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Review

Opposed hemispheric specializations for human hypersexuality and orgasm?

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ABSTRACT

With a multiple case report analysis we demonstrate that hypersexuality more often results from right hemisphere (RH) ($n=26$) than left hemisphere (LH) ($n=7$) lesions, possibly because of LH release after the RH lesion, and that ictal orgasm more often occurs in patients with right-sided ($n=23$) than left-sided ($n=8$) seizure foci, with the symptom probably resulting from RH activation. The LH may be specialized for increasing sexual tension, whereas the RH may be specialized for release of this tension (orgasm), the former being catabolic and the latter anabolic. Several other interpretations of the findings are also discussed.

1. Introduction

The human sexual response comprises several distinct stages: (1) a nonspecific state of sexual tension or libidinousness or appetite; (2) a sexually specific excitement–stimulation–arousal (visual or somesthesic titillation, erection or tumescence or lubrication) while conceptualizing or experiencing a sexual stimulus; (3) masturbation or copulation; (4) ejaculation/vaginal–rectal spasm; (5) a mind state called *orgasm,* which accompanies and persists beyond the spasms; (6) resolution; (7) a refractory period and a renewal of the cycle.

The central nervous system mediates all of these aspects of the sexual experience. Functional imaging and EEG studies of healthy people during sexual activity typically reveal bilateral activation in many cerebral areas, particularly in the temporal lobe [1–16]. However, most studies do not distinguish between the different states of the human sexual response, because the functions are tightly linked and interdependent in real-life sexual ecologies, or because they cannot all be investigated in the laboratory.

Two pathological sexual phenomena clearly reveal hemispheric specialization, namely, postlesion hypersexuality and ictal orgasm. We define *hypersexuality* as an increase in libido, leading to repeated masturbation or pressure for sexual intercourse. *Ictal orgasm* is defined as a subjective feeling of orgasm occurring at the beginning of a seizure, with or without a feeling of arousal, more often pleasant, but which can be painful, and resembling what is experienced at normal sexual climax. Hypersexuality, or nonspecific sexual tension, is a catabolic metabolic state. In opposition to this, orgasm is conducive to the anabolic metabolic state, rest, immobility, and so on. These aspects of human sexuality, tension and release, seem to involve opposed brain hemispheres.

1.1. Hemispheric specialization of sexual tension

Patients with chronic intense hypersexuality associated with unilateral hemispheric hyperperfusion typically present with left hemisphere hyperperfusion [17–21], rarely with right hyperperfusion [22,23]. Right hemisphere hypoperfusion is also associated with hypersexuality [24–28]. Together, these findings suggest that hypersexuality results from interhemispheric imbalance: a right hemisphere sexually inhibiting process and a left hemisphere activating process.

A left amygdalar predominance in libido is supported by animal studies. In male rats, the posterodorsal subnucleus of the medial amygdala, involved in precopulatory behavior but not in intromission or ejaculation [29,30], is larger in the left than right hemisphere [31]. Only the left amygdala volume decreases significantly after castration, and only the left hemisphere displays an effect of hormone treatment. When hypersexuality follows a temporal lobectomy in humans, the contralesional amygdala is hypertrophic [32]. Heath [33] described left amygdala activation during peak excitement before orgasm immediately followed by right activation during orgasm via depth electrodes in a patient with epilepsy. In addition, the left amygdala is activated during sexual excitation and deactivated during orgasm in men [33–35].

Stroke and other destructive pathologies are associated with higher libido after right more often than left hemisphere lesions [36–38],

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whereas hyposexuality is more often associated with left than right hemisphere lesions [39,40].

1.2. Hemispheric specialization of release from sexual tension (orgasm)

Sexual release occurs only with orgasm and is associated with greater right hemisphere blood flow. Functional imaging studies reveal that during or just after self-induced orgasm in healthy participants, right hemisphere hyperperfusion and left hypoperfusion occur [41,42] or only left hemisphere hypoperfusion occurs [43]. The widespread asymmetries are maximal in the frontal and temporal lobes.

Ictal orgasm provides a unique opportunity to observe orgasm isolated from sexual excitement/tension. Orgasmic ictus arises predominantly in the right temporal lobe [44,45]. Among 20 reported cases of women with ictal orgasm, 70% had a right and 21% had a left focus [46]. However, only women were reviewed and cases without EEG spikes and early ictal symptoms were included. Thus, their population was not ideally suited to assess hemispheric specialization.

1.3. The psychic tonus model of hemispheric specialization

Braun [47] proposed a new model of hemispheric specialization. The left hemisphere activates mentation and behavior, whereas the right hemisphere inhibits mentation and behavior because right hemisphere lesions often cause positive symptoms such as hallucination, hyperlalia, agitation, and delusion, whereas left hemisphere lesions have the opposite effects. He postulated that the common thread underlying all these effects is that the left hemisphere biases toward the expenditure of energy (catabolism of oxygen and glucose), whereas the right hemisphere is specialized to favor economy (i.e., anabolism of oxygen and glucose) [47]. Devinsky proposed a parallel interpretation about delusions after right hemisphere (and frontal) lesions, explicitly attributing positive symptoms to left hemisphere release [48].

Neurological cases of hypersexuality and orgasm can be interpreted in terms of Braun's model of hemispheric specialization [47]. Sexual arousal is a state in which energy, as defined above, is likely to be expended, whereas orgasm is an opposing state for energy. The common French expression *la petite mort* ("little death"), designating orgasm, evokes this aspect [43].

1.4. Purpose of the present study

We sought to determine the extent to which sexual appetite or tension and release reflect opposed hemispheric specializations. The review focuses on testing the following hypothesis: hypersexuality is left hemisphere dominant, and sexual release (orgasm) is right hemisphere dominant. We suggest that neurological patients with hypersexuality and intrusive orgasms provide more reliable localizing data on sexual function than hyposexual or anorgasmic patients because these latter manifestations can result from medication, pain, learned helplessness, loss of self-worth, depression, or remote brain disturbances.

2. Method

2.1. Collection of cases

We searched for cases with unilateral lesions presenting with hypersexuality after the lesion and cases with isolated paroxysmal orgasm resulting from a unilateral epileptic focus. Hypersexuality was defined as a radical increase in libido, that is, desire for sex. Cases with only bizarre or socially inappropriate sexual behavior were excluded. Ictal orgasm was defined as a subjective feeling of orgasm occurring during the aura or at the beginning of the ictus. To find case reports, in a first step, we used the databases Google Scholar and Pubmed, with the search terms *hypersexuality*, *masturbation*, *libido*, *sexual desire*, *lesion*, *stroke*, *head injury*, and *tumor* for the hypersexual cases, and *orgasm* and *epilepsy* for the ictal cases. Articles written in Spanish, French, German, or English were read and could be included in the database. In addition, our laboratory has been collecting published case reports on other related topics for many years, and thus, most of the cases presented in this article were found in our own filing cabinets. More than a thousand titles, abstracts, and articles were reviewed, but we did not record the exact number.

2.2. Inclusion/exclusion criteria and control variables

All hypersexual cases had to have a unilateral lesion, determined by MRI, CT, or resection location. We excluded cases with prelesion sexual problems or baseline psychiatric disorders associated with hypersexuality (e.g., mania). Two cases may have had a mood disorder prior to their lesion, but this was not documented [49,50]. Following brain injury, new-onset epilepsy and psychiatric symptoms associated with right hemisphere lesions (e.g., hallucinations, delusions, mania [talkativeness, psychomotor agitation]) were recorded (Table 1). Postlesion aggressiveness, compulsiveness, disinhibition, euphoria, and anxiety and interval from lesion to hypersexuality were recorded.

The rationale of case selection was to test hypotheses of hemispheric specialization. With respect to the hypersexual group, a lesion that impairs predominantly one hemisphere is usually associated with focal EEG slowing or hypoperfusion in the lesioned hemisphere [51]. Therefore, any patient with ictal hypersexuality or contralesional focal EEG slowing was excluded because we could not determine "side of lesion" in such cases. Likewise, any patient with unilateral hyperperfusion, in either hemisphere, was also excluded. The selection criterion for the ictal orgasm cases was a unilateral focus determined by interictal or ictal discharges on scalp EEG. Indeed, if the discharge is unilateral with preictal or early ictal spiking, metabolic imaging typically reveals increased blood flow in the focal region. By contrast, late ictal and postictal phenomena cannot be localized or lateralized as they may reflect ictal spread, inhibition, or shutdown [52]. Spikes were required because they are strongly associated with hyperperfusion, a marker of activation [53–55]. Because orgasmic aura at ictal onset was self-reported, we wanted to use the time in which awareness is best preserved and ictal spread is limited to localize and lateralize the ictal onset. As unilateral discharges can spread to the contralateral hemisphere during seizures and symptoms result from contralateral activation, this spread pattern occurring after the orgasm was noted for control analyses. We also sought information on presence and location of structural lesions and accompaniments of ictal orgasm (e.g., sexual sensations or excitement, autonomic symptoms, or conscious orgasm), ictal hallucinations, fear, or euphoria (see Table 2). Exclusion criteria were (1) a bilateral focus, (2) a nonictal target symptom, (3) lack of EEG in the case report, (4) EEG showing slow activity without epileptiform or ictal discharges (i.e., spikes), (5) ictal metabolic imaging (fMRI or SPECT) indicating hypermetabolism contralateral to the focus or hypometabolism ipsilateral to the focus, and (6) seizures provoked by intercourse or orgasm.

We recorded age, gender, handwriting preference, lesion etiology, intrahemispheric lesion/focus localization and size (the size is defined by the number of impaired lobes), presence/absence of neurological disorder (e.g., hemiplegia, neglect, or any symptom that could help to localize the lesion), neuropsychological impairments (e.g., aphasia, agnosia, intellectual disability), psychiatric disorders or symptoms as defined in DSM-IV (e.g., hallucination, delusion, mania, depression), medical illness, medications, and date of publication of the article (see Tables 1 and 2). Depression, mania, and bipolar disorder were not exclusionary features.