Sexual Interest and Neuroimaging of the Site of the Libido

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In humans, the sexual cyclicity of estrus that occurs in animals is not present, and sexuality is sometimes evoked by the imagination. The central site of the libido has long been unclear. We analyzed the site of the libido in healthy male volunteers with the aid of the RigiScan plus™, which can evaluate the erectile state in real time. By evaluating the erectile phenomenon in real time, we could confirm that sexual stimulation was fully transmitted and could identify the phases of sexual activity. In the excitement phase, the occipital lobe is the area specifically activated as indicated by positron emission tomography. We also found that in addition to this area, part of the cerebellar vermis was specifically activated. During the plateau phase, the occipital lobe, which contains the visual cortex, and the temporal lobe, which contains the auditory cortex, became more highly activated than during the excitement phase, and in addition, the ventral striatum (putamen) was specifically activated. Although these findings are interesting and important in the field of sexual medicine, it is supposed that the subjects show interest in sexually stimulating videos and watch them in many imaging analyses of the site of the libido. Regarding sexual interest, we reported that a sex difference existed in visual attention to a sexual video by an eye-tracking system. We also showed that attention to the sexual region in the video depends on the personality characteristics of men. Here, we show recent evidence of sexual libido and interest including our experimental results.

Key words: sexual interest, neuroimaging, libido

Introduction

Sexual desire, which is the source of sexual activity, is, so to speak, an animal instinct, and from the viewpoint of species preservation, it is an extremely important desire for all animals including humans. However, in humans, whose regulatory functions in the brain are very complex, the central site of the libido has long been unclear. Meanwhile, a variety of experiments have been attempted on animals other than humans, and action pathways to the central site of the libido have been introduced. In other words, after being integrated in the thalamus as sensory information, sexual stimuli enter the amygdala directly as an emotional sensory pathway and activate the medial preoptic area and the hypothalamus, leading to the initiation of sexual arousal. Furthermore, in males, as proof of the initiation of sexual arousal, responses of the autonomic nervous system such as penile erection occur. Therefore, we can say that stimulation that provokes an erection is exactly associated with sexuality. However, human sexuality is more complicated than that of other animals. In humans, the sexual cyclicity of estrus that occurs in animals is not present, and sexuality is sometimes evoked by the imagination. Humans differ greatly from animals in these points. Hypothalamus was believed to be very important for humans over 20 years ago, because it was reported that the probability of a...
Specific aggressive sexual behavior reduced by unilateral ventromedial hypotalamotomy due to the diminished sexual drive in men with aggressive sexual delinquency. Recently, there have been various reports of the use of imaging techniques such as positron emission tomography (PET) and functional magnetic resonance imaging (fMRI) to analyze the central site of the libido in human subjects. However, in addition to the hypothalamus, amygdala and medial preoptic area, various other areas such as the putamen, claustrum, islet, anterior occipital lobe and inferior frontal lobe have also been reported as sites of the human libido and thus it remains hard to say that the site of the libido has been identified.

By using PET analysis as a more reliable methodology, we have identified a site of the libido that is specifically timed with sexual activity. Additionally, we have analyzed sexual interest, which is connected with sexuality, and we present our combined results.

Problems with the analytical methods

Several reasons have been proposed for why imaging of sites of the human libido were different depending on the report. First, the type of imaging used in the analysis, PET or fMRI, is described as one reason.

Several analyses of the site of the libido using both methods have been reported, but the two methods are different in spatial resolution and temporal resolution, and it is unlikely that the same results can be obtained. In particular, fMRI can identify detailed changes, but the drawback of increased numbers of false-positive results has been pointed out.

In addition, because monitors for sexual stimulation and instruments to confirm the erectile phenomenon cannot be used in fMRI, it reasonably has limitations as an analytical method. If more reliable analysis results are to be obtained, ingenuity in the use of diagnostic imaging techniques is essential.

Second, it has been pointed out that sexual stimuli including films, tapes, videos and photos are not standardized. Differences in the content of sexual stimuli inevitably imply differences in the response to these stimuli. Previous studies have rarely referred to the quality of the sexual stimuli used.

This sexual stimulation leads to the third problem, evaluation of the erectile phenomenon. As mentioned previously, if a subject is properly stimulated sexually, the erectile phenomenon must occur as its response.

To date, however, few analyses have evaluated the erectile phenomenon, and even in those that have, most evaluations were only answers to questions, and thus the reliability of the evaluations was low. Furthermore, a more significant problem is the time of diagnostic imaging. In general, human sexual activity is divided into the following 4 phases: phase 1, the excitement phase (excitement into latency and tumescence); phase 2, the plateau phase (plateau into erection and rigidity); phase 3, the orgasm phase (orgasm into emission and ejaculation) and phase 4, the resolution phase (resolution into detumescence). It is natural in a sense that a difference in the phase of sexual activity analyzed would lead to a difference in the site of the libido activated on imaging.

To resolve these problems, we analyzed the site of the human libido.

Analysis of the libido during specific sexual activity

We analyzed the site of the libido in healthy male

Figure 1 The RigiScan plus™ can evaluate the erectile state in real time
volunteers with the aid of the RigiScan plustm (Figure-1), which can evaluate the erectile state in real time. When the RigiScan plustm is used, the two loops are attached around the coronal sulcus and the root of the penis, and the apparatus that records the data is fixed to the femoral region or the abdomen. Penis circumference is measured every 30 seconds by a strain gauge made of stainless steel wires hidden within the loop cover. When penis circumference increases by 10 mm or more, penis hardness is automatically measured, and the measurement is repeated every 30 seconds until the increase in penis circumference becomes 10 mm or less. This is considered to be the most reliable test for the evaluation of the erectile phenomenon.

By evaluating the erectile phenomenon in real time using the RigiScan plustm, we could confirm that sexual stimulation was fully transmitted and could identify the phases of sexual activity (Figure-2, 3). Furthermore, by presenting a control (mosaic) video, which was perfectly created with the same quality of color, chroma and volume as the...
original video used for sexual stimulation, to a subject, we established a high degree of reliability.

In addition, we used PET scanning because the imaging analysis required this modality, and also there are few false-positives with PET. At first, in the early stage of erection, i.e., in the excitement phase, the occipital lobe is the area specifically activated as indicated by PET. This area is generally considered to be in the high-order visual cortex, and there is no inconsistency in the fact that even when any type of video is watched, this area is activated. We found that in addition to this area, part of the cerebellar vermis was specifically activated, and we speculated that it was involved in sexuality during the excitement phase. Recently, the association of sexuality with the cerebellar vermis has been reported in other studies, including animal experiments, which supports our results. We also found that during the plateau phase, the occipital lobe, which contains the visual cortex, and the temporal lobe, which contains the auditory cortex, became more highly activated than during the excitement phase, and in addition, the ventral striatum (putamen) was specifically activated (Figure-4). With respect to the putamen, there is a report that the putamen plays a part in the libido, and thus we believe that our results have high reliability.

Analysis of sexual interest

In many imaging analyses of the site of the libido, including our studies, it is supposed that the subjects show interest in sexually stimulating videos and watch them. In other words, even if sexually stimulating videos are presented to the subjects, if they become too nervous to watch these videos, then analysis will be impossible. Because no procedure for the assessment of sexual interest has existed up to now, sexual interest has not even been scientifically analyzed. No diagnostic or therapeutic procedures exist for patients with decreased libido. Recently, an analysis that evaluated an object of interest by tracing the subject’s visual line was reported in the field of psychology. We invented a device that continuously traces a visual line on the monitor and also invented a method to quantitatively evaluate sexual interest by analyzing the area that intrigues the subject when watching a sexually stimulating video (Figure-5). This method is ideal because sexual interest can be evaluated quantitatively and noninvasively. After using this system, we reported that a sex difference existed in visual attention to a sexual video: men viewed the opposite sex for longer periods than women, and women viewed the same sex for longer periods than men. Interestingly, women paid more attention to the non-human regions than did men. The possibility exists that women subconsciously viewed human regions with less attention than did men because women were less interested in sexual presentation than were men, rather than that...
women were more interested in the non–human regions, such as the bathtub or the appearance of the bathroom, than were men. We also investigated whether attention to the sexual region in the video depends on the personality characteristics of men, assessing this with an eye-tracking system. Regarding the gaze duration for the sexual region, multiple stepwise regression analysis showed that only social introversion was associated negatively. It was unclear whether these differences were a result of a congenital or an acquired factor. We are now investigating sexual female-to-male transsexual persons because they are very masculine but female in terms of anatomical sex.

Conclusion

We have not yet reached a definitive conclusion on the specific site of the libido. We expect that analyses of the libido will be further advanced with reliable research methods in human subjects.

References