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RECENT ADVANCEMENTS IN TACKLING NEUROBEHAVIORAL DISORDERS

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ABSTRACT

This abstract addresses neurobehavioral disorders linked to brain damage, encompassing conditions such as Multiple Sclerosis (MS), Dementia, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorder (ASD), and Post Traumatic Stress Disorder (PTSD). These disorders, resulting from traumatic or non-traumatic brain injuries, significantly impact behavior, emotions, and learning processes. The complexities of assessing acquired brain injuries (ABIs) include inconsistent methodologies and inadequate neurodiagnostic data, complicating the understanding of their effects. Risk factors include lifestyle and genetic elements, while prevention focuses on health maintenance and cognitive reserve. For MS, the emphasis is on disease-modifying therapies, exploring B-cell-depleting therapies, and lifestyle influences. ADHD treatment combines pharmacological and behavioral strategies, addressing impulsivity and inattention. ASD management involves behavioral and pharmacological interventions, aiming to improve social behaviors and address irritability. PTSD treatments include pharmacological approaches targeting noradrenergic dysfunction and psychological interventions like trauma-focused cognitive-behavioral therapy. Overall, this review emphasizes the need for comprehensive, multidisciplinary approaches in managing neurobehavioral disorders to improve patient outcomes.

KEYWORDS: Neurobehavior, ADHD, Autism, PTSD, Dementia, Multiple Sclerosis.

1. INTRODUCTION

Neurobehavioral disorders, tied to brain damage, include conditions like multiple sclerosis (MS), dementia, attention deficit hyperactivity disorder (ADHD), Autism Spectrum disorder (ASD), and Post-Traumatic Stress Disorder (PTSD). Brain injuries may result from external forces or illnesses, categorized as traumatic or non-traumatic. These conditions lead to noticeable changes in behavior, emotions, and learning processes, sometimes termed as neurodevelopmental disorders. Acquired Brain Injuries (ABIs) contribute to organic behavioral deficits, presenting challenges in evidence-based literature due to study design issues. Analysing neurobehavioral sequelae after ABI faces challenges like inconsistent methodologies, varying severity levels, and complex assessments of environmental factors. Many studies lack essential neurodiagnostic data, hindering understanding of acquired brain injury effects.[1,2]

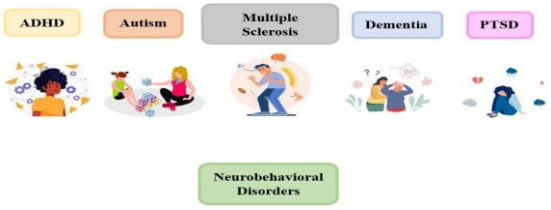

Fig.1: different types of neurobehavioral disorders.

2. DEMENTIA

A brain injury or disease-related chronic loss of two or more cognitive capacities is known as dementia. It is marked by a acquired decline in cognitive abilities across various domains, reaching a severity that hinders social or professional functioning.[3]

It is marked by a significant deterioration in cognitive capabilities, encompassing memory, cognitive processes and reasoning that makes everyday tasks difficult.[4] Dementia is a significant neurocognitive disorder, with 95% of individuals diagnosed suffering from conditions like Alzheimer's disease, neurodegeneration caused by strokes, or other types of dementia. Unfortunately, no permanent cure currently exists for dementia[5] and Alzheimer's disease (AD) constitutes 60–70% of instances of dementia.[6]

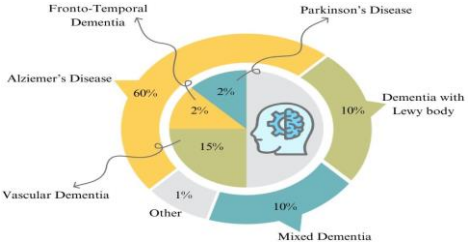

Fig. 2: Types of Dementia.

2.1 Risk factors & preventions

2.1.1 Risks: Factors contributing to an increased risk of dementia encompass early-life aspects (such as education), midlife factors (including high BP, overweight, loss of hearing, traumatic brain injury, and alcoholism), and later-life considerations (like smoking, depression, physical inactivity, social isolation, diabetes, and pollution of air). Certain conditions that arise in later life, such depression, may have a reciprocal effect and contribute to the dementia prodrome.[3] Some genetic factors, including ApoE4, PSEN1, PSEN2, and APP are acknowledged as prominent risks of dementia. ApoE4, in particular, stands out as the risk gene with the most substantial impact.[7]

2.1.2 Preventions: Reduce air pollution, treat hypertension, prevent head injuries, minimise diabetes, and lessen midlife obesity, continue doing regular workout, decrease the likelihood of depression, refrain from excessive drinking, reduce neuropathological damage, whether it involves amyloid or tau-mediated processes, vascular issues, or inflammatory responses. Additionally, address hearing impairment continue to interact with people frequently; and obtain a high degree of education, Increased and maintained cognitive reserve as part of the comprehensive approach.[7]

2.2 Recent Advancements in Treatment of Dementia

2.2.1 Pharmacological Interventions

Few FDA-approved medications for Alziemer disease dementia have been seen to be effective for cognitive symptoms, some of them are presently prescribed and produce a moderate clinical benefit. The first medication for AD that was licenced in the US was acetylcholinesterase inhibitors. This drug lead to a relative rise in acetylcholine levels at the synaptic cleft, enhancing cholinergic neurotransmission by inhibiting the brain's acetylcholinesterase enzyme. The administration of ACI-35, A vaccine designed to stimulate the immune system, aims to clear abnormal Tau protein. Currently undergoing testing in a Phase I clinical trial by AC Immune.[4]

In the recent years five clinical trials were executed, employing monoclonal antibodies directed against Aβ, namely aducanumab, crenezumab, gantenerumab, and solanezumab. Additionally, there was a trial incorporating a combination of gantenerumab and solanezumab. Aducanumab, in particular, is designed to specifically address aggregated forms of Aβ. exhibiting a preference for binding to parenchymal over vascular amyloid in the brain.[6]

At present, clinically approved medications consist of inhibitors of the acetylcholine receptor (ACHEIs), including donepezil, galantamine, and rivastigmine, along with the N-methyl-D-aspartate (NMDA) receptor inhibitor memantine, are among the medications employed. Nevertheless, their utilization is marked by restricted efficacy attributed to issues related toindication, tolerability, and side effects.[5]

2.2.2 Non-pharmacological interventions

Engaging in both aerobic activities like walking and swimming, as well as non-aerobic or conditioning exercises like weightlifting, improves cardiovascular health and has an impact onblood pressure and lowers the risk of stroke. Randomized trials suggest potential benefits on cognitive and physical function, though not consistently. A sleep education program in a clinical trial reduction in instances of waking up during the night, the overall duration of being awake at night, and manifestations of depressive symptoms over the period of six months.

Social engagements (e.g., parties, holidays, support groups, dog therapy) may have positive effects. A diet healthy for brain or Mediterranean diet (e.g., nuts, berries, green leafy vegetables, fish) is recommended. A comprehensive approach involving a combination of dietary modifications, physical exercise, cognitive training, and monitoring of risk factors demonstrated enhanced cognitive function in individuals susceptible to decline. For moderate- to-severe dementia, engaging in activities may be challenging, and limitations are necessary for safety.[8] During the terminal phase of dementia, palliative care can provide assistance and support. and caregiver attention is crucial. Ongoing efforts for dementia care should include caregiver education. Safety, encompassing mental, physical, and financial well-being, must bemonitored by caregivers.[3]

Past studies exploring psychosocial treatments for individuals with Mild Cognitive Impairment (MCI) or dementia revealed that psychological interventions have demonstrated efficacy in effectively diminishing depression.[10] Furthermore, a comprehensive multicentered randomized controlled trial, known as the ETNA3 study, assessed three distinct interventions against the standard treatment for Alzheimer's disease patients. These interventions included: cognitive training through group therapy, reminiscence facilitated by group therapy, and individualized cognitive rehabilitation. Their findings indicated that clinically significant outcomes were achieved solely through individualized cognitive rehabilitation. The program for cognitive rehabilitation and cognitive behavioral treatment for early dementia, known as CORDIAL, included Cognitive Behavioral Therapy (CBT), reminiscence therapy, and cognitive rehabilitation. In the CORDIAL study, a randomized controlled trial, this comprehensive intervention demonstrated a significant reduction in depressive symptoms among female participants.[9, 10]

3. MULTIPLE SCLEROSIS (MS)

It's disorder of the CNS with an autoimmune origin and is the most common neurological disability. Regions of inflammation in both gray and white matter, occurring in

multiple focal points, result in the death of oligodendrocytes and the destruction of myelin sheaths. These immune processes contribute to significant physical, cognitive, and neurological impairments, frequently appearing in young adults.[11] The most common cause of non-traumatic neurological impairment is multiple sclerosis. pathogenic features of multiple sclerosis is the inflammation associated with demyelination and neurodegeneration.[12]

Tissue damage in Multiple Sclerosis (MS) exclusively impacts the Central Nervous System (CNS) remains unaffected, with no impact on the Peripheral Nervous System (PNS). There are two possible clinical outcomes for MS i.e., progressive or relapsing. Relapsing Multiple Sclerosis (RMS) the most general form of the disease, distinguished by distinct episodes of neurological impairment followed by partial, total, or no recovery.[12]

3.1 Risk Factors and Preventions

3.1.1 Risks: Growing evidence suggests that lifestyle decisions and diverse environmental elements participates in the initiation and advancement of MS. Factors such as geographical location, vitamin D levels, Infection with the Epstein-Barr Virus (EBV), the hygiene hypothesis, confirmation of cytomegalovirus (CMV) infection through serological means, exposure to tobacco smoke and organic solvents, childhood obesity, engaging in shift work, consumption of caffeine, alcohol intake, exposure to salt, and the composition of intestinal microflora are all factors considered in the context of various environmental influences are identified as key epigenetic contributors to the development of multiple sclerosis.[13] Research conducted with the pediatric population experiencing relapsing-remitting multiple sclerosis (RRMS) and clinically isolated syndrome (CIS) indicated that elevated consumption of saturated fat might elevate the likelihood of an MS relapse.[14]

3.1.2 Preventions: The current evidence supporting exercise (and physical activity) in reducing the risk of multiple sclerosis is limited and in its early stages, a recent line of research has explored the notion that exercise and physical activity might possess neuroprotective effects, ultimately influencing the progression of MS.[15] Physical activity is a secure and widely acknowledged symptomatic intervention with positive impacts on various symptoms (tertiary prevention) in individuals with MS. Nevertheless, recent findings indicate that exercise may extend its influence beyond symptom management, potentially exhibiting disease-modifying effects (secondary prevention) and even playing a preventive role by reducing the risk of developing the disease (primary prevention) in individuals with MS.[16]

3.2 Recent Advancements in Treatment of Multiple Sclerosis

Present management approaches prioritize addressing acute attacks, alleviating symptoms, and diminishing biological activity through the implementation of disease-modifying therapies. Patients commonly report various manifestations, including Disturbed sensation, compromised balance, movement challenges, impaired vision, sphincter disorders, and cognitive function impairment.[13]

3.2.1 Pharmacological Interventions

In recent decades, growing evidence implicates B cells in multiple sclerosis pathogenesis. Datafrom various studies on B-cell-depleting therapies, such as Rituximab (RTX), suggests their inclusion as treatment options in the existing array of disease-modifying therapies for MS. RTX, has been shown to effectively reduce inflammatory activity, lower relapse rates, and minimize new brain lesions on MRI in both Relapsing–Remitting MS (RRMS) and Progressive MS (PMS) patients. Moreover, RTX is well-tolerated, presents acceptable safety risks, and exhibits a favorable cost-effectiveness profile.[12] Present approaches to managing the condition Focus on addressing acute episodes, relieving symptoms, and reducing biological activity through the application of therapies that modify the course of the disease. These therapies alter the progression of MS by suppressing or modulating immune function, exerting their anti-inflammatory effects mainly during the relapsing phase. They lower the frequency of relapses, mitigate the buildup of MRI lesions, and stabilize, postpone, and in certain instances, slightly enhance disability.[13]

Some of the FDA approved disease modifying therapies are available oral disease-modifying therapies (DMTs) in the market encompass Dimethyl fumarate, sold as Tecfidera, sanctioned by the FDA for treating various forms of relapsing MS, including clinically isolated syndrome (CIS), RRMS, and relapsing forms of secondary progressive MS (SPMS). Fingolimod, commercially labeled as Gilenya, is FDA-approved for CIS and relapsing MS. Injectable DMTs consist of Glatiramer acetate, commercially recognized as Copaxone, an FDA-approved injectable DMT for relapsing-remitting MS (RRMS). Copaxone has shown both tolerability and sustained clinical effectiveness in managing MS over prolonged use. Alemtuzumab, marketed as Lemtrada, holds FDA approval for individuals with aggressive RRMS. Other infusion treatments encompass Mitoxantrone, commercially termed Novantrone, FDA-approved for aggressive RRMS, secondary progressive MS (SPMS), and progressive-relapsing MS (PRMS), administered every three months. Another infusion therapy is Ocrelizumab, commercially known as Ocrevus, recently approved for both RRMS and primary progressive MS (PPMS) patients. [12, 17]

3.2.2 Non-Pharmacological Interventions

Disease-modifying therapies (DMTs) inhibits the development of multiple sclerosis by suppressing or adjusting immune function. Their main anti-inflammatory effects occur mainly during the relapsing

phase of multiple sclerosis. They decrease the frequency of relapses, diminish the build-up of MRI lesions, and stabilize, postpone, and, in certain instances, slightly enhance disability.[12] An alternative dietary approach tested across various autoimmune conditions is the Paleolithic diet which underscores the intake of vegetables, fruits, and their dietary fiber, while abstaining from meat, milk, and cereal grains. A year-long study focusing on multiple sclerosis (MS) and employing a very low-fat diet did not yield significant improvements in clinical and MRI-derived disease outcomes. Nonetheless, the low-fat diet did lead to positive changes in lipid profiles and BMI, ultimately correlating with a decrease in fatigue levels as reported by the patients.[18] These preliminary results have led to the formulation of new research plans investigating the impact of low-fat versus modified Paleolithic diets, commonly referred to as the Wahls diet, on fatigue, quality of life, and motor as well as cognitive functions among individuals with multiple sclerosis.[14,18] The idea that exercise and physical activity possess neuroprotective qualities is primarily grounded in research from fundamental sciences. However, recent clinical studies have also provided some backing to this notion. These studies focus on conditions, akin to MS, characterized by inflammatory neurodegeneration. Within these models, numerous investigations consistently endorse the neuroprotective impact of both aerobic and resistance training.[16]

4. ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD)

ADHD is one of the most prevasive neurobiological development disorder in kids and is marked by impulsive behaviour, hyperactivity, and inattention.[19] Its diagnostic categorization is predicated on behavioural symptoms being seen.[20] The disease is frequently identified in childrens, and in as many as 70% of instances, the symptoms cause functional disability that lasts into adulthood.[21] Patients with ADHD exhibit abnormalities in "Executive Functions" (EF), or higher-order cognitive processes, Crucial for mature adult goal-driven behaviors.[22]

4.1 Risk Factors and Preventions

4.1.1 Risks: Exposure to paracetamol during pregnancy was linked to and increased chance of ADHD in the progeny. The likelihood of ADHD in offspring is heightened when there is compelling evidence of pre-pregnancy obesity, preeclampsia, and hypertensive issues during pregnancy. Additionally, there is substantial suggestive evidence connecting pre-pregnancy overweight and elements of the mother's metabolic syndrome to an increased risk of ADHsD inthe child.[19]

4.1.2 Preventions: In educational areas like schools, primary prevention approaches centre around fostering positive behaviors. This involves implementing school-wide rules and reward systems. Typical classroom strategies include labelling expectations and norms, giving clear instructions and directions, and rewarding positive behaviour with praise. Teachers use consequences (like creating rules for the classroom) and antecedents (like giving praise or appreciation) to encourage on-task behaviour and reduce agitating behaviour, It is advisable to:

(a) Tailor these approaches for students from diverse cultural and linguistic backgrounds.
(b) Enhance them for students at risk for ADHD who benefit from increased structure and consequences to achieve success.[23]

4.2 Recent Advancements in Treatment of Attention Deficit Hyperactivity Disorder

4.2.1 Pharmacological Interventions

Individuals with ADHD can be treated with pharmacologic, nonpharmacologic, or combined treatments. FDA-approved medications include:
Nonstimulant medications, such as atomoxetine, as well as extended-release formulations of clonidine and guanfacine and stimulants like amphetamines and methylphenidate. In a comprehensive analysis of double-blind, randomized controlled trials lasting an average of seven weeks, ADHD-approved drugs outperformed placebos in terms of reducing the severity of impulsivity, hyperactivity, and inattention.[21] All these treatments have demonstrated efficacy in addressing symptoms of ADHD and improving functional results, including enhancing the quality of life, academic achievements, reducing accident rates and injuries. Importantly, these medications do not seem to be linked with substantial adverse outcomes or side effects.[24]

4.2.2 Non-Pharmacological Interventions

Psychiatric recommendations suggest social skills training and behavioural therapies in addition to medicine, noting that medication alone is frequently insufficient for therapy. However, there are few standards regarding the specific components of these non-pharmaceutical interventions. Parenting books include advice and recommendations for parenting techniques and cognitive training.[25]

Pharmacological treatments have been combined with or substituted with a variety of non-pharmacological treatments. It has been demonstrated that dietary changes like omega 3 slightly improve the symptomatology of ADHD. Interventions focused on meditation, like yoga and mindfulness, are popular.to enhance one's physical and emotional well-being. Although parental training has demonstrated limited long-term effectiveness, interventions implemented in schools and summer programs, including Cognitive-Behavioral Therapy (CBT), contingency management, and academic interventions, are considered primary treatment approaches. These approaches are classified as "first-line" and have proven to enhance academic performance. Neurofeedback treatments seem to have some benefit in

reducing the cognitive and self-control symptoms connected to ADHD. The FDA sanctioned the game-based digital therapy on June 15, 2020, tailored to tackle attention difficulties in 8 to 12-year-old children with inattentive or combined-type ADHD. EndeavorRx stands as the exclusive game-based digital therapeutic tool presently accessible in the United States, marking a groundbreaking FDA approval as the first of its kind for any medical condition. According to the FDA, the device has proven its efficacy in improving attention levels, evaluated through computer-based testing.[25,27]

5. AUTISM SPECTRUM DISORDER (ASD)

ASD encompasses a genetically diverse range of neurobehavioral conditions characterized by deficiencies in three essential behavioral sections: Human interaction, communication, and stereotypical repetitive behaviors.[28] A diverse neuropsychiatric condition impacting approximately one in thirty six children, ASD manifests in youths with notable behavioral challenges such as irritability, aggression, and hyperactivity.[29]

5.1 Risk Factors and Preventions

5.1.1 Risks: The interplay among various genetic and environmental risk factors is a crucial aspect. Although the exact cause of autism spectrum disorder (ASD) is not entirely clear, genetics is widely acknowledged as a significant threat factor. Studies have demonstrated a 76% agreement in monozygotic twins, affirming the substantial inheritability of autism spectrum disorder while also emphasizing the significant impact of environmental factors.[30]

5.1.2 Genetic Factors: Autism spectrum disorder is linked to genes related to synapses, including neuroligin 3, neuroligin 4, neurexin 1, and SH3, and multiple ankyrin repeat domains.

3. Uncommon mutations and Copy Number Variations (CNVs) present in neurexin genes have been associated with autism spectrum disorder and psychiatric disorders. Which suggests disruptions in synaptic function, controlled by neurexins and their associated binding partners, may be associated with the underlying mechanisms of ASD. Certain perspectives consider autism as a synaptic disorder. Uncommon mutations, in some instances, may lead to autism by disrupting specific synaptic pathways, including those associated with cell-cell interaction.[31]

5.1.3 Environmental Factors: Being exposed to the chemical pollutants during critical developmental phases appears to influence neural and behavioral development, suggesting a role for environmental factors. The mechanisms leading to pathology include neurotoxicity, immune system dysregulation.[30]

5.1.4 Dietary Factors: The presence of excessive or deficiency of micronutrients can impact neurodevelopmental results in progeny. Overweight and underweight during pregnancy are linked to an elevated risk of autism spectrum disorder. Obesity during pregnancy activates the immune system, leading to chronic uterine inflammation and abnormal neuronal growth, resulting in neurodevelopmental impairments in the child. Similarly, maternal undernutrition triggers a stress response, inducing harm to neurons by releasing an excessive amount of proinflammatory factors.[30] The diet intake of a pregnant woman holds a crucial significance in child's neurodevelopment. Use of prenatal vitamins or multivitamins, along with sufficient intake of folic acid and vitamin D, has been linked to a reduced likelihood of having a child with autism spectrum disorder.[32]

5.1.5 Preventions: It is advised to closely observe and provide treatment, even for mild infections or episodes of inflammation during pregnancy. Prophylaxis includes vaccination programs to avoid infections, and mothers on long-term medications should be under surveillance.[30]

Prenatal vitamins are designed to meet the increased nutrient needs during pregnancy, often containing higher levels of folic acid, iron, and vitamin B 6 and B 12 compared to standard adult multivitamins. However, formulations vary widely, and some prenatal vitamins, such as certain gummy varieties, may lack key nutrients like iron. Research on the association between prenatal vitamins and Autism Spectrum Disorder often attributes protective effects to the presence of folic acid in these supplements. Folic acid, a vital component, serves as a cofactor in one-carbon metabolism, particularly in converting homocysteine to S-adenosyl-methionine, a crucial methyl donor. This process is essential for methylation, a mechanism implicated in DNA synthesis and methylation directly related to neurodevelopment. Insufficient folate levels may lead to DNA damage and neuronal death. Adequate folate during critical periods of pre-conception and early pregnancy is crucial for favorable neurodevelopment in the foetus.[32]

5.2 Recent Advancements in Autism Spectrum Disorder

Pharmacological and nonpharmacological psychosocial interventions, including positive behavior support, are utilized to manage challenging behaviors. Positive behavior support involves comprehending these behaviors through a person-centered approach.[33]

5.2.1 Pharmacological Interventions

As of now, only two medications, risperidone and aripiprazole, have obtained approval from the USFDA for addressing irritability associated with ASD. Advancements in understanding the pathophysiology of ASD have revealed novel targets for pharmacologic intervention, encompassing the neuroimmune system, the endocannabinoid system, and the glutamatergic neurotransmitter system.[29]

5.2.2 Non-Pharmacological Interventions

Behavioral interventions continue to be the primary approach for treating Autism Spectrum Disorder. However, several potential targeted treatments are being seen to address the underlying neurophysiology of ASD. Besides pharmacological treatments there are some non-pharmacological treatments which are considered to be the primary approach in managing ASD focuses on addressing the fundamental symptoms of the disorder. Holistic treatment approaches that target the fundamental symptoms of ASD have proven effective in enhancing language, cognition, and functional skills among childrens. These models implement intensive, long-term, and multidisciplinary strategies within naturalistic environments.[34]

Applied Behavior Analysis (ABA) is characterized as a strategy for comprehending socially relevant responses. it is a practice often termed behavioral intervention, emphasizing its main focus on modifying environment related factors to enhance social behavior.[35]

6. POST TRAUMATIC STRESS DISORDER (PTSD)

PTSD is perhaps a psychological ailment that arises as a result of exposure to a distressing event and is marked by symptoms causally associated with a traumatic experience.[37] These involve intrusive experiences associated with the trauma, avoidance of both internal and external reminders of the trauma, and negative shifts in thoughts and mental state occurring or intensifying after the trauma, and alterations in arousal and reactivity that commence or worsen following the trauma.[36]

6.1 Risk Factors and Preventions

6.1.1 Risks: Numerous risk factors contribute to the development of PTSD overlap with those observed in various psychiatric disorders. Risk factors associated with post-traumatic stress disorder includes elements like susceptibility in females, lower socio-demographic background, a history of prior mental disorders, a familial history of mental health issues, and traumatic childhood experiences. Vulnerability to PTSD is particularly pronounced in cases of prolonged trauma or interpersonal traumatic events.[37]

6.1.2 Preventions: Delivering self-directed online psychoeducational resources to caregivers and children, coupled with providing self-directed psychoeducational materials for children within the initial three months following a traumatic incident is Demonstrating growing proof of effectiveness in preventing clinically significant posttraumatic stress symptoms in kids and adults.[38]

6.2 Recent Advancements in Post-Traumatic Stress Disorder

6.2.1 Pharmacological interventions

Noradrenergic dysfunction is extensively recorded in PTSD and is proposed to have a pivotal role in the occurrence of intrusive reliving of traumatic memories. This claim is supported by evidence showing the effectiveness of Prazosin, a noradrenergic receptor inhibitor, has shown efficacy in relieving nightmares and mitigating the re-experiencing symptoms associated with PTSD. Additional confirmation comes from findings that the administration of propranolol, a beta-adrenergic antagonist, shortly after trauma exposure reduces subsequent reactivity to reminders, though it does not entirely prevent the development of PTSD, soon after exposure to trauma, reduces sensitivity to stimuli, though it does not entirely prevent the development of PTSD.[38]

Cycloserine, acting as a partial agonist targeting the glutamatergic receptor, cycloserine is utilized to improve the process of extinction learning. Adenosine is utilized to reduce activity in both the amygdala and the noradrenergic system. Cannabinoids are used to relieve symptoms such as insomnia, nightmares, and hyperarousal associated with PTSD. Additionally, intravenous ketamine, functioning as a glutamate NMDA receptor antagonist, is employed in PTSD treatment, for rapid symptom reduction. However, current evidence-based clinical practice guidelines advise against using Divalproex, guanfacine, risperidone, benzodiazepines, ketamine, hydrocortisone, D-cycloserine, and cannabis derivatives are among the pharmaceutical and therapeutic agents considered in the management of various conditions, including psychiatric disorders and neurological conditions for PTSD treatment.[39]

6.2.2 Non-Pharmacological Interventions

Early psychological intervention aimed at preventing symptoms of traumatic stress, initiated within three months of a traumatic incident. Trauma-focused cognitive-behavioral therapy (TF-CBT) is a psychological intervention primarily utilizing techniques focused on trauma-related cognition, behavior, or a combination of both. This encompasses exposure therapy and the application of methods delivering trauma-focused cognitive, behavioral, or cognitive-behavioral interventions. Stress management involves psychological intervention primarily focused on teaching anxiety or stress management techniques.[40]

7. CONCLUSION

Advancements in the treatment of neurobehavioral disorders have shown significant promise in addressing conditions such as dementia, multiple sclerosis (MS), attention deficit hyperactivity disorder (ADHD), autism spectrum disorder (ASD), and post-traumatic stress disorder (PTSD). Pharmacological innovations, such as acetylcholinesterase inhibitors for Alzheimer's disease, B-cell-depleting therapies for MS, and FDA-approved medications for ADHD and ASD, have provided new avenues for symptom management and disease modification. Non-pharmacological approaches, including cognitive rehabilitation, physical exercise, diet modifications, and behavioral therapies, have also demonstrated efficacy in improving cognitive and physical functions, enhancing social interactions, and

reducing depressive symptoms. These holistic treatments emphasize the importance of combining pharmacological and non-pharmacological strategies to maximize therapeutic outcomes. This comprehensive review shows the integration of advanced diagnostic tools and personalized medicine holds the potential to further enhance the quality of life for individuals affected by these disorders.

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