MEASUREMENTS OF THE ELASTICITY OF THE MAMMARY GLAND AS RELATED TO THE HUMAN MILK EJECTION REFLEX

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A. G. Ginetsinskii, V. F. Vasil'eva, M. G. Zaks, M. M. Sokolova, and V. A. Soo [1] have described how an elasticity measurement may be used to study the capacity of the human breast; the method was applied by V. A. Soo [3] to study the relation between pressure in the gland and the milk content, and pressure changes caused by pituitrin, which caused a contraction of the alveoli. In the present work we have used this method to study the milk ejection reflex during breast feeding.

METHOD

Observations were made between the 5th and 19th day after the onset of lactation on 59 women who were feeding their babies. In 41 cases it was the first child which was being fed, and in 18 cases other children had been born previously. We used the device developed by A. G. Ginetsinskii and his co-workers [1] and previously employed by V. A. Soo [3].

The principle of the method was as follows. A small metal disk with a conical elevation in the center is applied to the skin of the gland. A pendulum which takes the form of a small hammer supported on a horizontal axis falls from a certain distance on to the cone of the disk, and rebounds after it has struck it. The duration of the contact is measured by means of the deviation of the mirror of a ballistic galvanometer connected in an electrical circuit which is completed by the hammer as it falls on the cone, and broken when it rebounds. The greater the pressure in the mammary gland, the shorter is the period of contact. Measurements were begun 15-20 minutes before feeding.

The disk was applied to the breast from which the infant was to feed; then six to eight changes in pressure were rapidly applied at approximately 1 minute intervals. The disk was then transferred to the opposite gland, from which the infant had fed the previous time, and a further six to eight corresponding measurements were made. The infant was then handed to the mother, and after the breast had been prepared in the usual way, breast feeding commenced. During the whole of the feeding time, and 8-10 times afterwards, pressure measurements were made in the opposite breast. The disk was then again transferred to the opposite side, and the measurements repeated on the breast from which the infant had fed. The amount of milk taken was measured by weighing the infant.

RESULTS

During feeding, considerable pressure changes are produced in the opposite breast.

Figs. 1 and 2 illustrate the most typical reactions.

In some cases (see Fig. 1) the pressure in the opposite breast increased rapidly, and then fell equally rapidly and remained low for the whole of the feeding time, and after feeding it rapidly returned to its original value. In other cases, there was again a rapid increase in pressure, which then underwent rhythmical changes, rising and falling alternately. At the end of feeding the pressure in the opposite breast returned, as before, almost to its

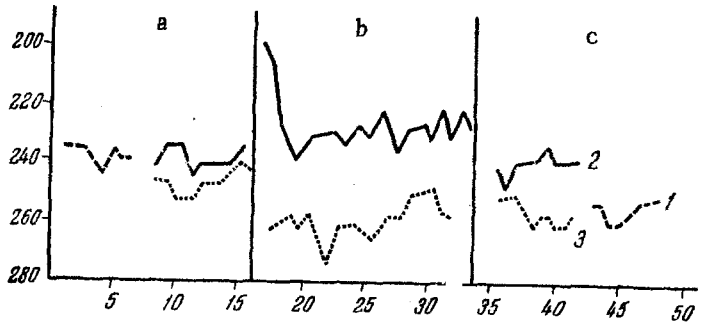

Fig. 1. Pressure changes in the mammary glands in subject I. A. during feeding, 6th and 16th days of lactation. Abscissa – time (in minutes); ordinate – pressure in the mammary gland expressed in arbitrary units (millimeters of the galvanometer scale). a,b,c) different periods of breast feeding; 1) change in the pressure in the breast in use before and after feeding; 2) same, on the opposite side on the 6th day of lactation; 3) response of the opposite breast on the 16th day of lactation.

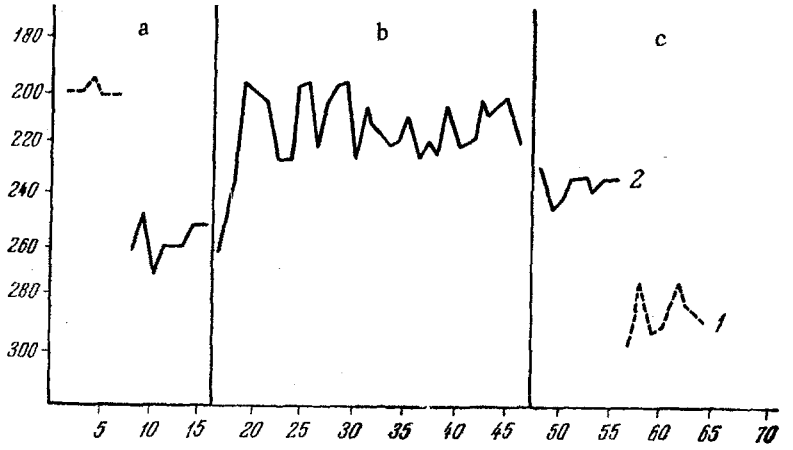

Fig. 2. Reaction of the mammary gland to feeding. Subject L. V., 7th day of lactation. Indications as in Fig. 1. 1) Change in tension in the breast in use, before and after feeding; 2) same,on the opposite side.

original value. Finally, in some cases (see Fig. 2) there was an initial quick rise, after which the pressure remained elevated, and continued elevated even after feeding had ceased.

According to reports, feeding causes an increased pressure in the opposite breast. In the publications to which we have referred, it was shown that this increase occurred either because of an expansion of the internal spaces of the gland (its volumetric system) caused by engorgement with milk, or, when the amount of milk remained unchanged, through a contraction of the contractile elements of the walls of the alveoli and ducts. Relaxation of the contractile elements or emptying of the gland causes a reduction in pressure.

In our experiments, there was no reason to suppose that there was any appreciable change in the amount of milk on the opposite side. Therefore all the pressure changes which were recorded (either increases or decreases) were due to the tone of the contractile elements. The initial increase in pressure was evidently due to the oxytocin reflexly secreted by the neurohypophysis, which is stimulated by the act of breast feeding; the oxytocin reaches the alveoli, and stimulates the contraction of the myoepithelium. The subsequent response of the unused breast shows many individual variations, but there is a common tendency: the pressure returns to its original level, and the initial effect of oxytocin is not maintained. In some cases the readjustment occurs rapidly (see Fig. 1), in others it is less complete, and sometimes (see Fig. 2) there is hardly any stabilization. Presumably, this stabilization of the pressure in the unused breast is associated with the reflex reduction in the tone of its contractile elements in

response to the increased pressure in the volumetric system. A reflex relaxation effect of this kind has been studied by detailed observations on cows [2]. It has an important adaptive significance, because it prevents the development of an excessive pressure in the gland, which could prevent milk excretion.

The results we have obtained indicate that in women this relaxation reflex is very well developed. It may be that the ability to cause a great reduction in the tone of the contractile elements in response to an increased pressure compensates for the development of a moderate pressure in the volumetric system.

The three characteristic types of reaction of the unused breast indicate apparently that the unconditioned relaxation reflex may be developed to various extents during the first few days of lactation. The evidence is that as lactation develops, the reaction of the unused breast may change considerably. A typical example of such changes is shown in Fig. 1. It can be very clearly seen that during the ten days which elapsed between the first and second measurements, the relaxation reflex has become considerably enhanced; consequently feeding takes place without any appreciable increase in pressure occurring in the opposite breast.

We must also consider the pressure changes occurring in the used breast after feeding. V. A. Soo [3] has shown that the pressure increases in the time intervals between feeding, and falls considerably immediately after the breast has been emptied. However, she did not investigate the direct relationship between the amount of milk removed from the gland during feeding and the gradual fall in pressure. We have made such measurements, and they are shown in Fig. 3.

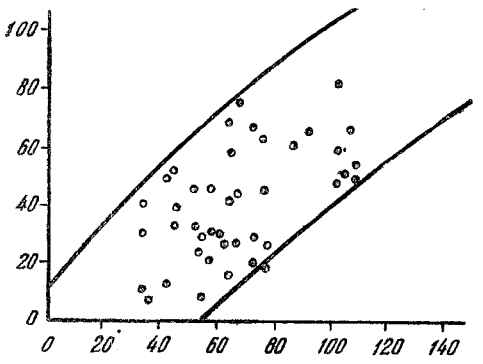

Fig. 3. Relationship between the fall in pressure and the amount of milk withdrawn. Abscissa – amount of milk withdrawn by infant (in ml); ordinate – fall in pressure in the breast after feeding (in mm of the galvanometer scale).

The relationship between the amount of milk removed by the infant and the fall in pressure is very clearly shown. Naturally, there is a considerable variation between different experiments, but the limits of these variations are very clearly defined, and the nature of the relationship is well shown.

Our results therefore confirm the work of V. A. Soo, who proposed that the rise in pressure in the mammary gland after feeding is due to the accumulation of milk.

SUMMARY

Mammary gland function was studied by measuring its tension. The changes in tension were measured during milk discharge. At first the tension in the opposite gland was found to rise, but it then fell to approximately the initial level. The pressure reduction is due to a special relaxation reflex which prevents the development of an excessive pressure. A relationship was established between the elastic tension in the gland and the amount of milk removed from it.

LITERATURE CITED

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