Magnetic Resonance Imaging in Down’s Syndrome

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ABSTRACT: 100% of brains of Down’s adults over age 40 will show Alzheimer-type neuropathologic changes in the frontal and temporal lobes. In an attempt to image these lesions, magnetic resonance imaging (MRI) was performed in seven patients with Down’s syndrome, ranging in age from 17 to 45 years, using a resistive unit operating at 0.15 Tesla. All scans were within normal limits except for one 45 year-old patient with severe left temporal lobe atrophy. No areas of abnormal signal were seen in the frontal or temporal lobes and the white matter lesions commonly seen in elderly demented subjects were not visualized in this group. We conclude that these white matter lesions are likely coincidental and not causally related to Alzheimer’s changes. The pathologic process leading to the formation and development of Alzheimer’s changes in the brains of Down’s adults may not be visible on magnetic resonance images.

RESULTS

It is known that patients with Down’s syndrome often experience a precipitous decline in mental functioning in the fifth decade and close to 50% over the age of forty-five years will have a full dementia syndrome. 1,2 There is abundant evidence which indicates that close to 100% of brains of Down’s patients over forty years of age will show the presence of Alzheimer’s type neuropathological changes, most commonly in the hippocampi and frontal white matter.3,4 It would seem that the neuropathological and neurochemical processes which occur in Down’s syndrome are very similar to those occurring in Alzheimer’s disease, but they occur at a much earlier age.5,6 Patients with Down’s syndrome therefore represent an ideal population to study with magnetic resonance imaging (MRI) in an attempt to visualize Alzheimer’s changes and to document any chronological pattern in their development.

METHODS AND MATERIALS

Seven patients with Down’s syndrome, ranging in age from 17-45 years, were entered into this study. All patients were living in group homes and functioning well in supervised workshops. They were all able to independently sign informed consents. The studies were performed on a Technicare resistive unit operating at 0.15 Tesla. An attempt was made to perform axial and coronal studies on all patients using as rapid an imaging sequence as possible due to the concern that the patients would become uncooperative in the scanner. The spin echo technique for image acquisition was used. The axial scans were T1 weighted using a repetition time (TR) of 2,000 milliseconds, echo times (TE) of 60 and 120 milliseconds and a slice thickness of 1.00 cm. The scans were then analyzed for the presence of any abnormalities. Particular attention was paid to the temporal lobes and hippocampi, frontal lobes and deep white matter. We were interested in areas of abnormal signal, localized atrophy or ventricular enlargement.

The patients’ ages and MR findings are summarized in Table 1. None of the patients were clinically demented. The three patients in the youngest age group (20-29 years) demonstrated
Table 1: Patients ages and MR findings.

<table>
<thead>
<tr>
<th>Case</th>
<th>Age</th>
<th>MR Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) BB</td>
<td>29</td>
<td>no abnormality</td>
</tr>
<tr>
<td>(2) DM</td>
<td>32</td>
<td>no abnormality</td>
</tr>
<tr>
<td>(3) LS</td>
<td>35</td>
<td>poor quality, no abnormality</td>
</tr>
<tr>
<td>(4) FL</td>
<td>35</td>
<td>motion artifact, no abnormality</td>
</tr>
<tr>
<td>(5) JAM</td>
<td>45</td>
<td>mild generalized atrophy, marked focal atrophy in left temporal lobe with enlarged sylvian fissure</td>
</tr>
<tr>
<td>(6) AW</td>
<td>25</td>
<td>motion artifact, mild generalized atrophy</td>
</tr>
<tr>
<td>(7) WC</td>
<td>26</td>
<td>mild frontal and temporal atrophy</td>
</tr>
</tbody>
</table>

no significant lesions on their scans (Figure 1) although two patients showed mild atrophic changes in the temporal regions and generous ventricles which suggested mild central atrophy (Figure 2). There were three patients in the 30-39 year age group. Two patients became restless and agitated while in the magnet and consequently only axial studies were performed. Although two scans were degraded by artifact, no abnormalities were seen in this group. The scan on the oldest patient (45 years) demonstrated marked left temporal lobe atrophy with a very prominent left sylvian fissure (Figure 3). No other lesions could be identified.

**DISCUSSION**

Dementia is defined as a dysfunction in more than one of the four major cognitive ability areas — language, memory, reason-
ing and construction. More than 50% of the senile dementias are of the Alzheimer’s type with the remainder usually resulting from cerebrovascular atherosclerosis. The neuropathologic changes of Alzheimer’s disease typically include cell loss, neurofibrillary tangle formation in the neocortex, amygdala and hippocampus and extensive senile plaque formation. These changes may be seen in the normal elderly population but occur at an earlier age in Alzheimer’s, clustering in the 55-65 year age group.

There are striking similarities seen between the brains of Alzheimer’s patients and those of Down’s subjects who survive into the third decade. Many investigators have found nearly identical patterns of cell loss and neurofibrillary tangle formation in the brains of adult Down’s patients but these occur at least ten years earlier than in Alzheimer’s patients. Nearly 90% of brains of Down’s patients over the age of 30 and 100% over age 40 will show the typical neuropathological changes of Alzheimer’s. This group therefore represents an ideal population in which to study the development and formation of plaques and tangles. Despite the anticipated difficulties with patient co-operation, our purpose in this study was to define imaging correlates of these changes in an early sequential manner using the newest, most sensitive technique available, MRI.

CT scanning of elderly demented and nondemented subjects has been of little value in either predicting the level of cognitive function or demonstrating features specific for Alzheimer’s disease. Nonspecific cortical atrophy, ventricular enlargement and deep white matter lucencies have been seen with CT in demented and non-demented subjects.

In our group of Down’s subjects, we were unable to visualize any specific abnormalities which would correlate with the known underlying neuropathologic changes. Mild to moderate generalized cortical and localized temporal lobe atrophy are expected findings in Down’s syndrome. We did not visualize any deep white matter lesions in the temporal and frontal lobes or periventricular regions. There have been studies which suggest an association between the presence and severity of patchy white matter lesions and advancing age, cerebrovascular disease and cognitive loss. These areas of abnormal signal have not however been seen in the few patients with Alzheimer’s disease who have been imaged with MR to date. The inability to detect any deep white matter lesions in the Down’s group adds weight to the premise that the pathological process leading to the formation and development of Alzheimer’s changes may not be visible on MR images. It is also likely that these white matter lesions often seen in elderly patients are likely coincidental and not causally related to Alzheimer’s changes.

Despite the technical difficulties regarding patient co-operation, a larger series of Down’s patients, particularly those in the older age groups and those with a clinical dementia syndrome, should be imaged to verify these preliminary findings.

REFERENCES

Figure 3 — Case 5: (a) SE Scan, TR 2,000, TE 60. Axial images through the temporal lobes show prominence of the left Sylvian fissure due to marked localized atrophy (arrow). (b) This localized atrophy shows as a high signal with TE 120. (c) SE Scan, TR 2,000, TE 60. No other abnormalities are seen in the temporal lobes.