

Cytotoxicity of local anesthetics on human mesenchymal stem cells.

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Abstract

BACKGROUND: Local anesthetics are frequently delivered intra-articularly to provide perioperative pain control. Previous studies have shown that the commonly used drugs lidocaine, ropivacaine, and bupivacaine can be toxic to human chondrocytes. The present study was conducted to determine whether the toxic effects of local anesthetics on human chondrocytes also extend to human mesenchymal stem cells.

METHODS: Human mesenchymal stem cells from three healthy donors were grown in tissue culture and exposed to the following anesthetic treatments for sixty minutes: (1) 1% lidocaine, (2) 2% lidocaine, (3) 0.25% bupivacaine, (4) 0.5% bupivacaine, (5) 0.2% ropivacaine, and (6) 0.5% ropivacaine. The cells were then allowed to recover for twenty-four hours in regular growth media, and viability was measured with use of fluorescent staining for live cells or a luminescence assay for ATP content.

RESULTS: The live cell counts and ATP content were correlated ($r^2 = 0.79$), and 2% lidocaine was found to be significantly more toxic than all doses of bupivacaine and ropivacaine. Treatment with 1% lidocaine resulted in significantly fewer live cells (49%) compared with the control, and the live cell count was also significantly less than that for the other anesthetics. However, the ATP level in the 1% lidocaine group was not significantly lower than those in the other groups. Bupivacaine and ropivacaine did not exhibit significant differences in toxicity compared with the control or with each other.

CONCLUSIONS: Ropivacaine and bupivacaine had limited toxicity in human mesenchymal stem cells. However, lidocaine could significantly decrease mesenchymal stem cell viability. Since other studies have shown ropivacaine to be less toxic to chondrocytes than bupivacaine, ropivacaine may be a safer intra-articular anesthetic.

CLINICAL RELEVANCE: Mesenchymal stem cells likely play a key role in healing following surgical procedures such as microfracture and ligament reconstruction. If local anesthetics are used following joint surgery, selection of an agent with low toxicity toward mesenchymal stem cells, such as ropivacaine, may maximize tissue healing potential.

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