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SHORT-TERM AND LONG-TERM EFFECT OF OXYTOCIN ON THE MORPHOLOGY AND FUNCTIONAL ACTIVITY OF FEMALE RAT SUBCUTANEOUS ADIPOSE TISSUE

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ABSTRACT. The aim of the present work was to study the short-term and long–term effect of Oxitocin on the morphology and functional activity of the adipose tissue of adult female rats. Short-term Oxitocin effect was studied on 5 rats, each treated with a single injection of 0.008 IE Oxytocin s.c.; long-term effect – on 5 rats, treated for 10 days with 0.008 IE Oxytocin per day s.c.; 5 rats (injected with acquaous solution of Natrium chloratum 0.9% s.c. in the same way) were used as controls. After the last application fragments of subcutaneous tissue from the femoral region of each animal were resected and frozen at
–18° C. On consequent fresh cryostat sections staining with hematoxylin-eosin and SudanIII–hematoxylin (for lipids demonstration by Daddi, 1896), as well as enzymehistochemical reactions for NADH2-cytochromC-reductase, Glucoso-6 phosphase-dehydrogenase, lactat dehydrogenase and lipoprotein lipase were carried out. The results demonstrated that short-term treatment with Oxytocin did not effect the morphology and functional activity of the rat subcutaneous tissue. The adipose tissue of the long-treated animals demonstrated some changes in comparison with the controls: among the typical unilocular aipocytes some multilocular fat cells (with several lipid droplets and centrally located nucleus) appeared. These multilocular adipocytes expressed positive activity for NADH2-cytochrom C-reductase, Glucoso-6 phosphase-dehydrogenase, lactat dehydrogenase and lipoprotein lipase. The data suggest that Oxytocin induces an effect on rat adipose tissue and it depends on the prolongation of the treatment.

KEY WORDS. Oxytocin, adipocytes, rat

INTRODUCTION

Update it is proved that a lot of factors influence the morphology and functional activity of the adipose tissue. Eating increases adipose tissue lipoprotein lipase activity (1). Some other authors (2) report that exercise increases the amount of hormone-sensitive lipase in intraabdominal adipose tissue. The regulatory role of growth factors, vitamins, steroid and non-steroid hormones has gained a considerable interest. Most of the investigations in this field are carried out mainly in primary cultures of stromal-vascular cells of adult adipose tissue (3,4). There are studies reporting the effect of insulin, dexamethasone, growth hormone, etc. on adipoconvertion and adipocytes enzyme activity in primary cultures (5,6,7,8). There is evidence for sex steroid inhibition of lipoprotein lipase in men (9). But as a whole little is known about the precise mechanisms of hormonal regulation and hormonal effects on the morphology and functional activity of adipose tissue in vivo.

Oxytocin is a nonapeptide secreted by the magnocellular neurons of the hypothalamus and acting as a hormone. Oxitocin was found to be produced in testis and ovary where it exherts a modulating effect on steroidogenesis (10). Recently some reports appeared about its effect on the function and morphology of adrenal cortex cells in vivo and in vitro where it was proved that the hormone stimulated steroidogenesis (13,14). There is scarce information in literature concerning the involvement of Oxytocin in the regulation of follicular and luteal ovarian cell steroidogenesis (10). No data is available about the effect of Oxytocin on the adipocytes, which might shed some light on the role of the hormone on the adipose tissue during pregnancy and lactaion – the time when its main action takes place.

The aim of the present investigation was to study the short-term and long-term effect of Oxytocin on the morphology and functional activity of the subcutaneous adipose tissue of adult female rats in situ.

MATERIAL AND METHODS

Fifteen female Wistar rats (130-150 g.; water and food ad libitum) were used for the experiment. Short-term Oxytocin effect was studied on 5 rats, each treated with a single injection of 0.008 IE Oxytocin s.c.; long-term effect – on 5 rats, treated for 10 days with 0.008 IE Oxytocin per day s.c.; 5 rats (injected with acquaous solution of Natrium chloratum 0.9% s.c. in the same way) were used as controls. At the end of the experiment (after the last application) fragments of subcutaneous tissue from the femoral region of each animal were resected and frozen at –18° C. On consequent fresh cryostat sections staining with hematoxylin-eosin and Sudan III – hematoxylin (for lipids demonstration) by Daddi, 1896, as well as an enzymehistochemical reaction for NADH2-cytochrom C-reductase, Glucoso-6 phosphase-dehydrogenase, lactat dehydrogenase (Hess et al., 1958) and lipoprotein lipase (Gomori, 1952) were carried out. In the controls of the reactions were fulfilled without substrates.

RESULTS

Our histological and histochemical investigations revealed that a short-term treatment with Oxytocin did not affect the rat subcutaneous adipose tissue. It preserved its

normal morphology, which did not differ from the morphology of the adipose tissue of the control animals. I.e. it consisted of packets of mature-like unilocular fat cells, each of which contained one large lipid drop occupying almost the whole cell and scant cytoplasm and flattened nucleus pushed to the periphery. (fig.1,)
The adipose tissue of the Oxytocin long-term treated animals demonstrated some changes. It consisted of packages of typical mature-like unilocular adipocytes and some multilocular fat cells among them. The multilocular adipocytes contained several different in size lipid droplets and a centrally located nucleus. (fig.2)
The enzymehistochemical study of the three groups (short term treated animals, long-term treated animals and the controls) showed that positive reactions for NADH2-cytochrom C-reductase, Glucoso-6 phosphase-dehydrogenase, lactat dehydrogenase and lipoprotein lipase were demonstrated only in the multilocular adipose cells, present in the adipose tissue of the Oxytocin long-term treated rats. (fig.3) No enzymehistochemical activity was detected in the unilocular fat cells.

DISCUSSION

Our results indicate that only a long-term treatment with Oxytocin affects the functional activity and the morphology of the adipose tissue. The hormone exerts a stimulatory effect on the activity of lipoprotein lipase in the adipocytes of the long-term treated animals. Bearing in mind that lipoprotein lipase has been proved to be the key enzyme of adipocyte proliferation and differentiation in vitro and in vivo (14), as well as important for the intracellular turnover of fatty acids in adipose tissue (15), the data make us think that Oxytocin may be leads to a push in the adipocyte differentiation of the progenitor cells that are present in the adult adipose tissue. The observed by us multilocular adipose cells after a long-term Oxytocin treatment might be accepted as those stimulated for differentiation and maturation progenitor adipose cells.
The mechanisms of the effect of Oxytocin remain to be elucidated. We think that one of the possibilities is that it might act via the steroid hormones for which it has been reporeted to have a stimulatory influence on adipocyte development (5,6,7). Recent studies demonstrated that the nonapeptide hormone Oxytocin stimulated the function and morphology of adrenal cortex cells in vivo and in vitro (11,12), as well follicular and luteal ovarian cell steroidogenesis (13). Having in mind that Oxytocin affects steroidogenic activity of adrenal cortex cells (16) and steroid hormones enhance adipocyte development a relatioship between both processes might be supposed. Another mechanism of the Oxytocin effect could be supposed, too – a direct stimulatory effect of the hormone on adipose tissue via Oxytocin receptors in the adipocytes. This hypothesis remains to be proved.

CONCLUSION

Our findings demonstrated that Oxytocin has an influence on the adipose tissue of adult female rats. The effect of the hormone depends on the duration of treatment.

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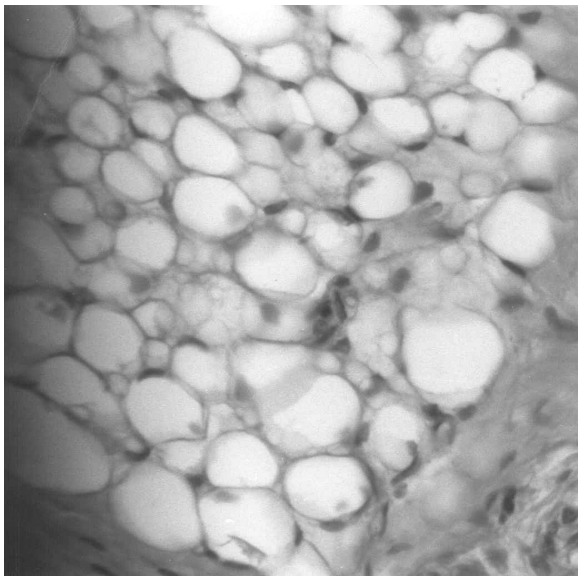

Fig.1 A fat lobule of unilocular adipose cells in rat subcutaneus adipose tissue. Short-term Oxytocin treatment. Cryostat section. Hematoxylin-eosin staining. Magn. X200.

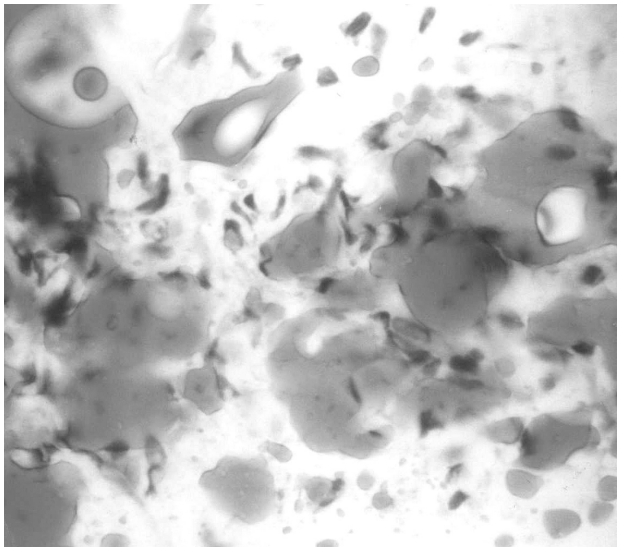

Fig. 2 A fat lobule of rat subcutaneus adipose tissue. Unilocular and multilocular adipose cells. Long-term Oxytocin treatment. Cryostat section. Sudan III - hematoxylin staining. Magn. X200.

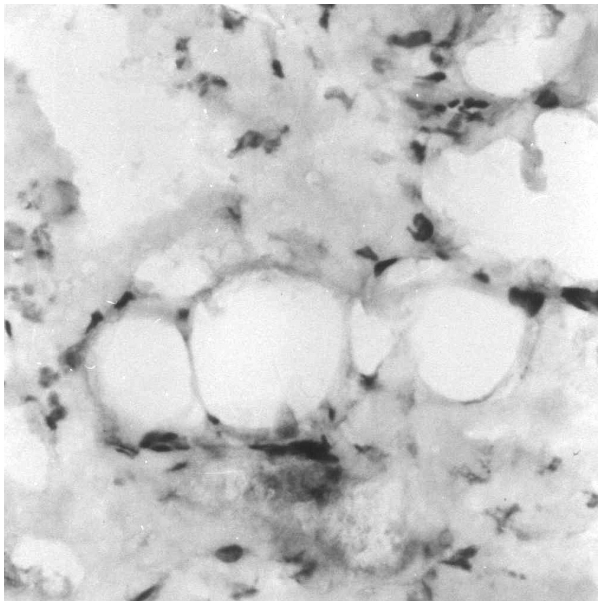

Fig.3 Lipoprotein lipase activity in multilocular adipose cells in rat subcutaneous adipose tissue. Long-term Oxytocin treatment. Magn. X400.