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Drug Permeation through the Three Layers of the Human Nail Plate

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The in-vitro permeation characteristics of a water soluble model drug, 5-fluorouracil, and a poorly water soluble model drug, flurbiprofen, were investigated through three layers of the human nail plate (namely, the dorsal, intermediate and ventral nail plates), using a modified side-by-side diffusion cell. The dorsal-filed nail plate, the ventral-filed nail plate and the dorsal-and-ventral-filed nail plate were prepared to known thickness and then used with the full-thickness nail plate to investigate the permeation characteristics of each single layer.

Most of the lipids in the human nail plate were found in the dorsal and ventral layers. The rank orders of the permeation fluxes for 5-fluorouracil and flurbiprofen were both: dorsal-and-ventral-filed nail plate > dorsal-filed nail plate > ventral-filed nail plate > full-thickness nail plate. With respect to 5-fluorouracil permeation through each single layer, the permeability coefficient of the intermediate layer was higher than those of other single layers. However in the case of flurbiprofen, the permeability coefficient of the ventral layer was higher than other single layers. The diffusion coefficient of 5-fluorouracil and flurbiprofen in the dorsal layer were the lowest of any single layer. The drug concentration in each layer was estimated using each respective permeation parameter. The drug concentration in the nail plate was observed to be dependent on the solubility and the flux of the drug.

From these findings, we suggest that the human nail plate behaves like a hydrophilic gel membrane rather than a lipophilic partition membrane and that the upper layer function as the main nail barrier to drug permeation through its low diffusivity against the drugs.