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Affinity hemodialysis for antiviral therapy with specific application to HIV. (English)

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Summary: We propose an artificial lymph node to improve immune function in fighting viral diseases. The device is based on hemodialysis using a cartridge containing a solid phase affinity resin. Virus capture is mediated by a collection of broad specificity antibodies covalently coupled to agarose. Viral proteins, which can directly damage uninfected cells, are also efficiently removed. Immobilized antisense DNA provides a mechanism to remove infectious viral nucleic acids. Theoretical calculations suggest that the device could effectively remove virus, toxic viral proteins and infectious viral nucleic acids from the blood thereby limiting disease by preventing reinfection of new cells.

In the absence of newly infected cells, previously infected cells are cleared by the immune system. For a typical immobilized antibody, calculations predict a pseudo first order rate of capture ($t_{1/2} \sim 10\,\text{min}$) with viral load reduction $\sim$ 660-fold at equilibrium. Theoretical calculations of a diffusion limited process predict $t_{1/2} \sim 2.8\,\text{h}$. Measured transport rates for latex particles in a prototype device are significantly faster than the theoretical diffusion limit suggesting that transport is primarily convective and sufficient to allow rapid virus clearance. Since the device is highly selective it can be used in conjunction with drug therapy and other treatments.

MSC:

92C50 Medical applications (general)

Keywords:

virus load; replication rate; clearance rate; affinity hemodialysis; virus diffusion; immobilized antibodies