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Professor Giyoong Tae's joint research team suggests the possibility of treating ischemia/reperfusion damage with mesenchymal stem cells loaded with nanoparticles

- GIST (Gwangju Institute of Science and Technology) School of Materials Science and Engineering Professor Giyoong Tae and Dankook University Department of Nanobiomedical Science Professor Hee Seok Yang developed a technology to suppress ischemic liver damage using mesenchymal stem cells equipped with biocompatible nanoparticles.

  - The research team mounts Prussian blue (PB) nanoparticles that have the effect of decomposing reactive oxygen species on mesenchymal stem cells (MSCs) that are difficult to survive in tissues damaged by reactive oxygen species and improved the therapeutic effect factor.

- In various cases such as myocardial infarction, stroke, peripheral arterial disease, and organ transplantation, hypoxia occurs due to blood vessel obstruction, and excessive reactive oxygen species are generated by rapid oxygen supply due to ischemia/reperfusion, and these reactive oxygen species directly damage tissues by inducing inflammation.

- Treatments using stem cell delivery to damaged tissues is currently being used and many studies are being conducted, but its effectiveness is limited because high oxidative stress caused by inflammation of damaged tissues is transmitted to stem cells, reducing the therapeutic effect.

- Mesenchymal stem cells (MSCs) release factors that have therapeutic effects and can suppress ischemia/reperfusion damage as immune regulation is possible, so studies have been conducted to prevent damage by delivering MSCs. However, in the presence of excessive reactive oxygen species, MSCs show a remarkably low survival rate, leading to a low therapeutic effect.

  - Prussian blue (PB) is a biocompatible nanoparticle that has been approved as a drug by the FDA, and it is also used as a formative agent for MRI and as a photothermal therapy. PB nanoparticles also contain in vivo catalase (an enzyme that breaks down hydrogen peroxide into water and oxygen) and superoxide dismutase (an enzyme that catalyzes the disproportionation reaction that converts excess oxide ions into oxygen and hydrogen peroxide). It has the characteristics of a nanozyme with similar enzymatic properties.

- The research team mounted PB nanoparticles with reactive oxygen species decomposition effect inside the MSC through endocytosis, and nanozyme-mounted MSCs (PB-MSC) showed a high survival rate in an environment of reactive oxygen species and were therapeutic factors, confirming that the emission characteristics of were well maintained.

  - When applied to a liver ischemia/reperfusion rat model, it was demonstrated that nanozyme-loaded MSCs (PB-MSC) not only reduced the necrosis of liver tissue but also recovered liver function faster than normal MSCs.

- GIST Professor Giyoong Tae said, "The results of this research can be applied to improve the survival and treatment performance of various cells besides mesenchymal stem cells. It can be applied not only to ischemia/reperfusion but also to the regeneration of various organs and tissues, suggesting an important possibility to improve the overall effect of cell therapy for tissue regeneration."

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