RENAL BLOOD FLOW IN THE CONSCIOUS, UNRESTRAINED RAT.

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ABSTRACT

The aim of this project is to test the hypothesis that **the rate of renal blood flow remains constant under normal physiological conditions.** Methods were developed for long term studies of renal blood flow (using the Doppler flow probe) and blood pressure in the conscious unrestrained rat. Special care was taken to maintain and observe the rats under normal, physiological conditions.

Since the Doppler flow probe measures blood velocity rather than flow, changes in renal arterial diameter will alter the output of the flow meter, even if flow is constant. In order to measure flow more accurately, changes in vessel diameter were prevented by a short length of Silastic tubing inserted into the renal artery under the probe. Blood flow was expressed as a percentage of the maximal flow measured when the animal was completely relaxed. Using this preparation, renal blood flow was measured continuously under normal conditions in both the light and dark cycles. Studies were performed to assess the effects on renal blood flow of anaesthesia, surgery and stress, and to assess the effect on renal blood flow of blockade of the renal nerves.

Renal blood flow was depressed approximately 50% by anaesthesia, due to the effects of the anaesthetic agent rather than the accompanying surgery. Renal blood flow did

not fully recover for 3-4 days after anaesthesia with, or without surgery.

Renal blood flow was depressed by stress, even though blood pressure was unchanged. A mild sudden auditory disturbance caused a transient 23% fall in renal blood flow. A continuous auditory disturbance, depressed renal blood flow by 16% for several minutes. Handling the rat resulted in a 33% fall in renal blood flow which lasted for over 30 minutes.

When measured continuously, renal blood flow was found to vary considerably. When the rat was completely relaxed renal blood flow was highest (defined as 100%). Renal blood flow remained high when eating and drinking (79%), but fell when the rat became alert but completely still (74%). During general movement renal blood flow was low (73%) with flow lowest while grooming (64%). Flow was apparently related to the degree of alertness and to activity. The extent of variation of flow is such that the calculated mean daily value of renal blood flow was only 80% of the maximum flow observed during complete relaxation.

The depression of renal blood flow seen during activity and disturbance was largely prevented during reversible blockade of the ipsilateral renal nerve, induced by slow infusion of Xylocaine around the renal artery. It was completely abolished by bilateral renal nerve blockade with

Xylocaine. The depressive effects of activity and disturbance on renal blood flow were restored an hour after the Xylocaine infusion ceased. These studies clearly show that renal nerve is involved in control of renal blood flow under physiological conditions.

It is clear that renal blood flow varies markedly under normal physiological conditions and in response to the external environment. **A constant renal blood flow is not a necessity for normal renal function.**

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DEFINITIONS

Observed behavioural patterns have been classified as:
Alert: motionless and expectant or sniffing the air.
Completely relaxed: curled up, very relaxed.
Eating or drinking.
Exploring or **fossicking** in litter.
Grooming.
Lightly quiescent: curled up, less relaxed.
Nesting or **moving in sleep:** twitching, scratching or changing position.
Resting: inactive in standing position.
Stretching, scratching or general whole body movement.

Other terms used in the text are:
Active: nesting, moving in sleep, eating, drinking, alert, exploring in litter, grooming or stretching.
Bilateral renal nerve block: infusion of Xylocaine onto both renal arteries.
Contralateral renal nerve: the right renal nerve.
Ipsilateral renal nerve: the left renal nerve, the side of the Doppler flow probe.
Passive: completely relaxed, lightly quiescent or resting.
Unilateral nerve block: an infusion of Xylocaine onto the left renal artery, the side of the Doppler flow probe.

Abbreviations have been largely avoided. Where necessary the following were used:
A-D: analog to digital.
PAH: para-amino hippuric acid.
PE: polyethylene.
PVC: polyvinyl chloride.
PVP: polyvinylpyrrolidine.
RBF: renal blood flow.
S.E.: standard error of the mean