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Original Article

Staged Radiofrequency Ablation and Surgical Resection for Multiple Lung Metastases of Germ Cell Tumors

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Abstract

Purpose: To evaluate the morbidity and efficacy of percutaneous radiofrequency ablation (RFA) performed before surgical resection for multiple residual lung metastases of germ cell tumors with negative tumor markers. **Materials and Methods:** This Review Board-approved retrospective study was carried out on five consecutive patients (mean age: 31 years, range: 22–41) treated successively with percutaneous RFA and surgery for multiple lung metastases of germ cell tumors. Mean number of lung metastases before treatment was 9.4. Staged procedures were performed on an average of 7.2 months (range: 1–16) after the primitive tumor resection. **Results:** The median clinical and imaging follow-up was 26 months (range: 24–36). Percutaneous RFA was technically feasible in one session under general anesthesia and CT guidance in all cases. On average, 2.8 tumors were ablated per patient (range: 1–6), and three of five procedures were bilateral. Three patients developed pneumothorax requiring drainage, but no severe complications were reported. Mean time between RFA and surgical resection of residual tumors was 2.5 months (range: 1–5). No local recurrences were noted, but one patient died due to metastatic evolution. **Conclusion:** Staged percutaneous RFA and surgical resection could be efficient with low morbidity for the management of multiple lung metastases of germ cell tumors.

Keywords: *Germ cell tumor, lung metastasis, radiofrequency ablation, surgery*

Introduction

Wide surgical resection of residual lung masses is recommended for prognostic and therapeutic reasons after initial chemotherapy for metastatic germ cell tumors.[1] First, only a complete resection of pulmonary metastases may be associated with long-term survival.[1] Second, if lung lesions pathologically represented persistent or transformed germ cell cancer, the patients may benefit of a second-line chemotherapy. Only an extensive resection allows this evaluation. However, depending on the number of metastases, thoracic surgery can be difficult to perform and lead high morbidity. It can compromise pulmonary function even for young patients.

As the vast majority of lung metastases following chemotherapy can typically just be extirpated with very minimal removal of surrounding lung tissue to begin with and pathologically often demonstrate complete necrosis for which no surgery is indicated,[2-4] minimally invasive treatments such as image-guided thermal ablations may be considered for these patients in addition of surgery to facilitate it. Radiofrequency ablation (RFA) has been developed over the last 10 years for the treatment of primary and secondary lung tumors, mainly for patients with advanced-stage disease or comorbidities that contraindicate surgery.[5] However, the literature remains scarce on the treatment of germinal tumors with this technique. Recent results indicate that lung RFA is well tolerated and provides a high rate of local tumor control without compromising lung function parameters.[6-8] Nevertheless, a high number of metastases can limit the performance of RFA techniques, in particular, due to the increased risk of severe complications (pneumothorax mainly).[8] Moreover, certain location may lead an increased risk of rare but severe complications after RFA, such as the bronchopleural fistula more frequently observed after treatment of superficial tumors.[9] Furthermore, no extensive pathology assessment may be provided by the biopsies performed during RFA.

Therefore, we hypothesized that the combination of percutaneous RFA and

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surgical resection could be complementary, circumventing the limitations of each of these two therapeutic options, and still being well tolerated and effective to prevent tumor regrowth and local relapse. The purpose of this brief study was to evaluate the morbidity and efficacy of percutaneous RFA, followed by surgical resection for multiple residual lung metastases of germ cell tumors with negative tumor markers.

Materials and Methods

Patients

This retrospective single-institution study was Institutional Review Board approved. Five patients were consecutively included between 2010 and 2012 [Table 1] with following criteria: pathologically proven metastatic germ cell tumors, no lymphadenopathy identified on imaging, multiple residual metastases located only to the lung after chemotherapy, and negative serum tumor markers. Exclusion criteria of RFA were central lesions located near the pulmonary vasculature (<1 cm) with high risk of major bleeding. The combination of RFA followed by surgery was discussed during a multidisciplinary team meeting with the goal to preserve pulmonary volume. All therapeutic options and their risks and benefits were explained to patients who gave informed consent. All RFAs of metastases located >1 cm of the pleura were first performed, and second, all other residual tumors were surgically resected with curative intent and for final pathology assessment.

Treatments

All patients were initially treated with a first-line chemotherapy (bleomycin, etoposide, and cisplatin) and surgery of all subdiaphragmatic tumors (primary tumors, metastasis, and lymph nodes) or cerebral tumors. One patient had two cerebral metastases, which were resected. The median time between initial surgical resection of the primary tumor and RFA was 6.5 months (range: 1–16). The initial number of lung masses larger than 5 mm was between 2 and 21 (mean 9.4), with a maximal size ranging from 12 to 30 mm (mean: 23.6). All tumors were bilateral.

RFA procedures were performed percutaneously (LeVeen CoAccess, Boston Scientific, Natick, MA, USA) under computed tomography (CT) guidance and general anesthesia [Figure 1]. All RFAs but two were performed bilaterally, in two lobes on average (range: 1–4), and all targeted tumors were treated in one session [Table 1]. A pleural drainage was performed systematically when both sides were treated concomitantly during the same session. RFA procedure time was shorter than 60 min in all cases (40 min in mean; 30–60). After the first CT scan examination following RFA, surgical resection was planned for each patient in a single setting, except for one patient requiring two sessions due to bilateral residual tumors, under general anesthesia. It consisted in a wedge resection after a hemiclamshell incision and mediastinal lymphadenectomy.

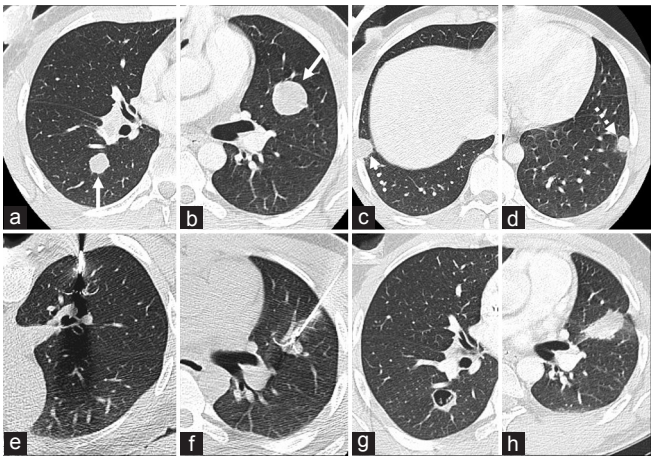

Figure 1: The axial-enhanced computed tomography scan of the right (a) and left side (b) showing two deep metastases (arrows) before chemotherapy in a 22-year-old man with retroperitoneal choriocarcinoma (patient five). For these tumors, radiofrequency ablation was planned after three cycles of chemotherapy. After chemotherapy, the axial-enhanced computed tomography scan of the right (c) and left side (d) showing two additional sub-pleural metastasis (arrows). A surgical resection was planned for these two nodules in addition of a lymphadenectomy curage. The axial nonenhanced computed tomography scan of the right (e) and left side (f) showing the two radiofrequency ablation performed in the same procedure with an expandable electrode. A posterior way for the right tumor was performed before an anterior approach for the left tumor. Six months after radiofrequency ablation and surgical treatment, no residual tumor was observed on the axial-enhanced computed tomography scan of the right (g) and left side (h)

In addition of the clinical and biological evaluation, a follow-up was the conducted by contrast enhance CT-scan imaging, planned at 2 months of the RFA and every 6 months thereafter.

Analysis

All patient data were compiled and analyzed. Data were entered into a worksheet for storage and extraction/analysis (Excel, Microsoft, Redmond, Wash). Procedure-related complications and side effects were noted and classified on the basis of criteria proposed by the Society of Interventional Radiology[10] and the National Cancer Institute Common Terminology Criteria Adverse Events (CTCAE, version 4.0). Survival was defined as time from staged treatment to recurrence of tumors assessed on imaging according to response evaluation criteria in solid tumors criteria[11] or last date of follow-up.

Results

Safety

Pneumothorax that required a 24-h drainage (Grade 2 of the CTCAE) was observed in the two cases with ablations on one side only. Only one pneumothorax was observed after bilateral RFA, but all the patients had preventive drainage in this case. All patients were discharged within 2–3 days. Low levels of postoperative pain (visual analog

Table 1: Patient characteristics

Patient	Age	Tumor site	Pathology	Initial Stage	Number of cycles of chemotherapy	Time between primary tumor resection and RFA (months)	Lung metastasis (number)	Maximal size (mm)	RFA (nodules treated)	Complications	Time between RFA and surgery (months)	Recurrences	Follow-up
1	41	Right testis	Carcinoma	pT3	4	7	2	26	1	Pneumothorax	3	Liver	Died (24 months)
2	28	Right testis	Teratoma	pT1	4	6	12	28	3	Pneumothorax	1	No	Alive at last news (38 months)
3	33	Right testis	Non-seminomatous germ cells tumor	pT2	3	16	6	12	2	No	5	No	Alive at last news (33 months)
4	31	Right testis	Seminomatous germ cells tumor	pTis	3	6	21	30	6	Pneumothorax	3	No	Alive at last news (26 months)
5	22	Retro peritoneal	Choriocarcinoma	pT2	3	1	6	22	2	No	1	No	Alive at last news (26 months)

RFA: Radiofrequency ablation

scale < 3) disappeared progressively within 1 week after thermal ablation in all cases.

Technical efficacy

Technical success of RFA or surgery was seen in all cases. Pathological examinations of resected masses have demonstrated complete necrosis in all cases.

Survival

The clinical and imaging follow-up period ranged from 26 to 38 months (median, 26 months) [Table 1]. Secondary efficacy of the staged treatment could be noted in all cases, without residual enhancement or tumor growth observed within the ablative site at 6 months on the subsequent CT scans. Thereafter, no lung recurrences were observed on CT-scan imaging follow-up in all patients. All patients, but one, were still alive at the time of analysis. This patient with a pT3 testicular carcinoma died secondary to metastatic evolution (liver) 24 months after RFA. The serum tumor markers remained negative.

Discussion

To avoid an extensive surgical resection of lung, our study showed that adding RFA before surgical resection did not compromise the final prognosis of patients treated with this combination. Staged strategies of RFA and surgical resection have been previously reported for patients with bilateral metastases to improve patient outcomes by minimizing lung resection and thereby maximizing lung function.[6,12] Only three pneumothorax occurred in three of five patients of this study at the time of the procedure. In the literature, the incidence of pneumothorax is up to 67%,[8] but a chest tube is needed in only half on them and rarely pleural sclerosis is required (1.6%).[13] However, as a preventive chest tube placement was performed in case of bilateral RFA in our study, we may have underestimated the incidence of pneumothorax. No other complication was reported.

As reported in this study, the location of metastases in addition of their number determined the strategy of the staged treatment. First, RFA was performed for metastases located >1 cm deep of the pleura, even in the two lungs, to avoid extensive surgical resection of functional lung tissues. Second, all peripheral residual tumors were resected by the surgeons and a prognostic pathological analysis was obtained. During surgery, intraoperative finger palpation may enable to detect additional nodules that were not depicted on radiological images. This consideration also decreased the risk of bronchopleural fistula,[9] which was more frequently encountered in case of pleural contact of the RFA.

Our study is limited by its retrospective nature and the small number of patients included. While RFA did not have any significant adverse effects for the very small numbers of patients included in this study, RFA carries certain additional risk of complications and the staged treatment

has to be reserved before further evaluation for cases where surgery could be difficult or too extensive.[7,13]

Conclusion

This brief study demonstrated that combination of percutaneous RFA followed by surgical resection is feasible and could be complementary to efficiently treat multiple lung metastasis. While this staged strategy may circumvent the limitations of these two therapeutic options, the potential clinical benefit should be studied on a wider scale and in long term.

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Conflicts of interest

There are no conflicts of interest.

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