Are hot tubs safe for people with treated hypertension?

Tae Won Shin, Merne Wilson, Thomas W. Wilson

Abstract

Background: People with hypertension are commonly warned to check with a physician before using a hot tub, but there is little literature on which to base this advice. We compared symptoms, heart rate, and systolic and diastolic blood pressure in response to 10 minutes of hot-tub immersion in a group of patients with treated hypertension and in a control group normotensive subjects.

Methods: We recruited 21 patients (18 men and 3 women aged 43–76 years) with stable, treated hypertension and 23 control subjects (14 men and 9 women aged 19–83 years) without hypertension. They were studied, in mid-afternoon, at a public facility. Systolic and diastolic blood pressure and heart rate were measured at baseline, during immersion in a hot tub at 40°C and for 10 minutes after immersion. We asked each subject to report any symptoms.

Results: None of the subjects reported dizziness, chest pain or palpitations. During immersion, systolic blood pressure fell in both groups, from a mean (and standard deviation [SD]) of 144 (17) mm Hg to 122 (18) mm Hg in the hypertensive group ($p < 0.05$) and from 130 (14) mm Hg to 110 (17) mm Hg in the control group ($p < 0.05$). It returned toward baseline within 10 minutes after the subjects left the hot tub. Diastolic blood pressure also fell, whereas heart rate was increased in both groups. The hypertensive group showed a slightly lower maximal increase in heart rate than the normotensive group (5 [SD 5] v. 13 [SD 10] beats/minute, $p < 0.05$).

Interpretation: Immersion in a hot tub for 10 minutes lowers blood pressure in subjects with treated hypertension, but no more than in normotensive control subjects. Spending 10 minutes in a hot tub should be safe for most treated hypertensive patients.

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pressure and heart rate readings were obtained 1, 5 and 10 minutes after the subjects entered the hot tub. Care was taken to position the arm at heart level during the recordings. The questionnaire was again administered between the 5- and 10-minute recordings. After 10 minutes the subjects left the hot tub and resumed sitting. Heart rate and blood pressure were monitored for 10 further minutes, and the questionnaire was again administered (between 5 and 10 minutes).

We calculated sample size requirements based on a fall in systolic blood pressure in the control group of 15 (standard deviation [SD] 10) mm Hg and a “clinically significant” difference in the reduction in systolic blood pressure in the hypertensive subjects of 25 (SD 10) mm Hg. For this, we required 18 subjects per group at $\alpha = 0.05$ and $1 - \beta = 0.90$. We compared the baseline characteristics of the groups using one-way analysis of variance. We compared changes in blood pressure and heart rate within each group using analysis of variance with repeated measures, and compared dichotomous variables using the $\chi^2$ test.

**Results**

The baseline characteristics of the subjects are shown in Table 1. The hypertensive subjects were more likely than the normotensive subjects to be older, female and obese. However, the age range in the 2 groups overlapped considerably (43–76 years and 19–83 respectively). Systolic and diastolic blood pressure and heart rate were higher in the hypertensive than in the normotensive subjects ($\text{p} < 0.05$).

We recorded no severe adverse effects before, during or after immersion the hot tub. No subject reported more than very mild headache or dizziness. None complained of palpitations or chest discomfort.

The changes in systolic and diastolic blood pressure and heart rate are shown in Fig. 1. Both groups showed a substantial fall in blood pressure and an increase in heart rate in the early phase of immersion; the values returned toward baseline 5–10 minutes after the subjects left the tub. The mean maximal change in systolic blood pressure in the hypertensive group was $-26.3 \pm 12.5$ mm Hg, compared with $-21.8 \pm 10.4$ mm Hg in the normotensive group, a nonsignificant difference. Diastolic blood pressure also fell rapidly as in the normotensive group. Although the heart rate response was reduced in the hypertensive subjects, blood pressure in this group returned to baseline values almost as rapidly as in the normotensive group.

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**Table 1: Baseline characteristics of hypertensive subjects and normotensive control subjects immersed in a hot tub for 10 minutes**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Hypertensive subjects $n = 21$</th>
<th>Normotensive subjects $n = 23$</th>
<th>$\text{p}$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (and SD), yr</td>
<td>60.6 (10.1)</td>
<td>43.0 (17.3)</td>
<td>$&lt;0.02$</td>
</tr>
<tr>
<td>Sex (male/female), no. of subjects</td>
<td>18/3</td>
<td>14/9</td>
<td>0.03</td>
</tr>
<tr>
<td>Mean body mass index (and SD)</td>
<td>25.9 (3.9)</td>
<td>23.0 (3.4)</td>
<td>NS</td>
</tr>
<tr>
<td>No. of antihypertensive drugs used</td>
<td>1–3</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Mean systolic blood pressure (and SD), mm Hg</td>
<td>144.8 (17.3)</td>
<td>130.0 (14.2)</td>
<td>$&lt;0.05$</td>
</tr>
<tr>
<td>Mean diastolic blood pressure (and SD), mm Hg</td>
<td>92.7 (8.9)</td>
<td>83.1 (9.1)</td>
<td>$&lt;0.05$</td>
</tr>
<tr>
<td>Mean heart rate (and SD), beats/min</td>
<td>83.3 (14.8)</td>
<td>74.7 (12.9)</td>
<td>$&lt;0.05$</td>
</tr>
</tbody>
</table>

Note: SD = standard deviation; NS = not significant.

The mean increase in heart rate was significantly lower in the hypertensive group than in the normotensive group (5.2 [SD 5.2] v. 12.9 [SD 9.5] beats/minute, $\text{p} < 0.05$). This difference persisted after the data for the 2 hypertensive subjects using $\beta$-blockers were removed from the analysis.

Fig. 2 depicts the frequency distribution of maximal changes in systolic blood pressure; there was no difference between the 2 groups. The frequency distribution of maximal heart rate changes was shifted downward in the hypertensive group (data not shown).

There was no correlation between age and the change in blood pressure or heart rate in either group or in the subjects as a whole. Also, we found no effect of female or male sex on these changes.

**Interpretation**

In this group of treated hypertensive subjects, immersion in a hot tub caused substantial falls in systolic and diastolic blood pressure accompanied by an increase in heart rate. However, none of the subjects became symptomatic, and the changes in blood pressure, both in absolute and in percentage terms, were not different from those in the normotensive control subjects. Although the heart rate response was reduced in the hypertensive subjects, blood pressure in this group returned to baseline values almost as rapidly as in the normotensive group.

We found no studies with which to compare ours. In the 1980 Australian study the subjects were immersed for 3 consecutive 20-minute periods separated by either standing or light exercise. A report in which healthy animals (3 dogs and 2 monkeys) were immersed in 40°C–45°C water for 60 minutes documented a shocklike, apparently hypovolemic state following the exposure. Our protocol was much less demanding, and we did not observe symptomatic hypotension, arrhythmias or other symptoms.

The effects of high-temperature sauna bathing on hemo-
dynamics\textsuperscript{5,6} and on other physiologic functions have been investigated. In general, few adverse effects have been reported, either in normotensive subjects or in patients with hypertension or coronary artery disease. Indeed, Luurila\textsuperscript{7} reported that only 1.7\% of all sudden deaths in Finland occurred within 24 hours after exposure to a sauna. In healthy people a 30-minute sauna increases the heart rate but does not affect blood pressure.\textsuperscript{8} Presumably the increase in cardiac output compensates for the vasodilation-induced fall in peripheral resistance. Likewise, systolic blood pressure did not change during a 14- to 20-minute sauna in 11 young hypertensive subjects treated with either placebo or diltiazem.\textsuperscript{9} Systolic blood pressure did fall by 12 mm Hg when these subjects were treated with atenolol. This reduction seems less than the reduction of 26 mm Hg observed in our subjects. The question arises as to whether the hot tub truly induces a greater fall in blood pressure than the sauna. It is plausible that the lower body positive pressure due to the water initially increases venous return, leading to the production of cardiac natriuretic peptides.\textsuperscript{10} These potent vasodilators may further decrease peripheral resistance.

How much can blood pressure be reduced acutely without causing symptoms? Studies done several decades ago in which normotensive subjects and subjects with treated and untreated hypertension were given sympathoplegic agents to acutely reduce blood pressure showed that cerebral blood flow was unchanged when mean arterial pressure was reduced by 25\% (equivalent to a reduction of 35\% in systolic blood pressure).\textsuperscript{11,12} Furthermore, no symptoms were reported until systolic blood pressure was reduced by 50\%. Accordingly, a reduction of 20\%–25\% in mean arterial pressure within “minutes to hours” is recommended for hypertensive emergencies.\textsuperscript{13} We observed reductions in mean arterial pressure of 26\% (from 99 to 73 mm Hg) in the normotensive group and of 23\% (from 110 to 85 mm Hg) in the hypertensive group. Only 3 normotensive subjects and 1 hypertensive subject showed reductions greater than 30\%, and none showed reductions greater than 35\%; none complained of hypotensive symptoms.

It should be noted that we measured blood pressure with the subject seated rather than supine or standing. It is possible that greater changes would have been observed in standing subjects. Caution should be exercised in extrapolating our findings to patients with other disorders. For example, seizures have been provoked in people with epilepsy by hot-water immersion.\textsuperscript{14} Similarly, children may be more susceptible to symptomatic, heat-induced hypotension.\textsuperscript{15} Finally, none of our subjects was taking long-acting nitrates

\begin{figure}
\centering
\includegraphics[width=\textwidth]{fig1.png}
\caption{Systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate in hypertensive subjects (n = 21) (black circles) and normotensive subjects (n = 23) (white squares) before, during and after 10-minute immersion in a hot tub at 40°C. Error bars are standard error of the mean. Grey areas represent time spent in the hot tub.}
\end{figure}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{fig2.png}
\caption{Frequency distribution of maximal changes in systolic blood pressure (SBP) during hot-tub immersion in the normotensive and hypertensive groups.}
\end{figure}
or wearing nitroglycerine patches. It is uncertain whether these potent vasodilators would aggravate hypotension from hot-tub use; this warrants investigation.

In summary, we have shown that a 10-minute immersion in a hot tub is likely safe for most people with hypertension controlled with drug treatment. Physicians can reassure their patients.

References


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