Effect of Acupressure on Thirst in Hemodialysis Patients

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\textbf{Key Words}
Thirst \cdot Salivary flow rate \cdot Acupressure \cdot Hemodialysis

\textbf{Abstract}

\textbf{Background:} Thirst and dry mouth are common among hemodialysis (HD) patients. This paper reports a study to evaluate the impact of an acupressure program on HD patients’ thirst and salivary flow rates. 

\textbf{Methods:} The acupressure program included placebo, followed by true acupressure each applied for 4 weeks. Twenty-eight patients (mean age 57.6, SD = 16.13 years) first received a sticker as placebo acupressure at two acupoints CV23 and TE17 three times a week for 4 weeks, and then received true acupressure in the same area for the next 4 weeks. Salivary flow rate and thirst intensity were measured at baseline, during and after treatment completion for both the placebo and true acupressure program.

\textbf{Results:} The true acupressure program was associated with significantly increased salivary flow rate (0.09 ± 0.08 ml/min at baseline to 0.12 ± 0.08 ml/min after treatments completion, \(p = 0.04\)). The mean thirst intensity also improved from 4.21 ± 2.66 at baseline to 2.43 ± 2.32 (\(p = 0.008\)) after treatment completion in HD patients. There was no statistically significant difference in pre-post program salivary flow rate; however, significant improvement in thirst intensity scores was observed (\(p = 0.009\)) in the placebo acupressure program. 

\textbf{Conclusion:} This study provides preliminary evidence that acupressure may be effective in improving salivary flow rates and thirst intensity.

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cally significant increased resting and stimulated salivary flow rate during and after the acupuncture treatment when compared with baseline [15]. Another study used an untreated control group and found that acupuncture only resulted in a significant increase in paraffin-stimulated saliva secretion for patients with primary Sjögren’s syndrome [17]. In other studies, the effectiveness of acupuncture with radiation-induced xerostomia has been shown to increase salivary flow rates and to reduce xerostomia intensity [16, 18, 19]. These findings suggest that acupuncture may be a useful treatment for the stimulation of salivary flow in xerostomia patients.

Unfortunately, acupuncture is an invasive procedure that must be delivered by licensed practitioners. Acupressure on the other hand, is a massage technique of Chinese origin that stimulates acupoints of the human body. Acupressure differs from acupuncture in that it is a therapy that puts pressure on acupoints on the surface of the body to relieve obstructions and to balance the energy flows; however, its effects are thought to be similar to those achieved by acupuncture. It is hypothesized that acupuncture can result in restoration of normal bodily function [20–22].

Acupressure uses hands as a tool to press acupoints on the skin. Patients can experience soreness, numbness, heaviness and fullness resulting from acupoint pressure. This subjective sensation can be experienced differently by individuals, and is referred to as ‘De Qi’ [21, 22]. Pressure is usually applied for a minimum of 15 s, but it can last for between 30 s and 5 min [23]. The amount of pressure applied depends on patients’ tolerance. Pressure can be applied until the patient experiences numbness, pressure, heaviness, soreness or a feeling of distention [21]. The effectiveness of acupressure in managing the symptom of thirst and improving salivary flow for patients has, however, not been tested. The present study was a single-blind and repeated-measures study to develop and undertake a preliminary evaluation of an acupressure strategy to stimulate salivary flow rates and improve HD patients’ thirst symptoms.

**Patients and Methods**

**Patients and Study Design**

Patients were recruited from an HD center of a medical hospital in South Taiwan. All patients had had thirst symptoms in the last month and were undergoing regular HD three times a week. Patients with chronic heart failure and current skin problems (e.g. ulcer, rash) in the acupressure areas, or who were taking medications including tricyclic antidepressants, anticholinergics, antihistamines (with anticholinergic effect), and beta-blockers which may induce dry mouth, were excluded from the study. An acupressure protocol was developed based on a review of the literature [21, 24, 25] and in consultation with 5 licensed traditional Chinese physicians, who had graduated from medical schools in Taiwan or China and practiced Chinese medicine for more than 10 years. Two acupoints were used to increase salivary flow rate: Lianquan (CV23) on the anterior midline of the neck and Yifeng (TE17) posterior to both ear lobes. No previous study has documented the effects of acupressure on salivary flow rate in HD patients with thirst symptom. In this preliminary study, we therefore chose to evaluate whether acupressure could both increase salivary flow and decrease thirst intensity over time, by comparing a period of placebo intervention (‘stickers’ placed on the acupressure points) with a period of true acupressure (pressure delivered by the hands). The study design thus involved a single group with repeated measures involving a period of placebo intervention, followed by true acupressure, each applied for four weeks.

To standardize the intervention, principles of acupressure performance were defined. According to the literature, the power of pressure depends on patients’ tolerance. Pressure is applied until the patient has numbness, pressure, heaviness, soreness or feeling of distention [21, 22]. To determine the pressure to be applied in this study, 5 subjects not in the main study undergoing HD were chosen for a pilot study. Patients reported experiencing a ‘De Qi’ sensation when the pressure was maintained at 1–2 kg. Therefore, 1–2 kg of finger pressure was applied in this study.

In order to enhance intra-rater reliability and to maintain the consistency of the pressure, prior to implementing the study, the finger pressure of 2 investigators was measured using a scale that had a unit of 20 g and maximum capacity of 6 kg. The investigators were self-trained and the force of finger pressure was measured for each investigator over a 1-month period. The force of finger pressure was measured before the first subject was treated and after the last one was treated on the days of dialysis. The mean forces for all measurements were 1.96 kg (SD = 0.42) at first measure and 1.54 kg (SD = 0.28) at the end measure in true acupressure period.

Furthermore, for each investigator, 10 subjects not enrolled in the main study were selected to determine accuracy in selection of acupoints. The accuracy of the selection of two acupoints was determined by 2 experts who confirmed 100% accuracy for each investigator.

For the first 4 weeks, all participants received ‘a sticker’ as placebo acupressure three times a week, and then received true acupressure three times a week to the same area for the last 4 weeks. Each acupoint lasted for 3 min; a total of 9 min for each time. Salivary flow rate and thirst intensity were measured at baseline, during the intervention (after 3, 6, 9 treatments completion) and after completion of the 12 treatments in each of the placebo and true acupressure program.

The study was approved by the university and hospital human experimental and ethics committee. The researcher explained the study to potential participants, and written informed consent was obtained. Participants could withdraw at any time without adverse consequences.

**Assessment of Salivary Flow Rates and Thirst Intensity Parameters**

Demographic and medical data were obtained from each patient once informed consent had been obtained. The following...
baseline characteristics were recorded: age, gender, religion, marital status, educational level, career, living condition, previous experience with Chinese medicine and acupressure, and medicine history, including period of HD, IWG, diabetes mellitus history, residual urine output (daily urine flow), thirst in the past month, salivary flow rate and thirst intensity.

The salivary flow rates were measured for unstimulated whole saliva, which was collected by oral cotton. The collection of whole saliva was performed under resting conditions in a hemoroom, at least 1 h after eating, smoking and drinking. Each saliva sample was collected over 10 min and measured by weight in grams. All samples were measured to an accuracy of 0.0001 g by the electric scale (Mettler B204S, Switzerland) presuming that 1 g of saliva is equivalent to 1 ml. Another instrument, a 10-point verbal rating scale ranging from 0 (no thirst) to 10 (worst thirst possible), was used to measure participants’ intensity of thirst before, during and after the acupressure period measures (t = 1.38, p = 0.18). The salivary flow rate at baseline was 0.10 ml/min (SD = 0.09) with a range from 0.001–0.33 ml/min. At baseline, half of the subjects (50%) had a salivary flow rate lower than 0.10 ml/min, 12 patients (42.8%) had a range from 0.10 to 0.30 ml/min, and only 2 patients (7.2%) had a salivary flow rate above 0.30 ml/min.

During the intervention period, all assessments were performed at pre-treatment (1 data point) and 1, 2, 3 weeks during the treatment period (3 data points) and after treatment completion (1 data point) on each placebo and true acupressure program. At each time point, salivary flow rate and thirst intensity for each participant was measured.

**Statistical Analysis**

Data were coded and analyzed using the SPSS version 16.0 statistical software package. Descriptive statistics were generated related to participant’s characteristics and variables. A paired-samples t test was conducted to compare baseline in salivary flow rate and thirst intensity measures before the placebo and true intervention program. To compare the changes for each outcome measure between baseline and 1 week, 2 weeks, 3 weeks after test and after treatment completion, generalized estimation equation (GEE) procedures were used. A level of p < 0.05 was considered statistically significant.

The parameters of the above statistical model were estimated with GEE to consider within-person variability. The GEE approach has been proposed as a non-parametric and appropriate method to conduct the repeated measurement analysis and to account for the correlated structure of disability data across repeated measurements. The main advantage of using GEE (when compared to maximum likelihood approaches) is that GEE is suitable for the analysis of both continuous and discrete outcome variables. Another advantage is that GEE seems to be quite robust against the working correlation structure, which must be assumed as correct for the within-subject correlations. In designs where m = 2, the calculated odds ratios or coefficients with the GEE approach are exactly the same as they were calculated with multiple logistic or linear regression, but all available longitudinal data were used to calculate the risk in this model.

**Results**

A total of 28 subjects (14 male, 14 female) fulfilled the above-mentioned criteria and were enrolled in this program. All of the subjects lived with their families. Most subjects were married (95.2%) and had religious beliefs (81%). Most of the subjects were unemployed (82.1%), 2 patients (7.1%) were retired, and only 3 patients (10.7%) were employed. A detailed description of the patients’ baseline parameters in terms of mean age, sex, duration of dialysis treatment, thirst intensity in the past month, residual urine output, educational level, diabetes, IWG at baseline, previous experience with Chinese medicine and acupressure are presented in table 1.

<table>
<thead>
<tr>
<th>Females/males</th>
<th>14/14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>57.61 ± 16.13¹</td>
</tr>
<tr>
<td>Time on dialysis, months</td>
<td>34.79 ± 46.51¹</td>
</tr>
<tr>
<td>Thirst in the past month, scores</td>
<td>5.54 ± 3.13¹</td>
</tr>
<tr>
<td>IWG, kg</td>
<td>2.45 ± 1.14¹</td>
</tr>
<tr>
<td>Residual urine output</td>
<td></td>
</tr>
<tr>
<td>&lt;100 ml/day</td>
<td>12 (42.9%)</td>
</tr>
<tr>
<td>100–500 ml/day</td>
<td>8 (28.6%)</td>
</tr>
<tr>
<td>500–1,000 ml/day</td>
<td>2 (7.1%)</td>
</tr>
<tr>
<td>No</td>
<td>6 (21.4%)</td>
</tr>
<tr>
<td>Educational level</td>
<td></td>
</tr>
<tr>
<td>Primary school or lower</td>
<td>7 (25%)</td>
</tr>
<tr>
<td>Secondary school</td>
<td>4 (14.3%)</td>
</tr>
<tr>
<td>High school or higher</td>
<td>17 (60.7%)</td>
</tr>
<tr>
<td>Diabetes</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>9 (32.1%)</td>
</tr>
<tr>
<td>No</td>
<td>19 (67.9%)</td>
</tr>
<tr>
<td>Chinese medicine experience</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>18 (64.3%)</td>
</tr>
<tr>
<td>No</td>
<td>10 (35.7%)</td>
</tr>
<tr>
<td>Acupressure experience</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2 (7.1%)</td>
</tr>
<tr>
<td>No</td>
<td>26 (92.9%)</td>
</tr>
</tbody>
</table>

¹ Mean ± SEM.
scores at baseline of ≤3 points, 13 (46.4%) with scores of 4–6 points, and 6 (21.4%) with scores of ≥7 points. The mean intensity of thirst was 4.75 (SD = 2.53) with a range from 1 to 10. Sixteen of the subjects (57.1%) reported that their intensity of thirst had not changed over time, half of the subjects (52.4%) felt thirsty all the time. Most of the subjects (82.1%) used drinking to reduce their feeling of thirst, 4 of the subjects (14.3%) used other methods to reduce thirst symptoms, such as chewing gum, and only one person (3.6%) ignored the feeling of thirst.

At baseline, there was a significant association between thirst intensity and salivary flow rate (r = –0.46, p = 0.01). Baseline measures of thirst intensity did not differ between the placebo and true intervention period (t = 1.40, p = 0.17).

The effects of acupressure are shown in table 2. In the placebo acupressure period, there was no statistically significant difference in treatment scores over the five time points for salivary flow rate (p = 0.37). However, there was significant difference in thirst intensity scores (p = 0.009) using GEE analysis after covariate adjustments for sex, age and time on dialysis. For the placebo acupressure group, this finding indicates no significant improvement in salivary flow rates, but a significant improvement in intensity of thirst scores is observed.

At the end of true acupressure phase of the study, the mean salivary flow rate was higher and thirst intensity was lower when compared with the baseline for the true acupressure period. Using GEE analysis after covariate adjustments for sex, age and time on dialysis, statistically significant differences in scores for salivary flow rate and thirst intensity over the five time points were observed (p = 0.04, p = 0.008, respectively). Moreover, for the true acupressure group, the number of patients with xerostomia (salivary flow rate <0.1 ml/min) decreased from 17 patients at baseline to 12 patients at the end of the true acupressure period. Similarly, for the true acupressure group, the number of patients with thirst intensity scores more than 4 points decreased from 17 patients at baseline to 7 patients after true acupressure treatment completion. These differences noted for the true acupressure program were not observed for the placebo acupressure program.

**Discussion**

Our study has confirmed previous findings of a widespread low salivary flow rate in ESRD patients. Only 2 patients reach the normal range salivary flow rate of 0.3 ml/min at baseline, with the mean salivary flow rates before acupressure program being 0.10 ± 0.09 ml/min. These results indicate that subjects in this study had more hyposalivation than reported in previous studies [4, 26–27]. This may be attributed to the differences in sample inclusion criteria, since all participants in this study had thirst as a symptom. A negative correlation between thirst and low salivary flow rates has been documented in some studies in ESRD patients [3, 4]. This correlation, which was confirmed in our study, may indicate that the decrease in salivary flow rate in ESRD patients is greater in HD patients with thirst symptoms than in the ESRD population. The salivary flow rate is consistent with definitions of xerostomia, where salivary flow rate is defined as <0.1 ml/min [28]. However, participants in this study did not report using methods to increase saliva production to relieve their thirst symptom, due to their disliking of the resulting taste. This means that half of the study subjects may have problems with eating dry food, and need to sip liquids to aid in swallowing food. Such increased fluid intake would increase IWG in HD patients.

The results of this study provide some evidence that acupressure on the acupoints CV23 and TE17 increased

**Table 2. Main variables at baseline and during acupressure treatment**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Treatment completion</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salivary flow rate, ml/min</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Placebo</td>
<td>0.10 ± 0.09</td>
<td>0.08 ± 0.07</td>
<td>0.08 ± 0.07</td>
<td>0.09 ± 0.09</td>
<td>0.10 ± 0.08</td>
<td>0.37</td>
</tr>
<tr>
<td>True</td>
<td>0.09 ± 0.08</td>
<td>0.08 ± 0.10</td>
<td>0.07 ± 0.07</td>
<td>0.08 ± 0.13</td>
<td>0.12 ± 0.08</td>
<td>0.04</td>
</tr>
<tr>
<td>Thirst</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Placebo</td>
<td>4.75 ± 2.53</td>
<td>4.00 ± 3.00</td>
<td>3.96 ± 2.69</td>
<td>3.60 ± 2.84</td>
<td>3.21 ± 2.48</td>
<td>0.009</td>
</tr>
<tr>
<td>True</td>
<td>4.21 ± 2.66</td>
<td>3.52 ± 2.76</td>
<td>3.63 ± 2.62</td>
<td>2.67 ± 2.18</td>
<td>2.43 ± 2.32</td>
<td>0.008</td>
</tr>
</tbody>
</table>

Data presented as mean ± SD; p < 0.05 was regarded as significant by GEE analysis.
the salivary flow rates in HD population and are similar to the results obtained in studies using actual acupunc-
ture techniques in improving symptoms related to radia-
tion-induced xerostomia. The choice of acupressure
points for the study was selected by 5 physicians who were
certified in traditional Chinese medicine. CV23 and
TE17 are mainly in the regions of the submandibular and
labial glands; these acupoints have also been used in the
acupuncture treatment of xerostomia studies [15–17].
The treatment schedule was modeled on the aforemen-
tioned studies in treating xerostomia, with a protracted
course involving three weekly sessions for a total of twelve
acupressure treatment sessions.

The underlying mechanism that has been proposed
for acupressure is that it works by affecting the autonom-
ic nerve system to release neuropeptides which increase
saliva [29]. Acupressure is thought to provide relief if the
stimulation is sufficiently strong to stimulate the median
nerve. It was assumed that improvements in the placebo
acupressure should not be as good as those in the true
acupressure group because the placebo group used a
sticker on the pressure point, although the acupoints
were the same. Moreover, this study showed that the sal-
ivary flow rates did not increase progressively during the
true acupressure period, the salivary flow rate only in-
creased after acupressure treatment completion. These
results provide some evidence to suggest that participants
may require a minimum of at least twelve sessions (that
is three sessions per week for 4 weeks) of acupressure to
reach the 'threshold' where the effect is present. A target
volume of increase in salivary flow rates of around ≥0.1–
0.3 ml/min may be necessary to avoid the sensation of dry
mouth [28]. Moreover, the twelve sessions of true acu-
pressure used in this study have significantly increased the
salivary flow rate, and as such it is not surprising to
note that the thirst intensity in HD patients was also af-
fected. The results from this study thus suggest that acu-
pressure might have an important role in managing pa-
tients with low salivary flow rate and thirst. Unfortunat-
ely, the long-term effect was not followed so it was not
known how long the effect can be maintained.

Our findings suggest that an acupressure treatment on
points CV23 and TE17 that lasts for 3 min, respectively, 3
days per week, for a total of 4 weeks can increase salivary
flow rates, and decrease thirst intensity in HD patients.

**Limitations**

The methodological limitations of this study lie in the
small sample size and the failure to measure the long-
term effects. Moreover, as with most studies of these ther-
apies, therapists are not blinded and as such may be sub-
ject to some bias. Also, while a repeated measure design
was used, the internal validity might be affected due to
practice effects associated with repeated uses of the VAS
over time. Moreover, as all subjects received the placebo
first, any inference about the effect of time cannot be as-
sessed.

It is also acknowledged that while each participant was
told that we would provide two methods for stimulating
acupoints, and as such were blind as to which interven-
tion was the ‘true’ intervention, participants are likely to
have noticed reduced or no pressure with the placebo’
stickers’ stimulation on acupoints. As such, while par-
ticipants were not informed that ‘stickers’ were a placebo
intervention, they may have concluded that the ‘true’ acu-
pressure was the ‘true’ intervention. This may explain our
observation that the intensity of thirst after twelve ses-
sions of ‘a sticker’ acupressure in the placebo acupressure
period declined, as well as the differences observed be-
tween true and placebo interventions, reflecting a psy-
chological reaction in some HD patients. That is, al-
though the objective measures of salivary flow rate did
not increase in the placebo time period, more subjective
measures of thirst did show some changes. The substan-
tial difference in thirst scores between the end of the pla-
aceo period and the commencement of the true interven-
tion suggests, however, that any psychological reaction
may not have a long-term effect.

Although we concluded in this preliminary study that
acupressure may be a valuable method for the stimulation
of salivary secretion in many HD patients with thirst,
further research is required using a crossover design, and
a more effective placebo involving pressing sham acu-
points not related to salivary flow rate or thirst as a con-
trol treatment instead of a sticker maneuver. In addition,
almost all the patients felt discomfort and could not toler-
ate over 3 min of pressure on each acupoint. It might be
preferable to use a different treatment to stimulate the
acupoints, such as TENS to make patients more comfort-
able.

We recommend that the methodological limitations of
this study and different treatments should be considered in
future studies.

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