Computerized tomography and surgical treatment in intracranial suppuration

Report of 30 consecutive unselected cases of brain abscess and subdural empyema

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The authors report their experience with 30 cases of intracranial suppuration: 23 with brain abscess and seven with subdural empyema. All of the cases were diagnosed by means of computerized tomography and enhancement with intravenous contrast material. Most of the patients were treated by single or repeated aspiration through burr holes.

Key Words - computerized tomography - brain abscess - subdural empyema - enhancement with contrast material - surgical treatment

The introduction of computerized tomography (CT) in surgical neurology has revolutionized the investigation of intracranial lesions. We have found it particularly valuable in the investigation of intracranial suppuration. We are reviewing our experience with 30 consecutive unselected and surgically treated cases of intracranial suppuration diagnosed by CT.

Summary of Cases

Some 1400 cases were investigated by means of CT in this department over a 12-month period, June, 1975, to May, 1976. Among these, 23 cases of cerebral abscess and seven of subdural empyema were diagnosed and surgically treated.

Brain Abscess

The origin of the infection in 23 brain abscesses is analyzed in Table 1. Head injuries and pyogenic meningitis were most frequently the cause of intracranial suppuration. The site of the abscess is summarized in Table 2.

Although the provisional diagnosis was based on a careful neurological examination,
the exact localization and specific diagnosis of cerebral abscess was made following CT. The CT picture of a cerebral abscess is consistent and a firm diagnosis can usually be made from it. Characteristically, it shows as a thin rim of higher than normal brain density, surrounding an elliptically shaped center of low density. Surrounding the sharply demarcated capsule of the abscess, an area of edema of low density is seen, associated with mass displacement of ventricle and midline structures (Fig. 1).

The firm delineation of the capsule is the characteristic on which a positive diagnosis can be made. After enhancement, the well defined, regular and sharply demarcated capsule contrasts markedly with the irregular ring-like structures seen in rapidly growing gliomas with necrotic centers (Fig. 2). No significant enhancement was seen in two of our 10 patients with posttraumatic abscesses, possibly because the investigation was carried out early during the encephalitic phase. In four abscesses no enhancement was attempted.

Although the infusion of contrast material during CT is useful in locating the lesion and in delineating certain characteristic features, it is not possible at this stage to make an unequivocal diagnosis. However, the presence of gross cerebral edema and the concomitant displacement of structures, the presence of a regular "capsule" surrounding low-density material, the presence of daughter abscesses, and sulcus staining, all contribute to a presumptive diagnosis of cerebral abscess.

Tumor, subdural hematoma, metastases, and recent infarction must be considered in the differential diagnosis. Tumor offers the greatest problem and all the facets of CT must be taken into account before an unequivocal diagnosis can be made. In the unenhanced CT scan a tumor may have a higher, the same, or lower tissue density. It is
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not possible to generalize, but the majority of meningioma and slow-growing gliomas tend to have tissue density higher than normal brain density, and rapidly growing tumors tend to have a tissue density lower than brain tissue. The difficulty appears with tumors of the same density as the brain tissue where brain edema and concomitant distortion, displacement, and dilatation of ventricles is minimal. In these cases, where a strong presumptive clinical diagnosis of tumor is made, enhancement with contrast material becomes obligatory.

The enhancement of a tumor tends to be at the periphery delineating the lesion from the surrounding edematous brain tissue. Any density change after the injection of 20 ml of contrast material favors a diagnosis of tumor. The meningioma shows an affinity for the contrast material and the enhancement is homogenous, whereas in the case of a glioma it tends to be marginalized, ring-like, and irregular, circumscribing areas of low density which can be either tumor cyst or extensive tumor necrosis. The ring-like structures seen in tumors can readily be distinguished from abscess as they tend to be less sharply defined, thicker, and irregular.

A chronic subdural hematoma may offer some difficulty in diagnosis, but it can be distinguished from an abscess or brain tumor in that a subdural hematoma enhances poorly. It requires up to five times as much contrast material to outline the brain against the non-changing bulk of a hematoma. Metastases enhance poorly and, when multiple, the diagnosis can easily be reached. Metastases are usually readily distinguished from abscesses but this distinction between tumors is less pronounced. A low-density lesion that does not enhance is suggestive of a recent infarction.

The survival rate arising from operative treatment is shown in Table 3. Repeated CT scans are mandatory to ascertain the course of the abscess. Initially, Steripaque was injected into the abscess cavity together with antibiotics, on the assumption that it would enhance subsequent scanning and stimulate gliosis. Steripaque is no longer instilled into abscess cavities as it was found that it did not facilitate visualization and also caused considerable artifact on subsequent scanning. It has also been noticed that with aging of the capsule, subsequent CT rarely requires enhancement.

Subdural Empyema

The origin of infection in the seven cases of subdural empyema is shown in Table 4 and the site and mortality in Table 5. The CT scan shows a crescent-shaped area of decreased density at the periphery of the brain and mass displacement of the ipsilateral ventricle and midline structures. Enhancement with intravenous contrast material of a subdural collection of pus demonstrates a characteristic rim-like crescent adjacent to the cortex (Fig. 3 left). In four of the cases we found the parafalx collection of pus was well marked (Fig. 3 right). All the patients were subjected to aspiration through multiple

| TABLE 3 |
| Operative treatment and mortality in 23 cases of brain abscesses |

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. of Cases</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>aspiration, single or repeated</td>
<td>18</td>
<td>14  4</td>
</tr>
<tr>
<td>aspiration and drainage</td>
<td>3</td>
<td>3  0</td>
</tr>
<tr>
<td>excision</td>
<td>2</td>
<td>2  0</td>
</tr>
<tr>
<td>total</td>
<td>23</td>
<td>19  4</td>
</tr>
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burr holes and irrigation with ampicillin or Chloromycetin (chloroamphenicol).

**Treatment and Mortality**

Two of the 23 brain abscesses in our series were totally excised. This is the method favored by LeBeau, et al. Four of the 23 patients died. Seven cases of subdural suppuration in conjunction with a parafalx collection of pus were treated by aspiration through burr holes; two of these patients died. One patient with a massive collection of pus in the subdural space associated with a thick capsule (Fig. 4) required a craniotomy.

The overall mortality in our total series of 30 consecutive cases was six (20%). This compares very favorably with the much larger series of LeBeau, et al. who reported a mortality of 70% to 100% of those treated by aspiration and 50% to 70% of those treated by piecemeal excision in the acute cases; and 60% to 63% of those treated by aspiration and 25% to 28% of those treated by piecemeal excision in the subacute cases. Bhandari and Sarkari reported 37 cases of subdural empyema with 12 deaths. In our opinion each case should be individually assessed and treated either by aspiration or aspiration followed by excision. If the recent results are compared with those of the era before the introduction of the CT scanner, a substantial improvement is noted which cannot be attributed to improvement or variation in technique only. The reduction in the mortality rate during the past year, since the introduction of CT, could be due to accurate localization that has brought about a variation in treatment, with a tendency to treat abscesses primarily by aspiration. Com-
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FIG. 5. Computerized tomography scans of a patient with a right parietal parasagittal brain abscess. Left: After enhancement with contrast material, the abscess is seen associated with widespread cerebral edema of the right hemisphere. Right: After two aspirations. Fragments of the shrunken capsule are seen.

Computerized tomography assists in careful postoperative follow-up studies and the progress of intracranial suppuration can be traced as clearly demonstrated in Figs. 5 and 6.

Discussion

The methodology of surgical treatment of an acute, subacute, or chronic abscess is to a large measure dictated by the individual case and, no doubt, will be influenced by experience gained with CT. Although in most cases the radioactive isotope scan gives an unequivocal answer to the exact site of the abscess, the degree of accuracy is not comparable to CT. The localization of abscesses by means of angiography is very much inferior to either of the above methods.

A review of the literature of the past few years shows that the most useful diagnostic tests in brain abscesses have been angiography and ventriculography. Further, angiography was regarded as the most useful test in the detection of subdural empyema. Other authors favored different diagnostic procedures, with the emphasis on angiography, or isotope scan, electroencephalography (EEG) and angiography, or EEG and isotope scan.

FIG. 6. Computerized tomography scan of a patient with a left temporoparietal subdural empyema (left), and 13 days later after aspiration through a burr hole (right).
TABLE 4

<table>
<thead>
<tr>
<th>Origin of Infection</th>
<th>No. of Cases</th>
</tr>
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<tbody>
<tr>
<td>sinus infection</td>
<td>2</td>
</tr>
<tr>
<td>meningitis</td>
<td>2</td>
</tr>
<tr>
<td>abscess of scalp</td>
<td>1</td>
</tr>
<tr>
<td>posttraumatic infection</td>
<td>1</td>
</tr>
<tr>
<td>postoperative infection</td>
<td>1</td>
</tr>
<tr>
<td>total</td>
<td>7</td>
</tr>
</tbody>
</table>

TABLE 5

<table>
<thead>
<tr>
<th>Site of Empyema</th>
<th>No. of Cases</th>
<th>Died</th>
</tr>
</thead>
<tbody>
<tr>
<td>lt frontal</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>lt frontal &amp; parafalx</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>rt frontal</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>bilateral &amp; parafalx</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>total</td>
<td>7</td>
<td>2</td>
</tr>
</tbody>
</table>

In 30 consecutive unselected cases of brain suppuration the majority of patients were treated by repeated aspiration and only two by total excision. We do not desire to claim that the method of aspiration is superior to other methods of treatment, but this method of treatment might prove to be the best if CT is available for the accurate determination of the location of the abscess, the presence of mono- or multiloculation, multiple abscesses, and the presence of parafalx collection of pus. It is also possible to follow easily and accurately the evolution of the brain abscess and subdural empyema and the course of surgical treatment.

References


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