsky performance status during treatment.

**DOC/Carbo vs VIN/CIS**

Like DOC/CIS, DOC/Carbo treatment showed mean improvements from baseline on the LCSS global QOL, whereas VIN/CIS showed declines.\(^6\) The overall difference in treatment effect was significant (\( P = 0.016 \)). Figure 4 (page 6) illustrates the results for EQ5D global health status, which were also superior for DOC/Carbo (\( P < 0.001 \)).

LCSS pain scores improved in both groups during treatment, with a nonsignificant tendency toward less pain with docetaxel treatment (\( P = 0.34 \)). Results for weight loss with DOC/Carbo were identical to those with DOC/CIS; that is, 7% of patients lost \( \geq 10\% \) of their weight during DOC/Carbo treatment, as opposed to 15% of the control patients (\( P < 0.001 \) by Fisher’s exact test). Changes from baseline in Karnofsky performance status also paralleled those found for DOC/CIS. Figure 5 (page 6) illustrates the superior results achieved with DOC/Carbo as compared with VIN/CIS.

**Promise of TAX 326**

TAX 326 indicated that DOC/CIS was a promising therapy for first-line treatment of stage IIIB or IV NSCLC.\(^5\) DOC/CIS proved superior to VIN/CIS in terms of overall survival (\( P = 0.044 \)) and overall response rate (\( P = 0.029 \)). In contrast, DOC/Carbo treatment was not significantly better than the VIN/CIS regimen in terms of survival or response rates. Both docetaxel arms achieved significant reductions in grade 3 or 4 anemia, nausea, and vomiting. In general, both DOC/CIS and DOC/Carbo also improved QOL, health status, pain scores, weight loss, and Karnofsky performance status. No differences were recorded for grade 3 or 4 neutropenia or infection or for treatment-related mortality. Both combinations therefore proved safe and effective.

Dr. Fossella explained that the study had met its objectives. “Part of the thrust of [TAX] 326 was to get the data on the table to say to the FDA and also to the oncology community, Well, look, this study shows what intuitively we would suspect, which is that not only is docetaxel a good drug to use in the second-line setting, but there’s no reason why you can’t use it in the first-line setting as well— that is, in combination with platinum [agents].” The study thus “reinforces the findings of phase II studies, which show that docetaxel-platinum combinations are active in the first-line treatment.”

Dr. Fossella emphasized that the QOL results are nearly as
important as tumor response and survival. “I think one of the important things to take home from this trial is the quality-of-life data. In this patient population, I don’t think we’re ever going to hit a home run. We’d have to make a major, major breakthrough to hit a home run in terms of seeing really significant differences in survival. I think the more interesting thing about this study is that we were able to show significant improvements in quality of life that were consistent.”

Phase III Japanese Study of Docetaxel and Cisplatin in NSCLC

In Japan, a previous Phase II trial of docetaxel at 60 mg/m² combined with cisplatin at 80 mg/m² achieved a response rate of 42% and a median survival of 43.3 weeks for first-line treatment of NSCLC. Vindesine + cisplatin has been the standard treatment in Japan for stage IV NSCLC since 1998. Docetaxel + cisplatin (DP) was therefore compared with vindesine + cisplatin (VP) in the following Phase III randomized trial by Nishiwaki and colleagues.

Study Design

Patients aged 20 to 74 years with untreated stage IV NSCLC were eligible. Patients were required to have histologic or cytologic confirmation of disease, an ECOG performance status of 0 to 2, functional organs, and life expectancy of ≥3 months. Patients with asymptomatic...
brain metastasis and those with painful bone metastasis and a performance status of 3 were eligible for the study. All subjects provided written informed consent.

A total of 311 patients were enrolled between June 1998 and March 2000. After randomization, 156 patients were assigned to receive DP and 155 to VP. Nine patients were excluded, leaving 302 patients who met the study criteria, or 151 subjects in each group.

For DP, dosing was docetaxel 60 mg/m² over 1 hour on day 1 + cisplatin 80 mg/m² over 2 hours on day 1, given every 3 to 4 weeks; for VP, vindesine 3 mg/m² as an I.V. bolus on days 1, 8, and 15 + cisplatin 80 mg/m² over 2 hours on day 1, given every 4 weeks. Both treatments were to be given for 2 or more cycles. Crossover treatment with docetaxel or vindesine was not allowed, and prophylactic steroids were not used. Outcomes included survival, tumor response, and tolerability of the treatment.

Comparability of Groups
The DP and VP groups were generally similar. Median age was 63 and 64 years, respectively; 64% versus 68% were male; and performance status was 0 or 1 in about 96% of both groups. Some variability arose in histologic categories; the DP group contained more adenocarcinomas (120 vs 103) but fewer squamous cell carcinomas (17 vs 33) than the VP group. Numbers of large cell cancers and other types were similar.

Fewer treatment cycles were completed in the VP group. The total numbers of cycles were 420 for DP and 327 for VP, which equated to median numbers of 3 and 2 cycles, respectively. Specifically, all patients in both groups completed 1 cycle, but respective completion rates for 2, 3, and 4 cycles were 87%, 56%, and 28% for DP, compared with 76%, 35%, and 11% for VP. Twice as many patients in the VP group discontinued treatment before the second cycle, 14% because of disease progression (versus 7% in the DP arm) and 10% because of adverse events (versus 5% in the DP arm).

Survival and Response Rates
The overall tumor response rate was 37.1% with the docetaxel regimen versus 21.2% with the vindesine regimen (P <0.01). Table 6 provides a breakdown of response rates for DP versus VP, showing complete responses in 3 versus 0 patients and partial responses in 53 (35%) versus 32 (21%), respectively. The median duration of response was 13.1 weeks for the DP arm and 9.3 weeks for the VP arm. Lack of change in the tumor was more common with the VP regimen than with DP (76 [50%] vs 63 [42%]), as was disease progression (38 [25%] vs 27 [18%]).

Preliminary survival data by Kaplan-Meier analysis up to 1 year after treatment showed a longer median survival time of 11.3 months with DP and 9.6 months with VP (P=0.245 by log-rank test). Respective survival rates at 1 year were 47.7% versus 42.9%, although these data should be considered preliminary. Two-year follow-up will be reported in subsequent publications.

Similar proportions of patients in the DP group and VP group required subsequent treatment with radiation (33.1% and 37.1%) and chemotherapy (37.1% and 35.1%). As might be expected, more patients in the DP arm received further doses of docetaxel (13.9%, vs 2.6% in VP) and more subjects in the VP arm received vindesine (4.6%, vs 0 in DP). Proportions receiving other chemotherapeutic agents were similar.

Toxicity
Grade 3 or 4 toxic adverse events were evaluated with use of the National Cancer Institute Common Toxicity Criteria (NCI-CTC scale). DP caused greater nonhematologic toxicity than VP, consisting of gastrointestinal problems including nausea and vomiting (10% vs 4%, P <0.05), diarrhea (9% vs 1%, P <0.05), and anorexia (20% vs 9%, P <0.01). However, DP produced lower rates of hematologic toxicity than VP, including anemia (10% vs 23%, P <0.01) and leukopenia (46% vs 66%, P <0.01). Neutropenia occurred in about 75% of both groups. All other complications arose in 1% to 3% of patients. Despite the lack of prophylactic steroids, severe edema was not observed.

Summary of the Japanese Study
The docetaxel regimen achieved significantly better tumor response and exhibited stronger tendencies toward higher median survival and 1-year survival than the vindesine control. Nishiwaki and colleagues believe that longer follow-up may well yield statistically significant survival data. Although DP produced more nonhematologic (gastrointestinal) toxicity, this disadvantage was somewhat offset by the reduction in hematologic toxicity compared with VP. Overall, DP proved effective and safe for first-line therapy of stage IV NSCLC and may be considered one of the primary treatment choices.

Conclusion
Both trials illustrate the efficacy of docetaxel plus cisplatin for the first-line treatment of advanced NSCLC. The results for DP in the Japanese trial are particularly interesting because
they reflect the results of DOC/CIS in TAX 326 for tumor response rate, duration of response, median survival time, and 1-year survival in relation to their respective comparison groups. Aside from some differences in gastrointestinal adverse effects, the toxicity data are comparable for all of the docetaxel regimens (VP, DOC/CIS, and DOC/Carbo).

Although vindesine is not approved for use in the United States and is therefore not the standard comparator for docetaxel regimens in this country, Dr. Fossella believes that the study by Nishiwaki and colleagues is relevant to the US literature on docetaxel because of its rigorous design and similar conclusions. "It's a parallel study [of] a docetaxel-platinum combination. In our study, we showed that a docetaxel/platinum combination shows improvement in quality of life and equivalence with regard to carboplatin and docetaxel, and then superiority with regards to cisplatin/docetaxel over a standard regimen. [Therefore] the Japanese study is a parallel study that showed the survival data are better with the docetaxel group."

"The thrust of TAX 326 and the Japanese study," Dr. Fossella concluded, "is to demonstrate the equivalence, if not superiority, of Taxotere/platinum combinations in the first-line setting" for the treatment of advanced NSCLC. Dr. Fossella also indicated that he believes the efficacy and safety of docetaxel have been amply demonstrated. Researchers are now actively exploring the use of novel targeted therapies, such as epidermal growth factor receptor inhibitors, angiogenesis inhibitors, gene therapies, and other strategies. The future role of docetaxel/platinum combination regimens may well be in conjunction with these new treatments that exert their effects at the molecular level.

—Laura Ninger, ELS

References