약물탑재형 기도재생 스텐트 개발
Functional Nanofiber Coated Drug Eluting Tracheal Stent

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1. Introduction

In the case of tracheal rupture or stenosis, most effective way is to insert a commercially available metal stent. However, the implantation often causes a fever or a pain on the contact surface between trachea and the stent. And also the metal stent should be removed after a certain time implantation. Indomethacin has highly crystalline and very poorly water solubility. It is a non-steroidal anti-inflammatory drug (NSAID) that is effective to reduce fever, pain, stiffness, and swelling. , Thus, we developed a functional tracheal scaffold consisting of indomethacin loaded nanofiber and bare metal stent for tracheal tissue engineering.

2. Methods

To control the drug release kinetics and enhancement of mucosal regeneration, gelatin and PLCL were coated layer by layer on a metal stent by an electrospinning method. Pure gelatin is highly water-soluble and therefore gelatin fibers were cross-linked using 1-ethyl-(3-3-dimethylaminopropyl) carbodiimide hydrochloride (EDC). Indomethacin was loaded in the gelatin layer by soaking & drying method (0.1, 0.5, and 1 wt% in ethanol for 10 min). The morphology of functional drug eluting tracheal stent was characterized by a scanning electron microscope (SEM). And mechanical properties of the constructs such as air leak pressure, ultimate tensile stress, and modulus were calculated and evaluated. Drug release was performed by a high performance liquid chromatography (HPLC).

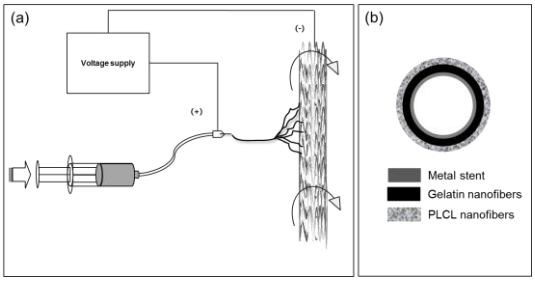

Fig. 1 (a) Schematic diagram of the electrospinning system and (b) component parts of the scaffold

3. Results

The mean average diameter of gelatin fibers was ranged from 1.2 to 1.4 um measured by SEM, and well coated and fixed on a metal stent. PLCL nanofibers that were well grafted on the gelatin fibers were reinforced the mechanical properties of scaffold. Bi-layered nanofiber-coated stent showed enough mechanical properties as a tracheal stent, which confirmed by Air leak and mechanical tests. For indomethacin loading on a stent, stent was immersed in a series of drug solutions (different concentrations) for 10 min. At the result of HPLC, total amounts of indomethacin on a stent were 77.8, 323.1, and 670.5 ug / scaffold, respectively. The release kinetic of the drug from stent was determined at the time of 1, 2, 4, 8, 24h, 2, 4, 7, 14, 21, and 28 day. According to HPLC results, all the scaffolds showed a sustained release profile regardless of indomethacin content.

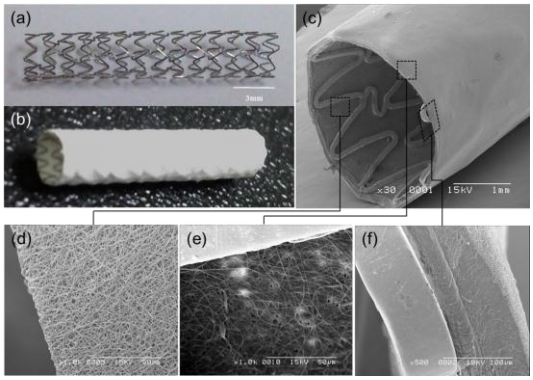

Fig. 2 Composite tracheal scaffold: photographs of (a) metal bare stent, and (b) tracheal scaffold composed of metal bare stent and bi-layer nanofibers; SEM micrographs of (c) stent covered with nanofibers, (d) exterior surface of PLCL nanofibers, (e) interior surface of gelatin nanofibers, and (f) cross section

4. Conclusion

In this study, we fabricated the tissue-engineered tracheal scaffold that be composed of metal bare stent, bi-layer nanofiber, and indomethacin. The metal bare stent in part of the composite scaffold supplied to maintain the internal lumen for trachea reconstruction. Functionally designed nanofiber coated tracheal stent with anti-inflammatory drug may be useful for tracheal regeneration.

References

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