

The Effect of Acute and Chronic Thermotherapy on Type 2 Diabetic Skeletal Muscle Cell Viability and Gene Expression: Pilot Study

LOUAY BACHNAK, JEAN SPARKS, XAVIER F. GONZALES, DANIEL E. NEWMIRE & FELIX OMORUYI

Phytomedicine Lab, Life Sciences; Texas A&M University – Corpus Christi; Corpus Christi, TX 78412

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Advisor / Mentor: Felix, Omoruyi (felix.omoruyi@tamucc.edu)

ABSTRACT

Diabetes is a chronic metabolic disease affecting millions of people globally. Type 2 diabetes is associated with insulin resistance or a defective secretion of insulin from the pancreas. The skeletal muscle system accounts for 80% of glucose uptake and is a vital player in healthy aging and muscle mass maintenance. **PURPOSE:** The purpose of this study was to investigate the effects of thermotherapy on gene expression and cell viability in Type 2 Diabetic skeletal muscle. **METHODS:** Human skeletal muscle myoblast (HSMM) and Diabetic Type 2 human skeletal muscle myoblast (D-HSMM) (Lonza Inc, Walkersville, MD) were cultured until 90% confluency was, and then subjected to a heat treatment – acute or chronic. The chronic heat treatment consisted of a 30-minute exposure to 40°C, three times a week for three weeks, while the acute heat treatment consisted of a one-time exposure to 40°C for 30 minutes. Approximately, 10⁵ cells of each cell type (HSMM and D-HSMM), along with growth media, were seeded into 24-well plates for a total volume of 2 mL per well. Groups included control cells (CON), chronic treatment (CH), and acute treatment (AC). Following a 48-hour incubation period, the chronic treatment occurred, while the acute treatment was performed during the last session of the chronic treatment. Following the treatments, cell viability and density were determined. The cDNA was isolated and a real-time polymerase chain reaction (QuantStudio 3 Real-time PCR Instrument, Thermofisher, Waltham, MS) was performed to assess an array of gene expression. **RESULTS:** Through a qualitative assessment of gene expression, HSMM yielded the highest elevations under the chronic treatment compared to the control - ADRB2 (6.944-fold), FOXO1 (4.191-fold), and DMD (3.613-fold). Similarly, D-HSMM under the acute treatment yielded an upregulation of ACTB (23.58-fold), IGFBP3 (4.123-fold), and DYSF (3.209-fold), while in the chronic treatment, an upregulation of ADRB2 (3.132-fold) was observed. There was significant evidence supporting a difference between cell viability percentage following the acute thermotherapy (p=0.0089), however, no significant change occurred in chronic thermotherapy (p=0.6400). There was no significant correlation between acute and chronic treatments on both cell types. **CONCLUSION:** The results suggest an increase in gene expression is related to actin activity (ACTB), sarcolemma repair (DYSF), and cellular responses (IGFBP3, FOXO1, DMD) which could be indicative of a boost in transcriptional regulation. An increase in ADRB2 indicates an increase in the regulation of energy balance due to the environmental change in both treatments. A significant difference is evident between acute treatment and the control in regard to cell viability percentage.