PRELIMINARY COMMUNICATION

Effect of Cigarette Smoking on Fetal Breathing Movements in Normal Pregnancies

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Summary

In 18 women with uncomplicated pregnancies smoking two cigarettes significantly reduced the proportion of the time that fetal breathing movements were present.

Introduction

Observations on human fetal breathing movements as measured by an ultrasound A-scan method (Boddy and Robinson, 1971; Boddy and Mantell, 1972) showed that they give a direct measure of fetal health and wellbeing and may warn of impending trouble (Boddy and Dawes, 1975; Boddy *et al.*, 1975). It was noticed that in high-risk pregnancies the fetuses of women who smoked during the observation made breathing movements for a smaller proportion of the time. Thus we undertook a systematic investigation to determine the effect of cigarette smoking on the incidence of fetal breathing movements in normal pregnancies.

Methods

Eighteen women with uncomplicated pregnancies of 32-38 weeks of gestation were studied. All were subsequently delivered of normal, healthy infants; 10 were primiparae. All smoked at least five cigarettes a day and many up to 20 a day. They all abstained from smoking for at least 12 hours before the study.

The proportion of the time that fetal breathing is present varies with the time of day, rising from about 45% in the early hours of the morning to nearly 90% in the early evening (Boddy and Dawes, 1975; Boddy *et al.*, 1975). The observations reported here were therefore made between 09.00 and 11.30 hours. All the women had a normal breakfast, which increases the incidence of fetal breathing from its low overnight value.

The fetal chest wall movements were recorded using a Smith-Kline Ekoline 20 ultrasonoscope (Boddy and Robinson 1971). The ultrasound beam was directed to the fetal heart and the movement of the thoracic cage was detected and recorded on a Devices pen recorder. After observation for a control period of 20-70 minutes the woman smoked consecutively two cigarettes of her own brand and in her normal fashion. The onset of smoking and its duration were noted not on the record but separately. Fetal chest wall movements were recorded for 90 minutes after the onset of smoking.

Fetal chest wall movements are not continuous, a burst of movement being interspersed with periods of apnoea. The proportion of the time that fetal chest wall movements were present was recorded in each successive five-minute period. To avoid bias in evaluating the records the duration of the control period was deliberately varied. Six records were cut into five-minute periods, coded, randomized, and analysed. The results were similar to that of the other 12, intact records. Analysis by a second, independent observer gave the same results.

Results

In each of the 18 women the smoking of two cigarettes caused a fall in the proportion of the time that fetal breathing movements were observed. During the control period (mean 40 minutes) fetal chest wall movements were present for an average of 65% of the time (see fig.). Within five minutes after beginning the first cigarette the proportion of the time that fetal breathing movements were present had fallen to 50%. The mean duration of smoking was $18 \pm \text{S.E. } 1$ minute. The incidence of fetal breathing movements fell to a minimum of 45% at about 35 minutes. It returned towards the control value about an hour after the second cigarette was finished. The reduction in fetal breathing movements was statistically highly significant ($P < 0.001$).

Mean proportions of the time ($\pm$ S.E.) that fetal breathing movements were present in 18 normal pregnant women at 32-38 weeks of gestation. Two cigarettes smoked consecutively caused highly significant reduction in incidence of fetal breathing movements.

The mean duration of apnoea was increased from the control value of $5.6 \pm \text{S.E. } 0.34$ second to a maximum of 9.2 ± 1.6 seconds 30 minutes after the onset of smoking. The longest period of apnoea seen in the control period was 20.3 ± 1.5 seconds; this reached a maximum of 42.0 ± 7.3 seconds 35 minutes after the onset of smoking. With the present method of recording movements of the chest wall, continuous accurate determination of the irregular fetal breathing rate is difficult. In three records there was a small increase in the rate after maternal smoking.

Discussion

Breathing movements before birth in sheep and man are episodic and irregular. Their frequency is increased by hypercapnia in sheep, and probably also in man, yet measurements of rate have not yet proved a useful guide to fetal health. On the other hand, measurements of the proportion of the time that fetal breathing movements are present do provide useful information on the state of the fetus (Boddy and Dawes, 1975; Boddy *et al.*, 1975).

Our results show that smoking two cigarettes consecutively affects fetal respiratory movements. It is less easy to determine the mechanism responsible. The result could have been due to actions on the mother—for example, a reduction in maternal placental blood flow leading to fetal hypoxia—or on the fetus—for example, by the placental transfer of some constituent of tobacco smoke such as nicotine. It could have been due to the nicotine content of the cigarette or to the carbon monoxide generated. Preliminary observations with cigarettes which do not contain nicotine suggested that smoking them does not alter

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fetal breathing movements; but further control studies will have to be done to exclude the possibility of the degree of inhalation varying with the type of cigarette.

Cigarette smoking in pregnancy is suspected of being detrimental to the fetus. Statistical surveys have shown that the babies are smaller at birth (Butler *et al.*, 1972) and suggested an increase in prematurity and perinatal mortality. It is not easy to relate our observations on the acute effects of smoking two cigarettes to the long-term epidemiological reports. Nevertheless, physiological factors such as hypoxia and hypoglycaemia, which might be expected to have a detrimental effect on the fetus, also reduce the normal incidence of fetal breathing movements in animals and man (Boddy and Dawes, 1975; Boddy *et al.*, 1975). Whether the similar effect of cigarette smoking is to be interpreted in the same way is as yet a matter for conjecture. The size of the transient change observed (see fig.) was less than the normal diurnal variation in the incidence of fetal breathing.

We make this report because clinical physiologists and

obstetricians in several countries are beginning to use fetal breathing movements as an index of health. These observations are best made some hours after the last cigarette has been smoked to exclude the acute effects of this variable.

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References

- Boddy, K., and Dawes, G. S. (1975). *British Medical Bulletin*, 31, 3.
 Boddy, K., and Mantell, C. D. (1972). *Lancet*, 2, 1219.
 Boddy, K., and Robinson, J. S. (1971). *Lancet*, 2, 1231.
 Boddy, K., Dawes, G. S., and Robinson, J. (1975). *Modern Perinatal Medicine*, chapt. 27. Chicago, Year Book Medical Publishers. In press.
 Butler, N. R., Goldstein, H., and Ross, E. M. (1972). *British Medical Journal*, 20, 127.

MEDICAL MEMORANDA

Neutral-lipid Storage Disease: A New Disorder of Lipid Metabolism

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In 1953 Jordans described two brothers with progressive muscular dystrophy whose leucocytes and monocytes contained large fat vacuoles. Rozenszajn *et al.* (1966) later reported a similar abnormality in the white blood cells of two sisters who also had ichthyosis but no evidence of myopathy. We report here a similar abnormality of leucocytes, which was, however, part of a generalized accumulation of neutral lipid droplets in most cells of the body and which differed from known lipid-storage disorders in many significant respects.

Case Report

A 22-year-old Ugandan Asian woman presented in the dermatology outpatient department with a scaly generalized skin disorder which had been present all her life and which was associated with itchiness of the skin. It affected the face, trunk, and limbs, including the flexures, and was diagnosed as lamellar ichthyosis. She had no other complaints and coped adequately at work. Her diet was vegetarian with milk daily and occasional eggs.

Examination.—Apart from a generalized skin disorder an examination showed a slightly plump healthy girl (height 157 cm, weight 62 kg) of normal intelligence. There was no lymphadenopathy, and spleen and liver were not palpable. Examination of all systems showed nothing abnormal.

The blood count showed an iron-deficiency anaemia (haemoglobin concentration 8.2 g/dl) due to menorrhagia, which responded fully to oral ferrous sulphate.

FIG. 1—Neutrophil polymorph leucocyte showing multiple clear lipid vacuoles (a) and eosinophil polymorph leucocyte showing multiple clear lipid vacuoles (b).

The stained blood film, in addition to hypochromia, showed multiple vacuoles up to 1.2 μ m in diameter in the cytoplasm of neutrophil, eosinophil, and basophil polymorphs and in monocytes (fig. 1). These were not seen under ordinary microscopy in lymphocytes nor in red cells. These vacuoles took up fat stains, such as oil red-O. There were no acanthocytes. Three siblings and two cousins did not have similar blood abnormalities.

Distribution of Lesions.—All investigations were performed with the patient's informed consent. On the advice of a gynaecologist a curettage was carried out because of her menorrhagia.

Sternal Marrow.—Lipid vacuoles were present in the granulocytic series, in monocytes, but not in erythroblasts or megakaryocytes. Vacuoles were absent in myeloblasts, relatively small and often solitary in promyelocytes, and more prominent in myelocytes and particularly metamyelocytes. Plasma cells showed similar vacuoles.

Gastrointestinal Tract.—There was a striking vacuolation of the columnar epithelial cells beginning about one-sixth of the way up the villi and increasing until maximal in cells of the villus tip. Within a single cell vacuoles were multiple and dispersed through the cytoplasm. Goblet cells showed scanty vacuolation as did Paneth cells at the base of the crypts. Scanty foamy macrophages were found in the lamina propria.

Similar vacuolation was found in the rectal epithelium, most marked in a subnuclear distribution. Foamy macrophages and free lipid were prominent in the lamina propria. A biopsy specimen from the body of the stomach showed vacuolation and lipid deposition in the glandular cells, but this was lacking in gastric pits and the surface mucosa.

Skin.—There was hyperkeratosis with some parakeratosis and focal spongiosis. There was a mild perivascular chronic inflammatory

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