

# EFFECT OF SIX-DAY HYPOKINESIA ON OXYGEN METABOLISM IN OLD AGE

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After six days of strict confinement of elderly and old people to bed the oxygen supply of the subcutaneous cellular tissue is depleted and the intensity of its tissue respiration is slightly lowered. The oxygen uptake of the blood and urine, the coefficient of incomplete oxidation, and the oxygen deficit of the body are increased.

Hypokinesia is an important factor in premature aging [5, 7, 9, 10]. In connection with the role of oxygen deficiency in the development of senile changes [4, 6, 8] the study of the effect of hypodynamia on the parameters of oxygen metabolism and oxidoreduction processes in elderly and old people is of particular interest.

The object of this investigation was to study the effect of hypokinesia on the absorption of oxygen, its partial pressure in the tissues, and the content of incompletely oxidized products in elderly and old people.

## EXPERIMENTAL METHOD

The partial oxygen pressure ( $pO_2$ ) was determined in the subcutaneous cellular tissue of the left forearm by a polarographic method. The active cathode was a bare platinum wire electrode 0.4 mm in diameter and the reference anode a Ag-AgCl electrode applied to the distal third of the right leg. A steady voltage of 0.7 V was applied to the electrodes for the measurements. Graphic records were obtained by means of a type ÉPP-09M3 automatic electronic potentiometer through an F166/1 photocompensation amplifier. The results were expressed in mm Hg and the electrode was calibrated after each investigation in physiological solutions with known  $pO_2$ .

Inhalation of oxygen for 10 min and compression of the limb vessels for 10 min were used as function tests to assess the oxygen supply to the subcutaneous cellular tissue and the intensity of its oxygen consumption. The dosage of oxygen was measured and the oxygen load recorded by the SG-1m spiograph. The spiographic investigation also enabled the oxygen absorption and its deficit in the body to be determined [3].

The content of incompletely oxidized products in the blood was determined by Roman's method with a correction for sugar by the Hagedorn-Jensen method and for chlorides by Levinson's method. The oxygen uptake of the urine was determined by Brin's micromethod with correction for chlorides by Mohr's method, and the nonprotein nitrogen of the urine was determined by a semimicro-Kjeldahl method.

Altogether 21 clinically healthy males aged 60-74 years (elderly) and 75-89 years (old) were investigated before and after strict confinement to bed for six days.

## EXPERIMENTAL RESULTS

After strict confinement to bed of the elderly and old people the increase in  $pO_2$  in the subcutaneous cellular tissue during inhalation of oxygen fell from  $38.2 \pm 4.69$  to  $24.4 \pm 3.21$  mm Hg ( $P < 0.02$ ), reflecting

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TABLE 1. Effect of Hypokinesia on Indices of Oxidoreduction in Elderly and Old Persons ( $M \pm m$ )

Index	Before hypokinesia	After hypokinesia	P
Oxygen uptake of 24-h urine (in g) . . . . .	9,08 $\pm$ 0,91	11,5 $\pm$ 0,52	<0,05
Coefficient of incomplete oxidation . . . . .	1,14 $\pm$ 0,034	1,36 $\pm$ 0,059	<0,001
Oxygen uptake of blood (in mg %) . . . . .	233 $\pm$ 9,08	270 $\pm$ 9,71	0,01

impairment of the oxygen supply to the subcutaneous cellular tissue. There was a tendency toward an increase in the latent period of decrease of  $pO_2$  in the subcutaneous cellular tissue on the change from oxygen inhalation to inhalation of air ( $41,6 \pm 4,24$  sec compared with  $34,4 \pm 4,12$  sec before hypokinesia;  $0,2 < P < 0,3$ ), and also in the vessel compression test ( $11,9 \pm 1,55$  sec compared with  $8,6 \pm 0,2$  sec;  $0,05 < P < 0,1$ ).

These parameters reflect the intensity of tissue respiration and they rise as the intensity falls [2]. That the observed tendency for the oxygen consumption of the subcutaneous cellular tissue to fall after hypokinesia is a real one is confirmed by the fact that, despite the marked reduction in the increase in  $pO_2$  during oxygen inhalation under these conditions, the duration of stabilization of  $pO_2$  on the change from oxygen inhalation to air inhalation was virtually unchanged ( $483,6 \pm 31,2$  and  $473,2 \pm 27,39$  sec respectively). In addition, despite the impairment of the oxygen supply to the subcutaneous cellular tissue, the value of  $pO_2$  in this tissue for the elderly and old persons after hypokinesia remained virtually at the initial level ( $48,6 \pm 2,62$  mm Hg).

After the course of hypokinesia the oxygen absorption of the elderly and old persons was unchanged ( $214,2 \pm 20,12$  ml/min compared with the initial  $228,9 \pm 8,54$  ml/min). The oxygen uptake of the blood and 24-hour urine and the coefficient of incomplete oxidation were increased in the elderly and old persons after confinement to bed for six days (Table 1). The significant increase in the concentration of incompletely oxidized products in the blood and urine reflects impairment of oxidoreduction under the conditions of hypokinesia leading to less complete oxidation of metabolites. The increase in the coefficient of incomplete oxidation is evidence of less complete oxidative reactions.

Excessive absorption of oxygen from hyperoxic mixtures compared with the absorption of oxygen during inhalation of air (the oxygen deficit) is known to be due to the accumulation of metabolites whose oxidation requires the consumption of an additional quantity of oxygen in the body [1, 11]. For that reason the increase in the oxygen deficit observed in the elderly and old subjects after hypokinesia for six days ( $24,8 \pm 3,76\%$  compared with  $12,2 \pm 1,33\%$ ;  $P < 0,003$ ) can be explained by the increased level of incompletely oxidized products detected under those conditions.

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