Extrahepatic bile duct regeneration in pigs using collagen scaffolds loaded with human collagen-binding bFGF

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1. Introduction

Reconstruction of extrahepatic bile duct is important after surgery caused iatrogenic injuries or lesion resection caused tissue loss [1–3]. As laparoscopic cholecystectomy is now the gold standard for symptomatic cholelithiasis. Numerous reports have demonstrated that the incidence of bile duct injuries has risen from 0.1%–0.2% to 0.4%–0.7% from the era of open cholecystectomy to the era of laparoscopic cholecystectomy [4]. Currently, repairing of these defects usually utilizes surgery of biliary tract, such as primary suturing, end to end anastomosis, biliary-enteric bypass, autologous tissue patch, synthetic materials or biological materials patch. The synthetic materials include expanded polytetrafluoroethylene, Gore-Tex vascular grafts, bioabsorbable polymer (BAP) and so on. Small intestine submucosa (SIS) and collagen sponge are the often used biological materials [6–10].

The result of surgery repair of these lesions is unsatisfactory because of the unpredictable outcomes. Even though these lesions are benign, their biological behavior is usually very similar to that of the malignant lesions for the frequent recurrences and complications, which make repeated repairs necessary and more and more complex at each time [5]. Polytetrafluoroethylene [6] and Gore-Tex vascular grafts [7] are nonabsorbable materials. Despite of their adequate mechanical strength, their biocompatibility is not good enough and their complications, including infection and chronic foreign body reactions could not be ignored. As an absorbable material, BAP [8] maintains enough mechanical strength but can not induce fast tissue regeneration. SIS [9] and collagen sponge [10] can promote tissue regeneration; however their mechanical strength is poor, which would lead to occasional stricture formation. Therefore, it is necessary to develop suitable biomaterials for the reconstruction of extrahepatic bile duct.

Basic fibroblast growth factor (bFGF) has a positive effect on therapeutic neovascularization and tissue regeneration [11–13]. It is a potent mitogen of a wide variety of cell types of mesodermal origin including the fibroblasts, vascular endothelial cells and smooth muscle cells [14]. Previous studies believe that bFGF can promote extrahepatic bile duct regeneration [9,15]. It also has been reported to promote the regeneration of skin, bladder, and abdominal wall effectively with a certain drug delivery system [16–18].

In the present study, a collagen membrane patch was developed to bridge the gaps in extrahepatic bile duct in order to establish bile

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