Original Article

Drug-eluting beads bronchial arterial chemoembolization in advanced and standard treatment-refractory/ineligible non-small cell lung cancer

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Background: The treatment strategy for previously standard treated non-small cell lung cancer (NSCLC) still remains challenged. This study was to evaluate the effectiveness and safety of epirubicin-loaded drug-eluting bead transbronchial artery chemoembolization (D-BACE) plus bronchial artery infusion chemotherapy (BAIC) in patients with refractory advanced NSCLC.

Methods: Between January 2018 and December 2022, 32 patients with refractory advanced NSCLC [26 males; mean age of 64±9.3 (range, 41–78) years; 19 squamous carcinomas (59.4%)] who had received one or more previous standard treatments and received D-BACE (epirubicin 50 mg) plus BAIC (lobaplatin 30 mg/m^2) were included in our study. The study evaluated several parameters including local tumor response based on Response Evaluation Criteria in Solid Tumors (RECIST) 1.1 criteria, progression-free survival (PFS), overall survival (OS), and complication rates. To examine the impact of different factors on PFS and OS, Kaplan-Meier and Cox regression analyses were performed.

Results: A total of 68 D-BACE plus BAIC sessions (median, 1, range 1–7) were performed. Overall response and disease control rates were 25% and 100%, respectively. The median PFS and median OS were 6.0 months [95% confidence interval (CI): 4.1–7.9] and 14.0 months (95% CI: 4.8–23.2), respectively. The number of cycles in the D-BACE plus BAIC treatment was found to be an independent predictor of PFS and OS. There were no instances of severe procedure-related complications or deaths during the study.

Conclusions: The combination of D-BACE and BAIC shows great potential as a treatment choice for patients with refractory advanced NSCLC.

Keywords: Interventional radiology; chemoembolization; non-small cell lung cancer (NSCLC); catheterization; bronchial artery

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Introduction

Non-small cell lung cancer (NSCLC) is the predominant type of lung cancer, representing the majority of lung cancer cases. Due to the occult onset of NSCLC, approximately 70% of patients are diagnosed at an advanced stage, resulting in poor 5-year survival rates ranging from 10% to 20% (1). Systemic treatments, such as chemotherapy, molecular targeted therapy, and immunotherapy, are commonly used for patients with refractory advanced NSCLC. However, treatment options for NSCLC become limited when tumors stop responding to standard therapy. Additionally, patients with poor performance status as a result of cardiovascular and pulmonary ailments may not meet the criteria for receiving systemic therapy. The prognosis for refractory advanced NSCLC is extremely unfavorable, as indicated by a median time for disease progression of approximately 3.4 to 3.8 months. Furthermore, the median overall survival (OS) duration ranges from around 6.5 to 7 months (2).

Transcatheter arterial chemoembolization of the bronchial arteries has emerged as a treatment option for large multifocal lung tumors (3). Drug-eluting bead transbronchial artery chemoembolization (D-BACE) is an innovative drug delivery system that effectively blocks the arteries supplying nutrients to tumors, while also gradually releasing powerful chemotherapy drugs directly into the tumor tissue (4). D-BACE is safe, feasible, and well tolerated in patients with advanced lung cancer (4-9). Bronchial artery infusion chemotherapy (BAIC) is an effective intra-arterial intervention that efficiently administers concentrated doses of anticancer drugs directly to the tumor tissue. This treatment is commonly employed alongside other therapies, and it has showcased promising outcomes in terms of lung cancer treatment response (10). Both D-BACE and BAIC have the capability to effectively enhance drug concentrations in specific organs while simultaneously reducing drug levels in the peripheral areas of the body (5). Recently, a combination of embolization and arterial infusion was reported in patients with metastatic lung tumors (11,12). D-BACE plus intercostal arterial infusion chemotherapy has shown effectiveness and good tolerance in treating patients with NSCLC and previously treated malignant pleural effusion (10,13). However, there have been limited studies investigating the efficacy and tolerability of D-BACE and BAIC in patients with refractory advanced NSCLC. Hence, this study introduces a novel approach termed salvage therapy, which combines D-BACE and BAIC, and aims to evaluate its effectiveness and safety in individuals who have undergone prior treatment for NSCLC. We present this article in accordance with the STROBE reporting checklist (14) (available at https://qims.amegroups.com/article/view/10.21037/qims-24-1789/coif).

Methods

Study design and patient selection

This single-center retrospective study was approved by the Institutional Review Board (IRB) of Guangdong Provincial People's Hospital (No. KY2024-050-02). The requirement for informed consent was waived by the IRB due to retrospective analyses of patient records and imaging data. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

Between January 2018 and December 2022, 52 consecutive patients diagnosed with NSCLC through histological confirmation were enrolled in this study. The inclusion criteria for patients were as follows: (I) age exceeding 18 years; (II) refractory advanced NSCLC with either local progression or intolerance to systemic therapies after standard treatment; and (III) a willingness to receive interventional therapy. The patient exclusion criteria were as follows: (I) Eastern Cooperative Oncology Group performance score >2; (II) incomplete data; (III) untreatable coagulation disorder; and (IV) no measurable lung tumor lesions. Patients with advanced NSCLC who underwent D-BACE plus BAIC as first-line therapy were also excluded from this study. A comprehensive flow diagram depicting the process of selecting patients is presented in *Figure 1*. Finally, this study enrolled 32 patients with refractory advanced NSCLC who received treatment with D-BACE plus BAIC. The mean age was 64±9.3 years (41–78 years).

Treatment procedures

Interventional procedures were performed by one of two interventional radiologists with at least 20 years of experience. Potential tumor-feeding arteries were scrutinized on computed tomography (CT) angiography before endovascular treatment. After successful percutaneous right femoral artery puncture using the modified Seldinger technique under local anesthesia, a 5-Fr Cobra 2-shaped, MIK or RH catheter (Cook, USA) was successively inserted bilaterally in the bronchial and/or non-bronchial systemic arteries to localize the tumor-feeding arteries. Angiography was performed using a catheter to confirm that the tumor-feeding arteries were identified. Superselective angiography

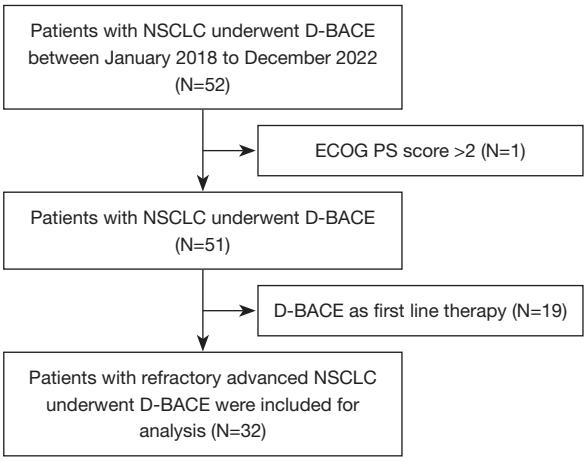

Figure 1 Study flowchart. D-BACE, drug-eluting bead transbronchial artery chemoembolization; ECOG PS, Eastern Cooperative Oncology Group performance status; NSCLC, non-small cell lung cancer.

and intubation were performed using a 2.7-Fr microcatheter (Progreat, Terumo, Japan). Selective digital subtraction angiography was performed carefully to identify the anterior spinal artery. A chemotherapeutic agent (lobaplatin, 30 mg/m^2) was injected through a microcatheter. In cases with multiple feeders, the total dose of the chemotherapeutic agent was divided according to the degree of tumor staining in each artery (15). The procedure involved the use of DC Bead™ particles (Boston Science, London, UK) with a size range of 300–500 μm to embolize the artery that supplies the tumor. These particles were loaded with 50 mg of epirubicin (Pfizer, New York, USA) for targeted treatment. The embolization endpoint was stasis or near-stasis of the target vessel, or devascularization of the tumor. If one bolt of DC Bead™ particles could not reach the embolization endpoint, 300–500 μm Embosphere microspheres were used for supplementation until complete embolization. D-BACE plus BAIC cycles were repeated on demand; when no vital tumor-feeding arteries were observed on contrast agent-enhanced CT at every 4–6 weeks, D-BACE plus BAIC was discontinued, and the patients underwent the next CT at 8-week intervals.

Assessment of outcomes and safety

The primary endpoint was to determine the rate of target tumor lesion response, which was assessed through the first follow-up contrast CT scan conducted 4–6 weeks after the initial D-BACE plus BAIC therapy. The evaluation of the response was carried out following the guidelines provided by the Response Evaluation Criteria in Solid Tumors (version 1.1) (16). Complete response (CR): all target lesions disappear, no new lesions appear, and tumor markers return to normal, sustained for at least 4 weeks. Partial response (PR): the sum of the maximum diameters of the target lesions decreases by ≥30%, sustained for at least 4 weeks. Stable disease (SD): the sum of the maximum diameters of the target lesions decreases but does not reach PR, or increases but does not reach PD. Progressive disease (PD): the sum of the maximum diameters of the target lesions increases by ≥20%, or new lesions appear. Secondary endpoints included progression-free survival (PFS), OS, and treatment-related complications. PFS was determined as the duration from the commencement of initial D-BACE plus BAIC therapy to either the occurrence of tumor progression or the occurrence of death. On the other hand, OS was determined as the time between the initiation of the D-BACE plus BAIC therapy and either death or the last follow-up. Complications were classified as minor or major according to the guidelines of the Society of Interventional Radiology (17).

Statistical analysis

Categorical variables were typically represented by frequencies and percentages, providing an understanding of the different categories and their proportions. Continuous variables were described by the mean and the standard deviation. To investigate the correlation between previous immunotherapy and tumor response, Spearman's rank test was used. Additionally, the OS and PFS were calculated using the Kaplan-Meier method. Any variables that had a P-value less than 0.1 in the univariate analyses were included as candidate variables in a stepwise Cox proportional hazards analysis. Through the multivariate analyses, independent predictors of PFS and OS were identified. The hazard ratios (HR) along with the corresponding 95% confidence interval (CI) were compared. The data was analyzed using SPSS software (version 25.0; IBM, Armonk, New, USA). Statistical analysis was conducted using two-sided tests, and a significance level of P≤0.05 was considered statistically significant.

Results

Patients' demographics

Demographic characteristics are summarized in *Table 1*. Eight of the 19 patients with squamous carcinoma received

Table 1 Patients' demographics and baseline (N=32)

Variables	N (%)
Age (years)	
≤65	19 (59.4)
>65	13 (40.6)
Sex	
Male	26 (81.3)
Female	6 (18.8)
Performance status score	
0	16 (50.0)
1–2	16 (50.0)
Location of tumor	
Central type	16 (50.0)
Peripheral type	16 (50.0)
Histological type	
Squamous	19 (59.4)
Non-squamous	13 (40.6)
Adenocarcinoma	11 (34.4)
Other	2 (6.3)
EGFR status	
Mutation	8 (25.0)
Wild type/unknown	24 (75.0)
PD-L1 (TPS)	
<1%	25 (78.1)
≥1%	7 (21.9)
Tumor size	
≤5 cm	15 (46.9)
>5 cm	17(53.1)
TNM stage	
IIIA	7 (21.9)
IIIB	9 (28.1)
IIIC	1 (3.1)
IVA	11 (34.4)
IVB	4 (12.5)
Treatment line	
2	15 (46.9)
≥3	17 (53.1)

EGFR, epidermal growth factor receptor; PD-L1, programmed cell death ligand 1; TPS, tumor cell proportion score.

Table 2 D-BACE plus BAIC procedure cycle and targeted arteries (N=32)

Variables	Value
Number of cycles	1 [1–7]
1	20 (62.5)
2	2 (6.3)
≥3	10 (31.2)
Targeted arteries	
Bronchial arteries	17 (53.1)
NBSA	7 (21.9)
Bronchial arteries + NBSA	8 (25.0)

Data are median [range] or n (%). BAIC, bronchial artery infusion chemotherapy; D-BACE, drug-eluting bead transbronchial artery chemoembolization; NBSA, non-bronchial systemic artery.

D-BACE plus BAIC as secondary treatment after the first standard treatment progression. Of the 13 patients with non-squamous NSCLC, one patient with adenoid cystic carcinoma received D-BACE plus BAIC as a secondary line after chemotherapy immunotherapy progression, and one patient with pulmonary sarcomatoid cancer received D-BACE plus BAIC as a secondary line due to the development of immune-associated hepatitis after chemotherapy immunotherapy and refused to receive systemic therapy. Among the 11 remaining patients with adenocarcinoma, seven had no driver gene mutation, and five received D-BACE plus BAIC as second-line therapy due to the first standard treatment progression or intolerance to chemotherapy. Additionally, six patients had received tumor surgery and seven underwent radiation therapy as standard treatment before D-BACE procedure (*Table 1*).

Treatment details

A total of 68 sessions (mean ± standard deviation: 2.13±1.77) of D-BACE plus BAIC were performed. Out of the 32 patients involved in the study, 22 of them were administered with 1–2 cycles of D-BACE in combination with BAIC. On the other hand, four patients underwent three cycles, two patients went through four cycles, one patient received five cycles, two patients completed six cycles, and finally, one patient completed a total of seven cycles (*Table 2*).

Of the 32 patients, 25 (78.1%) had lung tumors supplied

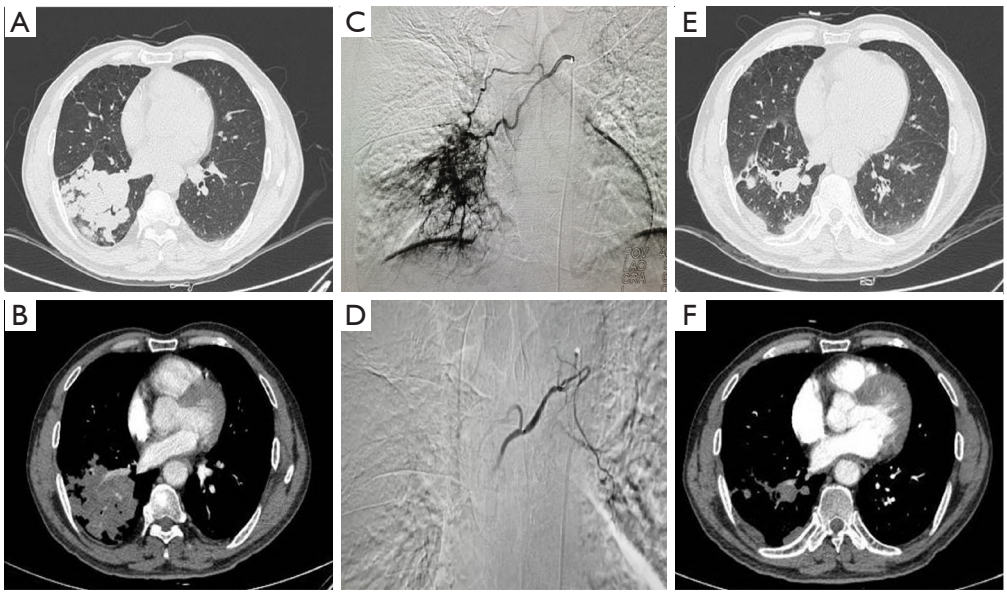

Figure 2 A 59-year-old man with IIIC stage right lung squamous cell carcinoma received D-BACE, whose tumor progressed after chemotherapy and immunotherapy. Preoperative CT showing malignant tumor of the right lung (A,B). (C) The right bronchial arteries were the blood supply artery of the tumor. (D) After 50 mg of epirubicin, D-BACE were successfully embolized. (E,F) Six weeks after D-BACE plus BAIC the right lung tumor was significantly smaller than before. CT, computed tomography; D-BACE, drug-eluting bead transbronchial artery chemoembolization; BAIC, bronchial artery infusion chemotherapy.

by the bronchial arteries or intercostal bronchial arteries, with or without non-bronchial systemic arteries, while seven patients (21.9%) had lung tumors supplied solely by non-bronchial systemic arteries (*Table 2*). Six patients had systemic artery-to-pulmonary artery shunts, one patient had both bronchial arteriopulmonary artery shunts and bronchial arteriopulmonary venous shunts. *Figure 2* and *Figure 3* demonstrate typical illustrations of bronchial and non- bronchial systemic angiograms.

Tumor response

The responses of the treated tumors at 4–6 weeks according to the Response Evaluation Criteria in Solid Tumors (RECIST) were PR [8 of 32 participants (25%)], SD [24 of 32 participants (75%)], and no CR or PD. The overall response rate (ORR) was 25% (CR + PR), and the disease control rate (DCR) was 100% (CR + PR + SD). Of the eight patients with PR, four had a history of immunotherapy before D-BACE plus BAIC. The association between previous immunotherapy and tumor response was analyzed using Spearman's rank test, r_s=0.462, P=0.008. This indicates that previous immunotherapy was associated with tumor response to some extent.

Complications

No major procedure-related complications such as spinal cord infarction was observed. Minor complications included nausea, vomiting, transient chest pain, fever, and fatigue. Among the patients, 8 (25.0%) had nausea and vomiting, 12 (37.5%) experienced pain, 1 (3.1%) had fever, 7 (21.9%) had fatigue. All minor complications resolved after conservative symptomatic therapy.

Survival analysis

The median follow-up duration was 15 months (2.5–31 months). The percentage of patients who died during follow-up was 53.1% (17 of 32). The median PFS and OS were 6.0 months (95% CI: 4.1–7.9) and 14.0 months (95% CI: 4.8–23.2), respectively (*Figure 4A,4B*). The estimated PFS rates at 6-month, 1-year, and 2-year were 50.7%, 28.1%, and 0%, respectively, while the estimated OS rates at 6-month, 1-year, and 2-year were 81.3%, 57.4%, and 47.0%, respectively. In the univariate and multivariate analyses of PFS, only the number of D-BACE plus BAIC cycles (P=0.022) was significantly associated with PFS and emerged as an independent predictor (*Table 3*). Similarly,

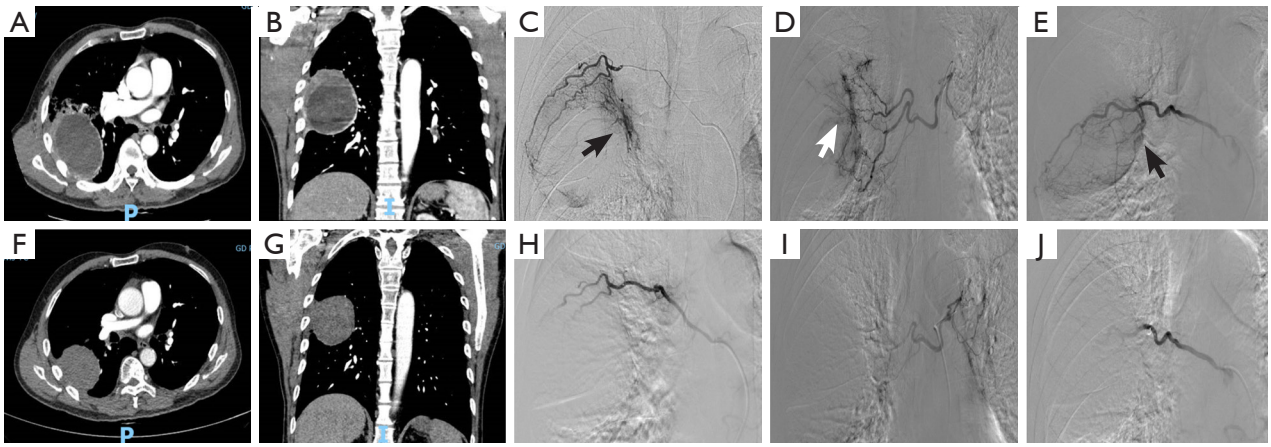

Figure 3 A 61-year-old man with right lung sarcomatoid carcinoma received D-BACE. Preoperative CT showing malignant tumor of the right lung (A,B); (C,E) the intercostal arteries and (D) right bronchial arteries were the blood supply artery of the tumor. (C,E) Intercostal arteries and (D) right bronchial artery angiogram show a hypervascular staining lesion in the right lung as well as shunting with branches of the right pulmonary arteries (C and E, black arrows) or right pulmonary vein (D, white arrow). On three postembolization angiograms (F-H) obtained after drug-eluting beads transbronchial artery chemoembolization, neither the hypervascular lesion nor the pulmonary shunt is visualized. (I,J) Six weeks after D-BACE plus BAIC the right lung tumor was significantly smaller than before. BAIC, bronchial artery infusion chemotherapy; CT, computed tomography; D-BACE, drug-eluting bead transbronchial artery chemoembolization; P, plane.

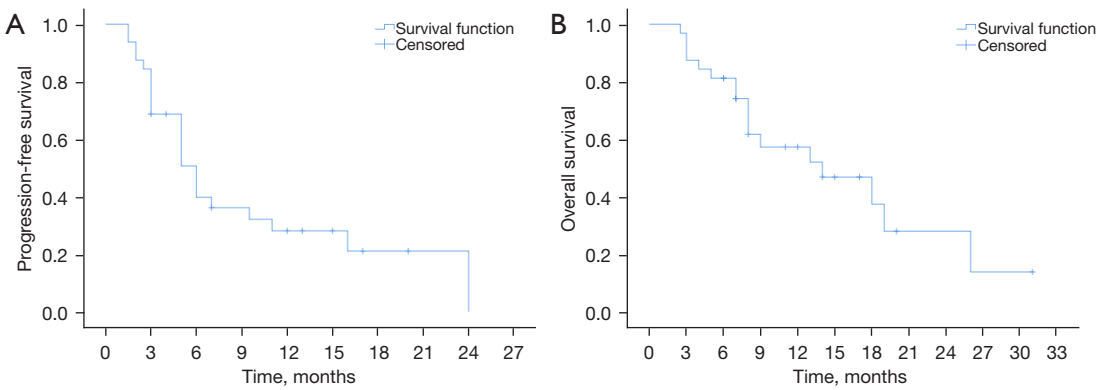

Figure 4 Progression-free survival (A) and overall survival (B) curves in patients with previously treated NSCLC after D-BACE plus BAIC treatment. BAIC, bronchial artery infusion chemotherapy; Cum, cumulative; D-BACE, drug-eluting bead transbronchial artery chemoembolization; NSCLC, non-small cell lung cancer.

in the univariate analyses of OS, performance status score (P=0.029), number of D-BACE plus BAIC cycles (P=0.017), and subsequent systemic therapies (P=0.038) were significantly associated with OS (*Table 4*). In the multivariate analyses, only the number of D-BACE plus BAIC cycles (P=0.022) was an independent predictor of OS (*Table 4*).

Discussion

For NSCLC that progresses after the first and secondary standard treatment, the current change in targeted drugs or chemotherapy regimens and multi-drug combination therapy are commonly used, but the results are still unsatisfactory. Patients with severe adverse reactions, such as severe immune-associated pneumonia, severe liver function injury, and severe bone marrow suppression, during systemic therapy in the first and second lines of treatment, may have poor compliance with systemic therapy in subsequent lines of treatment. The failure of first- and second-line treatments further reduces patient compliance

Table 3 Univariate and multivariate analysis of prognostic factors for progression-free survival with Cox proportional hazards model

Variables	Univariate analysis		Multivariate analysis	
	HR (95% CI)	P	HR (95% CI)	P
Age (>65 years)	1.10 (047, 2.60)	0.820	–	–
Sex (female)	0.94 (0.31, 2.79)	0.907	–	–
Performance status score (≥1)	0.93 (0.40, 2.15)	0.857	–	–
Tumor size (>5 cm)	2.07 (0.87, 4.93)	0.100	–	–
Tumor location (proximal)	1.50 (0.64, 3.51)	0.353	–	–
Pathology (squamous)	2.21 (0.86, 5.69)	0.100	–	–
Number of D-BACE plus BAIC cycles (>2)	0.27 (0.09, 0.83)	0.022	0.27 (0.09, 0.83)	0.022
Subsequent systemic therapies (yes)	0.74 (0.31, 1.76)	0.500	–	–

BAIC, bronchial artery infusion chemotherapy; CI, confidence interval; D-BACE, drug-eluting bead transbronchial artery chemoembolization; HR, hazard ratio.

Table 4 Univariate and multivariate analysis of prognostic factors for overall survival with Cox proportional hazards model

Variables	Univariate analysis		Multivariate analysis	
	HR (95% CI)	P	HR (95% CI)	P
Age (>65 years)	1.69 (0.62, 4.57)	0.304	–	–
Sex (female)	0.70 (0.20, 2.49)	0.586	–	–
Performance status score (≥1)	3.56 (1.14, 11.13)	0.029	2.98 (0.79,11.31)	0.108
Tumor size (>5 cm)	1.51 (0.58, 3.98)	0.401	–	–
Tumor location (proximal)	0.71 (0.25, 1.99)	0.512	–	–
pathology (squamous)	1.86 (0.64, 5.39)	0.255	–	–
Number of D-BACE plus BAIC cycles (>2)	0.20 (0.05, 0.75)	0.017	0.17 (0.04, 0.78)	0.022
Subsequent systemic therapies (yes)	0.30 (0.10, 0.94)	0.038	0.53 (0.15, 1.86)	0.321

BAIC, bronchial artery infusion chemotherapy; CI, confidence interval; D-BACE, drug-eluting bead transbronchial artery chemoembolization; HR, hazard ratio.

with post-line treatment. This retrospective study of 32 patients suggests that D-BACE plus BAIC is a safe and effective treatment for refractory advanced NSCLC, with no major complications. Tumor control, defined as the achievement of CR, PR, or SD, was successfully achieved in all cases within this series. Furthermore, the median OS in this study was 14.0 months, which appears to be better than that achieved with gemcitabine plus carboplatin (10.0 months), pemetrexed (7.4 months), or docetaxel (10.0 months) (18,19). We also found that patients who had previously received immunotherapy had a better tumor response than those who had not. Our results add to the growing body of literature, suggesting that D-BACE plus BAIC is a promising treatment option and may provide a reasonable alternative for refractory advanced NSCLC.

For the management of NSCLC, D-BACE plus BAIC offers two important advantages over systemic chemotherapy. First, the lesions in refractory advanced NSCLC are usually large, leading to blood circulation disorders in the tumor. As such, it is difficult to reach the tumor and its center through an intravenous drip, let alone the effective drug concentration, resulting in poor systemic efficacy and high toxicity (20). The administration of transarterial chemoembolization and infusion chemotherapy leads to high concentrations of drugs within the tumor tissue, which can effectively overcome chemoresistance (3).

Second, drug-eluting beads have the capacity to embolize the arteries that supply nutrients to tumors, thereby depriving the tumor of its vital source. Additionally, these specialized beads gradually release the chemotherapy drugs, they are loaded with, over the course of a month, ensuring a sustained and controlled delivery of medication directly into the tumor tissue. As a result, the concentration of drugs in the peripheral blood remains minimal. Therefore, the incidence of adverse reactions caused by chemotherapeutic drugs in D-BACE plus BAIC is lower than that in systemic chemotherapy. The theoretical basis for selecting lobaplatin as an arterial infusion chemotherapy drug is as follows: (I) although cisplatin, carboplatin, nedaplatin and other platinum-based chemotherapy drugs are commonly used in the clinic of NSCLC, the patients in this study have been resistant to these drugs, so the efficacy of using these drugs after arterial infusion chemotherapy is expected to be poor, and lobaplatin does not have cross-resistance with the first- and second-generation platinum-based drugs mentioned above. (II) Lobaplatin, as a third-generation platinum, has lower toxic side effects than first-generation platinum, and has shown good anti-tumor effects on NSCLC in previous animal experiments and clinical studies (21,22). (III) Compared with oxaliplatin, lobaplatin has better water solubility, and the pH value of its water soluble is 6–8, which is close to the normal physiological pH of human body, so it is more suitable for arterial perfusion chemotherapy, which will not cause arterial irritant spasm. Liu *et al.* conducted a study that revealed the superior outcomes of D-BACE in terms of PFS and OS when compared to chemotherapy for patients with refractory advanced NSCLC. This study indicates that D-BACE has the potential to serve as an additional treatment option due to its favorable therapeutic efficacy, ability to enhance quality of life, and its tolerable safety profile for these patients (1). He *et al.* conducted a comprehensive analysis on the effectiveness and safety of D-BACE in comparison to that of BAIC, followed by polyvinyl alcohol (PVA) particle embolization, for treating advanced squamous cell lung cancer after the failure of systemic therapy. The study revealed that the D-BACE group demonstrated a median PFS of 4.3 months and OS of 12.6 months. In contrast, the BAIC plus PVA group exhibited a significantly shorter median PFS of 3.2 months and OS of 8.1 months. These results unequivocally indicate the superiority of D-BACE over BAIC plus PVA embolization in the treatment of advanced squamous cell lung cancer (23). The median PFS and OS in the D-BACE group were shorter than those observed in our study. This may be because BAIC was not performed in the D-BACE group, and squamous cancer accounted for 59.4% (n=19) of the patients in our study. According to a multicenter prospective study, the use of D-BACE resulted in a notable enhancement in the quality of life for patients with refractory NSCLC. Additionally, the study revealed a median OS of 11.5 months when utilizing this treatment approach (24). However, it should be noted that squamous cancer accounted for 83.7% of the patients in this prospective study, which might have influenced the observed OS. The study reported promising efficacy with a median PFS of 7.0–11.0 months and OS of 8.0–18.4 months, as well as tolerable toxicity in patients with refractory advanced NSCLC (6,23-25). The PFS and OS rates in these studies were better than those in our study. We suggest that the reason for this difference could be attributed to the fact that only 56.3% (18/32) of patients received systemic therapies in our study. However, patients who received subsequent systemic therapies had higher OS than those without, as shown in the univariate analysis, although subsequent systemic therapies were not identified as an independent influencing factor in the multivariate analysis. These findings suggest that combination therapy may benefit some patients.

In this study, minor adverse events after D-BACE plus BAIC, such as transient chest pain, nausea, vomiting, fever, and fatigue, were usually self-limiting or resolved after conservative symptomatic therapies, which is consistent with previous studies (10,24). Major complications such as esophageal fistula, spinal cord infarction, posterior circulation cerebral infarction, and myocardial infarction due to non-target embolization were not observed in our study, and were also rare in a recent bronchial artery embolization series (5,25). However, these serious complications should be noted and avoided, with careful monitoring during the procedure. Based on our experience, the following points may help reduce the complications of the operation: iodized oil should be avoided for embolization of lung cancer because the small diameter of iodized oil droplets can easily cause ectopic embolization, which can further lead to serious complications, such as spinal cord injury and cerebral infarction (24). Drug-eluting beads or microsphere embolization with an inner diameter ranging between 300 and 500 mm is strongly advised based on an in-depth anatomical study. This study proposes that the anastomotic diameter of both the bronchial and pulmonary arteries could potentially accommodate sizes of up to 325 mm (26). An additional factor to consider is that when using an

excessively large embolization material, it primarily leads to proximal embolization. This, in turn, significantly diminishes the effectiveness of the treatment due to the establishment of collateral circulation (24). Drug-eluting beads or blank microspheres were utilized in all patients due to their superior size, uniformity, and improved penetration characteristics compared to those of PVA or gelatin sponge particles. Notably, these microspheres possess smooth hydrophilic-coated surfaces, which significantly reduce the risk of clumping within catheters (25). These results indicate that regurgitation does not occur more easily with drug-eluting beads or blank microspheres than with PVA or gelatin sponge particles. As clumping increases the transient resistance to embolic injection, systemic pulmonary shunts should be identified, and a suitable particle embolic agent of particle size should be selected to seal the fistula before D-BACE. Vascular variation or abnormal anastomosis should also be recognized, especially if the tumor-feeding vessels originate from the subclavian artery branches or have anastomotic branches, because ectopic embolization may cause posterior circulation stroke. In addition, blood vessels that communicate with the coronary arteries should also be considered when embolizing, because ectopic embolization may cause myocardial infarction.

The limitations of this study are predominantly associated with the limited sample size and the absence of a control group. In addition, there was heterogeneity in the standard systemic therapies given to patients included in this study; it is difficult to assess the potential effect. Additionally, it is still unknown which chemotherapeutic agents loaded with eluting beads are the most effective and safe in treating NSCLC. A multicenter prospective study showed that drug-eluting beads loaded with epirubicin for D-BACE was effective and safe in treating refractory NSCLC (24). In this study, we also used epirubicin for loading DC Bead™ particles, while oxaliplatin, vinorelbine, and gemcitabine have been reported for loading CalliSpheres beads, which are commonly used for lung cancer in systemic chemotherapy (27-29). However, these drugs are not available for being loaded onto DC Beads according to the manufacturer's instructions. Moreover, we found a correlation between previous immunotherapy and tumor response after treatment. However, due to the retrospective nature of this study, conducting an in-depth analysis was difficult, and we could not provide a convincing explanation. Further studies on immune status and treatment response are expected to answer this question. Finally, only 31.2% of the patients underwent more than three sessions of D-TACE, which may be insufficient to achieve satisfactory efficacy.

Conclusions

D-BACE combined with BAIC is a feasible, safe, and effective treatment option for patients with refractory advanced NSCLC. We present our experience using this technique for patient selection and demonstrate its feasibility with a satisfactory safety profile.

Acknowledgments

None.

Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://qims.amegroups.com/article/view/10.21037/qims-24-1789/rc

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