Datas

1 Assumptions

Notation	Definition (according to [?])	Value
U	Total aqueous humor	
F_h	Fluid inflow in posterior chamber	mean daily value : $2.4\mathrm{mm}^3/\mathrm{min}$ datas : $2.1 – 4.0\mathrm{mm}^3/min$
F_e	net inflow via trabecular path	
p	IOP	$14 – 30\mathrm{mmHg}$
R	output hydraulic resistance	$2.5–5\mathrm{mmHgmin}/\mathrm{mm}^3$ [?] $4\mathrm{mmHgmin}/\mathrm{mm}^3$ (mean) [?]
p_e	pressure in the episcleral veins	$4 – 8$ mmHG
p_a	pressure in the ciliary body capillaries we can find it by using the formula $p_a = 1/3\mathrm{MAP}$ *REF?*	$30 – 35\mathrm{mmHg}$ [?] HBP : $35.5\mathrm{mmHg}$ – NBP : $31.1\mathrm{mmHg}$ LBP : $26.6\mathrm{mmHg}$
L_p	permeability of the equivalent membrane	$0.3\mathrm{mm}^3/\mathrm{minmmHg}$
$\Delta\Pi_p$	osmotic pressure diff. accross membrane (proteins)	$\approx 25\mathrm{mmHg}$
$\Delta\Pi_s$	osmotic pressure diff. accross membrane (low molecular component)	$-400 – -450\mathrm{mmHg}$
σ_p	reflection coeff. (proteins)	1
σ_s	reflection coeff. (low molecular components)	*must range* $0.02–0.2$
C_{p_1}	proteins concentration at membrane output (blood plasma)	$\approx 7\mathrm{g/dl}$
C_{p_2}	proteins concentration at membrane output (aqueous humor)	≈ 0
C_p	proteins concentration	$\equiv C_{p_1}$
ρ	universal gas constant $\times$ absolute temperature	$8.31 \times 300\mathrm{J/mol}$ $2493\mathrm{N.m/mol}$
C_1	total molar concentration of low-molecular components (blood)	$306.64.10^{-3}\mu\mathrm{mol}/\mathrm{mm}^3$ **??**[?]
C_2	total molar concentration of low-molecular components (intra-ocular fluid near ciliary body surface)	
C_2^0	Initial possible value of C_2	$325.02\mu\mathrm{mol/mL}$ $= 325.02.10^{-3}\mu\mathrm{mol}/\mathrm{mm}^3$ [?]
Q_s	Flux of these low-molecular components	
J	Influx due to active transport	$\approx 0.04–0.18\mu\mathrm{mol/min}$
ξ_s	average permeability of membrane for low-molecular species	
$\overline{C}$	$\dfrac{C_1 + C_2}{2}$	

2 Mathematical model

$$\frac{\mathrm{d}V}{\mathrm{d}t} = L_p\left((p_a - p) - \sigma_p\Delta\Pi_p - \sigma_s\rho(C_1 - C_2)\right) - \frac{p - p_e}{R}$$

$$f(v,p) = 0$$

$$V^\star \frac{\mathrm{d}C_2}{\mathrm{d}t} = -\xi_s(C_2 - C_1) + J + (1-\sigma_s)\, L_p\left((p_a - p) - \sigma_p \Delta\Pi_p - \sigma_s \rho (C_1 - C_2)\right) \frac{C_1 + C_2}{2}$$

Resolution ? (stationary state ?)

$$p\left(L_p + \frac{1}{R}\right) = L_p\left(pa - \sigma_p \Delta\Pi_p - \sigma_s \rho C_1\right) + \frac{p_e}{R} + \sigma_s \rho C_2$$

$$p = \alpha_1 + \alpha_2 C_2$$

$$\alpha_1 = \frac{1}{L_p + \frac{1}{R}}\left(L_p\left(p_a - \sigma_p \Delta\Pi_p - \sigma_s \rho C_1\right) + \frac{p_e}{R}\right)$$

$$\alpha_2 = \frac{\sigma_s \rho}{L_p + \frac{1}{R}}$$

$$\Delta\Pi_s = \rho(C_1 - C2)$$

then

$$C_1 = \frac{\Delta\Pi_s}{\rho} + C_2$$

Resolution : non stationary state ?

$$V = V_0 + \alpha(p - \beta) - \beta P$$

$$\frac{\mathrm{d}V}{\mathrm{d}t} = \alpha \frac{\mathrm{d}p}{\mathrm{d}t}$$

But we're gonna go with ODE system

$$\alpha \frac{\mathrm{d}p}{\mathrm{d}t} = f(p, C_2)$$

with

$$V^\star \frac{\mathrm{d}C_2}{\mathrm{d}t} = g(p, C_2)$$

3 values

L_p	$0.3mm^3$
σ_p	1
σ_s	0.02-0.2
$p = p(R)$	
C_1	??
??	$2.5 - 5$ mmHg min / mm^3
¿¿¿¿¿¿¿ d30c0c707ca6ead34131d29007f34f702bac5546 $V^\star$	volume of intraocular fluid between the folds of the e

Notation	Definition (according to [?])	Value
$2l$	characteristic distances between the folds of strongly convoluted surface of the ciliary body	$100\mu\mathrm{m}$
D	diffusion coefficient (low molecular species in water)	$\approx 10^{-9}\mathrm{m/s}$
T_1	characteristic time of diffusion mixing ($T_1 = l^2/D$)	$< 2.5 \approx 1$
T_2	dwell time of fluid between the folds of ciliary body ($T_2 = V^\star/F_h$)	$\approx 10\mathrm{min}$
V_1	volume of posterior chamber	$\approx 60\mathrm{mm}^3$
T_3	dwell time in the posterior chamber ($T_3 = V_1/F_h$)	$\approx 25\mathrm{min}$
L	characteristic distance covered by the fluid in posterior chamber	$\approx 1\mathrm{cm}$
T_4	diffusion time in the posterior chamber ($T_1 = L^2/D$)	$\approx 2 \times 10^2\mathrm{min}$
Q_e	solute outflow from $V^\star$ into the posterior chamber	
V_2	volume of solid structure	
V_3	volume of blood in blood vessels and choroids	
S	area of the posterior chamber-facing secreting surface of the ciliary body	$6\mathrm{mm}^2$
ξ_0	epithelial membrane permeability coeff. for low-molecular admixture per unit area ($\xi_0 = \xi/S$)	$10^7\mathrm{m/s}$
α	volume compliance of the eye shell (varies significantly)	$1\mathrm{mm}^3/\mathrm{mmHg}$
τ	characteristic time of transient processes for hydrodynamic quantities (if $\Delta\Pi_s = \mathrm{Ct}$)	$\approx 1\mathrm{min}$ (or somewhat higher

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4 Goal

1. Paper values $\rightarrow$ p
2. R, L_p, σ_s
3. as 2/ for $p_a = 20 \ldots 40$
4. $R = R(p)$
5. V_3 choroid
6. connect with retina

Here is change
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Now in the general case where $\Delta\Pi_s$ varies

τ_c	characteristic time (stabilization of the concentrations) (if $\Delta\Pi_s$ varies)	an order greater than τ *need checking*
$F_h^\star$	characteristic influx rate	$\approx 2.4\mathrm{mm}^3/\mathrm{min}$
p_t	amplitude of $p(\omega)$	
$\Delta\phi$	phase shift relative to the forcing action	