SHORT REPORT

Unusual T cell receptor phenotype V gene usage of γδ T cells in a line derived from the peripheral nerve of a patient with Guillain-Barré syndrome

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Abstract

Guillain-Barré syndrome is considered to be an immune mediated disorder but the relative role of T cells and antibodies in its pathogenesis is unclear. As gut infection with Campylobacter jejuni is the most common antecedent infection it is possible that gut derived T lymphocytes might play a part in the development of the syndrome. The T cell receptor phenotype (TCR) of a nerve γδ T cell line obtained from a sural nerve biopsy taken from a patient with a demyelinating form of GBS was determined using polymerase chain reaction (PCR) and flow cytometry (FACS). This TCR was compared with the phenotype preferentially expressed in the peripheral blood of the same patient.

The T cell nerve line was found to express Vγ8/δ1 which represents an unusual T cell subset normally found on lymphocytes resident in epithelial tissue such as the gut. The peripheral blood γδ T lymphocytes from the patient were of the Vγ9/δ2 subset, which is the phenotype predominately expressed in the peripheral blood of healthy subjects.

In conclusion, the presence of this unusual population of Vγ8/δ1 lymphocytes in nerve would be consistent with a pathogenetic role for gut associated lymphocytes in the pathogenesis of Guillain-Barré syndrome associated with C jejuni.

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Up to 30% of all cases of Guillain-Barré syndrome are preceded by infection with Campylobacter jejuni. Structural similarities and antibody cross reactivity between the LPS of strains isolated from patients with Guillain-Barré syndrome and peripheral nerve gangliosides have been demonstrated.1–3 Campylobacter jejuni infection originates in the bowel and persistent infection of stool is recognised in a proportion of patients with Guillain-Barré syndrome for some weeks after symptoms of the neuropathy are apparent. Gut T lymphocytes may therefore be important in the generation of T cell responses against C jejuni. We have therefore analysed the γδ T cell phenotype of a nerve derived T cell line from a patient with GBS associated with C jejuni to see if there was evidence of a TCR suggestive of gut origin.4

Methods

The patient fulfilled standard diagnostic criteria for an acute inflammatory demyelinating polyradiculoneuropathy (AIDP) form of Guillain-Barré syndrome.5 Full informed consent was obtained for the nerve biopsy and the study received ethical permission from our institution’s local research ethics committee. A raised ELISA titre of 1/320 for IgM antibody against C jejuni was suggestive of a recent infection. The nerve biopsy was performed 10 days into the neuropathy when the illness was still progressing (disability grade 3); the patient had subjective sensory abnormalities in the distribution of the sural nerve biopsy (sensory grade 1).

Venepuncture was performed at day 6 of the neuropathy and peripheral blood mononuclear cells (PBMCs) were isolated and their proliferative responses assessed using triitated thymidine incorporation as described previously.6 C jejuni (Penner serotype heat stable 4, phage group 146) was isolated from a stool sample of another patient with Guillain-Barré syndrome, cultured, and used as a source of antigen in proliferation assays at a concentration of 5 µg/ml. Salmonella agona and Yersinia enterocolitica were obtained from the Department of Microbiology (Queen Elizabeth Hospital, Birmingham, UK) and used at a concentration of 3 µg/ml and 1 µg/ml respectively. The T cell mitogen phytohaemagglutinin (PHA, Murex Diagnostics, Dartford, UK) and purified protein derivative (PPD) of Mycobacterium tuberculosis were used at concentrations of 1 µg/ml and 10 µg/ml.

The nerve T cell line was generated as described previously.6 Cells were stained with IgG, isotype control, CD3, CD4 (DAKO Ltd, Bucks, UK), CD8, γδ (Becton Dickinson, Oxford, UK) and to the following γδ subsets: Vγ1, Vγ9, Vδ2, Vδ3 (Immunotech/Coulter, Luton, UK) and Vγ8 (gift from Professor R Kieszling, Karolinska Institute, Sweden), for 30 minutes at 4°C and analysed on a FACS (Coulter, Luton, UK). Analysis of other Vγ/Vδ...
subsets were not investigated by flow cytometry due to lack of availability of antibodies, but were studied by PCR.

RNA was extracted from 5x10⁶-10⁷ PBMCs and nerve derived T lymphocytes using a Qiagen RNeasy Mini Kit (Qiagen, West Sussex, UK), following the manufacturer's instructions. Reverse transcription was carried out using oligo dT primers (Gibco BRL, Paisley, UK) at 70°C for 5 minutes then 37°C for 1 hour with 200 U Reverse Transcriptase (Superscript II; Gibco BRL).

The PCR was by a standard protocol as described previously, with minor modifications. Briefly, cDNA was amplified using a variable region (V) 5' primer (V61–5, V72–5, V8–10) and either a constant (C) Cy or Cδ region 3' primer. The primer sequences have been described previously by Söderström et al. Cycle conditions were as follows; denaturation 94°C for 60 seconds, annealing 55°C for 60 seconds, and extension 72°C for 60 seconds; PCR samples were amplified for 42 cycles and were sampled every three cycles from cycle 20 by removing 10 µl aliquots. Samples were analysed by 1.5% agarose gel electrophoresis and stained with ethidium bromide. Actin was used as a housekeeping gene and concentrations of cDNA were adjusted to maintain optimal and equal concentrations for the primers used.

**Results**

The proliferative response of PBMCs obtained from this patient with *C. jejuni* was mean cpm=13 855, SI=37. PBMC responses to other gram negative bacteria, *Salmonella* and *Yersinia* were lower than to *C. jejuni* (cpm=11367, stimulation index (SI)=30 and cpm=7051, SI=19, respectively). This patient also exhibited high proliferative responses to PHA (cpm=19 533, SI=53) and PPD (cpm=17242, SI=46.9).

Analysis of the nerve derived T lymphocytes from this patient showed that the cells were CD3⁺ T cells (99.8%), 23% were CD4⁺ and 74.6% were CD8⁺, 64% expressed the γδ TCR and 27% expressed the γδ TCR. After the in vitro expansion of the nerve derived T cells with PHA and interleukin 2 the cells showed no ability for specific proliferation to *C. jejuni.* (Data not shown.) However, analysis of the γδ TCR usage by flow cytometry showed marked skewing of their TCR phenotype so that all the γδ T lymphocytes expressed the Vδ8 subset (27%). No staining above background concentrations was seen when the nerve T cells were stained with Vγ1, Vγ9, Vδ3. A proportion (4.8%) were positive at the cell surface for Vδ2. Analysis of the peripheral blood lymphocytes showed that they were 7.4% γδ TCR⁺, expressing predominantly Vγ9/δ2. No staining was seen for Vγ8.

Analysis by PCR showed that the nerve derived T lymphocytes were positive for Vγ2, Vγ5, Vγ8, Vγ9, and Vδ61 transcripts. Sampling of these reactions showed that the first PCR products to be detected at cycle 32 were Vγ2, Vγ5, and Vγ8. Reverse transcriptase-PCR showed that PBMCs were positive for Vγ2, Vγ5, Vγ8, Vγ9, Vγ10, Vδ1, Vδ2, Vδ3, and Vδ5 (figure). Vγ10 has previously been shown to be a pseudogene in humans. No PCR products could be detected in the negative controls (no cDNA) using any of the primer pairs (data not shown).

**Discussion**

Here we report that nerve derived T lymphocytes isolated from the peripheral nerve of a *C. jejuni* positive patient with Guillain-Barré syndrome preferentially expressed a Vγ8/Vδ61 phenotype. Although transcripts were detected in the nerve T cells for Vγ9, this V region could not be detected above background concentrations at the cell surface by flow cytometry. Due to the limited number of Vγ TCR specific antibodies we could not seek expression of Vγ5 directly, although transcripts for Vγ5 were detected by PCR. Almost all the γδ T cells derived from nerve, detected by flow cytometry, expressed Vγ8 making it unlikely that any significant number of T cells expressed Vγ5 despite the presence of message. This latter TCR is of interest as transcripts for this TCR γ chain were detected by PCR in the nerve derived γδ T cell line from a patient that we have previously reported. A very small percentage seemed to express Vδ2 but we could not detect any transcript for this gene nor for Vδ3 (figure). These nerve derived T cells were distinct from those found in the peripheral blood, which contained transcripts for some of the Vγδ subsets but were predominantly
Vγ9/δ2 by flow cytometry. This confirms that the cells generated from the nerve culture were not simply lymphocytes from any contaminating peripheral blood.

γδ T cells of the human gut have been shown to preferentially express Vγ8Vδ1^+ and Vγ8/δ1 cell numbers are also increased in blood from patients with inflammatory bowel disease.\(^8\) We have previously shown that γδ T lymphocytes could be cultured from nerve biopsies,\(^7\) and postulated a role for γδ T lymphocytes typical of an intraepithelial origin and thus possibly resident in gut may be selectively recruited to nerve and thus available to play a part in demyelination.

Recruitment of T cells to inflamed tissues requires expression of adhesion molecule and chemotactic chemokines by vascular endothelial cells at the inflammatory site.\(^11\) The expressed molecules may vary in a tissue specific manner, over time and in response to proinflammatory cytokines and other mediators. The array of counter ligands for adhesion molecules and of chemokine receptors governs the T cell subsets that are recruited. This implies that selection of Vγ8/δ1 T cells for recruitment to peripheral nerve requires selectivity at, for example, the level of nerve endothelial expressed adhesion molecules or chemokines and/or specific expression of adhesion counter ligands or chemokine receptors on the Vγ8/δ1 T cells. As yet, there is no information on nerve specific or γδ-directed T cell recruitment, although this will be a valuable approach for further studies. Once recruited, there is evidence that γδ T cells can contribute to the chemokine pool within inflamed tissue, at least in the CNS.\(^13\)

Direct proliferation of nerve derived lymphocytes to either C jejuni or ganglioside antigens has not so far been demonstrated but prolonged culture of lymphocytes, in these conditions, may impair antigen specific responses and thus render it impossible to detect such specific proliferation.

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