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RESEARCH ARTICLE

The role of septal nuclei in modulation of sexual behavior in young male rats

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ABSTRACT

Background: The septal region has attracted the attention of many due to its apparent involvement in variety of motivational, emotional, and associate process. **Aims and Objectives:** This study was done to assess the effect of the septal lesion on sexual behavior in male albino rats**. Materials and Methods:** In this experimental study, 16 sexually experienced male albino rats were selected randomly out of which 8 rats were septal lesioned (participants) and remaining 8 rats were sham-operated (control). To assess the effect of septal lesion, we compared the latencies and frequencies of male sexual behavior components (pursuit, mount, intromission, and ejaculation) in sham and septal lesion rats. The occurrence of each pursuit, mount, intromission, and ejaculation was scored according to classical criteria. **Results:** Compared to sham-lesioned, the sexual behavior is significantly reduced in septal lesioned rats as indicated by an increase in latencies of different components and shows a significant decrease in intromission and ejaculation frequency, decrease in sex drive but no change in pursuit and mount frequency. **Conclusion:** The result indicates that the sexual behavior is modulated in bilateral septal lesioned male rats which proves the role of septal nuclei in controlling the reproductive functions in male rats.

KEY WORDS: Bilateral Septal Nuclei Lesion; Sham Lesion; Young Male Rats; Sexual Behavior

INTRODUCTION

Much of the social behavior in which rodents engage is related to reproduction, such as maintaining a breeding territory, seeking mates, mating, and caring for young. Rodents belong to the internally fertilizing species that require sexual behavior for reproduction. The dyadic, heterosexual patterns of most mammalian species are sexually dimorphic, but they also share mutual components in both sexes: Sexual attraction is reciprocal, sexual initiative is assumed, appetitive behavior is engaged in, and mating involves consummatory, and post consummatory phases in females as well as in males.[1] Fertilization and reproductive success of mammals depends on sexual behaviors which enable mammals to copulate with the opposite sex. Septal nuclei is one of the important parts of limbic system, but its role in sexual behavior so far is nonspecific, except in self-stimulation, aggressive, and drinking behavior.[2] It is proven that the lesions of the medial preoptic area (mPOA) have an inhibitory effect on male sexual behavior[3-7] whereas electrical stimulation (ES) of mPOA facilitates it.[8,9] Swanson and Cown[10] have demonstrated that the lateral septal nucleus, which can be divided into dorsal, intermediate and ventral parts, receives its major input from the hippocampal formation and projects to the medial septal-diagonal band complex. The ventral part of the nucleus also sends fibers through the medial forebrain bundle to the medial preoptic and anterior hypothalamic areas, to the lateral hypothalamic area and the dorsomedial nucleus, to the

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mammillary body (including the supramammillary region), and the ventral tegmental area. It is possible, therefore, that the lesions in the septum may alter sexual behavior.

It has been found that extent of potentiation of lordosis and soliciting behavior after the destruction of the lateral septum has been increased not only in females[11,12] but also in male rats.[2,13] To determine whether the septal region is involved in lordosis control, Zasosrin *et al*.[14] examined the effects of ES there on the copulatory behavior of ovariectomized, hormone-primed, sexually receptive females in the presence of sexually active males and conversely found diminished lordotic activity in female hamsters. Sharma *et al*.[15] demonstrated that stereotaxic lesions in the septal region of female rats disturbs the gonadotropin secretion and consequently the ovarian cycle and increased estrogen excretion in urine and inhibition of new follicular growth. Similarly, lesion around septal nuclei exert influence over ovaries as is manifested by a reduction in ovarian and uterine weights, marked disruption of estrous cycle and suppression of sexual activity.[16] Involvement of septal nuclei in the modulation of male sexual behavior in rats was investigated and found alteration in sexual behavior in septal lesioned rats.[2,17] Thus, it may be postulated that septal lesion may influence the release of gonadotropic releasing hormone in the hypothalamus which, in turn, influence the release of gonadotropic hormone from anterior pituitary and therefore affect sexual behavior and fertility.

The present study was designed to determine the role of septal nuclei in modulating sexual behavior as very little experimental evidence is available on the effect of the septal lesion on sexual behavior in male rats.

MATERIALS AND METHODS

The present study was conducted to determine the role of septal nuclei in modulating sexual behavior in male albino rats. All male rats were subjected to sexual behavior studies by presenting them stimulus female, and sex drive score (SDS) recorded. Rats were divided into two groups:

- Group I (n = 8) were sham-operated
- Group II (n = 8) were septal lesioned.

Selection of Animals

A total of 16 adults sexually experienced male albino rats were selected for the study. The animals were housed in separate polyvinyl cages, under 12 h light and 12 h dark regime (light on at 18.00 h and off at 6:00 h) and controlled room temperature.

Screening

All male rats were screened for sexual behavior in an arena measuring 30 cm × 40 cm × 40 cm. The male rats were placed in the arena for 5 min adaptation period before the introduction of a sexually receptive female. Only those rats which ejaculate within 5 min of introduction of female rats into the arena were selected for the study. The behavioral studies were conducted under dim light illumination during the dark phase of the dark/light cycle.

Stereotaxic Technique

Sterotaxic procedure was described in Figure 1. Rats were anesthetized with sodium pentobarbitone 35 mg/kg of body weight intraperitoneally and then given atropine sulfate 25 mg/cc to minimize any respiratory discomfort. The anesthetized rats were fixed properly in the apparatus through the ear bars. The holes are drilled at the mark points through the skull. The unipolar (anodal) electrode (28 gauge) varnished except at the tip was lowered stereotaxically in predetermined sites using coordinates from Paxinos and Watson.[18] The other electrode (neutral) was fixed to the ear of the animal. Using research stimulator S.S. 44 (Medicare), a D.C. anodal current of 1.5 mA intensity was passed for 20 s in lesion groups. The lesions were made bilaterally.

In sham group, the electrode was lowered to septal nuclei, but no current was passed. After the procedure was over, electrodes were removed from the skull and skin was sutured and the site was cleaned with spirit.

Test Procedure for Male Sexual Behavior

Male rats were introduced into the test arena 5 min before the introduction of the stimulus female. Introduction of the sexually receptive female marks the beginning of the experiment. The components of male sexual behavior are pursuit, mount, intromission, and ejaculation. The latencies of the different components of male sexual behavior were recorded using separate stopwatches for each of the parameters studied. Simultaneously frequencies of the different components of sexual behavior were also recorded in

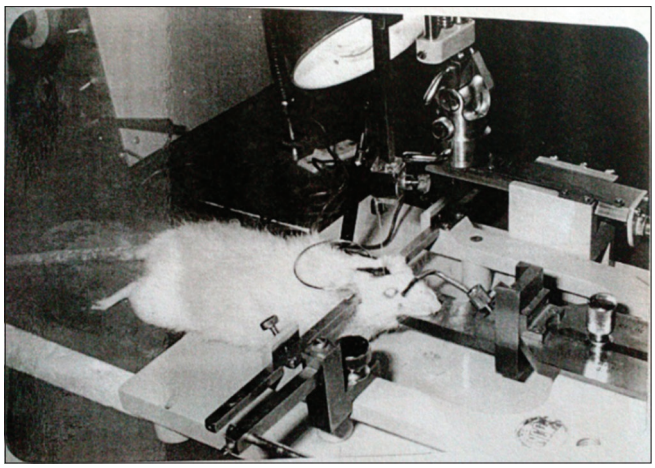

Figure 1: Test procedure

10 min. The occurrence of each pursuit, mount, intromission, and ejaculation was scored according to classical criteria [Figure 1].

SDS

Weightage was given to individual components of male sexual behavior for quantification of sex behavior as mentioned in Table 1.

The sequence of the arrangement of four parameters indicates an increasing of sex drives. The order of arrangement is justified by the circumstances that these parameters appear in this sequence during sexual maturation.[19] Weightage was given to all counts of the four events occurring during the test period, and all the values were added up.

Statistical Analysis

The mean of the sexual behavioral score was calculated before and after septal lesioned rats and ANOVA was applied to see if the difference observed in the individual group was significant. This was followed by Tukey's multiple comparison tests to test the level of significance of observed differences in individual groups.

RESULTS

Tables 2 and 3 show the effect of bilateral septal lesions on frequencies, sexual drive score, and latencies of sexual behavior components (pursuit, mount, intromission, and ejaculation) before and after lesion in sham-operated and septal lesioned rats. The results indicate that septal lesions are effective in suppressing the sexual behavior in rats as indicated by increase in pursuit, mount, intromission, and ejaculation latencies ($P < 0.01$) as shown in Table 3. In pre-operative and post-operative conditions in both the groups and also significant increase in pursuit, mount, intromission, and ejaculation latencies ($P < 0.01$) in Group II (septal lesioned) compared with Group I (sham-operated).

Table 2 shows significant decrease in intromission and ejaculation frequency ($P < 0.01$), decrease in SDS (0.01) but no change in pursuit and mount frequency in Groups I and II before and after operative procedure with significant decrement in intromission and ejaculation frequency and SDS but no change in pursuit and mount frequency in Group II when compared with Group I.

Table 1: SDS

Parameter	SDS
Pursuit	1
Pursuit+mount	2
Pursuit+intromission	3
Pursuit+ejaculation	4

SDS: Sex drive score

DISCUSSION

The medial and lateral septal nuclei have attracted attention due to its apparent role in a variety of motivational, emotional, sexual, and associative processes. Unfortunately, till date, the neural basis of these behavioral activities is poorly understood. The aim of this study was to determine whether bilateral electrolytic lesion in the septum does affect sexual behavior and found an increase in the pursuit, mount, intromission, and ejaculation latencies; decrease in the mount, intromission, ejaculation frequency, and decrease in the SDS, indicating that SAM and IEM are impaired.

Beach *et al*. have suggested that copulatory behavior in rat requires a successive activation of two excitatory mechanisms, the sexual mechanism (SAM) and the intromission and ejaculation mechanism (IEM). In sexual behavior first, there is a need for sexual arousal. When this occurs, intromission can be achieved, and copulation follows. Intromission and copulation then provide new additional source of stimulation so that the animal passes ejaculation threshold and ejaculation.[20] The findings of our study correlated with the study done earlier[2,17,21,22] and suggested that septum has facilitatory influence on masculine sexual behavior in rats.

The known connections of the septal region relate to it most directly to the hypothalamus and those parts of

Table 2: Bilateral septal lesions on pursuit, mount, intromission, and ejaculation frequencies and SDS in 10 min (mean±SD)

Sexual behavior parameters	Group I (*n*=8)		Group II (*n*=8)	
	Pre-operative	Post-operative	Pre-operative	Post-operative
Pursuit	8.12±1.67	5.94±1.15	8.06±1.09	8.56±0.85
Mount	5.19±0.63	4.19±0.63	3.75±0.62	2.63±0.54
Intromission	12.25±0.69	14.25±0.35	14.31±1.52	8.50±1.07*
Ejaculation	1.06±0.06	1.00±0.00	1.06±0.06	0.38±0.12*
SDS	86.12±4.72	89.18±3.50	90.18±8.42	60.56±4.65*

*Statistical significance, SDS: Sex drive score

Table 3: Effect of bilateral septal lesions on pursuit, mount, intromission, and ejaculation latencies in seconds (mean±SD)

Sexual behavior parameters	Group I (*n*=8)		Group II (*n*=8)	
	Pre-operative	Post-operative	Pre-operative	Post-operative
Pursuit	11.06±2.13	11.87±2.00	7.37±1.27	14.62±1.70*
Mount	46.62±9.01	53.43±10.39	34.62±6.38	119.37±24.39*
Intromission	65.56±13.07	71.75±14.97	42.37±6.63	154.87±32.42*
Ejaculation	338.62±17.17	288.5±14.98	187.25±22.04	381.25±51.36*

*Statistical significance

the brain stem and telencephalon that share significant connections with the hypothalamus. Swanson and Cowan have demonstrated that the ventral part of the lateral septum projects massively to the medial preoptic area (mPOA) and the adjoining area. The importance of POA in the regulation of masculine behavior is well known in mammals.[5,23] ES of POA, dorsomedial hypothalamus and the lateral hypothalamic area evoke a typical sequence of sexual behavior. It is seen that lesions of preoptic area-anterior hypothalamus severely disrupt male copulatory response.

Some studies have demonstrated that a large horizontal cut made between the septum and preoptic area strongly facilitates lordosis and soliciting behavior both in female and male rats and these suggest the importance of ventral neural output of septum in the mechanism of inhibition of female sexual behavior in rats.[15,24] Thus, it is likely that lateral septal area together with mPOA and median forebrain bundle may play a role in integrating limbic influences for expression of total masculine behavior.

CONCLUSION

We have shown that the bilateral lesion of the septal nuclei reduces sexual behavior significantly in male albino rats. This indicates that septal nuclei control the functions of the reproductive organ in male rats. Another alternative may be to estimate sexual hormonal levels in male rats following septal lesions to elucidate the exact mechanism of action of the septal lesion.

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