acids. This view has recently been sustained[12–14]. An inhibitory allosteric effect, due to binding of the sugar sufficiently close to the amino acid-binding site or vice-versa, was suggested. Given the characteristics of the experimental technique used in the research described here, it is impossible to decide from the results which of the varying interpretations offered to explain this phenomenon is the most acceptable, even though the mutual interaction between galactose and leucine in vivo is very clearly confirmed.

Summary. The inhibitory action of L-leucine on the intestinal absorption of D-glucose and D-galactose, as well as the inhibitory action of D-galactose on the absorption of L-leucine at various concentrations by rat small intestine has been studied. The further effect was more clearly evidenced when the medium was perfunded through the intestine in a closed circuit system using a peristaltic pump.

J. Bolufer, J. Larralde and F. Ponz

Department of Animal Physiology, University of Navarra, Pamplona (Spain), 16 April 1975.

[12] J. W. L. Robinson and F. Alvarado, Pflügers Arch. *326*, 48 (1971).
[13] F. Alvarado, R. Torres-Pinedo, L. Mateu and J. W. L. Robinson, FEBS Lett. *8*, 153 (1970).
[14] F. Alvarado and A. Mahmood, Biochemistry *13*, 2882 (1974).

The Effects of Jaundiced Plasma and Hypercholesterolaemic Plasma on Vascular Sensitivity to Injected Noradrenaline

Alterations in renal perfusion have been shown in a variety of liver diseases[1,2]. We have investigated the possibility that this may be due to a potentiated pressor response to circulating noradrenaline (NA).

Isolated perfused kidneys and segments of rabbit femoral artery were removed from an anaesthetized animal and perfused at constant flow in a warmed organ bath. The preparations wer first perfused with a physiological saline solution containing NaCl 118.0, KCl 4.69, NaH_2PO_4 1.33, $NaHCO_3$ 25.0, glucose 5.56, $CaCl_2$ 2.52 and $MgCl_2$ 1.05 m*M*/l and the perfusion pressure was monitored proximal to the preparation. As the flow was constant (4–5 ml/min), any change in resistance of the system was reflected in a change in perfusion pressure.

The arterial constrictor responses to NA were determined by graded injection of NA in warmed saline as a bolus into the perfusate just proximal to the preparation. These responses were obtained before, during and after perfusion of the preparation with the experimental plasma.

Figure 1 shows a log dose/response plot for a typical experiment when jaundiced baboon plasma was used. It can be seen that the jaundiced plasma caused the dose/response curve to shift to the left of the initial curve

[1] M. C. Kew, Gut *13*, 748 (1972).
[2] M. C. Kew, C. Limbrink, R. R. Varma and S. Sherlock, Gut *13*, 421 (1972).

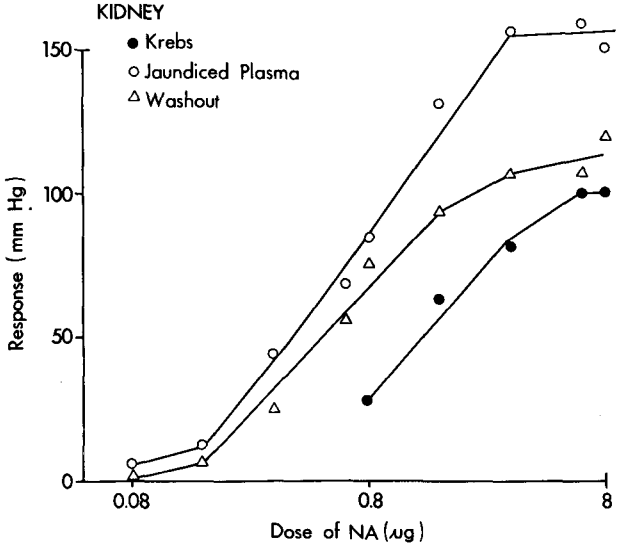

Fig. 1. Kidney log dose/responses – jaundiced plasma. Kidney responses in mm Hg (*y* axis) plotted against the doses of injected NA (*x* axis). The closed circles show the responses to NA obtained when Krebs was initially perfused. The open circles show those obtained when the jaundiced plasma was perfused, and the open triangles show those when Krebs was re-perfused. It can be seen that jaundiced plasma shifts the curve to the left and that the washout returns the curve towards normal.

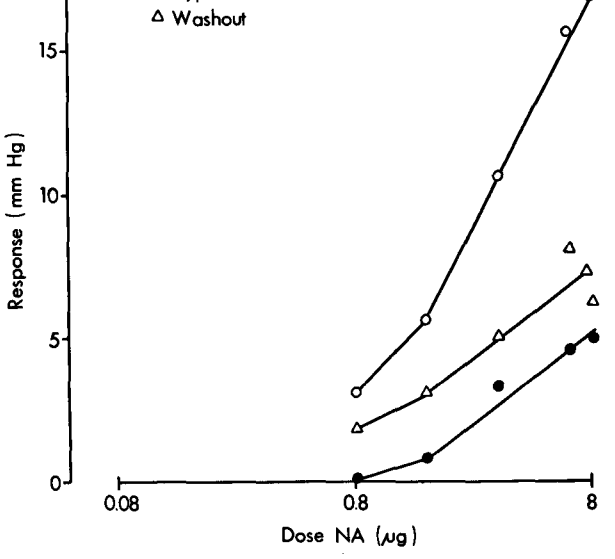

Fig. 2. Artery log dose/responses – lipid plasma. This graph shows the artery responses in mm Hg (*y* axis) plotted against the doses of injected NA (*x* axis). The closed circles show the responses obtained to NA when Krebs was initially perfused. The open circles show those obtained when the hypercholesterolaemic plasma was perfused, and the open triangles show those when Krebs was re-perfused. It can be seen that the plasma shifted the curve to the left and the washout moves back towards normal.

indicating that a potentiation of the effects of NA had occurred. When the plasma was washed out, the curve returned towards normal. This pattern was repeated in all of the 5 kidney experiments and 5 artery experiments. No potentiation was seen in 8 control experiments when normal plasma was perfused.

Many constituents of plasma are increased in jaundice, and these results would suggest that one or more of them was potentiating the effect of NA. One possibility was thought to be the steroids. It has been shown in heart muscle that cholesterol and other steroids potentiate the effects of NA by inhibiting the catecholamine's extraneuronal uptake and metabolism[3]. As jaundice shows an elevation in total cholesterol[4] associated with an elevation of β-lipoproteins, we have also considered the effects of a hyperlipidaemic plasma.

In FREDRICKSON's[5] type II hyperlipidaemia, there is an increased plasma cholesterol similar to that occurring in jaundice. 60 ml samples of heparinized plasma were taken from fasting patients with FREDRICKSON's type IIa hyperlipidaemia, and 3 of these samples pooled to perform an artery experiment. Figure 2 shows a log dose/response plot of the effects of NA on an artery before, during and after perfusion with the hyperlipidaemic plasma. An NA potentiation was found in this experiment and in 5 others when the plasma was perfused. No potentiation was found when using normal human plasma.

Thus our results would suggest that the altered renal perfusion found in jaundice (particularly during periods of hypotension[6]) may be due to a potentiated pressor response to circulating catecholamines. One possible constituent causing this could be the increased β-lipoprotein and cholesterol. Hypercholesterolaemia may well be more intimately related with pathological tissue ischaemias, such as cardiac infarction, than we yet realise.

Summary. Jaundiced plasma and plasma from hyperlipidaemic patients was perfused into an isolated artery or kidney preparation. The responses of the artery to doses of noradrenaline when Krebs solution was perfused were compared to the responses when the plasmas were perfused. It was found that both jaundiced and hyperlipidaemic plasmas potentiated the effects of noradrenaline on the isolated arteries and kidneys.

T. A. MCCALDEN, D. BLOOM and C. ROSENDORFF[7]

Department of Physiology, University of the Witwatersrand, Hospitalstreet, Johannesburg 2001 (South Africa), 6 January 1975.

[3] L. L. IVERSEN and P. J. SALT, Br. J. Pharmac. *40*, 528 (1970).
[4] S. SHERLOCK, in *Diseases of the Liver*, 4th edn. (Blackwell Scientific Publications, Oxford 1968), p. 27.
[5] D. S. FREDRICKSON, R. I. LEVY and R. S. LEES, New Engl. J. Med. *276*, 24 (1967).
[6] R. D. WILLIAMS, D. W. ELLIOT and R. M. ZOLLINGER, Arch. Surg. *81*, 334 (1960).
[7] We wish to thank the Liver Unit at the South African Institute for Medical Research for all biochemical estimations and also the Lipid Clinic volunteers and staff for their assistance.

Relative Distribution of Types A and B Atrial Receptors in Dogs, Cats, Monkeys and Rabbits

PAINTAL[1] described mainly two types of receptors in the walls of the cardiac atria. The type A receptors fire during atrial contraction and the type B fire during atrial filling. In addition, he recognized an intermediate type with bursts of discharge during both phases. The impulses from all these receptors are transmitted in vagal afferent fibfes. The occurrence of the intermediate type of receptor leads to the possibility that the two main types belong to the same population. It was suggested by PAINTAL[2] that, if the two types of receptors were functionally similar, then, in a random sample study, the intermediate type should occur more frequently than the 'pure' types, viz. the A and B types. This possibility was examined in this study on dogs, cats, monkeys and rabbits. The results of this study have been presented in an abstract elsewhere[3].

Methods. In anaesthetized animals breathing spontaneously, nerve impulses were monitored from the cervical vagal afferents using convential techniques[1]. The main criterion for identification of atrial receptors was the time relation of their discharge to the ECG. Other criteria described by PAINTAL[1,4,5] were also used. Since every one of the endings identified as an atrial receptor with intact chest has been located in the right or left atrium after opening the chest[1,2,4,6], punctate location[1] was considered unnecessary in this study to establish the location of the receptor.

Results and discussion. The results are summarized in the Table. It is clear that the relative distribution of the two main types of atrial receptors is different in different animals. One type can occur to the relative or nearly total exclusion of the other. This suggests that they differ functionally. This is also supported by the observation that the intermediate receptor does not occur more frequently than the 'pure' types.

The type A: type B ratio of 1:1.8 in cats in the present study is comparable to PAINTAL's[2] ratio of 1:1 and to the ratio of 5:8 seen in the data of ARNDT et al.[7]. The ratio obtained in monkeys is in reasonable agreement with the figures of CHAPMAN and PEARCE[8], who found 8 type B receptors to one of type A.

Our failure to find any electrophysiologically identifiable atrial receptors in the aortic or vagus nerves of the rabbit is in keeping with the observation[9] that nerve endings in the atrial endocardium of the rabbit are scant in number, and the few that are present are illformed compared to those in cats and dogs. However, it must be noted that we have been looking only for afferent activity with a cardiac rhythm. There may be atrial endings with an irregular discharge.

[1] A. S. PAINTAL, J. Physiol., Lond. *120*, 596 (1953).
[2] A. S. PAINTAL, Ergebn. Physiol. *52*, 74 (1963).
[3] P. S. RAO, Indian J. Physiol. allied Sci. *26*, 31 (1972).
[4] A. S. PAINTAL, in *Handbook of Sensory Physiology, Enteroceptors* (Ed. E. NEIL; Springer-Verlag, Berlin, Heidelberg and New York 1972), vol. 3/1.
[5] A. S. PAINTAL, Physiol. Rev. *53*, 159 (1973).
[6] J. P. GILMORE and I. H. ZUCKER, J. Physiol., Lond. *239*, 207 (1974).
[7] J. O. ARNDT, P. BRAMBRING, K. HINDORF and M. ROHNELT, J. Physiol., Lond. *240*, 33 (1974).
[8] K. M. CHAPMAN and J. W. PEARCE, Nature, Lond. *185*, 1237 (1959).
[9] J. F. NONIDEZ, Am. J. Anat. *61*, 203 (1937).