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The effect of Ge, Si and Sn phthalocyanine photosensitizers on cell proliferation and viability of human oesophageal carcinoma cells

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Abstract

The photodynamic activity of water soluble mixed sulfonated metallophthalocyanines complexes: $GePcS_{mix}$, $SnPcS_{mix}$ and $SiPcS_{mix}$ on human oesophageal carcinoma (SNO) cells are reported, and compared with the activity of the unmetallated H_2PcS_{mix} and of the newly synthesized water soluble adjacently substituted binaphthalo phthalocyanine (complex **3**). The alkaline phosphate (ALP) showed damage to the cell membrane in the presence of complex **3** without irradiation. The $GePcS_{mix}$ complex caused a relatively large increase in inflammation and a high intracellular ATP.

Keywords: Phthalocyanine; Cell viability; Cell proliferation; Germanium; Silicon; Tin

1. Introduction

Metallophthalocyanine (MPc) complexes have proved to be highly promising as photosensitizers for photodynamic therapy (PDT), due to their intense absorption in the red region of visible light. High triplet state quantum yields and long triplet lifetimes are required for efficient sensitization, and these criteria may be fulfilled by the incorporation of a diamagnetic metal (or metalloid) such as zinc, aluminum, tin, germanium or silicon into the phthalocyanine macrocycle. Sulphonated aluminium phthalocyanine derivatives have been used successfully as photosensitisers in photodynamic therapy (PDT) [1–4] and there is an on-going effort to develop other non-transition metal phthalocyanine sulphonates for the same purpose. Improving on the triplet state yield and lifetime as well as the singlet oxygen yield, cell uptake and killing abilities of the currently employed sensitizers, has resulted in increasing research into new sensitisers. Mixed-sulfonated aluminium phthalocyanine ($AlPcS_{mix}$) commercially known as Photosens® has been developed as a PDT drug in Russia, and has been used in hospitals with a fair measure of success [5]. However, other non-transition metal phthalocyanines containing a mixture of differently sulfonated rings ($MPcS_{mix}$) have not received much attention. Some recent studies have shown that chelation of Pc ligand to the metal is not a binding prerequisite for antitumor photodynamic activity [6,7].

We have recently [8,9] reported on the photophysical and photochemical properties of $MPcS_{mix}$ complexes where M = Ge, Al, Sn, Si and Zn. $GePcS_{mix}$ in particular exhibited excellent photochemical and photophysical behaviour compared to the rest of the $MPcS_{mix}$ including the commercially employed $AlPcS_{mix}$. However, only the latter has received considerable attention for in vitro studies. The main aim in PDT is to facilitate cell death and a lot of work has been done to elucidate cellular activities that lead to cell death in PDT as reported in the reviews

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