Polymer nanoparticles as a targeted drug delivery system for the treatment of rheumatoid arthritis

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Rheumatoid arthritis (RA) is one of the many diseases for which current therapies are not sufficiently effective or cause severe side effects.

RA is an autoimmune disease affecting about 1% of the population and leads to chronic systemic and synovial inflammation, joint damage and cartilage destruction. Nanoparticles (NPs) are becoming increasingly important for modern drug delivery due to their adaptable properties.

NPs made from biodegradable polymers such as PLGA offer controlled synthesis for desired size, shape and surface properties. They effectively encapsulate hydrophilic and hydrophobic drugs for more efficient delivery and reduced side effects, while protecting the drugs from degradation. Customisation through surface modifications, such as antibody conjugation, enables tissue- or cell-specific targeting.

This work addresses the unmet need in the treatment of rheumatoid arthritis (RA), where the current gold standard drug methotrexate, among others, exhibits limited efficacy and can cause severe side effects in many patients.

My aim was to produce, optimise, and analyse novel drug-loaded PLGA nanoparticle-antibody conjugates that specifically target the inflamed synovial tissue in the RA joints. These conjugates were tested using TEM, DLS, Zeta Potential measurements, and other techniques. The results showed a suitable mean diameter ranging from 100 to 250 nm, a PDI<0.1, and controlled drug release over 5 days. Moreover, the coupling efficiency with the synovial-specific antibody was improved to 50 − 80%, and the NPs were confirmed to be non-toxic to cells.

Future studies will focus on examining the protein corona and therapeutic effects.