Increasing the cells adhesion to silk meshes: first step towards cell-based therapy for hernia repair

Recent studies in the field of tissue engineering have demonstrated that combining cells with meshes prior to implantation successfully enhanced hernia repair. The idea is to create a biologic coating surrounding the prostheses with autologous cells, before transplantation into the same patient (Fig. 1). However, due to the lack of a prompt and robust cell adhesion to the meshes, extensive and expensive *in vitro* cultivation is required to obtain a homogenous cell layer covering the mesh, before re-implanting the biomaterials in the patient.

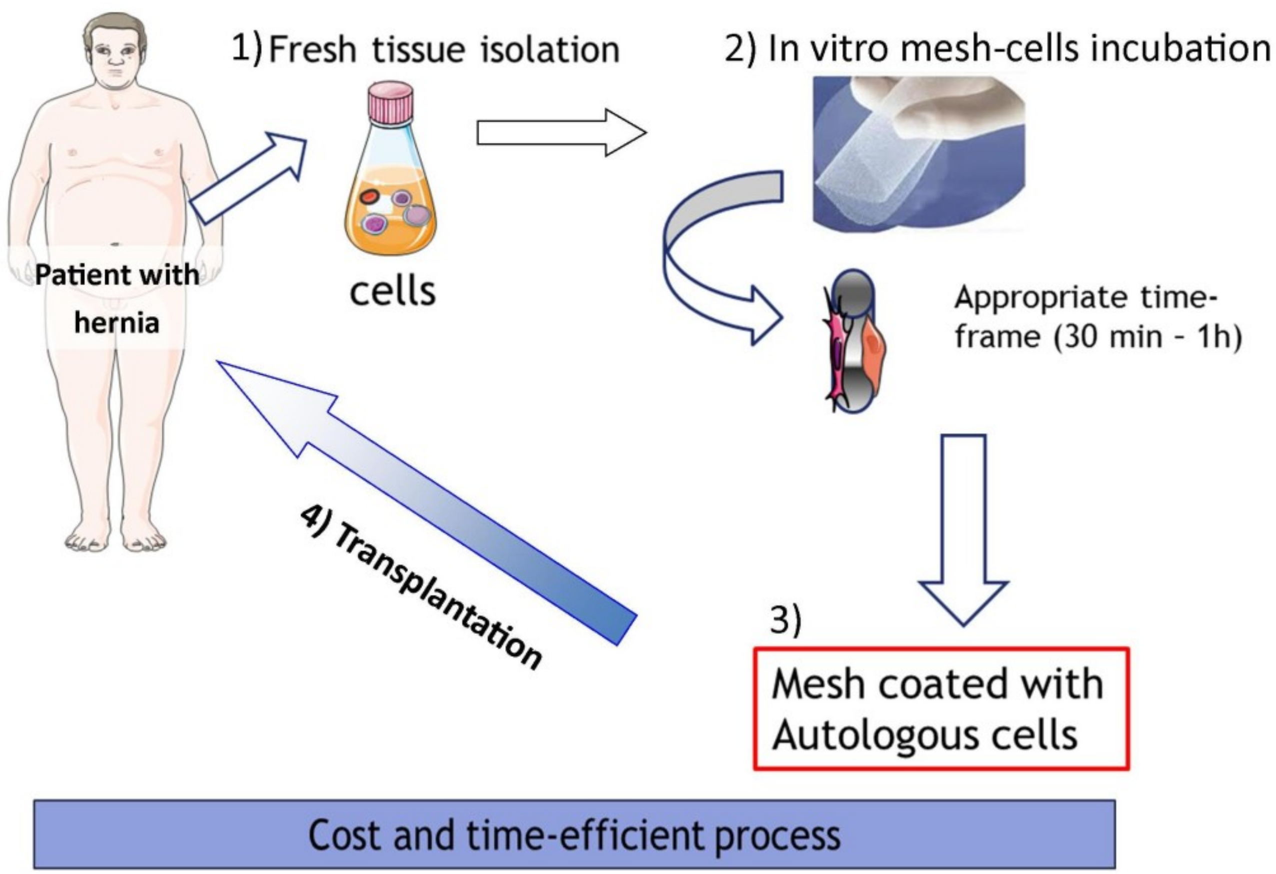

Fig. 1. Schematic illustration of the several steps required for cell-based therapy for hernia repair. First, prior to the surgery, cells patient are isolated and then incubated in vitro with the mesh in order to obtain a prosthesis coated with autologous cells, in a short period of time. During the surgery, the mesh is implanted following conventional surgical approaches in the same patient. We hypothesize that by combining silk mesh with autologous cells might significantly improve the healing of the defect and the quality of the hernia repair.

In this context, the objective of this publication is to manufacture meshes made of silk fibres and to enhance the cytoadhesion and cytocompatibility of the biomaterial by surface immobilization of a biological pro-adhesive protein, derived from plants: Lectin. On this study, we selected silk as silk-based biomaterials have emerged as potential candidates for various applications in tissue engineering and regenerative medicine. One of the reasons is related to the remarkable mechanical properties (silk is one of the toughest fibres found in nature) associated with its slow degradation kinetic, which makes silk a great choice for mesh biomaterials.

To summarize, we manufactured meshes made of silk fibres, tailored them with lectin grafting and finally evaluated the cytocompatibility and the inflammatory response of silk and silk-lectin meshes compared to commercialized polypropylene mesh (PP), using fibroblasts and peripheral blood mononuclear cells, respectively.

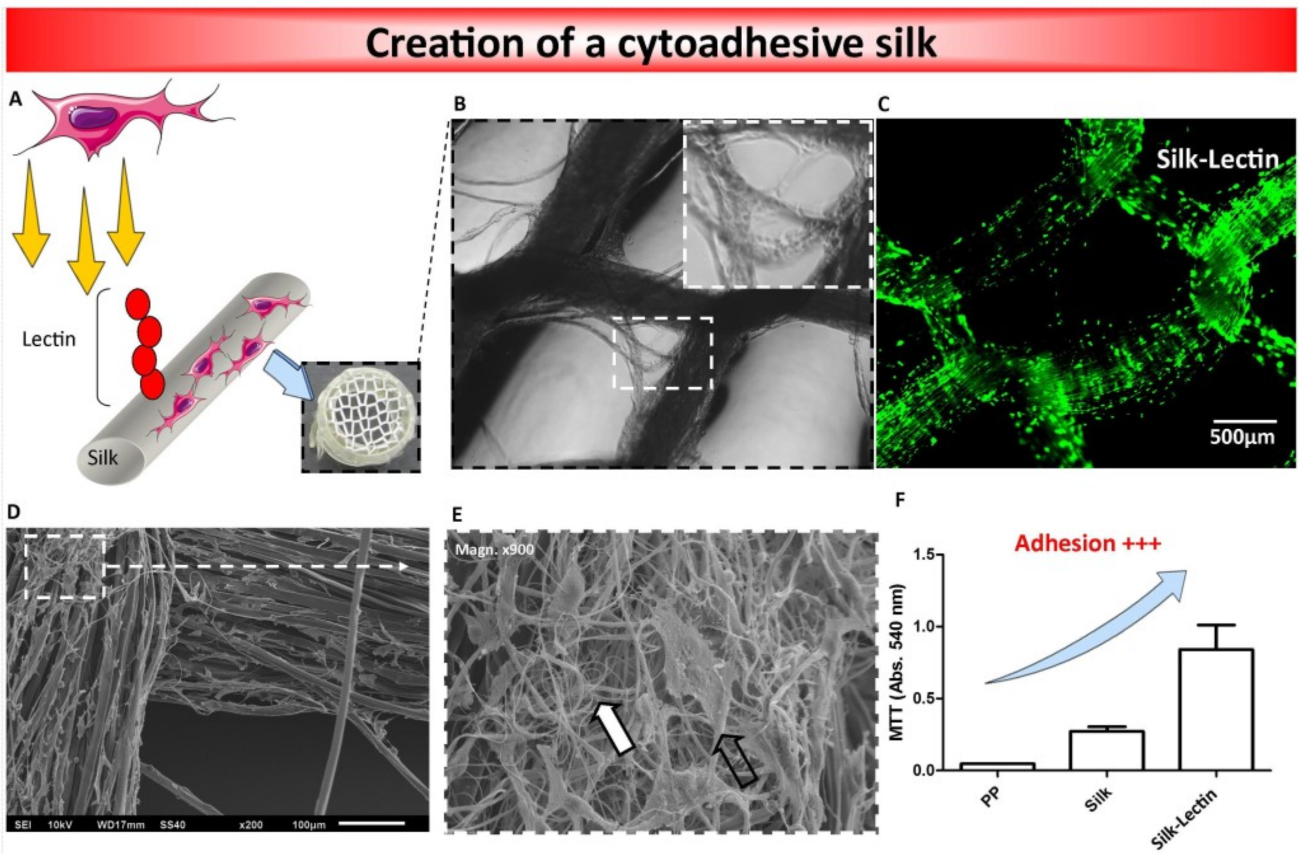

Fig. 2. Characterization of silk-lectin mesh on fibroblast cells. Illustration of the Lectin grafting on silk meshes (A) and investigation of the meshes colonization by fibroblasts through microscopic observation (B), calcein staining (C, showing in green fluorescence cells alive), scanning electron microscopy (D and E) and cell quantification (F). We were able to demonstrate that by modifying silk meshes using Lectin, we significantly increased the mesh colonization by fibroblasts: pre-requisite for any cell-based therapy.

The *in vitro* experiments revealed that the cytocompatibility of silk can be enhanced by surface immobilization with lectin without exhibiting negative response in terms of pro-inflammatory reaction (Fig. 2). Grafting lectin to silk meshes could bring advantages to facilitate cell-coating of meshes prior to implantation, which is an imperative prerequisite for abdominal wall tissue regeneration using cell-based therapy.

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Publication

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