

In-vivo inhibition of intracapsular lens epithelial cell growth using sealed capsule irrigation for secondary cataract prevention

- preliminary results -

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Purpose: In a laboratory setting, we investigated efficacy and safety of sealed capsule irrigation (SCI) during cataract surgery for secondary cataract prevention which is especially important for successful restoration of lasting sight. The PerfectCapsule System enables the application of pharmacological substances into the vacuum sealed capsular bag selectively targeting remaining lens epithelial cells without influencing surrounding tissues.

Methods: SCI was performed in fresh porcine eyes. Eyes were cut in half at the equator and fixated on a special designed and manufactured table upon a translucent slide allowing bilateral evaluation of the capsular bag (Miyake/Apple posterior view). After removal of cornea and iris (open sky technique), capsulorhexis was performed using forceps followed by lens removal by hydroexpression. The PerfectCapsule device was attached on the anterior capsule covering the capsulorhexis completely and fixated by applying vacuum using a syringe. Sealed capsule irrigation was performed using different solutions for 2 minutes: Alcohol 90%, BSS, preservative-free lidocaine 2%, distilled water or saline solution 30%, 22.5%, 15%. Capsular bag changes during the treatment were evaluated using the Miyake/Apple posterior view and specimens were PAS stained and further histopathologically investigated for lens epithelial cell death.

Results: In porcine eyes, vacuum was strong, no leakage occurred and no visible capsular bag damage was noted. Zonular stress during application of vacuum and during irrigation was minimal. Saline solutions had a higher cell toxicity equivalent to alcohol 90% compared to BSS, lidocaine or distilled water with almost no remaining epithelial cells. However, we observed also a mechanical effect of the irrigation fluids when comparing eyes without any irrigation to those irrigated with different solutions. In some eyes, we saw remaining lens cortex fibers (Fig. 5) obviously protecting lens

epithelial cells and preventing cell death. Figures 1-6 are illustrating our preliminary results.

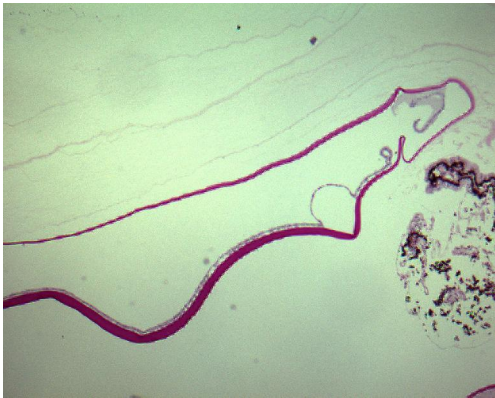


Fig. 1: Remaining epithelial cells after lens removal without SCI treatment. PAS staining, original magnification: 4x



Fig. 2: Clear capsular bag after SCI using alcohol 90%. PAS staining, original magnification:10x

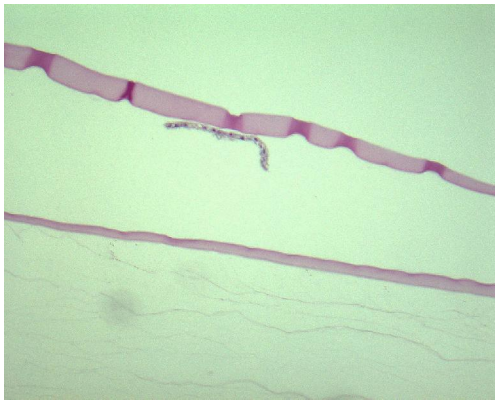


Fig. 3: Remaining cells after SCI using BSS. PAS staining, original magnification:10x

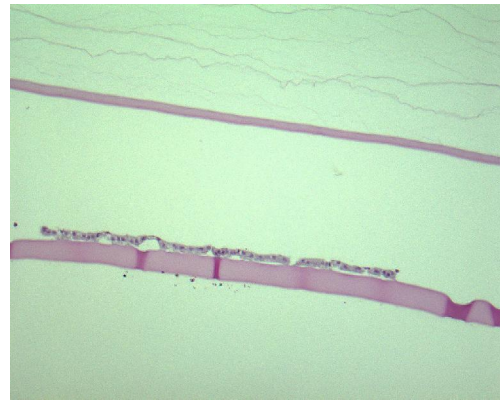


Fig. 4: Remaining cells after SCI using lidocaine 2%. PAS staining, original magnification:10x



Fig. 5: Remaining cells after SCI using Aqua dest. PAS staining, original magnification:10x

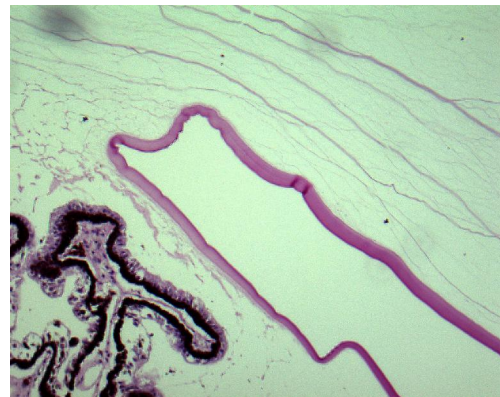


Fig. 6: Clear capsular bag after SCI using NaCl 22.5%. PAS staining, original magnification:10x

Conclusions: Sealed capsule irrigation is a safe device in terms seal, vacuum and capsular bag stability. Laboratory studies indicated the potential cell toxicity of different solutions for SCI treatment showing best results for saline solutions. However, there was already a mechanical effect of the irrigation noticed. Using the improved model with which the irrigation fluid can be applied with a higher volume through a second syringe might even improve secondary cataract prevention. Further clinical studies are necessary to investigate anterior and posterior capsule opacification after irrigation using saline solutions.
