A role for methotrexate in the management of non-infectious orbital inflammatory disease

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Abstract
Aim—To evaluate the clinical usefulness of methotrexate for patients with non-infectious orbital inflammatory disease who fail to respond to systemic corticosteroids and/or orbital irradiation.
Methods—The medical records of patients with non-infectious orbital inflammatory disease who were treated with methotrexate at Oregon Health Sciences University between June 1993 and June 2000 were examined. Methotrexate was administered at a median maximum dose of 20 mg per week (range 15–25 mg per week) in conjunction with folate supplementation. Patients were followed with regular ophthalmic examinations, as well as serum liver enzyme levels and blood cell counts. Clinical signs of regression of the orbital inflammation, visual acuity, dosage and duration of methotrexate therapy, requirement for concurrent corticosteroid administration, and adverse drug reactions were recorded.
Results—The study cohort included 14 patients (24 eyes) with diagnoses including non-specific orbital inflammation (n=7), Tolosa-Hunt syndrome (n=1), thyroid orbitopathy (n=3), Wegener’s granulomatosis (n=1), sarcoidosis (n=1), and Erdheim-Chester disease (n=1). In all cases, methotrexate was commenced as a corticosteroid sparing agent. 10 patients (71%) completed a 4 month therapeutic trial of methotrexate. Median duration of treatment for the nine (64%) patients who experienced clinical benefit was 25 months (range 10–47 months). Six respondents were ultimately able to cease methotrexate, including the single patient who required concurrent long term corticosteroid therapy. Complications included fatigue, gastrointestinal disturbance, hair thinning and mild, reversible serum liver enzyme elevation. Two patients (14%) discontinued treatment because of adverse effects.
Conclusion—Methotrexate is a well tolerated immunosuppressive medication which may benefit patients with recalcitrant non-infectious orbital inflammatory disease.

Orbital inflammatory disease is the term used to describe a group of inflammations that involve one or more of the tissues within the orbit. Although uncommon, these inflammations cause distressing symptoms and may progress rapidly to irreversible visual loss. The most frequently encountered form of non-infectious orbital inflammatory disease is thyroid orbitopathy, but other systemic diseases such as sarcoidosis and various systemic vasculitides may also cause this condition. Non-specific orbital inflammatory disease, previously referred to as orbital pseudotumour, is the second most frequent diagnosis among this patient population.

Patients with non-infectious orbital inflammatory disease are generally treated with a course of high dose oral corticosteroid and/or orbital irradiation, irrespective of the aetiological diagnosis. However, some individuals will fail to respond to these modalities, the reported response rates varying from approximately 50–80%. Furthermore, non-specific orbital inflammation which initially responds to corticosteroid frequently recurs after the cessation of treatment. Systemic corticosteroid therapy is associated with a myriad of adverse effects. For example, moderate doses of prednisone universally cause weight gain and mood change. Chronic use of corticosteroids is associated with a wide variety of adverse effects including osteoporosis, reactivation of infections, hyperlipidaemia, diabetes mellitus, avascular osteonecrosis, and cataract formation. Some studies have concluded that corticosteroid use shortens life expectancy in patients with rheumatoid arthritis. Permanently dry eye, retinopathy, and optic neuropathy should not occur with currently recommended radiation doses, but radiation induced cataracts may result if appropriate lens shielding is not employed, and there is a theoretical risk of radiation related malignancy.

The alkylating agent cyclophosphamide has been recommended for achieving control of steroid and radiation resistant non-infectious orbital inflammatory disease, and when a systemic vasculitis is diagnosed it is often employed as first line therapy. Although cyclophosphamide is frequently effective in these situations, the drug has serious adverse effects including profound bone marrow suppression and the risk of opportunistic infections, sterility, and secondary malignancy. In view of such potential complications, we have preferred to use methotrexate when treating patients with recalcitrant non-infectious orbital inflammatory disease. We have retrospectively reviewed our experience with this therapy.

Patients and methods
We examined medical records of patients with non-infectious orbital inflammatory disease treated consecutively at the Ocular Inflammatory Disease Service of the Oregon Health Sciences University with methotrexate over a
A role for methotrexate in the management of non-infectious orbital inflammatory disease

Patients with alcoholism or known liver disease were not treated with methotrexate. The initial dose of methotrexate was 7.5 mg per week orally, increased to 15 mg per week, 1 week later. The dose was increased at monthly intervals to a maximum of 25 mg per week depending on clinical response and side effects. In some cases, a switch from oral to subcutaneous or intramuscular administration potentiated the therapeutic effect and improved gastric tolerance. We routinely prescribed folate supplements in a dose of 1 mg per day orally, and counselled against alcohol consumption. Timing of clinical reviews varied between patients, depending on factors including diagnosis and form of orbital involvement, response to therapy, and dosage changes. We would generally review a patient 1 month after commencing therapy, and at 3–6 month intervals once the clinical condition had stabilised. If no clinical benefit was noted after 4 months of treatment methotrexate was ceased. We would generally obtain baseline serum creatinine level and liver function tests, a full blood cell count and viral hepatitis B and C serology before beginning treatment. Liver function tests and blood cell count were then monitored 2–4 weeks after every dosage change, and every 2 months for a stable dosage. The alternative to taper and discontinue methotrexate was always discussed with patients who had been in clinical remission for 6–12 months. This decision was ultimately based on patient preference, as guided by physician judgment.

From the medical records, we recorded clinical information which included demographic details, aetiological diagnosis, previous therapies, indication for commencing methotrexate, dosage schedule, duration of treatment, reason for ceasing methotrexate, adverse reactions, liver function abnormalities and need for adjustments to dosage, clinical response to therapy, and dosage changes. We would generally review a patient 1 month after commencing therapy, and at 3–6 month intervals once the clinical condition had stabilised. If no clinical benefit was noted after 4 months of treatment methotrexate was ceased. We would generally obtain baseline serum creatinine level and liver function tests, a full blood cell count and viral hepatitis B and C serology before beginning treatment. Liver function tests and blood cell count were then monitored 2–4 weeks after every dosage change, and every 2 months for a stable dosage. The alternative to taper and discontinue methotrexate was always discussed with patients who had been in clinical remission for 6–12 months. This decision was ultimately based on patient preference, as guided by physician judgment.

Specific diagnoses included non-specific orbital inflammation (seven), Tolosa–Hunt syndrome (one), thyroid orbitopathy (three),

<table>
<thead>
<tr>
<th>Patient</th>
<th>Diagnosis</th>
<th>Age (y)</th>
<th>Sex</th>
<th>Initial visual acuity</th>
<th>Final visual acuity</th>
<th>Methotrexate</th>
<th>Duration of treatment</th>
<th>Clinical benefit</th>
<th>Adverse reactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Erdheim-Chester disease</td>
<td>41</td>
<td>M</td>
<td>RE 20/15 LE 20/15</td>
<td>RE 20/20 LE 20/20</td>
<td>Methylprednisolone, 25 mg</td>
<td>18 months</td>
<td>Clinical benefit</td>
<td>Gastrointestinal disturbance, elevated serum liver enzymes</td>
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<td>2</td>
<td>Non-specific orbital inflammation</td>
<td>34</td>
<td>F</td>
<td>RE 20/20 LE 20/20</td>
<td>RE 20/40 LE 20/40</td>
<td>Prednisone, irradiation</td>
<td>11 months</td>
<td>Clinical benefit</td>
<td>Prednisone ceased, arterial claudication</td>
</tr>
<tr>
<td>3</td>
<td>Non-specific orbital inflammation</td>
<td>48</td>
<td>F</td>
<td>RE 20/20 LE 20/20</td>
<td>RE 20/40 LE 20/40</td>
<td>Prednisone, irradiation, decompression</td>
<td>20 mg: 25 months</td>
<td>Clinical benefit</td>
<td>Gastrointestinal disturbance, fatigue</td>
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<td>4</td>
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<td>55</td>
<td>F</td>
<td>RE 20/20 LE 20/20</td>
<td>RE 20/40 LE 20/40</td>
<td>Prednisone, irradiation</td>
<td>15 mg: 11 months</td>
<td>Clinical benefit</td>
<td>Gastrointestinal disturbance, fatigue</td>
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<td>5</td>
<td>Wegener's granulomatosis</td>
<td>19</td>
<td>F</td>
<td>RE 20/20 LE 20/20</td>
<td>RE 20/40 LE 20/40</td>
<td>Prednisone, azathioprine</td>
<td>8 weeks</td>
<td>Inadequate trial</td>
<td>Methotrexate ceased due to side effects</td>
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<td>6</td>
<td>Tolosa-Hunt syndrome</td>
<td>50</td>
<td>F</td>
<td>RE 20/20 LE 20/20</td>
<td>RE 20/40 LE 20/40</td>
<td>Prednisone, azathioprine</td>
<td>47 months</td>
<td>Clinical benefit</td>
<td>Prednisone ceased</td>
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<td>7</td>
<td>Thyroid orbitopathy</td>
<td>63</td>
<td>F</td>
<td>RE 20/20 LE 20/20</td>
<td>RE 20/40 LE 20/40</td>
<td>Prednisone, irradiation</td>
<td>10 months</td>
<td>Clinical benefit</td>
<td>Fatigue, arthralgia, elevated serum liver enzymes</td>
</tr>
<tr>
<td>8</td>
<td>Thyroid orbitopathy</td>
<td>47</td>
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<td>RE 20/20 LE 20/20</td>
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<td>Prednisone, irradiation</td>
<td>36 months</td>
<td>Clinical benefit</td>
<td>Prednisone ceased</td>
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<td>9</td>
<td>Non-specific orbital inflammation</td>
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<td>M</td>
<td>RE 20/20 LE 20/20</td>
<td>RE 20/40 LE 20/40</td>
<td>Prednisone, irradiation</td>
<td>12 months</td>
<td>Clinical benefit</td>
<td>Prednisone ceased</td>
</tr>
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<td>10</td>
<td>Non-specific orbital inflammation</td>
<td>71</td>
<td>F</td>
<td>RE 20/20 LE 20/20</td>
<td>RE 20/40 LE 20/40</td>
<td>Prednisone, irradiation</td>
<td>10 months</td>
<td>Clinical benefit</td>
<td>Prednisone ceased</td>
</tr>
<tr>
<td>11</td>
<td>Non-specific orbital inflammation</td>
<td>38</td>
<td>M</td>
<td>RE 20/20 LE 20/20</td>
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<td>Prednisone, irradiation</td>
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<td>Clinical benefit</td>
<td>Prednisone ceased</td>
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sarcoïdosis (one), Wegener’s granulomatosis (one), and Erdheim-Chester disease (one). The majority of patients were referred from the Orbital Clinic at Oregon Health Sciences University. Diagnosis had been based on a combination of clinical findings and radiographic changes, although, in seven cases, orbital biopsy with histopathology was also necessary. The indication for treatment in all cases was inability to taper or to tolerate systemic corticosteroids. However, some patients had also been treated previously with orbital corticosteroids. The response to treatment is summarised in Table 2. Of the 14 patients, four (29%) with diagnoses of non-specific orbital inflammation (two), Wegener’s granulomatosis (one), and Erdheim-Chester disease (one), discontinued treatment before completing an adequate 4 month trial. In two cases (14%) this decision was because of medication side effects. The remaining two patients preferred to stop treatment, but reported no adverse effects. One patient (7%) with a diagnosis of non-specific orbital inflammation had a 4 month therapeutic trial, but failed to show a clinical response. Of the remaining nine patients, we judged that all nine (64%) experienced clinical benefit from the medication. In other words, a beneficial clinical response was observed in nine of 10 patients (90%) who had an adequate trial of methotrexate.

Evidence for clinical response to methotrexate varied between patients. One patient with non-specific orbital inflammation involving predominantly muscle and another patient with Tolosa-Hunt syndrome experienced relief of pain and diplopia, with return of ocular motility. In two patients there was sustained resolution of orbital masses, in one case a non-specific muscle based inflammatory mass and the second related to sarcoidosis. A patient who had previously lost the sight of the right eye as a result of aggressive non-specific orbital inflammation, developed left eye involvement, and required unacceptably high doses of prednisone to control the disease. Atraumatic Cushing’s syndrome was apparent at the time of our initial review. She maintained a best corrected left visual acuity of 20/40 following treatment with methotrexate and a low maintenance dose of corticosteroid. Another patient with a unilateral superior rectus-levator complex mass, diagnosed as non-specific orbital inflammation after imaging and biopsy, was referred with distressing upper lid swelling which had adversely affected the result of a recent lid surgery. After commencing methotrexate, lid symptoms improved, allowing the referring orbital surgeon to undertake further lid surgery. Eighteen months later, she developed involvement of the second orbit, and was re-diagnosed as suffering from thyroid eye disease. However, as the inflammation was relatively quiescent at this time, the methotrexate was ceased. One patient with thyroid orbitopathy demonstrated improvement in soft tissue inflammatory signs and orbital motility. Another patient was able to recover from a steroid induced pseudotumour cerebri without recurrence of significant thyroid related ocular symptoms. A third patient had a partial remission of thyroid orbitopathy, with residual intermittent soft tissue symptoms and diplopia she preferred to tolerate. These symptoms interfered minimally with her activities of daily living, and she tolerated methotrexate significantly better than oral prednisone.

For the nine patients who responded to methotrexate, follow up period from commencing of therapy was a median of 43 months, with a range of 11–84 months. The duration of treatment for the nine responders ranged from 10 to 47 months, with a median of 25 months, and the maximum dose of methotrexate ranged from 15 to 25 mg per week with a median of 20 mg per week. Five patients took methotrexate by a parenteral route. Six responders were able to cease methotrexate, although subsequently one patient has taken a brief course of oral prednisone for relapsing orbitopathy. Another group of six patients, the individual with Tolosa-Hunt syndrome, was able to cease methotrexate for a period of 19 months. She then experienced recurrent inflammation which has required re-incorporation of the drug with a tapering course of prednisone. Of the nine patients who responded to methotrexate, six patients were initially using systemic corticosteroid and five were able to be tapered off this medication. Two of these five patients subsequently required a single limited course of corticosteroid for an inflammation flare before the clinical remission became sustained. The patient who required ongoing systemic corticosteroid therapy while taking methotrexate was finally able to cease both medications.

In this series, deterioration of visual acuity was never the primary indication for treatment. No eyes showed significant reduction (2 or more Snellen lines) in visual acuity, and there was significant improvement of visual acuity in six of 24 treated eyes. Methotrexate related adverse reactions are summarised in Table 3. Twelve patients (86%) experienced one or more side effects. Seven patients (50%) experienced fatigue, and the same number complained of various types of gastrointestinal disturbance. Other side effects included headache
A role for methotrexate in the management of non-infectious orbital inflammatory disease

1223

therapy for ocular inflammatory disease.15 Shah and colleagues reported on methotrexate non-infectious orbital inflammatory disease. addressed the role of this medication for methotrexate treatment for orbital inflammatory disease clearly understood.21 One of the effects of methotrexate, a folic acid antagonist, are not the clinical anti-inflammatory properties of individuals. Basic mechanisms responsible for partial response to methotrexate in five of these with our findings, they observed complete or their cohort included six patients with non-responded to a dose reduction, and limited treatment in only 14%. Fatigue and gastrointestinal upset were reported most often. This relatively high rate of minor drug related complications is consistent with rheumatological literature. Between 52% and 65% of patients treated with methotrexate for rheumatoid arthritis experience gastrointestinal disturbances, and 21–38% of these individuals experience central nervous system symptoms including fatigue and headache.11 Despite these adverse effects, one large 7 year multicentre study of patients with rheumatoid arthritis reported that only 7% of subjects taking methotrexate discontinued the drug because of adverse effects.12 We routinely used folate supplements to minimise adverse reactions. In addition, a switch from oral to parenteral administration was often effective in alleviating gastric upset. There were no haematological disturbances or opportunistic infections.

A major concern when prescribing methotrexate is the potential for hepatic toxicity. Almost half of the patients we treated experienced elevation of serum liver enzyme levels. In all cases, these changes normalised either spontaneously or in response to a dose reduction. Hepatic fibrosis generally occurs in the context of long term methotrexate use.22 Duration of therapy for orbital inflammatory disease is often relatively short. Median treatment time was approximately 2 years, and two thirds of our patients have been able to cease treatment. However, we preferred to monitor patients according to guidelines provided by the American College of Rheumatology for treatment of rheumatoid arthritis.23 These recommendations require that all patients have pretreatment liver function tests, with tests repeated 4–8 weekly thereafter. Liver biopsy is indicated if five of nine serum aspartate aminotransferase levels are elevated over a 12 month period or if the serum albumin level is abnormally low, despite dose reduction and possibly temporary discontinuation of methotrexate. The presence of piecemeal necrosis with moderate to severe fibrosis is an indication to cease the treatment.

Certainly methotrexate therapy carried less risk to the patient than would cyclophosphamide or long term systemic corticosteroid therapy. Consequently, although cyclophosphamide is probably more likely to control orbital inflammation, our findings suggest that methotrexate is an effective, less toxic alternative for patients with these conditions.24 The one patient with Wegener’s granulomatosis in our series elected to cease methotrexate therapy prematurely because of side effects.

This retrospective study suggests that methotrexate is a well tolerated immunosuppressive medication which may benefit patients with non-infectious orbital inflammatory disease who fail treatment with systemic corticosteroid

Table 3 Prevalence of adverse reactions during methotrexate treatment for orbital inflammatory disease

<table>
<thead>
<tr>
<th>Adverse reaction</th>
<th>Prevalence: total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrointestinal disturbance</td>
<td>7/14 (50)</td>
</tr>
<tr>
<td>Fatigue</td>
<td>7/14 (50)</td>
</tr>
<tr>
<td>Headache</td>
<td>2/14 (14)</td>
</tr>
<tr>
<td>Arthralgia</td>
<td>2/14 (14)</td>
</tr>
<tr>
<td>Hair thinning</td>
<td>2/14 (14)</td>
</tr>
<tr>
<td>Elevated serum liver enzyme levels</td>
<td>6/14 (43)</td>
</tr>
</tbody>
</table>

in two patients (14%), arthralgia in two patients (14%), and hair thinning in two patients (14%). Serum liver enzyme elevation was noted in six patients (43%), but these changes normalised either spontaneously or in response to a dose reduction.

Discussion

We have treated 14 patients with various forms of non-infectious orbital inflammatory disease with methotrexate as a corticosteroid sparing agent. Almost two thirds of the total patient cohort experienced clinical benefit, on a median maximum dose of 20 mg per week for a median of 25 months. Further, 90% of patients who had an adequate therapeutic trial demonstrated a favourable clinical response to therapy. Two thirds of responders were able to cease methotrexate, including the single patient who had required ongoing systemic corticosteroid therapy while taking methotrexate.

Methotrexate is standard treatment for individuals who suffer from rheumatoid arthritis, with significant clinical benefits demonstrated in randomised controlled clinical trials.11 12 We treated with an average weekly dose which was approximately twofold higher than that reported in these trials. A number of non-comparative case series including a total of 77 patients indicate that methotrexate may be useful in the management of various forms of uveitis, scleritis, and peripheral ulcerative keratitis.13–20 However, only one report has addressed the role of this medication for non-infectious orbital inflammatory disease. Shah and colleagues reported on methotrexate therapy for ocular inflammatory disease. Their cohort included six patients with non-specific orbital inflammations. In agreement with our findings, they observed complete or partial response to methotrexate in five of these individuals. Basic mechanisms responsible for the clinical anti-inflammatory properties of methotrexate, a folic acid antagonist, are not clearly understood.21 One of the effects of inhibiting dihydrofolate reductase is an enhanced extracellular release of adenosine. Recently published studies indicate that adenosine acts on a number of leucocyte subtypes through at least four receptors, having multiple anti-inflammatory effects, such as inhibiting production of pro-inflammatory cytokines and chemokines, and stimulating production of anti-inflammatory cytokines and cytokine inhibitors.21

The majority of our patients noted one or more adverse reactions to methotrexate. However, these effects were generally mild, often responded to a dose reduction, and limited

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and/or orbital irradiation. Specific benefits of methotrexate therapy include minimal haematological toxicity, little risk of opportunistic infection and secondary malignancy, once a week ease of administration, and relatively low cost. We believe that a trial of methotrexate should be attempted for most patients with recalcitrant orbital inflammation before the institution of cyclophosphamide therapy.

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13 Wong VG, Hersh EM. Methotrexate in the therapy of cyclo- 
20 Shetty AK, Zganjar BE, Ellis GS, et al. Low-dose methotrexate in the treatment of severe juvenile rheuma-