Stable inhibitors of the 5-lipoxygenase pathway for treating asthma and cancer

Background/Medical Problem
5-Lipoxygenase (5-LO) is an enzyme that catalyses the conversion of arachidonic acid to biologically active leukotrienes (LTs). LTs are cellular signalling mediators involved in inflammatory diseases, such as asthma, atherosclerosis, cardiovascular diseases and diverse types of cancer, e.g. acute myeloid leukaemia. Competitive LT receptor antagonists such as montelukast and zafirlukast have been developed to decrease the symptoms of an overexpression of LTs. They bind to the cysteinyl leukotriene receptor (CysLT1), which is disadvantageous, since lipoxygenases also produce other LTs that bind to other receptors. Therefore, the inhibition of 5-LO is beneficial, since the production of all LTs is decreased. Zileuton for treatment of asthma is the only drug on the market inhibiting the 5-LO pathway. However, the pharmacological profile of zileuton is disadvantageous, since it is rapidly metabolised.

Technology/Solution
We have investigated the substitution of metabolisable phenyl rings of lipoxygenase inhibitors by metabolically stable boron compounds, namely, carboranes (C2B10H12). Carboranes are icosahedral boron clusters in which two boron atoms are replaced by carbon atoms. They are non-toxic, have remarkable biological stability, and the carbon atoms can be functionalised easily and selectively. We have found that the introduction of carboranes does not influence the inhibitory potential for the 5-LO pathway, but strongly and selectively increases the cytotoxicity for cancer cells.

Further reading:

Benefits
• 5-Lipoxygenase is a therapeutic target involved in diseases like asthma, atherosclerosis and cancer
• Carboranes improve pharmacokinetic behaviour
• Carborane-based 5-LO inhibitors increase the selective cytotoxicity for cancer cells
• Easy and fast synthesis in three steps

Potential Applications
• Treatment of 5-LO dependent tumours
• Tumour imaging
• Boron neutron capture therapy (BNCT)
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Development Status

**Idea**
Introduction of metabolically stable carboranes into inhibitors of the 5-LO pathway to enhance the pharmacokinetic profile of related drugs.

**Demonstrator**
Introduction of carboranes maintains the inhibitory potential for 5-LO, but the cytotoxicity for invasive melanoma and colon cancer cell lines is strongly increased. \( IC_{50} = 10 \text{-} 20 \mu \text{molar} \)

**Animal studies**
Mice with colon adenocarcinoma show an improved response to the investigated compounds (clear reduction of tumour). No acute toxicity.

**Clinical studies**
We are looking for cooperation partners to carry out preclinical and clinical studies.

Intellectual Property Rights
Patent is pending

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Cooperation Options
- License Agreement
- R&D Agreement
- Ownership Agreement

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