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Using volumetric brain analysis to differentiate a patient with 117 multiple personalities from schizophrenia: a case report and literature review

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Introduction

DID is defined in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) as a "disruption of identity characterized by the presence of two or more distinct personality states." This involves discontinuity in sense of self and agency as well as variations in "affect, behavior, consciousness, memory, perception, cognition, or sensory-motor functioning."[1] The DSM-5 estimates the 12-month prevalence of DID as 1.5% of the American adult population.[1] In other studies of DID, the prevalence is estimated to be between 1% and 3%, with higher rates among patients with other comorbid psychiatric conditions.[2] In the inpatient setting, the prevalence of DID has been estimated to be as high as 7.5%.[3] The severity of DID in terms of distinct identity varies from two reported identities to 23 reported distinct identities,[4] however the average number of reported distinct identities stated is 13.[1] DID has been associated with or may co-occur with other psychiatric conditions. Many studies have shown an association between DID and history of childhood trauma or maltreatment between ages 4-8.[5] About 80-100% of patients diagnosed with DID have a comorbid diagnosis of post-traumatic stress disorder (PTSD) or a lifetime history of PTSD.[6]

DID is not only a challenging diagnosis to arrive at, but also difficult to distinguish from other psychiatric disorders with similar symptomatology. DID is often defined as possession of two or more discrete and distinct alters or what is sometimes referred to as ego states. Ego states usually manifest unconsciously when a subject is faced with adverse environmental and social triggers.[7] Alters are interpreted as separate states of being, that have been reported to express an individual's set of ideas, values, memories, personality, gender, age, and even facial expressions that is entirely separate from their original, unique persona. In some instances, an aura has been reported to supersede an alter being pulled from the unconscious to the subconscious.[7] The memories that many of the alters elicit are often entirely different from what the original persona has experienced, so much so that it cannot yet be explained by dementia or any other medical condition.[8]

DID and other psychiatric disorders such as schizophrenia have some diagnostic features in common that can often make it challenging to differentiate these comparable conditions. Schizophrenia and DID may both exhibit auditory hallucinations, negative symptoms, some degree of cortical atrophy, and are both often associated with comorbid substance abuse. In current literature, however, clinicians have found some differentiating ideas and evidence that suggest a number of key differences between these disorders. Of note is the finding that the auditory hallucination manifested in up to 80% of patients with DID often manifest at an early age, are experienced as internal in origin, and rarely responds to antipsychotic medication.[8] Conversely, patients with schizophrenia experience hallucinations as environmental, third person, external, or internal in origin and this is usually associated with negative symptoms such as flat affect, catatonia, associability, and anhedonia. Schizophrenia has also shown better response profiles to antipsychotic medication compared to DID.[9] Some patients diagnosed with schizophrenia have also reported higher delusion scores than DID. It is important to note that one of the major diagnostic differences between these disorders is the presence of amnesia or significant disparities in time. Some theories have suggested that DID patients engage in an autohypnotic phenomenon, as a defense mechanism, and have endured significant childhood trauma that is hypothesized to potentiate the onset of the disorder.[8] In contrast, childhood trauma does not seem to be directly related to the onset of schizophrenia and other psychiatric conditions. There is evidence that up to 90% of patients with DID also meet the diagnostic criteria for PTSD. This comorbidity is important to note when examining brain imaging. In addition, other conditions such as borderline personality disorder, bipolar disorder, anxiety disorders, dysfunctional early childhood attachment styles, and childhood neglect have all been implicated or associated with DID in literature.[10] Risk factors for DID include but are not limited to chronic childhood trauma, young age (onset from 28-34 years old), suicidal ideation with previous attempts, monozygotic twins, promiscuity, gender dysphoria, substance abuse, comorbid psychiatric conditions, and depersonalization.[8,10]

Many psychiatric disorders are associated with significant changes in brain morphology at gross and molecular levels. The aim of our study is to explore the possibility of using volumetric analysis of specific brain regions to support the diagnosis of DID and to potentially help differentiate DID from schizophrenia. One of the primary ways this has been done in the past was to focus on brain imaging, specifically,

CT and MRI scans. Reinders et al. conducted a study using whole brain correlation analysis in a subset of patients with DID observed significant reduction in the cortical volume in areas such as the insula, anterior cingulate and parietal regions of the brain. Other findings include reduction in temporal and orbitofrontal region surface area, as well as reduced volume in the amygdala and hippocampus.[10,11] An interesting abnormality that has been reported in DID patients is a significant reduction in cerebral blood flow in the orbitofrontal areas of the brain but an increase in the superior frontal and occipital areas of the brain.[12] In contrast, common brain abnormalities that have been reported in schizophrenia include decreased gray matter thickness, reduced volumes in the cingulate gyrus, and dilation of the ventricles bilaterally.[13,14] A reduction in the volume of the hippocampus, amygdala, and medial temporal regions of the brain have also been reported in patients with borderline personality disorder.[15] Evidence also suggests decreased volume of the cerebrum and amygdala, but a markedly increased volume of the putamen in adolescent patients diagnosed with bipolar disorder.[16] Among the various psychiatric conditions, PTSD has been mostly associated with DID. Some significant brain abnormalities that have been reported in PTSD include asymmetrical reduction in hippocampal size and decreased gray matter volumes.[17] It is also important to note that patients with DID and comorbid PTSD have shown the most significant brain atrophy and abnormal brain imaging than either PTSD or DID alone.[10]

In pursuit of the possibility of using brain image findings to further differentiate DID from schizophrenia, we present an uncommon case of a patient with DID who presented with 117 separate personalities. As we found her diagnosis a challenge to differentiate from schizophrenia, we explored the perspective of potential differences in brain imaging. A volumetric analysis of diverse brain regions on brain imaging was performed. We also reviewed literature focusing on volumetric analysis of brain areas as they relate to DID and schizophrenia. The implications of our findings and the potential for supporting the diagnosis of DID is discussed.

Case presentation

We present the case of a 24-year-old single, Hispanic woman, with reported prior psychiatric diagnoses of depressive disorder, psychotic spectrum illness, anxiety disorder, past psychiatric hospitalizations, and comorbid history of cannabis and stimulant use disorder. She presented to the psychiatric emergency room after contacting emergency medical services due to the inability to control her aggressive behavior. She related feeling an 'overwhelming force' control her body which made her act aggressively towards her mother. During initial assessment in the emergency room, she expressed thoughts of stabbing her mother with a knife. She was observed constantly talking to herself and she referred to her legal name as a third person. Collateral information from her mother confirmed reports of aggressive behavior directed towards her mother. She was also noted to have identified herself by a different name "Constantine," which according to the mother was not her legal name. Her behavior was considered to be disorganized and unpredictable, which rapidly and repeatedly changed from being calm and cooperative with interview and assessment to moments of agitation and disinterest with the interview process.

Initial laboratory works up in the emergency room revealed a normal complete metabolic panel, complete blood count, and endocrine function. Qualitative urine toxicology screen was negative for cannabis, stimulants and other illicit substances. The emergency room physician considered the patient to be having an acute psychotic episode, likely due to schizophrenia. It was determined that she posed potential risk of danger to her mother due to self-report of homicidal ideation towards her mother. She was then admitted to the inpatient service for psychiatric stabilization and treatment. Collateral information from her mother at the time detailed that she had indeed been diagnosed with Schizophrenia with little or no response to antipsychotics for 2 weeks preceding her presentation in our emergency room. Her mother requested a review of her provisional diagnosis during her admission.

On the day of admission, she reported becoming "Phoenix"who was an angry personality with aggressive tendencies. "Phoenix" was the identity that had homicidal ideations towards her mother. She reported that when her other personality, "Constantine," emerged, she contacted emergency medical services to seek treatment. It was presumed that she was expressing delusional thoughts due to an acute psychotic process. The initial treatment plan targeted her presumed psychotic symptoms. As the patient had reported previous trial and preference for long acting injectable antipsychotic medications, she was restarted on the same. Paliperidone 234 mg intramuscular (IM) and Paliperidone 156 mg IM injection were given with consent from the patient after a trial on the oral Risperidone 4 mg in two divided doses to assess tolerability. Medications, however, had no significant effect on her as she continued to talk to herself in the third person and identify as a different name after her second week of stay. In addition, the reassessments done to explore improvement revealed that "Constantine" and "Phoenix" were not the only identities controlling and causing her to act aggressively. She reported she had different other selves who sometimes took over her body and talked back to her. Over the course of her inpatient stay, she confirmed a total of 117 personalities, which included 78 females and 39 males. The list of personalities as written by the patient is shown in Figures 1 & Figures 2.

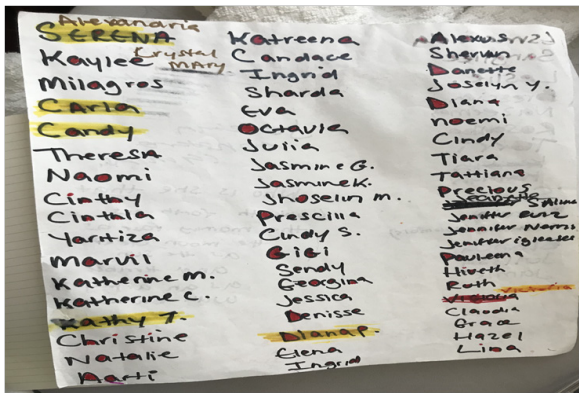

Figure 1 Patient's handwritten list of female alters.

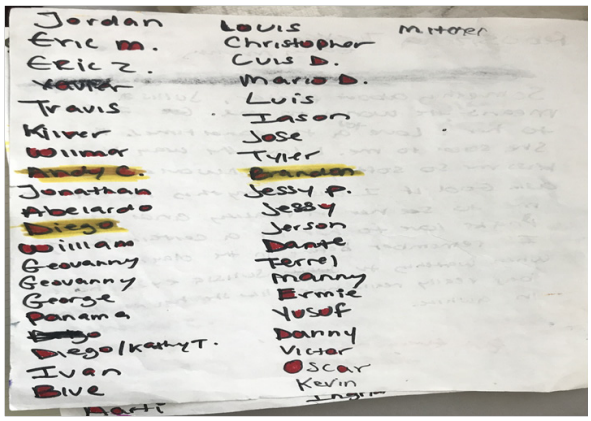

Figure 2 Patient's handwritten list of male alters.

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Out of the 117 personalities, nine alters were dominant and present more frequently than the others: "Shirley," "Chino," "Constantine," "Phoenix," "Alexandria," "Leiann," "Jullisa," and "Mary" (who is also known as "Crystal"). Some of the names shared had overlapping similarities such as "Katherine M," "Katherine C," "Eric M," and "Eric Z." Moreover, some names were variations of male and female counterparts such as "Constantine" and "Constance," respectively. The patient indicated that even with the similarities, she experienced the personalities as having different emotions and proclivities. There were also noticeable variations in ethnicity, gender, and sexual orientation of the alternative identities. For instance, "Diego," who was also known as "Kathy T" was transgender. "Aarti" and "Yusuf" were also personalities that had cultural differences from the patient's primary identity. The patient was able to describe a network of interactions between the personalities. For example, "Constantine" always came to the patient's rescue when "Shirley" was bothering her or when "Phoenix" was compelling the patient to act aggressively. On one occasion, "Constantine" had an altercation with "Shirley" which involved writing an aggressive letter to "Shirley," signed by the name "Constantine." According to the patient, the onset of her experience of separate identities was four years ago.

As the diagnosis of the patient had expanded to include the potential of DID, the patient was interviewed using a Structured Clinical Interview for DSM-5 (SCID-5) Clinician version by the American Psychiatric Association.[18] Her diagnosis of schizophrenia was modified to Other Specified Schizophrenia Disorders as she did not meet the explicit criteria of schizophrenia by time duration. Her symptoms usually lasted less than one month in the acute phase with or without treatment. In addition, at no point during these episodes did she experience more than one symptom that could be considered psychosis, including her belief of her having another identity. Other diagnoses explored were bipolar disorder, borderline personality disorder, PTSD, delusional disorder, major depressive disorder which were all ruled out. She did meet the criteria for DID using the SCID-5 Clinical Version. PTSD was excluded. Her diagnosis was revised from schizophrenia to DID with differentials being other Specified Schizophrenia Disorder. A Dissociative Experience Scale (DES) administered revealed a score of 62. Scores over 30 at the DES suggests a high likelihood of having a dissociative identity disorder.[19]

A CT scan of the brain was done to explore supportive and non-supportive findings for schizophrenia, or other findings that could further reduce the likelihood of schizophrenia such as the presence of enlarged ventricles. The volumetric dimensions of various brain regions in the patient were measured and noted in Table 1 as well as the normal ranges for these areas. The patient demonstrated decreased volume in the cerebral cortex, particularly in the superior, inferior, middle, and inferior temporal gyri as compared to the normal range. The hippocampus, amygdala, basal ganglia, cerebellum, thalamus, corpus callosum, and striatum were also decreased in dimensions as compared to the normal range. The ventricles size was not noted to be enlarged.

Table 1 Comparing patient's volumetric measurement and normal ranges

Brain region	DID	Normal ranges
Cerebral cortex	Superior Frontal Gyrus: 14989mm^3 (decreased Left)	Superior Frontal Gyrus: 15300mm^3 (Left)
	Inferior Frontal Gyrus: 14802mm^3 (decreased Left)	Inferior Frontal Gyrus: 17266mm^3 (decreased Left)
	Middle Frontal Gyrus: 28909mm^3	Middle Frontal Gyrus: 28920mm^3
	Inferior Temporal Gyrus (decreased Left) 15980mm^3	Inferior Temporal Gyrus 16680mm^3
	(Total) 1076800mm^3	(Total) 1077300mm^3 (SD 97.4)[7]
Hippocampus	10033mm^3	10675mm^3 (SD 88.15)[8]
Amygdala	2899mm^3	3987 (SD 36.23)[8]
Basal ganglia	Caudate nucleus 5970mm^3	Caudate nucleus 5826mm^3
	Nucleus accumbens 352mm^3	Nucleus accumbens 350mm^3
	Globus pallidus 1899mm^3	Globus pallidus 1625mm^3
	Putamen 6100mm^3	Putamen 5622mm^3
	(Total) 200100mm^3	(Total) 19930mm^3 (SD 2061)[9]
Cerebellum	134511mm^3	134563mm^3[10]
Ventricle size	20090mm	20110mm^3 (SD 9940)[11]
Thalamus	15418	15436mm^3[12]
Corpus Callosum	3080mm^3	3094.88mm^3(SD 436.07)[13]
Striatum	456	469(mm^2) [14]

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Table 2 Comparing common volumetric brain differences in patients with DID, schizophrenia and normal ranges

Brain region	DID	Schizophrenia	Normal ranges
Cerebral cortex	The volume of gray matter in the left superior frontal gyrus in DID patients was smaller compared to HC. Smaller gray matter in the left inferior frontal gyrus, and left frontal pole[24]	There was a significant effect on grey matter volume of the middle and inferior, but not the superior frontal gyrus. The group effect for middle frontal gyrus volume was because of a reduced volume in the schizophrenia group[25]	
		Patients with schizophrenia evince reduced gray matter volume in the left middle temporal gyrus and bilateral reductions in the inferior temporal gyrus.[25]	
	DID patients, white matter CV was smaller in the left inferior temporal gyrus (anterior division) and the right temporal pole region[24]	1140900mm^3 (SD 116.9)[26]	1077300mm^3 (SD 97.4)[26]
Hippocampus	Bilateral hippocampal volumes in DID participants compared to HC were observed to be significantly smaller[27]	Hippocampal volumes in Schizophrenia participants compared to HC were observed to be significantly smaller[25,28]	10675mm^3 (SD 88.15)[29]
	1867.58mm^3 (SD 305.54)[5]	10211 (SD 228.20)[29]	
Amygdala	Findings include both normal size and smaller size amygdala[25]	Smaller size amygdala[24]	
	1455.97mm^3 (SD 331.42)[5]		3987 (SD 36.23)[30]
		3862 (SD 93.66)[29]	
Basal ganglia	Significantly larger volume of the total caudate gray matter and left caudate gray matter[27]	Significantly larger volume of the total caudate gray matter and left caudate gray matter[25]	
	No significant differences in the nucleus accumbens were observed[27]	Smaller volume in the nucleus accumbens were observed[25]	
	A significantly larger volume of the right pallidum in DID-PTSD patients, however, DID-PTSD patients demonstrated larger bilateral putamen and right pallidum compared to PTSD-only patients	A smaller in the pallidum and putamen bilaterally[25]	19930mm^3 (SD 2061)[25]
		19972mm^3 (SD 2284)[25]	
Ventricle size	None reported in literature	Reduction in schizophrenia[14]	20110mm (SD 9940)[14]
		29710mm^3 (SD 17590)[14]	

Her treatment plan was modified to include reality testing sessions of her multiple separate self-identities, identifying triggers for the emergence of her beliefs of having separate identities, and developing coping mechanisms that prevent aggressive acts during her episodes of believing she was one of the more aggressive personalities. The sessions were done daily for four hours over a period of ten days. Over the course of her treatment, the patient showed significant improvement and eventually began to identify by her legal given name. As the patient discussed her different personalities, she was able to identify triggers to identity alterations and create behavioral plans to avoid the triggers. Although she still admitted occasional beliefs of being controlled by her personalities, she was able to express better control of the triggers. She was discharged back to the community, with identification by her legal name. She did not require psychotropic medications as she responded to therapy alone.

Discussion

This case presents a patient with 117 distinct personalities. Her initial diagnosis of schizophrenia is not uncommon in DID patients. Factors leading to initial misdiagnosis of DID as schizophrenia have been discussed in literature.[20] Collateral information as well as further clinical observation and therapeutic engagement lead to a more comprehensive assessment of her dissociative identities. A SCID-5 was used to support a diagnosis of DID with the patient not meeting criteria for schizophrenia. Her presentation is considered unusually severe, given the number of personalities exceeds 100. In the literature, the average number of personalities reported is 13 with 50 being the maximum documented.[4] Few reported cases of patients presenting with over 150 alters have been reported.[21] Her case is thus unique and may provide some insight into current models of DID and how to differentiate it from other psychiatric conditions.

Identifying and distinguishing DID from other psychiatric conditions such as schizophrenia or dissociative schizophrenia can be a challenge. The symptomatology of DID patients commonly overlaps with those seen in patients with schizophrenia. It is not uncommon for schizophrenic patients to score high on dissociative scales. A significant association was found between dissociative symptoms and schizophrenia in a study of dissociative symptoms in schizophrenic

patients conducted by Ghoreishi & Shajari.[22] The patient in this case was interviewed using SCID-5 and the diagnosis of DID was confirmed through psychiatric evaluation and medical management. Ghoreishi et al.[22] reported a statistical significant association between dissociative symptoms and schizophrenia. The study found that the prevalence of dissociative symptoms in schizophrenic patients, on the basis of DES test criteria, was significantly higher than the control group. This association is of grave importance as dissociative symptoms may present similar to psychotic symptoms in many instances. The findings were further supported by a study by Spitzer et al. which confirmed significant accompaniment of schizophrenia with dissociative symptoms.[23]

As challenges remain in differentiating schizophrenia and DID, we conducted a literature review on findings in schizophrenia and DID with the goal of determining the possible differences in imaging that can help with diagnosis. We aimed to identify peer-reviewed articles related to the same. We searched PubMed for articles on the imaging findings in schizophrenia, dissociative identity disorders and normal subjects. The search was conducted using the keywords and MeSH terms: "brain imaging schizophrenia," "brain imaging dissociative identity disorders," "brain imaging healthy controls." We also searched the reference list of eligible articles to identify additional articles relevant to this study. Endnote was used for citation management and de-duplication of references. Screening for eligible articles was conducted independently by five authors. Eligible studies were those that focused on the image findings in patients with schizophrenia, or DID. Given the paucity of articles on this topic, all types of studies were considered for analysis including experimental, cohort, case-control, case series, and case reports. While there were multiple articles reported on the same study population, only the most recent publications were included in our final review. Any disagreement regarding the eligibility of an article was resolved by discussion among the authors. Relevant data from eligible articles were extracted and entered into a data abstraction form. Table 2 outlines the similarities and differences that can be found in brain scans of both schizophrenic and DID patients from the systematic review.

In summary, there are differences in regional volumetric measurements on the CT scan of patients with schizophrenia and patients with DID that can supplement differentiating between diagnoses. DID patients have a decreased volume of gray matter in both the left and right superior frontal gyrus of the cerebral cortex as well as the left inferior frontal gyrus and left frontal pole. In contrast, schizophrenic patients did not show any volumetric changes in the superior frontal gyrus but showed reduced volume in the middle frontal gyrus, left middle temporal gyrus and bilateral inferior temporal gyrus of the cerebral cortex. Both DID and schizophrenic patients had decreased hippocampal and amygdalar volumes. DID and schizophrenic patients both have larger volumes of total caudate grey matter and left caudate grey matter. Another factor, however, that can be used to differentiate between patients with DID from schizophrenia is the volume of their nucleus accumbens and right pallidum. Patients with schizophrenia have a smaller volume in nucleus accumbens when compared with DID patients, who have no change in volume. Patients with schizophrenia have smaller pallidum and putamen bilaterally when compared with DID-PTSD patients who were found to have a larger volume of the right palladium.

It is possible to understand from cognitive studies, why the brain regions identified in our patient and other patients in literature may be pathological in DID. For instance, Goldberg et al. found an association found between superior frontal gyrus and self-awareness which is often lost in patients with DID.[31] They compared activity elicited by the introspection task with that elicited during the slow categorization task during the visual scan. They consistently found that regions selectively activated by the introspection task were found within the superior frontal gyrus extending medially to the anterior cingulate region and caudally to the paracingulate region. Lateralization of the pathology in the prefrontal cortex to the left hemisphere was significant upon observation. In the study by Goldberg et al., most prominent activations were found in both medial and lateral aspects of the prefrontal cortex with clear lateralization to the left hemisphere.[31] Another study, one conducted by Tacikowski et al.[32] was consistent with our findings of pathology in the left inferior temporal gyrus. This study examined the unconscious self-specific processes found in association with the anterior part of the left inferior temporal sulcus.[32]

While additional studies may be needed to further analyze and understand differentiating features between DID and schizophrenia using volumetric brain analysis, the case above and literature review may provide pointers to increase the index of suspicion for dissociative identity disorder using brain image findings. Possible areas to look for including the superior frontal gyrus, left inferior frontal gyrus volume loss in the absence of ventricular enlargement as increasing the likelihood of DID. Obvious limitations are the need to characterize the sensitivity and specificity of these findings, which is not readily determined based on the paucity of literature and the single case presented above.

Conclusion

The diagnosis of Dissociative Identity Disorder (DID) remains a challenge. In many cases, it is difficult to differentiate DID from schizophrenia. Volumetric analysis of brain imaging may provide additional supportive evidence for the diagnosis of DID with possible findings of interest being volume loss of the left superior frontal gyrus, volume loss of the left inferior frontal gyrus and the absence of ventricular enlargement. Further studies are needed to understand the significance of these findings.

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Conflicts of interest

The authors have no conflicts of interest to declare.

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