CHARACTERISTIC FEATURES OF THE EXCITABILITY OF THE FOOD CENTER IN PHYSIOLOGICALLY MATURE NEWBORN INFANTS

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Research conducted in our laboratory has shown that the behavior of the newly born organism immediately after birth is determined by two dominants: food and thermoregulation [5]. Little study has been made of the special features of the excitability of the food center in newborn infants, although this subject is interesting not only from the point of view of the physiology of these infants, but also because of the need for rationalizing infant feeding and establishing it on a sound hygienic basis.

Laboratory studies have shown that the food center of physiologically mature newborn infants possesses high excitability soon after birth [1, 7, 8, 10].

The object of the present investigation was to detect any changes in the excitability of the food center in the course of time when breast feeding is started late (12 h after birth), as is generally accepted.

EXPERIMENTAL METHOD

The degree of excitability of the food center in newborn infants is best characterized by the sucking reflex: ability to perform the act, its intensity, and its duration. Another index of the excitability of the food center is the volume of milk sucked from the mother's breast or from the bottle. To record the sucking reflex, the ordinary system of pneumatic transmission was used: the teat, placed in the infant's mouth, was connected through a system of tubes and a three-way cock to a Marey's capsule. The first recording of the sucking reflex was made from 10-15 min after birth. During the first 2 h after birth, recordings were made every 20-30 min, and then every 1-2 h for 12 h, i.e., until the first time the infant took the mother's breast. The volume of milk sucked by the infant was measured by test weighing in the usual manner.

The infants selected for the investigation were physiologically mature newborn infants, according to our suggested classification [3]. A sign of a physiologically immature newborn infant is the absence or feebleness of the sucking reflex. We recorded the sucking reflex in 36 infants, 3 or 4 times in each case. The number of test-weighed infants was considerably larger.

EXPERIMENTAL RESULTS

Experiments on newborn animals and observations on newborn children have shown that each successive excitation of the food center is brought about endogenously, as the result of the acquisition of "fasting" properties by the blood [1, 2, 9].

In the antenatal period the fetus obtains the nutrients it requires continuously from the maternal blood. After birth, as soon as the cord is tied, this influx of nutrient materials ceases. The blood of the newborn infant begins to grow poorer and poorer in nutrient materials, and the excitability of the food center is consequently increased. This is shown, on the one hand, by food-seeking movements and crying, and on the other by the sucking reflex. These signs of excitability of the food center are most marked during the first hour after birth. During this period the sucking reflex is characterized by the extent of its receptive field. Sucking movements and pursing of the lips may be elicited not only by introducing the nipple into the mouth, or by tactile stimulation of the mucous membrane of the lips and the skin of the cheek and chin, but also by tactile stimulation of more distant areas of skin. The last feature is a characteristic sign of the dominant mechanism of excitation of the food center in newborn infants.

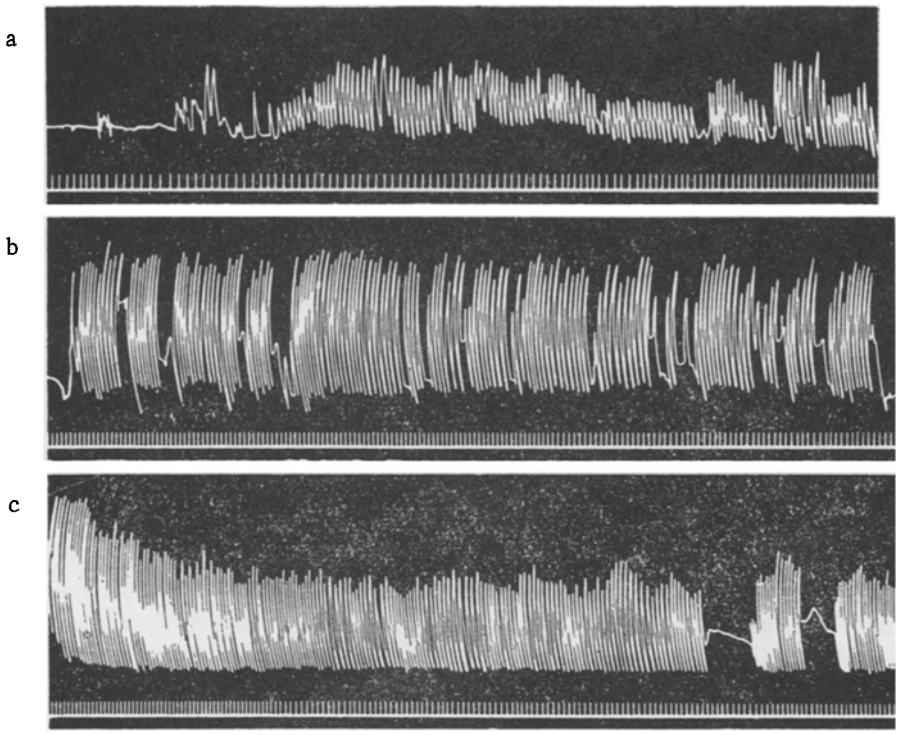

Fig. 1. Curves of the sucking reflex in the newborn infants at various times after birth: a) 25 min after birth; b) 55 min; c) 40 min.

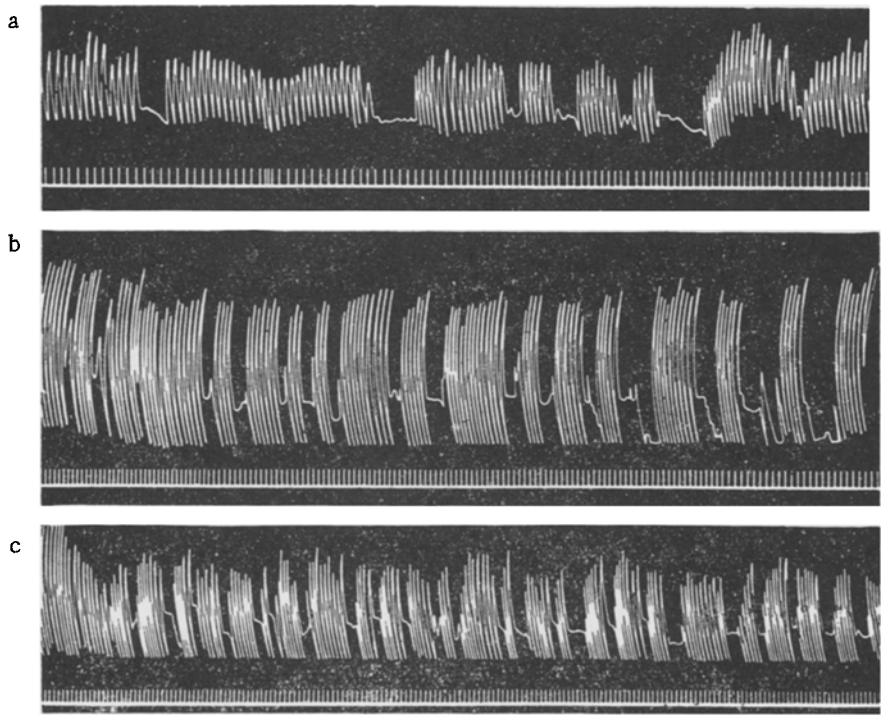

Fig. 2. The same as in Fig. 1: a) 30 min after birth; b) 40 min; c) 1 h 25 min.

In one group of infants, insertion of the teat into the mouth during the first hour after birth caused efficient sucking movements after 10-30 sec (Fig. 1a). In another group of newborn infants, they began as soon as the teat was inserted (Fig. 1b).

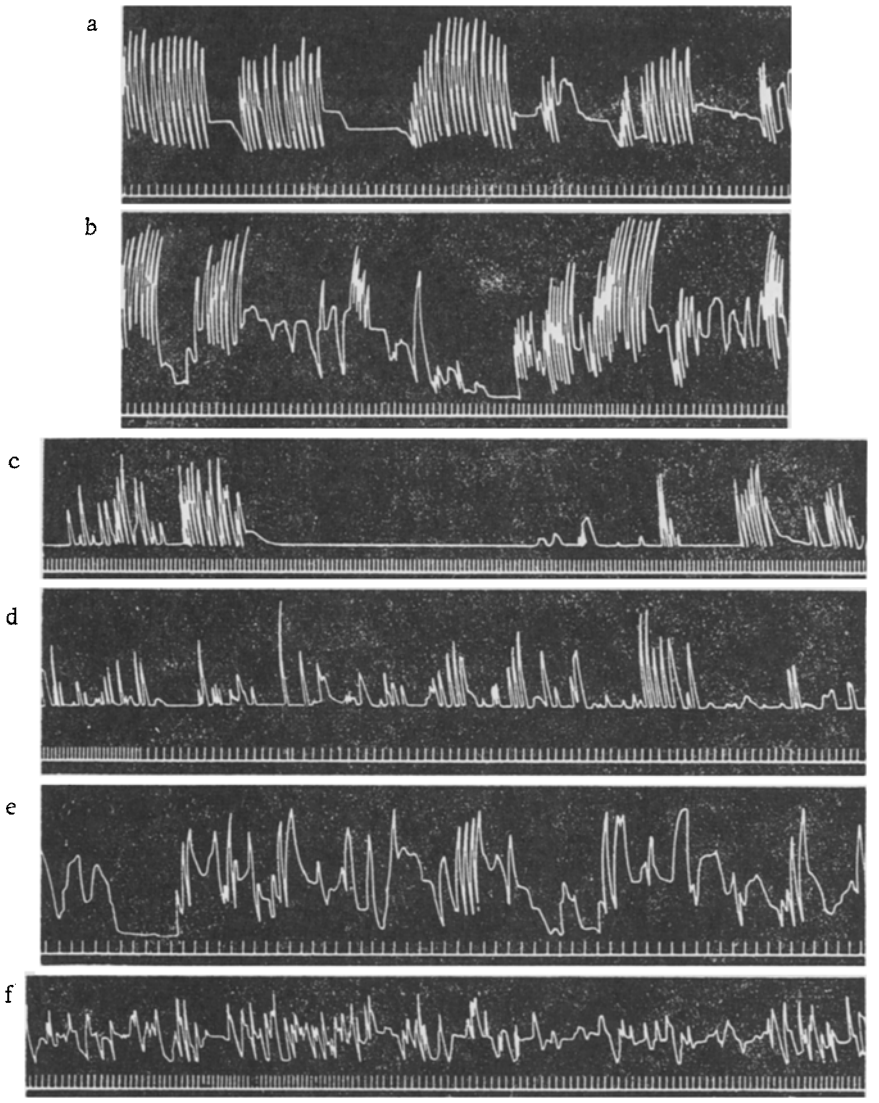

Fig. 3. The same as in Fig. 1: a) 2 h after birth; b) 3 h; c) 5 h; d) 6 h; e) 8 h; f) 11 h.

In some of the newborn infants the sucking movements were continuous or almost continuous. In individual infants the continuous sucking movements (during the first hour after birth) lasted 40-50 min. They then began to be punctuated by pauses, initially variable, and subsequently increasing in duration (Fig. 1c). The amplitude of the sucking movements thereafter gradually diminished, and the sucking movements became irregular and finally disappeared.

In other infants the sucking movements were periodic in character, as shown by the presence of a pause of varying duration after a certain number of sucking movements (Fig. 2a,b). One hour, or at the beginning of the second hour after birth, the pasues between the periods of sucking movements became more frequent, and the periods themsevles shorter (Fig. 2c). During the first hour after birth the periodic and also the continuous sucking movements sometimes lasted 40-60 min, after which the sucking reflex was gradually extinguished.

The manner of cessation of the sucking reflex just described must be distinguished from that usually found during feeding from the breast or bottle. In the latter case the cessation of sucking movements is an expression of inhibition of the food center. This inhibition is caused by afferent impulses from the mechenoreceptors of the wall of the stomach, stretched by the entry of milk [2,9]. In the former case the cessation of the sucking movements is an expression of depression of the food center, which is modified by the progressive impoverishment of the blood of the newborn infant in nutrient materials.

At the end of the second hour, and especially during the third hour after birth, the depression of the food center

became still more marked. By the second hour the food-seeking movements were gradually extinguished, and the infant stopped crying. The receptive field of the sucking reflex was gradually contracted. The infant now responded by pursing the lips and attempting to make sucking movements only if a tactile stimulus were applied to the receptors of the lips and the skin of the cheeks and chin, and made no response to stimulation of other parts of the body surface. When the teat was placed in its mouth, the child did not begin at once to make sucking movements, but reacted with lip movements of little use in the act of sucking. The pauses between the periods of sucking movements continued to lengthen (Fig. 3a). These manifestations were still more apparent 3 hours after birth (Fig. 3b).

With each succeeding hour, a more prolonged and extensive stimulation of the receptive field of the sucking reflex was required in order to elicit sucking movements. The reflex sucking movements which developed were of short duration and interrupted with pauses which became longer and longer (Fig. 3c, d). The receptive field of the sucking reflex continued to shrink. After the fourth, and especially after the sixth hour, the sucking reflex could be elicited only by plating the teat in the infant's mouth and only after a long latent period (1-2 min). The duration of the latent period was still longer 8-10 h after birth. After the sixth, and especially after the eighth hour, the sucking movements became increasingly haphazard in character (Fig. 3e, f).

Studies of the excitability of the food center of the newborn infants by means of estimation of the volume of milk sucked by them showed that during the first hour after birth the infants were able to suck 30-40 ml, or in some cases as much as 50 ml, of milk from the mother's breast or from the bottle, depending on the amount of amniotic fluid present in the stomach at birth. At or after the second hour, the volume of milk sucked from the mother's breast or from the bottle gradually decreased. Six hours after birth, for instance, the infant could suck out more than 10 ml of milk from the breast and not more than 15-20 ml from the bottle, and 12 hours after birth not more than 5 ml and 10-12 ml, respectively. When the nipple or teat was placed in the infant's mouth, it did not respond at once with a sucking reflex. As we stated above, the latent period was the longer, the later the child obtained its first feed. Despite the later start of breast feeding, in contrast to what was observed during the first hour after birth, the newborn infants displayed no reactions indicating a demand for feeding. The child did not cry and did not make sucking, feeding movements.

We may conclude from these findings that when the newborn infant is put to the breast late, the food center gradually loses its excitability in relation to the endogenously acting stimulus, the progressive impoverishment of the blood in nutrient materials. Reflex excitability isnot lost during the 12 hours after birth, but the extent to which it is shown diminishes from hour to hour.

These results indicate an analogy between the excitability of the food and respiratory centers in the newborn, which we have mentioned more than once before [2, 4]. In asphyxia neonatorum the respiratory center also loses its excitability in relation to the action of the humoral stimulus (carbon dioxide) and to oxygen lack, but continues for a long time to maintain its reflex excitability in relation to stimulation of the receptors of the nasal mucosa with ammonia vapor or pure oxygen.

When breast feeding is late in starting our observations show that reflex excitability of the food center may be maintained, although greatly diminished, for 24-36 h after birth.

SUMMARY

A study was made of the changes (in time) of the alimentary center excitation in physiologically mature neonates with a customary late beginning of maternal breast nursing (12 hours after birth). The alimentary center manifested the greatest excitability up to 1 hour following birth. From the second hour the excitability of the alimentary center dropped progressively. The capacity of the alimentary center for endogenic excitation is gradually lost due to progressive depletion of nutritive substances. The reflex excitation of the alimentary center, manifested by the appearance of sucking reflex only upon insertion of a nipple into the mouth, is still retained, but it also gradually diminishes with the time lapse following birth.

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