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Advancing skin cancer treatment through dual drug loading into liposome-derived nanosystems

Margarida Corte-Real[1], Francisco Veiga[1,2], Ana Cláudia Paiva-Santos[1,2*] and Patrícia C. Pires[1,2,3*]

[1] Department of Pharmaceutical Technology, Faculty of Pharmacy of the University of Coimbra, University of Coimbra, Portugal
[2] REQUIMTE/LAQV, Group of Pharmaceutical Technology, Faculty of Pharmacy of the University of Coimbra, University of Coimbra, Portugal
[3] Health Sciences Research Centre (CICS-UBI), University of Beira Interior, Portugal

INTRODUCTION & AIM

Nanotechnology has emerged as a highly promising field in skin cancer treatment, offering innovative approaches to targeted drug delivery and therapeutic strategies. Specifically, nanocarriers have the potential to enhance the efficacy and selectivity of drug delivery to tumour cells.

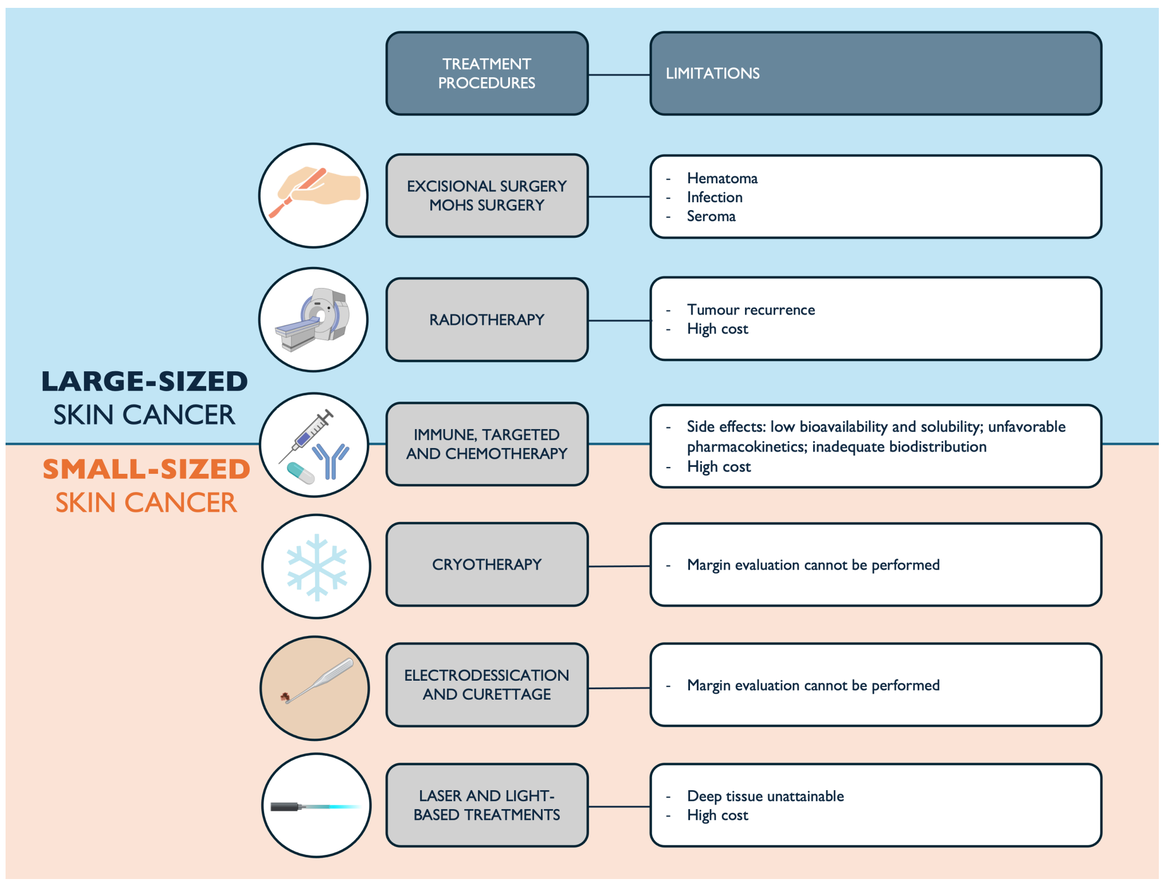

Figure 1. Representation of current skin cancer treatment procedures and the respective limitations (produced with Biorender).

Provide a comprehensive evaluation and synthesis of the current research on the enhancement of skin cancer treatment through the co-encapsulation of drugs into nanosystems.

METHOD

A literature review was performed according to the key research: (liposomes OR niosomes OR transfersomes OR transferosomes OR ethosomes) AND ("dual-loading" OR "dual loading" OR “dual-encapsulation” OR “dual encapsulation” OR “dual-delivery” OR “dual delivery” OR "co-encapsulation" OR "coencapsulation" OR "co-delivery" OR "codelivery" OR "co-administration" OR "coadministration”) AND (melanoma OR “basal cell carcinoma” OR “squamous cell carcinoma” OR “skin cancer”).

This literature research took into account the:

- **Types of skin cancer**
- **Nanosystems for skin application – a focus on liposomes and derived systems**
- **Challenges associated with administration routes**
- **Cancer signaling pathways**
- **Formulation characterization**

Zeta potential
Particle size
Polydispersity index
Encapsulation efficiency
Drug release

RESULTS & DISCUSSION

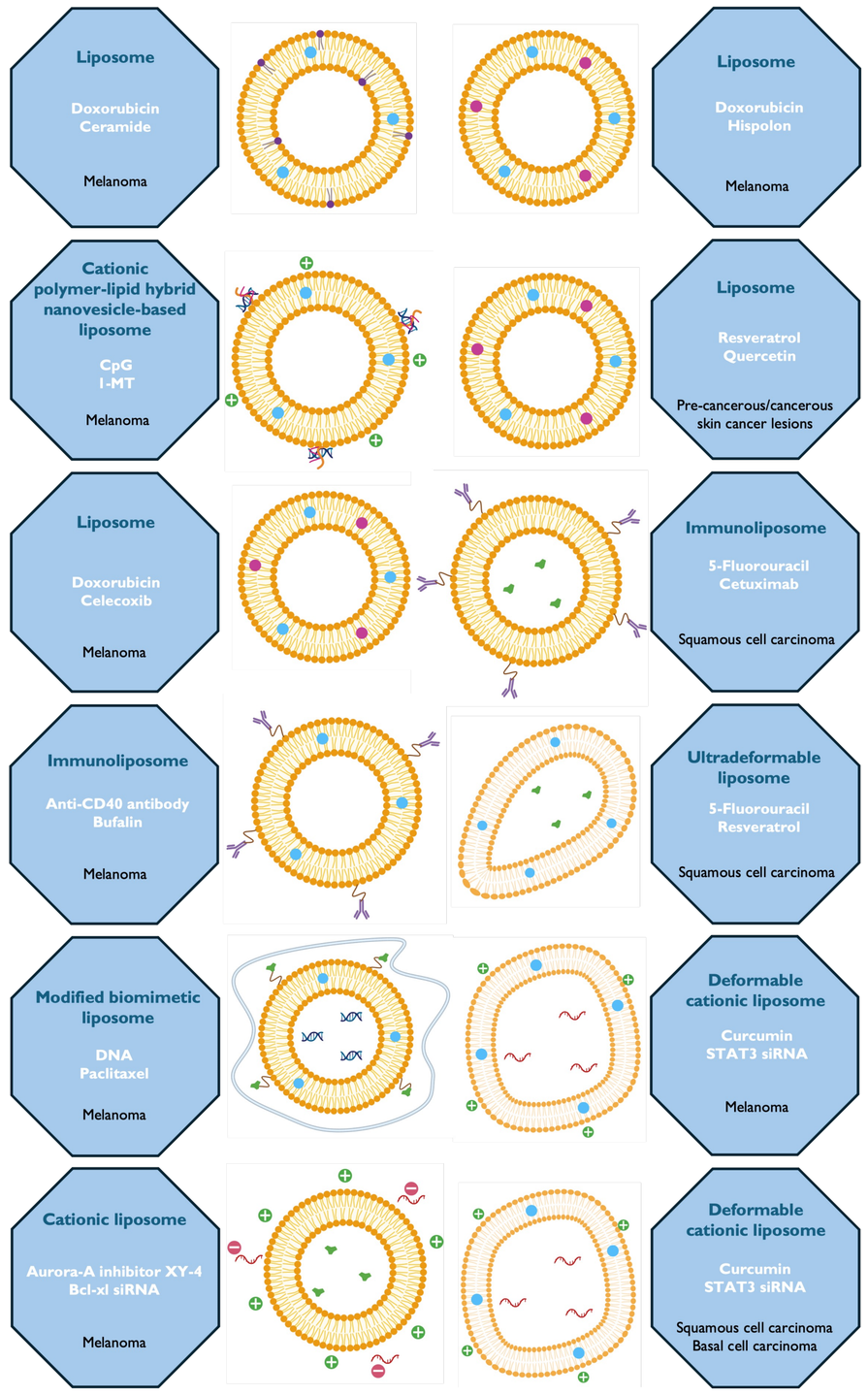

Figure 2. Diagrammatic representation overview of the 12 articles revised, including the type of liposomes, dual therapeutic agents and type of skin cancer/lesions explored in each study (produced with Biorender).

All the developed delivery systems:

- nanoscale range
- < 600 nm → reach deep layers
- homogeneous populations (PDI ≤ 0.3)

Most of the developed delivery systems:

- enhanced stability
- greater electrostatic stability, and consequently prevents aggregation (|ZP| > 30 mV)
- liposomes, immunoliposomes and deformable cationic liposomes

Doxorubicin: general inhibition of tumor cells → efficacy of the treatment

Incapacity of commercialization → large-scale production, stability maintenance

CONCLUSION

Conventional cancer therapies have limited effectiveness and severe side effects, while dual-loaded liposomal systems improve drug delivery, enhancing outcomes and reducing toxicity. These systems are promising for skin cancer treatment, especially when combining chemotherapy, gene therapy, and/or immunotherapy. However, further clinical research is needed to confirm their long-term safety and efficacy.

REFERENCES