pyrogen production. On the other hand, it has been demonstrated that small amounts of LPS microinjected into the anterior hypothalamus or pre-optic area, produced a long-lasting fever (Myers, Rudy & Yaksh, 1971). Therefore, the exogenous pyrogen potentiation by DMSO is probably related to a better transport of the pyrogen into the central nervous system. This hypothesis is open to further research.

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Body temperature control and arterial gases during halothane anaesthesia in the rat

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For metabolic studies we wished to maintain rats under halothane for up to 4 h with minimal disturbance to their core temperatures, or arterial Po_2, Pco_2, and pH values. Our findings seem relevant to the conduct of any experiment with rats under halothane. It was already known that halothane inhibited heat production in rats (Nikki & Tamisto, 1968).

Experiments were carried out on male, Wistar albino rats, 221–265 g, fully acclimated to 20° ambient temperature. Halothane–air–oxygen mixtures were prepared as described by Sebesteny (1971), but with the halothane reservoir kept at 11–12°. Halothane concentrations were calculated from the vapour pressure–temperature equation (Hill, 1972) and the flow rates of the gases. Anaesthesia was induced by 10 min exposure in a dessiccator to 2·2–2·5% (v/v) halothane. After induction each rat was placed with its head in a mask. Its ambient temperature was measured by mercury thermometers placed alongside it and controlled by the positioning of lamps. Its core temperature was monitored by a thermocouple in the colon. Blood sampling was usually from a tail artery (Agrelo & Dawson, 1968), but sometimes via a carotid cannula introduced 3–6 days earlier (Popovic & Popovic, 1960). Blood removed was immediately replaced by an equal volume of 0·9% saline. Each rat received 300–400 i.u. of heparin parenterally shortly before the first blood sample was taken. Po_2 values could not be maintained in the normal range unless the anaesthetic mixture contained extra oxygen, and the mixture was always enriched by 5–6% (v/v). The halothane concentration required just to maintain stage III anaesthesia, as shown by the suppres-

Table 1. *Values of $T_a(37)$ in post-absorptive and starved rats in the prone and supine posture.* In most rats more than one estimate of $T_a(37)$ was made in each posture, each estimate alternating with one in the other posture. The means of these mean values are shown, ± s.e.m. (n). Anaesthesia lasted 2–5 h.

	Prone, °C	Supine, °C
On wooden bench post-absorptive	27·1 ± 0·4 (13)	28·5 ± 0·6 (11)
starved	30·1 ± 0·5 (9)	30·5 ± 0·5 (9)
On foam blocks, starved	27·9 ± 0·2 (22)	29·1 ± 0·2 (18)

sion of the flexor withdrawal reflex, was 1·6% (v/v) just after induction, falling to 1·20–1·25% (v/v) 40 min later. For some, but not all rats the concentration could be further reduced to 1·05–1·15% (v/v) about 2 h after induction.

When core temperatures were normal, 37–38°, and the ambient temperature was initially such as to maintain the core temperature constant, a slight change, up or down, in the former caused the latter to drift in the same direction. Thus the rats appeared to be temperature-conforming. (For some rats with core temperatures below 35° the ambient temperature required to arrest the fall was higher than that required to maintain a normal core temperature).

Assuming that rats were exactly temperature-conforming (Bligh & Johnson, 1973) the ambient temperature required to maintain the core temperature at 37·0°, $T_a(37)$, could be found for each rat. Thus if at ambient T_a° the core temperature was steady at $(37 + \Delta)$°, $T_a(37)$ was $(T_a - \Delta)$°. Mean values of $T_a(37)$° depended upon whether the rats were prone or supine, or post-absorptive (5–10 h after withdrawal of food) or starved (24–30 h), and upon their supporting surface (Table 1).

Differences in thermal insulation probably account for these results, starved rats losing heat faster than post-absorptive ones because they had less fat cover, supine rats faster than prone because belly and perineum were exposed, and rats on the bench faster than those on expanded polystyrene. Confirmation was obtained by turning each rat over, often several times, while maintaining anaesthesia, and determining $T_a(37)$ after each inversion. The value of $T_a(37)$ changed in the expected direction in 42 out of 45 experiments. The replication in individual rats of $T_a(37)$ determinations in these experiments showed also that in a given posture and nutritional state values of $T_a(37)$ in individuals rarely differed by more than 1·5°, and were significantly less variable than the mean values within each group (within-rat variance less than within-group variance, $P < 0{\cdot}01$, F-test).

Halothane raised arterial P_{CO_2} and lowered arterial pH values from those found before anaesthesia. The latter were normal (Little & Threlfall, 1974). Steady values were not reached until about 0·5 h after induction, but thereafter were constant within experimental error. Most of the variance in the mean values (Table 2) was between rats. The fall in pH was slightly greater than expected from the increase in P_{CO_2}. Neither was significantly correlated with posture or $T_a(37)$. The mean P_{CO_2} and pH values attained after 0·5 h were similar to those in rats under other anaesthetics: sodium pentobarbitone (Rector, Bloomer & others, 1964), ether (Darrow, Schwartz & others, 1948) and hexobarbitone (Cotlove, Holliday & others, 1951).

The results have practical implications. 1. Temperature-conforming behaviour and the elevation of $T_a(37)$ above the acclimation temperature, 20°, shows that thermoregulatory heat production was inhibited. Probably, however, basal heat production was unaffected, as in those with least thermal insulation (starved, supine on a bench)

Table 2. *Arterial* P_{CO_2}, *pH and base excess before and during anaesthesia.* Measurements were made using a pH/blood gas analyser (Model 313, Instrumentation Laboratory Inc., Altrincham, Cheshire, U.K.), and are corrected to 37° (Severinghaus, 1965; Little & Threlfall, 1974). Mean values with s.d. (n) are given, where n is the number of rats. At least two estimates were made at each time period in each rat. Anaesthesia lasted 1·6–4·7 h, mean 3·2 h.

	Before anaesthesia	During first 0·5 h	After first 0·5 h
P_{CO_2}, mm Hg	26·6 s.d. 2·3 (5)	35·5 s.d. 4·0 (9)	41·6 s.d. 3·2 (13)
pH	7·50 s.d. 0·01 (5)	7·40 s.d. 0·04 (10)	7·36 s.d. 0·02 (13)
Base excess, m equiv litre^{-1}	−0·3 s.d. 1·5 (5)	−1·5 s.d. 1·7 (10)	−1·0 s.d. 1·2 (13)

$T_a(37)$ was the same as that found by Denckla (1970) in her study of lower critical temperature and minimal oxygen consumption. Unanaesthetized control rats for metabolic studies under halothane should, therefore, be maintained in an environment at which their heat production is also basal, namely 28–32° (Stoner & Marshall, 1971). Denckla (1970) compared rates of O_2 consumption in conscious rats and rats under pentobarbitone, and found that, in many of the former, rates were somewhat elevated as the rats were not wholly inactive. Consequently even in the thermoneutral environment of 28–32° controls are not strictly comparable for all purposes. 2. Within a group of rats under halothane values of $T_a(37)$ are likely to be too different for there to be any one ambient temperature at which all the core temperatures are normal. Therefore one must monitor the core temperature of each anaesthetized rat and adjust its ambient temperature accordingly. 3. While an elevation of arterial P_{CO_2} and reduction in pH must be accepted, both become very steady from 0·5 h after induction of anaesthesia, and frequent blood sampling for monitoring is unnecessary.

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