ABSTRACT

The tubuloglomerular feedback (TGF) system is an important regulator of the single nephron glomerular filtration rate. (The nephron is the fundamental functional unit of the kidney.) Experiments in rats (by others) have revealed that TGF can mediate regular and irregular oscillations in nephron tubular fluid flow, pressure, and NaCl concentration; moreover, the TGF systems of nephrons whose glomeruli are nearby on the vascular tree frequently exhibit coupled oscillations. Mathematical modeling indicates that the regular oscillations arise from a Hopf bifurcation; that the regular oscillations may serve to enhance NaCl delivery to the distal nephron and thereby elevate NaCl excretion; and that the irregular oscillations, which are found in hypertensive rats, and which appear to meet empirical standards for deterministic chaos, are not truly instances of deterministic chaos but instead arise from multistability, coupling, parameter lability, and episodic perturbations.