**METHODS**

The records of children, who attended the Pediatric Department at Nalanda Medical College & Hospital, Patna, Bihar were analyzed retrospectively. Children aged 1-18 years receiving levamisole for at least six months for treatment of SDNS or FRNS were included. Infantile NS, congenital NS and NS secondary to systemic illnesses were excluded. SDNS was defined when there were two consecutive relapses while on alternate day steroids or within 14 days of their discontinuation. FRNS was defined by two or more relapses in six months or more than three relapses in any twelve months. Relapses were treated according to Indian Pediatric Nephrology Group guidelines [4]. Levamisole was started in SDNS/FRNS children at a dose of 2 mg/kg/day at the end of twoweeks of daily steroids on induction remission.

Prednisolone was given at a dose of 1.5 mg/kg every other day for 4 weeks and then gradually tapered to a maintenance dose of 0.5 mg/kg every other day at 6 months and 0.25 mg/kg every other day at end of 1 year.

**RESULTS**

A total of 97 children (53 boys) completed 6 months of levamisole therapy; 62 (64%) of these were FRNS. None of the children had renal failure, hypertension or gross hematuria. The baseline characteristics at the start of levamisole therapy are shown in Table I.

The duration of levamisole therapy ranged from 6 to 24 months with a mean (SD) duration of 18.7 (6.4) months. Levamisole was effective in 77.3% children, was stopped in 15 (15.5%) children as it was ineffective, and 7 (7.2%) children were lost to follow-up. Frequent relapsers showed a better efficacy to levamisole in comparison to steroid-dependent NS (80.6% vs. 71.4%; P=0.001). The relapses were also less during the period of post-levamisole therapy.

**Conclusion:** Levamisole is an effective alternative therapy in frequently relapsing and steroid-dependent nephrotic syndrome.

**ABSTRACT**

Objectives: To assess the efficacy of levamisole in frequently relapsing nephrotic syndrome and steroid-dependent nephrotic syndrome.

Study Design: Retrospective analysis of hospital case records.


Methods: Case records of children who were diagnosed as steroid-dependent or frequently relapsing nephrotic syndrome, were reviewed. Levamisole was given daily (2 mg/kg/d) along with tapering doses of alternate day steroids after remission on daily steroids.

Results: Levamisole was effective in 77.3% children with a better (80.6%) efficacy in frequently relapsing nephrotic syndrome. A total of 34 children completed 1 year follow-up post levamisole therapy. The cumulative mean (SD) steroid dose 1-year before therapy was 4109 (1154) mg/m2 and 1-year post therapy was 661 (11) mg/m2 (P<0.001). The relapses were also less during the period of post-levamisole therapy.

Conclusion: Levamisole is an effective alternative therapy in frequently relapsing and steroid-dependent nephrotic syndrome.

**KEYWORDS**

Treatment, Steroids, Outcome, Relapse, Nephrotic syndrome.
duration of 11.84 (1.3) months. Mean (SD) serum albumin at the start of therapy was 2.32 (0.5) g/dL and at completion of therapy was 4.12 (0.3) g/dL.

At the end of 24 months, 40 children completed therapy and these children were kept under surveillance for at least a year. A total of 34 children were followed-up for 1 year post-therapy and the cumulative steroid dose and relapse rates are shown in Table II. The steroid dose and relapse rates were significantly less after levamisole therapy. Relapse-free period was observed in 25 (73.5%) children during therapy and in 22 (64.7%) children during the one year period of post-levamisole therapy.

Before the administration of levamisole, 7 SDNS children had received cyclophosphamide. Renal biopsy was performed in all these children. Four children had minimal change disease and 3 had diffuse mesangial proliferation by histopathology. Levamisole therapy was effective in 8 children.

**TABLE I**

Baseline Characteristics of the Study Population

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>SDNS</th>
<th>FRNS</th>
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</thead>
<tbody>
<tr>
<td>No. (%)</td>
<td>35 (36.6%)</td>
<td>62 (63.9%)</td>
</tr>
<tr>
<td>Male gender, n (%)</td>
<td>18 (51.4%)</td>
<td>35 (56.5%)</td>
</tr>
<tr>
<td>Age at diagnosis, y</td>
<td>2.5 (1.1)</td>
<td>5.1 (1.8)</td>
</tr>
<tr>
<td>Age at beginning of therapy, y</td>
<td>3.9 (1.7)</td>
<td>4.8 (2.3)</td>
</tr>
</tbody>
</table>

**SDNS** — Steroid-dependent nephrotic syndrome; **FRNS** — Frequently relapsing nephrotic syndrome; *Values in mean (SD).*

**DISCUSSION**

In this retrospective study of 97 children with SDNS or FRNS, levamisole was found to be effective in majority (77.3%), with a better efficacy in children with FRNS as compared to those with SDNS.

In our study, levamisole was administered in daily dosing schedule based on personal experience; most guidelines suggest alternate day therapy in nephrotic syndrome. Fu et al. [5], in a comparative study between daily and alternate day levamisole usage in children with FRNS and SDNS, reported that daily levamisole usage can be considered when response to alternate day usage is unsatisfactory. We did not have any comparison group as this study was a retrospective analysis.

Madani et al. [6] evaluated the efficacy of levamisole among 304 children and demonstrated that it was effective in children with both SDNS and FRNS. In their study, the relapse rates reduced by about one-half after levamisole therapy. Alsaran et al. [7] documented a response in 90.6% children with FRNS/SDNS. Sumegi et al. [8] followed 34 children for a duration of 5–36 months and documented a reduction in relapse rate after levamisole therapy. Our results are in concordance with the above studies. In children with effective therapy, we were able to taper and stop steroids in majority of patients. Bagga et al. [9] also showed that levamisole was effective in children with SDNS. In a meta-analysis of randomized controlled trials [10], Durkan et al. showed that prolonged course of levamisole reduces the incidence of relapses.

Various studies have reported side effects while on alternate day levamisole schedule, though these were not life-threatening and were reversible on discontinuing levamisole [6,7,9,11]. We did not observe any side effects, even in those who completed 2 years of daily levamisole therapy.

**CONCLUSION**

To conclude, daily levamisole along with initial low dose steroid therapy can be effective in children with FRNS/SDNS with a better efficacy in children with FRNS. It significantly reduces the cumulative dose of steroid intake and relapse rates. Levamisole can be used as an effective steroid-sparing agent in children with frequently-relapsing and steroid dependent nephrotic syndrome.

**REFERENCES**