Imidazoacridones with Anti-Tumor Activity

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Technology description

The present invention relates to novel bifunctional molecules with anti-tumor activity. These agents are composed of an imidazoacridone moiety linked by a nitrogen containing aliphatic chain of various length and rigidity to another aromatic ring system capable of intercalation to DNA.

Previous studies on related symmetrical bis-imidazoacridones revealed that only one planar imidazoacridone moiety intercalates into DNA. The second aromatic moiety, which is crucial for biological activity, along with the linker resides in DNA minor groove, and is believed to interact with DNA-binding proteins (most likely, transcription factors and /or repair proteins). The symmetrical bis-imidazoacridones arrest the growth of sensitive cancers (especially colon cancers) but do not kill the tumors. It was hypothesized that the growth arrest was due to the inability of the affected tumor cells to repair DNA damage caused by the compounds. Remarkably, bis-imidazoacridones are very well tolerated, are very tissue selective and do not appear to damage normal tissues.

Since the binding of the symmetrical bis-imidazoacridones to DNA was unsymmetrical, the inventors have developed unsymmetrical compounds in which one imidazoacridone moieties was replaced by other intercalating groups, with the expectation that this would enhance biological activity while retaining the remarkable tissue selectivity and low systemic toxicity. The new compounds contain intercalating moieties such as 3-chloro-7-methoxyacridine or naphthalimide along with the original imidazoacridones.

These new compounds, especially those containing naphthalimide moiety, are extremely cytotoxic against variety of tumor cells in vitro (IC50 at low nanomolar range) and kill tumor cells by inducing apoptosis. In vivo, in nude mice xenografted with human tumors, the compounds significantly inhibited the growth of such tumors as colon tumor HCT116 and Colo205 as well pancreatic tumors (lines 6.03 and 10.05 freshly established from a patient). These compounds are extremely potent agents against hepatocellular carcinoma as evidenced by their ability to eradicate liver cancer in an orthotopic liver cancer model in rats. The primary molecular target of these very potent compounds is the inhibition of both topoisomerase I and II, although other targets may be important as well. Remarkably, no toxicity was observed at the therapeutic doses. These are among the most potent agents known against cancers of the GI tract and appear to be tolerated very well.

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