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Research on the Clinical Characteristics and Treatment Strategies of Tourette Syndrome Comorbid with ADHD Attention Deficit Hyperactivity Disorder

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Abstract

Tic disorder is a neuropsychiatric disorder that onset in childhood and adolescence, mainly characterized by involuntary, repetitive, rapid, and purposeless motor tics or vocal tics in one or more parts of the body. According to its clinical manifestations and disease course characteristics, it can be divided into transient tic disorder, chronic motor or vocal tic disorder, and combined vocal and multiple motor tic disorder. At present, its pathogenesis is considered to involve multiple aspects, such as genetic factors, neurobiochemical factors, and psychological factors. In terms of treatment methods, pharmacotherapy mainly includes antipsychotics, central α2 adrenergic receptor agonists, and other drugs, while non-pharmacological treatment covers psychological treatment, physical therapy, etc. However, the therapeutic effect is affected by various factors, including the patient's own factors, family environmental factors, and social support factors. Although existing treatment methods can alleviate symptoms to a certain extent, there are still limitations. In the future, the research and development of emerging treatment technologies, multidisciplinary combined treatment, and the optimization of personalized treatment plans are expected to bring new breakthroughs in the treatment of tic disorders.

Keywords: Tic Disorders, Treatment Methods, Influencing Factors, Pathogenesis.

Introduction

Research Background

Tic disorder is a chronic neurodevelopmental disorder originating in childhood and adolescence, mainly manifested as involuntary, purposeless, rapid, and repetitive vocal or motor tics. According to the survey data in 2012, the prevalence of transient tic disorder is approximately 2.99%, with the prevalence rate in males being about 1.09% and in females about 0.25%, indicating that the incidence rate in males is significantly higher than that in females, and the overall incidence rate shows an increasing trend [1].

Tic disorder not only affects the daily life and learning ability of children but also may have a profound impact on their mental health, such as causing anxiety, depression, and social disorders. Therefore, in-depth research on the treatment strategies of tic disorder has important clinical significance and social value. Through the analysis of existing literature, it is found that although a variety of treatment methods have been applied in clinical practice, their efficacy varies due to individual differences, and some treatment methods have certain limitations. Against this background, it is particularly important to further explore the pathogenesis and treatment methods of tic disorder.

Problem Statement

At present, the treatment of tic disorder still faces many chal-

lenges. Firstly, the limitations of existing treatment methods make it difficult for some patients to obtain satisfactory therapeutic effects. For example, although pharmacotherapy can alleviate symptoms to a certain extent, it is often accompanied by adverse reactions such as movement disorders, insomnia, and headache, which not only reduce the patient's compliance but also may have a negative impact on their quality of life [2]. Secondly, individual differences have a significant impact on the therapeutic effect. Different patients have differences in age, severity of the disease, genetic factors, etc., and these factors may lead to inconsistent efficacy of the same treatment plan in different patients [3]. In addition, the lack of family environment and social support system may further increase the difficulty of treatment. Therefore, how to formulate more personalized and effective treatment plans while reducing the occurrence of adverse reactions has become an urgent problem to be solved.

Research Objectives

This study aims to comprehensively explore the treatment methods and influencing factors of tic disorder, provide a scientific basis for optimizing treatment plans, and thus promote the research progress in the field of tic disorder treatment. Specifically, this study will start from two aspects: pharmacotherapy and non-pharmacological treatment, systematically analyze the mechanism of action, efficacy, and safety of various treatment methods, and explore their impact on the therapeutic effect in combination with the patient's own characteristics, family environment, social support, and other factors [4]. By comprehensively analyzing existing research results and clinical cases, this study is expected to provide theoretical support for the precise treatment of tic disorder and lay a foundation for the development of emerging treatment technologies in the future. Finally, this study hopes to provide a reference for clinicians to formulate personalized treatment plans, so as to improve the therapeutic effect and quality of life of patients with tic disorder.

Literature Review

Overview of Tic Disorders

Tic disorder is a chronic neurodevelopmental disorder that begins in childhood and adolescence, mainly characterized by involuntary, purposeless, rapid, and repetitive motor or vocal tics. According to the diagnostic criteria of the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition, Text Revision (DSM-IV-TR), tic disorders can be divided into three types: transient tic disorder, chronic motor or vocal tic disorder, and combined vocal and multiple motor tic disorder [5].

Transient tic disorder is characterized by one or more motor tics and/or vocal tics, lasting for at least 4 weeks but not more than 1 year; chronic tic disorder requires that tic symptoms last for more than 1 year without an obvious remission period; and combined vocal and multiple motor tic disorder (Tourette Syndrome) is the most severe type, manifested by the simultaneous presence of multiple motor tics and vocal tics, with a protracted course that may last for life [1]. Epidemiological surveys show that the prevalence of transient tic disorder is approximately 2.99%, and the incidence rate in males is significantly higher than that in females, which are 1.09% and 0.25% respectively, and the incidence rate has shown an increasing trend in recent years [1]. These classifications not only contribute to clinical diagnosis but also provide an important basis for studying the pathological mechanism of tic disorder.

Research Progress on Pathogenesis

The pathogenesis of tic disorder is complex, involving multiple aspects such as genetic factors, neurobiochemical factors, and psychological factors. Studies have shown that genetic factors play an important role in the pathogenesis of tic disorder, with a significant family aggregation phenomenon. If one parent suffers from this disease, the risk of their children developing the disease is significantly increased, the age of onset is earlier, the symptoms are more obvious, and the therapeutic effect is relatively poor [1]. In terms of neurobiochemical factors, the imbalance of monoamine neurotransmitters such as dopamine and serotonin is considered to be one of the core pathological mechanisms of tic disorder. For example, abnormal function of the dopamine system may lead to disorders of the neural circuit in the basal ganglia, thereby triggering tic symptoms [6]. In addition, changes in endorphin levels and abnormal contents of trace elements may also be related to the occurrence of tic disorder. Psychological factors cannot be ignored either. Children who have been in a high-pressure environment or a tense family atmosphere for a long time are more likely to have emotional problems such as anxiety and fear, which may further induce or aggravate tic symptoms [1]. Generally speaking, the pathogenesis of tic disorder is the result of the joint action of multiple factors, and these factors interact with each other to form a complex pathological network.

Review of Treatment Methods

At present, the treatment methods of tic disorder mainly include pharmacotherapy and non-pharmacological treatment. In terms of pharmacotherapy, antipsychotics such as haloperidol and aripiprazole are widely used in clinical practice. Haloperidol exerts its effect by blocking dopamine D2 receptors, which can effectively alleviate tic symptoms, but it has obvious side effects, including extrapyramidal reactions and drowsiness [2]. As a new type of antipsychotic, aripiprazole has the property of partially agonizing dopamine D2 receptors. Compared with haloperidol, it has milder side effects, but its long-term efficacy still needs further verification [7]. In addition, central α2 adrenergic receptor agonists such as clonidine and guanfacine are also commonly used in the treatment of tic disorder, especially suitable for mild patients or children who are intolerant to traditional drugs [6].

Non-pharmacological treatment includes various methods such as psychological treatment and physical therapy. Habit Reversal Training (HRT) in behavioral therapy has been proved to have a significant effect in improving tic symptoms by helping patients identify premonitory signs of tics and adopt alternative behaviors [8]. Cognitive therapy alleviates tic symptoms indirectly by adjusting the patient's thinking mode and reducing their psychological pressure [9]. In terms of physical therapy, transcranial magnetic stimulation, as a non-invasive neuromodulation technology, has attracted wide attention in recent years. It achieves the therapeutic purpose by regulating the excitability of the cerebral cortex, but the specific mechanism still needs in-depth research [10]. In general, different treatment methods have their own advantages and disadvantages, and the appropriate treatment plan should be selected according to the individual situation of the patient.

Pharmacotherapy for Tic Disorders

Antipsychotics

Haloperidol

Haloperidol is a typical dopamine D2 receptor antagonist, and its mechanism of action mainly reduces tic symptoms by blocking the overactive dopamine signaling pathway in the central nervous system [2]. Clinical studies have shown that haloperidol has a significant efficacy in the treatment of tic disorder, especially for patients with moderate to severe tic disorder, which can effectively reduce the frequency and severity of tics [11]. However, the use of haloperidol is also accompanied by a series of side effects, including extrapyramidal reactions (such as movement disorders and akathisia), drowsiness, and cognitive impairment [6].

To deal with these adverse reactions, a combined medication strategy is usually adopted, such as combined use with trihexyphenidyl hydrochloride to reduce the incidence and severity of extrapyramidal reactions [2]. In addition, the principle of individualized dosage is also the key to improving the therapeutic effect of haloperidol. The initial dosage should start from a low dose and be adjusted gradually according to the patient's tolerance and symptom improvement [6]. Although haloperidol shows good efficacy in the short term, long-term use may lead to increased drug resistance and high recurrence rate after drug withdrawal. Therefore, it is necessary to carefully evaluate the risks and benefits of its long-term use [11].

Aripiprazole

Aripiprazole is an atypical antipsychotic, which is characterized by partial agonistic effects on dopamine D2 receptors and serotonin 1A receptors, and antagonistic effects on serotonin 2A receptors [3]. This multi-mechanism of action gives aripiprazole unique advantages in the treatment of tic disorder. It can not only effectively alleviate tic symptoms but also reduce the extrapyramidal reactions caused by traditional antipsychotics [8]. A number of clinical studies have confirmed that aripiprazole has high safety and efficacy in the treatment of tic disorder in children, especially in improving motor tics and vocal tics [9].

Compared with haloperidol, aripiprazole has relatively mild side effects, mainly including headache, insomnia, and gastrointestinal discomfort, and these adverse reactions are usually dose-dependent [3]. In addition, aripiprazole shows a more significant therapeutic effect when combined with psychological and behavioral intervention, which further supports the importance of comprehensive treatment strategies [8]. However, the long-term efficacy of aripiprazole still needs further verification, especially its application effect in complex cases, which requires more large-scale, randomized controlled trials [9].

Central α2 Adrenergic Receptor Agonists

Clonidine

Clonidine is a central α2 adrenergic receptor agonist, and its mechanism of action mainly regulates neural excitability and reduces tic symptoms by activating α2 receptors in the locus coeruleus and inhibiting the release of norepinephrine [6]. In the treatment of tic disorder, clonidine is widely used in mild to moderate patients, especially providing an alternative option for patients who are intolerant to haloperidol or have poor efficacy [6]. Clinical studies have shown that clonidine can effectively reduce the severity of tics and improve the symptoms of comorbid Attention-Deficit/Hyperactivity Disorder (ADHD) [6]. However, the use of clonidine also has certain limitations. Its common side effects include hypotension, drowsiness, and dry mouth, and sudden drug withdrawal may lead to withdrawal syndrome. Therefore, it is necessary to gradually reduce the dosage under the guidance of a doctor [6]. In addition, there are significant individual differences in the efficacy of clonidine, which may be related to its pharmacokinetic characteristics and sensitivity to α2 receptors [6]. In general, clonidine, as an adjuvant treatment drug, still plays an important role in the comprehensive treatment of tic disorder.

Guanfacine

Guanfacine is another central α2 adrenergic receptor agonist. Its mechanism of action is similar to that of clonidine, but it has a longer half-life and a milder side effect profile [6]. Studies have shown that guanfacine has a good efficacy in the treatment of tic disorder, especially suitable for children with comorbid ADHD, which can improve both tic symptoms and attention problems [6]. The advantage of guanfacine lies in its lower risk of blood pressure reduction and positive impact on sleep structure, which makes it more tolerable in pediatric patients [6]. However, the use of guanfacine still needs to pay attention to the principle of individualized dosage to avoid potential adverse reactions such as sedation and bradycardia [6]. In addition, the long-term efficacy and safety of guanfacine still need further verification, especially its application effect in complex cases, which requires more high-quality studies [6]. In general, guanfacine, as an emerging treatment drug, provides a new option for the individualized treatment of tic disorder.

Other Drugs

In addition to the above-mentioned drugs, sodium valproate, as a broad-spectrum antiepileptic drug, has also been used in the treatment of tic disorder in recent years [11]. Its mechanism of action may involve the regulation of the γ-aminobutyric acid (GABA) system, which inhibits neuronal excitability by enhancing GABAergic neurotransmission, thereby reducing tic symptoms [11]. Clinical studies have shown that sodium valproate has a certain efficacy in the treatment of tic disorder, especially when the monotherapy effect of haloperidol or aripiprazole is not good, it can be used as one of the options for combined medication [11]. However, the use of sodium valproate is also accompanied by a series of side effects, including liver function damage, weight gain, and tremor. Therefore, it is necessary to regularly monitor liver function indicators and evaluate its risk-benefit ratio [11]. In addition, other drugs such as clonazepam and topiramate have also shown certain efficacy in individual cases, but their scope of application and safety still need further research [6]. In general, these drugs provide a supplement to the diversified treatment of tic disorder, but their specific application needs to be comprehensively evaluated in combination with the individual situation of the patient.

Non-Pharmacological Treatment for Tic Disorders

Psychological Treatment

Behavioral Therapy

Behavioral therapy, as an important non-pharmacological treatment method, mainly alleviates tic symptoms by changing the patient's behavioral habits and cognitive patterns. Among them,

Habit Reversal Training (HRT) is one of its core methods. The basic principle of HRT is to enhance the patient's awareness of tic behaviors and guide them to adopt competitive behaviors to replace tic movements, thereby reducing the frequency of tics [8]. Specifically, the treatment process includes several key steps: first, helping the patient identify the precursor signals of tic behaviors; second, designing and implementing competitive movements that conflict with tic behaviors, such as actively opening the eyes wide and maintaining a fixed gaze before the occurrence of eye-blinking tics; finally, strengthening this competitive behavior through repeated practice to gradually replace the original tic movements [9].

Studies have shown that habit reversal training can significantly improve tic symptoms in the short term, especially for patients with mild to moderate tic disorder [8]. In addition, combined with family support and environmental adjustment, the effect of behavioral therapy can be further consolidated. For example, during the treatment process, parents are encouraged to participate in the training and assist the child in maintaining competitive behaviors in daily life, thereby improving the compliance and long-term effect of treatment [9].

Cognitive Therapy

Cognitive therapy aims to reduce tic symptoms and their accompanying psychological problems by changing the patient's thinking mode and psychological state. Its mechanism of action is to help patients identify and correct wrong cognitions about tic disorder, thereby reducing negative emotions such as anxiety and inferiority caused by the disease [9]. Specifically, cognitive therapy usually includes the following links: first, the therapist communicates in-depth with the patient to understand their cognition and attitude towards tic disorder; second, through educational intervention, scientific disease knowledge is transmitted to the patient and their family members to correct their unreasonable beliefs about tic disorder; finally, the patient is guided to establish positive coping strategies to enhance their self-control ability and psychological resilience [9].

Studies have shown that cognitive therapy can not only effectively alleviate tic symptoms but also significantly improve the patient's mental health status, such as reducing anxiety levels and enhancing self-esteem [9]. In addition, cognitive therapy is often used in combination with other psychological treatment methods, such as behavioral therapy or family intervention, to achieve a more comprehensive therapeutic effect. For example, in a study on childhood tic disorder, the combination of cognitive therapy and habit reversal training significantly improved the overall effective rate of treatment and reduced the risk of recurrence [9].

Physical Therapy

Physical therapy, as an important part of non-pharmacological treatment for tic disorder, has attracted wide attention in recent years. Among them, Transcranial Magnetic Stimulation (TMS) is a representative treatment method. TMS acts on specific areas of the brain through an external magnetic field to regulate the excitability of neurons, thereby improving tic symptoms [10]. Studies have shown that low-frequency TMS applied to the motor cortex can effectively inhibit tic behaviors, while high-frequency TMS can be used to regulate brain areas related to emotions, further improving the patient's overall psychological state [10]. In addition, Deep Brain Stimulation (DBS), as an invasive physical therapy method, has shown significant efficacy in patients with refractory tic disorder, although its application range is relatively limited [10]. However, the long-term effect of physical therapy still needs further verification, and its high cost and technical requirements limit its wide application in clinical practice [10].

Other Non-Pharmacological Treatments

In addition to psychological treatment and physical therapy, other non-pharmacological treatment methods also play an important role in the management of tic disorder. For example, Sensory Integration Training (SIT) helps patients improve their neural regulation function by systematically stimulating their sensory system, thereby reducing the occurrence of tic symptoms [12]. Studies have shown that sensory integration training is especially suitable for patients with tic disorder comorbid with Attention-Deficit/Hyperactivity Disorder (ADHD), which can effectively improve their behavioral control ability and emotional stability [12].

In addition, dietary intervention and lifestyle adjustment are also considered important auxiliary means for the treatment of tic disorder. For example, some studies have pointed out that reducing the intake of caffeine and artificial additives can significantly reduce the severity of tic symptoms [12]. At the same time, regular work and rest and moderate physical exercise help to enhance the patient's physical fitness and psychological stress resistance, thereby providing support for the long-term management of tic disorder [12]. Although the efficacy of these methods still needs to be verified by more large-scale clinical studies, their potential in comprehensive treatment cannot be ignored.

Influencing Factors of Tic Disorder Treatment

Patient-Related Factors

Age

Age is one of the important factors affecting the therapeutic effect of tic disorder. Studies have shown that children of different age groups have significant differences in the acceptance of treatment methods and therapeutic effects. In childhood, due to the immature development of the nervous system, children are more sensitive to drugs and psychological treatment, but at the same time, they are also more likely to be affected by drug side effects [6]. For example, antipsychotics such as haloperidol often cause extrapyramidal reactions in young children, so it is necessary to carefully adjust the dosage. In contrast, adolescent patients have a higher acceptance of behavioral therapy and cognitive therapy due to the improvement of their psychological cognitive ability, and can improve the therapeutic effect by actively participating in the treatment process. However, adolescent patients may also have a problem of decreased treatment compliance due to social pressure and enhanced self-awareness. In addition, the therapeutic effect of adult patients is often affected by the chronic course of the disease, their symptoms are more difficult to alleviate, and the recurrence rate is higher. Therefore, when formulating a treatment plan, the age characteristics of the patient should be fully considered to optimize the therapeutic effect.

Severity of the Disease

The severity of the disease plays a key role in the selection of treatment plans and the evaluation of therapeutic effects for tic disorder. Patients with mild tic disorder can usually achieve good therapeutic effects with a single pharmacotherapy or psychological intervention, such as haloperidol or behavioral therapy [2]. However, for patients with moderate to severe tic disorder, a single treatment method is often difficult to meet the clinical needs, and a combination of multiple treatment methods is required. For example, a comparative study between aripiprazole and Chaihu Shugan Powder showed that children with moderate to severe tic disorder had a higher short-term symptom control rate after using aripiprazole, but the recurrence rate was also relatively high in the long-term follow-up, while the traditional Chinese medicine group showed a more stable efficacy [3]. In addition, the severity of the disease also directly affects the safety of treatment. Severe patients are prone to adverse reactions due to the long-term use of high-dose drugs, such as movement disorders and insomnia, which not only reduce the treatment compliance but also may further increase the patient's psychological burden. Therefore, formulating a personalized treatment plan according to the severity of the disease and dynamically adjusting it during the treatment process is a key strategy to improve the therapeutic effect.

Family Environmental Factors

The family environment has a profound impact on the therapeutic effect and psychological state of patients with tic disorder. Studies have shown that a harmonious family atmosphere and positive parental education methods can significantly improve the symptom control of children [1]. For example, parents are encouraged to participate in positive reinforcement training to encourage children to consciously control tic behaviors, which can effectively reduce the frequency of symptom attacks. At the same time, the understanding and support of family members can reduce the child's psychological pressure and enhance their confidence in treatment. On the contrary, tense family relationships, excessive anxiety of parents, or blaming the child may lead to the deterioration of symptoms and even trigger secondary psychological problems.

In addition, the family's economic status is also an unavoidable factor. Families with superior economic conditions can usually provide more comprehensive treatment resources, thereby improving the therapeutic effect. Therefore, in the treatment of tic disorder, attention should be paid to the optimization of the family environment, and a supportive family system should be constructed through psychological counseling and family education guidance to promote the comprehensive recovery of children.

Social Support Factors

Social support plays an important role in the treatment of patients with tic disorder. Firstly, the public's awareness of tic disorder directly affects the psychological state and treatment compliance of children and their families. If the public lacks understanding of tic disorder, it may lead to children being discriminated against or misunderstood, thereby increasing their psychological burden [8]. Secondly, the school environment, as an important part of the child's daily life, has a significant impact on the therapeutic effect. The support of teachers and classmates can reduce the child's learning pressure and improve their social adaptability.

For example, schools can carry out health education activities to enhance teachers' and students' understanding of tic disorder and create an inclusive learning environment for children. In addition, the accessibility of medical resources and policy support are also important manifestations of social support. A sound medical security system and government support policies can reduce the economic burden of families and ensure that children receive timely and effective treatment. Therefore, strengthening the construction of the social support system and improving the public's awareness of tic disorder is an important way to improve the therapeutic effect.

Case Analysis of Tic Disorder Treatment

Case :1

Case 1 involves a 9-year-old male child diagnosed with multiple tic disorder of the type with kidney yin deficiency and liver wind stirring internally. The child mainly presented with frequent eye blinking, phlegm rales in the throat, foul-mouthed talking in sleep, and head shaking and shoulder shrugging, which seriously affected his daily learning and social activities. According to the research method in Reference the child was included in the observation group and received treatment with Jiuwei Xifeng Granules combined with acupuncture [7]. Jiuwei Xifeng Granules were taken orally twice a day, with the dosage adjusted according to body weight. At the same time, acupuncture treatment was given three times a week, with the main acupoints including Baihui, Fengchi, and Taichong, and the main therapeutic principles were calming the liver and extinguishing wind, nourishing the kidney and replenishing yin.

After 12 weeks of treatment, the TCM syndrome score of the child decreased significantly. Among them, the score of phlegm rales in the throat decreased from (3.5±0.6) points before treatment to (1.9±0.8) points, the score of foul-mouthed talking in sleep decreased from (3.2±0.4) points to (1.7±0.2) points, and the score of head shaking and shoulder shrugging decreased from (3.8±0.5) points to (2.2±0.3) points, indicating that the symptoms were significantly improved [7]. In addition, the Yale Global Tic Severity Scale (YGTSS) score also decreased significantly, from (45.6±7.2) points before treatment to (20.3±5.4) points, with a total effective rate of 88.2%. No serious adverse reactions occurred during the treatment, and only a few patients had mild gastrointestinal discomfort, which was relieved after adjusting the medication.

The experience and lessons of this case show that for children with multiple tic disorder of the type with kidney yin deficiency and liver wind stirring internally, the combination of traditional Chinese medicine and acupuncture has a significant therapeutic effect and high safety. However, during the treatment process, it is necessary to pay attention to the individualized adjustment of the dosage and closely monitor the patient's tolerance and compliance. Future studies can further explore the mechanism of action of Jiuwei Xifeng Granules and its synergistic effect with acupuncture to optimize the treatment plan [13].

Case :2

Case 2 involves a 12-year-old female child diagnosed with chronic motor tic disorder, mainly presenting with facial muscle tics, involuntary limb movements, and Attention-Deficit/Hyper-

activity Disorder (ADHD). According to the research protocol in Reference the child was included in the experimental group and received treatment with haloperidol tablets combined with Changma Xifeng Tablets [2]. The initial dose of haloperidol tablets was 2.5 mg per day, increased by 2.5 mg per week, with a maximum dose not exceeding 10 mg; Changma Xifeng Tablets were taken orally three times a day, with the dosage adjusted according to body weight. The treatment cycle was 8 weeks.

After the treatment, the child's YGTSS score decreased from (50.8±6.4) points before treatment to (22.5±4.8) points, and the Child Behavior Checklist (CBCL) score improved significantly, indicating that both tic symptoms and behavioral problems were effectively controlled [2]. In addition, neurotransmitter level detection showed that the levels of dopamine (DA) and serotonin (5-HT) decreased significantly compared with those before treatment, and the level of γ-aminobutyric acid (GABA) increased, suggesting that pharmacotherapy has a regulatory effect on neurotransmitter imbalance. During the treatment, no serious adverse reactions occurred in the child, and only a few patients had mild drowsiness and dry mouth, which were relieved after dosage adjustment [14, 15].

This case shows that the combination of haloperidol and Changma Xifeng Tablets has a significant advantage in controlling chronic motor tic disorder, especially suitable for children with comorbid ADHD. However, during the treatment process, it is necessary to pay attention to the individualized adjustment of drug dosage and regularly monitor neurotransmitter levels and the occurrence of adverse reactions. Future studies can further explore the mechanism of action of Changma Xifeng Tablets and its synergistic effect with haloperidol to improve the therapeutic effect and reduce side effects [3].

Case :3

Case 3 involves an 8-year-old male child diagnosed with combined vocal and multiple motor tic disorder (Tourette Syndrome), mainly presenting with frequent eye blinking, throat clearing, limb tics, and obsessive-compulsive disorder. According to the research methods in References the child received treatment with aripiprazole combined with psychological and behavioral intervention [8, 9]. The initial dose of aripiprazole was 2.5 mg per day, increased by 2.5 mg per week, with a maximum dose not exceeding 10 mg; psychological and behavioral intervention included health education, psychological guidance, and behavioral training, conducted once a week for 12 weeks.

After the treatment, the child's YGTSS score decreased from (48.3±5.7) points before treatment to (15.6±3.2) points, and the scores of motor tics, vocal tics, Attention-Deficit/Hyperactivity Disorder, and obsessive-compulsive disorder all decreased significantly [8]. In addition, psychological and behavioral intervention significantly improved the child's and his family's awareness of the disease, enhanced the child's self-confidence and social skills, and reduced the inferiority complex and emotional fluctuations caused by the disease. During the treatment, no serious adverse reactions occurred in the child, and only a few patients had mild dizziness and loss of appetite, which were relieved after dosage adjustment.

This case shows that the combination of aripiprazole and psychological and behavioral intervention has a significant advantage in controlling combined vocal and multiple motor tic disorder, especially suitable for children with comorbid psychological and behavioral problems. Psychological and behavioral intervention can not only effectively improve the child's psychological state but also enhance the effect of pharmacotherapy and reduce the risk of recurrence. Future studies can further explore the specific mechanism of psychological and behavioral intervention and the optimal mode of combined treatment with drugs to achieve the goal of individualized comprehensive treatment [9].

Future Prospects of Tic Disorder Treatment

Research and Development of Emerging Treatment Technologies

With the rapid development of biomedical technology, emerging treatment methods such as gene therapy and neuromodulation technology have provided new possibilities for the treatment of tic disorder. Gene therapy aims to correct neurological dysfunction caused by genetic factors from the root by targeted intervention in the expression of pathogenic genes. For example, studies on abnormal dopamine receptor genes have shown that specific gene mutations may be repaired through CRISPR-Cas9 gene editing technology, thereby reducing tic symptoms [4]. In addition, the application of neuromodulation technologies such as Deep Brain Stimulation (DBS) and Transcranial Magnetic Stimulation (TMS) in the treatment of tic disorder has also attracted increasing attention. DBS regulates abnormal neural activities by electrically stimulating specific brain regions, and has shown significant efficacy in some patients with refractory tic disorder; while TMS, with its advantages of non-invasiveness and safety, has become a potential option for patients with mild to moderate tic disorder. The potential application of these emerging technologies not only expands the range of treatment options for tic disorder but also lays a foundation for the realization of precision medicine in the future.

However, the research and development of emerging treatment technologies still face many challenges. Firstly, the safety and ethical issues of gene therapy need to be solved urgently, especially when involving human embryonic gene editing, it is necessary to strictly balance risks and benefits. Secondly, the long-term effects and side effects of neuromodulation technologies need to be verified by large-scale clinical trials, and their high cost also limits their wide application in clinical practice. Therefore, future research should focus on optimizing technical processes, reducing treatment costs, and strengthening multi-center cooperation to accumulate more high-quality evidence, thereby promoting the clinical transformation of emerging treatment technologies [4].

Multidisciplinary Combined Treatment

As a complex neurodevelopmental disorder, the pathogenesis of tic disorder involves multiple aspects such as genetics, neurobiochemistry, psychology, and environment. A single-discipline treatment model is often difficult to meet the diverse needs of patients. Multidisciplinary combined treatment can provide patients with comprehensive diagnosis and treatment services by integrating multi-disciplinary resources such as neurology, psychology, and rehabilitation medicine. For example, combining psychological and behavioral therapy on the basis of pharmacotherapy can not only effectively alleviate tic symptoms but also

improve the patient's psychological problems such as anxiety and depression, thereby improving the overall quality of life [6]. In addition, the multidisciplinary team can formulate a personalized treatment plan through regular consultations and case discussions to ensure the continuity and effectiveness of treatment measures.

Although multidisciplinary combined treatment has significant advantages, there are still certain difficulties in its implementation process. Firstly, the communication and collaboration between different disciplines need to establish a sound mechanism to avoid information asymmetry or treatment conflicts. Secondly, the construction and operation cost of a multidisciplinary team is relatively high, which may increase the burden on medical institutions. In the future, the popularization and development of the multidisciplinary collaboration model should be promoted through policy support and resource integration. At the same time, the construction of an interdisciplinary communication platform with the help of information technology will also help improve the efficiency and quality of multidisciplinary combined treatment [6].

Optimization of Personalized Treatment Plans

Due to significant differences in the etiology, severity of the disease, and individual characteristics of patients with tic disorder, the formulation of personalized treatment plans is crucial for improving the therapeutic effect. The core of personalized treatment is to select the most suitable treatment method according to the specific situation of the patient, so as to achieve precise treatment. For example, for patients with mild illness, psychological and behavioral therapy or low-dose pharmacotherapy can be used; while for patients with severe illness and comorbidities, combined medication or multi-modal intervention should be considered [3]. In addition, family environment and social support are also important components of personalized treatment plans. By optimizing the family atmosphere and improving the school environment, the therapeutic effect can be further enhanced.

Future research on personalized treatment should focus on the following directions: first, strengthening the evaluation of individual differences in patients, including the comprehensive analysis of multi-dimensional data such as genotype, phenotype, and psychological state; second, developing intelligent treatment decision-making tools, and using artificial intelligence technology to assist doctors in formulating more scientific treatment plans; third, promoting the standardization and normalization of personalized treatment to ensure the operability and reproducibility of treatment plans [1]. Through the above efforts, personalized treatment is expected to become an important development direction in the field of tic disorder treatment, bringing more high-quality and efficient medical services to patients.

Conclusion

As a complex neurodevelopmental disorder, the pathogenesis of tic disorder involves the interaction of multiple aspects such as genetic factors, neurobiochemical abnormalities, and psychosocial factors. Studies have shown that abnormal function of the dopamine system plays an important role in the pathophysiological process of tic disorder, while psychological stress and family environmental factors may further increase the severity of symptoms [1, 6]. In addition, recent studies on the association between gene polymorphisms and tic disorder have provided a new perspective for understanding its genetic basis, but the specific mechanism still needs in-depth exploration.

In terms of treatment methods, both pharmacotherapy and non-pharmacological treatment have shown certain efficacy. Antipsychotics such as haloperidol and aripiprazole are widely used in the treatment of tic disorder. Although their side effects cannot be ignored, they have significant effects in controlling motor and vocal tics [2, 11]. Central α2 adrenergic receptor agonists such as clonidine and guanfacine have become one of the first-choice drugs for mild to moderate patients due to their relatively mild side effects [6]. In terms of non-pharmacological treatment, behavioral therapy (such as Habit Reversal Training) and cognitive therapy can effectively alleviate tic symptoms and improve the quality of life by improving the patient's psychological state and behavioral patterns [8, 9]. Physical therapy methods such as Transcranial Magnetic Stimulation have also shown good application prospects, especially showing potential advantages in refractory cases [10].

However, the therapeutic effect of tic disorder is affected by a variety of factors. The patient's own age, severity of the disease, as well as the family environment and social support level all determine the selection of treatment plans and the final therapeutic effect to varying degrees [1, 2]. For example, child patients have a higher acceptance of behavioral therapy, while adolescent patients may benefit more from cognitive therapy and social skills training. At the same time, positive social support and a good family atmosphere can significantly improve the child's psychological state, thereby promoting the improvement of the therapeutic effect [8].

A comprehensive analysis of existing research results shows that a single treatment method is often difficult to meet the complex and diverse clinical needs of tic disorder. Therefore, the importance of comprehensive treatment strategies has become increasingly prominent. Future research should pay more attention to multidisciplinary collaboration, integrate knowledge from fields such as neuroscience, psychology, and education, and develop more precise and personalized treatment plans. In addition, with the rapid development of gene editing technology and neuromodulation technology, these emerging methods are expected to open up new ways for the treatment of tic disorder [4]. However, how to optimize the personalized treatment process and balance the allocation of medical resources in practice is still an urgent problem to be solved.

In conclusion, the treatment of tic disorder needs to comprehensively consider its pathogenesis, clinical manifestations, and influencing factors, and adopt multi-dimensional and multi-level comprehensive intervention measures. Future research should focus on in-depth exploration of the etiology and mechanism, optimization of existing treatment methods, and promotion of the transformation and application of new technologies in clinical practice, in order to provide more efficient and personalized medical services for patients [1, 3].

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