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*AJNR Am J Neuroradiol* 1989, 10 (5 suppl) S67-S68  
[http://www.ajnr.org/content/10/5\\_suppl/S67.citation](http://www.ajnr.org/content/10/5_suppl/S67.citation)

This information is current as  
of April 23, 2024.

## MR Appearance of Intracranial Chloromas

Chloromas (granulocytic sarcomas) are solid tumors of myelogenous origin associated with acute and chronic myelocytic leukemia. Although chloromas can be found almost anywhere in the body, intracranial involvement of the CNS is particularly rare. The CT appearance of intracranial chloromas has been described [1, 2]. This report describes the MR appearance of intracranial chloromas in a patient with chronic myelocytic leukemia.

### Case Report

A 25-year-old man, previously in good health had severe headaches followed by diplopia. Evaluation by an ophthalmologist revealed a right sixth-nerve palsy, and the patient was admitted to the hospital for evaluation. Unenhanced CT of the head showed hyperdense lesions of the left frontal and bilateral temporal lobes, associated with some surrounding edema (Fig. 1). Enhancement of these lesions after administration of contrast material was uniform. The WBC was  $80,000/\mu\text{l}$ , and a bone marrow biopsy showed marked myeloid hyperplasia with less than 5% immature forms. A diagnosis of chronic myelogenous leukemia was made, and the patient was transferred to our hospital.

Examination revealed moderate papilledema, a right sixth-nerve palsy, and hepatosplenomegaly. The results of laboratory studies and another bone marrow biopsy supported previous findings. An MR scan of the brain was obtained 1 week after admission. On the basis of the clinical setting and the CT and MR findings, the intracranial lesions were thought to be chloromas, and the patient had cranial irradiation. His headache, papilledema, and sixth-nerve palsy disappeared. Follow-up CT showed resolution of the lesions.

### Discussion

In 1853 [3], King coined the term "chloroma" because of the characteristic green color of these tumors, which later was shown to be due to the presence of myeloperoxidase in the tumor cells. Not all chloromas are green, however, and the synonyms granulocytic sarcoma and myeloblastoma have been introduced.

The prevalence of chloromas is far greater in acute myelogenous leukemia, although a few cases associated with chronic myelopro-

liferative disorders have been described [4]. Chloromas may be present at the time of diagnosis, may precede the diagnosis by months to years, or may occur late in the disease.

Chloromas usually are found in association with bone; the tumor is thought to arise in the bone marrow and traverse the haversian canals to reach the periosteum. These tumors have shown a propensity for the cranium and facial bones and usually are attached to the dura or the periosteum of the bones of the paranasal sinuses, mastoid cells, or orbits [5].

Chloromas involving the CNS are exceedingly rare [6]. In post-mortem studies, diffuse leukemic meningeal or dural infiltration is found in as many as 25–50% of patients with leukemia [7]. Nodular infiltrates or parenchymal masses, however, rarely have been reported [5]. The advent of more effective chemotherapy has resulted in prolonged survival of patients with acute myelogenous leukemia, and consequently, the prevalence of CNS leukemia has increased. Azzarelli and Roessman [8] have postulated that CNS leukemia is the result of the passage of neoplastic cells from involved bone marrow of the skull to the dura. Then, by way of perivenous adventitial tissue connecting dura matter with subarachnoid space, the cells can invade the brain parenchyma.

On CT, intracranial chloromas may exhibit intermediate or high attenuation on unenhanced scans, may be associated with surrounding edema, and typically show uniform contrast enhancement [2]. These lesions may be confused with hematoma, abscess, meningioma, metastatic neuroblastoma, and CNS lymphoma [1]. The hyperdensity, uniform enhancement, and surrounding edema of this patient's intracranial lesions are certainly compatible with this description of the CT appearance of intracranial chloromas.

On MR images, the lesions were isointense with white matter on both the T1- and T2-weighted scans. Although this is an uncommon finding with intracranial masses, it has been described with meningiomas [9]. Kao et al. [10] reported an identical pattern in two other patients with chloromas. No comment was made about the intensity of bone marrow, but the published images suggest abnormal marrow signal intensity. On the basis of one proposed pathogenesis of chloromas, we would expect this to be a common finding, reflecting the intracranial extension of marrow infiltration.

It is important to consider chloromas in the differential diagnosis of extraaxial intracranial masses. Although these lesions might be

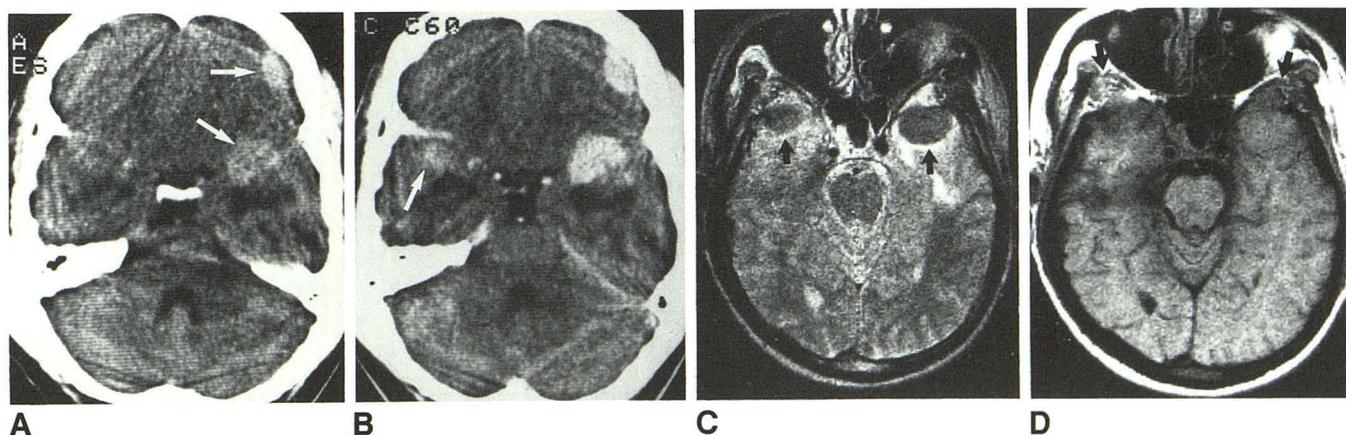


Fig. 1.—Intracranial chloromas.  
 A, Unenhanced CT scan shows hyperdense lesions (arrows) of left frontal and temporal lobes and associated edema.  
 B, Enhanced CT scan shows uniform enhancement of lesions and visualization of a third lesion in right temporal lobe (arrow).  
 C, T2-weighted MR image, 2500/90, shows hypointense lesions (arrows) in temporal lobes and surrounding high-signal edema.  
 D, T1-weighted MR image, 500/30, shows lesions are isointense with brain. Note low signal of marrow in adjacent sphenoid bones (arrows) compared with high signal on C.

mistaken for meningiomas on the basis of their signal intensities on MR images, the appearance of abnormal bone marrow should suggest the correct diagnosis. This information about the marrow is not available on CT images and further emphasizes the value of MR. We anticipate that MR contrast agents will increase the ability to detect these low-contrast lesions.

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