respiration. The discharge amplitude varies between 20 and 100 μv. In 20 consecutive preparations, 12 animals had satisfactory recordings made on the day after implantation. If the signal was satisfactory on the first day it remained so thereafter although animals were lost when wires were bitten through. Integrated activity was recorded in 7 animals for 20 min on consecutive days following implantation. Activity was greatest on day 1 and stabilized on days 4 and 5 at about 50% of the initial value. Reduction in arterial pressure with intravenous sodium nitroprusside or haemorrhage produced reflex rises in integrated activity. Anaesthesia with sodium pentobarbitone 30 mg/kg i.v. significantly reduced splanchnic nerve activity to 58 ± 8% (s.e mean, $n = 5$) of control 5 min after injection.

Rabbits are particularly suitable animals for these experiments because they remain quiet when placed in individual boxes and thus stable recordings of sympathetic activity can be made for several hours. We have used the technique for the evaluation of central and peripheral effects of beta blocking drugs (Lewis & Haeusler, 1975) and it has potential use in monitoring sympathetic nervous activity in chronic experiments.

References

LEWIS, P.J. & HAEUSLER, G. (1975). Reduction in sympathetic nervous activity as a mechanism of hypotensive effect of propranolol. *Nature Lond.*, **256**, 440.

SCHMITT, H., SCHMITT, H. & FENARD, S. (1974). A technique for recording sympathetic nerve activity in unanaesthetized dogs. *Neuropharmacology*, **13**, 347-351.

In vitro methods of assessing the physiological activation of macrophages in vivo

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The activation of macrophages, as assessed by a spreading and vacuolation of the cytoplasm and increases in respiratory and lysosomal enzyme activity, has been shown to occur during infection and various chronic inflammatory reactions. There is much circumstantial evidence that this activation *in vivo* is mediated by lymphokine.

In vitro, macrophages can be activated by prolonged contact with lymphokine (Nathan, Karnovsky & David, 1971; Nathan, Remold & David, 1973; Nath, Poulter & Turk, 1973). This activation only occurs however after the initial effects of lymphokine (which result in migration inhibition) have waned. The initial changes to the physiology of the macrophage appear to be an alteration in the utilization of the hydrogen liberated by the hexose monophosphate shunt, which results in reduced biosynthetic potential and a decrease in cellular permeability. These changes occur concurently with an inhibition of migrating ability as seen in the capillary tube assay. After 48-72 h of contact with lymphokine, these initial effects are reversed and increases in hexose monophosphate shunt activity and biosynthesis are seen as well as morphological changes, which result in the macrophages appearing similar to cells activated *in vivo*.

Because of this biphasic effect, it was felt that any contact with lymphokine *in vivo* would result in an altered response to subsequent lymphokine contact *in vitro*. This hypothesis has been tested by removing macrophages from animals at various times during a chronic protozoal infection (Leishmaniasis) and also after reinfecting immune animals and then recording the subsequent response of these cells to the lymphokine *in vitro*.

This was done by assaying the ability of these macrophages to respond in direct and indirect migration inhibition assays, and also by examining the effect of lymphokine contact on the activity of the hexose monophosphate shunt as detected by cytochemical tests for glucose-6-phosphate dehydrogenase activity.

The results of these studies indicate that changes in the status of macrophages during infection and following attempted reinfection can be detected by these methods, and these changes are consistent with the hypothesis that macrophage activation *in vivo* is mediated by contact with lymphokine.

References

NATHAN, C.F., KARNOVSKY, M.L. & DAVID, J.R. (1971). Alterations of macrophage functions by mediators from lymphocytes. *J. exp. Med.*, **133**, 1356-1376.

NATHAN, C.F., REMOLD, H.G. & DAVID, J.R. (1973). Characterization of a lymphocyte factor which alters macrophage functions. *J. exp. Med.*, **137**, 275-290.

NATH, INDIRA, POULTER, L.W. & TURK, J.L. (1973). Effect of lymphocyte mediators on macrophages *in vitro*. A correlation of morphological and cytochemical changes. *Clin. exp. Immunol.*, **13**, 455-466.

The effect of apomorphine on oral behaviour in piglets

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The new-born mammal has both nutritive and non-nutritive sucking requirements (Levy, 1934). When non-nutritive sucking is prevented, abnormal oral behaviour which can resemble the effect of apomorphine may be induced. The two types of sucking behaviour can be distinguished using equipment described by Stephens (1975). This consists of a wooden box lined with rubber sheeting. A rubber teat is inserted through a hole in one wall. The teat is connected to two microswitches which record teat movements and milk flow through the teat is also monitored. One-day-old piglets can be trained to feed from the teat in three days at which time they develop a regular pattern of teat activity. This consists of an ingestive phase lasting approximately 15 min during which the piglets drink the milk provided. Then follows a period of sporadic non-nutritive teat activity when the piglets nuzzle at or around the teat without drinking. Low doses of apomorphine (0.1-0.2 mg/kg s.c.) injected during the latter phase greatly prolong and intensify the non-nutritive teat activity. This method is useful for quantifying behavioural effects of apomorphine. The responses of other farm animals to apomorphine and other drugs thought to affect central dopaminergic neuron systems will also be shown and compared with abnormal oral behaviour seen under intensive husbandry conditions.

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References

LEVY, D.M. (1934). Experiments on the sucking reflex and social behaviour of dogs. *Am. J. Orthopsychiat.*, **4**, 203-224.

STEPHENS, D.B. (1975). Effects of gastric loading on the sucking response and voluntary milk intake in neonatal piglets. *J. comp. physiol. Psychol.*, **88**, 796-805.

Measurement of vascular changes in acute inflammatory responses

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Acute inflammatory responses are associated with increases in blood flow and accumulation of plasma proteins within the inflammatory lesion. We have modified existing techniques to measure the vascular changes caused by acute inflammatory stimuli in rat hindpaws. Experiments have been made in male rats, body weight 160-200 g, anaesthetized with urethane (1.25 g/kg i.p.). The inflammatory stimulus was applied to one paw and the other paw served as a control. Paw blood content was measured using [^{51}Cr]-labelled rat red blood cells (approximately 1 μCi) and accumulation of albumin in the tissue using [^{125}I]-labelled human serum albumin (approximately 250 nCi), each injected intravenously 5 min before the inflammatory stimulus. Paw blood and albumin content were expressed as volume in terms of venous blood. Blood flow was measured using [^{85}Sr]-labelled microspheres, 25 μ diameter (3M Company). The microspheres were injected into the left ventricle of the heart via a catheter in the right carotid artery. Blood flow to each hindpaw was expressed as a % of cardiac output and flow to the injured paw was also expressed as a % of the flow to the control paw. After injection of the microspheres the rats were killed and both paws removed and placed in vials to permit differential γ-counting of the ^{85}Sr, ^{51}Cr and ^{125}I content of the paws using a Packard autogamma scintillation spectrometer.

Table 1 shows the results from a typical group of experiments in which the inflammatory