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A correlation between $Paco_2$ and body temperature in febrile patients

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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 (°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	7·44	96
20	39·8	34	7·52	87
21	41·4	24	7·52	97
22	38·6	33	7·46	83
23	37·6	40	7·40	89
24	40·4	29	7·55	105
25	37·2	38	7·41	103
26	40·6	37	7·50	97
27	36·1	39	7·45	93
28	37·8	44	7·41	93
29	38·7	38	7·44	92
30	36·5	47	7·38	95
31	37·4	35	7·45	97
32	40·2	22	7·45	97
33	36·6	36	7·40	94
34	41·2	28	7·48	104
35	36·8	47	7·38	48
36	37·4	43	7·42	85
37	36·6	34	7·47	100
38	38·6	29	7·50	89
39	38·2	34	7·48	87
40	36·6	49	7·39	92
41	40·5	32	7·45	96
42	36·9	45	7·46	97
43	36·2	39	7·41	98
44	39·3	40	7·43	85
45	39·6	32	7·43	91
46	38·8	41	7·41	95
47	39·5	25	7·46	100
48	37·2	33	7·43	106
49	39·4	30	7·49	94

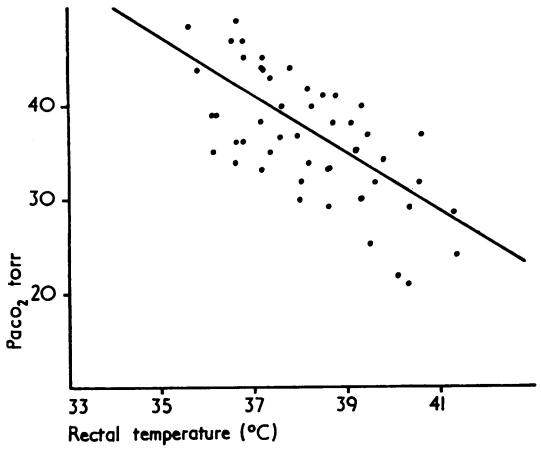

FIGURE. *The relationship between arterial carbon dioxide tension and rectal temperature in 49 subjects.*

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:

$$Paco_2 = -3{\cdot}06T + 153{\cdot}6 \quad (r = 0{\cdot}68)$$
$$pH = 0{\cdot}02T + 6{\cdot}7 \quad (r = 0{\cdot}62)$$

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 $P<0{\cdot}001$ as compared with $P>0{\cdot}1$ 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).

$Paco_2 = -3{\cdot}06T + 153{\cdot}6$ in febrile patients

$Paco_2 = -3{\cdot}00T + 151{\cdot}15$ 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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