Absorbable Polyurethanes for Wound Healing Applications

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Introduction:

Wound healing or wound closure devices are used to heal or close external or internal wounds. While wound strips, sealants and biomedical foams are used to close external wounds, sutures, staples and tissue adhesives and sealants can be used for internal wound healing. The past few years have witnessed an increasing interest and preference by surgeons towards replacing wound healing devices made with non-absorbable polymers with absorbable polymers. For example, non-absorbable sutures made from nylon have been replaced with absorbable polyester based sutures. Similarly, there are a number of wound healing applications where polyurethanes have been widely used. However, these commercially available medical grade polyurethanes are non-absorbable and hence cannot be used in wound healing applications where absorption is needed such as internal tissue adhesive.

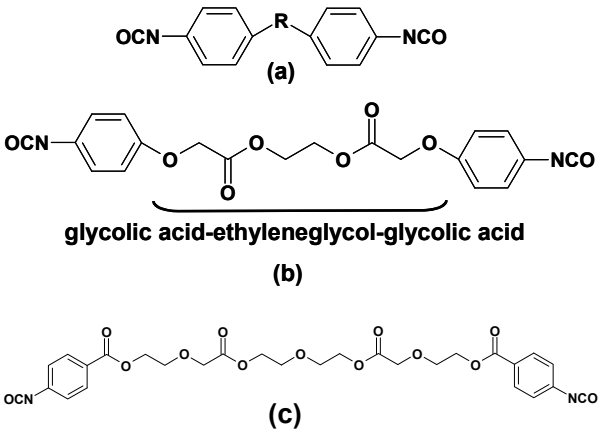

Figure 1. (a) Novel absorbable aromatic isocyanate (b) absorbable aromatic diisocyanate derived from safe and biocompatible glycolic acid and ethylene glycol monomers and paracetamol precursor (c) absorbable aromatic diisocyanate derived from p-aminobenzoic acid (PABA) and p-dioxanone

In this paper, we will present our portfolio of absorbable polyurethanes developed by us for various biomedical applications including external and internal wound healing applications. We have developed novel degradable aromatic isocyanates derived from paracetamol precursor and safe and biocompatible monomers as shown in Figure 1(a) where R represents a segment containing degradable linkages derived from glycolic acid, lactic acid, caprolactone, p-dioxanone and diols, an example of which is shown in Figures 1(b) and (c). The resulting novel absorbable isocyanates were then chain extended with polyethylene glycols and reacted with multi-armed absorbable isocyanates in presence of moisture from tissue as shown in figure 2 to form cross-linked polyurethane tissue adhesive which meets all the requirements of an ideal tissue adhesive. These absorbable polyurethanes possess hydrolysable hard segments. Moreover, changing the absorbable monomer component in the isocyanates can control the hydrolytic degradation of these polyurethanes. The synthesis and characterization of these absorbable polyurethanes will be presented in detail in the meeting.

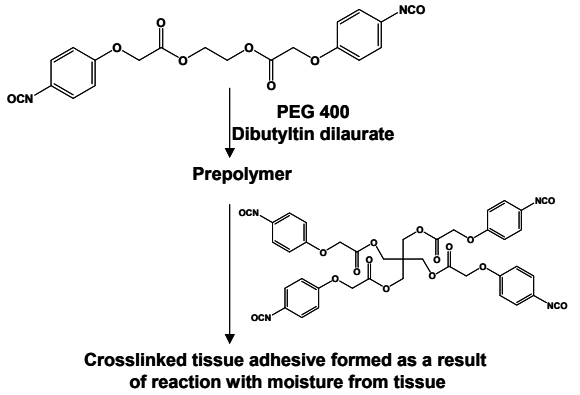

Figure 2 Absorbable crosslinked polyurethane based tissue adhesive

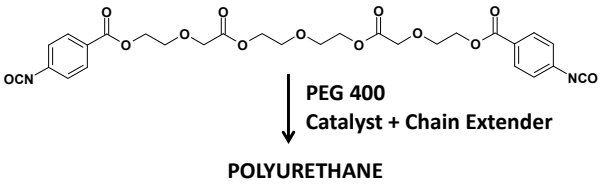

Figure 3 Absorbable polyurethane polymers for lyophilized foams for wound healing

Conclusions: In this paper we report synthesis and characterization of our portfolio of absorbable polyurethanes for wound healing applications. These absorbable polyurethanes will find use in preparation of reticulated as well as lyophilized foams and scaffolds for controlled delivery of biologics, drugs and anti-microbial agents to the site of wound and infection. Furthermore, these polyurethanes can also be used for tissue engineering and cosmetic applications to heal the scars on skin.

References:

(1) (a) Roby et al. US Patent No. 6894140 (b) Fuller et al. US Patent No. 4829099 (d) Bezwada, R.S. US Patent Publication No. 2006/0188547.