A Comparison of Lidocaine, Ropivacaine and Dexamethasone Toxicity in Tenocytes

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Disclosures

• No disclosures

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Local Anesthetic Toxicity

- Local anesthetics are toxic to several cell types.

- Multiple short term in vitro studies have demonstrated local anesthetic chondrotoxicity.
  - Bupivacaine and lidocaine toxicity is time and dose dependent in both animal and human chondrocytes.
  - Ropivacaine is significantly less chondrotoxic to human chondrocytes.
  - The ECM and superficial cartilage layer are protective.
  - Heat sensitizes bovine chondrocytes to local anesthetic toxicity.
Local Anesthetic Chondrotoxicity

• Long term outcomes of animal in vivo local anesthetic infusion and single injection remain unclear.

• Clinically, there is not strong evidence of negative outcomes with intra-articular local anesthetics.
  – The role of local anesthetics in post-arthroscopic glenohumeral chondrolysis remains questionable.
• Tenocytes are frequently exposed to local anesthetics and corticosteroids.
  – Intra-articular and subacromial shoulder injections
  – Extra-articular peri-tendinous injections

• The effects of local anesthetics on tenocytes has not been well studied.
  – Lidocaine has been shown to cause a dose and time dependent decrease in tenocyte proliferation and biosynthetic activity.
    • Scherb, et al, Orthopedics, 2009
  – Lidocaine combined with methylprednisolone and betamethasone potentiates tenocyte toxicity.
Hypotheses

• Lidocaine and Dexamethasone will cause a dose dependent decrease in tenocyte viability.

• Ropivacaine will not cause a dose dependent decrease in tenocyte viability.

• Dexamethasone will potentiate local anesthetic tenocyte toxicity.
Methods

• Bovine patellar tendon was obtained from five hind stifle joints.

• Monolayer tenocyte cultures were produced from each specimen.

• Cultured tenocytes were exposed for 30 minutes to:

<table>
<thead>
<tr>
<th>Solution</th>
<th>Treatment</th>
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<tbody>
<tr>
<td>0.9% NS</td>
<td>Dexamethasone (Dex)</td>
</tr>
<tr>
<td>1% Lidocaine</td>
<td>1% Lidocaine and Dex</td>
</tr>
<tr>
<td>2% Lidocaine</td>
<td>2% Lidocaine and Dex</td>
</tr>
<tr>
<td>0.2% Ropivacaine</td>
<td>0.2% Ropivacaine and Dex</td>
</tr>
<tr>
<td>0.5% Ropivacaine</td>
<td>0.5% Ropivacaine and Dex</td>
</tr>
</tbody>
</table>
Methods

• Tenocyte viability was assessed 24 hours after exposure using 2 assays:
  – CellTiter-Glo Luminescent Cell Viability Assay
  – FACS quantification of live and dead cells
    • Live cells: Calcein AM
    • Dead cells: 7-Amino-actinomycin D

• Significance was determined using ANOVA with Tukey's post-hoc analysis.
  – Significance set at p<0.05
Results:
CellTiter-Glo Cell Viability Assay

Cultures from 5 tendons with 6 replicates per treatment group.
Mean % viability ± SEM. *=p<0.01

NS: Normal Saline
L: Lidocaine
R: Ropivacaine
D: Dexamethasone
Results:
FACS quantification of live & dead cells

Cultures from 3 tendons with 6 replicates per treatment group.

Mean % viability ± SEM. *-p<0.01
Conclusions

• Lidocaine has significant, dose dependent tenocyte toxicity while ropivacaine does not.

• Dexamethasone alone does not have significant tenocyte toxicity.

• Dexamethasone potentiates ropivacaine, but not lidocaine, tenocyte toxicity.

• Additional in vivo and clinical studies are needed, but these findings suggest:
  – Injection of 1% lidocaine, 2% lidocaine or 0.5% ropivacaine combined with dexamethasone may carry a higher risk of tenocyte toxicity.

  – 0.2% ropivacaine combined with dexamethasone causes the least amount of tenocyte toxicity and may be a safer choice when performing peri-tendinous injections.
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