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Carrière S, Thorburn G D, O'Morchoe C C C & Barger A C. Intrarenal distribution of blood flow in dogs during hemorrhagic hypotension. *Circ. Res.* 19:167-79, 1966.

[Depts. Physiology and Anatomy, Harvard Medical School, Boston, MA]

The progressive decrease in blood volume and pressure produced by hemorrhage induces an unevenly distributed vasoconstriction in the kidney, first appearing in the outer cortex and progressively extending to its inner portion. The outer medullary blood-flow rate remains constant despite hypotension. [The SCI® indicates that this paper has been cited in over 280 publications.]

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The studies reported in this paper were performed in Clifford Barger's laboratory in the Department of Physiology at Harvard Medical School where I moved in 1962 to be a research fellow and thereafter an instructor. At that time, a method using ⁸⁵Kr for measuring the distribution of blood flow in the kidney was developed in the laboratory.¹ From there came the idea of using this method to further explore the concept put forward by Trueta and his group² that a marked reduction in cortical blood flow occurs in shock with the maintenance of normal medullary circulation. This concept had been challenged by different groups, but with the use of the ⁸⁵Kr method and autoradiograms particularly, we made an attempt to clarify the ambiguity about the status of the renal circulation that existed in the dog kidney during shock. The combination of these methods clearly demonstrated that the response of the renal cortical circulation to a condition like shock, which induces a stimulation of the autonomic nervous system and the renin angiotensin system in particular, is not uniform and varies from mo-

ment to moment. This is not the case for the medulla, which does remain stable.

This first study gave rise to several others performed in my own laboratory in the Department of Medicine at the University of Montreal in order to determine the mechanisms of action involved in the hemodynamic changes occurring during hemorrhagic hypotension. We demonstrated that even following retransfusion of the shed blood³ the hemodynamic changes still persisted. The respective roles of the autonomic nervous system and the renin-angiotensin system in the production of the outer cortical ischemia observed under these conditions were also identified.⁴

These studies in the dog, and others that followed,⁵ have clearly established the response of the renal vasculature to vasoactive stimuli and have allowed the use of the inert gas technique in human studies where a specific renal vasoconstriction, as in essential hypertension, for example, is suspected.

This paper has been frequently cited because it was the first to clearly demonstrate the minute-to-minute changes that occur in the cortical circulation of the kidney during hypotension. The dynamic changes were also well supported by autoradiograms, which added enormous credibility to the interpretation of the dynamic data. Some 20 years later, the data presented in this paper have still to be discounted. Regardless of the number of methods that have been described to measure the renal cortical circulation, no one has, as yet, produced additional information on this particular subject. As far as the medullary circulation is concerned, the data presented have been challenged on many occasions but not weakened. The inert gas technique in its application for measurement of medullary circulation, even when supported by autoradiograms, suffers several deficiencies, but so far, no reliable technology has been put forward for the measurement of the circulation in that region and hence, there is nothing with which to seriously challenge the data presented in this paper.

1. Thorburn G D, Kopald H H, Herd J A, Hollenberg M, O'Morchoe C C C & Barger A C. Intrarenal distribution of nutrient blood flow determined with krypton⁸⁵ in the unanesthetized dog. *Circ. Res.* 13:290-307, 1963. (Cited 425 times.)
2. Trueta J, Barclay A E, Daniel P M, Franklin K J & Pritchard M M L. *Studies of the renal circulation.* Springfield, IL: Thomas, 1947. 187 p.
3. Carrière S & Daigneault B. Effect of retransfusion following hemorrhagic hypotension on intrarenal distribution of blood flow in dogs. *J. Clin. Invest.* 49:2205-17, 1970.
4. Lechance J G, Arnoux E, Brunette M G & Carrière S. Factors responsible for the outer cortical ischemia observed during hemorrhagic hypotension in dogs. *Circ. Shock* 1:131-44, 1974.
5. Passmore J C, Leffler C W & Nelberger R E. A critical analysis of renal blood flow distribution during hemorrhage in dogs. *Circ. Shock* 5:327-38, 1978.