NEUROSARCOIDOSIS : EVALUATION WITH MRI

D. PICKUTH, S.H. HEYWANG-KÖBRUNNER

Department of Diagnostic Radiology, Martin-Luther-University, Faculty of Medicine, Magdeburger Straße 16, D – 06112 Halle/Saale, Germany.

SUMMARY
Clinical studies report a rate of 5 % and autopsy results a rate of 25 % of brain involvement in sarcoidosis. The aim of this study was to evaluate the role of magnetic resonance imaging (MRI) in the diagnosis of patients with neurosarcoidosis. The MRI brain scans of 22 patients with sarcoidosis were retrospectively reviewed, along with the clinical information that was provided in the request form. All patients had signs and symptoms referable to the head and were examined with gadolinium enhancement. Cranial (facial) nerve paralysis was the most common clinical manifestation identified in 10 patients. A wide spectrum of MR findings was noted : Periventricular and white matter lesions on T2W spin echo images, mimicking multiple sclerosis (46 %) ; multiple supratentorial and infratentorial brain lesions, mimicking metastases (36 %) ; solitary intraaxial mass, mimicking high grade astrocytoma (9 %) ; solitary extraxial mass, mimicking meningioma (5 %) ; leptomeningeal enhancement (36 %). These findings are not specific for sarcoidosis and one must consider appropriate clinical circumstances in arriving at the correct diagnosis. In selected cases with isolated brain involvement, meningeal or cerebral biopsy may be required.

Key words : neurosarcoïdose, differential diagnosis, magnetic resonance, imaging.

RÉSUMÉ
Neurosarcoïdose : évaluation par IRM
Il existe une atteinte cérébrale au cours de la sarcoïdose dans 5 % des cas selon les séries cliniques et dans 25 % des cas selon les séries d’autopsie. L’objectif de cette étude est d’évaluer le rôle de l’imagerie par résonance magnétique (IRM) dans le diagnostic des patients atteints de neurosarcoïdose. Nous avons analysé rétrospectivement les IRM cérébrales de 22 patients ayant une neurosarcoïdose et colligé les données cliniques à partir des demandes d’examen. Tous les patients avaient des symptômes neurologiques et ont eu une injection de gadolinium. la manifestation clinique la plus fréquente était une paralysie du nerf facial observée chez 10 patients. Les résultats de l’IRM étaient très variables : lésions pérvventriculaires et de la matière blanche, semblables aux lésions de la sclérose en plaque sur les images en écho spin T2 (46 %) ; des lésions multiples supratentoriales et infratentoriales, semblables aux méstases (36 %) ; une masse intraaxiale isolée, semblable à un astrocylome de stade avancé (9 %) ; une masse extraxiale isolée, semblable à un méningiome (5 %) ; un rehaussement leptomeningé (36 %). Ces signes n’étant pas spécifiques de la sarcoïdose, il faut considérer les circonstances cliniques pour faire le diagnostic. Une biopsie est parfois nécessaire chez des patients ayant une lésion cérébrale ou méningée isolée.

Mots-clés : neurosarcoïdose, diagnostic différentiel, imagerie par résonance magnétique.

Sarcoidosis is a multisystem disorder of unknown origin characterized in affected organs by an accumulation of non-caseating epithelioid granulomas. It is usually diagnosed in patients between 20 and 40 years of age. The disease is more common in women and in people of West African descent [1]. The lung is the most frequent organ affected, although clinical studies report a rate of 5 % of brain involvement in sarcoidosis. However, autopsy studies indicate a frequency of central nervous system involvement of approximately 25 %, implying a significant rate of subclinical neurologic disease [2].

Signs and symptoms of neurosarcoïdosis are variable and depend on location and size of granulomas. It has been noted in many series that neurologic involvement can be a significant cause of morbidity and mortality from sarcoidosis.

Corticosteroid therapy is the primary treatment for this disorder. Some patients respond rapidly, whereas others may require long-term therapy. Side effects of corticosteroids, aggressive disease or frequent recurrences may require other immunosup-
pressive drugs, e.g. methotrexate and cyclophosphamide [3]. Cerebral irradiation may be successful in some cases when other treatments fail. Prognosis of chronic neurosarcoidosis is poor.

Previous reports of neurosarcoidosis concentrated on clinical manifestations and outcome of the disease, rather than the neuroradiological findings [3-5]. There are very few descriptions on the magnetic resonance imaging (MRI) appearance of neurosarcoidosis, most of them being case reports [1, 6-9]. The aim of our study, therefore, was to evaluate in a relatively large number of patients the role of MRI in neurosarcoidosis.

METHODS AND PATIENTS

The MRI brain scans of 22 patients (14 females, 8 males; median age 34 years) with sarcoidosis were retrospectively reviewed, along with the clinical information that was provided in the request form. MRIs were obtained with the MAGNETOM SP and MAGNETOM VISION MRI units at 1.5 Tesla and with the MAGNETOM EXPERT MRI unit at 1.0 Tesla (Siemens, Germany). Axial and coronal images were obtained using spin echo sequences. 21 patients were examined at least once with gadolinium enhancement, 17/22 patients underwent serial examinations during steroid therapy.

All patients had signs and symptoms referable to the head. In our series, cranial nerve paralysis was the most common clinical manifestation identified in 10 patients (table I).

RESULTS

MRI, with and without contrast enhancement, revealed a wide spectrum of findings (table II). 10 patients showed periventricular and white matter lesions on T2WI, mimicking multiple sclerosis (figure 1). MRI demonstrated multiple supratentorial and infratentorial brain lesions, mimicking metastases, in 8 patients (figure 2). Two patients presented with a solitary intraaxial mass, mimicking high grade astrocytoma, one patient with a solitary extraaxial mass, mimicking meningioma (figure 3) (table III). Various amounts of vasogenic oedema were seen in the white matter adjacent to the masses.

DISCUSSION

It is important to diagnose neurosarcoidosis early because of the high morbidity and mortality associated with it [10]. The typical presentation is with cranial nerve palsies, particularly facial, but others include headache, fatigue, seizures, and multiple

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**Table I.** Presenting symptoms (n = 22).

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>n</th>
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<tbody>
<tr>
<td>Cranial nerve paralysis (facial nerve paralysis)</td>
<td>10</td>
</tr>
<tr>
<td>Headache, drowsiness, and seizures</td>
<td>8</td>
</tr>
<tr>
<td>Multiple sclerosis type symptoms</td>
<td>5</td>
</tr>
<tr>
<td>Subacute or chronic meningitis</td>
<td>5</td>
</tr>
<tr>
<td>Pituitary or hypothalamic dysfunction (diabetes insipidus)</td>
<td>2</td>
</tr>
</tbody>
</table>

**Table II.** MRI findings in neurosarcoidosis (n = 22).

<table>
<thead>
<tr>
<th>Findings</th>
<th>n</th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td>Periventricular and white matter lesions (T2WI)</td>
<td>10</td>
<td>46</td>
</tr>
<tr>
<td>Multiple supratentorial and infratentorial brain lesions</td>
<td>8</td>
<td>36</td>
</tr>
<tr>
<td>Solitary intraaxial mass</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>Solitary extraaxial mass</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Leptomeningeal enhancement (nodular or diffuse)</td>
<td>8</td>
<td>36</td>
</tr>
</tbody>
</table>

**Table III.** Main differential diagnoses of cerebral neurosarcoidosis.

- Multiple sclerosis
- Metastases
- Lymphoma
- Neurotuberculosis
- Low grade/high grade glioma

Imaging revealed leptomeningeal and ependymal enhancement in 8 patients, usually in the basal, hypothalamic and periventricular regions (figure 4). These meningeal lesions often could not be distinguished from carcinomatous, bacterial, fungal, or tuberculous meningitis. In some cases, meningeal or ventricular granulomas caused either communicating or obstructive hydrocephalus.

Abnormal enhancement was the finding that was most responsive to corticosteroid therapy, with response seen in 7/8 patients with leptomeningeal enhancement and in 6/9 patients with enhancing brain parenchymal masses. In five patients, the lesions decreased markedly in size after steroid treatment; no response was detected in the remaining four.

The chest radiograph was abnormal in all patients with neurosarcoidosis. In 17/22 patients, gallium uptake was consistent with the diagnosis of active sarcoidosis. Serum angiotensin-converting enzyme levels were raised in 10/22 patients. Cerebrospinal fluid features, including lymphocyte pleocytosis, raised protein levels, decreased glucose concentration, and negative cultures for fungus and mycobacterium, were of little help.
Fig. 1. — Neurosarcoidosis. Axial MR turbo inversion recovery magnitude (TIRM) (TR 9000, TE 110) image demonstrating bilateral, periventricular foci of high signal intensity.

Fig. 1. — Neurosarcoidose. IRM axiale, TRIM (TR 9000, TE 110) montrant un foyer préventriculaire bilatéral hyper-intense.

Fig. 2. — Neurosarcoidosis. Axial MR T1W (TR 600, TE 15) image with gadolinium enhancement showing multiple cerebellar granulomas of varying size.

Fig. 2. — Neurosarcoïdose. IRM axiale, T1 (TR 600, TE 15) avec rehaussement montrant des granulomes cérébraux multiples de taille variable.

Fig. 3. — Axial MR T1W (TR 600, TE 14) image with contrast medium reveals extraaxial granuloma with meningeal enhancement and vasogenic oedema simulating a meningioma. Biopsy-proven neurosarcoidosis.

Fig. 3. — IRM axiale, T1 (TR 600, TE 14) avec produit de contraste montrant un granulome extraaxial et un rehaussement méningé avec œdème vasogénique simulant un méningiome. Neurosarcoïdose histologique.

Fig. 4. — Extensive sulcal and periventricular enhancement in a 42-years-old male with neurosarcoidosis. Axial MR T1W (TR 700, TE 15) image.

Fig. 4. — Rehaussement des sillons et des structures péri-ventriculaires chez un homme de 42 ans atteint de neurosarcoïdose (TR 700, TE 15).
sclerosis type symptoms. Most groups have concur
red that facial nerve paralysis was the most common
manifestation of the disease [2, 3, 5]. Less common
presentations include amnestic syndrome, intracta-
ble hiccoughs, schizophreniform symptoms, and
acute stroke [8]. Any or all of the preceding neuro-
logic manifestations can occur without any evidence
of pulmonary or other systemic features of sarcoi-
doisis. The wide range of clinical symptoms is reflected
in the many MRI signs [11].

- Although some patients displayed a benign
course with the disease, the majority of patients had
persistent symptomatic disease requiring corticoste-
roid or other immunosuppressive therapy. Serial
MRI examinations during several months revealed
decreasing tumour size in 5/9 patients, which paral-
leled clinical improvement. Abnormal enhancement
was the finding that was most responsive to corticos-
teroid therapy.

Neurosarcoidosis has predilection for the base of
the brain, but any part of the central nervous system
may be affected [4]. Meningal involvement is in the
form of nodules or plaques, showing focal or diffuse
thickening on contrast enhanced MRI scans. This
finding, however, is rather nonspecific and is also
seen with many other disorders (table IV). The ap-
ppearance of single or multiple intraxial masses in
neurosarcoidosis indicates extension of granuloma-
tous disease from the meningeal or ventricular sur-
faces into the perivascular spaces and subsequently
into the parenchyma.

| Table IV. — Main differential diagnoses of meningeal
  sarcoïdosis.  
| TABLEAU IV. — Diagnostics différentiels principaux 
  de la neurosarcoidose méningée. |

| Meningitis (carcinomatous, bacterial, fungal, tuberculous) |
| Meningioma |
| Metastases |
| Lymphoma |
| Leukaemia |
| Plasmacytoma |
| Idiopathic hypertrophic pachymeningitis |

A commonly reported MRI finding in neurosarcoi-
dosis is hydrocephalus [1, 8]. This is usually the
result of fourth ventricular outflow obstruction or of
reduced resorption of cerebrospinal fluid. We have
only encountered three cases with either obstructive
or communicating hydrocephalus.

Sarcoidosis of the skull is extremely rare and ma-
manifests as osteolytic lesions; neither marginal sclero-
sis nor periosteal reaction has been reported.

In patients with a previous diagnosis of sarcoi-
doisis or in the presence of characteristic clinical and
radiological findings, the diagnosis of neurosarcoidosis
is relatively straightforward. When neurological in-
volved is the first or only manifestation of sarcoi-
doisis, the diagnosis is difficult and may be one of
exclusion. Moreover, when sarcoïdosis manifests as a
solitary intracranial mass without any leptomeninge-
al enhancement, the correct diagnosis becomes
very elusive.

In appropriate clinical circumstances, contrast en-
hanced MRI is the best noninvasive test for neuro-
sarcoidosis. It is capable of narrowing the diffe-
rential diagnosis, and it can be used to follow therapeu-
tic response. Normal MRI, however, does not ex-
clude the diagnosis of neurosarcoidosis, especially in
patients with only cranial neuropathies or in corti-
costeroid treated patients. Although computed to-
mography (CT) can demonstrate abnormalities in
some cases, MRI is superior to CT in demonstrating
the parenchymal and especially the meningeal le-
sions.

CONCLUSION

In conclusion, neurosarcoidosis remains a signifi-
cant complication for patients with sarcoïdosis. It
can mimic a host of more common disease processes,
such as multiple sclerosis, metastases, glioma, and
meningioma. It is important to keep neurosarcoido-
is in mind to preclude unnecessary surgery and to
guide appropriate treatment. In selected cases with
isolated brain involvement, meningeal or cerebral
biopsy may still be required.

REFERENCES

[1] HOLLANDER MD, FRIEDMAN DP. Neuroradiology case of the
Diagnosis and management of neurological sarcoidosis. Arch
[5] WIEHOLTER H, SCHMID E. Neurosarcoidose. Akt Neurolo-
[6] JACKSON RJ, GOODMAN JC, HUSTON DP, HARPER RL. Para-
falcine and bilateral convexity neurosarcoidosis mimicking
meningioma : Case report and review of the literature. Neu-
cerebellopontine angle meningioma. AJR 1998 ; 171 : 
275-276.
[8] ELLIS PK, BELL KE. The radiological investigation of neuro-
[9] HANDLEY MS, JOHNSON LM, DICK AR, BATNITZKY S. Neu-
rosarcoidosis with unusual MRI findings. Neuroradiology
[10] KADAKIA JK, COLLETTE PM, SHARMA OP. Role of magnetic
resonance imaging in neurosarcoidosis. Sarcoidosis 1993 ; 