

Biomechanical Assessment of Esophageal Elongation

Authors : Marta Kozuń, Krystian Toczewski, Sylwester Gerus, Justyna Wolicka, Kamila Boberek, Jarosław Filipiak, Dariusz Patkowski

Abstract : Long gap esophageal atresia is a congenital defect and is a challenge for pediatric surgeons all over the world. There are different surgical techniques in use to treat atresia. One of them is esophageal elongation but the optimal suture placement technique to achieve maximum elongation with low-risk complications is still unknown. The aim of the study was to characterize the process of esophageal elongation from the biomechanical point of view. Esophagi of white Pekin Duck was used as a model based on the size of this animal which is similar to a newborn (2.5-4kg). The specimens were divided into two groups: the control group (CG) and the group with sutures (SG). The esophagi of the control group were mounted in the grips of the MTS Tytron 250 testing machine and tensile test until rupture was performed. The loading speed during the test was 10mm/min. Then the SG group was tested. Each esophagus was cut into two equal parts and that were fused together using surgical sutures. The distance between both esophagus parts was 20mm. Ten both ends were mounted on the same testing machine and the tensile test with the same parameters was conducted. For all specimens, force and elongation were recorded. The biomechanical properties, i.e., the maximal force and maximal elongation, were determined on the basis of force-elongation curves. The maximal elongation was determined at the point of maximal force. The force achieved with the suture group was $10.1\text{N} \pm 1.9\text{N}$ and $50.3\text{N} \pm 11.6\text{N}$ for the control group. The highest elongation was also obtained for the control group: $18\text{mm} \pm 3\text{mm}$ vs. $13.5\text{mm} \pm 2.4\text{mm}$ for the suture group. The presented study expands the knowledge of elongation of esophagi. It is worth emphasizing that the duck esophagus differs from the esophagus of a newborn, i.e., its wall lacks striated muscle cells. This is why the parts of animal esophagi used in the research are may characterized by different biomechanical properties in comparison with newborn tissue.

Keywords : long gap atresia treatment, esophageal elongation, biomechanical properties, soft tissue

Conference Title : ICBBE 2022 : International Conference on Biochemical and Biomedical Engineering

Conference Location : Athens, Greece

Conference Dates : October 13-14, 2022