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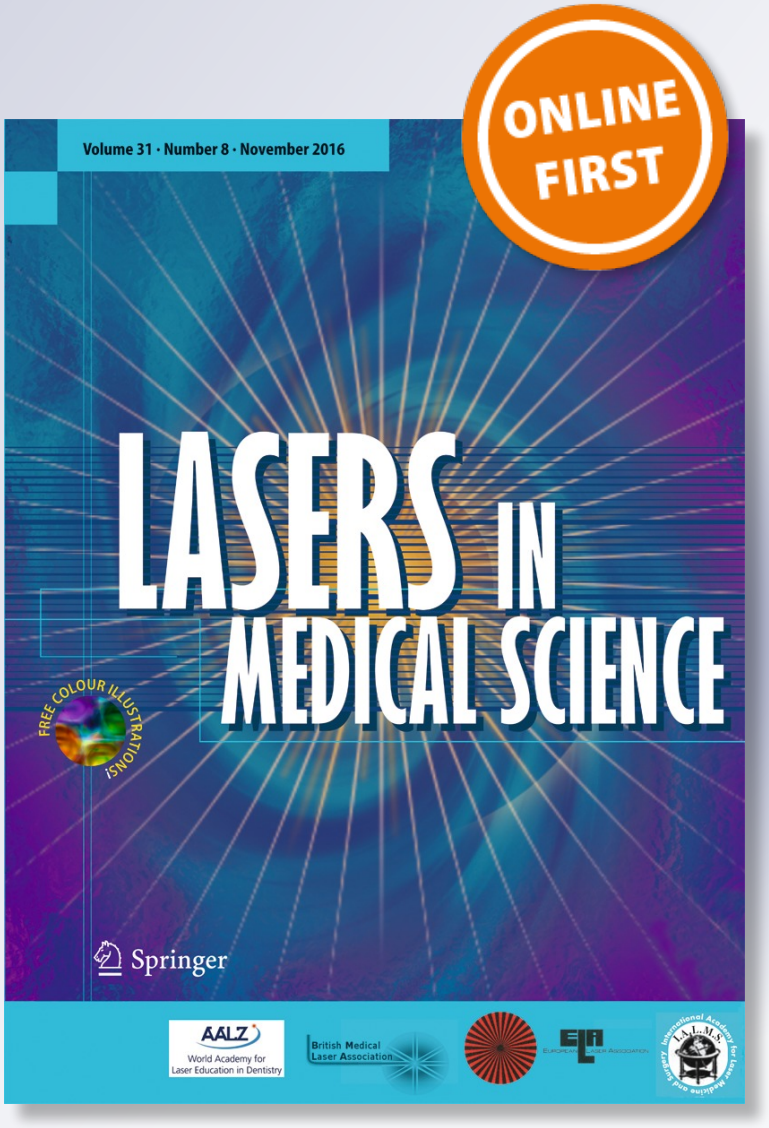


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ORIGINAL ARTICLE

# Nocturnal enuresis in children between laser acupuncture and medical treatment: a comparative study

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**Abstract** Nocturnal enuresis (NE) is intermittent involuntary voiding during sleep in a child aged 5 years or more. The study was conducted to compare the effect of using laser acupuncture and medication for the treatment of children with nocturnal enuresis (NE) and evaluation of urodynamic parameter after treatment. A randomized study included 45 children ranged from 5 to 15 years presenting with NE. They were randomized into three equal groups—group A, managed with desmopressin acetate; group B, managed with laser acupuncture; and group C, managed with a combination of laser acupuncture and desmopressin—all groups received behavioral therapy. The children were evaluated before and after 3 months of the study to record the efficacy of therapy, side effects and bladder capacity, and 3 months of follow-up after cessation of treatment by bladder diary. A statistically significant higher cure rate was reported in group B patients (73.3 %), while in groups A and C, improvement was reported in 20.0 and 13.3 %, respectively ($p$ value = 0.002). Laser acupuncture is noninvasive, painless tool, with no side effects and lower recurrence rate which can be considered as an alternative therapy for patients with NE.

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## Introduction

Nocturnal enuresis (NE) is intermittent involuntary voiding during sleep in a child aged 5 years or more; it is a socially disruptive and stressful condition which affects around 15 to 20 % of 5-year-old children and up to 2 % of adults with a high rate of spontaneous remission [1]. The exact pathogenesis of NE is still obscure; children who wet at night can be regarded as a "deep sleeper," have small bladder capacity, and/or have nocturnal polyuria secondary to lack of vasopressin [2]. In the absence of daytime symptoms, bladder overactivity (BOA) overnight can cause enuresis at children with bladder volume small for age [3]. The line of treatment has not been standardized. It is managed with medications as desmopressin or oxybutynin, and alternative modalities as alarms, hypnotherapy, and acupuncture [4]. Acupuncture is thought to correct the imbalance and restore internal homeostasis by stimulating various acupoints as acupressure, electro-acupuncture, and laser acupuncture [5]. Laser therapy applications in the form of monochromatic light over biological tissue are to create a stimulating, biomodulatory, and biological effects [6].

The purpose of this study was to investigate the effect of desmopressin acetate, laser acupuncture, and the combination of both in children with nocturnal enuresis (NE).

## Patients and methods

After approval of the Laser Institute Research Ethical Committee, the present study was carried out in the department of medical application of laser (M.A.L) National

Institute of Laser Enhanced Sciences (N.I.L.E.S) Cairo University, Egypt during the period from 2014 to 2015. The present study is a randomized comparative study included 45 patients of both sex age 5–15 years old with NE, and all patients were referred from pediatric and urology clinics, and were evaluated clinically for other urological or neurological disorders and investigated with urine analysis, and plain X-ray of the pelvis and spine. Patients with evidence of urinary tract infections, bladder dysfunction, chronic constipation, neurological or organic disorders, and trauma, contusion, or fracture in the spine or pelvis were excluded from the study. Based on the line of treatment, the patients were randomly assigned into three equal groups. The patient choose one of 45 closed papers numbered from 1 to 45, papers 1–15 was assigned to group (A): managed with desmopressin, papers 16–30 was assigned to group (B): managed with laser acupuncture and papers 31–45 was assigned to group (C): managed with combined therapy of laser acupuncture and desmopressin. All groups received behavioral therapy in the form of diet and fluid restriction, dry bed training daily.

Desmopressin was administered as 1 h before the bedtime dose of 60 μg sublingually once daily for 3 months. Laser acupuncture was administered twice weekly for 3 months using an infrared pulsed laser Giotto MED SPA 2003 made in Italy (Fig. 1): wavelength 905 nm, spot size diameter of 5 mm frequency 2500 Hz, average power 15 W, energy of 225 mJ applied for 1 min per point and pulse width of 100 ns and area = 0.2 $cm^2$. Laser acupuncture was applied at the following points: (REN 2, 3, 4), and (UB23, 28, 32 bilaterally) and SP6 bilaterally (Fig. 2).

The research was done after ethical approval from the Institute committee.

All parents read, approved, and signed informed consent.

**Fig. 1** Giotto MED SPA laser with protective eye goggles

## Evaluation and follow-up

### Urodynamic studying

The device was used to measure the pressure changes in the bladder with passive filling (cystometry) and its ability to evacuate urine, measured by volume voided over time (uroflowmetry).

### Cystometry test

1. Start the test by repeating the previous step.
2. Allow slowly filling of the bladder and note changes in bladder compliance, occurring of detrusor instabilities (DIs), bladder capacity, sensations, and leakage.
3. Ask the patient to cough and see leakage volume and vesical leak point pressure (VLPP).
4. Note the first desire to void and urgency.

### Uroflometry test

Uroflometry test was done by asking the patient to urinate with the cystometry catheters in place into a funnel attached to special equipment and record urine flow over time.

The study period was 6 months (3 months as a treatment course and 3 months as a follow-up after cessation of treatment), during which the patients were evaluated by written voiding diary and urodynamic test. The written voiding diary was recorded 2 weeks at the start and 2 weeks after cessation of treatment. Functional bladder capacity, bladder compliance, and bladder overactivity was evaluated by a urodynamic test after the end of treatment. Patients reevaluated as follow- up after 3 months by voiding diary and urodynamic study.

The response to treatment was defined as complete recovery if enuresis disappeared at least 14 consecutive days, partial recovery if there was >50 % decrease in the frequency of bedwetting, and treatment failure if there was < 50 % decrease in the wet nights or if the problem remained unchanged or worsened.

### Statistical analysis

The measured outcomes were compared using descriptive statistics, MNOVA test, ANOVA test, paired *t* test, chi-squared test, and test of marginal homogeneity. The level of significance for all statistical tests was set at $p < 0.05$. Statistical package for social studies (SPSS) version 19 for Windows was used.

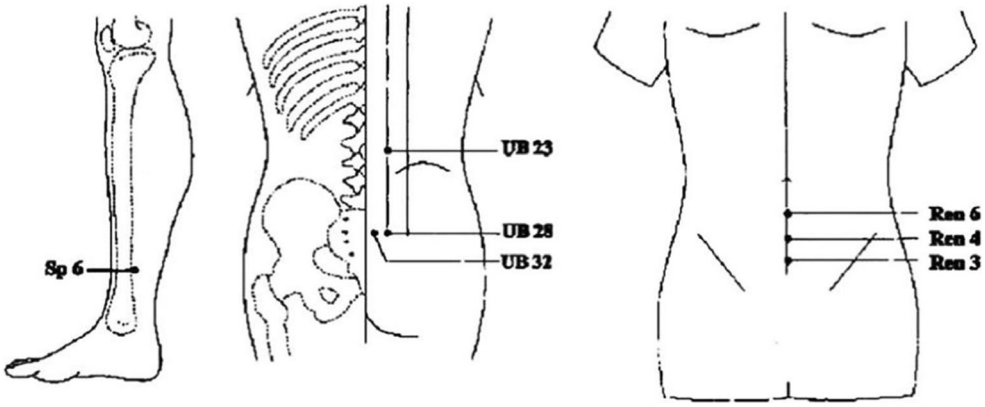


**Fig. 2** Acupuncture points used for treatment of NE

## Results

The study included 45 children aged between 5 and 15 years old from both sexes, with (NE); they were randomized into three equal groups based on the line of treatment. Data obtained from the three groups pretreatment and posttreatment regarding bladder capacity, bedwetting frequency, and bladder overactivity (BOA), and bladder compliance, recovery rate, and relapse rate were statistically analyzed and compared.

When comparing age mean ± SD, it was 9.43 ± 2.77 in group A, 8.8 ± 3.18 in group B, 9.93 ± 3.16 in group C, and $P = 0.59$ with no significance. Comparing the sex and weight of the patient's mean ± SD showed that there was no significance with $P = 0.62$ and $P = 0.79$, respectively.

Also, genetic inheritance showed no significance between all groups $P = 0.12$.

Three months after treatment, recovery and relapse rate were evaluated, and group B showed the highest recovery rate with a significant difference between all groups and $P = 0.002$ (Fig. 3). Also, group B showed the lowest rate of relapse; however, no significant difference in relapse rate was found between all groups ($P = 0.19$) as showed in Fig. 4.

On assessing the posttreatment bladder capacities and bedwetting frequency between all groups (Fig. 5), we found that group B had significantly better results regarding bladder capacity ($p = 0.01$), bedwetting frequency ($p = 0.0001$), and compliance ($p = 0.004$) (Table 1). There was no statistically significant difference in BOA mean values posttreatment ($p = 0.24$) (Table 2).

On assessing bedwetting frequency, bladder capacities, BOA, and bladder compliance in each group pretreatment and posttreatment, the only significance was found in group B, with $P = 0.0001$, 0.0001, 0.02, and 0.0001, respectively.

In our study, no serious side effects were observed except for groups A and C, as transient abdominal pain occurred with an unknown cause for three patients in group A and two patients in group C, while there were no side effects detected in group B throughout the treatment course.

## Discussion

Nocturnal enuresis tends to be a multifactorial disorder. There is an alteration in bladder capacity [7], the amount of urine excreted during the night (nocturnal polyuria) [8], uncontrolled bladder contractions [3], and failure to awaken to bladder fullness [9], and it is associated with embarrassment, emotional, physical, and social stress [1].

In our study, 73.3 % of patients of the group (B) reported a significant complete recovery (at least 14 consecutive dry days) comparing to group (A) who received desmopressin 20.0 % and group (C) who received combined therapy 13.3 % ($p$ value = 0.002).

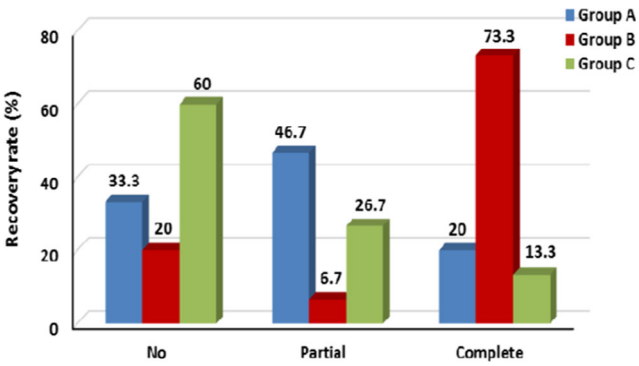


**Fig. 3** Frequency distribution of recovery rate of groups A, B, and C

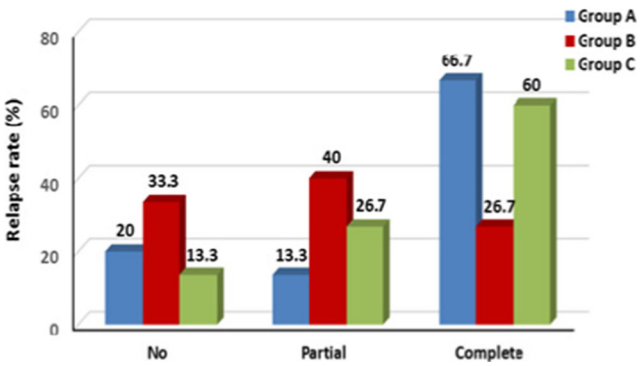


**Fig. 4** Frequency distribution of relapse rate of groups A, B, and C

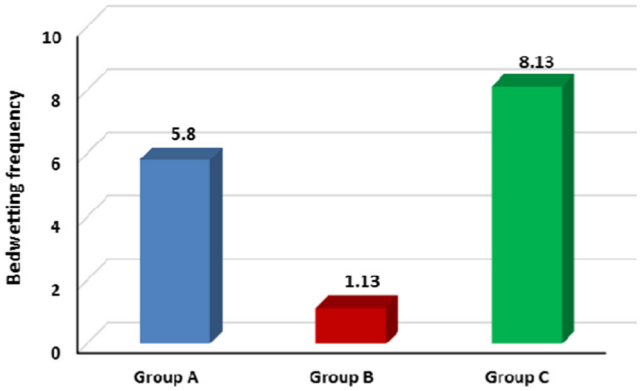


**Fig. 5** Posttreatment mean values of bedwetting frequency of groups A, B, and C

Our results support previous reports, but there are some differences in recovery rate after receiving laser acupuncture or medical treatment as a single treatment, in a review of clinical research by Gold et al. [10] who observed that the recovery rate was 65 % in a randomized trial on 20 children who received 10–15 sessions with a low power laser 670 nm, while in the same study on 20 children who received intranasal doses of desmopressin for 3 months, 75 % of participants were complete responders. Moreover, Caldwell et al. [1] mentioned that in a systematic review of 47 trials, 70 % of children treated with desmopressin (standard dose) had experienced a reduction in the amount and frequency of bedwetting compared with placebo, although less than half became completely dry. The relapse rate was high, with no difference between desmopressin and placebo, and only 18–38 % remained dry after drug discontinued.

Koumi et al. [11] used acupuncture over 6 months to treat 50 children and adolescents with persistent primary NE and reported a 76 % cure rate and 18 % partial improvement with stable results after the end of treatment.

The results of the present study also supported by the study of Karaman et al. [12] who examined the efficacy of laser acupuncture (635–670 nm) applied in 91 children aged 5–16 years with primary NE and reported significant complete recovery of 54.4 % and partial improvement in 22.8 %, while the rate of relapse at the end of 6 months was 2 % of their patients.

**Table 2** Posttreatment bladder over activity between groups A, B, and C

| BOA | Group A | Group B | Group C | $\chi^2$ | *p* value | Sig |
|---|---|---|---|---|---|---|
| No | 3 (20 %) | 8 (53.3 %) | 3 (20 %) | 5.42 | 0.24 | NS |
| Low amplitude | 3 (20 %) | 2 (13.3 %) | 4 (26.7 %) | | | |
| High amplitude | 9 (60 %) | 5 (33.3 %) | 8 (53.3 %) | | | |

$\chi^2$ chi-squared value, *p value* probability value, *S* significant

Bower et al. [13] conducted a systemic review of the use of acupuncture compared to desmopressin to treat enuretic children and observed cure rate in 65 vs. 75 %, respectively; better response achieved when acupuncture was combined with Chinese herbal remedies than when used as monotherapy. Moreover, Yuksek et al. [14] compared the efficacy of acupressure vs. oxybutynin in managing NE and observed in agreement with our results a better outcome with the use of acupressure in 58.3 % of their patients and reported that acupressure is a noninvasive, painless, and easy-to-apply therapy.

In contrast, Radvanska et al. [15] in a placebo-controlled study to assess the efficacy of laser acupuncture 670 nm in 31 enuretic patients observed no significant statistical differences in the reduction of bedwetting frequency between their three groups.

In this study, a response was observed of overactivity bladder improvement although the difference was not statistically significant. But, we found a significant difference in bladder capacities compliance before and after treatment for all groups.

Honjo et al. also observed a similar finding [16] after acupuncture treatment in 40 % of responders with a significant increase in the bladder capacity from 201 to 334 ml ($p < 0.05$), with no side effects recognized during the treatment. Also, Emmons et al. [17] used acupuncture 4 weeks in the placebo-controlled study to treat women with urge incontinence and reported a significant improvement in incontinence episodes, voiding frequency, urinary urgency, and bladder capacity.

**Table 1** Comparison of posttreatment bladder compliance distribution between groups A, B, and C

| Bladder compliance | Group A | Group B | Group C | $\chi^2$ | *p* value | Sig |
|---|---|---|---|---|---|---|
| Normal | 2 (13.3 %) | 7 (46.7 %) | 2 (13.3 %) | 19.07 | 0.004 | S |
| Mild | 3 (20 %) | 8 (53.3 %) | 5 (33.3 %) | | | |
| Moderate | 7 (46.7 %) | 0 (0 %) | 3 (20 %) | | | |
| Severe | 3 (20 %) | 0 (0 %) | 5 (33.3 %) | | | |

$\chi^2$ chi-squared value, *p value* probability value, *S* significant

In general, our results agree with these studies, but there are some differences in recovery rates. Using different acupuncture points, duration of treatment and dose of medication could cause such differences. In our study, we used a low dose of desmopressin, and we think that the effect would have been greater if desmopressin had been used in combination with another drug as oxybutynin that was found to treat detrusor instability in the majority of patients rather than monotherapy.

In group (C) managed with combined therapy of laser acupuncture and desmopressin unfortunately, only seven patients followed our practical guidelines and instructions and received the treatment course (24 sessions completely), while eight patients missed some sessions and took the medication in a random manner during the 3 months of treatment, and we think that this attitude affected the results of this group unlike what we expected.

Also, we found no side effects regarding the laser group which was also found in a study by Honjo et al. [16].

## Conclusion

Laser acupuncture therapy which is noninvasive, painless with short-term therapy, and no side effects can be considered as an alternative therapy for patients with NE after behavioral modifications. Moreover, the lower recurrence rate compared to other therapy modalities is another issue that should be considered. However, further studies with greater numbers of children and control group that receives only behavioral therapy should be required to support these findings.

**Author contributions** Jehan Alsharnoubi: Protocol development
Amany Abd Elazem: Data collection
Adly Sabbour: Data analysis
Jehan Alsharnoubi and Ahmed Shoukry: Manuscript writing/editing

**Compliance with ethical standards**

**Conflict of interest** The authors declare no conflict of interest

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