

Study of Reproductive Biology to Create an “Artificial Uterus” to Provide Nutrients for Great White Shark Embryos

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Premature deliveries of elasmobranchs sometimes occur in aquariums around the world, but it is difficult to maintain the fetus alive when it is born too small because of the lack of sufficient equipment to recreate the intrauterine environment. To create an artificial uterus to save and accommodate premature fetuses, we studied a variety of uteri from sharks with different modes of reproduction. In general, the gestation of viviparous sharks and the maternal input to intrauterine embryos is complex, especially in lamniform sharks, which includes the great white shark (*Carcharodon carcharias*); oophagy is one of the primary modes of embryonic nutrition. According to our recent studies, the nutrition of embryos for these types of sharks is more complex than previously thought, as embryos likely rely on changing the source of nutrition over the course of their development. We posit three likely nutrition sources: (1) a lipid-rich fluid that is secreted from the uterine epithelium but only during early gestation before the onset of oophagy, (2) embryos use the abundant uterine fluid before using the encased nutrient eggs at the early stage of development, and (3) uterine fluid before the onset of oophagy. The lipid-rich secretion in great white sharks is a unique mode of shark reproduction and resembles that of the trophonemata in pregnant mobulid rays. Currently, we are in the process of developing an artificial uterus to accommodate an embryo after the oophagous phase, and we are analyzing uterine fluid from the salmon shark (*Lamna ditropis*) to better understand the mechanism in the uterine epithelium that supplies oxygen to the embryos.