

Case Report

## Sudden Cognitive Decline in Bipolar Mood Disorder Patient with Underlying Severe Tardive Dyskinesia After the Failure of His Deep Brain Stimulation Device Battery

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**Abstract**— Bipolar disorder (BD) is a chronic mood disorder associated with multiple comorbidities. Structural and functional abnormalities in these subjects' brains have been related to cognitive deficits correlated with the severity of the mood symptoms. These deficits are also present in euthymic states, indicating a trait characteristic. Bipolar subjects would risk developing tardive dyskinesia due to being exposed to long periods of antipsychotic treatment. Unfortunately, the presence of tardive dyskinesia is also associated with worsening cognition. One treatment option for severe tardive dyskinesia is deep brain stimulation that has also been implicated with cognitive decline. We present a case of Bipolar disorder with underlying cognitive impairment, who had a deep brain stimulation device inserted for severe tardive dyskinesia. He was admitted to a depressive phase and was noted to have a sudden worsening of cognitive impairment following his deep brain stimulation device battery running low. Possible explanations discussed for this unexpected observation are attributed to a further deterioration of his tardive dyskinesia following the device failure and depressive episode, which causes added pseudo-cognitive deficit signs.

**Keywords**— Bipolar Disorder; Cognitive Decline; Tardive Dyskinesia; DBS (deep brain stimulation).

### I. INTRODUCTION

Bipolar disorder (BD) is a chronic, severe, recurrent mood disorder with a lifelong vulnerability. Clinical features are characterized by alternating episodes of mania or hypomania and major depression or mixtures of manic and depressive features [1]. Symptom recurrences, frequent relapses, and persistent residual symptomatology were used to categorize the spectrums. Sub-syndrome and minor affective symptoms predominate, and the symptomatic structure is primarily

depressive rather than manic. The severity of the symptoms fluctuated over time, and the dimensional illness of BD included a wide range of effective symptom severity and polarity [2].

The condition occurs across a wide range of ages, but the most common onset age is in the late teens or early 20s. The illness occurrences are often noted when a person contributes to society and during the critical phases of life such as studies, work, and family planning. It is often underdiagnosed or misdiagnosed with significant clinical

and economic consequences. Medical and psychiatric comorbidity is common in patients with bipolar disorder and causes high rates of morbidity and mortality.

Although mood episodes are regarded as the hallmark of this disorder, it is well recognized that other equally debilitating manifestations can occur. Cognitive impairment, such as impairment in attention, executive functions, and recall memory, can occur [3]. The development of tardive dyskinesia is due to exposure to long periods of antipsychotic therapy, mainly by patients with bipolar disorder. Hence, they are at risk to develop tardive dyskinesia disorder.

Studies have consistently shown that in both bipolar disorder and schizophrenia subjects, the presence of tardive dyskinesia is associated with more significant cognitive impairment. This is because similar neurological processes produce vulnerable involuntary movements in major functional psychoses and affective disorder [4].

Deep brain stimulation (DBS) has been used successfully as a treatment option for tardive dyskinesia, but it by itself can cause gradual cognitive decline. DBS targeted the main brain called the subthalamic nucleus (STN). When STN stimulated, it seems to be more commonly correlated with neuropsychological and behavioural alterations. However, this association area still needs further investigation. Furthermore, the STN effects would be concordant with basal ganglia (BG) connection, whereby has shown to connect motor, limbic and associative networks that impaired cognition.

Hence, a person with bipolar disorder that develops tardive dyskinesia, and undergoes DBS, would have an added risk of suffering cognitive decline from the disorder itself, pre-existing tardive dyskinesia and DBS. Here, we present a case of Bipolar Mood Disorder with cognitive impairment, who had a DBS device inserted for severe TD and tardive dystonia. Interestingly, his cognitive impairment after the procedure and his condition would worsen when his DBS device battery runs low. We discuss the possible explanations for this phenomenon.

## II. CASE REPORT

Mr L is a 37-year-old male treated for Bipolar Mood Disorder for over the past 17 years. His recent admission was with a four-month history of being depressed. On admission, his vital signs were normal, and all blood investigations were unremarkable. He did not consume alcohol nor smoke cigarettes, and there was no history of substance usage. He was diagnosed as having a Bipolar Mood Disorder in the depressive phase. He was treated with the following medication: Sodium Valproate 1000mg daily, Quetiapine 75mg daily, Escitalopram 10mg daily and Clonazepam 4mg daily.

Further history revealed that he had been slower in thinking, talking less and being forgetful for the past four to five years. He started experiencing severe tardive dyskinesia and tardive dystonia in the past four years. He shares continuous truncal extension, including left torticollis and retrocollis movements, associated with bilateral spasm and jaw-opening dystonia, with slurring of speech. Subsequently, he had a DBS with a microelectrode imaging (MER) device implanted three years ago for this condition. In addition, he

was also given pharmacological intervention, consisting of Clonazepam 4 mg daily. He received Botox (onabotulinumtoxinA) injection a month before his recent admission.

While in the ward, he was less attentive, quiet, and struggled with conversation as he appeared to have difficulty finding words to say. On several occasions, he seemed to be confused, disorientated with disorganized behaviour. These manifestations were a drastic change from before. A Mini-Mental State Examination (MMSE) was done while under observation in the ward and showed significant impairment with the scoring of 12/30. Remarkable findings were demonstrated by the performance of contrasted computerized tomography (CT) scan and an electroencephalogram (EEG). The additional information gained from his family members revealed that every time his DBI device battery runs low, he would be slower in thinking, talking less, becoming more socially withdrawn, and appearing lethargic. He was then referred to the neurosurgical team to check on his DBS battery. It was noted that his battery was low, with only about 5% of energy. MMSE repeated post-charging the DBS battery, with an improving score of 27/30.

## III. DISCUSSION

Cognitive impairment in mood disorders has been studied extensively. The severity of mood symptoms is associated with more severe cognitive dysfunction. However, cognitive deficits do persist during the euthymic periods. This may indicate that some types of cognitive deficits may represent some underlying fundamental trait characteristics [5]. Neuroimaging and neuropathological studies have helped to understand the underlying mechanisms of cognitive impairment in bipolar disorders. Both structural and functional abnormalities have been found in the dorsolateral prefrontal cortex associated with deficits in attention/working memory and executive functioning. Post mortem findings have also revealed abnormal neuronal density in the same area [1].

Tardive dyskinesia (TD) describes a syndrome of involuntary movements among individuals on the treatment of neuroleptic agents. The prevalence as high as 15 %, with the pathophysiology of predominantly. This was caused by the antidopaminergic mechanism in neuroleptic drugs [6].

TD is distinguished by involuntary, repetitive and stereotypic movements that result from prolonged dopamine blockade from antipsychotics. The symptoms of tardive dyskinesia typically involve the oral-buccal region but can also affect the neck, trunk, and extremities. The risk for developing tardive dyskinesia is higher in mood disorders than in psychotic disorders [7]. There is also a direct relationship between the type of mood episodes and tardive dyskinesia. Increased severity of depression is often associated with worsening tardive dyskinesia. Conversely, signs of tardive dyskinesia often reduce with mania [8].

Several studies have found that the presence and severity of tardive dyskinesia are associated with cognitive deficits [8] [9]. The underlying mechanisms of this association are still open to various interpretations. Several studies that were done on schizophrenic subjects postulates that the association may be explained in part by oxidative stress [10].

Motor symptoms are alleviated using deep brain stimulation of the subthalamic nucleus of tardive dyskinesia (TD). However, chronic stimulation of the subthalamic nucleus can lead to a decline in memory, phonemic fluency, semantic fluency, and executive function. The exact mechanisms of how deep brain stimulation leads to cognitive changes are still unclear. Connections exist between the subthalamic nucleus and other regions involved in cognition, such as the limbic and association areas. These areas may be affected by chronic stimulation of the subthalamic nucleus, leading to cognitive deficits [11].

In our case, his cognitive impairment can be explained by several causes; the underlying mood disorder itself, his concurrent severe tardive dyskinesia condition and the deep brain stimulation procedure that he is receiving (including the subsequent chargeable battery). However, why did his cognitive deficits drastically worsen when his deep brain stimulation device battery run low? His cognition should theoretically improve as there is no more stimulation of the subthalamic nucleus, which previously may have adversely affected other limbic structures involved in understanding. We offer several explanations for this paradoxical observation.

Firstly, the failing battery of his deep brain stimulation device would worsen his tardive dyskinesia. Furthermore, being in a depressive episode would also worsen his tardive dyskinesia, as explained earlier. Though tardive dyskinesia is associated with cognitive impairment, the proposed explanation of oxidative stress is a chronic process. It would not justify a sudden worsening of cognition, as seen in our case. The patient's worsening tardive dyskinesia could indirectly cause him to appear more cognitively impaired. The distress from his worsening tardive dyskinesia could have caused him to be less attentive, quiet and appear confused. Additionally, the severe motor manifestations of his tardive dyskinesia may cause him to struggle with conversation and seem difficult in finding words.

Another possible explanation for this patient's worsening cognition could be the depressive episode itself. It has been well recognized that severely depressed patients exhibit pseudo cognitive deficits. Furthermore, could his failing deep brain stimulation device worsen his depression? Deep brain stimulation has been used to treat treatment-refractory depression, though the target areas in the brain are different from when it is used to treat movement disorders. However, due to the complex nature of connections within other areas of the brain, cessation of deep brain stimulation in one maybe, may affect another place, hence worsening or precipitation depression.

#### IV. CONCLUSIONS

In conclusion, entertaining all possible causes of complications is in need when dealing with complex cases with multiple comorbidities. In this case, the patient's sudden worsening of cognition is only an assumption as an underlying cause. It is possibly associated with his deep brain stimulation device battery running low. Hence, the patient and his family were advised to check with their neurosurgical team to prevent this.

#### CONSENT TO PARTICIPATE

Patient in this case report gave consent for all data to be included in this report. Verbal informed consent for publication of the clinical details and/or clinical record/images was obtained from the patient/guardian/relative of the patient.

#### CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest.

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