SHORT REPORT

Paraneoplastic ophthalmoplegia and subacute motor axonal neuropathy associated with anti-GQ1b antibodies in a patient with malignant melanoma

L Kloos, P Sillevis Smitt, C W Ang, W Kruit, G Stoter

A 68 year old woman developed oculomotor paresis shortly after metastatic progression of her melanoma was discovered. She was then immunised with the tumour antigen MAGE-3 in combination with an immunological adjuvant. During immunisation her symptoms worsened and she developed severe, predominantly proximal axonal motor neuropathy and became bedridden. IgM antibodies against gangliosides GM2, GD3, and GQ1b were detected in serum obtained two weeks before and nine weeks after the onset of symptoms. Immunohistochemically, the patient’s IgM reacted with the tumour and co-localised with GQ1b. She improved neurologically following steroid treatment and became ambulatory.

Malignant melanoma is a potentially immunogenic tumour, and the development of melanoma vaccines has been an important line of research. Tumour specific antigens used as targets of melanoma immunotherapy are often surface glycoproteins that share immunogenic similarities with glycoproteins on the surface of normal melanocytes and cells in the central and peripheral nervous systems. The immune response against these melanoma antigens may also cross react with normal melanocytes or neurones, resulting in several clinical symptoms such as vitiligo, inappropriate secretion of antidiuretic hormone (SIADH), and chronic inflammatory demyelinating polyneuropathy (CIDP). We describe a patient with malignant melanoma who developed oculomotor paresis followed by a subacute motor axonal neuropathy associated with antiganglioside antibodies suggesting cross reactivity (“molecular mimicry”) between melanoma and peripheral nerve antigens.

CASE REPORT

The patient had been diagnosed with a malignant melanoma on her left foot in 1983. This was surgically excised (Breslow thickness 1.9 mm). In March 2000, at the age of 68, she complained of night sweating and weight loss of 17 kg over the previous six months. Computed tomography (CT) showed extensive retroperitoneal and left iliac lymphadenopathy. A CT guided biopsy of an iliac lymph node was undertaken and pathological examination showed malignant melanoma. Reverse transcriptase polymerase chain reaction (RT-PCR) showed tumour expression of the tumour antigen MAGE-3, and the patient was included in an immunotherapy trial. The treatment consisted of three intramuscular vaccinations at weekly intervals with 300 µg MAGE-3 recombinant protein in combination with immunological adjuvant.

In June, one week before the first vaccination, she developed double vision. Two weeks later she was referred to the neurology clinic. Examination revealed fluctuating external ophthalmoplegia. Motor and sensory examination was normal apart from absent deep tendon reflexes.

One month later (five weeks after the first vaccination), she developed rapidly progressive and predominantly proximal motor weakness: MRC muscle strength grade 3 in the deltoids and hip flexors, grade 4 in biceps and triceps, and grade 5 distally; weakness in the neck flexors was MRC grade 2. Sensory examination remained normal. The patient was admitted to our hospital for further investigation.

Cranial and spinal magnetic resonance imaging (MRI) before and after gadolinium administration was normal. The CSF was acellular with raised protein (1.9 g/l) and repeatedly negative cytology (on six occasions). Other laboratory studies were unremarkable including creatine kinase, calcium, and thyroid function studies. The erythrocyte sedimentation rate was 68 mm/hour. Antibodies to acetylcholine receptor and voltage gated calcium channels were negative and no antibodies were detected against the paraneoplastic Hu, CV-2, Ri, Yo, or amphiphysin antigens. A neostigmine provocation test produced no improvement in her symptoms. Electrophysiological studies showed normal motor and sensory nerve conduction velocities with normal or only mildly decreased motor amplitudes. There were no signs of dispersion or conduction block. Needle electromyography showed widespread acute denervation changes in the proximal muscles and mild denervation in the distal muscles. Low frequency (3 Hz) and high frequency (20 Hz) repetitive nerve stimulation did not change the compound muscle action potentials. Because of the proximal distribution of the weakness, a deltoid muscle biopsy was taken. Pathological examination did not show myelitis or myopathy. Sural nerve biopsy showed signs of axonal degeneration without inflammatory cells or immunoglobulin deposits.

The MAGE-3 vaccinations were stopped and she was treated with intravenous immunoglobulin (0.4 g/kg/d for five days). Despite this, her weakness deteriorated and she developed dysphagia and dysarthria. Subsequent steroid treatment (20 mg dexamethasone daily) resulted in a remarkable improvement in strength and bulbar function within two days. She was discharged from hospital on 12 mg dexamethasone a day with a gradual taper. There was continuing improvement in her symptoms and after six weeks she was able to walk again without help. Because of relapsing diplopia she was treated with five plasma exchanges, resulting in subjective improvement. She has remained steroid dependent (dexamethasone 6 mg/d).

METHODS

Serum samples were obtained from the patient two weeks before the onset of symptoms (three weeks before the vaccination was started) and nine weeks after the onset of symptoms (eight weeks after the vaccination). Both samples were analysed for the presence of antiganglioside antibodies against GM1, asialo-GM1, GM2, GM3, GD1a, GD1b, GD3,
GT1b, and GQ1b with an enzyme linked immunosorbent assay (ELISA) and confirmed with thin layer chromatography as described before. Serum was also tested for the presence of IgM and IgA antibodies against Campylobacter jejuni, cytomegalovirus, Epstein-Barr virus, and Mycoplasma pneumoniae, as described. Indirect immunofluorescent examination was undertaken on formalin fixed, paraffin embedded sections of the primary melanoma and the metastasis. In brief, the sections were prepared for double immunofluorescent labelling by microwave preparation (five minutes at 900 W) in citric acid (pH 6) followed by five minutes of 0.1% pronase treatment at 37°C. The patient's serum was diluted 1:200 and polyclonal rabbit anti-GQ1b, R2327E diluted 1:100 was added, followed by rhodamine and fluorescein labelled secondary antibodies. Antibody specificity was determined by incubation with a non-immune serum and by leaving out the primary serum. Images were analysed and photographed using a confocal fluorescent microscope.

RESULTS
Thin layer chromatographic overlay of the patient's serum to multiple purified gangliosides revealed strong and specific binding of IgM with GM2 (titre 200), GQ1b (titre 400), and GD3 (titre 200). The patient's serum did not react with the gangliosides asialo-GM1, GM1, GM3, GD1a, and GT1b. Weak background reactivity with GD1b was observed. The titres of the pre- and postvaccination samples (obtained two and nine weeks after the onset of symptoms, respectively) were the same. There was no IgG reactivity with any of the gangliosides tested. The patient's serum did not contain monoclonal bands as determined by immunoelectrophoresis. No evidence for recent infection with Campylobacter jejuni, cytomegalovirus, Epstein-Barr virus, or Mycoplasma pneumoniae could be detected.

On indirect immunofluorescence, the patient's IgM reacted with many of the tumour cells, as shown in fig 1A (fluorescein filter). Antiserum to GQ1b reacted with many of the same cells (fig 1B), as visualised with the rhodamine filter. Co-localisation is confirmed with double exposure in yellow (fig 1C).

DISCUSSION
The patient presented with external ophthalmoplegia in combination with areflexia and a high CSF protein concentration, with a normal CSF cell count and anti-GQ1b antibodies. She subsequently developed a severe subacute motor axonal neuropathy which made her bedridden within two months and was accompanied by involvement of the lower cranial nerves. The patient's neuropathy developed shortly after the diagnosis of recurrent melanoma and before vaccination, suggesting a paraneoplastic aetiology. Neither ophthalmoplegia nor subacute motor axonal neuropathy has previously been reported as paraneoplastic syndromes associated with melanoma. In this patient, other cancer related causes such as leptomeningeal metastases and direct invasion of the peripheral nerves by the tumour were excluded.

Most paraneoplastic neurological syndromes are considered autoimmune disorders caused by an immune response directed against antigens in the tumour which subsequently (cross) react with the same or similar epitopes in the nervous system. The patient had IgM autoantibodies in her serum which reacted with the gangliosides GM2, GD3, and GQ1b. All three antigens are immunogenic and are expressed on

Figure 1 The patient's IgM immunoreacts with many of the tumour cells visualised in green with fluorescein filters (panel A). Anti-GQ1b antiserum co-localises with most of the same cells as shown in red with rhodamine filters (panel B). Co-localisation is confirmed in yellow (panel C) by double exposure from the superimposition of red and green.

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melanoma tumours and cell lines, suggesting that the tumour may have triggered the production of antibodies. Indeed, the patient’s IgM also reacted with the melanoma tissue, co-localising with GQ1b. An immune aetiology of the neuropathy is further suggested by the remarkable, albeit partial, response to steroid treatment.

The importance of each of the target glycolipids for the pathophysiological mechanism remains unclear. Anti-GQ1b reactivity is strongly associated with oculomotor symptoms in patients with immune mediated neuropathies. Moreover, in 20% of patients with Guillain-Barré syndrome and anti-GQ1b antibodies, the EMG changes are mainly axonal, as in our patient. In vitro models have clearly shown that anti-GQ1b antibodies disrupt the neuromuscular junction, resulting in breakdown of axonal terminals; this suggests that they can be pathogenic in vivo. Anti-GM2 IgM antibodies can also affect neuromuscular transmission. A pathogenic role of these antibodies in our patient is less likely, because anti-GM2 antibodies are associated with demyelinating neuropathies and their specificity is questioned. Anti-GD3 antibodies most probably result from cross reactive epitopes with GQ1b.

Other forms of neuropathy have been described in association with melanoma, including five reported cases of chronic inflammatory demyelinating polyneuropathy (CIDP). A further pathophysiological relation between melanoma and neuropathy is suggested by reports of demyelinating neuropathy following vaccination with melanoma lysates. In contrast to the previously reported cases, the neuropathy in our patient was strictly motor axonal, and accompanied by upper and lower cranial nerve involvement.

The relation between the vaccinations and worsening of the neuropathy remains unclear. A direct relation with immunity directed against MAGE-3 is highly unlikely because MAGE-3 is a tumour specific antigen that is not expressed in the nervous system. Furthermore, the neuropathy and antiganglioside antibodies were clearly present before vaccination, and the titres of the antibodies were not influenced by the vaccinations. It is difficult to conclude whether the evolution of symptoms was spontaneous, or whether concomitant vaccination played an indirect role. Clearly, stimulation of the immune system—whether through an infectious process or through vaccination—could theoretically promote autoimmune phenomena by causing a systemic increase of inflammatory cytokines. Although there is no evidence that MAGE-3 vaccination caused the worsening of the neuropathy, our observation suggests the need for caution when inducing immune responses in patients with ongoing autoimmune symptoms.
neurologists, Bousry and Lhermitte reported two subsequent cases.1 An infantryman was thrown into the air by the bursting of a shell, rendered unconscious and recovered experiencing violent pains in the back. He had been knocked to the ground. His bent back was corrected by the application of plaster corsets. The other reported case was that of a chasseur who was buried in an explosion, knocked unconscious, and experienced acute respiratory distress, and subsequent mutism and camptocormia. One scéance of electrical treatment corrected the improper attitude of the trunk, though he did continue to experience “a few persistent lumbar pains”.

It would be difficult to doubt the probability that psychological factors influenced these men’s recuperation. To describe these soldiers as hysterical, though this was the terminology used during this period, or indeed that they suffered functional back bend, is probably unfair. They may well have suffered acute traumatic spinal injury and reactive muscle spasm (and contractures). Persistent stooping in shallow trenches, in appallingly poor conditions of deprivation and danger, may have been contributing factors weakening the tone of paraspinous muscles. However, these case reports suggest that the traumatic injury alone may be sufficient explanation for the bent spines. The management of camptocormia in the first world war was to provide biomechanical supports, such as corsets, apparently with good results. The psychological therapies of “persuasive re-education” were additive rather than pivotal, and faradisation (and other tortures) used only “if necessary”.

The Sandler triad of low self esteem with confusion of identity, sadomasochistic behaviour towards military authorities, and impotence were, in 1947, proposed as being an essential part of camptocormia. Umapathi’s recognised causes of camptocormia and the contributing factors however implicate organicity, as indeed do the original case reports.

**Head drop and camptocormia**

The article by Umapathi et al2 in this journal referred to the original use of the term camptocormia by Souques in 1915,3 though functional bent back was first described by Brodie in 1837. Mlle Rosanoff-Saloff supported Southard’s theory that psychological factors might have been contributing to the camptocormia in soldiers believed to have been suffering from hysteria. It would have not been unexpected for patients, like the man described by Southard with a bullet wound near the spine,1 to have developed spasm or even denervation of thoracic paraspinal muscles.

**References**


**Author’s reply**

We would like to thank Dr J M S Pearce for his comments. We agree with him on the proliferation of medical terms referring to similar or not identical conditions. One of the chief aims of writing this paper is to thread a line of commonality through the various names in literature, which in essence refer to an anterior curvature of the spine. Hence the title “Head drop and camptocormia, the spectrum of bent-spine disorders”.

However, we would like to disagree with Dr Pearce labelling the spinal deformity seen in ankylosing spondylitis as camptocormia. In arthritic conditions and diseases that affect bone, the spinal deformity is fixed. In the benti-spine disorders referred to in the paper, the deformity may reduce considerably, even disappear with change in position, for example when supine. We would therefore prefer to reserve the phrases head drop (used interchangeably with head ptosis) and camptocormia to neurological conditions that affect the strength or tone of the muscles controlling spinal posture.

As aficionados of medical history, we very much enjoy Dr A D Macleod’s letter. We agree that organic factors might have been contributing to the camptocormia in soldiers believed to have been suffering from hysteria. It would have not been unexpected for patients, like the man described by Southard with a bullet wound near the spine,1 to have developed spasm or even denervation of thoracic paraspinal muscles.

**T Umapathi**

Department of Neurology, National Neuroscience Institute, 11 Jalan Tan Tock Seng, 308433 Singapore, tumapathi@yahoo.com

**Infection and multiple sclerosis**

The article by Hawkes4 and the editorial commentary about the role of infectious agents in multiple sclerosis (MS) examined this question from a new viewpoint based on epidemiological observations.4 Several infectious agents, most not sexually transmitted, were reported to be associated with MS according to epidemiological data, serology in CSF and blood, or demonstration of pathogens in tissue. A relation with measles virus (MV) has been an early and most consistent finding. More recently, higher prevalence and higher titres of antibodies against human herpesvirus 6 (HHV6), but not other herpesviruses, were shown in MS patients compared to control groups, suggesting different exposure to HHV6 in MS.5 HHV6, like vaccine strain MV and certain wild type MV, uses the membrane co-factor protein (MCP; CD46) as a receptor for entry into cells. This suggests a possible involvement of CD46 in MS.

The possibility of a particular isoform of CD46 predisposing MS patients to infection is unlikely because all isoforms have similar affinity to MV. Increased levels of soluble CD46 have been reported in the serum and cerebrospinal fluid of MS patients, more in those who have HHV6 DNA.6 One interpretation of these findings involved increased activity of the complement system in MS. However, experimental studies show no influence of inflammatory cytokines on CD46 expression and do not support inflammation
as a cause of increased CD46. Incorporation of CD46 in the viral envelope, or a possible genetic propensity in MS patients, has also been considered as causes of increased CD46. While its origin in MS is unclear, soluble CD46 might be involved in viral pathogenesis by binding the virus in the viral phase and allowing another to attach to CD46 and spread from cell to cell. Both HHV6 and MV are infectious agents encountered in early childhood, and HHV6 can indeed become reactivated a few weeks after primary MV infection. On the other hand, because HHV6 and MV downregulate CD46 expression on the infected cell, they may diminish the entry of each other, delaying the time of infection. Therefore, they might produce increased antibody levels in young adults through delayed infection with, or reactivation of, each other. These suggest increased antibodies against these two viruses in MS may be interrelated.

The question remains whether a cause-effect relation exists between infectious organisms and MS, or whether viruses are just a consequence of the activation of the inflammatory-immune sequence or increased susceptibility of MS patients to infection. Studies of CD46 and other viral receptors seem warranted in MS.

B Anlar
Department of Pediatric Neurology, Hacettepe University, Ankara 06100, Turkey
banlar@hacettepe.edu.tr

References

Infection and multiple sclerosis
The paper by C H Hawkes (Is multiple sclerosis a sexually transmitted infection?) has caused predictable distress to people with multiple sclerosis (MS) and their families. Living with MS is a difficult enough experience without such sudden and avoidable alarm. The UK Multiple Sclerosis Society’s national helpline and local branches have been inundated with calls expressing anger and anxiety.

It is hard to understand the motive for publication when your own expert editorial commentator specifically referred to the paper’s “pure speculation” and “potential to cause harm”. Did the sensational nature of Dr Hawkes’s hypothesis and the virtual guarantee of extensive publicity it could receive outweigh proper consideration of its scientific merit?

There is also the worrying question of what damage may have been caused to the reputation of MS research in the UK by the lay media coverage which was attracted. The MS Society has a current forward commitment of around £12 million to nearly 70 research projects. That money is raised by voluntary donation. Anything which could discredit the quality of research here is of material concern to us.

M O’Donovan
Chief Executive, The Multiple Sclerosis Society, M S National Centre, 372 Edgware Road, London NW2 6ND, UK; modonovan@mssociety.org.uk

Delirium in old age


Delirium is an extremely important condition for a number of reasons. It is very distressing and frightening for those who experience the symptoms, and descriptions of the effects on the brain as a result of high fever have been well described. There is a high mortality associated with the development of delirium, and it is often associated with behavioural disturbance that can be troublesome for carers and attendants. Finally, it presents a unique opportunity to look at the interface between psychiatric symptoms caused by organic disease and functional disorders.

Twelve years ago, the same publishers and two of the current editors produced the first edition of delirium. It was a relatively thin book but set the standards that the current edition continues. Delirium is certainly a niche market, and there appear to be no direct competitors, although textbooks on old age psychiatry usually contain chapters and notes on delirium. The new edition is greatly expanded and very much up to date.

Every aspect of delirium is included, from the history and conceptual basis of the disorder through epidemiology, neurophysiology, clinical assessment, management, prevention, and, refreshingly, the role of family caregivers and nurses in managing the disease. The core tenet of the book is that delirium is a disorder that is relatively poorly recognised (particularly the hypo-alert type) by the general clinical professions, it is relatively easy to identify people at risk of developing delirium, and that there is a real possibility of a reasonable preventive strategy for the disorder. Twelve authors have contributed and, as delirium is relatively under-researched, this probably represents a significant proportion of the leading researchers in the field internationally. There are particularly interesting sections on the conceptual basis of the disorder and how it, and its component symptoms, are defined, methods of assessment of delirium are covered comprehensively, a summary of how evidence based management plans can be developed, and the prospects of prevention of delirium are given an adequate airing.

An interesting spin, which I discovered by accident, is that on the Oxford University Press website (www.oup.co.uk), one can see online updates of each individual chapter. Those present when this author last visited the website (December 2002) consisted of work that had been done from when the manuscript had been submitted to publication. It may be that reviews of the book might also appear online—this one will.

The book is a landmark in the literature on delirium, is a text of very high quality, and anyone seriously involved in the clinical management of patients with delirium or research on the subject would do very well to read this book.

A Burns

Neurophysiology in neurosurgery. A modern intraoperative approach

Edited by Vedran Deletis and Jay L Shils (Pp 469, $125.00), Published by Academic Press, California, 2002. ISBN 0-12-209036-5

This book comprises 17 chapters contributed by 24 authors. It has clearly benefited from most of the chapters being written in a more or less homogenous style and formed into seven parts mainly based on surgical procedures: motor evoked potentials/ neurophysiological base; intraoperative neurophysiology (ION) of the spinal (spinal cord monitoring); ION of peripheral nerves, nerve roots and plexuses; ION of cranial nerve and brainstem; ION of supratentorial procedures; ION during stereotactic neurosurgery for movement disorders; and ION and anaesthesiology management. Most of the chapters cover the background of methodology, description of the surgical procedure, and the related neurophysiological procedure, personal experience, and case reports, which gives a balanced theoretical and practical view on the topic of each chapter. One of the interesting features of this book is that it is accompanied by a CD that certainly enhances its value. Cross references are given at the end of the corresponding chapter rather than in the list of contents in the book, and at the front page of the display.

In conclusion, it is an authoritative review of intraoperative neurophysiology much weighted on the motor system for a wide range of surgical procedures. Perhaps, in its present form, those hoping for a more systematically informed text on intraoperative neurophysiology of the sensory system may feel slightly disappointed.

X Liu, T Z Aziz
The first edition of Clinical neurophysiology of the vestibular system, published in 1979, had a significance beyond its content: it affirmed that neurology had a stake in the vestibular system. The second edition, published in 1990, and now the third edition, incorporate these advances. And what a terrific book it still is: based on concepts, packed with facts, lucidly written, and rigorously referenced. Its structure is logical, and its language is clear, so that it is not only easy to search and browse but a pleasure to read from cover to cover. And it is comprehensive—no vestibular stone is left unturned.

There are four main parts, dealing in turn with: the structure and function of the vestibular system (four chapters); the clinical and laboratory evaluation of the dizzy patient (four chapters) [up-to-date, easy-to-understand illustrations, and above all the vestibulo-ocular reflex—the “VOR”]. The VOR is no ordinary reflex; one can measure accurately both its input and its output and come up with a transfer function for gain—a new concept then for neurology. We have learnt a lot more about measurement of vestibular function and about disorders of the vestibular system since 1979. The second edition, published in 1990, and now the third edition, incorporate these advances.

And what a terrific book it still is: based on concepts, packed with facts, lucidly written, and rigorously referenced. Its structure is logical, and its language is clear, so that it is not only easy to search and browse but a pleasure to read from cover to cover. And it is comprehensive—no vestibular stone is left unturned.

The role of metals in neurodegenerative diseases

The following abstract was not printed with the article by E. L. J. Hoogervorst, M. J. Elckelboom, B M J. Uitdehaag, and C H. Polman (One year changes in disability in multiple sclerosis: neurological examination compared with patient self report) in the April issue of JNPP (2003;74:439–42).

Objective: To characterise the relation between one year changes in neurologist rating of neurological exam abnormalities as measured by the EDSS and changes in patient perceived disability as measured by the GNDS in patients with MS.

Methods: 250 patients with MS were recruited at an outpatient clinic. Disability at baseline and one year follow up was assessed using the EDSS and GNDS. Correlations between change in EDSS, GNDS-sum score, functional systems, and GNDS subcategories were studied as well as the significance of changes in EDSS associated with changes in perceived disability.

Results: The correlation between one year changes in EDSS v GNDS was substantially lower (0.19) than cross-sectional correlations between EDSS and GNDS, either at baseline (0.62) or at follow up (0.77). Notably, changes in functional system scores that are based on neurological examination are poorly or not at all correlated with changes in disability as perceived by the patient. Analysing the impact of a significant worsening in EDSS score we found that this was associated with significant worsening, insignificant change, and significant improvement in the patients perceived disability in 45%, 39%, and 15% of patients, respectively.

Conclusion: Patients’ perception of change in disability differs not only quantitatively but also qualitatively from that of an examining physician. There are true differences in change as perceived by the patient and measured by the physician and changes in many dimensions of disability are relevant to the patient and have no measurable impact on the EDSS.

The authors of the short report entitled Paraneoplastic ophthalmoplegia and subacute motor axonal neuropathy associated with anti-GQ1b antibodies in a patient with malignant melanoma, published in the April issue of JNPP 2003;74:439–42, were listed in the incorrect order. The author order should read as follows: L Kloos, C W Ang, W Kruit, G Stoter, and P Sillevis