Exosomes as Nano-Theranostic Platforms for Gene Therapy
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Exosomes
- Biological membrane vesicles measuring 30 to 100 nm
- Secreted by most biological cells
- Contain abundance of small molecules, e.g. tetraspanin, receptors for adhesion
- Perform physiological functions
- Transport of genetic material, modulation of immune system, cell-to-cell communication

Physiological
- Shuttles for antigen presentation
- Stimulatory / inhibitory effect on immune system
- Function as possible cancer vaccine
- Attenuate ischaemia reperfusion in myocardial infarction
- Regulation of neuronal cell function
- Mediate transfer of RNA between cells

Pathological
- Similar composition and mechanism of action between exosomes and retroviruses
- Similarities in biogenesis and gaining entry into cells
- Exosomes and retroviruses may share a common ancestry
- Tumour cells secrete exosomes to mediate cancer progression and metastasis
- Cancer cells use exosomes as “decoy flares” to block pharmacological agents
- Exosomes are associated with the transfer of prion proteins in Creutzfeldt-Jakob disease

Functional Genetic Biomarkers
- Exosomes containing RNA have been found in breast milk, saliva, urine, and nasal fluid
- These exosomal RNAs can be used as minimally-invasive method of clinical diagnosis of diseases
- miRNA in exosomes secreted by tumour cells can be “harvested” to function as tumour markers

Nano-Therapeutic Gene Delivery
- Exosomes can be used as vehicles to deliver siRNA to suppress cancer cell growth
- Tumour-suppressive miRNA can be delivered via exosomes to confer a gene-silencing effect on recipient cells
- “Hybrid” exosomes can be engineered from dendritic cells to express neuron-specific peptides, with a potential for treating Alzheimer’s disease

Conclusions
- Exosomes can be a viable alternative to viruses as vectors for gene delivery
- As exosomes can be derived from the patient’s own cells, the issue of immunogenicity can be avoided
- Unlike viruses, exosomes do not self-replicate; hence probability of reversion to virulence is negligible
- “Hybrid” exosomes can be clinically engineered and optimised by incorporating specific receptors and payload

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Representative Publication: