The Quiet Epidemic in the Critical Care Setting: Acute Delirium and Behavioural Changes Following Cannabis Use: Decoding the Maze

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Abstract

Acute delirium and altered disruptive behaviour in an acute hospital setting despite the use of sedative agents is the most common indication for emergency unplanned intubations. Most of these patients are empirically treated for encephalitis whilst awaiting imaging and Cerebrospinal Fluid (CSF) and Polymerase Chain Reaction (PCR) tests. However, the increasing prevalence and legalisation of cannabis globally amongst young patient cohort have raised concerns regarding its long-term impact on brain health. Chronic cannabis use has been linked to frontal lobe atrophy, which can lead to significant cognitive and behavioural impairments, including early onset frontotemporal dementia (FTD). This case report presents a patient with frontal temporal lobe brain atrophy due to prolonged cannabis use presenting with altered disruptive behaviours and delirium, detailing diagnostic processes, management strategies, and implications for healthcare systems like the NHS. The article distinguishes between medical and recreational cannabis use, highlighting their distinct health outcomes. Frontotemporal dementia (FTD) is increasingly recognized as an underdiagnosed condition that often presents earlier than other dementias, such as Alzheimer's disease. The association of FTD with chronic cannabis use, particularly among younger patients, introduces unique challenges. It is essential to investigate the burden of cannabis induced FTD to inform future research and guide the allocation of healthcare resources for this uncharted issue. The "iceberg effect" of underreported cannabis-related neurological disorders complicates diagnosis and treatment, necessitating enhanced diagnostic vigilance and comprehensive epidemiological studies. This report aims to increase awareness among critical care and emergency care clinicians about the potential neurotoxic effects of chronic cannabis use, highlight limitations of current health care, scope for the future demands on the NHS and emphasise the need for early intervention and tailored healthcare approaches in managing cannabis-related neurocognitive disorders.

Keywords: Cannabis, Frontatemporal Dementia, Frontal Lobe Atrophy.

Background

The use of cannabis is becoming increasingly prevalent across the globe, with many regions moving towards its legalisation and social acceptance.[1] While the short-term psychoactive effects of cannabis are well-documented, there is growing concern about its long-term impact on brain structure and function.[2] Chronic cannabis use has been associated with various neuropsychiatric consequences, yet its role in structural brain changes remains a subject of ongoing research and debate.[2]

The frontal lobe, a critical region responsible for executive functions, decision-making, and behavioural regulation, is particularly vulnerable to the effects of chronic substance use.[3] Atrophy of the frontal lobe can lead to significant cognitive and behavioural impairments, profoundly affecting an individual's quality of life.[3]

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Emerging studies suggest a potential link between chronic cannabis use and brain atrophy, particularly in the frontal lobe.[2,4] This case report contributes to the medical literature by detailing a patient with frontal lobe brain atrophy attributed to prolonged cannabis use. The objective of this report is to elucidate the clinical presentation, diagnostic process, and management strategies for this condition, and to explore the possible effects of this on the NHS and health care sector.

By presenting this case, we aim to raise awareness among front door clinicians about the potential neurotoxic effects of chronic cannabis use on young patient cohorts and underscore the importance of early recognition and intervention from other clinical mimics of acute delirium.

Case Presentation

In late 2023, a patient in his mid-50s presented to Resus by ambulance with a history of persistent cannabis use and hyperactive delirium with altered mental status, new onset hyperactive delirium of unknown cause, threatened airway combined with persistent agitation and combativeness. On examination the patient was snoring, had a GCS of 7 (E1V1M5), respiratory rate of 12, saturation of 96% on room air and capnography normal.

Past medical history showed asthma and a cerebrovascular disease early in 2023. Patient also has a history of acute confusion and disorientation since 6pm the day before admission and remembers hitting his head a few times on the same day. On the day of the admission the patient experienced worsening agitation and confusion. The ambulance crew noted that they were unable to get any observations due to the patient's hyperactive delirium and agitation. The patient's family also noted that some weeks prior to his admission in late 2023 the patient had become increasingly aggressive and even painted on parts of his body. The patient admitted to the use of cocaine for a few months in 20's but has since only used cannabis and tobacco regularly. Patient used to be a powerlifter and has worked in a photo lab. There was no relevant family history and no history of cancer.

On admission, he was agitated with severe respiratory acidosis, normal glucose level and a white cell count of 21. He was empirically treated with antibiotics and antivirals for encephalitis. He was intubated as he was very agitated and unsafe to continue with further treatment for potential encephalitis. Post intubation, his CT head showed frontal lobe brain atrophy. MRI report confirmed a mature right frontal cortical infarct, a background of mild deep white matter chronic small vessel disease, generalised brain parenchymal volume loss with secondary ventricular prominence. An electroencephalography was unremarkable except for intermittent irregular slow waves over the left frontotemporal region consistent with underlying structural abnormalities or cerebrovascular lesion. A lumbar puncture was also performed with negative viral PCR. He was extubated and weaned of invasive ventilation.

Figure 1: CT Head Shows Frontal Lobe Brain Atrophy.

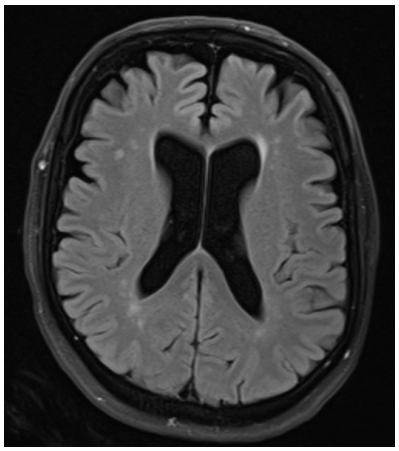

Figure 2: MRI Head.

He was deemed too young for an admission to in-house memory ward. As his brain health issues were due to chronic recreation drug use, he was not deemed to need an admission to an acute adult psychiatric unit.

Prior to this admission, the patient was given Carbamazepine (modified release) 200mg BD and referred to neurology for possible frontal seizures. Neurologist had noted that the patient had episodes of abnormal behaviour. He had multiple admissions to surrounding hospitals due to his hyperactive agitation and abnormal behaviour issues.

Unfortunately, this patient stayed on critical care unit after extubating for several weeks, as he was not safe to be discharged to a home setting.

He was discharged to a warden-controlled facility. He was referred to the community Memory clinic for further workup and social service input to assess his ongoing and further care needs.

Discussion

The case presented highlights a significant and emerging concern within the realm of neurological health, particularly regarding the impact of chronic cannabis use on frontal lobe function and subsequent development of early onset dementia. This discussion aims to address several key aspects related to the case, including the societal implications, healthcare burden, incidence of cannabis use, differences between medical and recreational cannabis use, and effects of frontal lobe atrophy on proprioception.

Table 1: Summarises Key Details from Relevant Studies, Highlighting Similarities and Differences with Our Case.

Study Reference	Patient Characteristics	Key Findings	Management Approach
Moshfeghinia *et al.*[5]	34-year-old male, physically healthy	Psychiatric and neurological symptoms, MRI: frontotemporal lobe atrophy	Antipsychotics
Mekala *et al.*[6]	22-year-old female, physically healthy	Catatonia and psychosis. Imaging: unremarkable	Antidepressants, benzodiazepine, and antipsychotics
Mandelbaum and de la Monte[7]	55-year-old male, physically healthy	Brain damage: regions of subacute or chronic demyelination	N/A Patient died of sepsis.
Leczycki *et al.*[8]	20-year-old male, physically healthy	Psychosis and new on-set seizures. Imaging: unremarkable	Benzodiazepine, and anti-epileptics
Živanović and Silić[9]	20-year-old male, physically healthy	Neurological and psychiatric symptoms. MSCT: cerebral atrophy	Antipsychotics and Anxiolytics

Mechanisms of Pathology and Injury

Chronic cannabis use has been associated with several neurocognitive impairments, particularly affecting the frontal lobe, a critical region responsible for executive functions, decision-making, and behavioural regulation.[3] The primary psychoactive component in cannabis, delta-9-tetrahydrocannabinol (THC), interacts with cannabinoid receptors in the brain, leading to altered neural connectivity and synaptic plasticity.[10] Prolonged exposure to THC has been shown to result in structural brain changes, including grey matter reduction and white matter integrity loss, particularly in the frontal lobe.[11] These changes can predispose individuals to cognitive decline and psychiatric disorders, such as early onset frontotemporal dementia.

Frontotemporal dementia (FTD) results from neuronal damage in the frontal and temporal lobes, leading to progressive impairments in behaviour, executive function, and language.[12] It is among the most prevalent forms of dementia in individuals under 65 years old.[13] Early-onset FTD typically manifests with abrupt mood swings, behavioural disinhibition, heightened aggression, reduced empathy, and working memory difficulties.[14]

Further negative Effects of Chronic Cannabis Use on the Brain and Cognitive Function

Cognitive Decline: Research published in the International Journal of Neuropsychopharmacology suggests that chronic cannabis use may be associated with cognitive decline in young adults, impacting crucial functions such as memory, attention, and processing speed.

Frontal Lobe Atrophy

Studies, including one from Addiction, indicate a correlation between chronic cannabis use and reduced grey matter volume in the frontal lobe, an area essential for executive function, decision-making, and emotional regulation.

Early-Onset Dementia

Although the link between cannabis use and dementia requires more research, a report in Lancet Psychiatry emphasises the need to explore the potential connection, especially given the increasing number of young adults diagnosed with dementia.

Impaired Memory and Learning

THC, the psychoactive compound in cannabis, can disrupt the hippocampus, crucial for memory formation. Chronic use may lead to learning difficulties, memory recall issues, and focus problems.

Decreased Cognitive Function

Chronic cannabis use, particularly when started in adolescence, can impair cognitive abilities such as processing speed, decision-making, and problem-solving.

Increased Risk of Psychosis

Heavy cannabis use may heighten the risk of psychosis, characterised by hallucinations and delusions, especially in individuals with a genetic predisposition.

Impaired Brain Development

The adolescent brain is still developing, and chronic cannabis use during this period may interfere with this process, potentially causing long-term cognitive and emotional consequences

Magnitude of Problem to Society, the National Health Service (NHS), and those Affected

The increasing prevalence of cannabis use poses a significant public health concern, with profound implications for society and the National Health Service (NHS). As the number of individuals experiencing cannabis-related neurocognitive disorders rises, the demand for specialised neurological and psychiatric services will escalate, exacerbating the existing strain on healthcare resources.[4] The economic burden associated with managing these conditions, including long-term care and support, underscores the need for preventive strategies and effective interventions.

Moreover, managing cases of early onset dementia due to chronic cannabis use imposes a substantial burden on the NHS. These patients often require extensive multidisciplinary care, involving general practitioners, neurologists, psychiatrists, and possibly other relevant specialists.[15] The need for comprehensive care plans, including medical treatment, cognitive rehabilitation, and social support, highlights the strain on an already overburdened healthcare system including secondary care and critical care units.[4] This burden is compounded by the limited availability of specialised services for younger patients with dementia, necessitating innovative care models and resource allocation strategies.

Furthermore, frontal lobe atrophy leads to significant impairments in cognitive functions such as planning, problem-solving, and impulse control.[16] Additionally, it can affect proprioception, which is the sense of body position and movement, further compromising balance and coordination.[17] To add to that, a study on regular cannabis users revealed

that habitual cannabis consumption is associated with reduced grey matter volume in regions rich in cannabinoid CB1 receptors, which are crucial for motivational and emotional processing.[11] The structural changes observed in the study directly correlated with the frequency of cannabis use and was heavily influenced by the age at which consumption began.[11] These impairments have profound implications for the patient's daily functioning and quality of life, necessitating targeted therapeutic interventions and supportive care strategies.[17] This can result in patients losing their independence and decreased quality of life. This may mean that patients will be relying on family, or carers. This is important to mention considering the strain on social care services in the UK. According to recent findings, the UK's social care system is facing serious challenges, which could exacerbate the care needs of these patients.[18] Understanding these issues is crucial for developing effective care strategies and addressing the complex needs of affected individuals.

Incidence of Cannabis Use, with comparison between Medical Cannabis Users and Recreational Cannabis Users

Cannabis use has become increasingly common, with significant variations in usage patterns between countries. In the UK, cannabis remains the most widely used illicit drug, with approximately 7.4% of adults aged 16 to 59 reporting use in the past year.[19] Comparatively, countries that have legalised cannabis, such as Canada and certain U.S. states, report higher usage rates but also greater awareness and regulatory frameworks to mitigate adverse health effects.[20] The impact of legislation on public health remains a topic of ongoing research, with evidence suggesting both potential benefits and risks.[20]

Consequently, it is crucial to differentiate between medical and recreational cannabis users when considering health outcomes. Medical cannabis users typically consume cannabis under medical supervision to manage specific health conditions, such as chronic pain or epilepsy.[19] It is important to mention that studies have found that medical cannabis users often engage in higher frequency and quantity of use, with most being daily users, this as a result puts medical cannabis users at higher risk of neurocognitive impairments.[21] Previous research that did not differentiate between medical and recreational cannabis use has indicated that daily cannabis consumption is linked to various risky behaviours and adverse outcomes.[22] This is an important finding to consider when looking at the increase in incidence of marijuana use disorders, which is by definition frequent and persistent use of cannabis.[23] Between 2001-2002 and 2012-2013, the frequency of cannabis uses in the United States more than doubled, accompanied by a substantial rise in marijuana use disorders during this period. Although not all cannabis users encounter issues, nearly three out of every ten users showed signs of a marijuana use disorder by 2012-2013.[24] Lastly, it is important to mention that a recent study found that medical cannabis users often present with diagnosed medical conditions and are typically older, with a higher likelihood of chronic health issues.[19] In contrast, recreational cannabis users generally tend to be younger and less likely to have significant underlying health conditions.[19] Understanding these distinctions can inform tailored interventions and public health policies aimed at minimising harm while maximising therapeutic benefits.

Iceberg Effect and Management

The reported case likely represents just the visible tip of a much larger issue. Many cases of cannabis-related neurological disorders may go undiagnosed or be misattributed to other causes, creating an "iceberg effect." This is especially true for frontotemporal dementia (FTD), as it can resemble various psychiatric conditions due to its significant behavioural symptoms.[12] This resemblance contributes to the iceberg effect, where many cases may go undiagnosed or misdiagnosed, resulting in underreporting and insufficient treatment. This highlights the need for increased diagnostic vigilance, improved reporting systems, and comprehensive epidemiological studies to fully understand the scope and impact of cannabis-related neurocognitive disorders. Furthermore, there are currently no specific guidelines for how to manage such presentations. Therefore, current treatments are based on controlling symptoms and reducing their severity. Studies have shown that antidepressants and second-generation antipsychotics may help these patients.[25]

Conclusion

Chronic cannabis use presents significant neurological risks, including frontal lobe atrophy and potential early onset frontotemporal dementia.[5] The NHS urgently requires tailored guidelines for the diagnosis and management of cannabis-related neurocognitive disorders to optimise patient outcomes and alleviate strain on healthcare resources. These guidelines should emphasise early detection through enhanced diagnostic protocols and the implementation of comprehensive care plans that address both medical and social needs. Moreover, as global attitudes toward cannabis evolve, policymakers must consider the neurological implications highlighted by such cases when shaping legislation on marijuana legalisation and medical use. Clear regulatory frameworks and public health strategies are essential to balance potential therapeutic benefits with the prevention of adverse neurological outcomes associated with chronic cannabis use. Understanding and addressing these challenges are crucial steps toward safeguarding public health in communities where cannabis use is prevalent.

Learning Points

- Chronic cannabis use may lead to frontal lobe atrophy, causing significant cognitive and behavioural impairments. Clinicians should monitor long-term cannabis users closely for signs of neurocognitive decline.
- Frontal lobe atrophy can impair executive functions, decision-making, and motor control, severely impacting quality of life and often requiring extensive care, potentially straining secondary and critical care setting.
- The increase in cannabis-related neurocognitive disorders strains healthcare systems, particularly the NHS. Early recognition and intervention are crucial to manage these patients effectively and reduce long-term healthcare burdens.
- Medical cannabis users, typically older with more chronic

health issues, differ from younger, healthier recreational users. Tailored interventions and public health strategies are necessary to minimise adverse effects and maximise therapeutic benefits.

- Cannabis-related neurological disorders may be underdiagnosed or misattributed, emphasising the need for improved diagnostic vigilance, reporting systems, and comprehensive studies to understand their full impact.

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