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Clinical and imag#ng features of leptomeningeal metastases from lung carcinomas

Poster No.:	C-1534
Congress:	ECR 2019
Type:	Scientific Exhibit
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Keywords:	Neuroradiology brain, Oncology, MR, Contrast agent-intravenous, Staging, Metastases, Cancer
DOI:	10.26044/ecr2019/C-1534

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Aims and objectives

Leptomeningeal metastasis (LM), a neurological complication of many systemic cancers, is characterized by malignant cells infiltrating leptomeninges and subarachnoid areas. LM is also known as carcinomatous meningitis, neoplastic meningitis, leukemic meningitis (for leukemia), lymphomatous meningitis (for lymphoma) and meningeal carcinomatosis (for carcinoma). The incidence of LM has increased over time in advanced cancers, as a result of prolonged survival with more effective and newer treatment modalities. Despite improved treatment modalities the prognosis of LM is extremely poor (1,2). In LM pathogenesis hematogenous spread is the most common way and malignant cells also can invaded by direct invasion, neural perineural-perivascular lymphatic pathways, or iatrogenic (during surgery) spread (3).

LM occurs in approximately 5% to 8% of patients with solid tumors and 5% to 15% of patients with hematologic malignancies. Among solid tumors, metastatic breast cancer is the most common etiology, followed by lung cancer and malign melanoma. Less common but reported in the literature are primary brain, gastric, prostate and colon cancers. LM occurs in approximately 1-6% of patients with lung cancer and most commonly in non-small cell lung cancer. Adenocarcinoma is most frequent histologic subtype, followed by squamous cell carcinoma (1,4).

Diagnosis of leptomeningeal metastasis is based on medical and clinical history, imaging, and cerebrospinal fluid (CSF) findings. The clinical presentation is nonspecific, with signs and symptoms varying from headache and confusion to focal neurologic deficits, such as cranial nerve palsies. In clinical trials low sensitivity has been reported for identification of malignant cells in the CSF. Due to its non specific clinical presentation and low sensitivity of cerebrospinal fluid results cytology diagnosis of LM is still a challenge. Imaging techniques contributes to making differential diagnosis and accurate management (1,2,5).

We aimed to present clinical and magnetic resonance imaging (MRI) features of leptomeningeal metastases from lung carcinomas with literature.

Methods and materials

We retrospectively analyzed the clinical and contrast-enhanced MRI findings of patients between June 2015 and July 2018. Inclusion criteria for this study were: histopathologically proven lung carcinomas and diagnosis of leptomeningeal metastases by brain MRI. For eligible cases, medical records were reviewed for patients' demographic characteristics, lung carcinoma subtypes, presenting symptoms/findings, medical history and MRI findings.

MRI scans were performed with 1.5T (Siemens Avanto, Erlangen, Germany) and 3T MRI scanner (GE Healthcare, Milwaukee, WI) with intravenous gadolinium contrast administration (Dotarem, gadoterate meglumine; Guerbet, Aulnay-sous-bois, France).

All images were analyzed retrospectively in concencus by two experienced radiologists without knowledge of patients data. Leptomeningeal involvement was evaluated in contrast-enhanced T1-weighted images. We documented location and enhancement pattern of leptomeningeal involvement, presence of cranial nerve involvement, hydrocephalus and subependymal nodule on MRI. The patterns of contrast enhancement were classified as linear, nodular and both of linear and nodular.

Statistical analyses were performed using the IBM SPSS Statistics software, version 20.0 (SPSS Inc, Chicago, IL, USA.) Continuous variables were expressed as median (minimum-maximum) and categorical variables as number (percentage). The distributions of the continuous were tested with the Kolmogorov-Smirnov test.

This study was approved by ethics comitee and informed consent was obtained from all patients included in the study.

Results

In this study nineteen patients (male /female: 17/2; mean age: 57±12 years; age range: 32-75 years) were included. The most common type was non-small cell lung cancer (70.6%), of which were all adenocarcinoma. The most common presenting symptoms were headache (100%) and altered consciousness (84.2%). Patients'and tumor characteristics are shown in Table 1. Leptomeningeal metastases were mostly occured in both infratentorial and supratentorial areas (57.9%). On MRI majority of enhancement pattern was nodular (57.9 %) followed by linear (26.3%) and both of them (15.8%) (Figs. 1-2). Hydrocephalus (42.1%) and subepandimal nodules (5.3%) were relatively rare (Fig. 3). Cranial nerve involvement was rarely detected only in two cases (Fig. 4). MRI characteristics of LM are illustrated in Table 2.

The potential data limitations of this study including retrospective nature, small patient population, heterogeneous clinical and tumor characteristics have to be pointed out.

Images for this section:

Table 1. Patients' and tumor characteristics

	n(%)
Number of patients	19
Age-*year, mean ±, (range)*	55.4±12 (29-75)
Gender	
Female	2 (10.5%)
Male	17 (89.5%)
Histologic type/subtype	
Non-small cell lung cancer	13 (68.4%)
Adenokarsinom	*13 (68.4%)*
Small cell lung cancer	6 (31.6%)
Presenting symptoms	
Headache	19 (100%)
Altered consciousness	16 (84.2%)
Vomiting	14 (73.7%)
Focal neurological deficit	14 (73.7%)
Cognitive impairment	10 (52.6%)
Seizure	3 (15.8%)
Treatment type	
Chemotherapy	6 (31.6%)
Chemotherapy +Radiotherapy	10 (52.6%)
Not known	3 (15.8%)
Outcomes	
Exitus	18 (94.7%)
Alive	1 (5.3%)

Table 1: Patients' and tumor characteristics

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Tablo 2. MRI characteristics of leptomeningeal metastases

	n(%)
Location	
Supratentorial	2 (10.5%)
Infratentorial	6 (31.6%)
Supratentorial + Infratentorial	11 (57.9%)
Enhancement pattern	
Linear	5 (26.3%)
Nodular	11 (57.9%)
Linear + Nodular	3 (15.8%)
Cranial nerve (CN) involvement	
CN 5, CN 7 and CN 8	1 (5.3%)
CN 4,5,6,7,8 ,9 and 10	1 (5.3%)
Presence of hydrocephalus	8 (42.1%)
Presence of subepandimal nodules	1 (5.3%)

Table 2: MRI characteristics of leptomeningeal metastases

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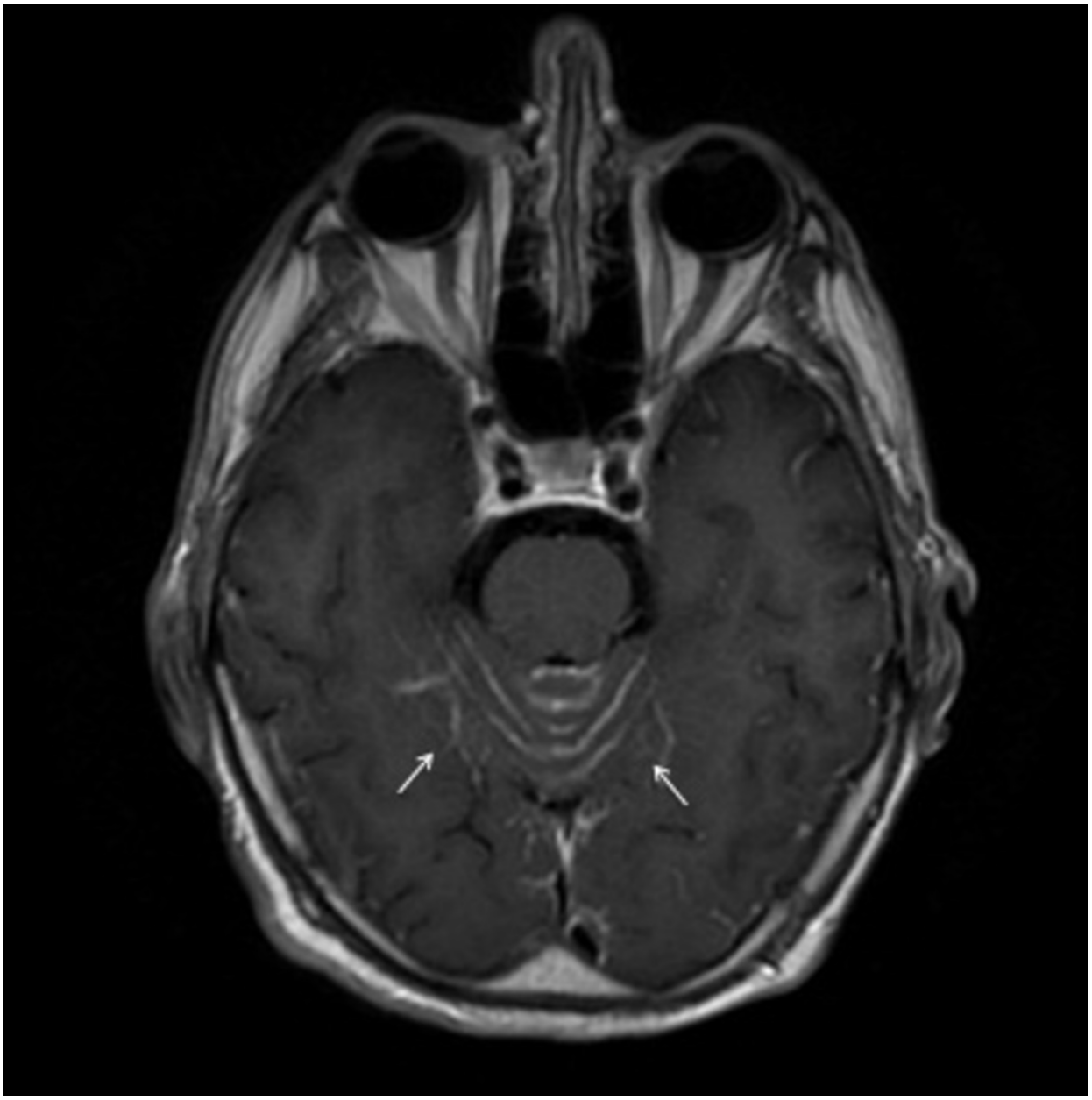


Fig. 1: Leptomeningeal metastases in a 61-year-old man with non-small cell lung cancer (adenocarcinoma). Axial contrast-enhanced T1weighted images (a, b) show leptomeningeal linear enhancement of cerebellar folia (arrows).

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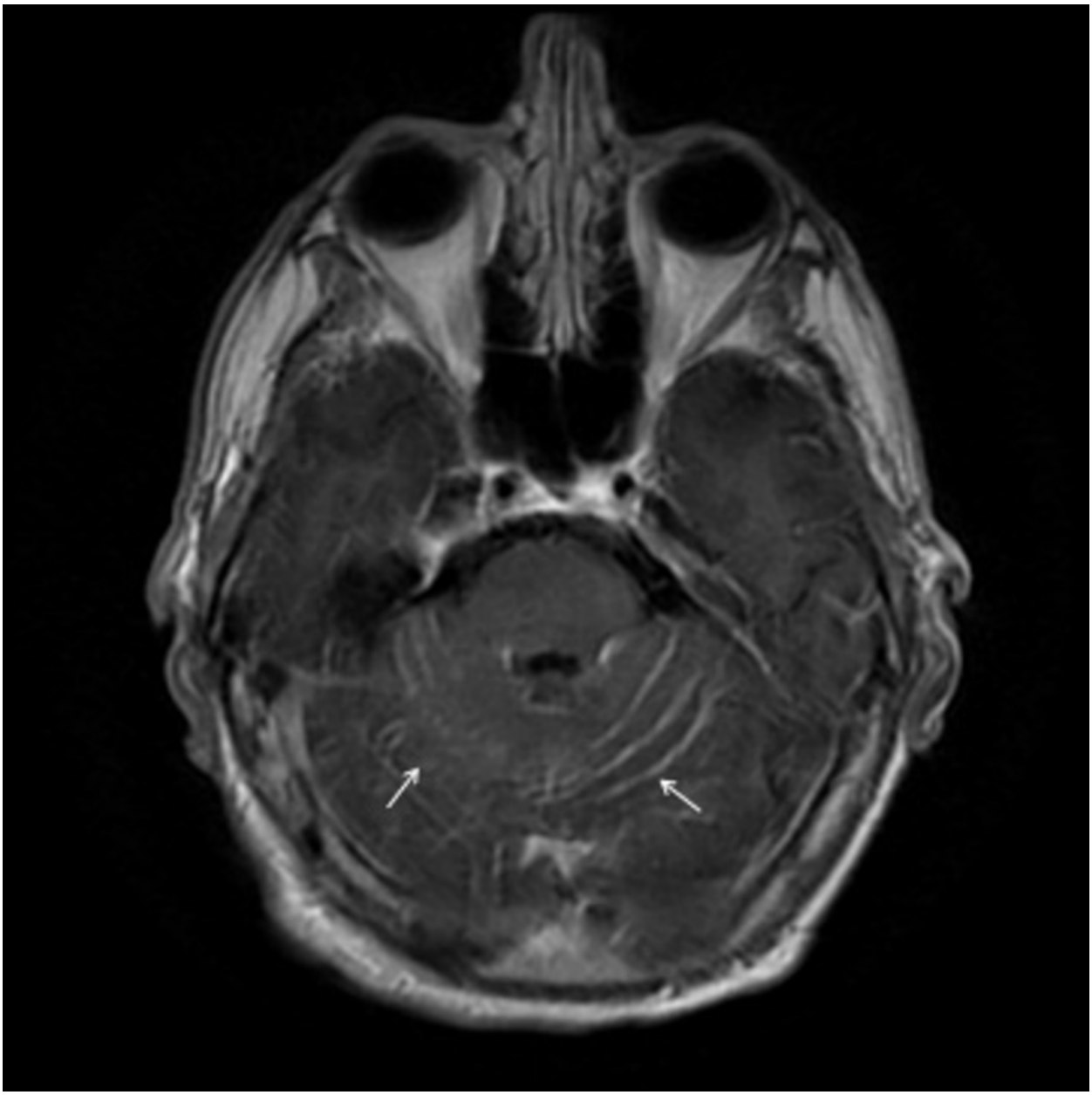


Fig. 2: Leptomeningeal metastases in a 61-year-old man with non-small cell lung cancer (adenocarcinoma). Axial contrast-enhanced T1weighted images (a, b) show leptomeningeal linear enhancement of cerebellar folia (arrows).

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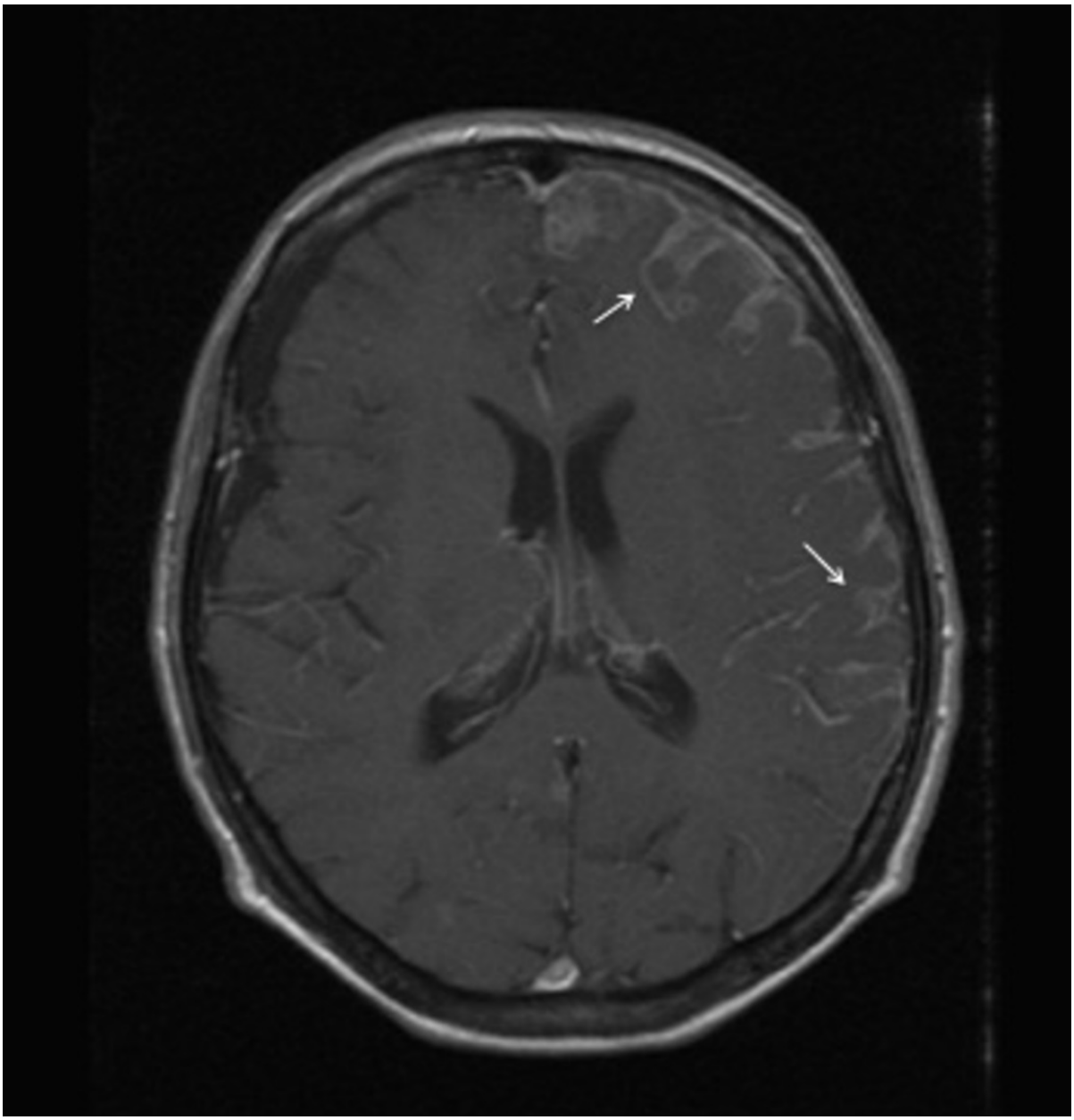


Fig. 3: Leptomeningeal metastases in a 58-year-old man with small cell lung cancer. Axial and sagittal contrast-enhanced T1weighted images (a, b) show leptomeningeal nodular and linear enhancement in left frontal lobe (arrows).

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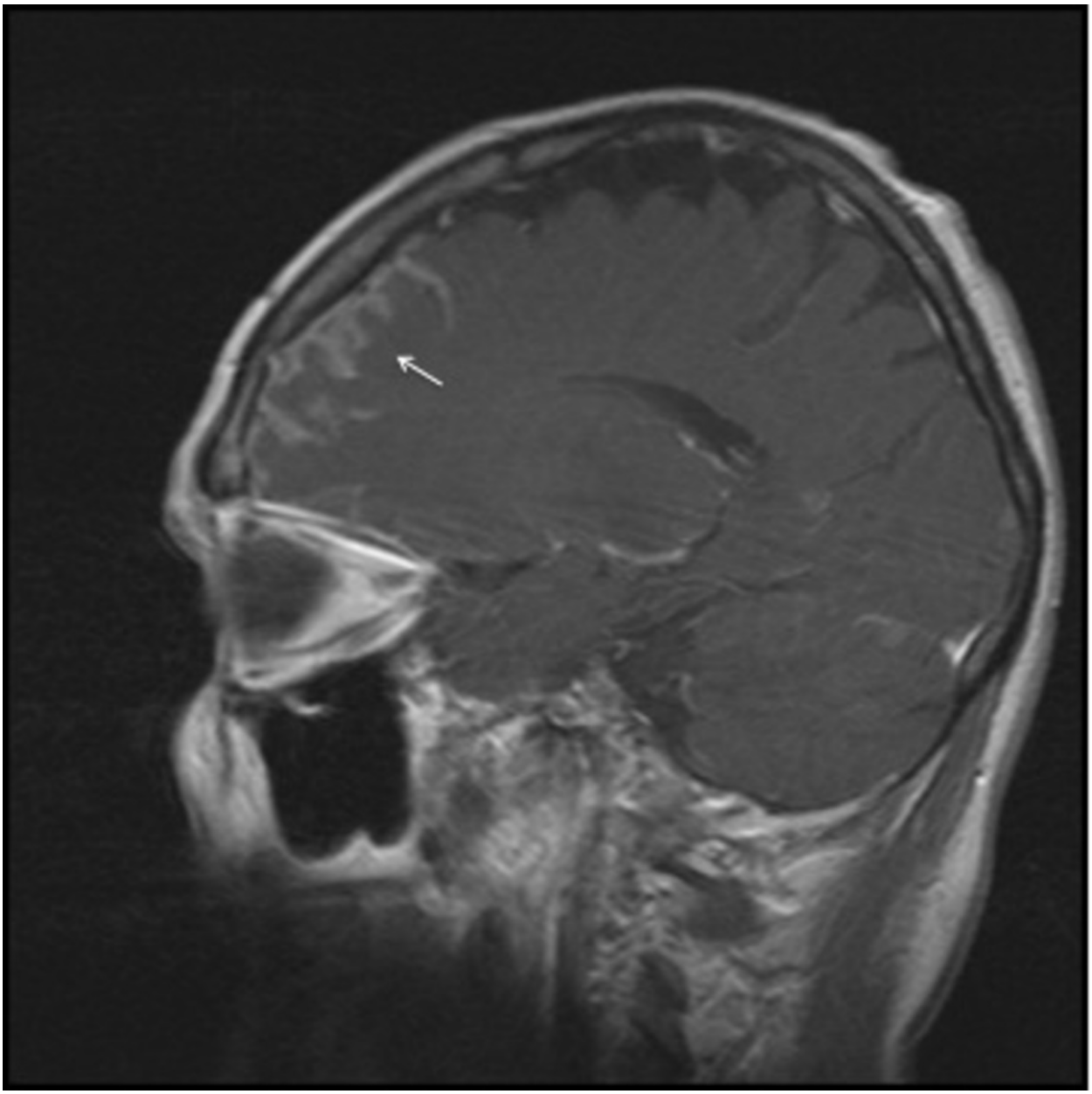


Fig. 4: Leptomeningeal metastases in a 58-year-old man with small cell lung cancer. Axial and sagittal contrast-enhanced T1weighted images (a, b) show leptomeningeal nodular and linear enhancement in left frontal lobe (arrows).

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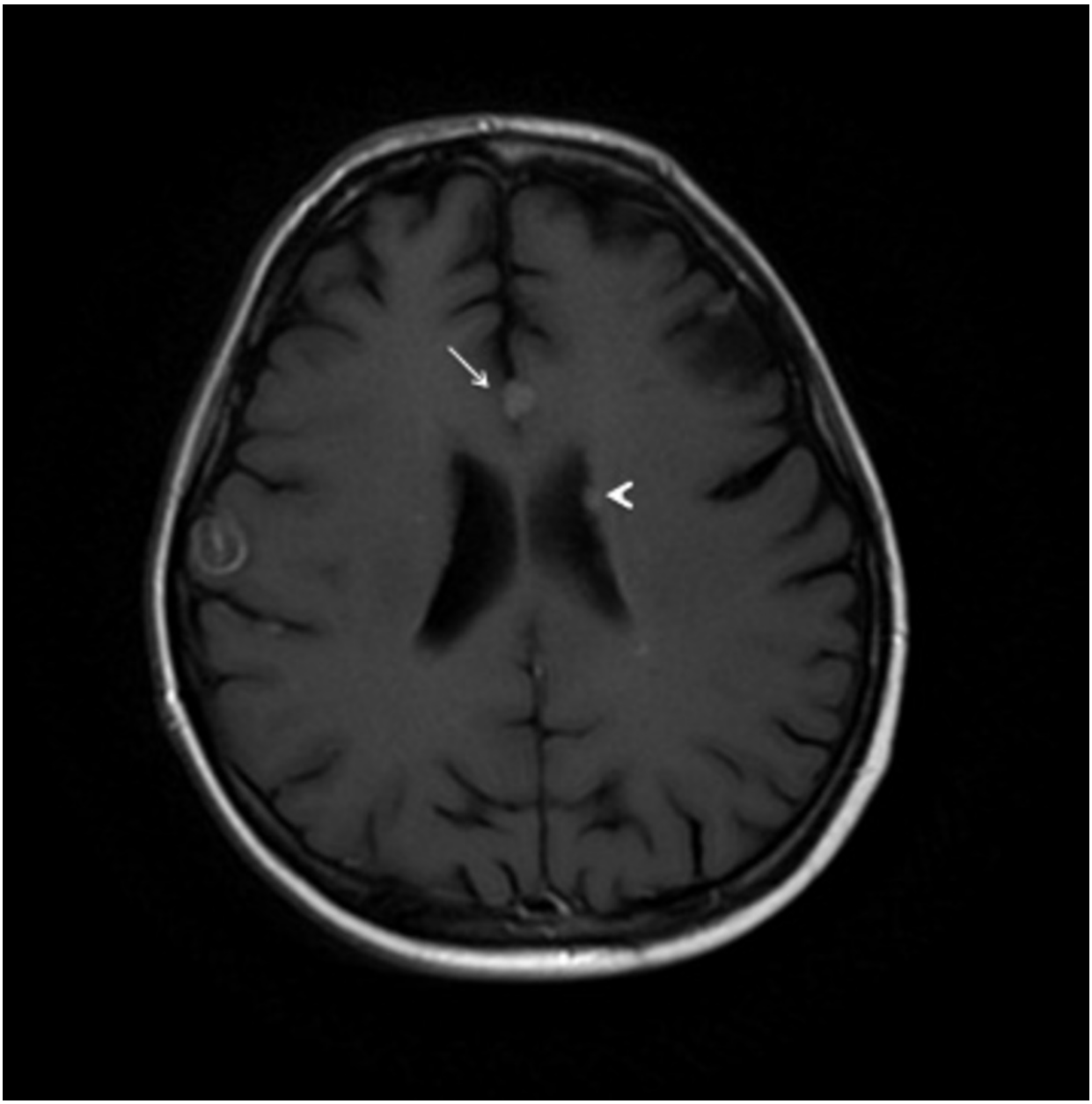


Fig. 5: Leptomeningeal metastases in a 57-year-old man with small cell lung cancer. Axial contrast-enhanced T1weighted images (a, b) show leptomeningeal nodular enhancements in bilateral frontal lobes(arrow) and subependimal nodules (arrowhead).

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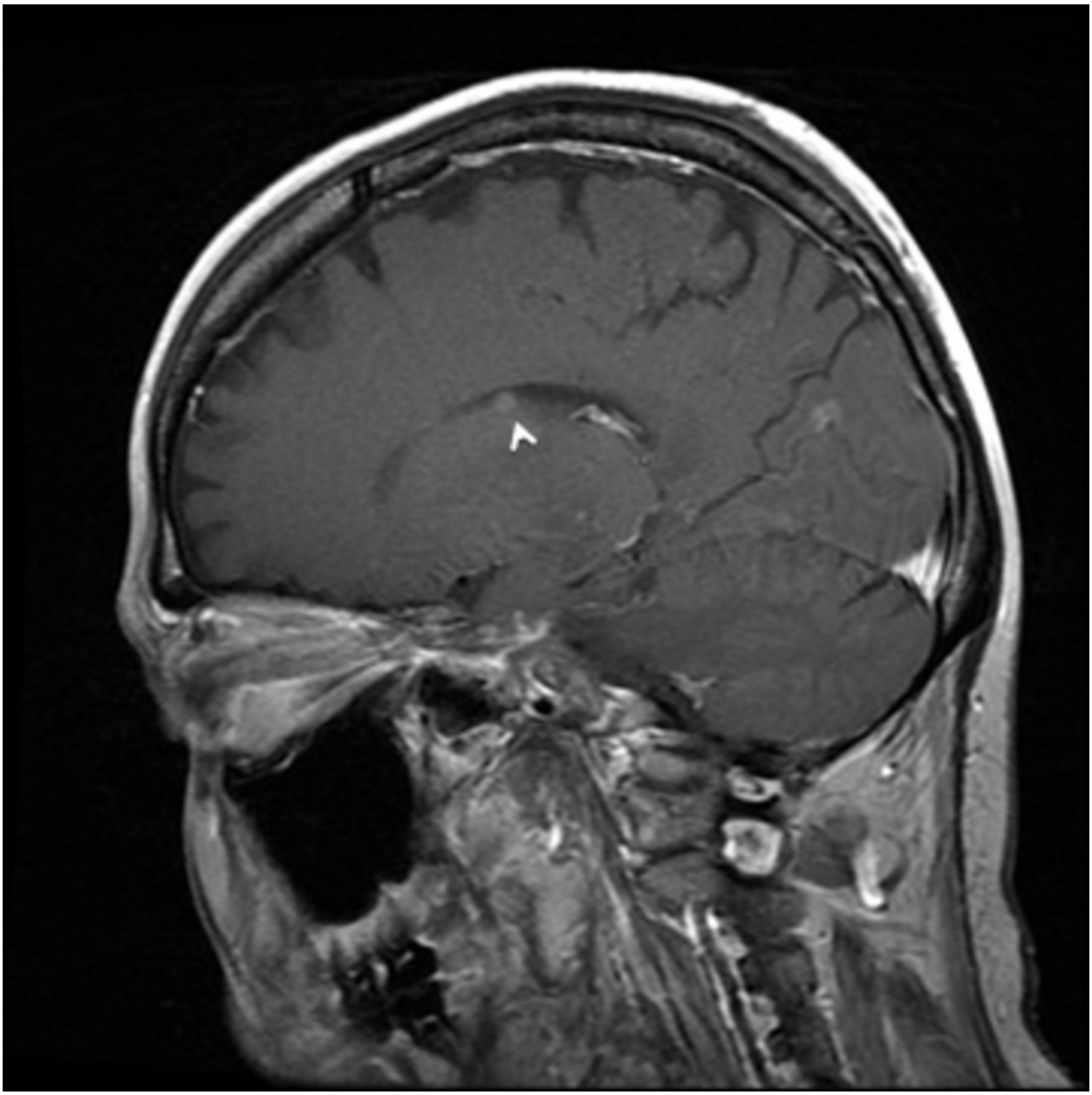


Fig. 6: Leptomeningeal metastases in a 57-year-old man with small cell lung cancer. Axial contrast-enhanced T1weighted images (a, b) show leptomeningeal nodular enhancements in bilateral frontal lobes(arrow) and subependimal nodules (arrowhead).

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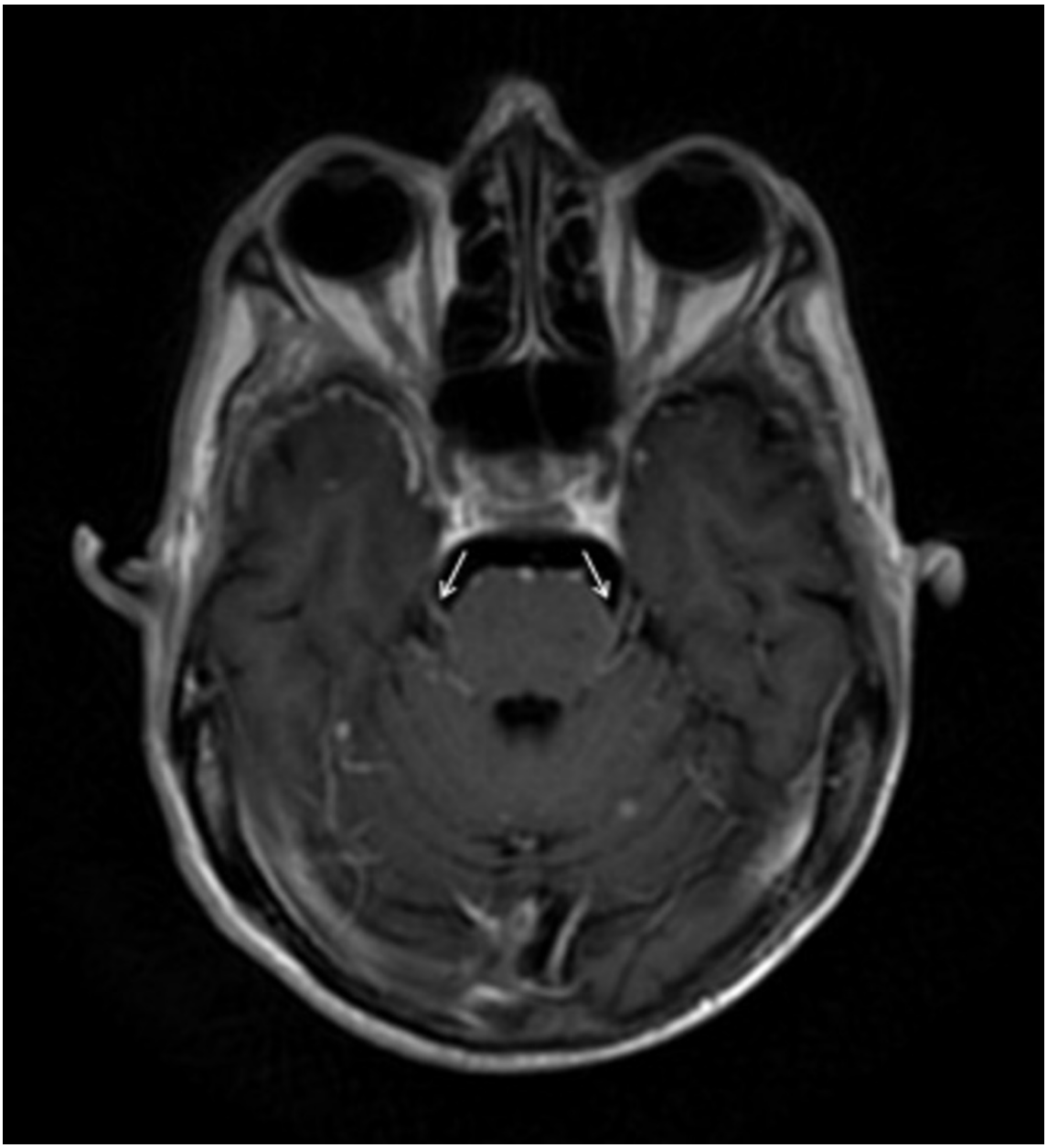


Fig. 7: Leptomeningeal metastases in a 62-year-old man with small cell lung cancer. Axial contrast-enhanced T1weighted images (a-c) show leptomeningeal nodular and lineer enhancements of bilateral cranial nerves (CN 4,5,6,7,8,9, and 10) and in cerebellar folia (arrows).

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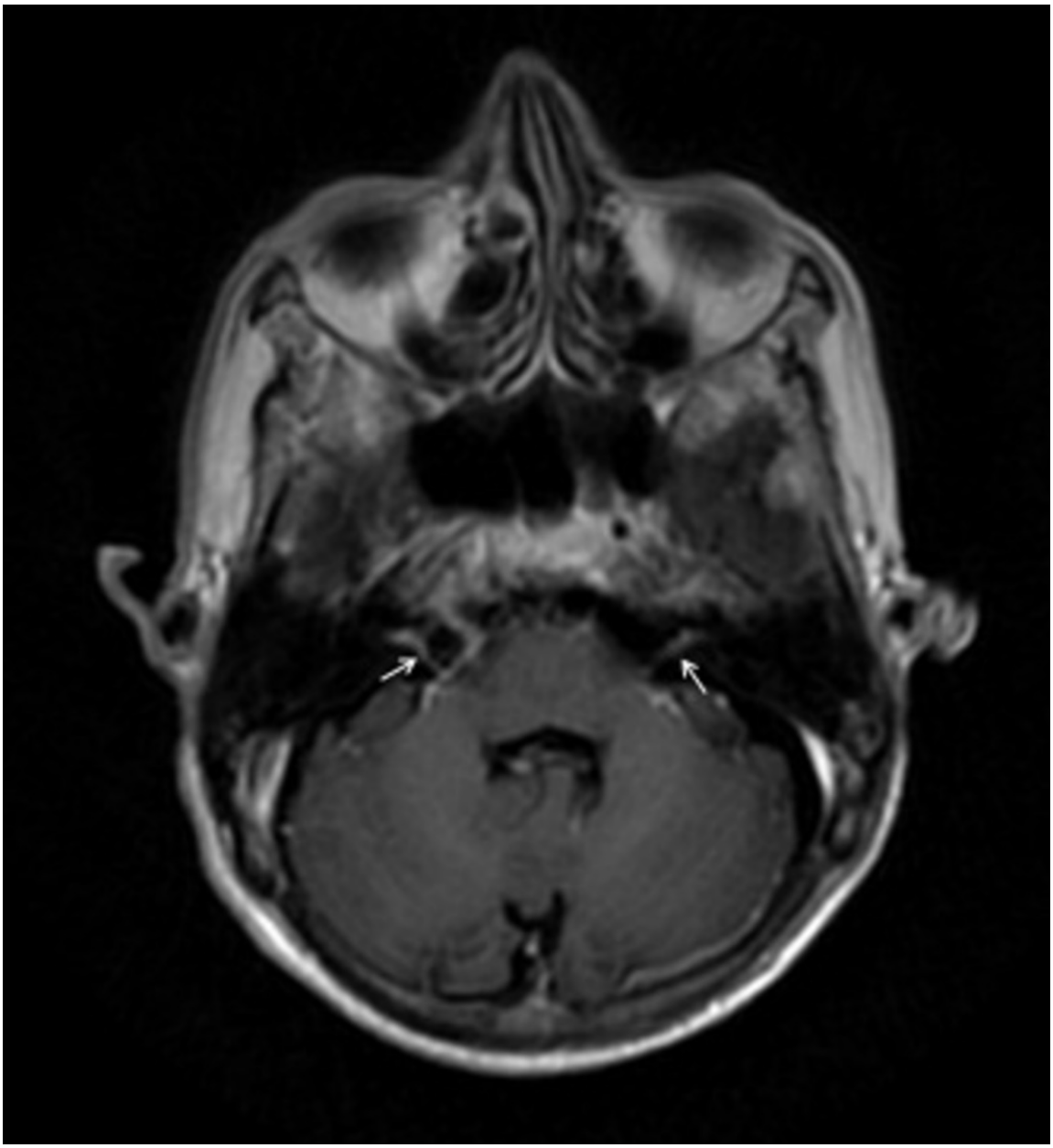


Fig. 8: Leptomeningeal metastases in a 62-year-old man with small cell lung cancer. Axial contrast-enhanced T1weighted images (a-c) show leptomeningeal nodular and lineer enhancements of bilateral cranial nerves (CN 4,5,6,7,8,9, and 10) and in cerebellar folia (arrows).

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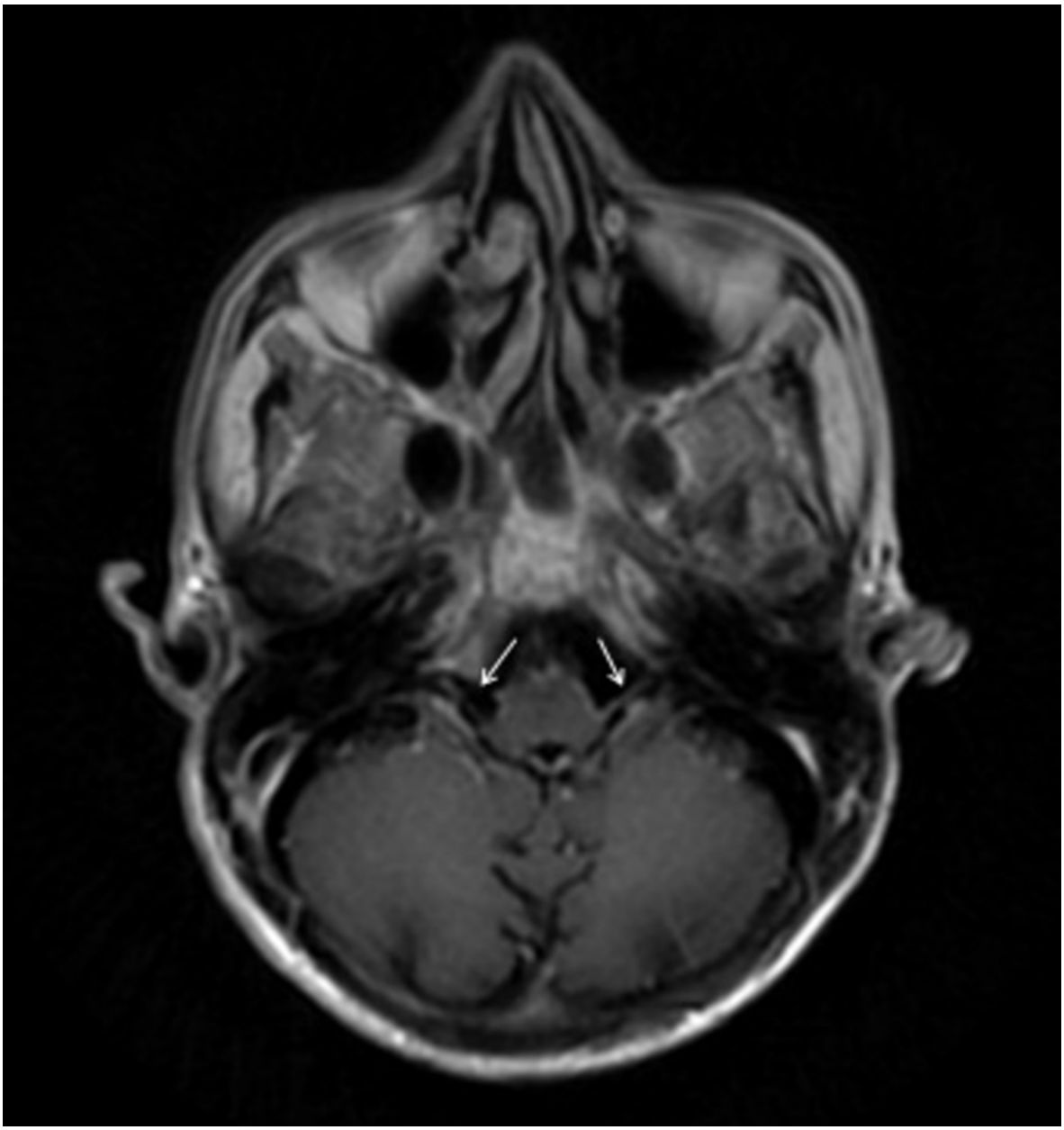


Fig. 9: Leptomeningeal metastases in a 62-year-old man with small cell lung cancer. Axial contrast-enhanced T1weighted images (a-c) show leptomeningeal nodular and lineer enhancements of bilateral cranial nerves (CN 4,5,6,7,8,9, and 10) and in cerebellar folia (arrows).

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Conclusion

LM represents a diagnostic challenge due to wide variety of clinical features and limited diagnostic tools. Imaging therefore may play an important role in detection, diagnosis and follow-up of LM. The clinical and imaging data found in our study are mostly similar with previous studies in the literature.

Clinicians and radiologists should be aware of leptomeningeal metastases that can be seen in patients with lung carcinomas who present with headache and altered consciousness. Contrast enhanced MRI is the most useful imaging modality of assesment in evaluating a patient with suspected leptomeningeal metastases. Understanding the most common clinical and MRI findings allows for accurate diagnosis and management of leptomeningeal metastases in lung carcinomas. In addition further research is needed to determine characteristic features of leptomeningeal metastases from lung carcinomas.

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