SHORT REPORT

Corticosteroids do not prevent optic nerve atrophy following optic neuritis

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Corticosteroids shorten the period of functional impairment following relapses in optic neuritis and multiple sclerosis (MS); however they have not, thus far, been shown to affect the final level of function compared with placebo.[1] There has been recent interest in the use of corticosteroids as neuroprotective agents by their effect of decreasing nitric oxide (NO) production by mononuclear cells.[2] NO is toxic to axons in vitro.[3] Pulsed corticosteroid treatment has been reported to reduce the development of cerebral atrophy, a putative marker of neuronal loss,[4] over a five year period in relapsing remitting MS.[5] Optic nerve atrophy has been shown to develop following optic neuritis.[6] This study assesses whether a single course of intravenous methylprednisolone (IVMP) during an attack of acute optic neuritis prevents the development of optic nerve atrophy following optic neuritis. Magnetic resonance imaging (MRI) data from a recent randomised placebo controlled trial of IVMP in acute optic neuritis were retrospectively evaluated.[7]

METHODS

The design, conduct and clinical results of the trial have been reported previously.[7] Briefly, 66 patients with a first episode of acute unilateral optic neuritis within 30 days of onset were enrolled into the study. The median duration of symptoms before randomisation was eight days (range 1–30). Six of the patients had clinically definite MS, another 14 had clinically probable MS, and the rest had clinically isolated optic neuritis. Their optic nerves were imaged with a short tau inversion recovery (STIR) sequence (TR 2500 ms, TE 40 ms, TI 175 ms, matrix 256×128, field of view 16 cm × 16 cm, 2 excitations, 5 mm contiguous slices) and were then randomised to receive either 1 g/day IVMP for three days or intravenous saline. Reimaging was performed six months later. In addition, at six months, a detailed clinical assessment was performed including Snellen visual acuity, contrast sensitivity using the Pelli-Robson chart, 30-2 Humphrey visual field examination, and colour vision using the Farnsworth-Munsell 100 (FM 100) Hue test. Normal values were taken to be a visual acuity of 6/6 or better, contrast sensitivity of 1.65 or better, Humphrey mean deviation of −3 dB or higher, and the total error score of the FM 100 of less than 110.[8 9] Whole field and central field pattern evoked visual evoked potentials (VEP) were also recorded.

Only images that were acquired on a Signa 1.5 T imager (General Electric, Milwaukee, WI) were available. Some early patients in the study were imaged on a Picker 0.5 T imager and these images were not available for study. In total, images from 45 patients at baseline and 59 patients after six months (30 given IVMP and 29 given placebo) were examined. The images were transferred onto workstations (Sun Microsystems, Mountain View, CA). Mean optic nerve area was measured by an observer blinded to image identity, treatment group, and acquisition order from two consecutive 5 mm orbital slices from the orbital apex forwards using a semiautomated contouring technique as described previously.[6] Each measurement was carried out three times independently of each other. In a previously reported study of a different patient cohort, five consecutive 3 mm orbital slices from a short echo fast fluid attenuated inversion recovery (sTE fFLAIR) sequence were measured.[6] It was not possible to measure a 15 mm segment in all subjects from the STIR images as in some patients the most anterior slice occurred at the point that the nerve sheath dilated as it attached on the back of the globe leading to an artificially increased area; hence a 10 mm segment was measured. This was less of a problem with the previous study because the sTE fFLAIR sequence suppresses the signal from cerebrospinal fluid. The presence of high signal lesions in the measurement area was noted and lesion lengths at baseline and six months were recorded from the data of the original study, measured by an experienced neuroradiologist.[7]

Statistical methods

The presence of nerve swelling at baseline and atrophy at six months was assessed in terms of the ratio diseased nerve area:healthy nerve area at the respective time points. Null hypotheses of ratio = 1 were examined by paired *t* tests on log nerve areas. The possible influence of a lesion in the measured portion of the nerve was examined by regression of log ratios on the presence of a lesion and its length. The association between atrophy and steroid use was assessed by regression of the log ratio of six month diseased nerve area:six month healthy nerve area and six month diseased area:baseline diseased nerve area on an indicator of steroid use, adjusting for relevant baseline nerve area. The influence of the presence of a baseline lesion was assessed by an interaction term. All paired tests or analyses involving both time points used only patients available at both time points. Associations between diseased nerve area at six months and VEP variables were assessed by linear regression on log diseased nerve area at six months; clinical variables were dichotomised about the threshold for the normal ranges and similarly assessed by logistic regression. To assess measurement reproducibility the within and between subject standard deviations (and hence coefficient of variation and reliability coefficients) were obtained from random effects analysis of variance.[10]

RESULTS

Table 1 gives measurement reproducibility results. At baseline optic nerve mean area was 18.4 (SD 3.8) mm^2 in diseased optic nerves and 17.8 (SD 3.6) mm^2 in healthy optic nerves (n = 45). The estimated geometric mean ratio (diseased nerve area:healthy nerve area) was 1.035 (95% CI 0.96 to 1.11; p = 0.33). At baseline, high signal was present in the measurement area in 36/45 patients. The presence of a lesion did not affect the ratio; however, the degree of swelling increased by 7.5% (95% CI 3.3% to 11.7%; p = 0.001) for each slice that a high signal lesion was visible on.

Abbreviations: IVMP, intravenous methylprednisolone; MRI, magnetic resonance imaging; MS, multiple sclerosis; NO, nitric oxide; STIR, short tau inversion recovery; VEP, visual evoked potentials

Table 1 Measurement reproducibility for the different subgroups

Variable	Mean (mm^2)	Within subject SD	95% reference range*	CV (%)	Reliability coefficient (95% CI)†
Acute diseased nerve area	18.4	1.13	± 2.21	6.4	0.92 (0.88 to 0.96)
Acute healthy nerve area	17.8	1.21	± 2.37	6.8	0.89 (0.84 to 0.94)
Six month diseased nerve area	16.4	0.76	± 1.49	4.6	0.96 (0.95 to 0.98)
Six month healthy nerve area	17.4	1.11	± 2.18	6.4	0.91 (0.87 to 0.95)

*1.96 × within subject SD; 95% of measurements are expected to lie within this departure from the true value.
†The proportion of total variance caused by between subject variation. Under assumptions which are plausible here, one minus this value is the proportion of variation caused by measurement error.
CV, coefficient of variation.

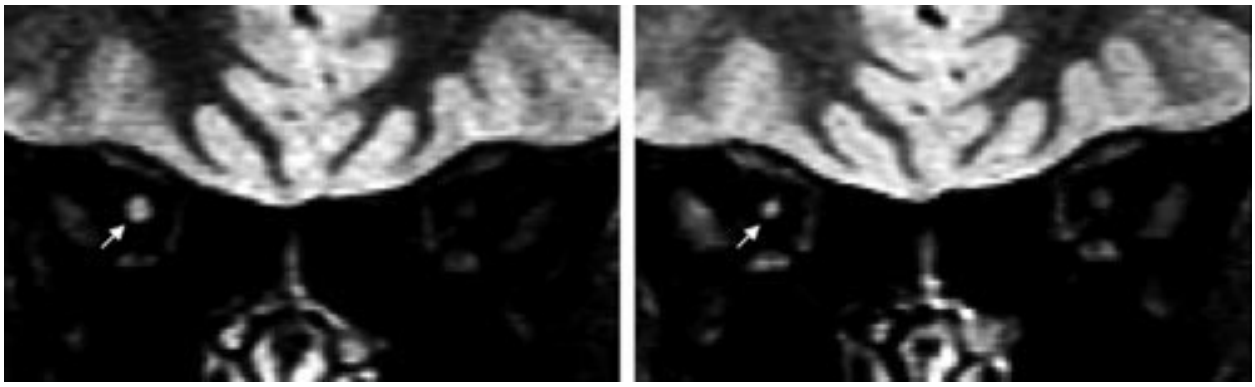

Figure 1 Short tau inversion recovery magnetic resonance images showing optic nerve swelling at baseline (left) and optic nerve atrophy after six months (diseased nerve arrowed) in a 27 year old man with right optic neuritis.

After six months optic nerve mean area was 16.4 (SD 3.8) mm^2 in diseased optic nerves and 17.4 (SD 3.5) mm^2 in healthy optic nerves (n = 59) (fig 1). The estimated geometric mean ratio (diseased nerve area:healthy nerve area) was 0.93 (95% CI 0.87 to 0.99; p = 0.02). A lesion was present in 56/59 patients in the orbital portion measured at this time point. Neither the lesion length at baseline or six months correlated with the degree of atrophy. There was no evidence of association between any of the clinical and VEP variables and six month diseased nerve area.

The mean area of affected optic nerves at six months in the IVMP group was 15.9 (SD 3.9) mm^2 (n = 30) compared with 16.9 (SD 3.8) mm^2 in the placebo group (n = 29). The ratio of six month diseased:six month healthy optic nerve area was 6.8% lower in the IVMP group than in the placebo group (95% CI, 16.1% lower, 3.6% higher, p = 0.19). The ratio of six month diseased nerve area:baseline diseased nerve area was 0.8% lower in the IVMP group than in the placebo group (95% CI 14.8% lower, 15.5% higher, p = 0.92). Neither the MS status nor the duration of symptoms before treatment was instigated affected these ratios.

DISCUSSION

This technique was able to show optic nerve atrophy following optic neuritis with good reproducibility as witnessed by the high reliability coefficients. The area measurements are greater than those produced from sTE fFLAIR images as the measurements from the STIR images include the nerve sheath. Even though the measurements were of the optic nerve–sheath complex, atrophy was still detected after six months. At the time that the images were acquired during the trial, the sTE fFLAIR sequence had not been developed and STIR was the preferred sequence for optic nerve lesion identification.

A study using sTE fFLAIR in a more chronic cohort of optic neuritis patients showed that increasing optic nerve atrophy was associated with worse vision and decreased VEP amplitudes.[11] Qualitative assessment of the sTE fFLAIR images from that study suggests that atrophy of the optic nerve sheath occurred as well (SJ Hickman, unpublished observations). The lack of correlation between the clinical outcome measures and optic nerve mean area in the present study may be caused by functional reorganisation in the visual system in the early recovery process,[12] potentially achieved by utilising redundant optic nerve capacity.[13] This plasticity may fail over time and this may be one explanation for the development of late clinical progression in MS.

There is no evidence from these data that a course of IVMP prevents the short term development of optic nerve atrophy following acute optic neuritis. This is consistent with the lack of long term functional benefit seen as a result of IVMP in both this and other studies.

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HISTORICAL NOTE

The West Riding Lunatic Asylum

"Few subjects in medicine are so intimately connected with the history and philosophy of the human mind as insanity. There are still fewer, where there are so many errors to rectify, and so many prejudices to remove. Derangement of the understanding is generally considered as an effect of an organic lesion of the brain, consequently as incurable; a supposition that is, in a great number of instances, contrary to anatomical fact." Philippe Pinel, Treatise on Insanity, 1801

Until the second half of the 19th century, the study of the brain and its interplay with the mind was beset by mysticism and confusion. Speculation was rife and constituted little better than a repository for the guesswork of ignorance. In varying degree, both neurology and psychology were culpable. In his book, *The metaphysical foundations of modern physical science*, EA Burtt described the concept of mind as "a convenient receptacle for the refuse, the chips and whittlings of science, rather than a possible object of scientific knowledge".

The 19th century hospitals, created for the mentally ill, had two distinct but intertwined functions. The first was to provide a caring place for the treatment of the mentally ill who were commonly spurned by society, receiving brutal and harsh physical treatments and inhumane restraints over many centuries. Pinel had written *Treatise on insanity*,[1] a revolutionary recipe for more gentle treatment and abolition of widespread brutality for the mentally ill. The second and often neglected function was the analysis of brain function and disease, whose investigation in time was to bear the fruits of the neurological sciences.

The 1842 Licensed Lunatic Asylums Bill proposed a Barristers' Commission because it was recognised that county licensing and visiting were defective. It stated that two legal commissioners should visit and report on county houses supplementary to the county visitors. The House of Commons rejected this proposal and an amended bill became the 1842 Inquiry Act. Two medical and two legal commissioners were added. One of the medical commissioners was a psychiatrist, the other a statistician. They jointly visited and reported on public asylums and licensed houses throughout England and Wales, and in 1844, the commission published a 300 page report with recommendations. The 1845 County Asylums Act compelled every county and borough in England and Wales to provide asylum treatment for all its pauper lunatics. Lord Ashley told Parliament that this would "effect a cure in 70 cases out of every 100" (Hansard 6 June 1845 column 193).

Northern institutions included The Retreat at York, opened by the Quaker merchant William Tuke in 1796, and extended by his son Henry, and grandson, Samuel Tuke. There was also The Retreat at Castleton Lodge, near Leeds, "under the skilful management of Mr Hare, surgeon".

The West Riding Pauper Lunatic Asylum[2] (later, Stanley Royd Hospital)[3] was sited in Wakefield, on East Moor, and Samuel Tuke gave advice about its workings and plans. It opened on 23 November, 1818. William and Mrs Ellis were the superintendent and matron from 1818 to 1831.It was a large establishment, and was repeatedly expanded. It was under the control of the West Riding Magistrates; and the initial land, buildings, and furniture cost about £100 000. CC Corsellis, MD, was an early resident physician and director and often had under his care about 450 lunatics. Henry Maudsley, born in Settle, in the Yorkshire dales, was briefly the director; he was the most esteemed psychiatrist of the day, and founded the Maudsley Hospital. Slater in 1864 noted its expansion:

"The asylum is situated about a mile north east of the town. Another building was erected in 1849, which far surpasses the old one, both in size and architecture; the whole combined are calculated to give accommodation to upwards of a 1000 patients."

The hospital had many clinical clerks, clinical assistants, and physicians who attended the sick.[4] By 1 January 1844, there were 433 patients—all paupers. The Stephen Beaumont Museum of Mental Health was in the hospital until it closed in 1995; it was moved to Fieldhead Hospital. It relates the history of the asylum and contains many exhibits. In 1948 a report on Wakefield was made by a medical officer to the new Leeds Regional Hospital Board. It described:

"The old gaol-like buildings at Wakefield are gloomy and depressing and the galleries where many patients aimlessly spend so much of their time are deficient in natural lighting. The accommodation can best be described as austerely pre-Dickensian, falling far short of usually acceptable standards . . ."

A major salmonella outbreak at Stanley Royd Hospital in 1984 led to the deaths of 14 psychogeriatric patients and the infection of nearly 400 others. The hospital closed in 1995.

The asylum had enjoyed highest repute founded on care and its renowned researchers. The most eminent were Sir David Ferrier[5] and Sir James Crichton-Browne.[6]

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