EXPERIMENTAL INCREASE IN RENAL MEDULLARY PERFUSION: A FACTOR REDUCING BLOOD PRESSURE IN TWO RAT HYPERTENSION MODELS?

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Background

There is evidence that **changes in renal medullary blood flow (MBF) can alter arterial blood pressure**: in particular, medullary hyperperfusion is thought to decrease the pressure **(Figure 1).** The mechanism is unclear: in the long term increased MBF could act via a sequence of a wash-out of medullary solutes (decrease in medullary hypertonicity) → inhibition of tubular reabsorption → increased renal excretion → reduction of body fluid volume.

Short-term medullary hyperperfusion could decrease blood pressure via a release, possibly very rapid, of a hormonal vasodilator, such as medullipin. However, we found earlier that short-term (1-hour) almost selective increasing MBF obtained by renal intramedullary infusion of **bradykinin (Bk)** induced no pressure decrease **(Fig. 2,** B. Bądzyńska, J. Sadowski, Acta Physiologica 2012).

Aim: In this study we examined, in two models of rat hypertension, effects on blood pressure of renal medullary hyperperfusion prolonged to four hours.

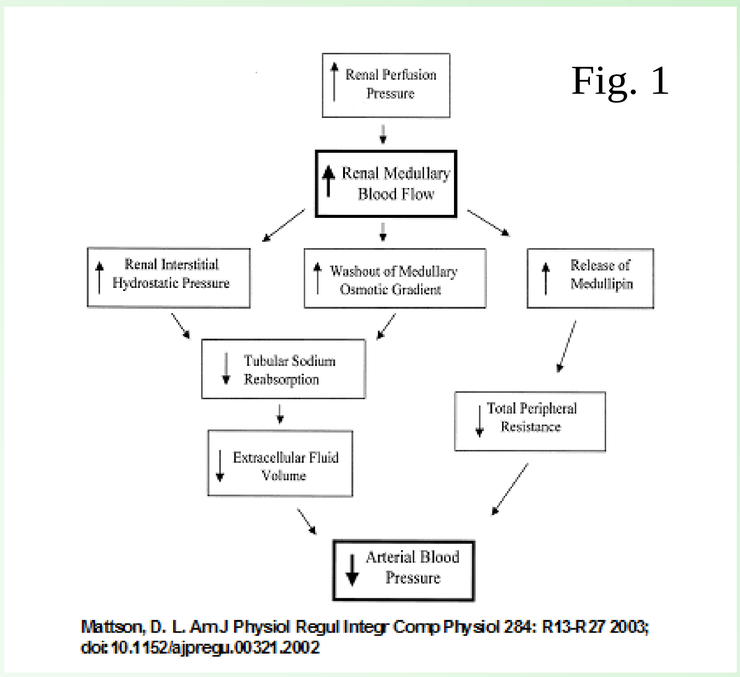


Fig. 1

Mattson, D. L. Am J Physiol Regul Integr Comp Physiol 284: R13-R27 2003; doi:10.1152/ajpregu.00321.2002

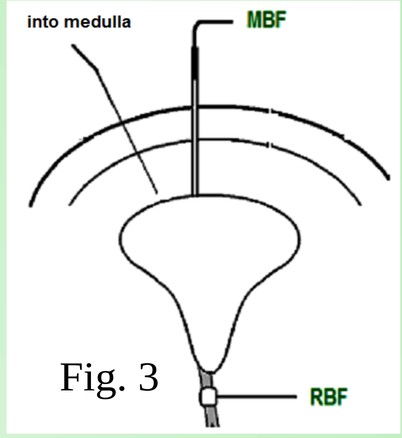


Fig. 3

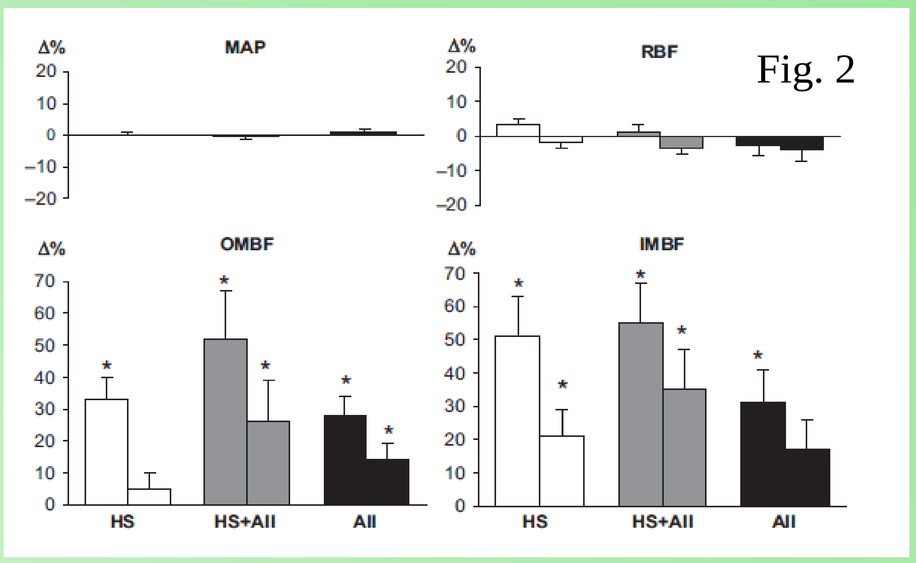


Fig. 2

Models of rat hypertension

(1) Sprague-Dawley rats subjected to unilateral nephrectomy, followed by 2-weeks' exposure to high-salt diet (4% Na w/w) (**HS/UNX**)

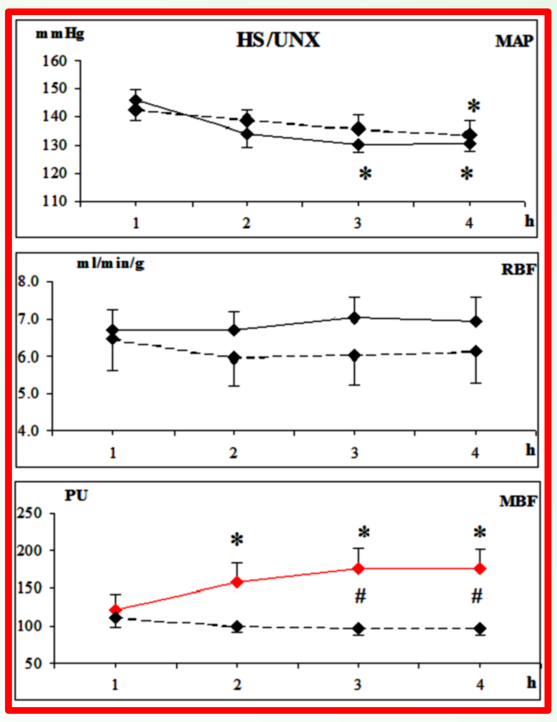
(2) Uninephrectomized spontaneously hypertensive rats (**SHR**).

Protocol: Anesthetized rats (Thiopental, i.p.), left kidney exposed, 4-hour intramedullary bradykinin **(Bk)** infusion **(Fig. 3)**, 240-480 µg/h/kg.

Intramedullary **Bk solvent** (saline) infusion in time control experiments

Measurements: Mean arterial pressure (**MAP**), left kidney blood flow (**RBF**, Transonic probe on renal artery), medullary blood flow **(MBF)** (needle intramedullary laser-Doppler probe).

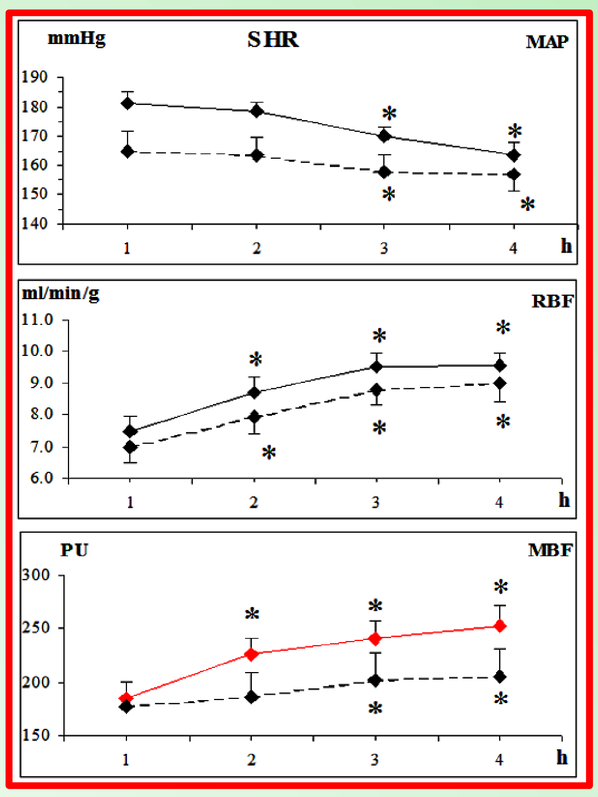
Left kidney urine flow (**V**) and excretion of sodium ($\mathbf{U_{Na}V}$) (ureteral cannula).

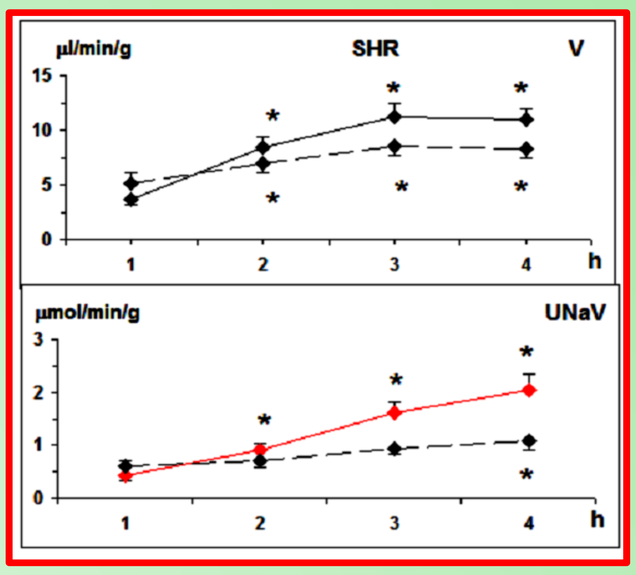


HS/UNX group

Intramedullary **Bk** (but not solvent) infusion significantly increased MBF without changing RBF. This was associated with progressing decrease in MAP which was quite similar with Bk and solvent infusion. There was no significant correlation between ↓ MAP and ↑ MBF.

Changes in V and UNaV were not significant.





SHR group

Intramedullary **Bk** infusion significantly increased MBF, a minor but still significant increase was seen with the solvent. MAP decreased and RBF increased with both infusions. There was no significant correlation between ↓ MAP and ↑ MBF. UNaV increased significantly more after Bk than after solvent infusion.

Red curve: the whole profile different from that for the solvent (ANOVA) * significantly different from baseline control # significantly different from corresponding value for solvent infusion

Summary and Conclusions

1. **In HS/UNX rats** renal intramedullary Bk infusion significantly and ***selectively*** increased perfusion of the medulla (MBF did not increase in the solvent-infused rats).
2. Blood pressure (MAP) decreased comparably in Bk- infused and solvent-infused groups. Moreover, there was no correlation between the decrease in MAP and the increase in MBF.
3. These findings ***do not support the hypothesis*** that in HS/UNX hypertension model the rate of renal medullary perfusion can control arterial pressure level.
4. **In SHR** the effect of intramedullary Bk was ***not selective***: both MBF and RBF increased significantly. Moreover, effect of Bk was ***not entirely specific***: MBF modestly increased also after solvent infusion, perhaps secondary to increasing RBF
5. This pattern of renal haemodynamic changes ***does not permit any conclusions*** regarding possible role of MBF in the observed decrease in blood pressure.
6. Parallel increases in MBF and UNaV, significantly more pronounced in Bk- than in solvent-infused rats, suggest natriuresis dependent on a wash-out of medullary solutes secondary to increased perfusion of the medulla.

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