Range of cross reactivity of anti-GM1 IgG antibody in Guillain-Barré syndrome

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Abstract
The cross reactivity of anti-GM1 IgG antibody with various gangliosides and asialo-GM1 in serum samples from 27 patients with Guillain-Barré syndrome was investigated. An enzyme linked immunosorbent assay (ELISA) absorption study showed that anti-GM1 IgG antibody cross reacted with asialo-GM1 in 32% of the patients, GM1b in 41%, GD1b in 22%, and GalNAc-GD1a in 19%, and that it did not cross react with GM2, GT1b, or GQ1b. The antibody that cross reacted with GD1b was associated with a high frequency of cranial nerve involvement and negative Campylobacter jejuni serology. Anti-GM1 IgG antibody has a broad range of cross reactivity which may contribute to various clinical variations of Guillain-Barré syndrome.

Keywords: Guillain-Barré syndrome, anti-GM1 antibody, cross reactivity

Guillain-Barré syndrome (GBS) is an autoimmune mediated neuropathy that has various neurological presentations. Evidence indicates that the presence of antiganglioside antibody is closely related to the clinical and electrophysiological features of GBS. Patients with anti-GM1 antibody often have a motor axonal neuropathy, but they rarely show sensory disturbance and cranial nerve involvement.1-3 In addition, anti-GM1 antibody is closely associated with prior infection by Campylobacter jejuni.1-3 Patients with anti-GM1 IgG antibody, however, do not always have these features. Antecedent upper respiratory tract infection, cranial nerve deficits, and sensory loss have been found respectively in 25%, 31%, and 19% of patients with this antibody.3

The coexistence of serum anti-GM1 antibody and antibodies to other gangliosides and asialo-GM1 occurs in some patients with GBS (reviewed by Hartung et al19), indicative that the cross reactivity of these antibodies is due to structural homology. Anti-asialo-GM1 and anti-GD1b antibodies in particular, are often found in patients with anti-GM1 IgG antibody. These antibodies seem to recognise a sugar sequence (Galβ1–3GalNAcβ1–4Gal) that is common to GM1, asialo-GM1, and GD1b. Further investigation, however, is needed to determine the antibody cross reactivity, and the range of cross reactivity of the anti-GM1 IgG antibody has yet to be clarified. Susuki et al6 have shown that fine specificity of anti-GQ1b IgG antibody is closely related to the clinical manifestations; deep sense disturbance is significantly present when anti-GQ1b antibody cross reacts with GD1b. We assume that the anti-GM1 IgG antibody has different fine specificities, which contribute to the various clinical manifestations seen in patients with GBS with anti-GM1 IgG antibody. The aims of this study were to clarify the range of cross reactivity of anti-GM1 IgG antibody and to examine its relation with clinical features.

Methods
We carried out an absorption study to examine the cross reactivity of serum anti-GM1 IgG antibody with various gangliosides (GM2, GM1b, GD1a, GalNAc-GD1a, GD1b, GT1b, and GQ1b) and asialo-GM1 using serum from 27 patients with GBS who tested positive for anti-GM1 IgG antibody in an enzyme linked immunosorbent assay (ELISA) (normal titre<500).7 Diagnosis of GBS was based on the established clinical criteria.7 The absorption study was done as described elsewhere7 with microtitre plates coated with 5 pmol portions of ganglioside or asialo-GM1. Serum samples were added to the wells at the dilution which gave an optical density between 1.0 and 2.0. After incubation at 4°C overnight, the samples were used as the primary antibodies in the standard enzyme linked immunosorbent assay. Absorption rates were expressed as percentages of the optical densities obtained with and without absorption. All results were confirmed twice to reduce technical bias.

Results
Anti-GM1 IgG antibody was absorbed effectively (20% or more absorption rate) by asialo-GM1 in 14 (52%) of 27 patients, GM1b in 11 (41%), GD1b in six (22%), and GalNAc-GD1a in five (19%, fig 1). The antibody was not absorbed by GM2, GT1b, or GQ1b. In 10 (37%) of the 27 patients, anti-GM1 IgG antibody was not absorbed by any of the gangliosides or asialo-GM1. Clinical features were not associated with antibody cross reactivity with any of the gangliosides or asialo-GM1, except for GD1b. Patients with anti-GM1 IgG antibody that cross reacted with GD1b more often had facial and bulbar palsies.
Table 1  Cross reactivity of anti-GM1 IgG antibody with GD1b and clinical features of GBS

<table>
<thead>
<tr>
<th>Cross reactivity with GD1b</th>
<th>Present* (n=6)</th>
<th>Absent (n=21)</th>
<th>p Value†</th>
<th>Odds ratio</th>
<th>95% Confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (male/female)</td>
<td>5/1</td>
<td>12/9</td>
<td>0.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median age (y)</td>
<td>47</td>
<td>43</td>
<td>0.35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diarrhoea</td>
<td>2 (33%)</td>
<td>14 (67%)</td>
<td>0.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>URTI‡</td>
<td>5 (83%)</td>
<td>5 (24%)</td>
<td>0.02</td>
<td>16</td>
<td>2.1–123</td>
</tr>
<tr>
<td>Ophthalomoplegia</td>
<td>1 (17%)</td>
<td>0</td>
<td>0.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facial palsy</td>
<td>2 (33%)</td>
<td>0</td>
<td>0.04</td>
<td>24</td>
<td>2.5–231</td>
</tr>
<tr>
<td>Bulbar palsy</td>
<td>3 (50%)</td>
<td>0</td>
<td>0.01</td>
<td>43</td>
<td>5.0–367</td>
</tr>
<tr>
<td>Sensory disturbance</td>
<td>3 (50%)</td>
<td>2 (9%)</td>
<td>0.59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C jejuni infection</td>
<td>2 (33%)</td>
<td>18 (86%)</td>
<td>0.02</td>
<td>0.083</td>
<td>0.013–0.55</td>
</tr>
</tbody>
</table>

*Absorption rate, 20% or more.
†Tested by Fisher’s exact test. A p value < 0.05 was considered significant.
‡Upper respiratory tract infection.

for cross reactivity of the antiganglioside antibody with various gangliosides.

Of the various fine specificities of the anti-GM1 IgG antibody, only its cross reactivity with GD1b was associated significantly with clinical features; however, the patient population was small. Lack of cranial nerve involvement and antecedent C jejuni infection have been regarded as clinical features of patients with GBS with anti-GM1 antibody. Our findings show that these features are closely related to the presence of anti-GM1 IgG antibody, which lacks cross reactivity with GD1b. By contrast, most patients who had anti-GM1 IgG antibody that cross reacts with GD1b had a history of upper respiratory tract infection and negative serology for recent C jejuni infection. These findings suggest that some other pathogen(s) that causes respiratory infection is often the antecedent agent of infection in patients with anti-GM1 IgG antibody that cross reacts with GD1b.

Serum anti-GD1b antibody increases in some patients with sensory ataxic neuropathy, and GD1b is a putative target antigen in this disease (reviewed by Dalakas and Quarles10). The frequency of sensory disturbance, however, did not differ whether or not anti-GM1 IgG antibody cross reacted with GD1b. Because ours is a retrospective and small study, the association between sensory disturbance and the fine specificity of anti-GM1 antibody needs further clarification.

Discussion
We showed that anti-GM1 IgG antibody in GBS has a broad range of fine specificity. As expected, in some patients the antibody cross reacted with asialo-GM1 and GD1b, which have a sugar sequence in common with GM1 at the non-reducing terminal. The antibody also recognised GM1b and GalNAc-GD1a which have a sugar sequence in common with GM1. Tatsumoto et al19 reported that GM1b and GalNAc-GD1a have a common three dimensional epitope with a stereoscopic structure, whereas they have no sugar sequence in common. Their findings and ours suggest that three dimensional structures, as well as the sugar sequences of gangliosides, are important for cross reactivity of the antiganglioside antibody with various gangliosides.

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