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Development and characterization of nano-fibrous membrane for the treatment of congenital diaphragmatic hernia

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Abstract
Congenital Diaphragmatic Hernia is a rare malformation, a hole in the diaphragm is formed early in the embryogenesis. The consequences are multiple. At the birth of the child, a surgery is required and in half of the cases, a prosthesis is necessary to fill the hole. The currently used prosthesis are not intended for this application, it is not enough stretchable due to its high stiffness, and therefore, often lead to the breaking of stiches and a recurrence of the hernia. The aim of my PhD is to design a new prosthesis for this specific application that will be easily and highly stretchable to follow the growth of the child. Using electrospinning, a membrane is formed, having a fibrous surface that mimic the extra-cellular matrix and thus enhance cell colonization for a better integration to the diaphragm. For the moment, the first results highlight a good biocompatibility and more than 300% stretchability (enough for the growth of the child). One of the issue of the membrane elaboration concerns its thickness, which has to be as homogenous as possible to avoid any differences in the mechanical properties. To solve this problem, we have studied the thickness profile of the fibrous mat on the collector as a function of the emitter used (multiple needles or needle-free) and its translation with respect to the collector. This allowed us to obtain 125 µm-thick membranes with less than 30 µm variation in thickness over a surface of 20 x 30 cm.

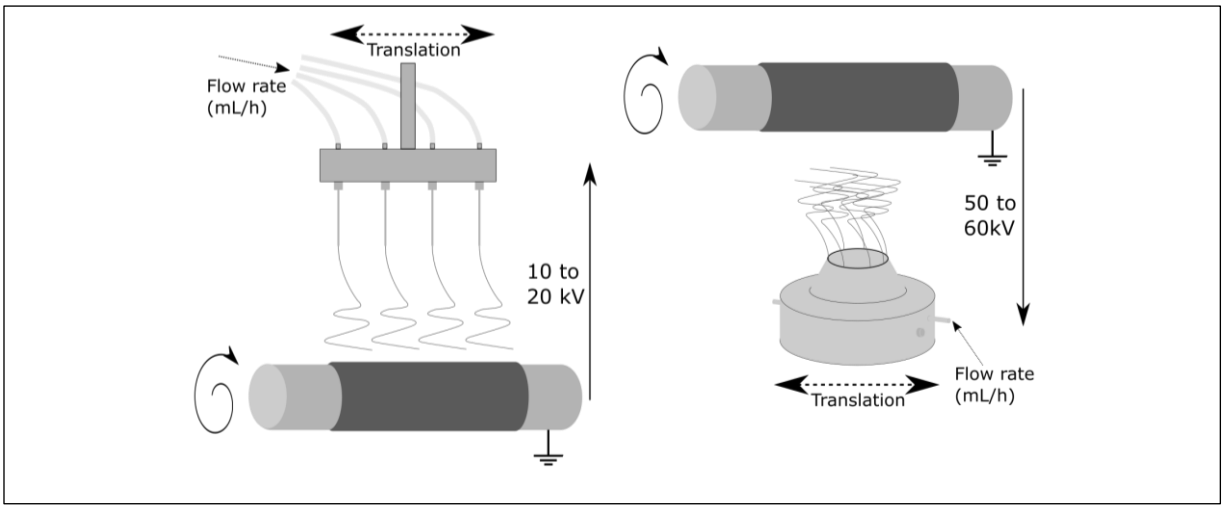

Figure 1: Electrospinning with a four needles emitter (left) and annular emitter (right)

Reference
1- McGivern MR, Best KE, Rankin J, and al. Arch Dis Child Fetal Neonatal Ed 2015; 100: F137–F144.