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Case Report

CT-guided microwave ablation of the nonsurgical aspergilloma

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ABSTRACT

Background: Aspergillosis is a fungal infection that can lead to development of an aspergilloma, especially in patients with a history of cavitary lung disease. It is generally managed with antifungal therapy followed by surgical intervention. There are, however, limited options for the nonsurgical patient. Microwave ablation is already an effective, minimally invasive treatment being used in some lung malignancies and may be an alternative and definitive treatment in the inoperable patient.

Methods: Two patients were considered for microwave ablation following their diagnoses of aspergillosis with hemoptysis. We sought to evaluate the efficacy of CT-guided microwave ablation of an aspergilloma in these patients who were not good candidates for surgical intervention.

Results: Two male patients presented with hemoptysis and were found to have an aspergilloma. Case 1 was initially treated with antifungals and did not improve. He proceeded with VATS, and the procedure was aborted intraoperatively secondary to a frozen chest cavity. The patient subsequently elected to undergo CT-guided microwave ablation. He did not experience any immediate complications but was hospitalized for hemoptysis several weeks later. He developed alveolar hemorrhage and ultimately succumbed to PEA arrest.

Case 2 was without hemoptysis at follow up and chose to pursue microwave ablation for definitive treatment. Case 2 developed post ablation pneumothorax requiring chest tube placement. Follow-up CT chest imaging was consistent with resolution of the aspergilloma.

Conclusion: Microwave ablation is a safe and effective therapeutic approach in the treatment of lung malignancy with no severe or death related complications. There are almost no absolute contraindications. Microwave ablation may be utilized as a therapeutic option in the treatment of an aspergilloma in the non-surgical patient. This novel application may challenge the current gold standard of surgical intervention.

1. Introduction

Aspergillosis is an infection caused by the fungus aspergillus. Invasive aspergillosis is most often seen in individuals that are immunocompromised and/or individuals with a history of lung pathology [1,2]. Aspergillus can colonize lung cavities leading to the

Abbreviations: MWA, Microwave ablation.

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formation of an aspergilloma. Patient's with cavitary lung disease such as COPD, cystic fibrosis, tuberculosis, sarcoidosis, nontuberculous mycobacterium, and lung cancer are at a higher risk of developing an aspergilloma [1,2]. Presenting symptoms usually involve the lungs and are clinically similar to pneumonia with fever, cough, dyspnea, chest pain, and even hemoptysis [2,3]. First line treatment is antifungal triazole therapy [1]. Hemoptysis is a life-threatening symptom that requires more urgent treatment. Bronchial embolization is a temporary measure used to treat a symptomatic aspergilloma typically followed by a lobectomy to remove the pulmonary parenchyma colonized by the fungus [3,4]. Surgical intervention is a high-risk procedure especially in patients who are emaciated, currently on immunosuppression therapy, and those with poor pulmonary reserve [3,4]. Currently, the risk of surgery is deemed less than the risk of massive bleeding [2]. There are limited treatment options for an inoperable patient with a chronic aspergilloma. We present a case series of two patients who underwent CT-guided microwave ablation (MWA) of an aspergilloma.

2. Case 1

A 62-year-old male with a medical history significant for COPD, type 2 diabetes mellitus, OSA, CKD IV, CVA and current smoker presented with hemoptysis and was found to have a left lower lobe mass/infiltrate on chest x-ray. A CT of the chest was significant for bullous emphysema and a 3-cm ovoid focus within a bulla in the left lower lobe that was thought to represent a mycetoma (Fig. 1). The patient had a previous chest CT that demonstrated a similar 1- cm lesion. The patient was evaluated by an infectious disease specialist who recommended initiating isavuconazole, performing a bronchoscopy with BAL, and doing a PET-CT to rule out malignancy. Bronchoscopy noted dynamic collapse and compression of the LLL. The 1,3-β-*d*-glucan assay and aspergillus IgG were found to be positive. BAL was positive for aspergillus and negative for acid-fast bacilli. There was a low suspicion of malignancy on PET-CT. Due to significant hemoptysis despite antifungal treatment, thoracic surgery was consulted for evaluation for possible left lower lobectomy. The patient underwent an attempted VATS, but the procedure was aborted intraoperatively due to extensive adhesions in the chest cavity. IR was consulted to consider a CT-guided microwave ablation of the fungal mass, which, to our knowledge, has not been previously attempted to treat an aspergilloma. The patient elected to proceed with MWA. There were no immediate complications on the day of the procedure, but within two weeks the patient returned to the hospital with hemoptysis. A chest X-ray in the ED was noted to have hazy opacifications throughout the left lung with more focal consolidation, which may have reflected new cavitation in the left perihilar region. The chest CT displayed a large consolidation/mass involving most of the left lower lobe with multiple locules of air measuring 12.6 cm. (Fig. 2). He underwent bronchoscopy and was found to have alveolar hemorrhage bilaterally with no identifiable source of bleeding. Partial hemostasis was achieved with epinephrine administration. He was started on a three-day course of tranexamic acid. Gram negative rods grew on the bronchoscopy culture and the patient was started on empiric antibiotics. The following day the patient was intubated following a massive hemoptysis and code blue. An emergent bronchoscopy was performed and noted bilateral mainstem clot burden. After a difficult ventilation attempt, he went into PEA arrest and expired.

3. Case 2

A 69-year-old-male with a past medical history of CAD, CABG, type 2 diabetes mellitus, GERD, COPD, HTN, HLD, and renal cell carcinoma (s/p right nephrectomy) was found to have an incidental LUL 10 mm nodule on chest CT during an ED visit for an episode of hemoptysis, sore throat, and body aches. The patient is a former smoker with a 52-pack year history. He was previously employed in construction and woodworking. Thoracic surgery reviewed the imaging and recommended navigational bronchoscopy and EBUS be performed given the patient's history of renal cell carcinoma. Navigational bronchoscopy and EBUS was performed, and pathology demonstrated scant stripped fragments of benign and reactive bronchial cells in the background of acute inflammation. Serial CT

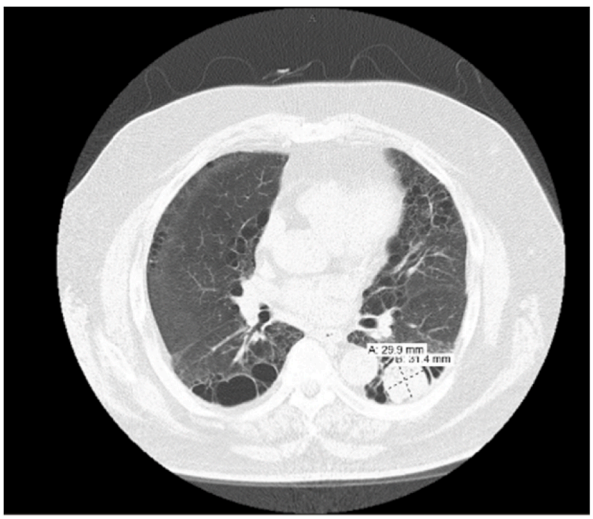

Fig. 1. CT chest revealed a 3 cm ovoid focus within a bulla of the left lower lobe. This mass may represent a mycetoma.

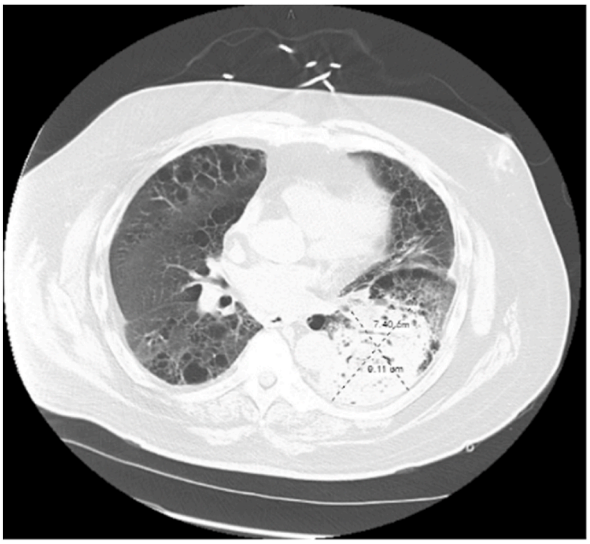

Fig. 2. CT Chest significant for 12.6 cm mass in left lower lobe likely sequelae of recent microwave ablation vs developing infectious process.

chest was recommended every four months to monitor the nodule for changes. Over the next 12 months, there was increased nodular density and size with the nodule measuring 1.4 cm (Fig. 3). Bronchoscopy was performed and pathology was negative for malignancy. A fungal culture grew aspergillus niger. An infectious disease specialist recommended to monitor patient without antifungal treatment as he was asymptomatic at this time. Definitive treatment options were discussed with thoracic surgery including alternatives to surgery. Per the patient's wishes, he was referred to interventional radiology for evaluation. He decided to proceed with microwave ablation for definitive management of his left upper lobe lesion. The procedure was complicated by a moderate sized left pneumothorax. There was no mediastinal shift and no diaphragmatic depression, but a large amount of soft tissue emphysema developed (Fig. 4). A chest tube was placed but there were persistent air leaks. He was taken for bronchoscopy with bronchial valve placement. He had a 6 mm, 7 mm, and 9 mm valve placed. Upon discharge from the hospital, his chest x-ray showed persistent left sided ground glass opacities, consistent with atelectasis. The patient was scheduled for bronchial valve removal within a month. In the interim, the patient experienced wheezing and was told this is common with bronchial valve placement and differences in air flow patterns. Bronchial valve removal was successfully performed the following month. A few months later, a repeat CT chest was performed, which was significant for post treatment changes such as an oblong nodular density at the anterolateral left upper lobe measuring 1.9 × 0.8 cm, which previously measured 1.4 × 1.0 cm. A follow-up chest CT three months later demonstrated an area of linear increased density consistent with scarring in the superior lingula (Fig. 5), with clearing of nodule. The patient has remained asymptomatic and without complications since the procedure.

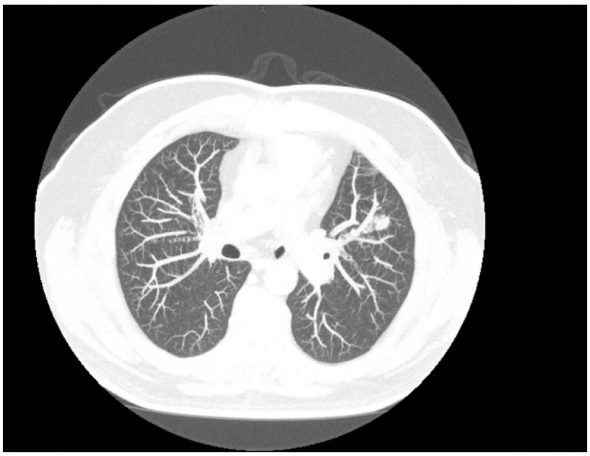

Fig. 3. 1.4 × 1 cm LUL nodule. PET/CT recommended for further workup.

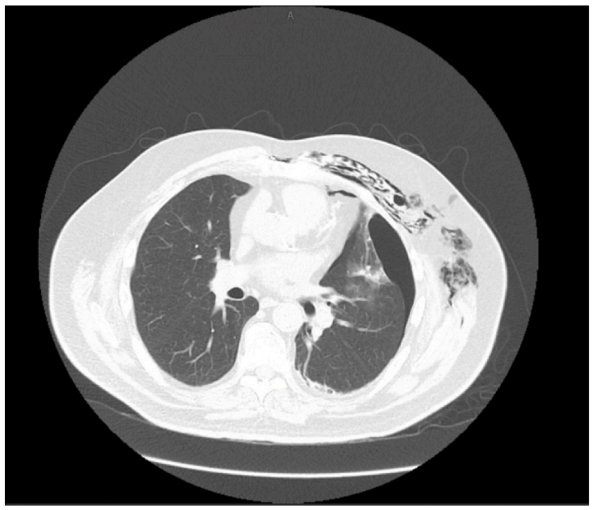

Fig. 4. Moderate LUL ablation zone pneumothorax s/p microwave ablation.

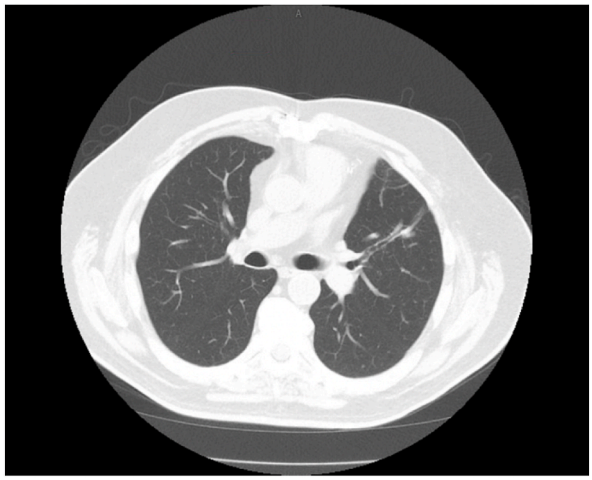

Fig. 5. Streak density in the superior lingula consistent with some parenchymal scarring. Lungs are otherwise clear.

4. Discussion

There are an estimated three million cases of chronic aspergillosis worldwide with an increasing prevalence in developed countries [5]. First line therapy for a chronic aspergilloma is antifungal therapy with an efficacy of 50–80% [6]. The gold standard for symptomatic aspergilloma and those who fail antifungal therapy is surgical intervention. There is a risk of developing hemoptysis from an aspergilloma that carries a 38% mortality risk, and some authors advocate for treatment in asymptomatic patients [6]. Endobronchial embolization may be used as a temporizing measure for hemoptysis, followed by lobectomy as a more definitive treatment.

Surgical intervention has a high risk of complications of up to 63% [6]. Common complications include pneumothorax, respiratory failure, hemorrhage, infection, and arrhythmias [6,7]. Surgery carries a 4–33% mortality [7]. For those who are nonsurgical candidates, there are limited therapeutic options. Delayed treatment of an aspergilloma may result in irreversible pulmonary damage [2]. CT-guided microwave ablation may be an alternative for the inoperable patient and those considered to be high risk.

Microwave ablation has been steadily gaining traction internationally for the treatment of pulmonary malignancies and tumor control in nonsurgical patients [8,9]. Surgical intervention of primary or metastatic lung malignancy can potentially be curative, but this technique carries a substantial risk and may be contraindicated in those having recurrence of metastatic lung malignancy or other comorbidities [9]. There are almost no absolute contraindications, and this therapeutic option may be performed in both an inpatient and outpatient surgical center [10]. The only absolute contraindications are thrombocytopenia, uncorrectable coagulopathy, and tumor location adjacent to a vital structure [10]. MWA is a minimally invasive approach that has been studied in lung cancer with good therapeutic outcomes [10]. This technique is performed under CT guidance to monitor needle position and to assist with targeting the tumor [9]. The advantage of microwave thermal ablation is the rapid speed of temperature rise it generates that results in systemic tumor control with low blood flow to the tumor and subsequent tumor necrosis [10].

CT-guided microwave ablation has been found to be safe and effective and have a low complication profile [10]. The therapeutic effects of disease control in one study were found to be 82–95% [10,11]. In one study "there was no correlation between the efficacy and clinical factors such as age, gender, smoking history, and tumor size before microwave ablation in this study" [10]. In tumor control, the efficacy was 84–87% in tumors up to 3 cm but there was a decrease in efficacy with tumors >4 cm [8,9]. The most common complication of MWA was pneumothorax with an incidence of 13–37% over four studies with a combined 167 patients [8–11]. There were no MWA-related mortalities noted [8–10].

Prior studies support the efficacy and safe use of MWA in pulmonary malignancies and metastatic diseases with minimal to no severe or death related adverse events [8–10]. The novel application of CT-guided microwave ablation may offer a potentially lifesaving technique to control the spread of parenchymal destruction by the eradication of the fungal ball. The further application of MWA in the management an aspergilloma and its efficacy needs to be studied. The low mortality rate of this minimally invasive approach in the treatment of lung malignancy is promising. This procedure allows for a novel, practice changing alternative to the current gold standard of surgical intervention. The small sample size of two cases is a limitation of this study. Consideration for future studies may include early intervention and effectiveness based on aspergilloma size.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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