Light-based nanomedicine approaches ocular cancer management: Future perspectives

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Aims: This review study evaluates the recent advancements in nanoparticle-based therapies for the most common ocular cancers: retinoblastoma (RB) and uveal melanoma (UM), with a focus in phototherapy (PTT) and photodynamic therapy (PDT).

Methods

A comprehensive literature review was conducted with the most recent progress in the nanoparticle-based therapies for the most common ocular cancers. Relevant preclinical and clinical studies were systematically analyzed.

Results/Discussion

A revolutionary aspect of nanotechnology in photo-based therapies is its potential for multimodal applications. For instance, gold nanoparticles (AuNPs) can act as enhancers for Optical Coherent Tomography (OCT), fluorescent or Photoacoustic (PA) imaging, allowing *in vivo* tracking and image-guided PTT, while they have also been used as dose enhancers in radiotherapy. Another treatment often combined with PTT or PDT is chemotherapy, leveraging the increased susceptibility of treated cells to chemotherapeutic drugs. PTT and PDT can also benefit from each other. For example, PTT increases local blood flow and oxygenation, mitigating the oxygen dependency limitations of PDT. Overall, NPs enable the co-deliver of a variety of molecules (light-activated, imaging-enhancing, chemotherapeutic), allowing several combinations between chemotherapy, PDT, PTT and radiotherapy, along with imaging, to leverage their synergetic effects.

Conclusion

The integration of nanotechnology into photo-based therapies can offer precision treatment and optimized administration, with some nanoformulations already in clinical trials and several others in preclinical studies. Given the ability to combine them with other therapeutic methods, such as radiotherapy and chemotherapy, as well as multiple imaging modalities, nanomedicine holds the potential to transform the ocular oncology landscape.

References

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