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Analysis of the Efficacy of Atomoxetine Hydrochloride Combined with Psycho-Behavioral Modification Therapy in the Treatment of ADHD in Children

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Abstract: *Objective:* To evaluate the therapeutic efficacy of atomoxetine hydrochloride (ATX) combined with psychological-behavioral modification therapy for attention-deficit/hyperactivity disorder (ADHD) in children. *Methods:* A total of 60 cases of ADHD children admitted to our hospital between November 2021 and November 2022 were selected and randomly grouped into Group I and Group II. There were 30 cases in Group I who were treated with ATX combined with psychological-behavioral modification therapy. There were 30 cases in Group II who were treated with ATX monotherapy, and the therapeutic effects were compared. *Results:* Before treatment, there was no difference in the behavioral problem scores and cognitive function indexes of the two groups (P□0.05). After treatment, the behavioral problem scores of Group I were lower than those of Group II, and the cognitive function indicators of Group I were lower than those of Group II ($P < 0.05$). The adverse reaction rate of Group I was lower than that of Group II, and the total effective rate was higher than that of Group II ($P < 0.05$). *Conclusion:* ATX combined with psychological-behavioral modification therapy improved the behavioral problems of ADHD children, enhanced their cognitive function, and reduced the adverse reactions to drug treatment.

Keywords: Atomoxetine hydrochloride; Psycho-behavioral modification therapy; ADHD in children

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1. Introduction

Attention-deficit/hyperactivity disorder (ADHD) is a behavioral disorder with a high prevalence in children, with symptoms such as mood swings, hyperactivity, and impulsive behaviors, which lead to learning difficulties. The conventional treatment for ADHD is oral medication, with atomoxetine hydrochloride (ATX) being the most commonly used [1]. ATX inhibits the effective reuptake of norepinephrine via the presynaptic amine pump, which enhances the inverse effect of norepinephrine and relieves the symptoms of the disease. Combined psychological-behavioral modification therapy can correct the child's learning disabilities and

behavioral problems, improve their concentration, and improve the overall efficacy of treatment [2]. In this study, 60 children with ADHD were selected to evaluate the therapeutic efficacy of ATX combined psychological-behavioral modification therapy.

2. Data and methods

2.1. General information

Sixty cases of children with ADHD treated in the hospital between November 2021 and November 2022 were selected and randomly grouped into Group I and Group II of 30 cases each. Group I consisted of 19 males and 11 females aged 4–13 years old, with an average age of 8.95 ± 1.48 years. The duration of the disease was between 7 months and 7 years, with an average duration of 4.15 ± 0.54 years. Group II consisted of 18 males and 12 females aged 5–12 years old, with an average age of 8.09 ± 1.51 years. The duration of the disease ranged from 8 months to 6 years, with an average of 4.27 ± 0.59 years. Data were compared and were not significant ($P > 0.05$). Inclusion criteria: (1) Patients aged ≤ 13 years; (2) complete clinical data; (3) IQ > 70 after Wechsler Intelligence Scale assessment; (4) fully participated. Exclusion criteria: (1) Patients with cardiorespiratory insufficiency; (2) intellectual disability; (3) limited communication ability; (4) dropped out halfway.

2.2. Methods

Group II was treated with ATX monotherapy. For children weighing < 70 kg, the initial dose administrated was 0.5 mg/kg per day, twice daily. The dosage was adjusted according to the child's condition after 3 days of continuous administration, with the maximum dose being < 1.2 mg/kg per day. For children weighing ≥ 70 kg, the initial dose administered was 40 mg per day, twice daily. The dose was adjusted accordingly after 3 days of continuous administration, with the maximum dose being < 1.2 mg/kg per day. The initial dose was 40 mg per day in 2 divided doses for 3 days. The maximum daily dose was 80 mg per day for 3 months.

Group I received ATX combined with psycho-behavioral modification therapy, where ATX was administered as above. A treatment team of psychologists and specialized nursing staff was established, with the team leader being the patient's attending physician. All team members received pre-service training to systematically learn the implementation of corrective therapy and treatment skills, and ensure that they pass the examination before they are allowed to work. Psycho-corrective therapy was carried out where healthcare workers actively interacted with the children by playing with them to gain their trust. The child's demeanor and thinking patterns were observed, and eye contact and body movements were utilized to strengthen the interaction effect and guide the child to focus his/her attention. During each interaction, small objectives were set, such as concentrating on the completion of the game and placing the blocks according to the requirements. After the completion of the objectives, the child was given a gift of money. The child was provided with affirmation, and the degree of completion of the objective was gradually increased so that the child would learn to correct the behavioral problems. Communication with the family was strengthened by telling the family not to scold or blame the child and to communicate patiently. Positive behavior or ideas were praised and the child's mistakes were patiently corrected. Behavioral modification therapy was carried out through positive reinforcement to guide the child to concentrate on learning tasks or eat in the correct sitting position. Moderate praise and rewards were used to stimulate the child's initiative so that they could maintain positive behaviors for a long period, which could alleviate their hyperactivity disorder in an orderly manner. The treatment cycle of psychological-behavioral modification was carried out for 3 months.

2.3. Observation indicators

(1) Behavioral problems

The Conners' Parental Symptom Questionnaire was issued and filled out by parents, combining the child's behavioral problems in the past 1 week with the corresponding options, which included a total of 48 questions including impulsive hyperactivity, learning, hyperactivity index, anxiety, psychosomatic problems, and conduct dimensions. All items were scored from 0–3, with 0 indicating no and 3 indicating always. A higher score indicated a greater behavioral problem.

(2) Cognitive function

The child's cognitive function was assessed by the Continuous Attention Test (CAT), a software developed by the Institute of Mental Health of Central South University, which tested the child's auditory and visual attention in the form of a human-computer dialog. The recorded indicators were the number of omissions in the Continuous Performance Task (CPT), the number of errors in the CPT, and the CPT reaction time.

(3) Adverse reactions

Adverse reactions such as decreased appetite, drowsiness, aggressive behavior, and dizziness were recorded.

2.4. Efficacy evaluation criteria

The Conners' score was used as the benchmark to evaluate the efficacy. Among them, significant efficacy: the decrease of Conners score is not less than 70%; preliminary efficacy: the decrease of Conners score is between 30% and 69%; no efficacy: the decrease of Conners score is not up to 30%.

2.5. Statistical analysis

Data were analyzed using the SPSS 28.0 software. Measurement data were expressed as mean ± standard deviation and the count data were expressed as %. Measurement data were analyzed using a *t*-test, and count data were analyzed using a chi-squared (χ^2) test. Results were considered statistically significant at $P < 0.05$.

3. Results

3.1. Comparison of behavioral problem scores between the two groups

As shown in **Table 1**, before treatment, there was no difference between the behavioral problem scores of the two groups ($P > 0.05$). After treatment, the behavioral problem scores of Group I were lower than those of Group II ($P < 0.05$).

Table 1. Comparison of behavioral problem scores between the two groups (mean ± standard deviation, points)

Group	Cases, *n*	Impulsive and hyperactive		Learning		Hyperactivity index		Anxiety		Psychosomatic problems		Behavior	
		Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
Group I	30	2.12 ± 0.31	0.70 ± 0.14	2.06 ± 0.33	0.57 ± 0.10	2.18 ± 0.31	1.04 ± 0.32	1.13 ± 0.35	0.41 ± 0.12	2.13 ± 0.33	0.38 ± 0.09	2.34 ± 0.29	0.71 ± 0.15
Group II	30	2.14 ± 0.26	0.94 ± 0.16	0.08 ± 0.31	0.78 ± 0.16	2.19 ± 0.28	1.75 ± 0.39	1.15 ± 0.37	0.78 ± 0.18	2.15 ± 0.31	0.64 ± 0.12	2.35 ± 0.31	1.06 ± 0.18
t	-	0.271	6.183	23.952	6.096	0.131	7.709	0.215	9.368	0.242	9.494	0.129	8.182
P	-	0.788	0.000	0.000	0.000	0.896	0.000	0.830	0.000	0.810	0.000	0.898	0.000

3.2. Comparison of cognitive function indicators between the two groups

As shown in **Table 2**, before treatment, the cognitive function indicators of the two groups were compared, and there was no difference ($P > 0.05$). After treatment, the cognitive function indicators of Group I were lower than those of Group II ($P < 0.05$).

Table 2. Comparison of cognitive function indexes between the two groups (mean ± standard deviation, points)

Group	Cases, *n*	CPT underreporting (times)		Number of CPT errors (times)		CPT reaction time (ms)	
		Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
Group I	30	10.28 ± 1.65	7.02 ± 0.58	11.42 ± 2.29	7.85 ± 1.32	468.98 ± 83.12	286.57 ± 70.19
Group II	30	10.30 ± 1.69	7.84 ± 0.59	11.48 ± 2.17	9.17 ± 1.40	467.85 ± 85.17	341.26 ± 71.85
t	-	0.046	5.429	0.104	3.757	0.052	2.982
P	-	0.963	0.000	0.917	0.000	0.959	0.004

3.3. Comparison of adverse reaction rates between the two groups

As shown in **Table 3**, the adverse reaction rate of Group I was lower than that of Group II ($P < 0.05$).

Table 3. Comparison of adverse reaction rates between the two groups [*n* (%)]

Group	Cases, *n*	Loss of appetite	Drowsiness	Aggression	Spinning	Rate of occurrence
Group I	30	1 (3.33)	0	0	1 (3.33)	6.67 (2/30)
Group II	30	2 (6.67)	2 (6.67)	1 (3.33)	3 (10.00)	26.67 (8/30)
χ^2	-	-	-	-	-	4.320
P	-	-	-	-	-	0.038

3.4. Comparison of the total effective rate of the two groups

As shown in **Table 4**, the total effective rate of Group I was higher than that of Group II ($P < 0.05$).

Table 4. Comparison of the total effective rates between the two groups [*n* (%)]

Group	Cases, *n*	Remarkable efficacy	Initial efficacy	No efficacy seen	Total effective rate
Group I	30	17 (56.67)	12 (40.00)	1 (3.33)	96.67 (29/30)
Group II	30	13 (43.33)	10 (33.33)	7 (23.33)	76.67 (23/30)
χ^2	-	-	-	-	5.192
P	-	-	-	-	0.023

4. Discussion

ADHD is a common disease that affects the physical and mental development of children and it is a public health problem of general concern to society [3,4]. The causes of the disease are related to environmental changes, genetics, and other factors, but the specific pathological mechanisms are still unclear. The disease decreases the attention of children, leading to impulsivity and hyperactivity, learning disabilities, and behavioral problems, which in turn will reduce their physical and mental health [5].

Currently, drug therapy is the conventional treatment to improve the symptoms of hyperactivity, with ATX being the most commonly used. ATX can improve the metabolism and flip-flop effect of norepinephrine, and

improve the degree of concentration of children, to enable them to complete their learning tasks [6]. After the drug is administered orally, its blood concentration reaches the peak in 1–2 h. ATX has a rapid onset of action and the components of the drug can be widely distributed in the body fluids, with a longer duration of action. The metabolites of the drug are similar to the pharmacological activity of the original drug, and its therapeutic effect is more significant. However, ADHD is a behavioral problem, hence simple drug treatment cannot fully improve the associated behavioral disorders. This calls for the need for it to be combined with psychological-behavioral modification therapy. The therapeutic goal of this treatment is to solve the behavioral and learning disorders of children, correct their personality quirks and behavioral problems, and prolong their attention span. This is so that the children can take the initiative to correct their abnormal behavior and improve the therapeutic outcome [7]. The combined application of these two methods illustrates the synergistic effect of drug therapy and psychotherapy, and symptomatic treatment can be carried out according to the pathological mechanisms.

The results showed that after treatment, the behavioral problem scores, cognitive function indexes, and adverse reaction rate of Group I was lower than that of Group II, and the total effective rate of Group I was higher than that of Group II ($P < 0.05$). The reason is that ATX can avoid the large and rapid reuptake of norepinephrine, increase its release, and then relieve the symptoms of the disease. It does not affect the specific concentration of neurotransmitters in children and is safe for long-term use. This can improve the effectiveness of the treatment of impulsive or hyperactive behavior. In addition, the flexibility of ATX is strong. According to the child's weight, the dosage of the drug can be adjusted accordingly, to ensure the individualization of the treatment program and timeliness, so that the therapeutic effect is enhanced [8]. The combination of psychological-behavioral modification therapy can improve the child's misbehavior and misperception, improve their behavior, and help children better adhere to the correct social behavior. Moreover, psychological-behavioral modification therapy can regulate the oxygen uptake of the brain tissue, improve the blood circulation of the cerebral cortex, enhance the regeneration and metabolism of the brain cells, and strengthen positive behaviors, all of which can significantly improve clinical efficacy [9]. Furthermore, the combined treatment can effectively solve the child's psychological and behavioral problems, alter their existing thinking and psychological state, and improve their self-control ability. This way, impulsive behavior can be minimized so that they dare to overcome the learning disabilities, and actively build up confidence in the treatment, to obtain long-term therapeutic effects. More importantly, psychological-behavioral modification therapy is a psychotherapeutic method, which can be carried out according to the causes of ADHD and has no adverse effects. However, the duration of this study was short and the sample size was small, hence the data lacked precision. In future studies, it is necessary to extend the observation time of the research subjects, expand the sample size, and conduct an in-depth analysis of the data to evaluate the therapeutic effect of ATX combined with psychological-behavioral modification therapy comprehensively.

5. Conclusion

ATX combined psychological-behavioral modification therapy improved the behavioral problems of children with ADHD, effectively enhanced the cognitive function of children, and reduced the adverse effects of medication. Its synergistic effects are worthy of popularization.

Disclosure statement

The author declares no conflict of interest.

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