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CASE REPORT

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Computed tomography-guided microwave ablation therapy for pediatric adrenal neuroblastoma with lung nodule a case report

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Abstract

Background Solid lung lesions are common in clinical practice, and percutaneous thermal ablation has been shown to be an effective treatment for these lesions. While computed tomography (CT)-guided microwave ablation (MWA) therapy is frequently used for adult solid lesions, it is rarely considered for pediatric cases.

Case presentation A case of an 8-year-old child with adrenal neuroblastoma and a left upper lung mass. The child successfully underwent lung mass ablation and experienced a long-term progression-free period with good recovery and no recurrence.

Conclusions This case suggests that MWA could be a valuable addition to existing treatment options for solid lesions in children.

Keywords Computed tomography, Microwave ablation, Pediatric

Introduction

Neuroblastoma (NB) is a pediatric tumor that originates from the developing sympathetic nervous system [1], most commonly affecting the adrenal gland. It is the most common solid tumor in children and accounts for approximately 15% of cancer-related mortality rates. The 5-year survival rate for high-risk NB patients is less than 50% [2]. In cases of adrenal NB with a concurrent lung mass, lung metastasis should be considered. Early diagnosis of lung metastasis can significantly improve the prognosis for pediatric patients [3]. Microwave ablation (MWA) is a safe and effective technique frequently used for treating benign and malignant solid lesions in adults [4]. However, the use of MWA for pediatric lung lesions has been rarely reported, and challenges such as pain or difficulty cooperating during the procedure often limit its application in young patients. This article reports on an 8-year-old child with adrenal NB and a left upper lung mass who successfully underwent MWA for the pulmonary mass.

Case report

An 8-year-old boy presented to the pediatric surgery department with complaints of "abdominal pain and fever." Abdominal CT (plain and contrast-enhanced)

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revealed a mass in the right adrenal region, highly suggestive of neuroblastoma with multiple lymph node metastases in the abdominal and retroperitoneal areas. A pathological diagnosis based on a fine-needle biopsy of the adrenal tumor was: (right adrenal biopsy) undifferentiated neuroblastoma. Bone marrow aspiration confirmed bone marrow involvement by neuroblastoma. According to the International Neuroblastoma Staging System (INSS), the patient was diagnosed with right adrenal neuroblastoma (undifferentiated type, INSS stage 4, INRG stage M, high-risk group) and was determined to have no surgical indication.

After receiving five cycles of chemotherapy, a follow-up imaging examination revealed a solid nodule in the left upper lobe measuring approximately 0.6 cm in diameter, suggesting possible metastasis of the adrenal neuroblastoma. During this period, the boy did not receive any antibiotic treatment. A complete blood count revealed a leukocyte count of 3.16×10^9/L and a neutrophil percentage of 49%. Respiratory tumor markers and infectious disease indicators showed no significant abnormalities. The leukopenia was considered secondary to chemotherapy-induced bone marrow suppression. The patient was treated with recombinant human granulocyte colony-stimulating factor (rhG-CSF) injections to increase the white blood cell count.

Imaging revealed a solid mass in the left upper lobe approximately 6 mm in diameter, raising concerns about potential metastasis from the adrenal NB. To address the possibility of malignancy in the lung lesion, a computed tomography (CT)-guided biopsy and MWA were performed under general anesthesia on the fifth day of admission, following the exclusion of surgical contraindications.

Prior to the procedure, the patient fasted for over 8 h. He was performed under conscious sedation. The patient was placed in the supine position on the CT examination table, connected to electrocardiogram monitoring, and given 5 L/min of supplemental oxygen. A CT positioning coordinate ruler was applied to the tumor area. The anesthesiologist administered dexmedetomidine at 0.1 μg/kg and sufentanil at 0.5 μg/kg 8–10 min prior to the procedure, followed by continuous infusion of sufentanil at 0.5 μg/kg/h for conscious sedation. Using CT guidance, the optimal puncture point, plane, angle, and needle depth were determined. After local anesthesia with 2% lidocaine, the patient was instructed to hold their breath while a lung biopsy needle was inserted into the lung lesion to obtain samples. Following the biopsy, the microwave antenna was positioned in the tumor using the same guidance techniques. The MWA was performed with the antenna confirmed within the tumor via CT imaging. The MWA device and water-cooled circulation system were connected, with parameters set to a 2450 MHz frequency and 40 W power. The ablation was carried out for 5 min, ensuring the treatment area extended 0.5 cm beyond the tumor margins [5]. After completing the procedure, the patient was instructed to hold their breath again while the needle was withdrawn, and the wound was disinfected and bandaged. A final CT scan showed an ideal ablation area, approximately (38 mm × 23 mm), with no complications such as pneumothorax or bleeding. The patient was under adequate sedation during the ablation procedure, and as a result, he did not report any pain or discomfort during the procedure. The patient was closely monitored in the ward and discharged on the second postoperative day. Pathological examination revealed interstitial inflammation and fibrous inflammatory exudate in the lung tissue, with no tumor present (Fig. 1). During an 8-month follow-up, a significant reduction in the ablation area and tumor size was observed. The child remains alive with no significant disease progression or notable clinical symptoms reported (Fig. 2).

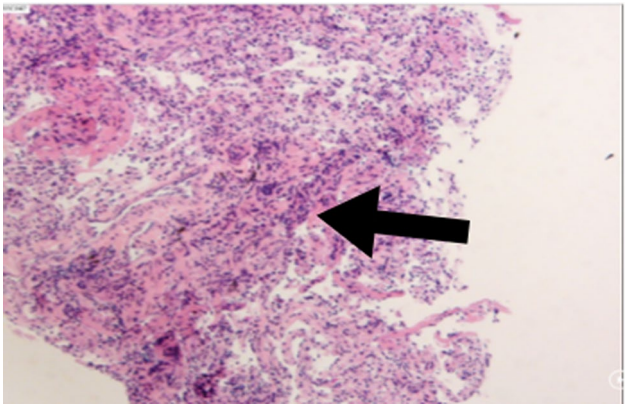

Fig. 1 Pathological diagnosis showed interstitial inflammation in lung tissue, with some being fibrous inflammatory exudate (H&E staining, 400 ×). The arrows indicate inflammatory cells and inflammatory exudate

Discussion

With the continuous development of minimally invasive thermal ablation technologies, MWA has emerged as a preferred method for treating solid tumors due to its low risk, high thermal efficiency, strong vascular coagulation, and rapid ablation capabilities [6].According to the former study, it found that ablative therapies are feasible in children with primary, recurrent or metastatic tumors in lung [7–9].

NB, a common malignant tumor in children, often originates in the abdomen, typically in the adrenal gland. It may present as an asymptomatic abdominal lump or cause symptoms such as hypertension, abdominal pain, bloating, or constipation due to local effects on abdominal organs [10]. While surgical resection of lung lesions is often confirmed by pathology, minimally invasive treatments like percutaneous

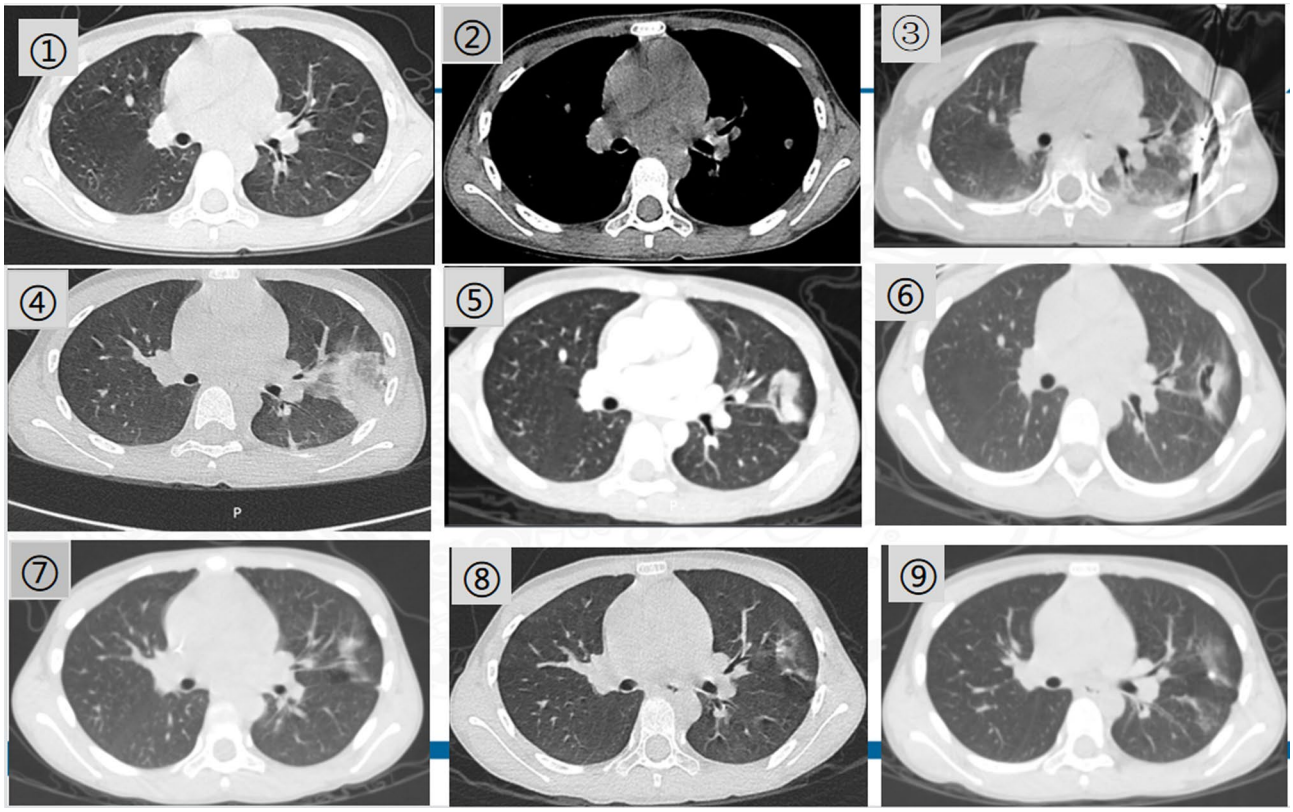

Fig. 2 Figuer 2 An 8-year-old male child was diagnosed with adrenal neuroblastoma. During chemotherapy, a CT scan revealed a nodule with a diameter of approximately 6 mm in the left upper lobe lingular segment, located in the peripheral 1/3 of the lung, which was treated with MWA Preoperative chest CT of MWA showed a single nodule in the left upper lobe lingular segment. ④, ⑤, ⑥ Follow up CT scans at 1, 3, and 5 months after MWA surgery. ⑦, ⑧, ⑨ CT scans at 8, 9, and 10 months after MWA showed a gradual reduction in the ablation area with no signs of local recurrence

thermal ablation have proven to be safe and effective alternatives, especially for younger patients. MWA has demonstrated a success rate exceeding 80% [11]. A retrospective study reported that CT-guided MWA achieved an 82.93% disease control rate in 45 lung cancer patients, with a pneumothorax incidence of only 13.3% [12]. Another study noted low rates of major complications post-MWA, including pneumothorax requiring catheterization (29.4%), rare arrhythmias (2.0%), empyema (2.0%), pulmonary fungal infections (2.0%), and herpes zoster (2.0%). All complications were resolved with treatment, except for herpes zoster, which resulted in long-term skin lesions [13]. MWA is also associated with shorter recovery times compared to traditional surgery [14].

Despite limited reports on MWA for solid lung lesions in children, the successful application of CT-guided MWA in this case highlighted its reliability and applicability for children with primary, recurrent, or metastatic tumors [15]. With its advantages of low invasiveness and strong repeatability, MWA presents a viable and safe treatment option for solid lung lesions in pediatric patients.

Abbreviations

CT	Computed tomography
MWA	Microwave ablation
NB	Neuroblastoma

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Author contributions

SC.P, JX.L and KL.H wrote the manuscript. GS.L, GY.F and X.H reviewed and interpreted imaging findings. Y.L and GQ.Y drew the figures. X.G, SW.C, HF.Z and J.L revised the manuscript and figures.

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Data availability

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request. All data are obtained through retrospective analysis of medical records and do not require a Clinical Trial Number.

Declarations

Ethics approval and consent to participate

The scheme of this report was approved by the Ethics Review Committee of the First Affiliated Hospital of Guangxi Medical University. Written informed consent was obtained from the patient.

Consent to publication
Written informed consent was obtained from the participant for publication of identifying information/images in an online open-access publication.

Clinical trial number
Not applicable.

Competing interests
The authors declare no competing interests.

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