Development of an Electrospun Composite as Substitutive Diaphragmatic Membrane

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The diaphragm is a layer of muscle and tendon that serves as the main muscle of respiration and plays a vital role in the breathing process [1]. Diaphragmatic hernia is a congenital defect that occurs in about 1 in 5,000 live births. As the treatment if the opening is large, an additional tissue is implanted to close it [2]. The Gore-Tex® prosthetic membrane is currently used in the Strasbourg University Hospital. We aimed to design a substitutive membrane made of electrospun nanofibers web. Electrospun nanofibers and composites are produced by using different kinds of polymers alone and with an elastomer material by testing different electrospinning time and conditions. Mechanical properties of substitutive membrane have to be as close as possible to the human diaphragm that have been represented by the pig’s diaphragm. Pig’s samples were excised from the left and right sides, vertically and horizontally based on the tendon fiber orientation. Uniaxial tensile tests have been done on electrospun and soft tissue samples. A climatic chamber was mounted to keep the samples close to body temperature and humidity. The mechanical tests confirmed that regardless of the sampling region, the pork’s diaphragm presented isotropic properties. For the optimum electrospinning conditions, nanofibers with an average diameter between 200 to 1200 nm were obtained, without defects. It has been also observed that by using an elastomer material while electrospinning, the mechanical properties of electrospun samples are improved regarding the initial specification. The electrospun composite membrane, which can fulfil the mechanical and structural properties of diaphragm is produced.