How Much Can Blood Pressure Be Lowered?

JOEL MENARD, M.D., GILLES CHATELLIER, M.D., PATRICE DEGOULET, M.D., PIERRE-FRANCOIS PLOUIN, M.D., AND PIERRE CORVOL, M.D.

SUMMARY  Whatever the therapeutic goal proposed for diastolic blood pressure in hypertensive patients, the actual results of treatment in various health care delivery systems throughout the world are not as good as generally assumed. In the two recent controlled therapeutic trials, 24.5% (Australian trial) and 29.9% (Hypertension Detection and Follow-up Program) of actively treated patients had diastolic blood pressure levels above 90 mm Hg. In three British hospital clinics, diastolic blood pressure was greater than 90 mm Hg in 69% of the treated patients after 6 months to 1 year of treatment. In our own clinic, the blood pressure of 947 hypertensive patients registered in the Artemis system (Paris) between 1976 to 1980 decreased after 2 years on medical treatment from 177/108 to 142/87 mm Hg. However 21.1% of the patients studied still had a diastolic blood pressure above 95 mm Hg. In the general population, the percentage of treated patients not attaining goal levels varies from 42.9% to 71%. Not only is it important to agree upon goals, but it is urgent to standardize methods for collecting and analyzing the results of antihypertensive treatments in various health care delivery systems, since high rates of therapeutic failures might be related to the physician's strategy, the patient's characteristics, the disease's particularities, and the limited efficacy and side-effects of presently available drugs. (Hypertension 5 (supp III): III-21-III-25, 1983)

KEY WORDS  • blood pressure control • Artemis computerized system

CRITICAL analysis of the results of antihypertensive treatment, as it was prescribed between 1972-1980 in various health distribution systems throughout the world, clearly reveals a gap between theory and practice. "How much should blood pressure be lowered in treating hypertension?" is a theoretical question without a scientific answer at the present time, whereas "How far can blood pressure be lowered?" is a practical question whose answer suggests that improvements are urgently needed.

Survey of diagnostic and treatment practices suggested an increasing acceptance of the need to treat blood pressure starting at systolic levels between 90 and 104 mm Hg, even before results were available from the Australian trial (lower limit of inclusions in the trial = 95 mm Hg) and the Hypertension Detection and Follow-up (HDFP) trial (lower limit of inclusion in the trial = 90 mm Hg).1-4 If we assume that a goal of 90 or 95 mm Hg for the diastolic blood pressure (DBP) of treated hypertensive patients is accepted by many physicians, the real question is "Is this goal, accepted if not demonstrated, attainable during the current management of hypertension?"

Material and Methods

We have critically analyzed blood pressure control using data from three basic sources.

Controlled Clinical Trials

We evaluated the results of the treatment of mild hypertension in patients of the Australian trial1 and those in the stepped-care program of the HDFP.2

Hospital Hypertension Clinics

The paucity of computerized medical records of hypertension care in hospital clinics makes evaluation difficult. Data are available from three British hypertension clinics,3 and we have also analyzed our own results4 in patients included in the Artemis system, between 1976–1980. Altogether, we selected 947 patients according to the following five criteria: 1) patients referred to the outpatient clinic between January 1, 1976 and December 31, 1980, and examined between 1 and 3 years after the initial visit; 2) a diastolic blood pressure greater than 95 mm Hg, at the first visit at the clinic; 3) no history of antihypertensive treatment; 4) a plasma creatinine level less than 200 μmol/liter; and 5) a fasting plasma glucose less than 10 mmol/liter. The blood pressure values on treatment were those obtained at the outpatient clinic during the visit closest to 2 years after registration in the Artemis System. Mean duration of follow up (±) for the 947 patients thus selected was 710 ± 150 days.
Population data from private practice were available from an internist affiliated with a university medical center in New York City.\(^7\) We also analyzed the data available from two community hypertension programs coordinated by the World Health Organization (WHO), one in Finland,\(^8\) and the other in France.\(^9\) Results obtained in the intervention group were analyzed.

**Results**

**Controlled Clinical Trials**

In the Australian trial, the object was to reduce DBP to 90 mm Hg or less, but, after 2 years, this goal was lowered to 80 mm Hg. The average DBP of the actively treated patients was indeed 90 mm Hg or more in 24.5% of the patients (n = 1549). In the HDFP trial, 42.2% of the patients in the stepped-care group had a DBP above 90 mm Hg after 1 year of treatment, and 29.9% after 5 years of treatment (n = 5485) (table 1).

In the Referred Care group of the HDFP, 47.5% of the treated patients was 90 mm Hg or more in 43.1% of our patients had a 174/111 mm Hg, and of 401 previously treated patients were not at goal (90 mm Hg) after 5 years.

**Hospital Hypertension Clinics**

At the WHO sponsored World Hypertension Conference in Paris, the goal was to reduce DBP to 95 mm Hg or less. In 1976, 206 charts of hypertensive patients were analyzed. Among 797 hypertensive patients was 177/108 (± 23/11) mm Hg. Two years later, the blood pressure was 142/87 (± 20/11) mm Hg; 43.1% of our patients had a DBP above 89 mm Hg, 21.1% above 95 mm Hg and 5.1% above 104 mm Hg.

**Private Practice**

From the office files of a New York city physician, in 1976, 206 charts of hypertensive patients were analyzed from among 375 initially selected. There were 101 patients who were present for follow-up at the first anniversary of their initial visit. Of the patients still attending the office, 59% had a SBP above 95 mm Hg. Among 797 hypertensive patients in the intervention group of the Finnish Community Control Program, 71% were not at goal (100 mm Hg). Among 629 hypertensive subjects in the intervention group of the French Community Control Program of Hypertension, 42.9% were not at goal (95 mm Hg).

**Discussion**

The question: "How much should blood pressure be lowered?" seems to have been solved, according to recommendations of several expert committees.\(^10\)-\(^13\) Indeed, if medical procedures are to be standardized throughout the world, the exact definition of a scientifically demonstrated goal for antihypertensive treatment cannot be provided. The examination of the natural history of blood pressure among various popu-

**Table 1. Blood Pressure Control in Different Health Care Environments**

<table>
<thead>
<tr>
<th>Study</th>
<th>No. of patients</th>
<th>BP criteria at entry</th>
<th>Follow-up DBP (mos)</th>
<th>Not at goal (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controlled trials</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANBPS(^1)</td>
<td>1549</td>
<td>95-109</td>
<td>48</td>
<td>&lt; 95</td>
</tr>
<tr>
<td>HDFP(^2)</td>
<td></td>
<td></td>
<td></td>
<td>&lt; 90</td>
</tr>
<tr>
<td>Stepped care</td>
<td>5485</td>
<td>&gt; = 90</td>
<td>60</td>
<td>&lt; 90</td>
</tr>
<tr>
<td>Referred care</td>
<td>5455</td>
<td>&gt; = 90</td>
<td>60</td>
<td>&lt; 90</td>
</tr>
<tr>
<td>Specialized clinics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>England(^3)</td>
<td>527</td>
<td>&gt; = 140/90</td>
<td>6-12</td>
<td>&lt; 90</td>
</tr>
<tr>
<td>France(^4)</td>
<td></td>
<td></td>
<td></td>
<td>&lt; 90</td>
</tr>
<tr>
<td>ARTEMIS, Paris</td>
<td>576</td>
<td>95-109</td>
<td>24</td>
<td>&lt; 95</td>
</tr>
<tr>
<td></td>
<td>371</td>
<td>&gt; = 110</td>
<td>24</td>
<td>&lt; 95</td>
</tr>
<tr>
<td>Population</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New York internist(^5)</td>
<td>101</td>
<td>&gt; = 160/95</td>
<td>12</td>
<td>&lt; 95</td>
</tr>
<tr>
<td>Finland community(^6)</td>
<td>797</td>
<td>&gt; = 160/95</td>
<td>60</td>
<td>&lt; 100</td>
</tr>
<tr>
<td>French community(^8)</td>
<td>629</td>
<td>&gt; = 160/95</td>
<td>60</td>
<td>&lt; 95</td>
</tr>
</tbody>
</table>

DBP = diastolic blood pressure; ANBPS = Australian Blood Pressure Study; HDFP = Hypertension Detection and Follow-Up Program.
vides different informations than blood pressure measurement at one visit, since important fluctuations in blood pressure can be observed in treated patients, as they are observed during screening. Moreover, the number of patients lost to follow-up even after 1 year of treatment may be responsible for an overestimation of the true percentages of controlled patients.

Large controlled therapeutic trials include patients in a special situation. They are volunteers participating in a study, have access to care in modern facilities, and are supervised by physicians deeply involved in hypertension research. Despite these ideal conditions, the goal of treatment is not attained in a relatively high percentage of patients. In these trials, lack of cooperation by the patients and lack of knowledge by the physicians do not account for these high rates of incomplete success. In hypertension specialty clinics, the knowledge of the physicians is theoretically unquestionable, and they have the flexibility to treat their patients with a wide range of drugs, which is not possible in the protocols of controlled trials. Nevertheless, the percentage of patients who do not achieve the blood pressure goals usually proposed remains important. Finally, in the general population, even if we only analyze health care systems where special effort for increasing quality of care has been made, such as a highly qualified internist in New York City or the intervention groups of the Community Control Programs, it is obvious that the results obtained do not coincide with recommendations provided by the experts.

These results emphasize the urgent need for a more generalized use of computerized systems to collect standardized data on hypertension treatment and its actual results in various health care systems. Physicians have been convinced of the necessity of measuring blood pressure and treating even mild asymptomatic hypertension, through the accelerated circulation of information to them from expert committees and university medical teachers and from the effort of pharmaceutical firms to inform them that control of high blood pressure is beneficial and feasible. In Great Britain as in the United States, most clinicians believe that they should treat mild hypertension, even at a blood pressure level for which the scientific evidence of the benefit of treatment is not available. The difference between the opinions of some British and American experts is reflected in the opinions of the practitioners in each of these two countries.

Unfortunately, even in the most experienced hands, presently available hypertension treatment is still a failure in an unacceptably high percentage of patients. The majority of reports emphasize the successes that agree with the theories, but neglect to analyze the failures and the underlying reasons. These reasons may include physicians' practices, patients' characteristics, particularities of the disease, drug side-effects, limited efficacy, and drug costs. The reality is that, whatever the system, in a proportion of hypertensive patients we cannot decrease blood pressure to goal level, whether it is 90, 95, or 100 mm Hg. We certainly need to know why, if we suspect that incomplete control of high blood pressure is accompanied by incomplete prevention of its complications.

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Discussion

DISCUSSANTS: A. ZANCHETTI  Hornberg
M. Moser  M. Mathieu
P. Sleight  J. Ledingham
J. Coope  J. Silverberg
R. Gifford  James
Angor  C. Rosendorf

ZANCHETTI: The important points here are when should the blood pressure be lowered and by how much.

Moser: The HDFP trial is still the largest clinical trial that has been one. Patients with mild hypertension were randomized for specific therapy. Many of them were in the group that some of our colleagues here said they would not treat, yet they benefited significantly from treatment. Reduction in death from coronary heart disease was noted as well as a significant reduction in deaths from strokes. The decrease in percentage may not be great but we must remember that a decrease of even 1% over 5 years means a reduction of deaths by 200,000 over 5 years. Second, it doesn’t surprise me that there are few patients in England with diastolic pressures reduced below 90 to 95 mm Hg because there is apparently little commitment to it. Eighty percent of our patients are reduced to these levels because we are committed to doing it.

Sleight: I said I was in no hurry to treat people who were initially at that level. If they continue with diastolic pressures of 90 to 95 mm Hg and, particularly, if they have other risk factors, I would treat them.

Moser: We would follow patients for 3 to 6 months to eliminate placebo effects and try nonpharmacologic methods, but then we would treat, whereas some of our European colleagues would not.

Coope: Dr. Gifford, what about the effect of strokes on hypertension? Immediately after a stroke, there is often a rise in blood pressure. At what point should we treat that?

Gifford: The effect is variable. The acute rise in blood pressure after a stroke usually subsides after a while. I am not anxious to reduce it acutely unless it is very high. After that, when the cerebral circulation stabilises, I look at it again. So, in general, I wait 3 weeks and then decide.

Angor (Copenhagen): The increase in cerebral blood flow during methyldopa treatment may have been due to the brain recovering from the stroke. The same would have been found in a normotensive stroke group. Second, the group of patients really at risk from ischemia due to overtreatment are those in the initial phase of malignant hypertension.

Gifford: Those who had malignant hypertension had the highest resistance. That did not prevent me from treating gradually over a few days, because the cerebral circulation will accommodate.

Hornberg (Uppsala): With regard to the choice of treatment in patients with hypertension and cerebrovascular disease, Dr. Gifford indicated that drugs causing orthostatic hypertension should be avoided. Is it wise to give drugs that affect the cardiac output, such as beta-blockers?

Gifford: I do use beta-blockers and have had no problem. I know of no studies affecting cerebral blood flow.

Unidentified Speaker: During deep sleep, there is a profound drop in blood pressure. Do you know if this affects cerebral blood flow and metabolism? When we try to control blood pressure in elderly patients, would it affect cerebral metabolism?

Gifford: It could, but we don’t have data to say that it does.

Mathieu: Have you any experience with angiotension-converting enzyme inhibitors on cerebral circulation in hypertension?

Ledingham: There is an anecdotal clinical suggestion that cerebral blood flow may be preserved at very low levels of systolic pressure in patients given captopril. But this is in cardiac failure rather than hypertension, because captopril does not often lower the pressure below regulatory levels in benign hypertension and is not much used in the acute malignant phase. All we can report after 1½ years of studying this problem is that at very low pressures on captopril we have had several patients with well-preserved cerebral circulations.

Zanchetti: There is experimental evidence in the rat that cerebral blood flow is well maintained when the blood pressure is lowered with captopril.
ROSENDORF: In a fairly large number of patients with malignant hypertension, we have determined that the lower limit of cerebrovascular autoregulation is about 115 mm Hg of arterial pressure. We don't know how fast we can safely bring the blood pressure down nor which drug we should be using.

GIFFORD: We do not see much malignant hypertension any more, but we used to treat it aggressively and get it down within 3 to 6 days. I do not recall it precipitating any clinical cerebrovascular event.

SLEIGHT: Ledingham's group treated patients more aggressively with intravenous therapy, particularly diazoxide, and did have a number of disasters when it was done too quickly. Personally, for nonpregnant malignant hypertension I put the patient into bed and give a beta-blocker and a diuretic. This is very satisfactory.

SILVERBERG: Throughout the world, general practitioners succeed in about 40% of their patients in bringing the diastolic pressures down to less than 95 mm Hg. You can double the quality of care by more intensive supervision by introducing the nurse into follow-up programs. This approach is rarely used except for occasional clinical trials.

JAMES (London): We have looked at a large series of patients treated with beta-blockers and found no change in cerebral blood flow at all, despite the animal work that suggests that a decrease occurs.
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