Intern. J. Neuroscience, 114:1581–1590, 2004

ISSN: 0020-7454 / 1543-5245 online
DOI: 10.1080/00207450490509339

Taylor & Francis
healthsciences

Clinical Case Report

HYPERSEXUALITY AND DYSEXECUTIVE SYNDROME AFTER A THALAMIC INFARCT

MARCELLO SPINELLA

Division of Social and Behavioral Sciences
Richard Stockton College of New Jersey
Pomona, New Jersey, USA

Hypersexuality can result from insults to several neuroanatomical structures that regulate sexual behavior. A case is presented of an adult male with a thalamic infarct resulting in a paramedian thalamic syndrome, consisting of hypersomnolence, confabulatory anterograde amnesia (including reduplicative paramnesia), vertical gaze deficits, and hypophonic speech. A dysexecutive syndrome also manifested, consisting of social disinhibition, apathy, witzelsucht, motor inhibition deficits, and environmental dependence. Hypersexuality uncharacteristic of his premorbid behavior was evident in instances of exhibitionism, public masturbation, and verbal sexual obscenities. In contrast to the few previous reports of hypersexuality following thalamic infarct, this case neither involved mania nor hemichorea. The relevance of the mediodorsal thalamic nucleus in limbic and prefrontal circuits is discussed.

Keywords dysexecutive, dysinhibition, hypersexuality, mediodorsal

Alterations in personality and behavior can occur after neurological insults of various etiologies. Lesions involving prefrontal circuits and the limbic system have particularly been noted in this respect. Prefrontal cortex is involved in executive processes of self-regulation, allowing for behavior that is more goal-oriented, autonomous,

Received 12 February 2004.
Address correspondence to Marcello Spinella, PhD, Division of Social and Behavioral Sciences, Richard Stockton College of New Jersey, PO Box 195, Pomona, NJ 08240-0195, USA. E-mail: rnarcello.spinel1a@stockton.edu

and flexible (Stuss & Knight, 2002). Prefrontal cortex forms part of a cortical-subcortical circuit, involving the striatum and the anterior and mediodorsal thalamic nuclei (Masterman & Cummings, 1997).

The prefrontal-subcortical circuit involving orbitofrontal cortex involves the striatum (including the ventral striatum and core of the nucleus accumbens), ventral pallidum, and mediodorsal thalamus (Haber et al., 1995; Ongur & Price, 2000). Lesions of the orbitofrontal circuit produce a behavioral syndrome of impulsivity, mood instability, a lack of empathy, behavioral disinhibition, poor judgment, and social inappropriateness (Malloy et al., 1993; Bechara et al., 1994). Previously uncharacteristic sexual inappropriateness may also ensue after a brain injury involving the orbitofrontal circuit (Starkstein & Robinson, 1997; Malloy et al., 1993). For example, Miller and colleagues (1986) have reported cases of people with orbitofrontal lesions manifesting inappropriate sexual advances and public masturbation. Hypersexuality has been reported in several cases of frontotemporal dementia, one of which noted the onset of homosexual pedophilia (Tang-Wai et al., 2002; Dell & Halford, 2002; Mendez et al., 2000).

Discrete lesions of the subcortical components of prefrontal circuits can produce similar behaviors. Lesions of the nucleus accumbens have been also associated with increased impulsivity in rats (Cardinal et al., 2001). Hypersexuality was reported in an adult with bilateral pallidal lesions due to carbon monoxide poisoning (Starkstein et al., 1989).

Hypersexuality was also reported in an elderly male patient with a lacunar infarct of the subthalamic nucleus, creating hypometabolism in the basal forebrain, temporal lobes, medial prefrontal cortex, and striatum (Absher et al., 2000). Acute mania, chorea, and hypersexuality developed in a male after right thalamic infarction (Inzelberg et al., 2001). Insidious neurological illness has led to criminal convictions for sex offenses. Ortega and colleagues (1993) reported the case of a female who manifested exhibitionism, incest, scopophilia, and zoophilia. She was arrested multiple times and died in jail, after which autopsy revealed severe demyelination in the thalamus, mesencephalon, and frontal lobes.

The case is presented here of a patient with a thalamic infarct and resulting disinhibited and hypersexual changes in behavior.

METHODS

Patient History

G.A. is a right-handed, Caucasian male who was 66 years of age when he suffered a cerebral infarct. He acutely developed diaphoresis, headache, nausea, and vomiting, and subsequently loss consciousness. Intubation was performed at the hospital emergency room, and CT showed massive intraventricular bleeding with blood present in all ventricles. A cerebral angiogram found an aneurysm or arteriovenous malformation, and a right frontal ventriculostomy was performed to alleviate intracranial pressure. CT performed 14 days postonset showed blood in the posterior left lateral ventricle. Medical history is otherwise significant for coronary artery bypass graft and diabetes mellitus with neuropathy and nephropathy. At the time of his infarct, G.A. was married and had four children. He was a retired university professor and operated a business. Before his stroke, he had been independent in all activities of daily living and exercised regularly.

There were no intraoperative complications and no seizure activity was noted during or after the onset of symptoms. One day post-onset, the patient was noted to be awake, following simple commands, and making purposeful movements. Right hemiparesis was also apparent at this time. Six days post-onset, he was noted to make one-word responses to simple questions, and conversational ability was noted at 11 days post-onset. Upon admission to an acute rehabilitation unit, he was found to be oriented to person only, and exhibiting hypophonic speech and a right superior visual field cut. Deficits were noted in his immediate and recent memory, as well as verbal reasoning in the interpretation of proverbs.

G.A. was noted to be lethargic and would sleep most of the day if he was not actively engaged by staff. He would open his eyes and respond when addressed, but would frequently close his eyes in the course of conversation, and lapse into unconsciousness when left unattended. His speech was notably hypophonic, and although he would increase the volume transiently when asked, it would soon after revert back into a hypophonic volume. G.A.'s behavior was notably passive; he did not initiate any activities spontaneously. Although

oriented to person and aware that he had suffered a stroke, he was unable to state his age or the date, guessing the year to be eight years before the actual date. When confronted with this fact, he demonstrated blunted affect and made cryptic, confabulatory responses, stating "They faked me out. They let some years go by without me knowing. They're hanging onto the past themselves." He was unable to elaborate further on such statements. G.A. also mistakenly believed that his hospital roommate was present when he had the stroke. There was evidence of reduplicative paramnesia of one of his sons. He named each family member correctly in a photograph, but then stated that he had an additional son with an identical name to the one in the photograph.

G.A.'s behavior showed marked disinhibition that was atypical of his premorbid personality, according to family members. In the hospital he made inappropriate sexual and scatological remarks to several staff members. He also exposed himself on several occasions, and when he was confronted he replied, "It's okay. I want them to see me." G.A.'s wife noted pronounced changes in his behavior, which included use of obscenities and masturbation in the presence of others. He also manifested witzelsucht, making childish jokes frequently and at inappropriate times, such as staff–family meetings. G.A. also showed complete unawareness of his cognitive and behavioral changes since his stroke. Performance on formal neuropsychological testing revealed multiple instances of stimulus-bound responses and confabulatory intrusions.

Neuropsychological Testing

Formal testing revealed intact basic sensory and fine motor functions (see Table 1). However, difficulty was noted on a 3-step motor hand sequence (Luria's fist-palm-edge). Oculomotor evaluation revealed saccades and horizontal smooth pursuit to be intact, but a complete absence of vertical smooth pursuit. He was able to recite up to 8 digits forward and 7 backward, placing him in the superior range for working memory. Performance was slow on the Trail Making Test (both A and B), a measure of visuomotor ability and mental sequencing. He was unable to do the Stroop test, making a stimulus-bound response instead. The stimulus page of the Stroop

TABLE 1. Summary of neuropsychological test findings

Sensory and Motor Examination	
Visual and Tactile sensory function	WNL
Fine motor function	WNL
Motor Sequencing (fist-palm-edge)	Impaired
Occulomotor smooth pursuit	Horizontal–WNL Vertical–absent
Occulomotor saccades to target	WNL
Attention/Concentration	
Stroop Test	Unable to do
Trail Making Test A	Time: 68" 2nd %ile
Trail Making Test B	Time: 195", 1st %ile
Digit Span Forward	8 digits, 99th %ile
Digit Span Backward	7 digits, 99th %ile
Visual Perception/Construction	
Rey-Osterreith Complex Figure (Copy)	22.5, <1st %ile
Memory	
Logical Memory I	3, <1st %ile
Logical Memory II	9, <1st %ile
Logical Memory Recognition	1/7 (Impaired)
Rey-Osterreith Complex Figure	
Immediate recall	0, <1st %ile
Delayed recall	0, <1st %ile
Recognition	16, 1st %ile
Executive Functions	
Controlled Oral Word Associations	
CFL total	40, 58th %ile
CFL perseverations	8, <1st %ile
Animals	3, <1st %ile
Antisaccades	
Saccades	0 errors (WNL)
Antisaccades	2/20 errors (Borderline)
Go/No-Go	
Imitation	20/20 correct (WNL)
Conflict (tap opposite)	18/20 correct (WNL)
Go/No-Go (inhibition)	19/20 correct (WNL)
Go/No-Go + Conflict	0/20 correct (Impaired)

WNL = within normal limits.

test consists of columns of color names, and although he was asked to read down the columns as quickly as possible, he only looked at the page and commented, "There's a lot of repetition on this page, an awful lot of repetition," and handed it back to the examiner. A dense, confabulatory amnesia was noted on tests of visual (Rey Osterreith Complex Figure Test, ROCFT) and verbal memory (WMS-

III Logical Memory). Impairments were noted on both recall and recognition trials, suggesting a severe lack of consolidation. Visual perception and construction, assessed with the ROCFT copy trial, showed intact visual perception but a severe lack of organization. Letter fluency, assessed with Controlled Oral Word Associations (CFL) was in the normal range, but there were a significant number of perseverative responses placing him in the impaired range. However, categorical fluency (generating names of animals) was in the impaired range. Executive motor inhibition was assessed with go/no-go testing. Although he was able to inhibit responses, he had difficulty shifting from one response set to the next, often reverting to the previous set.

DISCUSSION

This case presents strong evidence of a thalamic infarct. The acute onset and immediate sequelae are indicative of a stroke, combined with the cerebral angiogram and presence of ventricular blood. The continued presence of blood in the left posterior lateral ventricle suggest proximity to the mediodorsal nucleus and pulvinar (see Figure 1), although right-sided thalamic involvement cannot completely be ruled out. Follow up MRI done during inpatient rehabilitation did not reveal an infarct, although contrasts were not used and further MRI was not deemed justifiable.

The cognitive, emotional, and behavioral sequelae to this stroke strongly corroborate a paramedian thalamic syndrome, which consists primarily of hypersomnolence, confabulatory amnesia, and vertical gaze deficits (Guberman & Stuss, 1983). The memory deficits present here are suggestive of involvement of the mammillo-thalamic tract, which appears to be necessary and sufficient for an amnestic syndrome (Van der Werf et al., 2000). Reduplicative paramnesia is more commonly associated with lesions of fronto-temporo-limbic structures, likely representing a diaschesis in this case (Moser et al., 1998). The hypophonic speech prominent in G.A. has also been reported in paramedian thalamic stroke (Yasuda et al., 1989; Ghika-Schmid & Bogousslavsky, 2000; Lazzarino et al., 1991). Vertical gaze abnormalities in paramedian thalamic infarcts are likely due to

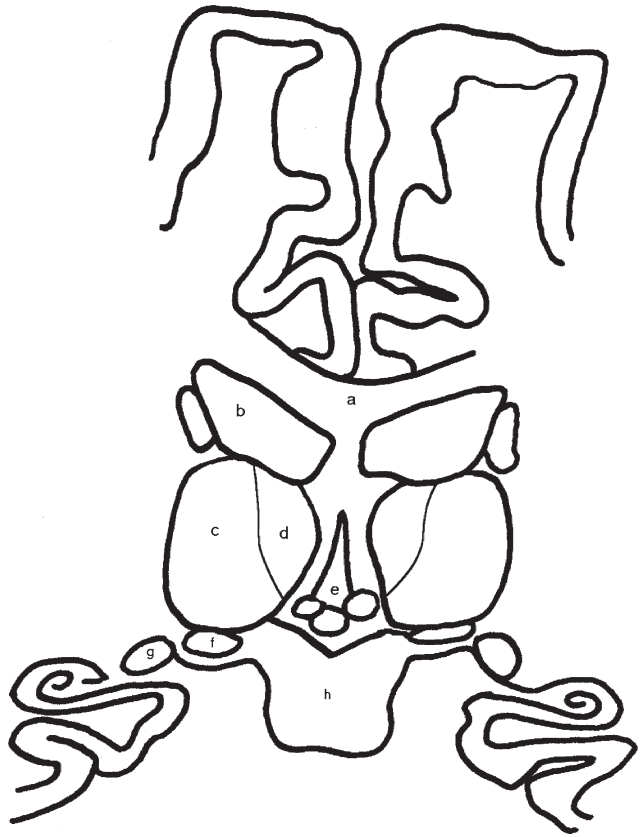

FIGURE 1. (a) Corpus callosum; (b) lateral ventricle; (c) pulvinar; (d) mediodorsal nucleus; (e) third ventricle; (f) medial geniculate nucleus; (g) lateral geniculate nucleus; (h) tectum. (Illustration by M. Spinella, 2004.)

involvement of the rostral interstitial nucleus of the medial longitudinal fasciculus (riMLF) (Clark & Albers, 1995).

Further, a dysexecutive syndrome was apparent in this case, involving personality changes (e.g., apathy, disinhibited/inappropriate behavior), perseverative responses, and deficits in organization, executive motor regulation, and sequencing. Combined amnestic and dysexecutive syndromes are typical of paramedian thalamic infarcts involving the mediodorsal nucleus (Stuss et al., 1988). Personality changes typical of frontal dysfunction have been reported in paramedian thalamic infarcts involving the left mediodorsal nucleus

(Fukutake et al., 2002; Fukatsu et al., 1997). Witzelsucht, noted in this case, is more commonly associated with orbitofrontal lesions or hypoperfusion (Vardi et al., 1994). G.A.'s ability to participate in activities with a complete lack of self-initiated behavior, combined with the highly stimulus-bound response made on the Stroop test, are suggestive of environmental dependence. This represents a milder degree of utilization behavior, which has also been described after paramedian thalamic infarction (Eslinger et al., 1991). Executive dysfunction and personality changes in these cases are explainable through participation of the mediodorsal nucleus in prefrontal-striatal-thalamic circuits. Indeed, thalamic infarcts have been shown to cause frontal hypoperfusion ipsilateral to the lesion (van der Werf et al., 1999; Chatterjee et al., 1997).

Only two other cases, to date, have reported hypersexuality in association with a thalamic lesion. Inzelberg and colleagues (2001) reported a case with a right thalamic infarct, with concurrent mania and hemichorea. Benke and colleagues (2002) reported a case of bilateral ischemic lesions of the mediodorsal nuclei, causing mania, dysexecutive symptoms, and hypersexuality, which was limited to inappropriate sexual verbalizations. A SPECT study in that case showed hypoperfusion bilaterally in dorsolateral prefrontal cortex and in right orbitofrontal cortex.

This case represents one of a very few reported cases of hypersexuality following thalamic infarct. It is one of a growing number of cases that demonstrate how neurological insults can contribute to or precipitate gross alterations in sexual behavior in individuals with no apparent premorbid problems. It is further illustrative of how lesions at multiple points along prefrontal-subcortical-thalamic and limbic circuits can produce hypersexuality.

REFERENCES

Absher, J. R., Vogt, B. A., Clark, D. G., Flowers, D. L., Gorman, D. G., Keyes, J. W., & Wood, F. B. (2000). Hypersexuality and hemiballism due to subthalamic infarction. *Neuropsychiatry Neuropsychology and Behavioral Neurology, 13,* 220–229.

Bechara, A., Damasio, A. R., Damasio, H., & Anderson, S. W. (1994). Insensitivity to future consequences following damage to human prefrontal cortex. *Cognition, 50,* 7–15.

Benke, T., Kurzthaler, I., Schmidauer, C., Moncayo, R., & Donnemiller, E. (2002). Mania caused by a diencephalic lesion. *Neuropsychologia, 40,* 245–252.

Cardinal, R. N., Pennicott, D. R., Sugathapala, C. L., Robbins, T. W., & Everitt, B. J.(2001). Impulsive choice induced in rats by lesions of the nucleus accumbens core. *Science, 292,* 2499–2501.

Chatterjee, A., Yapundich, R., Mennemeier, M., Mountz, J. M., Inampudi, C., Pan, J. W., & Mitchell, G. W. (1997). Thalamic thought disorder: On being "a bit addled." *Cortex, 33,* 419–440.

Clark, J. M., & Albers, G. W. (1995). Vertical gaze palsies from medial thalamic infarctions without midbrain involvement. *Stroke, 26,* 1467–1470.

Dell, D. L., & Halford, J. J. (2002). Dementia presenting as postpartum depression. *Obstetrics and Gynecology, 99,* 925–928.

Eslinger, P. J., Warner, G. C., Grattan, L. M., & Easton, J. D. (1991). "Frontal lobe" utilization behavior associated with paramedian thalamic infarction. *Neurology, 41,* 450–452.

Fukatsu, R., Fujii, T., Yamadori, A., Nagasawa, H., & Sakurai, Y. (1997). Persisting childish behavior after bilateral thalamic infarcts. *European Neurology, 37,* 230–235.

Fukutake, T., Akada, K., Ito, S., Okuda, T., & Ueki, Y. (2002). Severe personality changes after unilateral left paramedian thalamic infarct. *European Neurology, 47,* 156–160.

Ghika-Schmid, F., & Bogousslavsky, J. (2000). The acute behavioral syndrome of anterior thalamic infarction: A prospective study of 12 cases. *Annals of Neurology, 48,* 220–227.

Guberman, A., & Stuss, D. (1983). The syndrome of bilateral paramedian thalamic infarction. *Neurology, 33,* 540–546.

Haber, S. N., Kunishio, K., Mizobuchi, M., & Lynd-Balta, E. (1995). The orbital and medial prefrontal circuit through the primate basal ganglia. *Journal of Neuroscience, 15,* 4851–4867.

Inzelberg, R., Nisipeanu, P., Joel, D., Sarkantyus, M., & Carasso, R. L. (2001). Acute mania and hemichorea. *Clinical Neuropharmacology, 24,* 300–303.

Lazzarino, L. G., Nicolai, A., & Valassi, F. (1991). Aphonia due to paramedian thalamosubthalamic infarction. Remarks on two cases. *Italian Journal of the Neurological Sciences, 12,* 219–223.

Malloy, P., Bihrle, A., Duffy, J., & Cimino, C. (1993). The orbitomedial frontal syndrome. *Archives of Clinical Neuropsychology, 8,* 185–201.

Masterman, D. L., & Cummings, J. L. (1997). Frontal-subcortical circuits: The anatomic basis of executive, social and motivated behaviors. *Journal of Psychopharmacology (Oxford), 11,* 107–114

Mendez, M. F., Chow, T., Ringman, J., Twitchell, G., & Hinkin, C. H. (2000). Pedophilia and temporal lobe disturbances. *Journal of Neuropsychiatry and Clinical Neurosciences, 12,* 71–76.

Miller, B. L., Cummings, J. L., McIntyre, H., Ebers, G., & Grode, M. (1986). Hypersexuality or altered sexual preference following brain injury. *Journal of Neurology, Neurosurgery,* and Psychiatry, *49,* 867–873.

Moser, D. J., Cohen, R. A., Malloy, P. F., Stone, W. M., & Rogg, J. M. (1998). Reduplicative paramnesia: Longitudinal neurobehavioral and neuroimaging analysis. *Journal of Geriatric Psychiatry and Neurology, 11,* 174–180.

Ongur, D., & Price, J. L. (2000). The organization of networks within the orbital and medial prefrontal cortex of rats, monkeys and humans. *Cerebral Cortex, 10,* 206–219.

Ortega, N., Miller, N. L., Itabashi, H., & Cummings, J. L. (1993). Altered sexual behavior with multiple sclerosis: A case report. *Journal of Neuropsychiatry, Neuropsychology, and Behavioral Neurology, 6,* 260–264.

Pisani, A., Marra, C., & Silveri, M. C. (2000). Anatomical and psychological mechanism of reduplicative misidentification syndromes. *Neurological Sciences, 21,* 324–328.

Starkstein, S. E., Berthier, M. L, & Leiguarda, R. (1989). Psychic akinesia following bilateral pallidal lesions. *International Journal of Psychiatry in Medicine, 19,* 155–164.

Starkstein, S. E., & Robinson, R. G. (1997). Mechanism of disinhibition after brain lesions. *Journal of Nervous and Mental Disease, 185,* 108–114.

Stuss, D. T., Guberman, A., Nelson, R., & Larochelle, S. (1988). The neuropsychology of paramedian thalamic infarction. *Brain and Cognition, 8,* 348–378.

Stuss, D. T., Knight, R. T. eds. (2002). *The frontal lobes.* New York: Oxford University Press.

Tang-Wai, D., Lewis, P., Boeve, B., Hutton, M., Golde, T., Baker, M., Hardy, J., Michels, V., Ivnik, R., Jack, C., & Petersen, R. (2002). Familial frontotemporal dementia associated with a novel presenilin-1 mutation. *Dementia and Geriatric Cognitive Disorders, 14,* 13–21.

Van Der Werf, Y. D., Weerts, J. G., Jolles, J., Witter, M. P., Lindeboom, J., & Seheltens, P. (1999). Neuropsychological correlates of a right unilateral lacunar thalamic infarction. *Journal of Neurology, Neurosurgery, and Psychiatry, 66,* 36–42.

Van der Werf, Y. D., Witter, M. P., Uylings, H. B., & Jolles, J. (2000). Neuropsychology of infarctions in the thalamus: A review. *Neuropsychologia, 38,* 613–27.

Vardi, J., Finkelstein, Y., Zlotogorski, Z., & Hod, I. (1994). L'homme qui rit: Inappropriate laughter and release phenomena of the frontal subdominant lobe. *Behavioral Medicine, 20,* 44–46.

Yasuda, Y., Akiguchi, I., Ino, M., Nabatabe, H., & Kameyama, M. (1989). [Paramedian thalamic and midbrain infarcts associated with palilalia]. *Rinsho Shinkeigaku, 29,* 186–190.