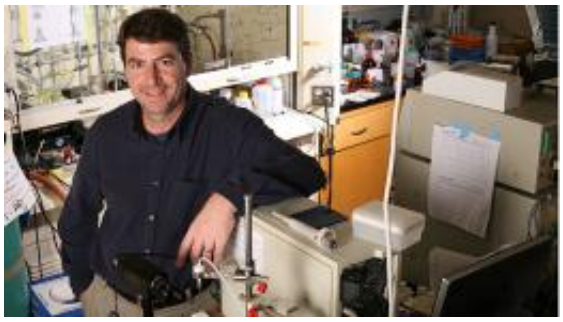
Mussel-Inspired 'Glue' for Fetal Membrane Repair (w/ Video)

22 January 2010



Phillip Messersmith and his research group use biologically inspired strategies -- such as mimicking in a sealant the sticking power of mussels -- to develop new biomaterials for the repair, replacement or augmentation of human tissue.

A sealant inspired by mussels' ability to stick to surfaces under wet conditions has shown promise in the repair of defects in human fetal membranes, according to a recent Northwestern University study.

During pregnancy, defects -- ruptures or holes -- in the fetal membrane can lead to the leakage of amniotic fluid, resulting in premature labor or termination of the pregnancy. Although some defects do repair themselves naturally, no method currently exists to effectively repair those that don't. One idea is to find a biocompatible material to seal off the opening.

"We tested our mussel-inspired sealant on living fetal tissue and found it was both biocompatible and effective at sealing the tiny holes -- two features essential in such a material," said Phillip B. Messersmith, who was one of the study's leaders. He is professor of biomedical engineering at Northwestern's McCormick School of Engineering and Applied Science.

The findings are published online by the *American Journal of Obstetrics & Gynecology*.

The fetal membrane is the structure that surrounds the developing fetus. Defects in the membrane result either from incisions during endoscopic fetal surgeries used in the treatment of some birth defects or premature and spontaneous ruptures in the fetal sac.

Messersmith and colleagues from Belgium, Switzerland and Canada punched holes three millimeters wide into human fetal tissue in vitro to replicate the tiny holes found in fetal membrane defects. They then applied their sealant as well as other sealant candidates (such as medical-grade superglues) to the holes and analyzed fetal tissue cell death for each sealant. The mussel-inspired sealant had the best results in both bonding and toxicity.

The injectable sealant is a mixture of two different solutions that, when combined, form a sealant or gel in 10 to 20 seconds. One solution is a simple synthetic polymer containing DOPA, a key amino acid found in the sophisticated proteins that are essential to mussels' ability to adhere to wet surfaces, and the other is a catalyst. (Messersmith first developed the polymer in 2002.)

The foot of the common mussel (*Mytilus edulis*) produces a sticky glue that keeps the shelled organism anchored to rocks and other objects, allowing them to withstand the extreme pounding of waves. Chemical analysis of this natural, waterproof glue showed that the key to its adhesiveness is a family of unique proteins called mussel adhesive proteins, which contain a high concentration of DOPA (dihydroxyphenylalanine).

Messersmith and his colleagues currently are testing the mechanical qualities of the mussel-inspired sealant and plan to conduct in vivo experiments in animal models.

More information: The paper is titled "Injectable Candidate Sealants for Fetal Membrane Repair: Bonding and Toxicity In Vitro."

Provided by Northwestern University