THE EFFECT OF SHAM FEEDING ON THE BASAL METABOLISM IN DOGS

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The physiologic mechanisms of functional connection between metabolism and digestion have not been fully investigated.

A number of experimental studies have established that changes in metabolism which arise in connection with the act of feeding cannot be explained solely by the processes of digestion and absorption of foodstuffs [4]. Data obtained by a number of authors [1, 3, 6] indicate the existence of a complex functional interdependence of gastric secretion and the level of metabolism, based on complex reflex mechanisms.

The aim of the present work has been the study of the effect of sham feeding on the basal metabolism in dogs.

EXPERIMENTAL METHOD

The experiments were performed on two dogs which had been subjected to esophagotomy, with Basov gastric fistulas. The basal metabolic rate was determined by the Douglas-Haldane method; this was done daily 15-30 minutes prior to sham feeding. Sham feeding with meat was continued until the animal refused the food offered. Experiments with sham feeding were carried out for 1 day or several days running. Two series of investigations were undertaken. In the first series sham feeding was carried out with an open gastric fistula and was accompanied by loss of gastric juice. In the second series sham feeding was carried out with a closed gastric fistula and was not associated with loss of gastric juice. Three hours after the sham feeding experiment the animal was fed in the usual way.

EXPERIMENTAL RESULTS

Relatively constant BMR values, with fluctuations of ± 6%, were obtained in control observations; these are in full agreement with literature data. The results of sham feeding experiments showed that a single sham feeding along with a loss of gastric juice evoked only slight changes in basal metabolism expressed either in a small drop in BMR or in some tendency for it to rise the next day after sham feeding.

Repeated sham feeds with an open gastric fistula which were given over a period of several days (5-9) led to a prolonged rise in basal metabolism (Fig. 1, 1). As early as the day following the first sham feed there was some rise in the BMR. Following the second sham feed the BMR reached a value equivalent to 1.68 cal·kg/hour. After the three subsequent sham feeds the BMR value dropped and reached the initial level. Two days after termination of sham feeding with an open gastric fistula there was again a rise in the basal metabolism to an average value of 1.64 cal·kg/hour. The BMR remained high during the subsequent 25 days, reaching 1.94 cal·kg/hour on some days. The oxygen utilization during this period (Fig. 1, 2) was 344 cm^3·kg/hour rising on some days to 411 cm^3·kg/hour. During the control period the average value for oxygen uptake was 277 cm^3·kg/hour. Repeated sham feeds accompanied by loss of gastric juice led, in addition to enhancement of oxidative

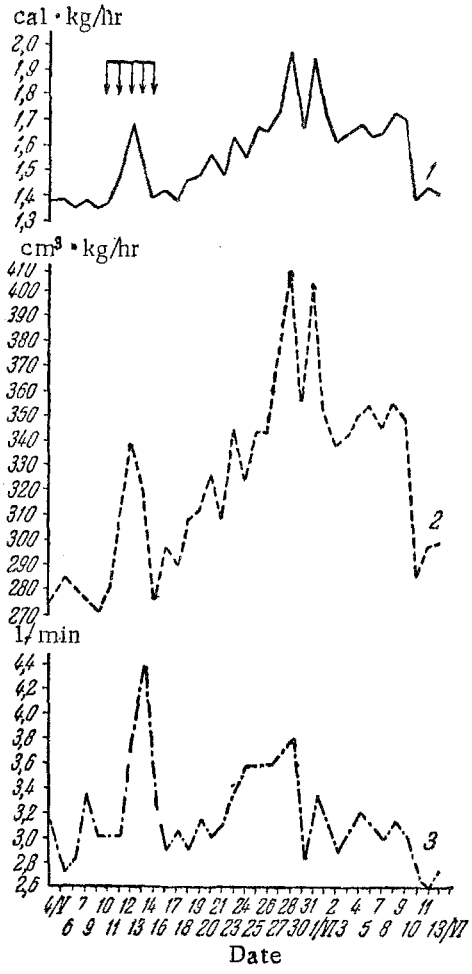

Fig. 1. Rise of BMR in dog; sham feeding with open gastric fistula accompanied by loss of gastric juice from the body. Arrows indicate days of sham feeding. 1) BMR in cal·kg/hour; 2) oxygen utilization in cm^3·kg/hour; 3) pulmonary ventilation in liters/min.

processes, to increased pulmonary ventilation (Fig. 1, 3).

Subsequent repeated series of sham feeding experiments over a period of 5-9 days did not increase the changes in BMR observed in the first series of investigations. Later, during the days on which six subsequent sham feeds were given, as well as during two weeks following termination of sham feeding experiments, there was persistent increase in basal metabolism on average to 1.69 cal·kg/hour and on some days up to 1.87 cal·kg/hour. Oxygen utilization increased on average from 312 to 348 cm^3·kg/hour, amounting on some days to 386 cm^3·kg/hour. Increased pulmonary ventilation was also observed and was particularly marked during the three days following termination of sham feeding experiments.

In the second series of experiments sham feeding was carried out with a closed gastric fistula and was not accompanied by loss of gastric juice. The experiments showed that the first single sham feed under these conditions caused lowering of basal metabolism amounting to an average of 15% over a period of several days (1-5). In subsequent experiments with single sham feeds with a closed gastric fistula which were carried out with intervals of 1-4 weeks, the lowering of basal metabolism was less marked. Repeated sham feeds given for several (5-6) days, unaccompanied by loss of gastric juice, lowered the basal metabolism (Fig. 2, a) over a considerable period of time (up to two weeks) as can be seen from Fig. 2, a, 1. After the fourth sham feed the basal metabolism returned to the initial level. However, following the last (sixth) sham feed the value of basal metabolism again dropped. The BMR remained low (average of 1.26 cal·kg/hour) during the next 14 days, dropping on some days to 1.14 cal·kg/hour. Oxygen consumption (Fig. 2, a, 2) which was, on average, 296 cm^3·kg/hour in the control period, dropped to 261 cm^3·kg/hour on termination of experiments with sham feeding with closed gastric fistula, and on some days was 241 cm^3·kg/hour. Pulmonary ventilation during the period of lowered basal metabolism either remained equal to the mean value observed during the control period or dropped to some degree (Fig. 2, a, 3). The respiratory coefficient varied within the range 0.69-0.9.

The data obtained were analyzed by means of experiments in which sham feeding was carried out with an open gastric fistula, but the juice secreted over a period of 3 hours was then reintroduced into the stomach (Fig. 2, b). Thus, the basal metabolism in the dog Nelka (Fig. 2, b, 1) showed an average of 1.56 cal·kg/hour during the control period. After five sham feeds with subsequent reintroduction into the stomach of the secreted juice its value dropped on average to 1.36 cal·kg/hour, and on some days was 1.20 cal·kg/hour. The basal metabolism remained low for the next 17 days. Oxygen consumption dropped on average from 322 to 278 cm^3·kg/hour, and on some days it was 243 cm^3·kg/hour (Fig. 2, b, 2). Some diminution of pulmonary ventilation was noted (Fig. 2, b, 3). The experiments thus demonstrated the same consistent features in the change of basal metabolism as those seen in experiments with sham feeding with a closed gastric fistula in which there was no loss of gastric juice.

Similar changes in basal metabolism associated with sham feeding under the same experimental conditions were obtained in a second dog – Kashtan.

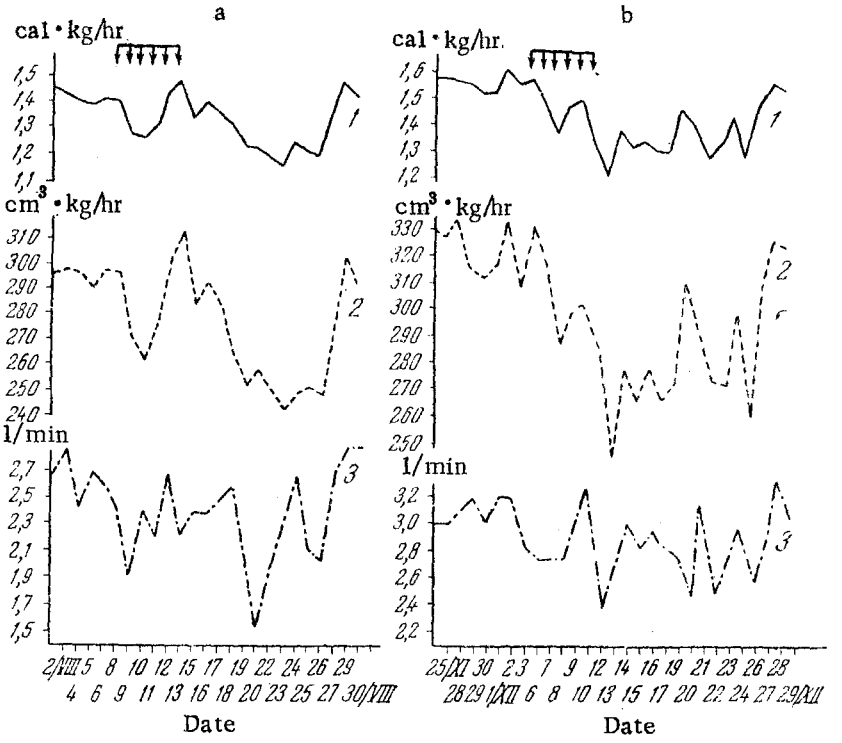

Fig. 2. Lowering of basal metabolism in dog; sham feeding with closed gastric fistula without loss of gastric juice (a); sham feeding with open gastric fistula with subsequent reintroduction into the body of secreted gastric juice (b). Arrows denote days of sham feeding. 1) Basal metabolism in cal•kg/hour; 2) oxygen utilization in cm^3•kg/hour; 3) pulmonary ventilation in liters/min.

The experimental data obtained indicate that prolonged excitation of the gastric glands in dogs associated with sham feeding continued for 5-9 successive days with open or closed gastric fistulae evokes prolonged (up to 25 days) changes in basal metabolism, the determining factor in the nature of the changes in basal metabolism being the loss or conservation of gastric juice by the body. Prolonged gastric gland secretion, not accompanied by loss of gastric juice, leads to lowering of basal metabolism, while prolonged gastric gland secretion accompanied by loss of juice leads, on the contrary, to prolonged rise in basal metabolism. The results of the present investigation agree with literature data [1, 6].

These facts again stress the close functional link between the regulation of the external secretory function of the gastric glands and basal metabolism. Changes in basal metabolism which occur on sham feeding suggest that a reflex mechanism plays the most important role in them. The prolonged character of the metabolic changes and the different directions assumed by them depending on whether the secreted gastric juice is lost or retained by the body indicate the presence of a humoral link in the regulation of the changes observed. This is also favored by literature data which point out the changes in the blood chemistry of dogs during sham feeding with an open and closed gastric fistula [5] as well as in man with relatively small losses of gastric juice [2].

SUMMARY

Reflex excitation of the gastric glands in sham feeding of dogs carried out for 5-9 days in succession with open and closed gastric fistula causes a prolonged change in the BMR (up to 25 days). Long-term secretion of the gastric glands, not connected with the loss of gastric juice, results in the decrease of the BMR. On the contrary, the loss of gastric juice by the body causes a prolonged rise in the BMR. The reflex mechanism is of the utmost importance in the changes of the BMR which appear during sham feeding. Prolonged changes in the BMR depending on whether the gastric juice which is secreted is retained or lost by the body point to a certain role played by the humoral factor in controlling these changes.

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