Introduction

Due to the limitation of current injection materials (autologous fat and calcium hydroxypatite) for augmentation laryngoplasty, development of injection materials which induce a simultaneous effect of augmentation by itself and tissue regeneration in the atrophied vocal fold, could be more feasible and physiologic. Because that appropriate tissue regeneration could be achieved with combination of biosynthetic scaffold, cells and regulatory factors, we introduced a poly(lactic acid-co-glycolic acid) (PLGA)/Pluronic F127 as an injectable scaffold of bioactive agents for regeneration of the atrophied vocal fold.

The PLGA is well known polymers and were approved by the U.S. Food and Drugs Administration (FDA) for several therapeutic applications because of their biodegradability, biocompatibility, and a long history of safe use in humans. PLGA is synthesized by means of co-polymerization of two different monomers, glycolic acid (GA) and lactic acid (LA). (Figure 1) PLGAs with different GA to LA ratios are currently being approved for suture (Vicryl®), vascular grafts, urological stents, skin substrates, and 3D porous scaffolds for tissue reconstruction6,9 and drug delivery carriers.10 However, it was reported that acidic by-products of PGA, PLA and PLGAs during degradation can sometimes lead to an inflammatory response in the human body.4,5

Pluronic F127 as a hydrophilic additive for hydrophobic PLGA can enhance the water diffusion into the PLGA matrix, and thus can allow continuous release of certain bioactive molecules from the hydrophobic PLGA, in particular at the initial stage of release.8 It did not lead to any adverse tissue responses, probably because of its fast absorption in the body (within a few days) as well as its own biocompatibility.7,9 (Figure 2)

In this study, we devised the injectable form of PLGA/Pluronic F127 and assessed the biocompatibility of PLGA/Pluronic F127 as a material for injection laryngoplasty.

Methods and Materials

Preparation of PLGA/Pluronic F127 solutions

- PLGA = PLA:PGA, mol ratio. 75:25
- PLGA pellet & Pluronic F127 powder mixture
  - PLGA:Pluronic F127 (w/w), 95:5
  - tetracyclol to 5% & 10% concentration

Results

Laryngoscopic & histological examination

- 5% & 10% PLGA/Pluronic F127 maintained for 8 weeks
- No significant inflammatory response.

Functional analysis

- High speed camera (Figure 7)
  - Regular & symmetric contact of vocal fold mucosa
  - without a distorted movement by injected PLGA/F127
  - Statistical analysis of vocal amplitude ratio (Table 1)
  - No difference of vocal amplitude b/w Lt. & Rt vocal fold

Discussion & Conclusions

- To the best of our knowledge, there has been no report regarding vocal fold injection using injectable form of PLGA.
- From the observations in the present study, we conclude that PLGA/Pluronic F127 be devised suitably for injection laryngoplasty and PLGA/Pluronic F127 be biocompatible for vocal fold.
- Further experiment will follow to elucidate the PLGA/Pluronic F127 scaffolding matrix’s role related with bioactive molecules including specific growth factors or drugs in the vocal fold.

References