Major Complications After Lung Microwave Ablation: A Single-Center Experience on 204 Sessions

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Background. The purpose of this study is to retrospectively evaluate the incidence of and risk factors for major complications after microwave ablation (MWA) of lung tumors.

Methods. From January 2011 to May 2013 in 184 consecutive patients (67 women and 117 men; mean age, 61.5 years; range, 19 to 85 years), 204 sessions of MWA were performed on 253 lung tumor lesions. Records were reviewed to evaluate prevalence of major complications and risk factors, which were analyzed using univariate and multivariate analyses.

Results. Major complications developed after 42 sessions (20.6%), including 32 cases (15.7%) of pneumothorax requiring chest tube placement which that were associated with emphysema ($p = 0.001$); 6 cases (2.9%) of pleural effusions requiring chest tube placement, which were associated with a distance of less than 1 cm from chest wall to target tumor ($p = 0.014$); 6 cases (2.9%) of pneumonia which that were associated with target tumor maximal diameter ($p = 0.040$); number of pleural punctures ($p = 0.001$) and ablation time ($p = 0.006$); and 1 case (0.5%) of pulmonary abscess. Two cases (1.0%) of the large pneumothorax occurred at the same time with extensive subcutaneous emphysema, including 1 case (0.5%) caused by bronchopleural fistula. Death related to the procedures occurred after 1 session (0.5%).

Conclusions. As a relatively practical and safe modality, lung tumor MWA can induce serious complications. Enough attention should be paid to patients with emphysema, subpleural, or large target tumor, but the indications for lung MWA need not be limited as most major complications were easily managed.

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Most patients with primary or metastatic lung cancer are unresectable because of poor physiologic or oncologic conditions. This prompted the development of lung ablation techniques. The most widely used technique is radiofrequency ablation (RFA) [1–9]. Compared with RFA, microwave ablation (MWA) is a less studied but promising modality that may improve the efficacy of thermal ablation in the lung [10–14]. It offers all the benefits of RFA as well as some other advantages such as enlarged ablation zones, reduced procedure times, and decreased heat-sink effects [15, 16]. In spite of being a minimally invasive procedure just as RFA, MWA can also lead to some major complications which have been rarely reported systemically. The purpose of this retrospective study was to evaluate the incidence of and risk factors for major complications after MWA of lung tumors.

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Patients and Methods

Patients

The Institutional Review Board at Medical College of Shandong University approved this retrospective study. Local ethics committee approval and written informed consent from all patients were obtained before the procedure, although informed consent was waived for our retrospective study. We searched the Provincial Hospital Affiliated to Shandong University database to identify patients who underwent lung MWA. From January 2011 to May 2013, 204 sessions of MWA were performed on 253 lung lesions of 184 consecutive patients (67 women and 117 men) with a mean age of 61.5 ± 13.4 (range, 19 to 85) years. The patient backgrounds and tumor characteristics were summarized in Table 1.

All tumors were diagnosed with direct or indirect pathologic evidence. The patients were not candidates for surgery because of previous pulmonary resection, poor cardiopulmonary status, multiple tumors, or other reasons after discussion with thoracic surgeons. The patients refusing surgery were also considered candidates. The patients who were considered unsuitable for MWA included the following: patients with 6 or more lesions in

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Table 1. Patient, Tumor and Procedural Characteristics and Results of Statistical Analysis to Determine Risk Factors for Major Complications With a Morbidity of More Than 1%

Characteristics	No. (%) of 204 Procedures or Mean ± SD	No Chest Tube for Pneumothorax (n = 172)[a]	Chest Tube for Pneumothorax (n = 32)	*p* Value for Univariate (Multivariate) Analysis	No Chest Tube for Pleural Effusion (n = 198)[b]	Chest Tube for Pleural Effusion (n = 6)	*p* Value	No Pneumonia (n = 198)	Pneumonia (n = 6)	*p* Value
Patient characteristics:										
Gender (female/male)	72(35.3)/132(64.7)	67/105	5/27	0.011(0.056)	70/128	2/4	1.000	71/127	1/5	0.427
Age (years)	61.5 ± 13.5	61.4 ± 13.3	62.5 ± 14.6	0.663(0.310)	61.6 ± 13.3	59.5 ± 19.2	0.707	61.6 ± 13.6	61.0 ± 7.5	0.920
Emphysema (no/yes)	157(77.0)/47(23.0)	140/32	17/15	0.0005(0.001)	154/44	3/3	0.137	153/45	4/2	0.623
Diabetes (no/yes)	168(82.4)/36(17.6)	145/27	23/9	0.090(0.123)	164/34	4/2	0.286	163/35	5/1	1.000
Hypertension (no/yes)	142(69.6)/62(30.4)	118/54	24/8	0.470(0.159)	139/59	3/3	0.371	139/59	3/3	0.371
Smoking index (≤100/>100)	103(50.5)/101(49.5)	89/83	14/18	0.406(0.973)	100/98	3/3	1.000	100/98	3/3	1.000
Previous radiotherapy (no/yes)	199(97.5)/5(2.5)	167/5	32/0	10.000(0.434)	194/4	5/1	0.140	194/4	5/1	0.140
Previous pulmonary surgery (no/yes)	194(95.1)/10(4.9)	165/7	29/3	0.194(0.075)	188/10	6/0	1.000	188/10	6/0	1.000
Previous chemotherapy (no/yes)	138(67.6)/66(32.4)	118/54	20/12	0.498(0.070)	134/64	4/2	1.000	136/62	2/4	0.088
Tumor characteristics:										
Origin (primary/metastasis)	148(72.5)/56(27.5)	125/47	23/9	0.926(0.149)	143/55	5/1	1.000	144/54	4/2	0.667
Maximal diameter (cm)	3.29 ± 1.93	3.34 ± 1.99	2.99 ± 1.59	0.348(0.373)	3.27 ± 1.92	4.08 ± 2.54	0.308	3.24 ± 1.91	4.88 ± 2.07	0.040
No. of treated tumors	1.24 ± 0.63	1.22 ± 0.62	1.31 ± 0.64	0.464(0.209)	1.24 ± 0.63	1.17 ± 0.41	0.779	1.22 ± 0.60	1.83 ± 1.17	0.256
Lower lung field involved (no/yes)	133(65.2)/71(34.8)	110/62	23/9	0.388(0.519)	130/68	3/3	0.421	130/68	3/3	0.421
Distance from chest wall (≤1/≥1 cm)	40(19.6)/164(80.4)	35/137	5/27	0.537(0.653)	36/162	4/2	0.014	39/159	1/5	1.000
Procedural characteristics:										
Approach (anterior/posterior)[c]	91(44.6)/105(51.5)	76/90	15/15	0.670(0.793)	87/104	4/1	0.185	89/101	2/4	0.688
No. of pleural punctures	2.87 ± 1.65	2.82 ± 1.69	3.13 ± 1.45	0.339(0.289)	2.86 ± 1.66	3.17 ± 1.72	0.654	2.80 ± 1.61	5.00 ± 1.79	0.001
Length of lung tissue traversed by antennas (cm)	5.93 ± 4.78	5.88 ± 4.87	6.17 ± 4.33	0.753(0.733)	5.97 ± 4.83	4.58 ± 2.73	0.486	5.88 ± 4.81	7.50 ± 3.83	0.415
Ablation time (minutes)	12.78 ± 11.13	12.66 ± 11.19	13.41 ± 10.99	0.730(0.530)	12.63 ± 10.92	17.83 ± 17.38	0.498	12.41 ± 10.86	25.00 ± 14.14	0.006

[a] With or without pneumothorax. [b] With or without pleural effusion. [c] Eight sessions with lateral approach were not admitted.