CHAPTER 9

Engineering Hyaluronan (HA) Hydrogels with Bioactive and Mechanical Signals

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Introduction

Interest in hyaluronic acid (HA), also known as hyaluronan, as a biomaterial has increased dramatically since the early 1980s with major clinical applications in ophthalmology (ocular surgery), in the treatment of degenerative joint disease (viscosupplementation for arthritis), and in adhesion prevention (anti-adhesive component in plastic surgery), combined with production of the polymer on an industrial scale. HA offers many unique advantages as a starting material to obtain hydrogels for regenerative medicine. First and foremost, is the ubiquitous distribution of HA in nature. It is found in virtually every species in the animal kingdom, as well as in the capsule of certain microorganisms, and in every tissue in the human body (Viola et al. 2015). Moreover, the HA repeating unit disaccharide (Fig. 1A) is identical in all species and all tissues and is therefore never itself recognized as immunologically foreign within its respective host. HA preparations with varying properties (molecular weight) and quality (ultrapure, non-pyrogenic, sterile) are now widely available from many manufacturers.

The second attribute of HA that is advantageous for preparing hydrogels is its unique physicochemical properties. HA solutions can be extremely elastoviscous, yet pseudoplastic enough to be extruded through narrow gauge needles. The third important factor underlying the biomedical utility of HA derives from the magnitude and pathways available for systemic HA metabolism. In the human body, the disposal of HA is almost

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