Thermal Stress Potentiates Bupivacaine Chondrotoxicity

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Background

- Post-arthroscopic chondrolysis is a rare complication of arthroscopy

**Potential contributing factors:**

<table>
<thead>
<tr>
<th>Intra-articular local anesthetics</th>
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<td>Radiofrequency probes/ thermal stress</td>
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<tr>
<td>Irrigation fluid composition/ pressure</td>
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<td>Suture/anchor materials</td>
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</tbody>
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Piper, et al 2011
Background

- Local anesthetics have been shown to be cytotoxic to animal and human articular chondrocytes *in vitro* and *in vivo* in a dose and time dependent manner

- Radiofrequency probes increase intra-articular temperatures
  - Flow dependent

- Thermal stress has been shown to be chondrotoxic to human articular chondrocytes

Hypothesis

- Sequential exposure to thermal stress followed by bupivacaine will result in decreased articular chondrocyte viability compared to exposure to bupivacaine alone
Methods

- Bovine articular cartilage obtained from six hind stifle joints
  - Full-thickness cartilage explants and monolayer chondrocyte cultures taken from each specimen

- Three specimens used to produce temperature/viability curve
  - 37 (control), 45, 50, 55, 60 and 65°C for 20 minutes
  - Viability measured 24 hours after treatment
    - Live/Dead Cell Viability/Cytotoxicity Assay for cartilage explants
    - CellTiter-Glo Luminescent Cell Viability Assay for cultured chondrocytes

- Thermo-toxicity threshold:
  - Temperature that did not cause a significant decrease in chondrocyte viability compared to control
Explant Temperature/Viability Curve

Monolayer Temperature/Viability Curve

Error bars = SE, n=5, *= p<0.05
Methods

- Five specimens then were treated in the following manner:
  - Explants exposed to 37° or 55° C for 20 minutes
  - Cultured chondrocytes to 37° or 45° C for 20 minutes
  - Thirty minutes later, the explants and cultured chondrocytes treated with either 0.9% normal saline or 0.5% bupivacaine for 30 minutes
  - 24 hours after treatment, chondrocyte viability was measured as described previously

- Significance determined using ANOVA with Tukey's post-hoc analysis
  - Significance set at p<0.05
Results
Thermal Stress and Bupivacaine in Explants

Mag. x10, Calibration bar 1mm

Error bars = SE, N=5, * = p<0.05
Results
Thermal Stress and Bupivacaine in Monolayer

Error bars = SE, N=5, * = p<0.05
Conclusions

- Thermal stress potentiates the chondrotoxic effect of bupivacaine in bovine articular cartilage in vitro
  - This occurs after sequential exposure

- This effect is seen in intact cartilage but not monolayer culture
  - Increased potentiation in explants may be due to protective effects of extracellular matrix

- Additional studies are needed to investigate potential clinical implications
Acknowledgements

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