

**CASE REPORT****PSYCHIATRY & BEHAVIORAL SCIENCE**

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## Sexual Behavioral Disinhibition Associated with Nucleus Lentiformis Lesion: A Forensic Neuroscience Perspective Through a Case\*

**ABSTRACT:** Organic brain disturbances particularly related to frontal cortex structures and subcortical areas including the basal ganglia may play a role in behavioral disinhibition disorders. Kluver–Bucy syndrome (KBS), which is one of the better knowns of these syndromes, includes hyperorality, visual agnosia, and hypersexuality, has been reported to occur after temporal lobe and amygdala lesions; however, several patients who had focal lesions in areas other than the temporal cortex and amygdala have been reported to present partial KBS symptoms. Nucleus lentiformis refers to a large portion of the basal ganglia including the putamen and globus pallidus, and specific structures within this broad area are known to be important for reward and value-based decision making. To date, KBS symptoms including hypersexual behavior associated with nucleus lentiformis lesions have never been reported. Here, we present a 38-year-old male patient who developed increased sexual interest and hyperorality after infarctions in the right lenticular nucleus and right occipitotemporal region and committed a first-degree sexual assault. He was sent to our institution for the assessment of criminal responsibility to the index sexual crime. According to a comprehensive and thorough forensic psychiatric evaluation, he was diagnosed as having an organic personality disorder with partial KBS symptoms. To the best of our knowledge, this is the first reported case of deviant sexual behavior and hyperorality developing after nucleus lentiformis infarction. We aimed to discuss possible neurobiologic explanations of late-onset deviant sexual behavior, which resulted in sexual criminal behavior following a cerebrovascular infarction.

**KEYWORDS:** cerebrovascular infarction, criminal responsibility, forensic psychiatry, Kluver–Bucy syndrome, sexual offense, neurobiology, nucleus lentiformis, sexual deviant behavior

Organic mental disturbances, which represent a demonstrable etiology in cerebral disease, brain injury or another insult leading to cerebral dysfunction that causes changes in personality or behavior, have drawn the attention of both experts and researchers in a forensic psychiatric context. Many cases of organic brain disturbances involving alterations in personality or behavior are associated with physical, cognitive, emotional, and behavioral impairment (1). Frontal and prefrontal lesions are associated with cognitive deficits including impaired executive functions, which are well-known factors that may tend to criminal behavior through difficulties concerning critical judgment and to a lack of inhibitions and tact in social settings (2). Besides dysfunctions related to frontal cortex structures, lesions in subcortical areas including the basal ganglia, which are primarily involved in

movement regulation, have also been associated with cognitive, affective, and behavioral disturbances (3). Impulsivity and behavioral disinhibition, which are the cardinal psychological elements in the understanding of criminal behavior (4), are associated with frontal-subcortical loop dysfunctions (5).

Hypersexuality is a deviant behavior concerning professionals in forensic settings who deal with sexual offenses (6) and has been suggested to have common neural correlates with behavioral disinhibition and increased impulsivity (7). Kluver–Bucy syndrome (KBS), which is one of the well-known behavioral disinhibition disorders, includes hyperorality, visual agnosia, and hypersexuality, has been reported to occur after temporal lobe and amygdala damage, in particular (6). Indeed, several patients who had focal lesions in areas other than the temporal cortex and amygdala have been reported to present partial KBS symptoms (8,9). Nevertheless, to the best of our knowledge, no individuals presenting KBS symptoms including hypersexuality and lesions in the nucleus lentiformis have been reported. Here, we present a patient with confirmed ischemic lesions in the right lenticular nucleus and right occipitotemporal region, who presented several KBS symptoms including hypersexuality and was alleged to have committed a sexual assault and was evaluated for the criminal responsibility.

### Case Report

Mr. D. was a 38-year-old single man who was sent to the Council of Forensic Medicine for an assessment of criminal

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\*All procedures followed were in accordance with the ethical standards stated in the Helsinki Declaration of 1975 in its most recently amended version. Informed consent was obtained from the patient. Institutional board permission and approval from the Council of Forensic Medicine has been obtained.

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responsibility for a sexual assault. The patient was detained in the institution for psychiatric evaluation for a week. According to his file review, he had an acute cerebrovascular infarction involving the right lenticular nucleus and right occipitotemporal region four years ago. At that time, his cranial magnetic resonance imaging (MRI) demonstrated ischemic changes in the aforementioned regions. His main findings on admission were left hemiplegia, mild facial asymmetry, and aphasia. His consciousness was normal, cooperation and orientation were intact, and other motor movements were normal. He was admitted to the neurology inpatient unit and antiaggregant treatment was started. After discharge, he was referred to a rehabilitation institution for a physiotherapy program.

Ten months after the cerebrovascular incident, his family reported personality and behavioral changes in the patient and he was admitted to an outpatient psychiatric unit. His parents stated that he progressively became irritable, easy to get angry and he started to curse frequently, and his social interactions decreased because of his impulsive and socially maladaptive behaviors. They did not report any sexually inappropriate behavior. On that date, the psychiatric examination was as following: orientation and cooperation were intact, affective indifference with inappropriate laughing, social disinhibition, and inappropriate oral movements including licking, biting, sucking, and chewing objects. He occasionally brought his hand to his mouth. No psychotic symptoms were noted. His insight was limited. He described an increase in sexual interest; frequent sexual thoughts, fantasies, and masturbation which is not accompanied by frequent sexual intercourse or inappropriate sexual behavior. He was diagnosed as having an organic personality disorder and KBS. Olanzapine 10 mg/day was started to treat his behavioral disinhibition. He was invited for bimonthly regular follow-ups to the psychiatry outpatient unit.

The criminal incident that was subjected to a judicial investigation occurred approximately one month after the first admission to psychiatry. Mr. D. took a young woman, who he met at the rehabilitation center three months ago, to a place far from the settlement center and forced her to have sexual intercourse. The woman, Miss. M, was a 20-year-old woman who was attending a vocational rehabilitation program with a diagnosis of mild intellectual disability at the same institution. The woman and her family pressed charges against Mr. D. and a judicial investigation was launched after the event. Miss M. stated that she had a fondness for Mr. D.; however, when they arrived at the isolated rural area, Mr. D. used his physical advantage over her and forced her to have sexual intercourse including vaginal penetration without consent. The public prosecutor brought a public lawsuit to the criminal court claiming that Mr. D. committed a first-degree sexual assault to a mentally incapacitated and physically helpless woman. At the first trial, Mr. D. stated that he and Miss. M had a romantic relationship and that he was sexually solicited by her at the time of incident. The defense attorney pleaded that his client had an organic mental disturbance that rendered him unable to know the nature and quality of the act he was performing and substantially impaired behavior controls. The attorney also presented Mr. D.'s medical records to the court, which opted to send him for a psychiatric evaluation to assess criminal responsibility for the offense, according to the Turkish Penal Code, Article 32.

Within the observation period in our detention unit, according to daily interviews and psychiatric examinations, observation reports of the medical staff, laboratory screening, brain imaging, social service reports, psychometric assessments, and the

evaluation of medical and forensic records, the following findings were recorded: Mr. D. was a 38-year-old man who was primary school-graduated, living with his parents, and unemployed. Except for the index offense, he had no a previous criminal record. Consciousness, cooperation, and orientation were intact. Neither delusion nor hallucination existed. Sleep and appetite were normal. He currently had no increased sexual interest and no inappropriate sexual behavior was observed. Inappropriate oral movements such as chewing and licking and mild left facial paralysis were recorded. In the forensic interview, when the incident was asked, he stated that he was aware of the wrongfulness of the alleged sexual assault but he could not help himself or resist his sexual drives for a while, and he confirmed that he had been planning to do this for last two or three days. At the unit, he easily adjusted to the environment, obeyed the rules of the unit, and got along well with other service users and medical staff. He did not manifest agitated or aggressive behavior. Current cranial MRI revealed chronic infarction zones in the right lenticular nucleus and right occipitotemporal region (Fig. 1). Projective and personality psychometric test results revealed no significant psychopathological features except difficulties in impulse control. Intelligence function was normal according to the examination and the Wechsler Adult Intelligence Scale in which he scored 92 (10). We excluded malingering through psychiatric examination and the Structured Inventory of Malingered Symptomatology (SIMS), which was scored as 9 (11). He had been previously admitted to psychiatric outpatient units several times with diagnoses of organic personality disorder and KBS; however, he had been nonadherent to prescribed treatments. No alcohol or substance use was reported. He had been observed unmedicated during the detention. We diagnosed him as having an organic personality disorder with partial symptoms of KBS. After a comprehensive and thorough evaluation, the forensic psychiatry board decided that despite timing between the cerebrovascular infarction and the behavioral change accounts for that the defendant undoubtedly suffered from a kind of organic personality changes to a great extent, it is insufficient to consider such causality in a compelling cause/effect argument, because it was understood that the defendant appreciated the nature and quality of the act he was doing and he was fully aware of what was morally and legally wrong. The index offense, which was understood to be previously planned and motivated by a sexual interest was rather considered as a result of acquired antisocial traits. Therefore, the board concluded that the defendant might have enough ability to control or direct his actions in respect of such behavior which should not be considered as a manifestation of an impulse control disorder. Thus, full criminal responsibility at the time of the offense for the first-degree sexual assault was reported to the court. The requested assessment report of criminal responsibility was presented to the court and he was discharged from the unit. Regular psychiatry and neurology follow-ups were recommended. The trial of the index assault is currently pending.

#### *Turkish Penal Code, Article 32*

The Turkish Penal Code (TPC, Law No. 5237) was enacted in 2004 and has been in force since 2005. The law was prepared in congruence with the major principles of the criminal laws of mainland European countries (12). Article 32 defines the basic principles and applications for the insanity defense and related criminal responsibility of the defendant. The evaluation of criminal responsibility is required to be performed by a health board comprising competent psychiatrists. According to the first paragraph (TPC, Article 32/1), a sentence shall not be imposed on a

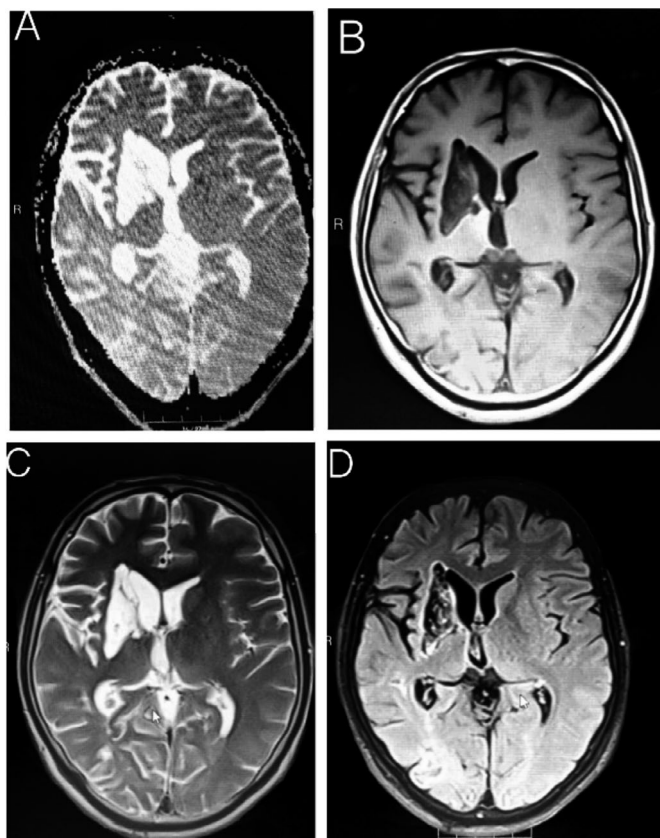


FIG. 1—Representative cranial magnetic resonance axial images of the lesion involving the right lenticular nucleus and right occipitotemporal region of the patient. (A) Diffusion-weighted. (B) T1-weighted. (C) T2-weighted. (D) Fluid-attenuated inversion recovery sequence.

defendant who, due to mental disorder, cannot comprehend the legal meaning and consequences of the act he has committed, or if, in respect of such an act, his ability to control his behavior was significantly diminished. However, security measures shall be imposed for such persons. This paragraph roughly covers the crimes that the defendant committed under the influence of severe mental disorders including psychotic disorders, severe intellectual disability, dementia, and delirium. The second paragraph of Article 32 proposes that, even if not to such an extent stated in the first paragraph, a defendant lacking the ability to control or direct his actions in respect of an offense committed by him is subject to a diminished sentence. The sentence to be imposed may be enforced partially or completely as a security measure specific to mentally disordered persons, provided the length of the sentence remains the same. This paragraph may come into force when a defendant commits a crime under the influence of mental disorders that substantially impair behavioral control, such as impulse control disorders. Nevertheless, case-based forensic psychiatric examinations and specific evaluations of causal relations between criminal behavior and mental state should be performed to assess the applicability of both paragraphs of Article 32 (13).

## Discussion

Our case is an important example of sexually deviant behavior that occurred after previous cerebrovascular infarction involving the right lenticular nucleus and right occipitotemporal

region in an individual who had no past criminal history and committed a first-degree sexual assault. Below, we discuss possible neural substrates that may be associated with sexual deviant behavior.

Findings from basal ganglia lesion studies have demonstrated that observed alterations in behavior correspond with established nonmotor circuits between frontal and subcortical structures, which are intimately involved in cognitive and emotional processes (14). Such processes are also functions of reward-related cortico-subcortical circuits. Dopaminergic neurons in basal ganglia, particularly in the striatum, have been recognized to be involved in reward-dependent learning and behavioral control (15). Impaired reward-related functions are associated with interrupted decision making, behavioral disinhibition, and impulsivity (16). Hypersexuality, which may be regarded as a manifestation of disinhibited behavior, could be related to the neurostructural deficits that led to impulsivity and behavioral disinhibition. For instance, medial basal frontal or diencephalic lesions of the brain and limbic structure lesions are associated with sexual disinhibition and other behavioral control disorders (17,18). As in our patient, previous papers have reported patients with lesions in temporal regions and basal ganglia structures such as the amygdala and caudate nucleus who presented disinhibited sexual interest and hypersexuality (6). Subcortical regions including the hypothalamus, and other basal ganglia mediate neuroendocrine and autonomic aspects of sexual drive and cortical regions including the frontal and temporal lobes implicated in the motor components of sexual behavior, the control of sexual response, drive, and functions (19,20). One of the major thalamo-cortico-subcortical circuits is the so-called limbic circuit, and strokes involving basal ganglia components of this circuit including thalamus, amygdala, and lenticular nucleus have been postulated to be associated with *de novo* hypersexual behavior (21). Furthermore, hypersexual behavior is also common in other neurological diseases affecting basal ganglia, including Huntington disease and in Parkinson's disease patients taking dopamine agonists (22,23).

One of the prototypes of disinhibition syndromes is KBS, which is characterized by altered sexual behaviors including an increase in the frequency and variety of sexual activity (24). Behavioral disinhibition and hypersexuality in KBS are associated with amygdala lesions, and animal studies have shown that temporal and other cortical region resections contributed to increased sexual interest, exaggerated sexual behavioral activity, disinhibited behavior, and hyperorality (6,25). In light of such findings, in our case, lesions of the occipitotemporal region could explain the involvement of the temporal region in regulating sexual behavior and oral movements. The patient's hypersexuality manifested approximately ten months after the cerebrovascular infarct. Congruent with our patient, studies conducted in human subjects with temporal lobectomy have shown that hypersexuality after temporal lobectomy might occur in both sexes, often with a latency averaging 1-6 months or more, and lasts from several months to more than 5 years (26-28).

The nucleus lentiformis plays the role of a pacemaker for the mesolimbic and cortical regions, which are mainly responsible for motoric coordination. On the other hand, researchers are attracted to the question as to the extent to which the nucleus lentiformis has a mediating or moderating function in emotional, cognitive, and behavioral regulation (29). Nucleus lentiformis represents a large portion of the basal ganglia including the putamen and globus pallidus and specific structures within this broad area are known to be important for reward and value-based

decision making, including the ventral striatum/nucleus accumbens and ventral pallidum (3,5). Neuropsychiatric manifestations of nucleus lentiformis lesions have a major need to be studied; very few patients with nucleus lentiformis stroke have been reported to present with neuropsychiatric symptoms, including psychosis (30,31). Despite Mokhber et al. (2018) have recently reported a 60-year-old male patient with an old cerebrovascular infarction involving lenticular nucleus who committed a sexual assault, they associated the assault due to an epileptic seizure related to previous stroke (32). With this regard, our case is important because it is the first patient with nucleus lentiformis infarction who presented personality and behavioral changes with partial KBS symptoms including hypersexuality and without any previous epileptic seizure and who committed a sexual assault, as far as we know.

Despite individual differences that have been reported, cortical and subcortical structures in the right hemisphere have been thought to be involved in sexual functions. According to brain imaging studies, volume alterations in basal ganglia and orbitofrontal structures are associated with hypersexuality (33). In addition, functional neuroimaging studies showed that impaired functional connectivity and reduced blood flow in the brain regions accommodating cortico-subcortical circuits, which are involved in emotional and cognitive functions, have been associated with heightened sexual drives and inappropriate sexual behaviors (34,35). Unilateral lesions, usually involving the temporal lobes, may lead to hypersexuality or hyposexuality (36), and increased libido is more common after right than left hemisphere strokes (28). Other studies showed that hyposexuality was seen more often in left hemisphere lesions, whereas hypersexuality was more frequent with right hemisphere lesions (37). Our patient's lesions in the temporal lobe were right-sided, which is supported by the aforementioned studies that linked hypersexuality with right hemisphere lesions.

To conclude, the particular importance of this case report is that the emergence of late-onset deviant sexual behavior, which resulted in criminal behavior following a cerebrovascular infarction. Our patient manifested partial KBS symptoms after the infarction and we discussed possible a neurobiologic explanation of late-onset deviant sexual behavior following a cerebrovascular incident including the right lenticular nucleus and right occipitotemporal region. To the best of our knowledge, this is the first reported case of deviant sexual behavior and hyperorality developing after nucleus lentiformis infarction. Research into the neurobiologic underpinnings of criminal behavior is an attractive field of forensic neuroscience. Lesion-induced symptoms that may lead to criminal behavior can come not only from the lesion location itself but also are related to brain circuitries that functionally connect localized lesions to different parts of a common brain network associated with value- and reward-based decision making (38,39). In fact, we are as yet far away from a full understanding of the neural substrates of all types of criminal behavior. Although we could not postulate an exact mechanism associating specific brain lesions and sexual criminal behavior, our case report will inspire further studies with an interest in the role of basal ganglia in reward mechanisms and related behavioral disinhibition leading to deviant sexual behavior. In our opinion, the more knowledge regarding neural correlates of criminal behavior accumulates, the more accurate and detailed forensic psychiatric evaluations will be performed to serve the criminal justice system as expert witnesses.

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