Background: Ultrasound has been suggested to be one of the most commonly used therapeutic modalities in clinical practice. One of the purported benefits of thermal ultrasound is its ability to increase blood flow to tissue. This benefit however, has not been sufficiently supported by current literature and research. The purpose of this study was to determine if there is a significant increase in blood flow to the brachial artery following a 3MHz thermal ultrasound at 1.0 W/cm² treatment over the brachial artery. Methods: 30 healthy individuals (mean age 22.3 ± 3.1 years) were recruited to participate in the study. Blood flow was measured using a Phillips HD11 XE Diagnostic Ultrasound System in time-averaged mean velocity (cm/sec) prior to, and following a thermal ultrasound treatment. The therapeutic ultrasound was performed using a Dynatron Solaris® 700 Series ultrasound machine. Results: Results indicated that ultrasound performed at 3MHz, 1.0 W/cm² for 5 min caused a statistically significant increase in blood flow (p = 0.015). Conclusion: This study demonstrated that ultrasound performed at 3MHz, 1.0 W/cm² for 5 min can be effectively used to promote healing through increases in blood flow. Keywords: blood flow, brachial artery, therapeutic ultrasound, thermal ultrasound

Experimental Design: A pre-test-post-test experimental design was followed for the present study. Measurements of blood flow using time-averaged mean velocity readings were gathered followed by a thermal therapeutic ultrasound treatment. Immediately following the thermal ultrasound treatment, researchers again collected a blood flow measurement.

• Procedures:
  - Subjects were positioned supine on a treatment table with their arm in 90 degrees of abduction, 90 degrees of elbow flexion, and full shoulder external rotation.
  - Brachial artery depth was collected using the diagnostic ultrasound machine.
  - Time-averaged mean velocity (TAVM) blood flow readings were collected using diagnostic ultrasound (Figure 2).
  - Thermal therapeutic ultrasound was delivered at the parameters of 5 minutes, 3MHz, and 1.0 W/cm².
  - TAVM was collected again immediately following therapeutic ultrasound treatment to identify changes in blood flow that may be attributable to the subjects therapeutic ultrasound treatment. (Figure 1)

• Statistical Design: Descriptive statistics were performed for age, gender, upper extremity dominance and brachial artery depth (Table 1). Data collected was analyzed using SPSS version 21 (SPSS Software. 21st edition: IBM, Upper Saddle River, New Jersey). Descriptive statistics included measurements of minimal, maximum, mean and standard deviation. A dependent T-Test was performed with the level of significance set at p ≤ .05.

Table 1: Descriptive statistics for subjects

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Gender</th>
<th>Upper Extremity</th>
<th>Brachial Artery Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-29</td>
<td>Male</td>
<td>Right</td>
<td>2.5 cm</td>
</tr>
<tr>
<td>30-39</td>
<td>Female</td>
<td>Left</td>
<td>3.0 cm</td>
</tr>
<tr>
<td>40-49</td>
<td>Male</td>
<td>Right</td>
<td>2.8 cm</td>
</tr>
</tbody>
</table>

Conclusions and Clinical Significance

The primary conclusion drawn from the results of this study indicate that blood flow can be effectively increased following a continuous, 5-minute, 3 MHz, 1.0 W/cm² ultrasound treatment with the Dynatron Solaris® 700 Series Ultrasound machine. Increasing blood flow to the site of an injury serves to create an optimal environment for healing by facilitating the delivery of nutrients and eliminating metabolic wastes present as a result of tissue damage. Clinically, this information provides evidence to support the use of ultrasound for a catalyst to accomplishing an increase in blood flow.

Future Research

• Future research should be conducted to examine the ability of other therapeutic ultrasound machines to increase blood flow.
• Other parameters have been suggested to sufficiently raise muscle temperature to the point at which an increase in blood flow is seen. These parameters should be examined for efficacy.
• Future studies may also wish to study the effect of such a treatment on damaged or injured tissue for which therapeutic ultrasound is most commonly used.

References