Verifying Engineering at Nanoscale: Electron Microscopy & Drug Delivery

Packaging drugs and genes into nanoparticles enables drug or gene biodistribution to be favourably altered, with an ultimate therapeutic benefit [1-3]. To acquire such control on the in vivo fate of drugs and genes requires that such particles be precision engineered and electron microscopy is one of the techniques used to visualise and confirm the results of such engineering.

Methods

Pharmaceutical nanosystems in our laboratory have been prepared from the self assembly of: a) comb type polymers [4-6] and b) dendrimers [7, 8] (fig. 1). By exercising control on the chemistry of these self assembling molecules, a variety of functional nanosystems may be prepared. Applying physical characterisation techniques including imaging to the resulting self assemblies and studying their in vivo behaviour ultimately enables robust correlations to be made between polymer chemistry, nature of the self assembly and drug delivery performance.

Results

Self assembling comb type polymers have been prepared from carbohydrates [2, 5], polyamino acids [4] and polyamines [1, 6] and altering the level of hydropho drug loaded nanoparticles increase drug bioavailability across the blood brain barrier by up to ten fold when compared to the current state of the art commercial emulsion system (fig. 4) [2]. Amphiphilic polyamine drug loaded nanoparticles increase drug absorption via the oral route by up to three fold when compared to the drug suspension in water [1]. Additionally polypropylenimine dendrimers form colloidal particles with DNA which are able to transfer an anti-proliferative gene, the tumour necrosis alpha gene, into mouse tumours and produce a 100 % response in all tumours studied, due in part to the additional anti-proliferative activity of the dendrimer [3].

Conclusions
It is possible to correlate polymer chemistry with the nature of the resulting self assembly and ultimately link a range of morphologically distinct nano-size self assemblies with specific drug delivery function. With these nanosystems, a ten fold increase in drug activity may be obtained [2] and an effective anti-cancer gene medicine is achievable [3].

References:

[7] Zinselmeyer, B.


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