Exploiting the bioengineering versatility of lactobionic acid in targeted nanosystems and biomaterials

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Exploiting the bioengineering versatility of lactobionic acid in targeted nanosystems and biomaterials

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Abstract

Lactobionic acid (LBA) has rapidly emerged as a strategic functionalization molecule in the development of nanoparticle-based platforms and biomaterials with promising therapeutic applications. Exploiting the multi-functionality of LBA has enabled to expand the drug loading, release and selective cellular uptake capacity of hepatoma-targeting chemotherapy and nanoparticle-based theranostic systems. The high liver-specificity displayed by LBA-conjugated dendrimers, micelles and nanoparticles has indeed reinforced the great potential of LBA in fine-tuning the surface engineering of promising drug carriers to combat hepatocellular carcinoma. Additionally, its cytocompatibility, selectivity and functionality confer unique properties to design synthetically engineered matrices with enhanced liver-specificity for liver tissue engineering applications. Notably, the biospecific identification and biochemical cross-linking specificity found with the asialoglycoprotein receptor (ASGPR) have converted LBA into the perfect cell-targeting ligand for strengthening the recognition between novel designed nanocarriers and hepatocytes at cellular level. The present review overviews the latest advances in the galactosylation of target-specific nanocarriers and polymers via LBA functionalization with an emphasis on the great bioengineering versatility offered by this polyhydroxy bionic acid in the preparation of next-generation tools ranging from contrast imaging agents to galactosylated scaffolds for the diagnosis and treatment of hepatic diseases. Perspectives on the bioengineering approaches that can foster the design of multi-functional LBA-conjugated therapeutic nanoplatforms are also discussed.

Keywords: lactobionic acid; hepatoma-targeting chemotherapy; targeted drug delivery; liver tissue engineering; galactosylated scaffolds; ASGPR.

1. Introduction

The incidence of severe liver functional damage, including hepatic failure and hepatocellular carcinoma (HCC), has rapidly grown in developed countries over the last decade, representing the third most frequent cause of cancer death [Bosetti et al., 2014]. Notwithstanding all the major therapeutic breakthroughs, both maintenance and restoration of liver-specific functions still remain as main challenges behind the treatment of liver diseases. As a result, improving the viability and *in vitro* functionality of hepatocytes employed in regenerative medicine has become the main driver