Chondrotoxic effects of local anesthetics used in peri-operative pain pumps
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Purpose: Chondrotoxicity initiated by post-operative, intra-articular pain pumps has recently been described by multiple institutions. This study evaluates the chondrotoxicity of anesthetic formulations commonly used in pain pumps.

Methods and Materials: Freshly isolated human articular chondrocytes were cultured in a custom bioreactor, which mimics commonly used in pain pumps.

Results: Significantly more chondrocyte necrosis was found in cultures containing 1% Lidocaine, 1% Lidocaine with epinephrine, Bupivacaine 0.25% with epinephrine, Bupivacaine 0.5% with epinephrine compared to controls (p<0.05) at 48 and 72 hours. 0.25% and 0.05% Bupivacaine exhibited no cytotoxic effects at any time point.

Conclusions: 0.25% and 0.5% Bupivacaine do not cause chondrocyte necrosis and are likely to be safe when used in pain pumps for 72 hours. All medications containing epinephrine (pH 7.4) were chondrotoxic and cannot be advocated for pain pump use.

Time-lapse confocal imaging of living chondrocytes in appositionally developing outgrowths at the agarose-media interface
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Purpose: Chondrocytes cultured in agarose can develop outgrowths resembling cartilage nodules at the agarose-media interface. The purpose of this study was to design a live cell time-lapse confocal imaging method to observe the development of hyaline-like outgrowths at the agarose-media interface.

Methods and Materials: Young adult bovine articular chondrocytes were enzymatically released, encapsulated in 2% low melting temperature agarose, and cultured for up to 1 month with daily sodium L-ascorbate supplementation. Cell proliferation in the interfacial outgrowth was observed on fixed cryosections by detection of Ki67 and incorporated BrdU. PKH26 membrane stain and acidine orange (AO) at 10 ng/mL, were used to perform live cell imaging with a confocal microscope equipped with a humidified culture chamber at 37ºC.

Results: Ki67 and BrdU staining showed proliferation mainly at the periphery of the outgrowths. PKH26 staining of living cells was weaker in peripheral compared to central cells, showing dye dilution caused by higher cell division in the outer regions. PKH26 time-lapse imaging was not possible because of photobleaching. Continuous incubation with AO allowed the acquisition of hundreds of 3D scans, in the absence of any apparent cellular damage. With the latter technique, we observed time lapse live cell division at the periphery of the outgrowths, as well as several unexpected dynamic features including cell cluster movement and chondrocyte migration over relatively large distances.

Conclusions: Interfacial chondrocyte outgrowths display an appositional growth mechanism partly resembling the growth plate. Time lapse live confocal microscopy of these outgrowths using low AO concentrations provides a new tool to study chondrocyte dynamics and cartilage growth processes.