FORMATION OF URINE

Urine is formed by 3 main processes (Fig. 4)

1. Glomerular filtration
2. Tubular reabsorption
3. Tubular secretion.

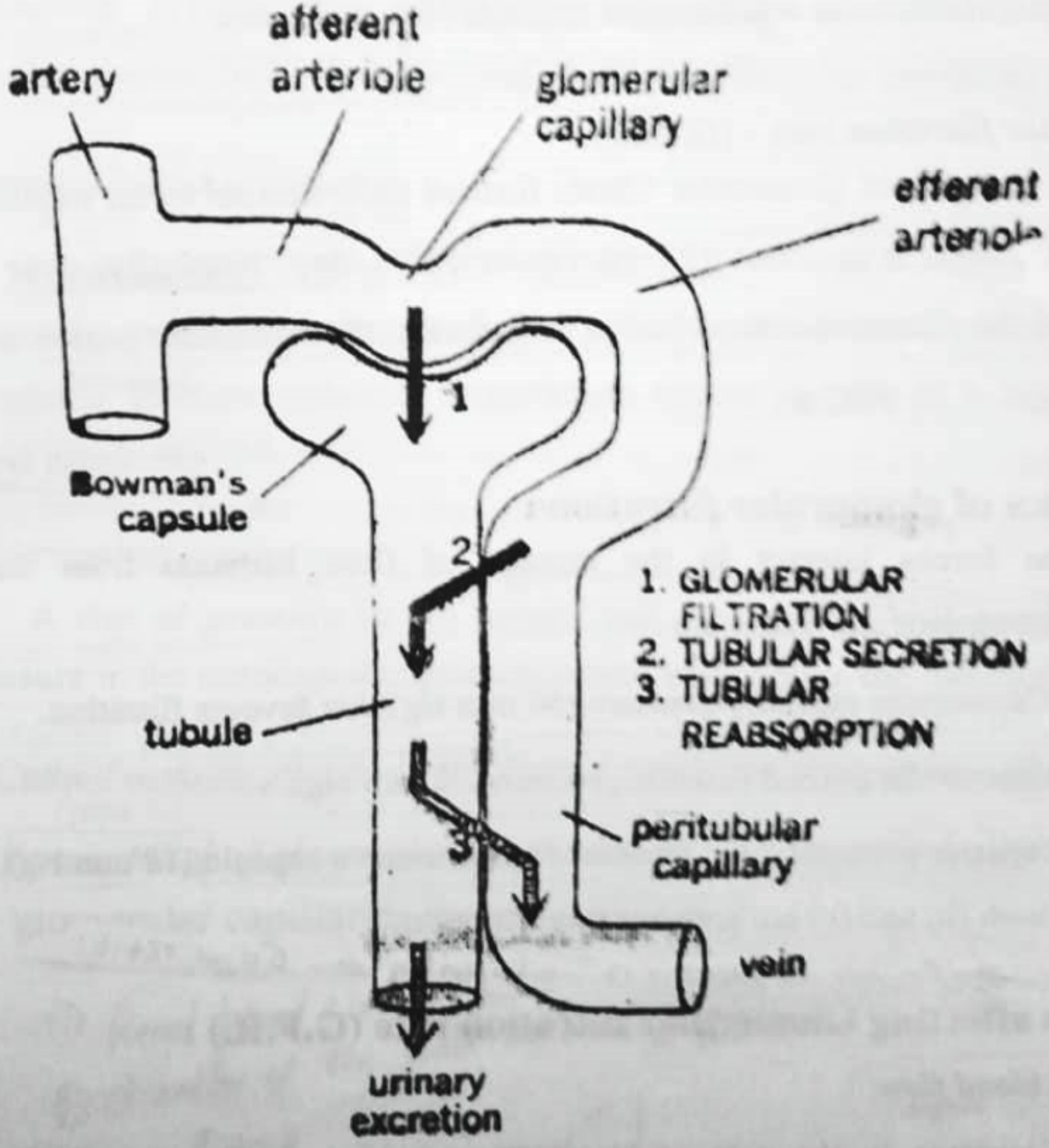

Fig. 4: The three basic components of renal function.

Glomerular filtration :

Glomerular filtration is the first step in urine formation. The glomerulus acts as a filter between the blood and the tubule. Filtration is a passive process.

Glomerular membrane is highly permeable. All substances with molecular weight above 70.000 do not pass through it.

Glomerular filtrate = plasma-its colloids (fat, proteins).

Glomerular filtration rate : (G.F.R.)

It is quantity of glomerular filtrate formed each minute in all nephrons of both kidneys. It is about 125 ml/min or 180 L/day. Normally, over 99 percent of the filtrate is reabsorbed in the tubules, the remainder passes into the urine.

Dynamics of glomerular filtration :

Three forces interact in the process of fluid filtration from the glomerular membrane. These are :

a - Glomerular capillary pressure (60 mm Hg) that favours filtration.

b - Glomerular colloid osmotic pressure (32 mm Hg).

c - copsular pressure, i.e. : pressure in Bowoman's capsule (18 mm Hg).

both (b) and (c) are antagonising filtration.

Factors affecting Glomerular filtration rate (G.F.R.) :

***1. Renal blood flow* :**

An increase in the rate of blood flow through nephrons leads to elevation of glomerular pressure and hence increase in G.F.R.

***iameter of glomerular blood vessels* :**

Afferent arteriolar dilatation increases the glomerular blood flow and merular pressure, both increases the filtration rate. Afferent arteriolar striction decreases the rate of blood flow into the glomerulus and reases the glomerular pressure, this will decrease G.F.R.

***Sympathetic stimulation* :**

During sympathetic stimulation e.g. stress conditions, the afferent terioles are constricted, both renal blood and filtration decrease.

***Arterial blood pressure* :**

An autoregulatory mechanism prevents a significant rise in the lomerular pressure corresponding to a rise in the systemic blood pressure. Automatic afferent arteriolar constriction occurs in case of a high arterial blood pressure.

5. ***Intrapelvic pressure* :**

A rise of pressure in the ureters and renal pelvis will produce back pressure in the intracapsular pressure which antagonises the filtration force.

6. ***Colloid osmotic pressure*** of plasma proteins antagonises filtration.

7. ***Permeability of glomerular capillaries*** : Increased permeability of

WATER BALANCE

Body water :

Water is the largest single constituent of the body, making up from 4 to 60 percent of the total body weight. Body water is distributed among three fluid compartments: The plasma (about 5%) and tahe interstitial fluid (about 15%) which together constitute the extracellular fluid. The rest is located in cells forming the intracellular fluid (about 40%)

Na^+ and Cl^- represent the primary osmotic components in the extracellular fluid, whereas K^+ and proteins are the major elements in the intracellular fluid. The amount of water in the body, at any time, is the result of input (gain) and output (loss).

Water gains :

A healthy man can maintain his body water through :

a- drinking water.

b- different food stuffs, from water contained as such or as a product of metabolism.

Water loss :

water is lost as :

a- urine from the kidney.

b- feaces from the G.I.T.

c- evaporation of sweat.

d- water vapour in expired air.

Control of extracellular fluid volume :

A set of several mechanisms controls water intake (thirst) and water losses (mainly the kidney i, e : renal mechanisms)

Thirst :

A thirst area in the hypothalamus is stimulated by increased osmotic pressure of body fluids or by decreased blood volume.

Renal mechanisms :

The mechanism for the maintenance of plasma volume relies on the detection of low plasma volume which is detected by baroreceptors (pressure receptors) situated in the carotid artery. Stimulation of baroreceptors activates the renin-angiotensin-aldosterone mechanism and aldosterone is secreted (Fig. 5). Aldosterone increased reabsorption of sodium, that is associated with water reabsorption, ending with restoration of plasma volume.

A main second mechanism is that depending on the presence of antidiuretic hormone (ADH). ADH is secreted from the posterior pituitary gland. ADH secretion is stimulated by increased osmotic pressure and by reduced plasma volume. ADH increases water reabsorption from the distal and collecting tubules.

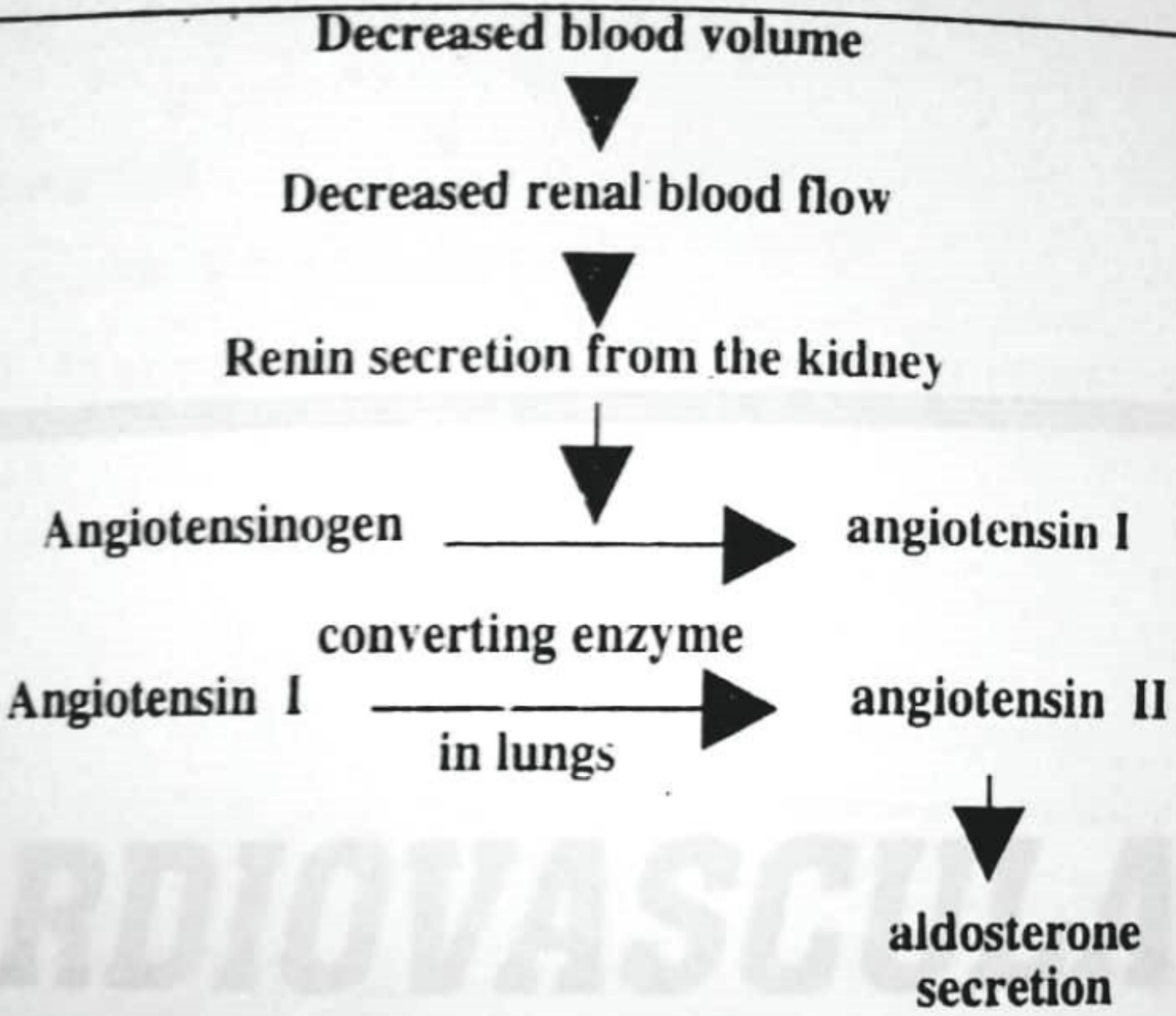

Fig. 5 : Renin-Angiotensin system