Mitochondrial activity is different in different sub-regions of the human amniotic membrane

What is the first image a human being probably sees? Provided a fetus could see, it would see the inner lining of the uterus, the so called amniotic membrane.

The amniotic membrane consists of two layers, the collagen-rich mesenchymal layer and, innermost, the epithelial layer. Furthermore, it can be divided into sub-regions, such as the placental region which is the amniotic membrane that covers the placenta, and the so-called reflected region, which is the amniotic membrane that does not cover the placenta. Of note, no part of the amniotic membrane has direct contact to the uterus or placenta, as the adjacent layer, the chorion, lies in between. For application, the amniotic membrane is peeled off the chorion and washed extensively (Fig.1).

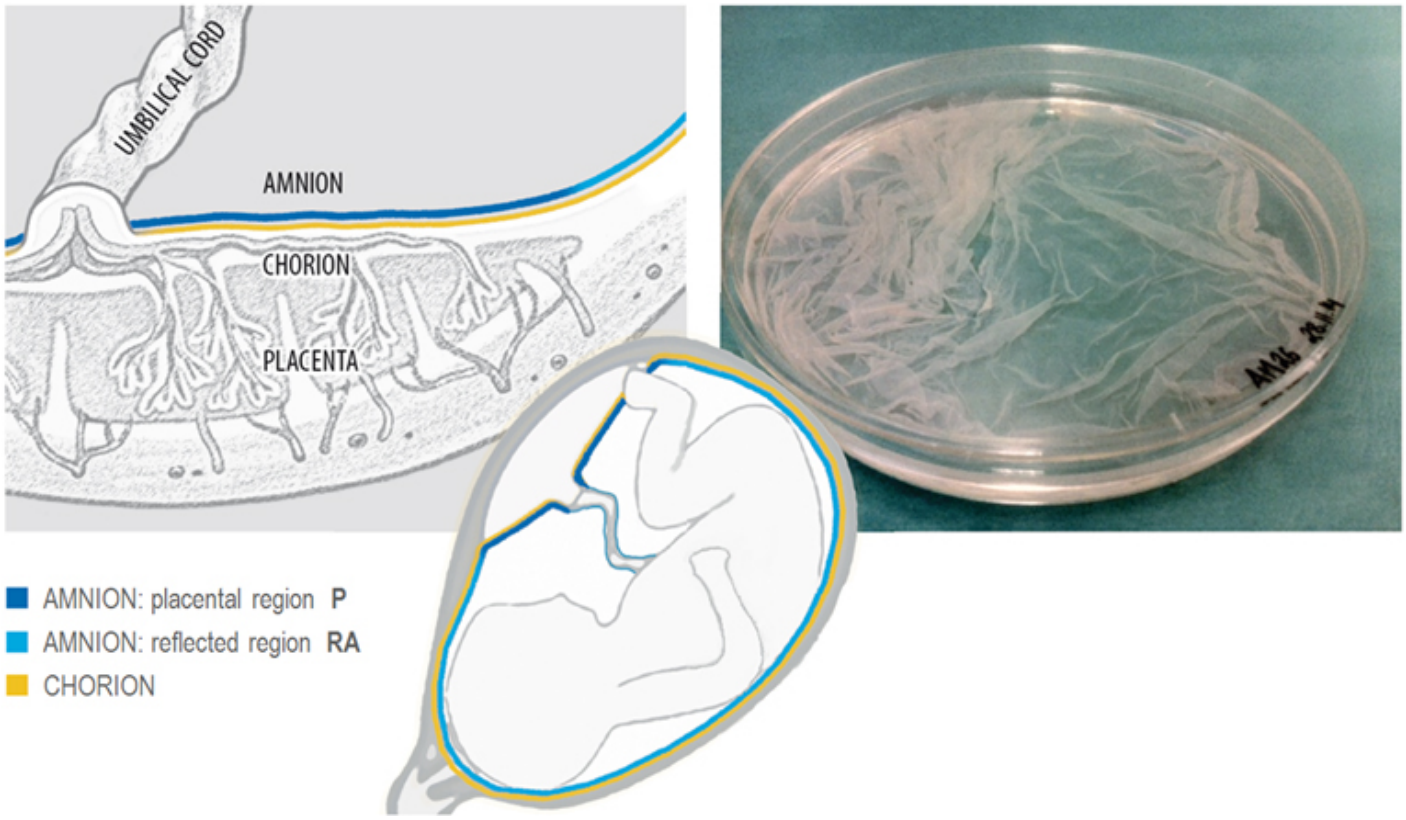

Fig. 1. Prepared human amniotic membrane

For over a century, the amniotic membrane has been used for therapeutic purposes. It started with applications for skin coverage, for instance for burn injuries. Later, it was used for reconstructions

surgery and, most importantly, ophthalmology such as cornea replacement.

Since the 1990ies, when the concept of stem cells came up, the application of the amniotic membrane took a turn towards tissue engineering. The properties of the amniotic membrane make it already an excellent material for tissue engineering. It is biocompatible, which means cells “like” it, there are no reported rejections known, and it has anti-inflammatory and anti-analgesic properties. However, most importantly for tissue engineering, the amniotic membrane contains stem cells with pluripotent characteristics.

So what, you might think now. Well, stem cells seem to have the ability to help injured cells or tissues to regenerate faster. There are lots of factors that contribute to the support of regeneration. According to recent studies, mitochondria may play an important role thereby. Mitochondria are cell organelles that make use of the oxygen we breathe, the so-called mitochondrial respiration. By-products of mitochondrial respiration are reactive oxygen species (‘radicals’). The counter-parts of these ‘radicals’ are antioxidants, which are substances or compounds that try to keep the concentration of radicals in a tissue at a low level.

Getting back to the amniotic membrane, we wanted to investigate, whether mitochondria are all the same on the amniotic membrane in its entirety. In order to do that, we measured mitochondrial activity of the cells of the amniotic membrane from different sub-regions.

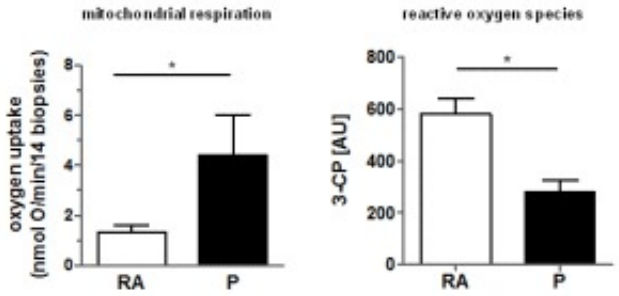

Fig. 2. Mitochondrial respiration and levels of reactive oxygen species

To our surprise, we found that the amniotic membrane that covers the placenta (P) has a 4-fold higher mitochondrial activity than the amniotic membrane that does not cover the placenta (RA) (Fig. 2A). Interestingly, we found that the level of ‘radicals’ was much lower in the placental amniotic region (Fig. 2B). This is insofar interesting, as this could mean that the placental amniotic region could have a higher antioxidant capacity.

At this point, we do not have an explanation for this differential mitochondrial activity of the human amniotic membrane. However, since mitochondria play an important role in tissue regeneration, this differential mitochondrial activity of the amniotic sub-regions may also impact therapeutic

applications of the amniotic membrane in clinics.

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Publication

Different metabolic activity in placental and reflected regions of the human amniotic membrane.
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