Understanding the interaction of polyelectrolyte architectures with proteins and biosystems

Polyelectrolytes such as e.g. DNA or heparin are long linear or branched macromolecules onto which charges are appended. The counterions neutralizing these charges may dissociate in water and will largely determine the interaction of such polyelectrolytes with biomolecules and in particular with proteins. Here Prof. Matthias Ballauff, member of IRIS Adlershof, and collegues review studies on the interaction of proteins with polyelectrolytes and how this knowledge can be used for medical applications. Counterion release was identified as the main driving force for the binding of proteins to polyelectrolytes: Patches of positive charge become multivalent counterions of the polyelectrolyte which leads to the release of counterions of the polyelectrolyte and a concomitant increase of entropy.

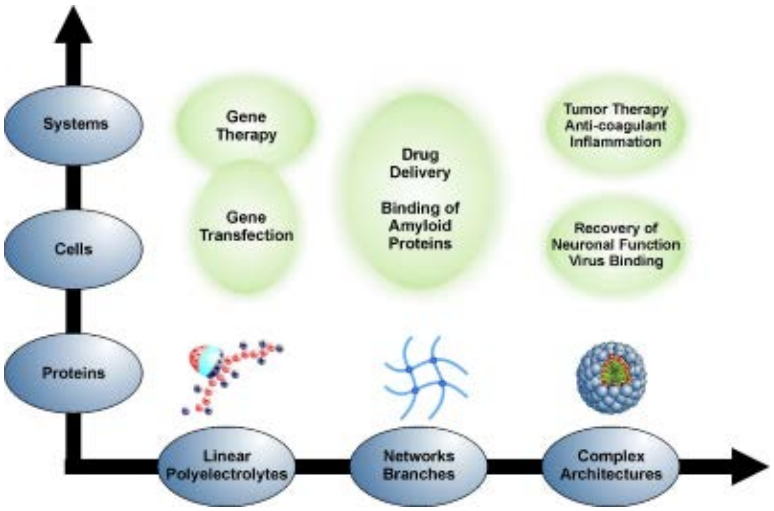

Figure 1: Interaction of polyelectrolytes with biosystems at different levels of complexity. The entire matrix of systems and problems surveys the possible medical problems to which synthetic polyelectrolytes may provide solutions

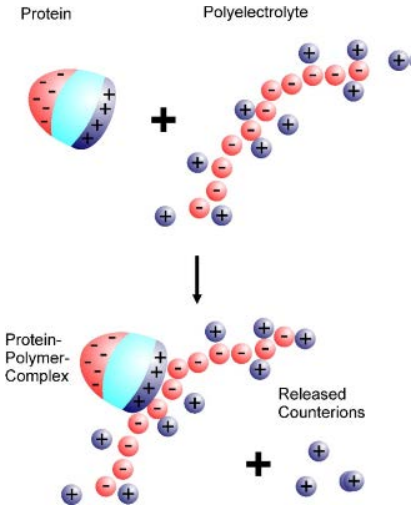

Figure 2: Interaction of proteins with highly charged polyelectrolytes as e.g. DNA by counterion release

This was shown by surveying investigations done on the interaction of proteins with natural and synthetic polyelectrolytes. Special emphasis is laid on sulfated dendritic polyglycerols (dPGS). The entire overview demonstrates that we are moving on to a better understanding of charge – charge interaction in system of biological relevance. Hence, research along these lines will aid and promote the design of synthetic polyelectrolytes for medical applications.

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