RENAL PHYSIOLOGY PART 3

RAAS, ANP, EPO systems

RAAS

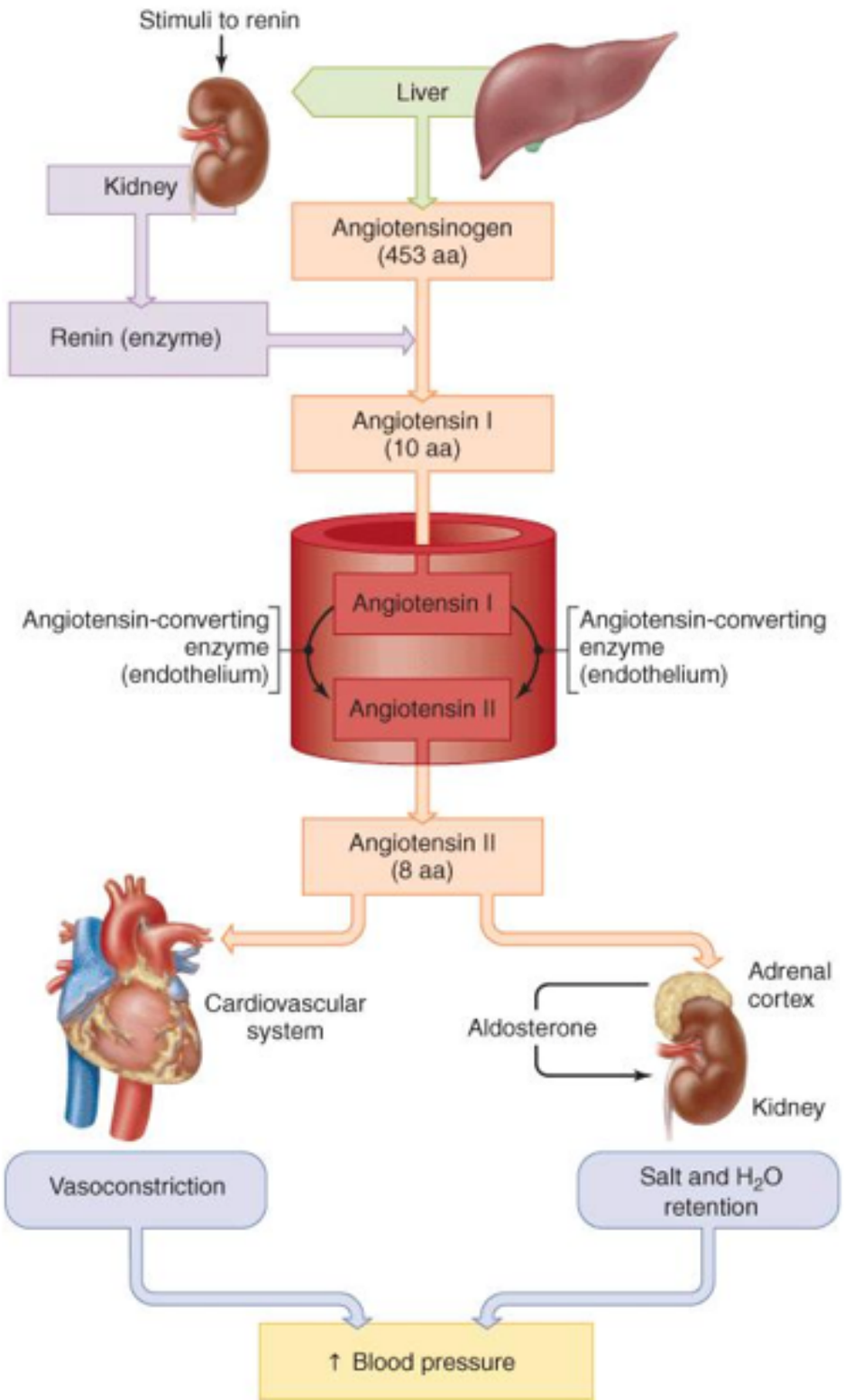

FIGURE 38–5 Summary of the renin–angiotensin system and the stimulation of aldosterone secretion by angiotensin II. The plasma concentration of renin is the rate-limiting step in the renin–angiotensin system; therefore, it is the major determinant of plasma angiotensin II concentration.

- Synthesis of renin/angiotensin
  - Pre renin synthesised in the kidney and other tissues such as the ovaries
  - Activated to renin in the kidneys (juxtaglomerular cells)
  - Angiotensin made from ACE in endothelium of the pulmonary circulation
- Actions
  - Renin —> converts angiotensinogen to angiotensin 1
  - Angiotensin 2 —> causes vasoconstriction (increases SBP and DBP)
  - Aldosterone secretion
  - Vasopressin secretion
  - Causes thirst
  - Facilitates release of noradrenaline
  - Causes contraction of mesangial cells —> reduce GFR, increases Na reapsorption directly in renal tubules
  - Decreases sensitivity of central baro receptors
  - Increases ACTH secretion

REGULATION OF RENIN SECRETION

- Secreted by pericytes in the vicinity of the afferent arterioles and similar micro vessels of the kidney from specialised cells of the juxtaglomerular apparatus - **the juxtaglomerular cells**
- This occurs in response to 3 stimuli
  - A decrease in arterial blood pressure (that could be related to a decrease in blood volume
  - A decrease in sodium load delivered to the distal tubule - this load is measured by the macula densa of the juxtaglomerular apparatus
  - Sympathetic nervous system which also controls blood pressure

THE MACULA DENSE

- Closely packed specialised cells lining the wall of the thick ascending limb of the loop of Henle at the transition to the distal convoluted tubule
- These cells are sensitive to the concentration of NaCl in the distal convoluted tubule
- A decrease in NaCl initiates a signal from the macula densa which has two effects
  - Decreases resistance to blood flow from the afferent arterioles, which raises glomerular hydrostatic pressure and helps return GFR towards normal
  - Increases renin release

REGULATION OF RENIN SECRETION

- Stimulants to secretion
  - Renal nerves firing
  - Increased catecholamines
  - Prostaglandins
  - Hypotension
  - Na wasting
- Inhibition to secretion
  - Angiotensin 2
  - Vasopressin
  - Increased Na and Cl absorption from the macula densa
  - Increased afferent arteriolar pressure
  - Inhibition of prostaglandins by indomethacin
  - Inhibition of catecholamines by beta blockers

ERYTHROPOIETIN

- Synthesised by kidneys to stimulate RBC production
  - angiogenesis
  - vasoconstriction
  - smooth muscle proliferation
- Stimulated by hypoxia and anaemia primarily
- Manufactured in the peritubular cells cells of the renal cortex

ANP

- Secreted in response to expansion of ECF and increase NaCl intake
- Causes natriuresis
- Made in heart
- Actions
  - Dilate afferent arterioles and relax mesangial cells to increase GFR
  - Inhibit renal tubular absorption of Na
  - Relax vascular smooth muscle and increase capillary permeability
  - Inhibit renin secretion
  - Inhibit the vasopressor effects of angiotensin 2 and catecholamines
- Factors effecting secretion
  - Increased ECF - atrial and ventricular stretch
  - Administraiton of thiorphan
  - Immersion in water up to neck