K. Okamoto  
J. Ito  
T. Furusawa  
K. Sakai  
S. Tokiguchi

Abstract We reviewed the imaging of four pathologically proven calvarial eosinophil granulomas. The diameter of the lesions ranged from 13 to 40 mm; three were biconvex, but the other had a collar-stud appearance. Two lesions were in the frontal and two in the parietal bone. On bone-window CT, a bevelled edge was seen in three cases and button sequestration in one, but no sclerotic rim was shown. Although one lesion had a low-density area, the lesions were slightly denser than grey matter. They were isointense with grey or white matter on T1-weighted MRI and gave heterogeneous high signal on proton-density and T2-weighted images. All enhanced markedly, with a less strongly enhancing portion within them. A tail of dural enhancement and reactive change in the overlying galea or temporal muscle were seen in all cases.

Key words Skull · Eosinophilic granuloma · Histiocytosis Langerhans-cell · Computed tomography · Magnetic resonance imaging · Scintigraphy

Introduction
Eosinophil granuloma, Hand-Schüller-Christian disease and Letterer-Siwe disease are characterised by idiopathic proliferation of histiocytes producing focal or systemic manifestations. Collectively, they are called Langerhans-cell histiocytosis (LCH) [1]. The localised form of LCH is commonly referred to as eosinophil granuloma; the term is reserved for cases in which the disease is limited to bone or lung. Accounting for approximately 70% of cases of LCH, this localised form is the least aggressive expression of the diseases with the best prognosis [1]. Eosinophil granuloma of the skull is most frequently seen in children or adolescents, and its imaging appearances have been described [1–5]. Articles on the MRI appearances of calvarial eosinophil granuloma are sparse [6–11]. We assess the imaging characteristics of eosinophil granuloma of the skull, reviewing four pathologically proven cases.

Materials and methods
We studied three boys and one girl ranging in age from 2 to 10 years (mean 6.7 years), using various imaging techniques. Each patient had a 1-month history of a cranial lump with pain or tenderness. Skull films were obtained in all patients as the initial imaging study. Subsequently CT and MRI were performed. Bone scintigrams with 99mTc-methylene diphosphonate (MDP), and gallium scintigrams were available for three patients. The diagnosis was confirmed by open biopsy or excision.

MRI was obtained with a 1.5-T system. A dynamic study was performed on two patients, and heavily diffusion-weighted echoplanar images ($b = 1200$ or $1100 \text{s/mm}^2$) with a caudocephalad diffusion gradient were also obtained in two cases.

Results
The clinical and radiological features are summarised in Tables 1 and 2. The lesion was solitary and monostotic in all patients; the frontal bone was involved in two, and the parietal bone in the other two. The lesions ranged
Table 1  Clinical, radiographic and scintigraphic features

<table>
<thead>
<tr>
<th>Case</th>
<th>Age/sex (years)</th>
<th>Length of history (months)</th>
<th>Chief complaint</th>
<th>Side</th>
<th>Craniogram</th>
<th>Involved bone</th>
<th>Size (mm)</th>
<th>Configuration</th>
<th>Sclerotic rim</th>
<th>Button sequestrum</th>
<th>Scintigram</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Bone (Tc-MDP)</td>
</tr>
<tr>
<td>1</td>
<td>2/M</td>
<td>1</td>
<td>A lump with tenderness</td>
<td>Right</td>
<td>Parietal</td>
<td>23–40</td>
<td>Geographic</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>+ (circular)</td>
</tr>
<tr>
<td>2</td>
<td>6/M</td>
<td>1</td>
<td>A lump with pain</td>
<td>Left</td>
<td>Frontal</td>
<td>13–18</td>
<td>Oval</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>not available</td>
</tr>
<tr>
<td>3</td>
<td>9/F</td>
<td>1</td>
<td>A lump with tenderness</td>
<td>Left</td>
<td>Frontal</td>
<td>20–30</td>
<td>Lobulated</td>
<td>–</td>
<td>–</td>
<td>+, positive, –, negative</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>10/M</td>
<td>1</td>
<td>A lump with pain</td>
<td>Left</td>
<td>Parietal</td>
<td>20</td>
<td>Round</td>
<td>–</td>
<td>–</td>
<td>+ (circular)</td>
<td></td>
</tr>
</tbody>
</table>

+, positive, –, negative

Fig. 1 a–e  Case 2.  a Skull film, lateral projection.  A rounded osteolytic lesion with an irregular, nonsclerotic rim is seen in the frontal bone (arrowheads).  b CT.  The frontal bone eosinophil granuloma is demonstrated as slightly denser lesion compared to grey matter of the underlying brain (*).  c T1-weighted image.  The lesion is biconvex and isointense with grey matter (*).  A small high-signal area is seen (arrow).  Signal from the adjacent bone marrow is decreased (arrowheads).  d T2-weighted image.  The lesion gives heterogeneously higher signal than brain, similar to that of subcutaneous fat.  A small higher-signal portion, corresponding to the small high-signal area in c, is seen (arrow).  e Contrast-enhanced T1-weighted image with fat-suppression.  The lesion enhances markedly, with a less enhancing portion (arrow).  A dural tail of enhancement (small arrowheads) and reactive galeal enhancement (large arrowheads) are also seen.