

# Hypersexuality or altered sexual preference following brain injury

BRUCE L MILLER,\* JEFFREY L CUMMINGS,† HUGH McINTYRE,\*  
GEORGE EBERS,‡ MARSHALL GRODE§

*From the Department of Neurology, Harbor-UCLA Medical Center,\* Los Angeles, CA, Departments of Neurology, UCLA Medical Center and Brentwood VA Medical Center,† Los Angeles CA, Department of Neurology, University of Western Ontario, London, Ontario, Canada,‡ Department of Neurosurgery, Cedars-Sinai Medical Center, Los Angeles, CA,§ USA*

**SUMMARY** Eight patients are described in whom either hypersexuality (four cases) or change in sexual preference (four cases) occurred following brain injury. In this series disinhibition of sexual activity and hypersexuality followed medial basal-frontal or diencephalic injury. This contrasted with the patients demonstrating altered sexual preference whose injuries involved limbic system structures. In some patients altered sexual behaviour may be the presenting or dominant feature of brain injury.

Hypersexual behaviour and alteration in sexual preference has been produced by experimental brain injury in animals<sup>1</sup> but appear to be unusual consequences of focal brain injuries in humans.<sup>2-4</sup> When such alterations occur, they offer meaningful insights into the anatomy and physiology underlying normal sexual behaviour and provide important evidence regarding the neurological basis of aberrant sexual behaviour. This study describes eight patients in whom sexual activity was either increased or changed following a focal brain injury. The relevant literature is briefly reviewed and clinico-pathologic correlations made.

## Case histories

### *Hypersexuality*

**Case 1** A 39-year-old right-handed businessman was admitted to the hospital following sudden collapse. Two weeks prior to admission he had the acute onset of a frontal headache associated with nuchal rigidity. The evening of his hospital admission he walked to the bathroom in his home and fell to the floor. Seconds later his wife found him repetitively saying his own name. He was brought to hospital awake and alert but his verbal output was sparse. In the hospital, he publicly masturbated and attempted to have intercourse with his wife and with female nurses in front of

his three roommates. Mental status examination on admission revealed a withdrawn and apathetic male. He answered many questions with curses but had normal digit span, constructions and language. He did not know the date and remembered none of three words after 3 minutes. Funduscopic examination revealed papilloedema and both legs were weak and spastic with bilateral Babinski signs.

A computed tomographic scan (CT) showed a basal-frontal haemorrhage and angiography revealed an aneurysm of the anterior communicating artery. He became extremely drowsy within 24 hours and slowly slipped into coma. Despite aggressive medical and surgical management he died 2 weeks after admission to hospital. Necropsy showed haemorrhage in the basal frontal areas bilaterally with involvement of the septal region.

**Case 2** A 59-year-old right-handed man was admitted to a psychiatric hospital in a floridly hypersexual state. Two years previously he had a grand mal seizure and at that time CT scan revealed a subfrontal meningioma. The tumour was removed transcallosally without complication. After surgery his desire for sexual activity increased from once per week to at least once and sometimes 3 to 4 times per day. Intercourse frequently lasted longer than 1 hour and he had some difficulty achieving orgasm. Over the next 9 months his excessive sexual demands led to the end of a close relationship with a girlfriend of many years.

Two years after his surgery he became increasingly preoccupied with sex and developed a manic syndrome. He was admitted to hospital where he publicly masturbated and sexually propositioned both male and female patients and staff (he had a past history of previous homosexual contacts). In hospital his behaviour was ameliorated with thiothixene and benztropine. Mental status examination revealed decreased generation of word lists (eight animals named in 1 minute) and mild difficulty with verbal memory (one of three words remembered after 3 minutes). The basic neurological exam-

Address for reprint requests: Dr Bruce L Miller, Department of Neurology, Harbor-UCLA Medical Center, 1000 W Carson Street, Torrance, California 90509, USA.

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ination was normal except for absence of olfaction. CT scan (fig 1) revealed bilateral basal medial frontal lucencies consistent with old infarctions. He was discharged after one month and was lost to follow-up.

**Case 3** At age 30 years a previously healthy right-handed man contracted a viral encephalitis. After recovery he developed complex partial seizures with occasional secondary generalisation. He had a variety of seizure auras, often hearing the sound of sweet, unrecognisable music. Multiple electroencephalograms (EEG) showed frequent right and rare left temporal sharp waves. After his recovery from encephalitis he became profoundly hyposexual. His wife complained that he never approached her sexually, and their frequency of intercourse dropped from 2 to 3 times per week to 1 or 2 times per year. In the postictal period, however, the patient became sexually aroused. His wife became aware of his postictal behavioural change and sought sexual relations with him during these periods. The arousal lasted less than 10 minutes and the patient was amnesic for the encounters. Following one prolonged complex partial seizure the patient felt intense sexual arousal lasting 12 hours.

**Case 4** A 31-year-old woman developed a severe headache and was admitted to hospital where a CT scan revealed blood in the basilar cisterns and angiography showed a right superior cerebellar artery aneurysm. The aneurysm was surgically clipped but 5 days after operation she had a stroke leaving a left-sided motor and sensory deficit, and a behavioural change.

Previously a shy person, she began to talk incessantly about sexual matters and propositioned her physicians. She developed a sexual preoccupation with her internist and discussed openly in explicit sexual language with him, and others, her desires for him. She propositioned only males, and on one occasion she requested intercourse with a cachectic 70-year-old patient dying of cancer. While in hospital, she described intense sexual excitement, and in retrospect she remembers feeling "warm" and "aroused" almost the entire month. In addition to the sexual excitement, she

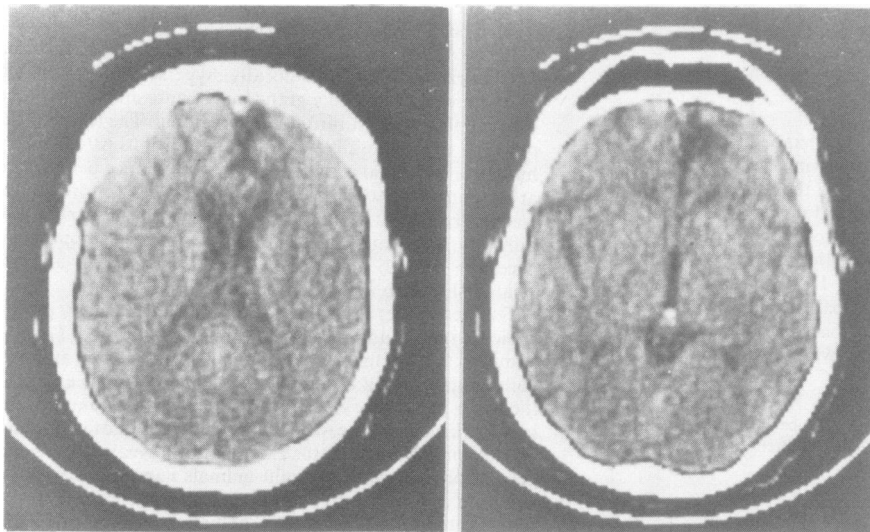
had increased appetite, disturbed sleep, and a verbal output that approached flight of ideas.

Mental status examination revealed normal attention with intact language, memory, and calculation. Her writing was very small and she had difficulty copying 3-dimensional drawings. She had a left homonymous hemianopsia, a mild left hemiparesis, and a dense left hemisensory deficit including diminished sensitivity to pain and temperature. CT scan (fig 2) demonstrated a lucency in the right thalamic and hypothalamic regions. She gradually recovered and the heightened sexual sensation disappeared after 1 month.

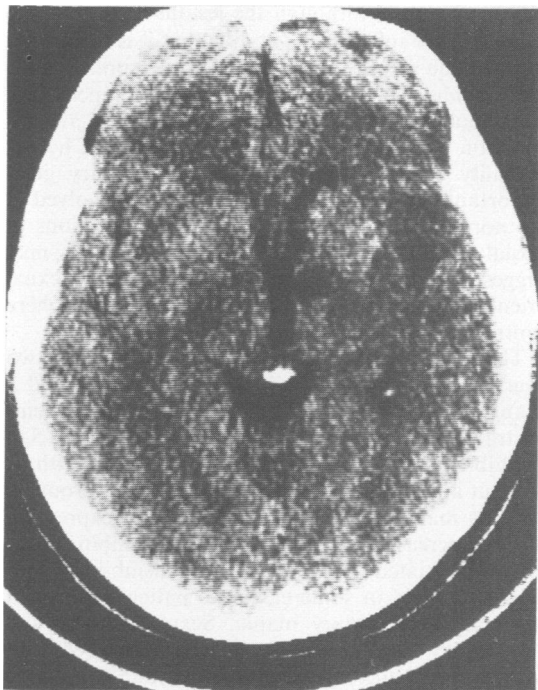
#### *Change in sexual orientation*

**Case 5** A 50-year-old man was hospitalised in 1981 by his wife in an effort to control his pathological sexual behaviour. They had been married for 30 years. For the first 15 years of the marriage they had a mutually satisfying relationship with sexual intercourse approximately 5 times per week. At the age of 34 the patient developed subtle changes in personality and displayed poor financial judgement. During the same year he lost his business, developed increasing difficulty with erection and ejaculation, began to make sexual proposals toward his 7-year-old daughter and her friends, and also began collecting pornography. After losing his business in 1968, he worked for approximately 7 more years at a job far below the level of his previous employment. He eventually developed urinary incontinence and in 1975 a diagnosis of "idiopathic" hydrocephalus was made. A ventriculo-atrial shunt was inserted, and the incontinence disappeared. At the same time it was noted that he was hypothyroid and he was treated for this condition.

He maintained an aberrant interest in sexual matters. He made frequent and increasingly more public sexual advances towards young children and his conversation was filled with sexual innuendo. He frequently embarrassed his wife by showing pornographic pictures to visitors at their home. IQ testing in 1977 revealed a verbal IQ of 105 and a performance IQ of 106. Endocrine testing suggested hypo-



**Fig 1** CT scan (Case 2) demonstrates bilateral basal-frontal infarction in a patient with a hypersexual syndrome following removal of a subfrontal meningioma.



**Fig 2** CT scan (Case 4) demonstrates a right thalamic infarction with possible hypothalamic involvement in a patient with a secondary mania and a hypersexual state.



**Fig 3** Pathology from Case 5 demonstrates an infiltrating hypothalamic glioma in a patient with a change in sexual preference from heterosexuality to pedophilia.

thalamic dysfunction and a repeat CT scan was normal.

By 1979 he discussed sex almost continuously. He was arrested for propositioning children in his neighbourhood. He also developed a Weber's syndrome (left third nerve palsy and a right hemiparesis). CT scan demonstrated a neoplasm involving the left brainstem from the pons to the midbrain. Soon afterwards he developed Benedikt's syndrome (left third nerve palsy, right hemiparesis and hemiataxia). Although the hypothalamus was not visibly involved on CT, the patient's endocrine testing suggested hypothalamic dysfunction.

The patient gradually deteriorated and died in 1984. Necropsy revealed a brainstem glioma involving the thalamus, hypothalamus, ventral midbrain and pons with greater involvement on the left side (fig 3). Histological studies demonstrated a hypercellular grade 3 astrocytoma.

**Case 6** A 75-year-old man developed herpes zoster ophthalmicus followed by encephalitis that quickly lead to coma. He improved slowly over 3 weeks but required nursing home care due to disinhibited behaviour and poor judgement. Two years later a CT scan showed hydrocephalus and a ventriculo-peritoneal shunt was inserted, but he deteriorated necessitating hospitalisation.

Prior to the encephalitis the patient and his wife had weekly sexual relations. In earlier years he had rarely suggested that they participate in "group sex" but had not insisted when she declined, and their relationship had been otherwise considered normal and satisfactory to his wife. An

increase in sexually motivated activity was apparent after he regained consciousness from his encephalitis. He made sexual comments toward females he encountered in the hospital and attempted to fondle the nurses. He masturbated publicly. After discovery of the hydrocephalus and shunt placement, his sexual behaviour became "disgusting" according to his wife. He became "the man with a thousand hands" attempting to fondle her each time she came within reach. He requested intercourse with her frequently and also asked that she have sex with other men while he watched, an interest never previously expressed.

On examination he was alert and language, memory and calculation were intact. He could name only six animals in 1 minute and he could not abstractly interpret proverbs or copy complex constructions. Neurological examination was normal except for mild psychomotor retardation. A CT scan revealed hydrocephalus with the tip of the shunt inserted into midline anterior hypothalamic-inferior septal structures. Cisternography was consistent with normal pressure hydrocephalus but the patient refused shunt revision.

**Case 7** A right-handed woman was well until age 31 years when she developed progressive lethargy, somnolence and confusion followed by a generalised seizure. She became comatose and had frequent generalised seizures. Cerebrospinal fluid (CSF) examination revealed lymphocytosis, normal glucose and an elevated CSF protein. Fungal and bacteriologic studies of serum and CSF were normal and an EEG showed generalised slowing with left-sided focal spike and slow wave activity. A presumptive diagnosis of herpes simplex encephalitis was made.

She gradually improved but manifested an aphasia with incoherent repetitive and irrelevant verbal output consisting mainly of neologistic jargon. Learning was severely impaired and she could not remember recent or remote events. She was emotionally indifferent. Sexual behaviour changed: she showed no interest in intercourse with her husband although she complied with his advances. She made both oral and manual sexual advances to female attendants in the hospital.

She gained 50 pounds and ate food and nonfood items, including toilet paper and faeces. There was little improvement or change in her behaviour over 13 years.

**Case 8** A 71-year-old man developed Parkinson's disease at age 61 manifested initially by micrographia. Slowness, rigidity, and tremor were apparent within 2 years. He worked as a clerk until age 66 when disability led to retirement. On levodopa-carbidopa his extrapyramidal symptoms abated but he became preoccupied with intrusive sexual fantasies and ruminations concerning sexual topics. He began to insert objects into his penis and on one occasion a pencil had to be surgically removed. His medication was reduced and the aberrant sexual behaviour abated. He had no history of psychiatric disturbances or previous sexual dysfunction or paraphilic behaviour. He had been married for over 30 years and his wife also denied that he had ever shown an interest in atypical sexual practices.

Mental status was normal and general neurological examination demonstrated findings consistent with idiopathic Parkinson's disease. CT scan of the head was normal and EEG showed mild slowing. During a 6 year follow up period, the patient has had no recurrence of unusual sexual behaviour.

## Discussion

The normal human sexual response has multiple components including arousal, copulation and orgasm. The stimulus leading to sexual arousal varies from person to person and is determined by a combination of experiential, genetic, and neurological factors. The organisation of the human sexual response and the neural basis for sexual preference is an area of neurology that is poorly understood and much of our information comes from lesion studies in animals. Animal studies are not completely applicable to humans, however, and even non-human primates have sexual behaviours that differ markedly from those of men and women. Hyposexuality is common with in-

jury to the brain although the lesions seen with this condition are sufficiently variable that it is difficult to identify one specific area in the brain responsible for the diminished sexual interest.<sup>5</sup> Hypersexual behaviour<sup>2</sup> and change in sexual preference<sup>6</sup> are less common following brain injury and study of hypersexuality in humans after focal brain injury gives important clues about areas of the brain involved in the normal sexual response. Likewise alterations in sexual preference associated with brain lesions may suggest which areas of the brain influence sexual orientation in humans. The cases presented here contribute to this evolving and complex field.

The patients described in this paper fall into two overlapping categories. All the patients developed a change in sexual behaviour (table). Cases 1 to 4 demonstrated an increase in sexual activity and Cases 5 to 8 exhibited an alteration in sexual preference with or without a heightened sexual drive. The first group of patients manifested a disinhibited public expression of their increased drive. This sexual disinhibition was often associated with a general disinhibition of behaviour, and in some cases the patients exhibited elements of secondary mania. Sexual disinhibition and public exhibitionism have been described with dysfunction of the basal frontal lobe,<sup>6</sup> and two of our patients with the syndrome (patients 1 and 2) had CT scan evidence of injury in this region. In case 1 the injury was due to the rupture of an anterior communicating aneurysm, and in case 2 a subfrontal meningioma had been present. Exhibitionism has also been described in patients with Huntington's disease,<sup>7</sup> epilepsy, multiple sclerosis, and Gilles de la Tourette syndrome.<sup>8,9</sup> Between 5 and 35% of those arrested for exhibitionism are found to be suffering from organic disorders to which the behaviour can be at least partially attributed.<sup>10,11</sup>

Table

Case	Gender	Age (yr)	Sexual behaviour	Lesion site	Cause
1	Male	39	Public masturbation with sexual advances toward female nurses	Basal frontal	Anterior communicating aneurysm
2	Male	59	Increased sexual drive with manic behaviour	Basal frontal	Meningioma
3	Female	31	Verbal preoccupation with sex and "erotic" feeling lasting 1 month. "Secondary mania"	Right thalamic-hypothalamic	Infarction following subarachnoid haemorrhage
4	Male	30	Sexual arousal post seizures. Intercital hyposexuality	Right temporal	Post-encephalitic seizure disorder
5	Male	50	Pedophilia with impotence	Left midbrain-hypothalamic	Glioma
6	Male	75	Voyeurism and sexual disinhibition	Hydrocephalus	Post-encephalitic
7	Female	31	Change from hetero- to homosexual preference	Bitemporal	Post herpes encephalitis
8	Male	71	Penile mutilation	Basal ganglia	Parkinsonism. Levodopa precipitated behaviour

Patient 3 developed hyposexuality and post-ictal sexual arousal associated with temporal lobe seizures after recovering from limbic encephalitis. Hyposexuality in patients with temporal lobe seizures is well known<sup>12</sup> and ictal sexual auras have been described but have occurred almost exclusively in women.<sup>13</sup> Hypersexual behaviour has most commonly been associated with the abrupt cessation of seizures either in the post-ictal period or following temporal lobectomy.<sup>14</sup> It is possible that the sexual behaviour following the seizures was due to continued limbic electrical discharge, or that the increased sexual activity was due to post-ictal disinhibition of structures in the septum and/or hypothalamus (an equivalent of post-ictal paralysis).

Patient 4 had a profound verbal preoccupation with sexual matters and exhibited a manic syndrome. Secondary mania has been described following brain injury and is more common in patients, like case 4, with lesions in the thalamic and periventricular regions of the right hemisphere.<sup>15</sup> Increased sexual drive is common in patients with mania although this patient's sexual preoccupation was unusually extreme. She described after recovery that she had experienced an erotic-orgiastic sensation throughout the period of her increased interest in sex.

The second group of patients (Cases 5 to 8) developed a change from what was previously a stable and established pattern of sexual behaviour. Like the first group, most of the patients (Cases 5, 6, and 7) also developed disinhibited public expression of their altered sexual behaviour. No single common anatomical area was involved in this second group of patients but in all cases the lesions were in or near the limbic system. The patients in this group with the most dramatic change in sexual preference had lesions in the temporal lobe and/or midbrain adjacent to the hypothalamus, and those with most marked sexual disinhibition also had frontal lobe damage.

Patient 5 manifested impotence and pedophilia associated with an infiltrating glioma of the midbrain-hypothalamic region (fig 3). This patient had a profound change in sexual orientation from a heterosexual pattern to an almost single-minded preoccupation with children. Early in the course of his long illness he was secretive about his interest in children. After he developed hydrocephalus he became increasingly more disinhibited about his new sexual preference. Pedophilia has previously been reported in association with post-encephalitic Parkinsonism, suprasellar meningiomas, post-anoxic encephalopathy, and epilepsy.<sup>3,4,16</sup> Henn and co-workers<sup>17</sup> found that of 111 offenders arrested for child molestation 14.4% had acquired organic psychosyndromes and an additional 13.5% were mentally retarded. Together these observations suggest that brain injury

may lead to pedophilia, and conversely, careful assessment of pedophilic patients may lead to the discovery of associated neurological abnormalities.

In Cases 6 and 7, viral encephalitis leading to limbic area damage was the predisposing neurological factor. Patient 6 was sexually disinhibited and developed voyeurism, a new sexual interest for him. In addition to the encephalitis, this patient had a malpositioned shunt inserted into the septal region and obstructive hydrocephalus. No other patients with voyeurism associated with focal brain lesions were found in the literature, but Berlin<sup>18</sup> reported one voyeuristic patient with an elevated luteinising hormone (LH) level and a second with elevations of both LH and testosterone. These endocrine studies were not done in the cases reported here. Case 7 developed the Kluver-Bucy syndrome and changed from a heterosexual to a homosexual orientation following herpes encephalitis. Similar alterations in gender preference in association with the Kluver-Bucy syndrome have previously been reported,<sup>19-21</sup> and a few patients were reported to have become disinhibited and publicly demonstrative.

Patient 8 developed genital mutilation when initially started on levodopa-carbidopa. Altered sexual behaviour was common in post-encephalitic Parkinsonism<sup>3</sup> and approximately half of Parkinsonism patients receiving levodopa experience an activation of sexual behaviour.<sup>22-24</sup>

Investigations of experimental animals and previous observations of humans with altered sexual behaviour establish three phases of sexual response: arousal, copulation, and orgasm. Sexual arousal and object choice depend primarily on limbic system structures including hypothalamus and temporal lobe. The preoptic nucleus of the hypothalamus is sexually dimorphic and *in utero* hormonal manipulations can reverse the gender preference of male and female rats.<sup>25,26</sup> Electrical stimulation of the nucleus also leads to copulatory behaviour and ablation produced permanent loss of sexual activity. In humans, hypothalamic lesions reduce sexual drive<sup>27</sup> and may have contributed to the altered object choice of Case 5.

Temporal lobe structures also play an important role in sexual preference and activity. Lilly *et al*<sup>19</sup> observed that in the human Kluver-Bucy syndrome, the bilateral temporal lobe dysfunction was associated more commonly with changes in sexual preference than with frank hypersexuality. Similarly a patient with fetishism and cross-dressing changed to a heterosexual pattern of sexual behaviour after temporal lobectomy for seizures.<sup>28</sup> In two patients reported here (Cases 6 and 7), change in sexual orientation was more prominent than increased sexual behaviour. Patient 3 had interictal hyposexuality combined with

postictal hypersexuality in association with temporal lobe epilepsy. Patient 6 manifested post-encephalitic voyeurism and patient 7 changed gender preference from heterosexual to homosexual after herpes encephalitis.

Arousal, the pleasure associated with sexual activity, and orgasm may, in part, be mediated by monoaminergic compounds.<sup>29</sup> Yohimbine elevates central norepinephrine levels and increases mounting behaviour in male rats even when associated with genital anaesthesia.<sup>30</sup> Dopaminergic compounds have also been associated with increased sexual drive<sup>21</sup> and Case 9 suggests that dopamine may play a role in sexual preference as well as drive.

Sexual arousal leads to increased copulatory activity. Although peripheral somatosensory inputs are important for this aspect of reproductive activity, human patients with paraplegia may experience arousal and even orgasm without peripheral sensory input, suggesting that central structures are sufficient for this experience.<sup>31</sup> Copulatory behaviour may be induced by stimulating the septal region in primates,<sup>32</sup> and Heath<sup>33</sup> described orgasmic sensations in patients during stimulation of this region. The patients in this series with true hypersexuality (Nos 1, 2, and 3) had lesions involving or adjacent to the medial septal area.

All these aspects of reproductive behaviour are mediated by structures with extensive frontal and limbic connections. The basal frontal area has multiple connections with the thalamus, hypothalamus and other elements of the limbic system.<sup>34</sup> Prominent efferent pathways connect the frontal lobe to the pre-optic region of the hypothalamus and may control sexual drive. Behavioural changes may be the only manifestation of damage to the basal frontal area and this region is vulnerable to both trauma and hydrocephalus. The disinhibited behaviour seen with injury to this region may include inappropriate discussion of sex<sup>6</sup> but increased sexual drive is less common. Two patients in this series with increased drive and actual increased sexual activity (Cases 1 and 2) had demonstrable lesions of the basal frontal lobe. In addition, several of the patients in this series had basal frontal injury in addition to other pathology that may have led to a mixed pattern with both alteration in sexual preference and disinhibited sexual activity.

These observations emphasise that specific sexual changes may occur following brain injury and in some cases the behavioural alterations may be the presenting or predominant manifestation of brain dysfunction. Hypersexual behaviour following brain injury is uncommon but when seen is often associated with basal frontal or diencephalic lesions. Drugs that increase central monoamines may produce a similar syndrome. Change in sexual orientation is more common with lesions in the limbic system and cases are

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described here with dysfunction of the hypothalamus and temporal lobe. Change in sexual behaviour should suggest the possibility of a brain lesion.

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