Why is blood pressure control unsatisfactory—or is it?

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Introduction

Arterial hypertension is a strong risk factor for cardiovascular and renal disease. There are several aspects that make the management of hypertension almost unique. Hypertension is common, i.e. there is a high prevalence of the condition in most industrialized countries; it is simple to detect, i.e. ubiquitously available office brachial manometry and/or ambulatory blood-pressure measurement ensure a rapid and valid diagnosis; it is treatable, i.e. there is a great choice and diversity of highly tolerable medications with proven blood pressure (BP)-lowering effects; and antihypertensive therapy is efficacious, i.e. there is a wealth of

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clinical trial data proving beyond doubt that treatment effectively reduces the risk of subsequent disease of heart, brain, and kidneys. In hardly any other field of internal medicine is the evidence base as sound as it is for the management of hypertension.

Nevertheless, recent population surveys from various countries paint a very sobering picture. The proportion of hypertensives who are treated and controlled below the target BP levels of 140 mmHg systolic and 90 mmHg diastolic is low: it is globally less than 30% of all hypertensives [1–4]. For example, in the late 1970s, control rates in the US were about 10% and they have risen to about 25% at present [1]. Temporal changes in BP control in Europe have been even more modest [3,4].

So what are the reasons why control of hypertension is so persistently unsatisfactory? In the following, we aim to outline some epidemiological perspectives relevant to the problem as to help refocus some crucial issues regarding the management of hypertension.

Population surveys exaggerate poor hypertension control

It should be noted that population surveys assess the presence of hypertension by measuring BP on one occasion only. This differs from clinical recommendations for the diagnosis of hypertension and is due to mainly practical considerations (cost and logistics of re-invitation, response rates, etc.). Despite the fact that two or three BP recordings are commonly taken on this one occasion, the pronounced biological within-person fluctuations make one-occasion measurements a highly unreliable procedure. In such a situation, a statistical phenomenon, known as regression-to-the-mean, tends to affect survey results in such a way that prevalence of hypertension is generally overestimated and treatment and control rates are underestimated [5]. Hence, survey results make the situation appear worse than it actually is. Attempts to correct for within-person variability have been presented [5]. However, the attenuation observed after applying such corrections were moderate and did not markedly change the situation with regard to control rates [6]. In the database of the MONICA Augsburg study [4] we found that correction resulted in an increase of control rates by about 2–8 percentage points, depending on age and gender (unpublished).

Control of systolic BP is worse than control of diastolic BP

The differential effectiveness of control of systolic and diastolic BP elevations has come into focus recently. Lloyd-Jones et al. [7] used data from the Framingham Heart Study to dissect patterns of hypertension control and found that systolic BP values below 140 mmHg were present in only 49.0% whereas a diastolic BP <90 mmHg was achieved by 89.7% of all treated hypertensives. They further evaluated the determinants of these patterns: greater age, overweight, and left ventricular hypertrophy (presumably reflecting duration and/or severity of hypertension) were significantly and strongly predictive of inadequate systolic control. The preponderance of a worse control of systolic BP elevations was subsequently confirmed by other studies. These included population surveys [1], practice settings [8], and studies in which hypertension control was assessed by home and ambulatory measurements [9]. In fact, most cases of uncontrolled hypertension consist of persistent systolic elevations, clustering particularly in older age groups [1]. This may be partly explained by physicians’ thresholds for drug intervention, which continue to be more sensitive to elevations of diastolic than systolic BP. Thus, 57% of physicians opted to start treatment in a middle-aged patient with uncomplicated diastolic BP levels of 90–94 mmHg whereas only 17% were ready to initiate therapy for a systolic BP between 140 and 149 mmHg [10]. Likewise, another office survey study revealed that physicians accept systolic BP values above 140 mmHg much more readily than a diastolic above 90 mmHg [8]. Thus, is it all the doctor’s fault?

The age dynamics of systolic and diastolic BP

There is another recent ‘discovery’ that needs to be mentioned here—as a matter of fact it is a re-discovery of old epidemiological knowledge: systolic BP increases up to old age in westernized societies whereas diastolic BP starts to decline after the age of 60 [11]. This is the reason why isolated systolic hypertension is more common in old age and why pulse pressure—the difference between systolic and diastolic BP—is also higher in the elderly. It further explains why the relationship of BP to coronary heart disease risk changes with age, with systolic BP becoming the dominant component in the elderly [12], and why pulse pressure determines risk in older hypertensives [13]. In summary, the older the patient the more important is systolic BP [14]. This age-dependent process has implications for BP levels in untreated and uncontrolled hypertensives. Table 1 illustrates that among untreated hypertensives there is a ‘natural trend’ for mean diastolic BP to fall below or close to control level with age while the opposite is seen for systolic BP. Apparently, this pattern is independent of physicians’ practices and the health care system. In addition, Table 1 confirms on the population level what others have found in clinical practice settings [15]: in many hypertensives, drug therapy does not prevent the increase of pulse pressure with age, mostly at the cost of systolic BP remaining above the threshold of 140 mmHg despite treatment.

Control of systolic vs diastolic BP: the trial evidence

Given this global age trend which implicitly counteracts the control of systolic and promotes that of
diastolic BP, what can we learn from clinical trial data? The Hypertension Optimal Treatment trial involving 18,790 patients aged 50–80 years, demonstrates the dilemma quite clearly: due to the titration with multiple antihypertensive agents, diastolic control was reached on average in all three treatment groups (mean achieved BP was 85.2, 83.2, and 81.1 mmHg), whereas the systolic target was mostly missed (achieved mean systolic BP of 143.7, 141.4, and 139.7 mmHg) [16]. This demonstrates that even in the intensified care setting of a clinical trial, which permitted multiple drug use, the control of systolic BP was much more difficult to achieve (notwithstanding considerations that impute underestimation of systolic measurements in this trial [17]). Furthermore, meta-analyses of outcome trials in the elderly show that trial interventions were barely effective in lowering average systolic BP below the control threshold of 140 mmHg [18,19]. Likewise, the Syst-Eur Follow-Up Study investigated the question of how well BP can be controlled. With a target of 150 mmHg [sic] and after up-titration of medications, the average BP achieved was 151/80 mmHg [20].

Control of systolic BP—wishful thinking?

There is hardly any doubt that lowering of BP confers a reduction of risk, and probably the lower we get the better. From this perspective, achievement of systolic BP below 140 mmHg and diastolic below 90 mmHg is a reasonable and defensible target. On the other hand, we have to account for the epidemiological and biological reality that the forces of ageing favour diastolic and impede systolic control. Trial evidence clearly demonstrates the difficulties physicians and patients encounter in achieving systolic targets in the majority of those treated. Then why not differentiate here? We suggest that a medically meaningful target for systolic BP of <140 mmHg (indicating the ultimate direction) may not equate with a benchmark of hypertension control. In particular, it may not be used to assess ‘adequate hypertension management’. It appears evident that individual systolic BP levels above 140 mmHg may have to be accepted in many patients despite adequate intensive therapy. If the restrictive threshold of 140 mmHg is maintained, however, ‘poor’ control is going to stay with us—unless drugs are introduced that more effectively lower systolic BP.

### Table 1. Mean systolic and diastolic blood pressure (mmHg) in different groups of subjects with hypertension (defined as systolic BP greater or equal to 140 mmHg or diastolic BP greater or equal to 90 mmHg or use of antihypertensive medication). MONICA Augsburg study, pooled surveys

<table>
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<tr>
<th>Age (years)</th>
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### References