

March 2009
QUESTION 13

Outline the factors that determine the composition and volume of glomerular filtrate in a normal person

Glomerulus

- specialised capillary bed
- approximately 500 000 present in adults
- located in the renal cortex
- responsible for determining the composition and volume of glomerular filtrate
- the filtration fraction is the % of renal plasma flow filtered at the glomerulus (usually 15-20%)

Glomerular filtrate

- is dependent on the product of the filtration coefficient and the net starling forces
- surface area and net pressures determine the volume, permeability determines the composition

$$GFR = K_F [(P_{cap} - P_{bowmans}) - (\pi_{cap} - \pi_{bow})]$$

- the glomerular filtration rate is 125ml/min
- this equates to a daily figure of 180L

Filtration coefficient

- is dependent on surface area and permeability
- the surface area is high, due to the anatomy of the glomerulus and the half million glomeruli present
- disease will reduce the number of glomeruli and therefore decrease the GFR
- the permeability is dependent on the action of basement membrane, podocytes and mesangial cells
- demonstrates very high permeability for molecules less than 7000Da (decreases above this)
- proteins, and protein bound substances are therefore not filtered significantly
- pathology may cause damage to these components or increase or decrease permeability
- mesangial cells under the influence of angiotensin II may contract and reduce filtration
- there is also a slight negative charge to the basement membrane which reduces anion filtration

Net filtration pressure (starling forces)

- net hydrostatic pressure is increased because the pressures between the afferent and efferents is high
- it occurs between two arterioles
- may be influenced by ANP, catecholamines, local autoregulatory mechanisms
- this is the only force that favours filtration
- the net hydrostatic pressure is around 45mmHg (60mmHg capillary - 15mmHg Bowman's)
- due to filtration Bowman's space is relatively protein free
- thus the force generally works against filtration = 24mmHg capillary - 0mmHg Bowman's
- overall net filtration pressure is therefore approximately 21mmHg