

# Kidney function: Optimization of nephrovascular network

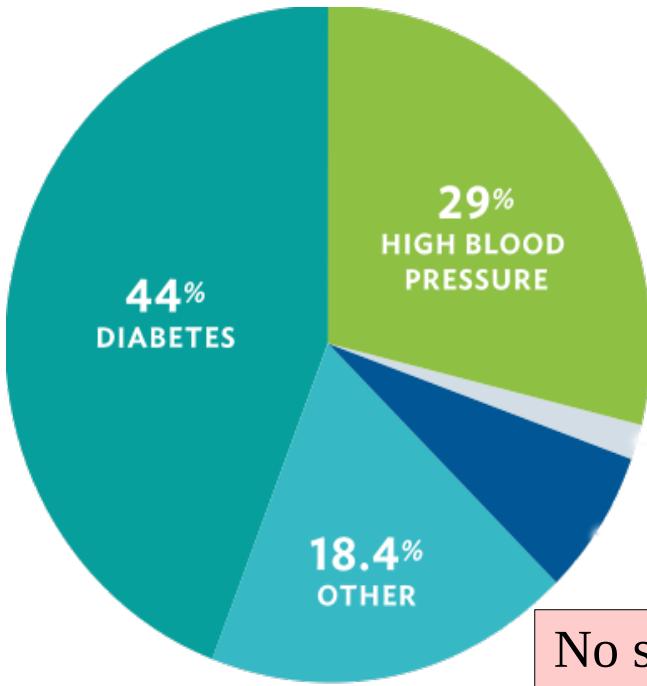
*Olga Sosnovtseva*  
Associate Professor

UNIVERSITY OF COPENHAGEN



# **SCARY TRUTH**

# Chronic Kidney Disease: A silent killer?



9 in 10 adults with CKD do not know they have it;

1 of 3 adults with diabetes has it;

Every 24 hours, 160 people with diabetes begin treatment for kidney failure;

Nearly 10% of global adult population) suffer from some kind of kidney problem/damage.

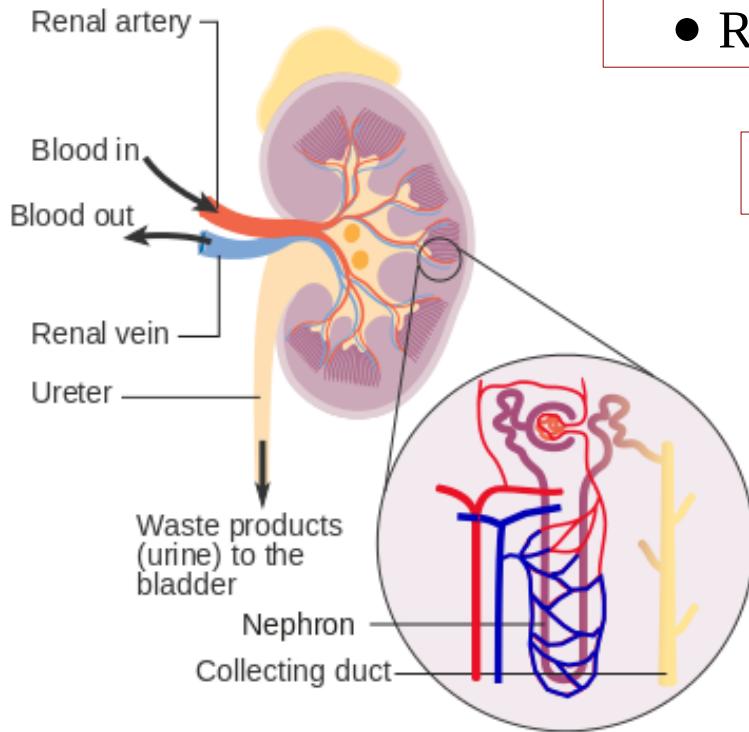
No signs or symptoms until >70% of kidney function is lost.

GPs screen only 20% of their diabetic patients for kidney disease.

Standard blood test: serum creatinin rises only if > 50% of renal function is already lost.

# KIDNEY FUNCTION

# Kidney function



- Regulation of water and electrolyte balance

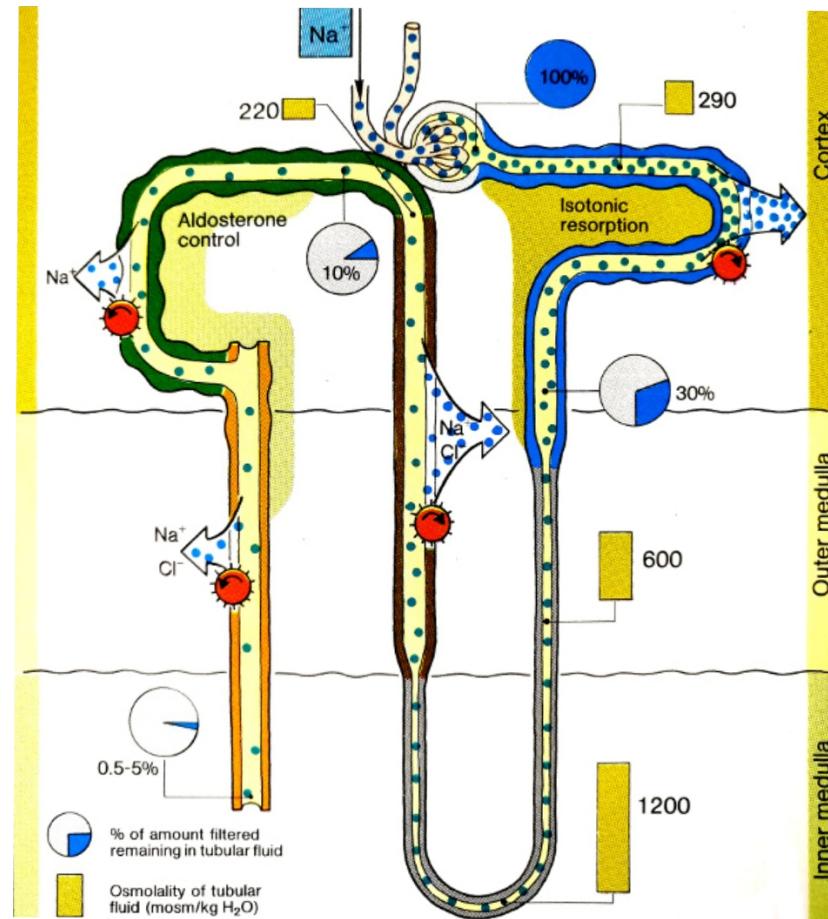
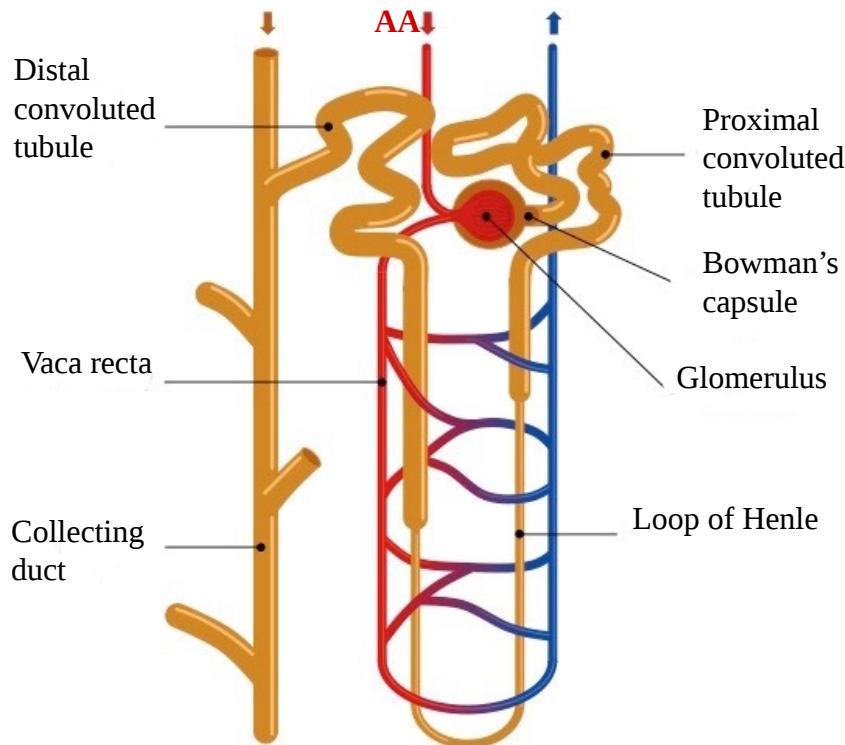
- Excretion of metabolic products

- Regulation of arterial pressure

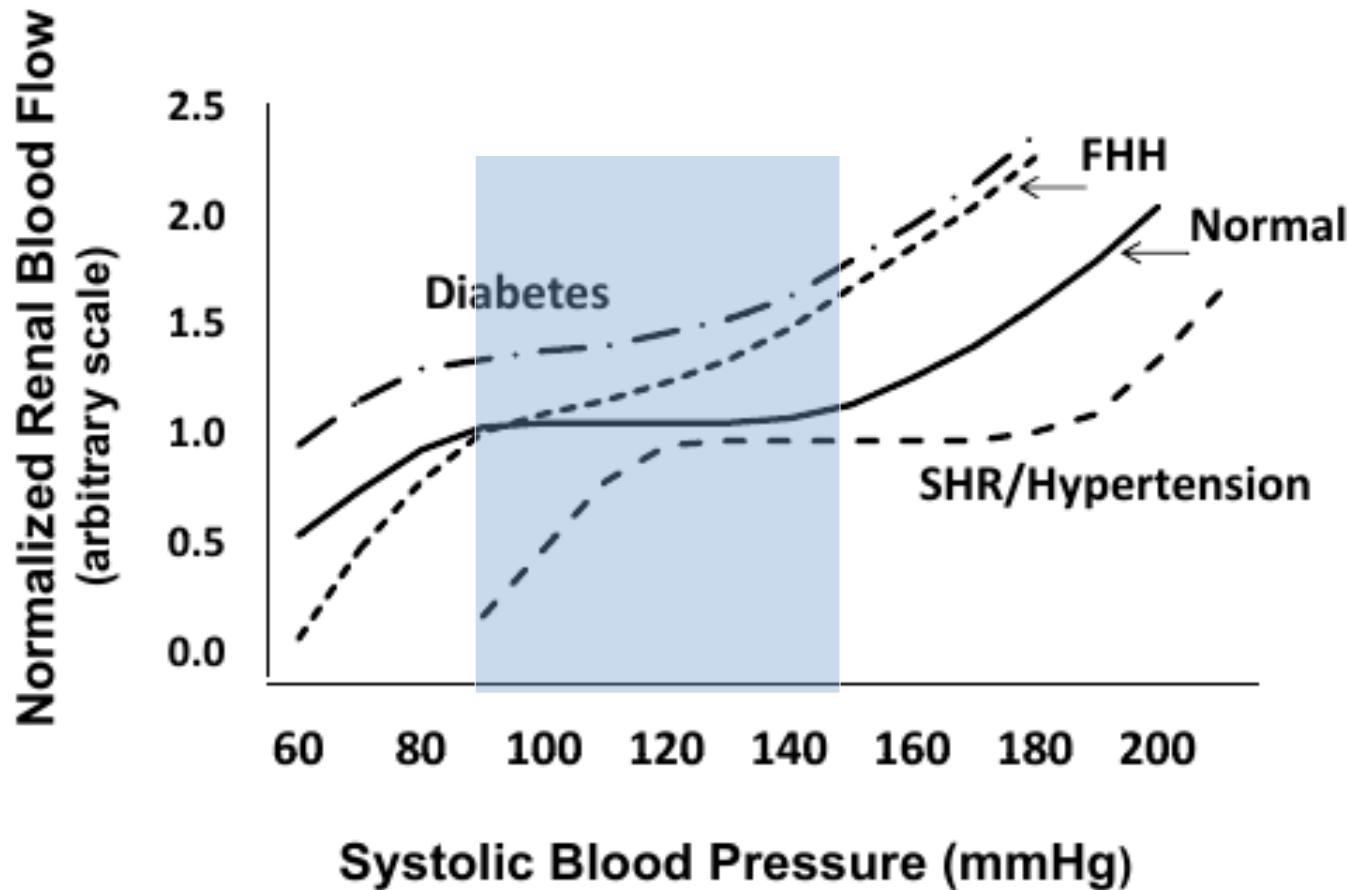
- Secretion of hormones

Modified <http://www.cancerresearchuk.org/> and  
Wikimedia Commons <https://commons.wikimedia.org/>

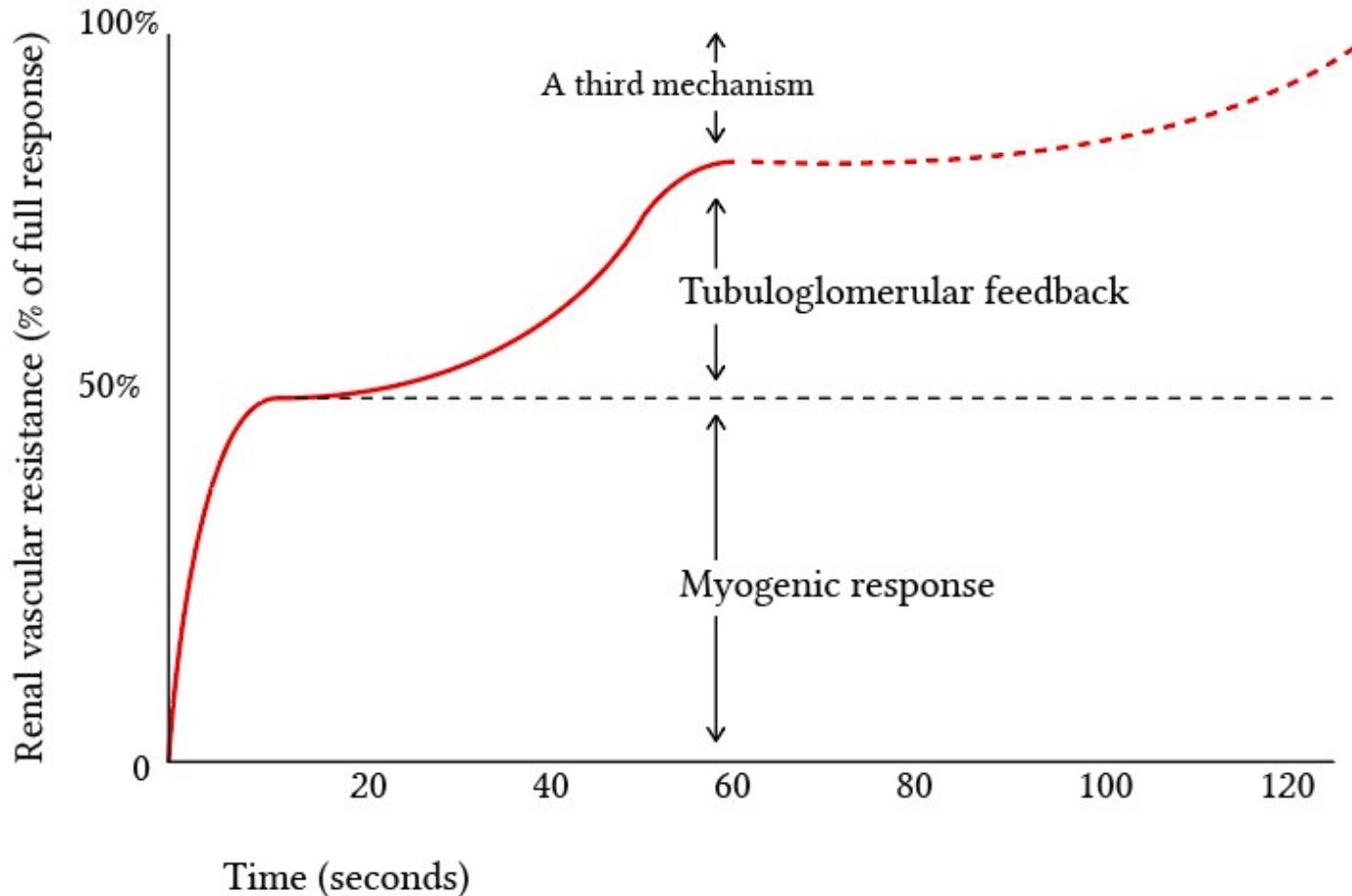
# Nephron function



# Renal autoregulation



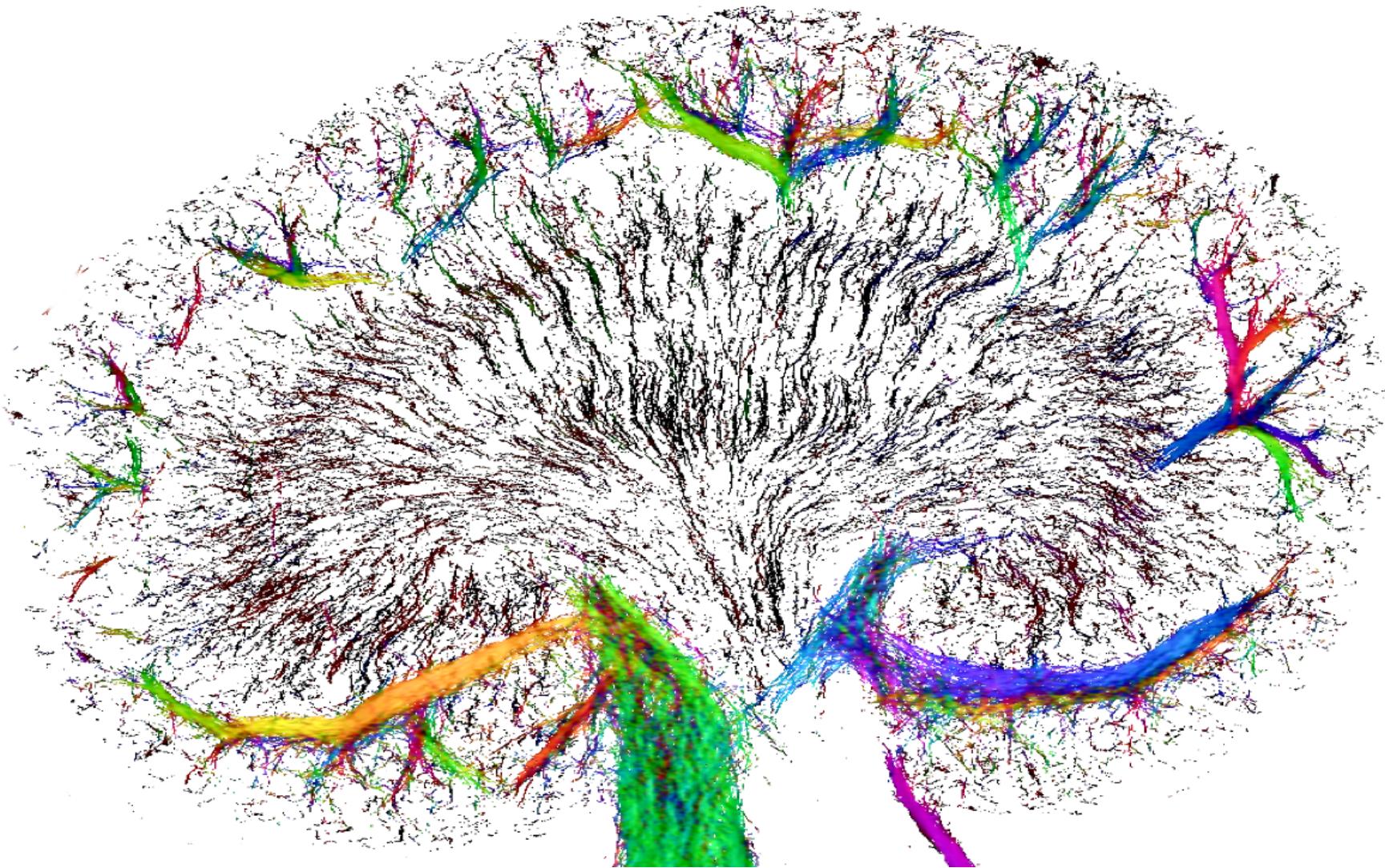
# Mechanisms of autoregulation



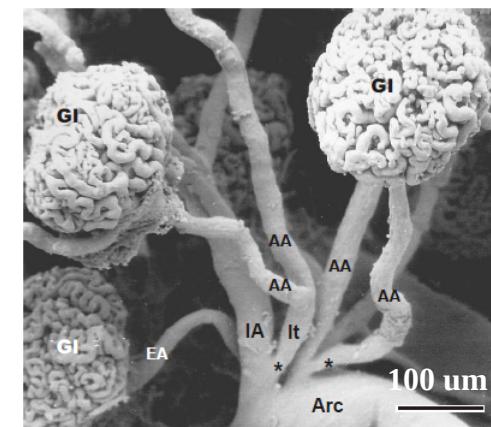
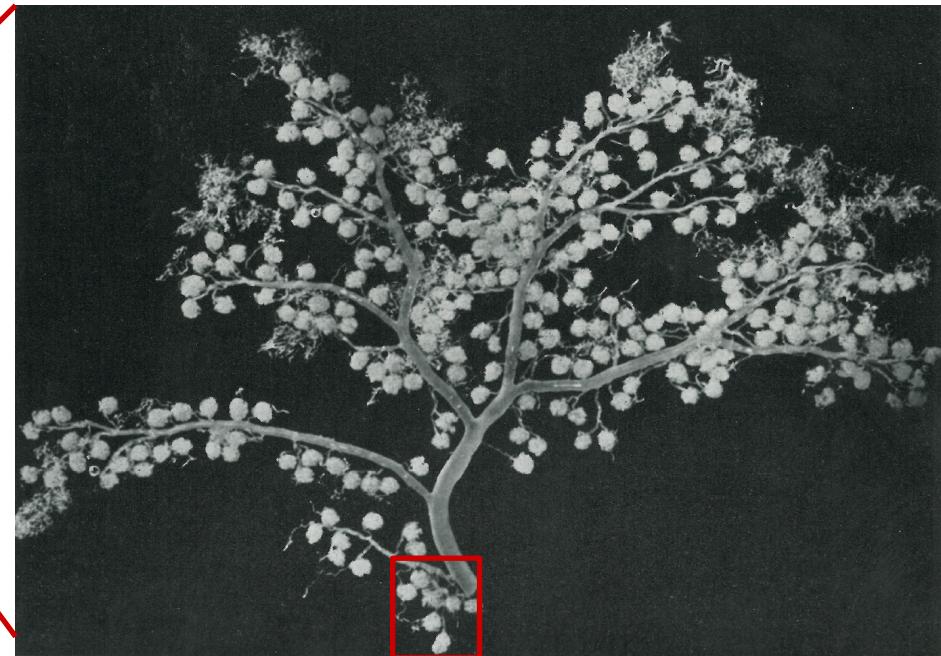
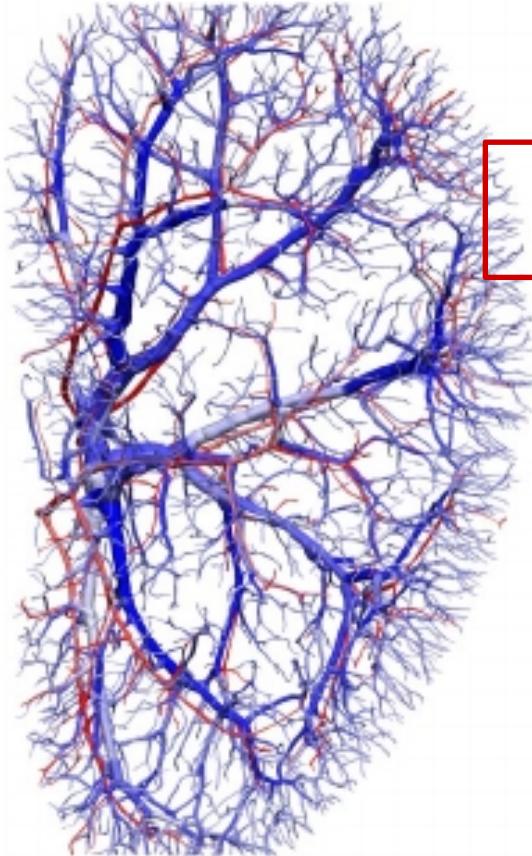
Adapted from A. Just, Am J Physiol 292 (2007)

# KIDNEY WONDERLAND

# Renal circulation

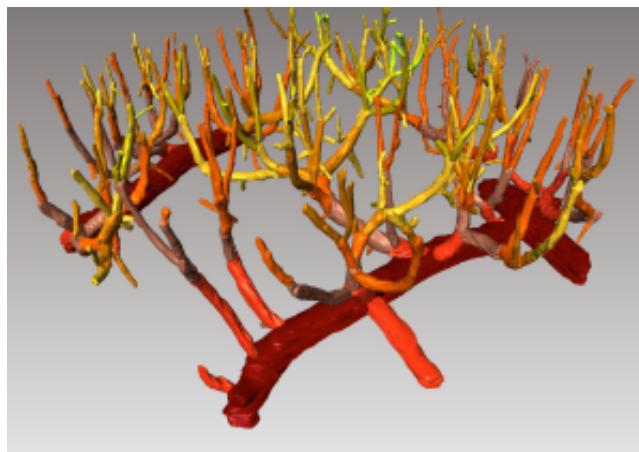


# Renal vascular tree

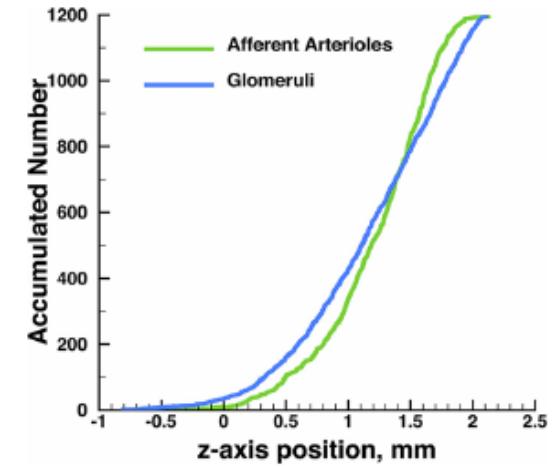
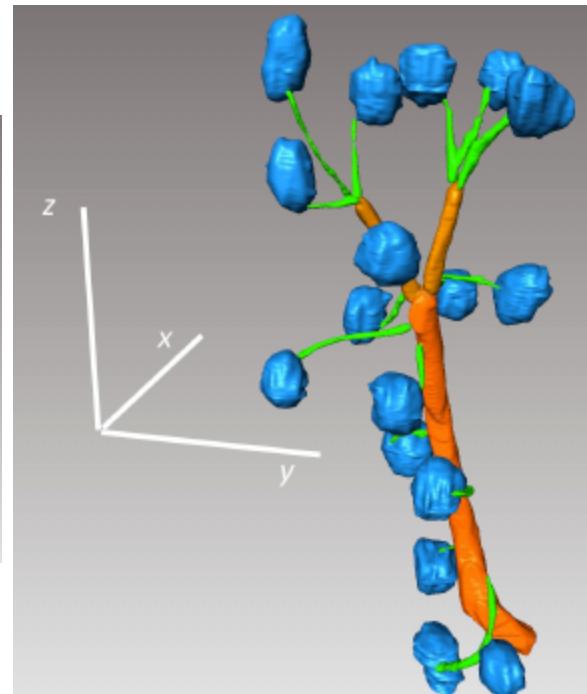


Nordsletten et al, Am. J. Physiol. 291, 2006  
Vodenicharov, Bulg. J. Vet. Med. 10, 2007

# Renal microvascular



- 7th Order
- 6th Order
- 5th Order
- 4th Order
- 3rd Order
- 2nd Order
- 1st Order
- Arcuate Artery



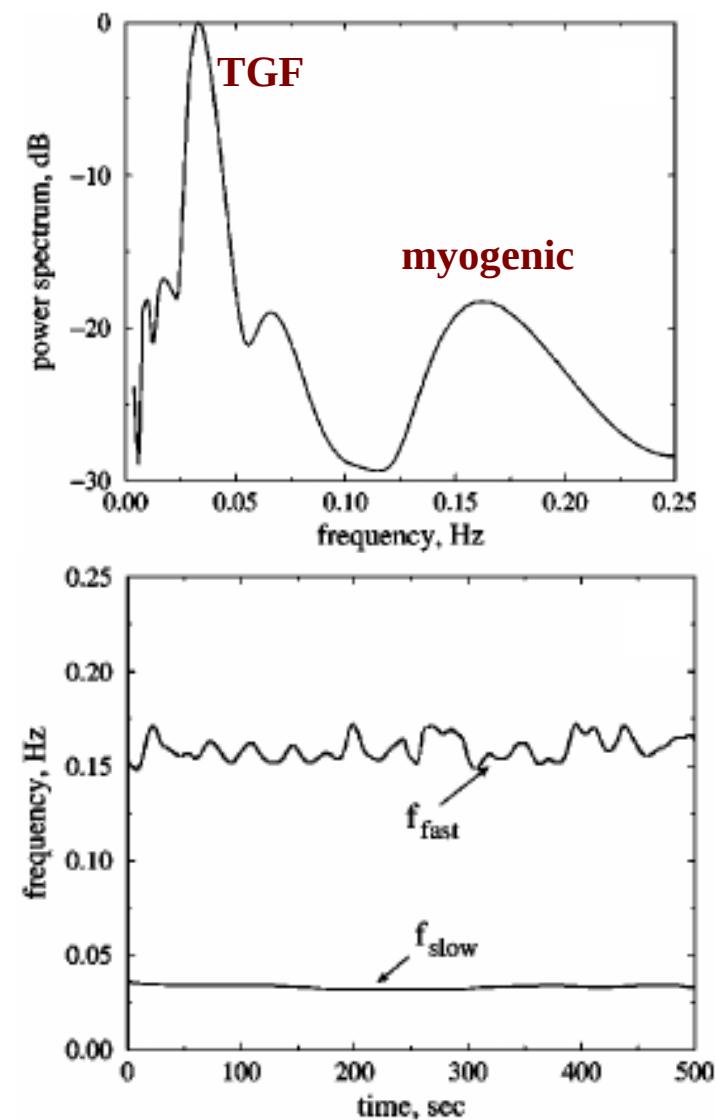
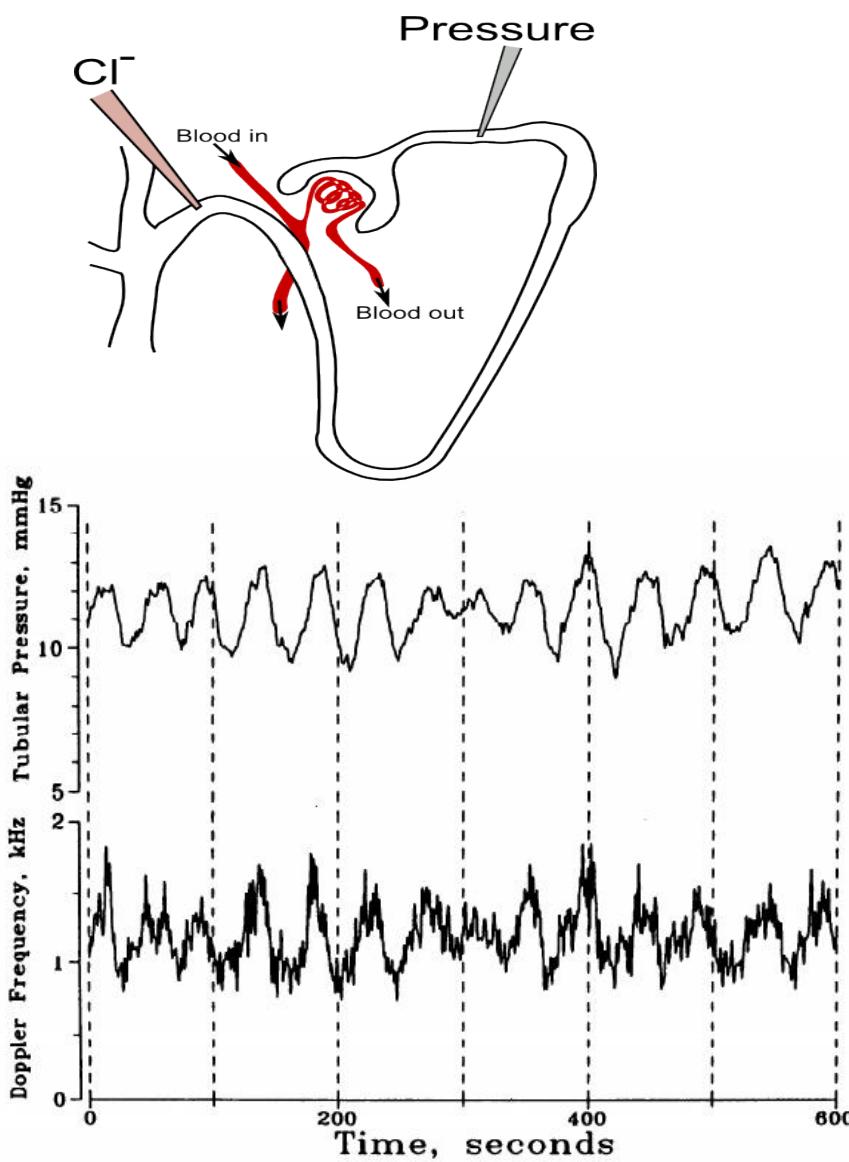
# Stable autoregulation in irregular environment



- How can the kidney achieve homogeneous perfusion despite being regulated locally in a highly variable arterial tree?
- What are the means of communication if post-glomerular blood flow from 90 % of glomeruli perfuse other nephrons, not the same nephron?
- How can each nephron maintain the same pressure when branching is so irregular?

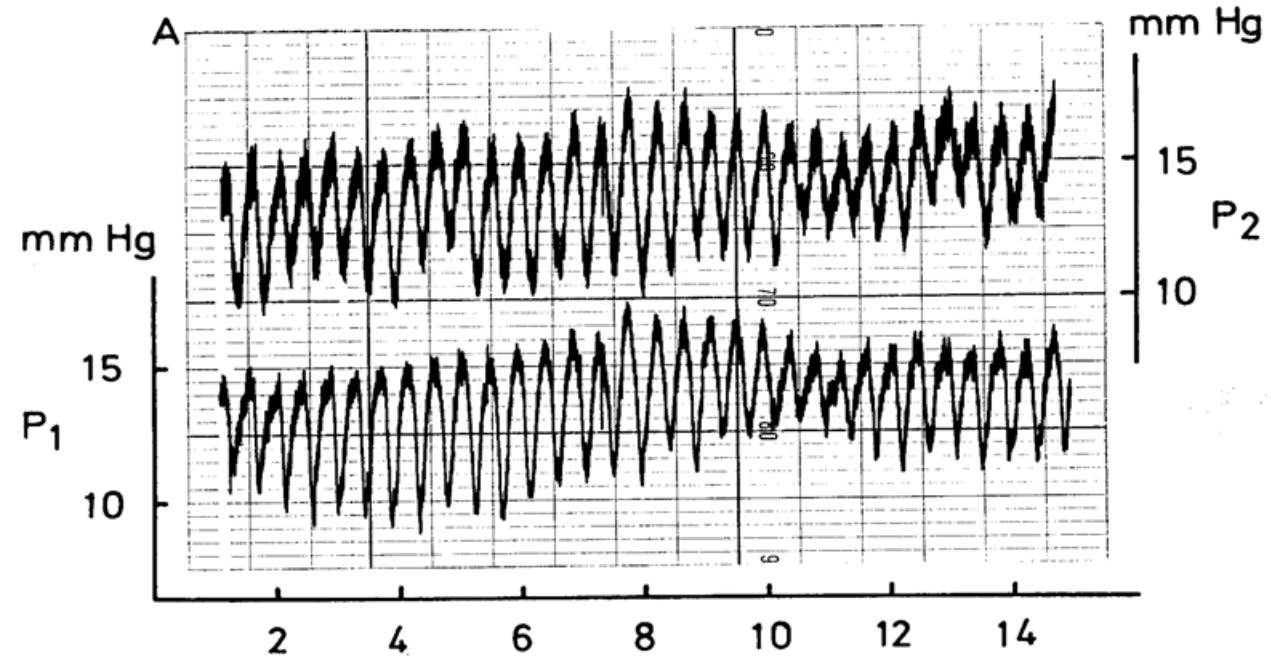
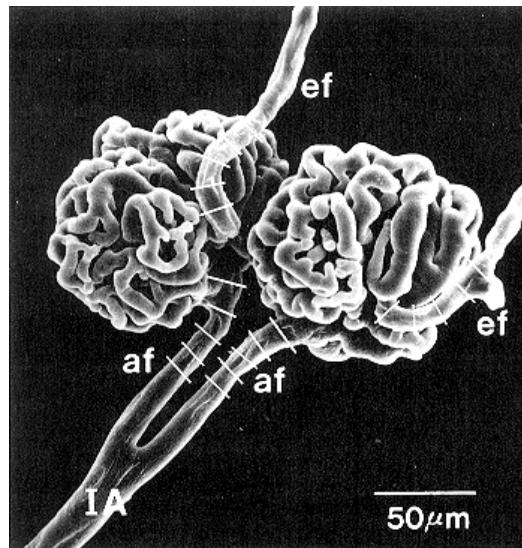
**Nephrons need to operate in larger groups**

# Oscillations

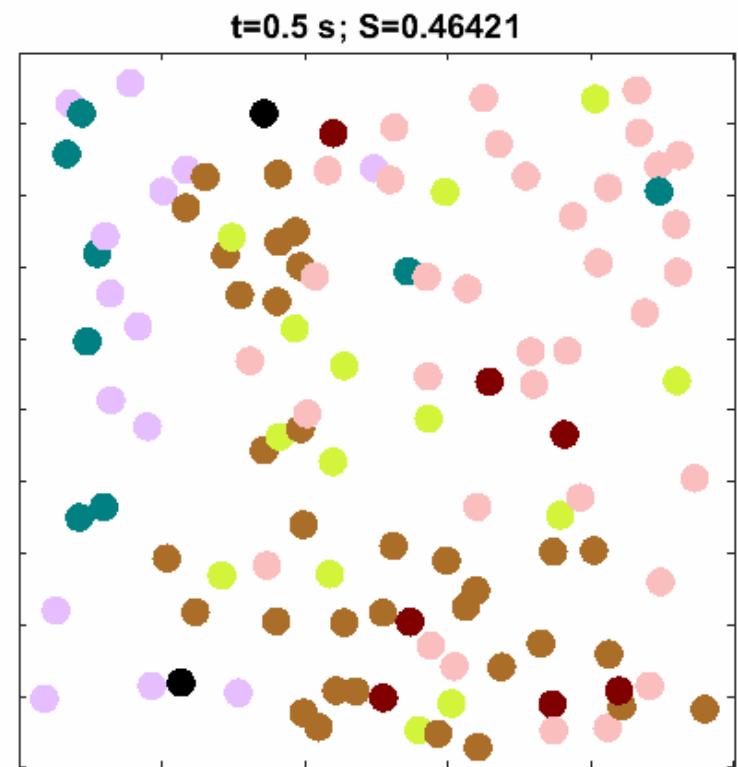
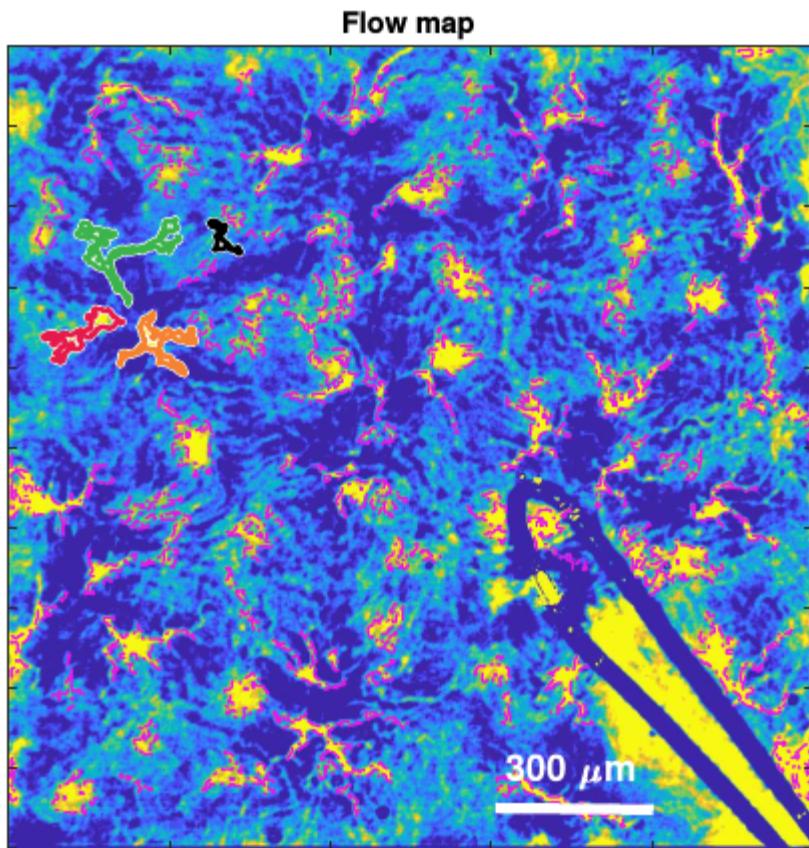


K.-P. Yip et al, Am. J. Physiol. 264, 1993  
 O. Sosnovtseva, PRE 70, (2004)

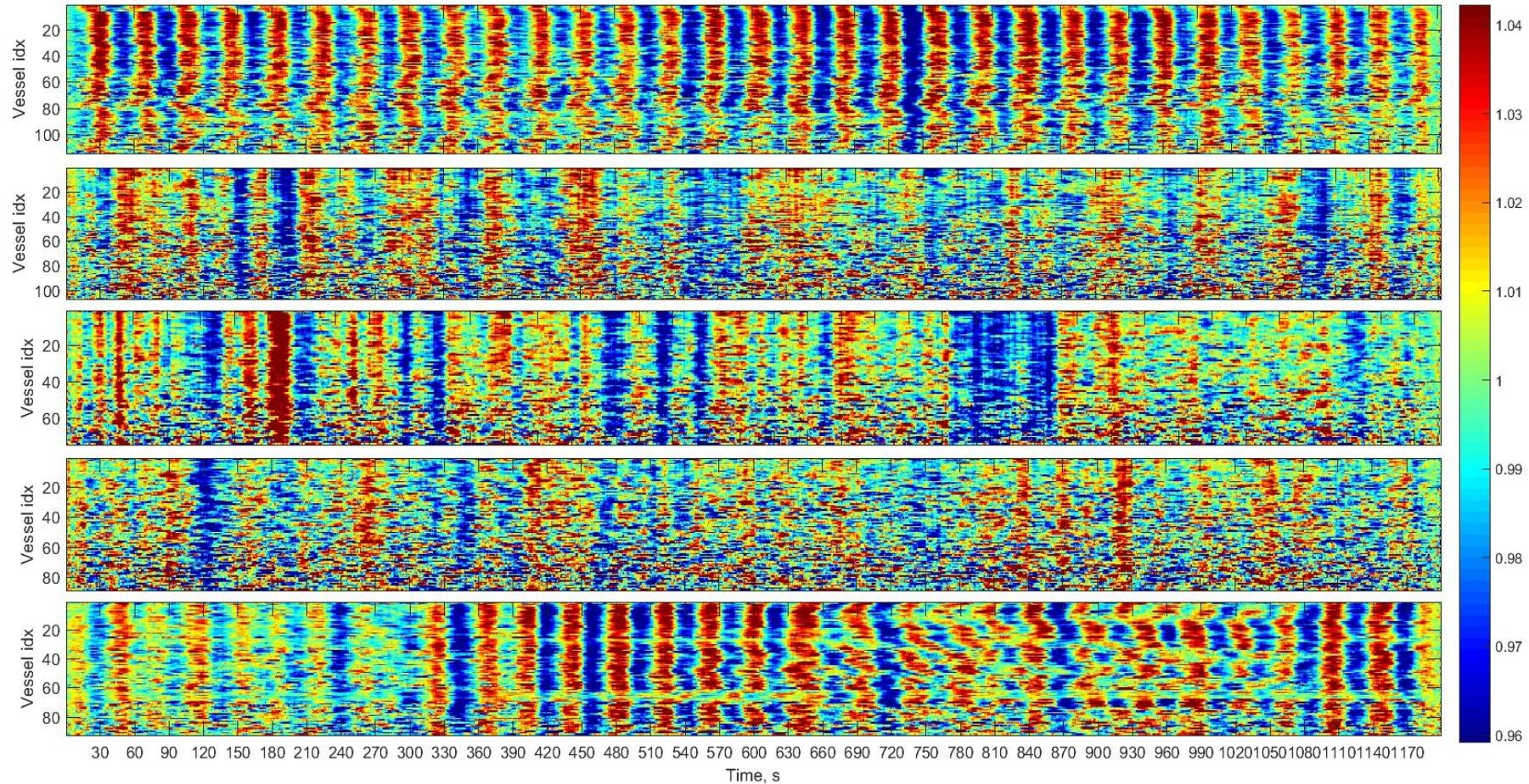
# Neighbors can communicate



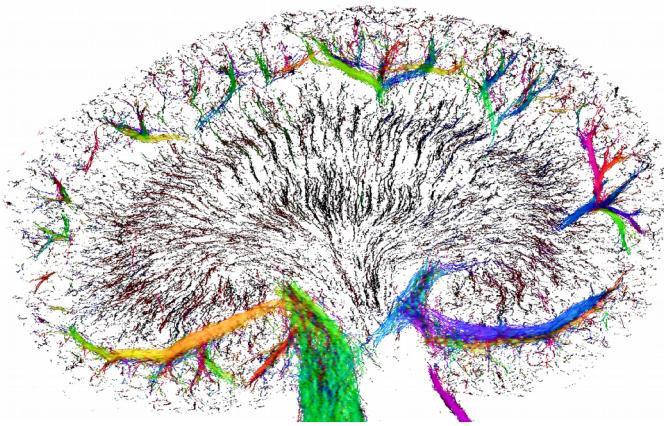
# Cooperative community



# Nephron synchronization



# Open questions



- What does the renal vascular tree actually look like?
- How many nephrons are coupled?
- How far can the signal travel?
- What happens during diabetes and hypertension?
- Is a rat really a tiny human?