# ROLE OF MID-DORSAL CAUDATE NUCLEUS IN MAINTENANCE OF BODY WEIGHT IN RATS ON ADMINISTRATION OF FOODS WITH DIFFERENT CALORIC DENSITIES

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**Summary** : Rats were fed with food of different caloric densities by addition of kaolin or groundnut oil to the normal food powder. The food intake, caloric intake and body weights were noted. These observations were compared before and after bilateral destruction of mid-dorsal caudate nucleus. The food intake before caudatal lesion varied appropriately with the caloric density of food thus maintaining caloric intake and body weight. After mid-dorsal caudatal destruction this feedback mechanism of maintaining body weight was operative with low caloric density diet but not with high caloric diet

**Key words** : rats, diet, caloric density, mid-dorsal caudate nucleus, lesion, body weight

## INTRODUCTION

The mechanisms involved in food intake are complex and are found both in centre and periphery. Among central mechanisms the hypothalamic mechanisms are important (1, 2, 3, 4, 5, 7, 11). However extra-hypothalamic centers such as temporal lobe-amygdaloid-hippocampal regions (13, 15, 20), mibdrain (22 and 23) and Globus Pallidus (12) are also known to influence the feeding behaviour. Bilateral caudatal lesions are known to bring about decrease in food intake as a long term response (14). Damage to dopaminergic nigro-striatal bundle leads to aphagia and adipsia because of sensory-motor deficit which includes inability to orient to environmental stimuli and inability to initiate feeding behavior (10, 17, 18, 19, 25).

However, as role of localised areas in caudate nucleus on feeding behavior has not been much studied, the present work is undertaken to study the effects of bilateral destruc-

tion of mid-dorsal caudatal area on regulation of food intake, caloric intake and body weight of rats kept on normal, calorically diluted and concentrated diets.

## MATERIAL AND METHODS

The study was done on male albino rats (n=11), weighing 150 to 200 *gms* and aged about 100 to 120 days at the start of the experiment. These animals were housed in individual plastic cages with wire mesh at the bottom to collect the overnight spillage of food for computing the food intake in 24 hours. The room was adequately lighted with natural day-night cycle and temperature was 25.0±3.5°C.

Animals were fed *ad lib* with food (Hindustan Lever supplemented by vitamins) in powdered form at 9.30 a. m. every day. The caloric density of this normal food was 351 Kcal/100 *gm* food. Dilution of food with kaolin (25% by weight) decreased the caloric density of the food to 263.25 Kcal/100 *gm* of food while concentration of food by groundnut oil (25% by weight) increased its caloric density to 488.25 Kcal/100 *gm* of food. Water was given *ad lib* through inverted water bottles fitted with stainless steel spouts.

Body weight and food intake were recorded everyday and food and caloric intake were computed for 100 *gms* of body weight of the animal.

Dietetic regime observed in all the animals was as follows :-

(a) All the groups received normal food and water *ad libitum* from day 110 to day 131 and their body weights and food intake were recorded at 9.30 a.m. (3 weeks).

(b) All the groups were then given the diet mixed with kaolin, and water *ad libitum* as before. This routine was followed from day 132 to day 153 (3 weeks).

(c) All the groups then received normal food and water *ad libitum* as in the beginning from day 154 to day 175 and their body weights and food intakes were recorded (3 weeks).

(d) This was followed by food mixed with oil (concentrated diet). This dietetic routine was followed from day 176 to day 197 (3 weeks).

[e] All the groups then received normal diet *ad libitum* as in the begining. This was given from day 198 to day 219 (3 weeks).

In all the 11 animals bilateral electrolytic lesions were made at 7.4 to 8.2 *mm* anterior to vertical zero plane (A 7.4 to A 8.2); 2 to 3 *mm* lateral to midline (L 2 to L 3) and 6.5 to 7.5 *mm* above the intraural line (H+1.5 to H+2.5). Cathodal current of 1.5 mA was passed for 30 seconds on each side to make an electrolytic lesion.

The same dietetic regime described earlier was then repeated. Results of food intake, caloric intake and body weight were compared before and after the lesion with diets of different caloric densities.

At the end of the experiment the animals were sacrificed and the site of lesion confirmed histologically, staining brain sections with cresyl violet.

## RESULTS

In all the lesioned and non-lesioned animals addition of either kaolin or oil to the diet caused an initial wide fluctuation in food intake during the first four days but subsequently this was stabilized. As such the observations on the food intake and body weight during these first four days after changing the caloric value of the diet are not included.

A separate group (n=14) of adult male rats was kept on a*d lib* normal diet for a similar period as in experimental studies, from age of 100 days to 197 days. These animals showed a steady rise in body weights and compared well with the rise in body weights and compared well with the rise in body weights in the series selected for the present experiment prior to caudatal lesion.

*Changes with diluted diet :* The changes before and after destruction of caudate nucleus are depicted in Table I.

Prior to lesion all animals showed significant increase in food intake after administration of diet diluted with kaolin ($P<0.01$). The caloric intake was fully compensated by this rise in food intake. Their body weight showed a steady increase throughot the period and was consistent with the observations made in control animals.

On destruction of caudate nucleus, intake of normal as well as diluted food diminished ($P<0.001$) as compared to the foods of respective caloric densities before the lesion.

Further, after the lesion the difference between intake of diluted and normal food was significant ($P<0.1$) as compared to the differences prior to lesion. However, there were no significant changes in caloric intake and body weight.

TABLE I : Changes in intake 100 *gm* body weight (Food and caloric) and body weight (mean ±S.E.) with diet of different caloric densities in rats (n=11) before and after mid-dorsal caudatal lesion.

| | *Before lesion* | | | *After lesion* | | |
|---|---|---|---|---|---|---|
| | *Normal diet* | *Diluted diet* | *Conc. diet* | *Normal diet* | *Diluted diet* | *Conc. diet* |
| Food intake | 6.6±0.2 | 8.1±0.3** | 4.5±0.1* | 5.9±0.4 | 6.7±0.3** | 4.7±0.2NS |
| Caloric intake | 23.1±0.8 | 21.4±0.5NS | 22.0±0.5NS | 20.7±1.5 | 17.5±0.8NS | 23.1±0.8*** |
| Body weight | 206.4±9.9 | 232.2±10.9NS | 274.7±14.4NS | 297.2±2.8 | 308.9±10.0NS | 366.1±17.2*** |

* — P<0.001

** — P<0.01

*** — P<0.05

NS — Not Significant

*Changes with concentrated diet :* The changes in food and caloric intake and body weight with concentrated diet before and after the caudatal destruction are also shown in Table I.

There was significant decrease ($P<0.001$) in concentrated food intake in all the experimental animals though mean caloric intake and body weight showed no significant changes. The differences in intake of normal and calorically concentrated food of prelesioned animals were not statistically significant.

After the caudatal lesion also there was no significant ($P>0.05$) decline on intake of concentrated food as compared to the intake of normal food. However, increase was shown ($P<0.05$) in caloric intake and body weight of lesioned rats after concentrated diet as compared to normal diet.

## DISCUSSION

It is observed in our laboratory that male rats increase their body weight with constant caloric intake for a large part of laboratory life and therefore considered as maintenance of constant body weight over a period of time. It is known that rats kept on fixed meal time (3 hours during 24 hours) could maintain body weight by adjusting their intake during the meal time (16). Rats forced to overfeed by stimulating lateral hypothalamus consumes less food during post-stimulus period until they attain their pre-stimulus body weight (24). The present study indicated that body weight shows a uniform increase as a function of time when challenged with dilute and concentrated diet before the lesion. This uniform increase is comparable with the similar rise in body weight in the 14 adult male rats maintained with *ad lib* normal diet for a similar period.

In our study, inspite of the fact that caloric intake is reduced after destruction of mid-dorsal caudate nucleus, there is no decrease in body weight. It is known that "set point" for energy stores is shifted to a higher level during intermittent starvation which in turn leads to increased deposition of fat and glycogen (9). Decreased caloric intake by lesioned rats causes a state of starvation and shifts the "set point" favouring the conservation of energy in the animal which prevented the decrease in body weight.

Dilution of food by non-nutritive substances like cellulose or kaolin is compensted by enhanced food intake in Rodents (8). A feedback control for food intake in such cases is postulated by some investigators (6,21). The present results of food intake can be analysed on this background. It is observed that non-lesioned animals maintain body weight as a function of time under two metabolic challenges, namely the dilute and

concentrated diets. However, after bilateral mid-dorsal caudatal lesion this feedback control is found to be not regulated with concentrated diet though the regulatory mechanism is not disturbed with dilute diet. This is likely to be due to change in flavour of food by addition of groundnut oil resulting in stimulation of sensory cues such as taste and smell.

The present work shows that bilateral destruction of mid-dorsal caudate results in diminished food intake on normal and diluted diets inspite of keeping light-dark cycle, room temparature, cage environment etc. constant. This agrees with reports published earlier (14, 17, 18, 19). But no significant change was observed in food intake of lesioned animals on concentrated diets. It thus appears that mid-dorsal caudate nucleus has stimulating effect on feeding behavior with normal or diluted food. Lesion of this area therefore reduces the intake of such foods. As regards concentrated food, groundnut oil adds to the flavour of food which overrides the effect of destruction of mid-dorsal caudate nucleus. This requires further study.

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