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Opinion Article

A Boronated Polymers and Cellular Protein Therapies to Treat Bone Cancers

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DESCRIPTION

Due to the unique physiological environment of the bone, chemotherapeutic therapy of malignant bone cancers frequently has poor therapeutic response, necessitating the development of novel therapeutic approaches. For this, they have described a protein nanomedicine that targets the bone. For intracellular protein delivery, the toxin protein saporin was co-assembled with a boronated polymer. The resulting nanoparticles were then coated with an anionic polymer poly (aspartic acid) to protect the positive charges on the nanoparticles and give the bone targeting function. The created ternary complex nanoparticles shown significant bone formation and had the ability to change their surface charge from negatively to positively when placed near a tumour site that had been activated by the extracellular acidity of the tumour. The de-shielded nanoparticles' boronated polymer aids in the intracellular delivery of saporin to tumour cells, where it exerts its anticancer effects in deactivating ribosomes.

Orthotopic bone tumours and bone metastatic tumours are two categories for malignant bone tumours. The most prevalent type of orthotopic bone tumour, osteosarcoma, primarily affects teenagers and young adults. Although the five-year survival rate for people with locally advanced osteosarcoma has increased it is still only a modest percentage for those with metastatic osteosarcoma. Patients with advanced malignancies including breast tumours are frequently diagnosed with bone metastases. Life-threatening effects from bone metastases include pathological fractures, bone pain, neurological deficits and paralysis which have a negative impact on quality of life. The existing therapeutic options for metastatic and orthotopic bone tumours are not at all satisfactory. Patients who have a bone tumour surgically removed frequently experience recurrence as a result of the tumor's location in the bone marrow not being completely removed. Additionally, patients with multiple metastatic bone cancers are not eligible for surgical treatment. Because of the unique physiological milieu of the bone the majority of bone cancers are not responsive to conventional radiation. Due to multidrug resistance and inadequate drug accumulation at the location of the bone tumour, chemotherapeutic therapy options for bone cancers are similarly restricted.

Bone-targeted nanomedicines with improved drug accumulation at bone tissues have recently been suggested as promising options for treating bone cancers. Targets suggested included inorganic minerals like hydroxyapatite found in bone tissues. Tetracycline, bisphosphonates, aspartic acid-rich peptides, phytic acid, anionic polymers and other compounds with strong hydroxyapatite binding affinities were attached to nanoparticles to increase their ability to accumulate bone. These ligands are advantageous for the targeted delivery of therapeutic medicines to bone defects and osteolytic lesions around bone malignancies because they have greater affinity with highly crystalline hydroxyapatite. To treat metastatic bone cancers and osteosarcoma, bisphosphonate conjugated nanoparticles were loaded with anticancer medications. Phytic acid, a naturally occurring chemical was combined with cisplatin to create bone-targeted Nano medicine for the treatment of bone metastatic cancer. It has also been suggested to use peptide and bisphosphonate conjugated nanoparticles in photothermal therapy to treat bone cancers. Targeted nanoparticle mediated combination therapies were also suggested to improve bone tumour therapy's therapeutic response and end the vicious loop between bone resorption and tumour growth. Although these nanomedicines revealed encouraging therapeutic outcomes, it is still urgently necessary to find new and effective therapeutic approaches for the treatment of orthotopic and metastatic bone cancers.

When compared to traditional small-molecule chemotherapeutics, protein medicines are more potent and selective. However, proteins are quickly broken down by proteases and have a difficult time acting on intracellular targets when they cross cell membranes. Polymers that can convey protein payloads inside of cells and shield proteins from proteolysis were created to address these problems. Through a combination of nitrogen-boronate coordination and ionic interactions, boronated polymer was proposed to combine with proteins. It demonstrated promising effectiveness in cytosolic

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transport of cargo proteins and peptides with maintained bioactivity. Here, we delivered the toxic protein saporin into bone tumour cells using a boronated dendrimer as the protein carrier. In addition to bone targeting, nanoparticles from positive to negative preventing the reticuloendothelial system's quick clearance of cationic nanoparticles during blood circulation.