A correlation between Paco_2 and body temperature in febrile patients

GASTON CHAPOT, MICHÈLE MULLER, NICOLE BARRAULT, NICOLE DARGNAT, and JEAN-MICHEL LANGUILLAT

*Laboratoire de Physiologie, Faculté de Médecine, 45 rue des Saints-Pères, Paris 6° and
Laboratoire de Mesure des Gaz du Sang, Hôpital de l'Hôtel Dieu, Paris 1°, France*

Chapot, G., Muller, Michèle, Barrault, Nicole, Dargnat, Nicole, and Languillat, J-M. (1974). Thorax, 29, 104-105. A correlation between Paco_2 and body temperature in febrile patients. Paco_2 has been measured in 49 patients with normal and raised body temperature. Within the temperature range 35.5°C - 41.4°C , there was an inversely proportional relationship between Paco_2 and body temperature with a highly significant correlation coefficient.

The value of Paco_2 in man is close to 40 mmHg under normal resting physiological conditions. We wondered whether this value would be altered by changes in body temperature since temperature and respiration are related (Chapot, 1967), as are Paco_2 and temperature in different homeothermic species with different basal temperature (Chapot, Barrault, Muller and Dargnat, 1972). This study was planned to investigate a possible relationship between raised body temperature and arterial carbon dioxide tension.

PATIENTS AND METHODS

Forty-nine febrile hospital patients were studied. They included 13 with influenza, 14 with malignant blood disorders, 11 with various infections, and 11 post-operative subjects. Patients with respiratory disorders or diabetes were excluded.

Blood was sampled from the femoral artery, the analysis being performed within 15 minutes of arterial puncture. Measurement of Paco_2 and arterial pH were performed with an IL meter. Patients' rectal temperatures were measured just before sampling. The temperature of the IL meter was adjusted to within 1°C of that of the patient, and the calibration was performed under these conditions. The correction of results as a function of this temperature difference, although very slight, was made according to Severinghaus's tables (Bradley, Stupfel, and Severinghaus, 1956; Severinghaus, 1965).

RESULTS

The results are recorded in the Table. The Pao_2 is not significantly changed, but pH values, although scattered over a wide range are, on

TABLE
BLOOD GASES AND pH IN FEBRILE PATIENTS

Patient	Rectal Temperature ($^\circ\text{C}$)	Paco_2 (mmHg)	pH	Pao_2 (mmHg)
1	38.5	41	7.44	92
2	37.6	37	7.40	97
3	36.1	35	7.44	95
4	35.8	44	7.41	98
5	37.2	44	7.40	90
6	39.1	38	7.50	91
7	38.2	42	7.43	97
8	37.2	45	7.36	85
9	39.5	37	7.45	90
10	38	32	7.50	98
11	40.6	21	7.54	95
12	38.6	33	7.49	95
13	38	37	7.47	97
14	39.2	35	7.58	95
15	38	30	7.48	101
16	37.2	44	7.40	98
17	38.3	40	7.41	92
18	35.6	48	7.40	91
19	36.8	36	7.52	96
20	39.8	34	7.52	97
21	41.4	24	7.46	83
22	38.6	33	7.40	89
23	37.6	40	7.55	105
24	40.4	29	7.41	103
25	37.2	38	7.50	97
26	40.6	37	7.45	93
27	36.1	39	7.41	93
28	37.8	44	7.44	92
29	38.7	38	7.38	95
30	36.5	47	7.45	97
31	37.4	35	7.45	97
32	40.2	22	7.40	94
33	36.6	36	7.48	104
34	41.2	28	7.38	48
35	36.8	47	7.42	85
36	37.4	43	7.47	100
37	36.6	34	7.50	89
38	38.6	29	7.48	87
39	38.2	34	7.39	92
40	36.6	49	7.45	96
41	40.5	32	7.46	97
42	36.9	45	7.41	98
43	36.2	39	7.43	85
44	39.3	40	7.43	91
45	39.6	32	7.41	95
46	38.8	41	7.46	100
47	39.5	25	7.43	106
48	37.2	33	7.49	94
49	39.4	30

FIGURE. The relationship between arterial carbon dioxide tension and rectal temperature in 49 subjects.

average, higher than normal and show a significant correlation with body temperature. The Paco_2 shows a highly significant inverse correlation with body temperature (Figure). The spread of the points is quite small considering the diversity of complaints of the patients. The equations for the straight line relationships between Paco_2 and temperature and between pH and temperature are:

$$\text{Paco}_2 = -3.06T + 153.6 \quad (r=0.68)$$

$$\text{pH} = 0.02T + 6.7 \quad (r=0.62)$$

where T is the rectal temperature in centigrade and r is the correlation coefficient. The level of significance for the relationship between Paco_2 and temperature is $P < 0.001$ as compared with $P > 0.1$ for the relationship between PaO_2 and temperature.

DISCUSSION

The variation of Paco_2 as a function of body temperature has not, to our knowledge, been studied in febrile patients, though it has in experimental hyperthermia. Gordon, Darling, and Shea (1949) found that hyperthermia in individuals placed in a very hot atmosphere was responsible

for hypocapnia. Moser, Perry, and Luchsinger (1963) found that hyperthermia caused by the injection of a pyrogenic substance was accompanied by marked hyperpnoea and moderate hypocapnia. Although these results were obtained under difficult conditions of measurement, since experimental hyperthermia often progresses rapidly and does not enable a steady state to be obtained, they nevertheless agree reasonably well with our findings.

This relationship between Paco_2 and temperature in febrile patients is remarkably close to that found in different homeothermic species (Chapot *et al.*, 1972).

$\text{Paco}_2 = -3.06T + 153.6$ in febrile patients

$\text{Paco}_2 = -3.00T + 151.15$ in different homeothermic species

The effect of temperature on Paco_2 and pH may be explained by the fact that fever increases ventilation and this leads to a fall in Paco_2 and a rise in pH. This relationship exists only in homeotherms in which the regulation of temperature and that of Paco_2 occur at the same time (Chapot, 1967).

Thus, if arterial carbon dioxide tension is measured in a febrile subject, the predicted normal value should be corrected according to our regression equation in order that an abnormality due to factors other than temperature should not be missed.

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