ABSTRACT. Objective. To assess the safety and efficacy of noncorticosteroid triple immunosuppressive therapy in the treatment of refractory chronic noninfectious childhood uveitis.

Methods. Subjects were retrospectively selected from a database. Patients were included if they were diagnosed with chronic, noninfectious uveitis at 16 years of age or under and treated with triple immunosuppressive therapy for at least 6 months (following failure of a combination of 2 immunosuppressants). Patient demographics, diagnoses, duration of uveitis, drug dosages, active joint inflammation, and ophthalmologic data were recorded. Efficacy outcomes for triple therapy were recorded at 6 months.

Results. Thirteen patients with bilateral uveitis were included. Using Standardized Uveitis Nomenclature (SUN) criteria, at 6 months only 11 eyes (42%) had a 2-step improvement in anterior chamber cell inflammation (n = 26). In addition, 2 patients required additional oral corticosteroid treatment. There were 4 significant infectious adverse events during a total of 21.9 patient-years (PY) on triple therapy (0.18 events per PY).

Conclusion. In this group of children with refractory uveitis, addition of a third immunosuppressive agent did not confer substantial benefit in redressing ocular inflammation and was associated with significant infections in a minority of patients. (First Release Oct 1 2013; J Rheumatol 2014; 41:136–9; doi:10.3899/jrheum.130594)

Key Indexing Terms:

UVEITIS JUVENILE ARTHRITIS IMMUNOSUPPRESSION
was defined as persistent inflammation of SUN grade 1+ or more anterior chamber cells.

Our study was part of an institutionally approved service evaluation project. Patient demographics, diagnoses, duration of uveitis, drug dosages, and active joint inflammation were recorded. Ophthalmologic data, including visual acuity and anterior chamber (AC) cells, were also recorded according to the SUN group's criteria. Inactive uveitis was defined as < 1 cell per field in the anterior chamber on slit lamp examination (grade 0). Ocular inflammation was said to be improved if there were a 2-step reduction in AC cell grade (or a decrease to inactive), and worsened with a 2-step increase in AC cell grade (or increase to grade 4). Data were reported for each eye separately.

Efficacy outcomes are reported at 6 months and data from all patients were available at this timepoint. In contrast, for our safety analysis, because adverse events were rare, the rate of significant adverse events that occurred during the total followup time was recorded per patient-year (PY) and calculated by this formula: event rate/PY = Σ (number of events) / Σ [time (since starting triple therapy) to event or data collection endpoint].

A significant adverse event was defined as one that was life-threatening, resulted in significant disability, or required a prolonged hospital admission. An infection was noted as significant if it required intravenous antibiotics or hospital admission. Adverse events that were not significant were not reported, because these were not included in the clinical pro forma and our records will therefore be incomplete. Reasons for stopping triple therapy were reported as written in patients' clinical records.

RESULTS
Characteristics of study population. Nineteen patients were identified as receiving triple therapy since January 2008. Of these, 6 were excluded because they had been using 3 agents for < 6 months. Therefore, 13 patients (8 female, 62%; median age 13 yrs) were included. Eleven had JIA, 1 had Blau syndrome, and 1 had idiopathic uveitis. Twelve of the patients identified had bilateral anterior uveitis and 1 had bilateral pan-uveitis. Triple therapy was started for control of uveitis in 7 patients and for both uveitis and arthritis in 6 patients. The median duration of uveitis when triple therapy was started was 3 years.

The combinations of triple therapy are shown in Table 1. Because of inadequate control of uveitis and arthritis in 2 patients, 1 of the medications was changed in 4 patients during followup. The median length of followup was 14 months (range 6–54 months). The total followup after starting triple therapy was 21.9 PY.

Visual acuity and uveitis activity. Before starting triple therapy, the median visual acuity was logMAR 0.18, 23.1% of eyes had a visual acuity of logMAR 0.4 or worse, and 3.8% of logMAR 1.0 or worse (n = 26). At 6 months these values were 15.4% and 7.7%, respectively (n = 26). Two eyes had reduced visual acuity before triple therapy began (hypermetropic amblyopia/amblyopia and aphakia), accounting for those with a visual acuity of logMAR > 1.0 that did not improve over the course of followup.

At baseline, 22 (84.6%) of the 26 eyes had active uveitis. All 4 inactive eyes were in patients with active uveitis in their fellow eye, and of these, 2 remained inactive for the entire followup period. Six months after commencing triple therapy, ocular inflammation had improved in 11 eyes (42.3%), but 17 eyes (65.4%) still had active anterior uveitis.

A total of 4 surgical procedures on 4 eyes were performed to treat uveitis or its complications during the followup period (3 trabeculectomies, 1 intraocular triamcinolone injection). Surgery was also required for 1 eye with strabismus.

Use of corticosteroids. Prior to starting triple therapy, 22 (84.6%) of the 26 eyes were treated with topical corticosteroids. After 6 months of using triple therapy (n = 26), 15 of the eyes (57.7%) were treated with a tapered dose, 8 (30.8%) remained the same, and an increased dose of topical corticosteroids was administered to 3 (11.5%). At that time topical corticosteroid drops were used in a total of 17 eyes (65.4%).

At baseline 2 patients were taking oral prednisolone and another 2 had received orbital floor corticosteroid injections. These patients were able to stop taking corticosteroids after 3 months of triple therapy.

At the first 6-month followup, 2 (15.4%) of the 13 patients had to have additional corticosteroids administered (oral prednisolone, methylprednisolone by IV) to control persistent ocular inflammation.

Adverse events and discontinuation of triple therapy. At the time data collection ceased, 7 patients were still taking triple therapy, while 6 had stopped taking at least 1 agent. Of these 6 patients, 1 patient was tapered off MMF therapy because the disease had become inactive, another patient stopped owing to subtherapeutic levels of tacrolimus, 3 stopped because of intolerance to 1 of the drugs (n = 2 for MTX and n = 1 for MMF), and 1 patient chose to stop MTX.

Over a total of 263 months of followup time, there were 16 adverse events recorded from patient notes. We classified 4 of these as significant since they required a prolonged hospital admission. These occurred in 3 patients: 1 had an episode of chicken pox, another had swine flu (H1N1), and another developed pneumonia on 2 separate occasions. The significant adverse event rate was 0.18/PY (rate of patients affected was 0.14/PY). Other studies using mono and duotherapy appear to show lower adverse event rates; however, there is a paucity of data available on adverse events in duotherapy papers.

DISCUSSION
We have presented 13 children with noninfectious chronic uveitis who had refractory uveitis, despite treatment with topical corticosteroids and 2 other systemic immunosuppressants. Our results show that despite some improvement in visual acuity, ocular inflammation improved in only 42% of the eyes at 6 months with the addition of a third immunosuppressant, but this was associated with a significant adverse event rate of 0.18/PY.

All but 1 of the patients was treated with MTX, and 11 of these 12 also received MMF. Other studies have highlighted the effectiveness of immunosuppressive agents as monotherapy, such as MTX and MMF, or in combination with other agents.
Table 1. Patient characteristics, previous treatments, and clinical features before and after starting triple therapy.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age (yrs)</th>
<th>Diagnosis</th>
<th>Duration Uveitis When TT Started</th>
<th>Age yrs, When TT Started</th>
<th>Previous Treatment</th>
<th>Third Drug Started</th>
<th>Medication Changes During Followup</th>
<th>Eye (LogMAR)</th>
<th>Visual Acuity</th>
<th>Anterior Chamber Cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>13</td>
<td>Psoriatic polyarticular JIA, chronic bilateral AU</td>
<td>3 yrs</td>
<td>10</td>
<td>MTX 17.5 PO, MMF 300</td>
<td>ADA 40</td>
<td>MTX 17.5 PO, MMF 300, ADA 40, TS BD BE</td>
<td>RE</td>
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<td>0.00</td>
</tr>
<tr>
<td>F</td>
<td>14</td>
<td>Oligoarticular JIA, chronic bilateral AU</td>
<td>4 yrs, 5 months</td>
<td>10</td>
<td>MTX 7.5 PO, INF</td>
<td>MMF 300</td>
<td>MTX 7.5 PO, INF, TS 6 x day RE, Pred</td>
<td>LE</td>
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<td>0.00</td>
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<tr>
<td>F</td>
<td>6</td>
<td>Oligoarticular JIA, chronic bilateral AU</td>
<td>1 yr, 8 months</td>
<td>6</td>
<td>MTX 12.5 PO, MMF 500</td>
<td>ADA 20</td>
<td>MTX 12.5 PO, MMF 500, TS BD BE</td>
<td>RE</td>
<td>0.30</td>
<td>0.18</td>
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<tr>
<td>F</td>
<td>15</td>
<td>Idiopathic chronic bilateral AU</td>
<td>3 yrs</td>
<td>14</td>
<td>MTX 25 PO, TAC 3</td>
<td>ADA 40</td>
<td>MTX 25 PO, TAC 3, TAC 3, ADA 40, TS QDS BE</td>
<td>RE</td>
<td>0.30</td>
<td>0.00</td>
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<tr>
<td>M</td>
<td>16</td>
<td>Blau, chronic bilateral granulomatous PU</td>
<td>6 yrs, 4 months</td>
<td>13</td>
<td>MTX 20 SC, ADA 30</td>
<td>MMF 800</td>
<td>MTX 20 SC, ADA 30, ADA to INF 29 mos</td>
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<td>0.78</td>
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<tr>
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<td>Polyarticular JIA, chronic bilateral AU</td>
<td>1 yr, 8 months</td>
<td>6</td>
<td>MTX 10 PO, MMF 480</td>
<td>ADA 20</td>
<td>MTX 10 PO, MMF 480, TS BD BE</td>
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<td>Polyarticular JIA, chronic bilateral AU</td>
<td>3 yrs, 1 month</td>
<td>7</td>
<td>MTX 10 PO, ADA 20</td>
<td>MMF 300</td>
<td>MTX 12.5 PO, ADA 20, TS TDS BE</td>
<td>RE</td>
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<tr>
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<td>5 yrs, 1 month</td>
<td>12</td>
<td>MMF 750, ADA 40</td>
<td>MTX 20 PO</td>
<td>MMF 750, MTX 20 SC, TS TDS BE</td>
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<tr>
<td>M</td>
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<td>Polyarticular psoriatic JIA, chronic AU</td>
<td>1 yr, 6 months</td>
<td>8</td>
<td>MTX 10 PO, INF</td>
<td>MMF 500</td>
<td>MTX 10 PO, INF, TS QDS BE</td>
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<tr>
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<td>MMF 850, ABT 440</td>
<td>TAC 1.5</td>
<td>ABT 400, MMF 850, TS QDS BE</td>
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<td>Polyarticular JIA, chronic AU</td>
<td>10 yrs</td>
<td>16</td>
<td>MTX 20 SC, MMF 1000</td>
<td>ADA 40</td>
<td>MTX 20 SC, MMF 1000, ADA 40, TS BD BE</td>
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<td>0.00</td>
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<tr>
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<td>Polyarticular JIA, chronic bilateral AU</td>
<td>2 yrs</td>
<td>7</td>
<td>MTX 12.5 SC, ADA 20</td>
<td>MMF 250</td>
<td>MTX 12.5 SC, ADA 20, TS BD BE</td>
<td>RE</td>
<td>0.18</td>
<td>0.18</td>
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<tr>
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<td>n/a</td>
<td>15</td>
<td>MTX 15 PO, MMF 1000</td>
<td>ADA 40</td>
<td>MTX 15 SC, MMF 1000, TS QDS BE</td>
<td>RE</td>
<td>-0.08</td>
<td>-0.08</td>
</tr>
</tbody>
</table>

ABT: abatacept (dose in mg, IV, monthly); ADA: adalimumab (dose in mg, subcutaneously, fortnightly); AU: anterior uveitis; BE: both eyes; INF: infliximab (dose 6 mg/kg, IV, every 8 weeks); JIA: juvenile idiopathic arthritis; LE: left eye; MMF: mycophenolate mofetil (dose in mg, PO twice daily); MTX: methotrexate (dose in mg, once weekly); Pred: oral prednisolone; PU: pan-uveitis; RE: right eye; TAC: tacrolimus (dose in mg, PO twice daily); TS: topical corticosteroids; TT: triple therapy.
with a single biologic agent, including adalimumab, infliximab, or abatacept. The use of tacrolimus for uveitis has been studied in adults but not in children. Although evidence suggests that three-quarters of childhood uveitis responds to MTX, there is a subgroup that is refractory to a combination of 2 immunosuppressive agents.

It is evident that triple therapy did not obviate the need for corticosteroids, although 57.7% of patients were able to reduce the frequency of topical corticosteroid eyedrops during the first 6 months of followup, which is a key surrogate measure of efficacy. The combination of 3 immunosuppressants in these 13 patients was, however, associated with 4 significant adverse events, all infections that are therefore potentially causally linked to the addition of further immunosuppression.

We acknowledge several limitations of our study and the conclusions drawn: first, the relatively small sample size and variable followup times for the adverse event data reported; second, the absence of a comparator control group; and third, the heterogeneity of the combination of therapies used, although 9 of the 13 patients did receive a single combination (MTX, MMF, and adalimumab). Given the small numbers, statistical analysis in an attempt to identify differences between subgroups would not be valid. It is not possible from the data presented here to assess the efficacy of any particular combination of triple therapy, but rather to comment in general on the effect and safety of the addition of a third immunosuppressant in this patient population.

Bearing in mind the above caveats, our study suggests that in children with refractory chronic noninfectious uveitis already receiving 2 immunosuppressive drugs, the addition of a third agent does not confer substantial benefit in redressing ocular inflammation and is associated with an increased risk of infectious adverse events. Therefore, we suggest that early intervention with first-line and second-line immunosuppressive agents, including biologics, may be more beneficial than attempts at late triple therapy rescue for established refractory disease.

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REFERENCES