HYPERTENSION

A Practical Approach

EPSTEIN and OSTER

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To our wives
Nina Epstein and Sharon Oster
and
To our children
David and Susanna Epstein and Marc, Harold and Jacqueline Oster

Preface

The historic report of Freis and associates in 1967 demonstrated in compelling fashion that therapeutic intervention in patients with severe hypertension decreased morbidity and mortality. Their findings represented a watershed in the management of this disease. Subsequently, the medical profession throughout the world invested enormous amounts of time, energy, and intellectual endeavor in further defining the vagaries of hypertension, extending our understanding of its pathophysiology, and establishing new and more appropriate therapeutic regimens.

Many books deal with all aspects of hypertension, but several tend to overwhelm or discourage the clinician who does not specialize in nephrology, cardiology, or hypertension—either by their encyclopedic format or their esoteric orientation.

This book has been developed to assist the primary care physician or internist who wishes to deepen his understanding of hypertension and to broaden his skills in managing patients with this disease. In a real sense, this is intended to be a "how-to" book in regard to both the diagnosis and the treatment of hypertension. We have attempted to present a middle course between the encyclopedic monographs on hypertension and the necessarily brief and more general coverage offered by standard textbooks of internal medicine. Sources and material not readily available to the practicing physician have been culled and collated for ready access.

Although this book is intended primarily for physicians, we believe that it will also prove to be useful to medical students and to the paramedical professional engaged either directly or peripherally in the care of the hypertensive patient.

In preparing this text, we imposed on the friendship of expert colleagues, who reviewed and criticized each chapter. Their skill, interest, and willingness to help are greatly appreciated: Drs. Marshall D. Lindheimer, Meyer D. Lifschitz, Solomon Papper, Lawrence M. Fishman, Andrew Taylor, and Ralph H. Aden, and Ellen Green, M.S., R.D.

Our deep gratitude goes to two fine ladies—Mses. Tam M. Eggers and Jacqueline Sheets—who provided excellent secretarial support, and to Lorraine Kilmer and her associates at Saunders, whose skills are beyond praise.

Finally, we would like to express our deep gratitude to our wives for their continued support and encouragement in helping us see this undertaking through from concept to publication.

MURRAY EPSTEIN

JAMES R. OSTER

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NOTE ON DOSAGE OF MEDICATIONS

Although every attempt has been made to provide accurate and current dosage schedules and listings of adverse reactions in this book, it is possible that they may change. Therefore, the reader is urged to review the package informational data of the manufacturers of the medications mentioned in this book.

THE AUTHORS

Contents

I

Natural History and Evaluation of Hypertension

1

WHAT IS HYPERTENSION?

Hypertension is one of mankind's most common diseases, affecting 15 to 20 per cent of all adult Americans. Furthermore, cardiovascular disease associated with hypertension constitutes a leading cause of both mortality and morbidity in the United States. In recent years, physicians and scientists have mounted a concerted effort to define the mechanisms responsible for high blood pressure and to design increasingly more effective approaches to therapy. Such efforts have been encouraged by abundant evidence that successful control of hypertension leads to diminished morbidity and mortality from stroke, heart disease, and, perhaps, renal failure. Perhaps the hallmark studies in this context were the early Veterans Administration Cooperative Studies on Antihypertensive Agents, which provided the first well-documented evidence that lowering blood pressure is of significant value in reducing the cardiovascular hazards of untreated hypertension. Clearly, it is imperative for the physician to attempt to identify and treat patients with hypertension in the general population.

Hypertension is accepted as one of the major disease states afflicting the population, but there is still debate regarding the level of blood pressure that is abnormally high. One renowned authority, Sir George Pickering, emphasized that there is no arbitrary dividing line between "normal" and "high" blood pressure. Rather, he argued that the relationship between arterial pressure and morbidity is quantitative: the higher the pressure, the worse the prognosis. In spite of the arbitrariness of dealing with exact figures, the setting of standards is necessary, since decisions regarding diagnostic evaluation and initiation of therapy must be predicated on some rational basis. Realizing that many "official" criteria are set without provision for such variables as the age and the sex of the patients, we would like to propose the following definition for definite hypertension, which is adapted from Kaplan:

Men under 45	130/90 mm Hg
Men over 45	140/95 mm Hg
Women	160/95 mm Hg

Aside from defining hypertension, it is often useful from an operational standpoint to categorize hypertensive patients according to the severity of their elevated blood pressure. We recommend the arbitrary guidelines shown in

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TABLE 1–1. SEVERITY OF HYPERTENSION

Severity	Diastolic BP	Systolic BP
Borderline	84–89 mm Hg	128–146 mm Hg
Mild	90–104 mm Hg	147–159 mm Hg
Moderate	105–114 mm Hg	160–180 mm Hg
Severe	Greater than 114 mm Hg	Greater than 180 mm Hg

Table 1–1 for classifying patients as having borderline, mild, moderate, or severe hypertension. Even though the risk to an individual patient does not necessarily correlate with the severity of his blood pressure elevation, such a schema is helpful in deciding whom to treat and how vigorously.

In considering the evaluation of a patient with hypertension, one should remember that the two principal forms differ greatly in prevalence. Hypertension is arbitrarily classified as being either *essential* or *secondary*. The former diagnosis is established by exclusion of identifiable secondary causes. *Essential hypertension*, the pathogenesis of which is still uncertain, accounts for approximately 95 per cent of cases in adult Americans and will be dealt with in Chapter 2. *Secondary hypertension*, implying a discernible and sometimes reversible *cause* for the elevated blood pressure, probably accounts for less than 5 per cent of cases and will be discussed in Chapter 3.

DETERMINING THE BLOOD PRESSURE

The initial step in management of the patient with suspected hypertension is documenting the presence of hypertension. Yet this seemingly simple maneuver is fraught with potential difficulties. Many blood pressure readings are incorrect, primarily because of two major problems: (a) controversy as to what constitutes a proper setting in which to obtain a "true" reading and (b) errors in measurement.

Proper Setting

Even though there is disagreement over whether a casual or an early morning basal pressure should be used, most clinicians agree that a casual blood pressure taken in the office is quite adequate, providing that a few simple precautions are adhered to (Table 1–2).

First, since blood pressure varies throughout the day (and indeed may vary seasonally), no patient should be labeled as hypertensive on the basis of one blood pressure reading. Rather, several determinations should be made over the period of a few days to several weeks, depending on the level of the pressure.

The clinician should be aware of a phenomenon termed "regression to the mean." This is a statistical term referring to the observation that the more often the blood pressure is taken, the more the pressure approaches that person's average reading. To look at it another way, with repetition, one is less likely to obtain the outlying higher or lower blood pressure values.

At any given visit an average of three blood pressure readings taken at least two minutes apart is preferable to the use of only one reading. Not infrequently, the first reading is unduly high, perhaps related to patient anxiety. Initially, it is worthwhile to determine the blood pressure in both the lying and sitting position, since certain conditions such as pheochromocytoma may be

TABLE 1–2. CONSIDERATIONS IN IMPROVING THE VALUE OF CASUAL BLOOD PRESSURE READINGS

1. Several determinations should be made over a period of a few to several weeks depending on the level of hypertension.
2. The patient should rest quietly for at least five minutes before measurement.
3. Factors that perturb the blood pressure should be avoided, including the following:
   a. Anxiety or pain
   b. Recent eating or smoking
   c. Recent exercise
   d. Cold
   e. Talking or performing mental calculations
   f. Bladder distention
   g. Medications
      (1) Sympathomimetic agents such as nasal drops or sprays, mydriatrics, cold remedies, appetite depressants, or methylphenidate
      (2) Adrenal corticosteroids
      (3) Estrogens

associated with marked posture-related differences. Once pharmacologic therapy has been initiated, this procedure is again indicated, especially if the antihypertensive agent has a tendency to produce postural hypotension. On the first visit only, the patient's pressure should be checked in both arms and in one leg to avoid missing the diagnosis of coarctation of the aorta or subclavian artery stenosis.

The patient should rest quietly in a pleasant setting for at least five minutes before the initial blood pressure determination. Several factors that may elevate the blood pressure and confound interpretation of the readings should be avoided. They include anxiety, eating, smoking, pain, talking or calculating during the actual measurement and the recent use of sympathomimetic agents (Table 1–2). The arm muscles should be relaxed and the forearm supported. A suitable cuff is applied firmly and evenly to the exposed upper arm, with care taken to avoid tight sleeves.

Causes of Error

There are several potential procedural and technical mistakes that can result in erroneous blood pressure readings (Table 1–3).

The mercury sphygmomanometer is the standard simple instrument for measuring blood pressure against which all other methods are compared (the very units of blood pressure, of course, are given in mm Hg). It is very uncommon for anything to be amiss with the mercury manometer per se, yet the instrument should be checked periodically to ensure that the mercury reservoir is full, that the glass column is clean, and that the air hole at the top is patent so that the mercury may fall freely. Aneroid devices, of course, must be properly calibrated by the manufacturer before use and should be periodically recalibrated against a mercury manometer, depending on the frequency of use and the care given to the instrument. If the needle does not register 0 mm Hg with the cuff uninflated, considerable error may result.

Improperly sized arm cuffs may present a problem. Although some controversy surrounds this issue, the most important potential source of inaccuracy is the use of a cuff with too short a balloon, resulting unpredictably

TABLE 1–3. CAUSES OF OBSERVER OR MECHANICAL ERROR IN BLOOD PRESSURE DETERMINATION

1. Inappropriate equipment
   a. Improper arm cuff (too short and/or too narrow)
   b. Faulty measuring device
      (a) Aneroid needle not registering 0 mm Hg with the cuff uninflated
      (b) Failure to calibrate aneroid periodically against mercury manometer
      (c) Too little mercury in sphygmomanometer
      (d) Dirt on glass column
      (e) Blockage of air hole
2. Erroneous determinations
   a. Improper placement of cuff on arm
   b. Failure to appreciate auscultatory gap
   c. Failure to appreciate or specify the difference between phase IV versus V of the diastolic blood pressure
   d. Improper inflation or deflation of cuff, i.e. either overly rapid or excessive inflation or excessively slow deflation
   e. Arrhythmias with marked pulse irregularities
   f. Observer bias

in artifactually high readings. Figure 1–1 depicts the influence of arm circumference on blood pressure measurements in normal subjects using different size cuffs. As is evident, use of the two cuffs whose length was only 26 cm was associated with falsely elevated readings when the arm circumference was greater than 28 to 31 cm.

We agree with The World Health Organization recommendation that a cuff with a longer balloon be used if the circumference of a patient's arm exceeds 30 cm. It has been suggested that the width of the balloon assumes importance only if the balloon is also too short, in which case a narrow cuff will also tend to produce erroneously high pressures. In *general*, no harm can arise from the use of the longer, wider cuff in virtually every *adult* patient regardless of arm dimension. When a larger cuff is not available, sometimes a regular-sized cuff can be applied to the forearm and the stethoscope placed over the radial artery.

Errors may arise from faulty techniques as well as from faulty equipment. For example, the cuff might not be placed at heart level, or one might fail to appreciate either the auscultatory gap or a large difference between phases four and five of the diastolic blood pressure.

In 1905, Korotkoff reported the auscultatory phenomena below the cuff that Riva-Rocci had described nine years previously. These Korotkoff sounds cover an average range of 45 mm Hg, which is subdivided into five phases of variable duration:

I. A loud, clear-cut snapping tone (14 mm Hg)
II. A succession of murmurs (20 mm Hg)
III. A duller snapping tone (5 mm Hg)
IV. A muffled tone (6 mm Hg)
V. A disappearance of all sounds

Despite much investigation, there is still disagreement over whether phase IV or phase V correlates best with the *true* diastolic blood pressure as measured by direct intra-arterial recording. This may mean that with the current state of knowledge neither criterion is more accurate or yields a smaller systematic

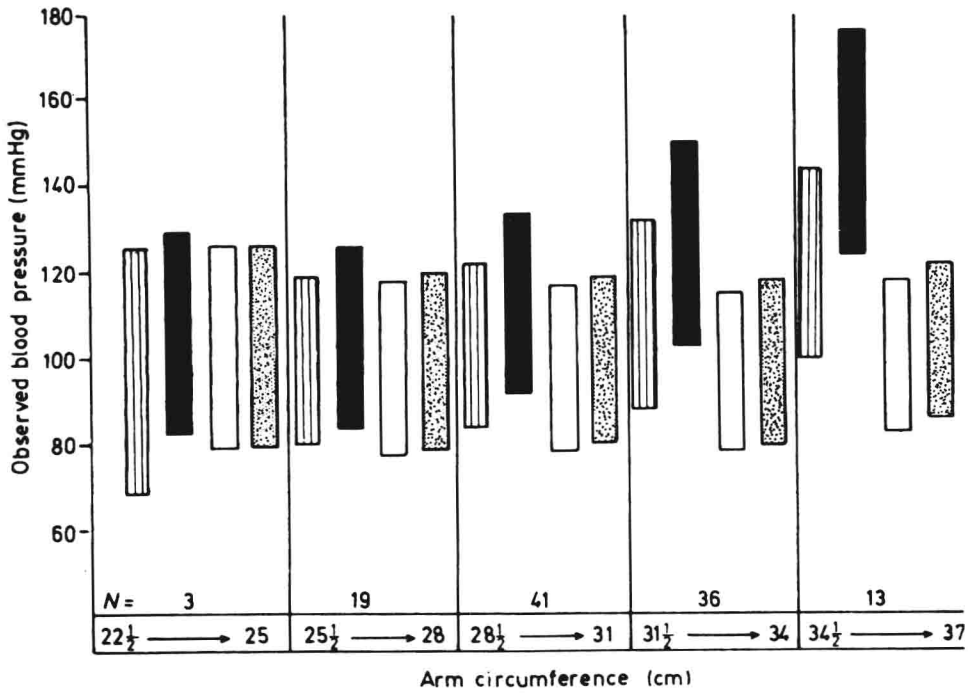

FIGURE 1–1. The influence of arm circumference on blood pressure measurements in normal subjects using different-sized cuffs. As can be seen, when the arm circumference exceeded 28 to 31 cm, the use of the two cuffs whose length was only 26 cm was associated with falsely elevated readings. (Reproduced with permission from King, GE: Clin Sci *32*:229, 1967.)

error. An important point, however, is the recent documentation that phase V readings have a smaller random variance and result in the best interobserver agreement. Although these observations certainly commend the use of phase V, the recommendation of the World Health Organization to record the levels of both phases, for example, 140/80–70 mm Hg, especially when the difference between them is greater than 5 mm Hg, makes good sense.

As noted in a study of 275 subjects, there is a difference in the ease of determining phase IV versus phase V in children and adults. In adults, unless a high output state such as aortic insufficiency or severe anemia is present, phase V may be appreciated in virtually every patient, whereas phase IV may be ascertained in only about 55 per cent of patients. In contrast, muffling is more frequent in children (84 per cent), and disappearance is heard in only 73 per cent.

If the blood pressure cuff is inflated excessively, the discomfort produced might elevate the pressure. Rarely, excessively slow deflation might lead to arterial spasm and inaccurately high pressures. If the cuff is deflated too rapidly, the observer tends to underestimate the readings. Arrhythmias with marked pulse irregularities make blood pressure recording difficult. Finally, observer bias can lead to error. Substantial (5 to 10 mm Hg) and consistent variations of blood pressure readings may occur between different observers. These may be related to faulty technique, hearing loss, inaccurate interpretation of Korotkoff sounds, preconceived ideas of important levels, bias from past readings, or concern for other considerations such as the patient's eligibility for life insurance. Obviously, observer preference for certain terminal digits, such as 5 or 0, may also produce inaccuracies.

TABLE 1–4. INDICATIONS FOR DETERMINATION OF BLOOD PRESSURE AT HOME

1. Marked lability of blood pressure
2. Sizable discrepancy between blood pressure readings inside and outside the physician's office
3. Poor control of blood pressure, particularly in association with hypotensive symptoms
4. As an aid for self-medication or dosage adjustment
5. As an aid to compliance in certain patients

A rare cause of potentially serious inaccuracy is based on the fact that blood pressure measurement by the indirect method used clinically (as opposed to direct measurement requiring arterial puncture) requires complete occlusion of the artery by the cuff. Patients with markedly thickened and sometimes calcified arteries (Monckeberg's sclerosis), whose brachial arteries cannot be compressed, may appear to have blood pressures as high as 300/200 mm Hg despite the administration of nitroprusside. This phenomenon has been termed pseudohypertension. We have seen one such patient whose intra-arterial pressure was measured and found to be 60/10 mm Hg. (Also see case study 1.)

HOME BLOOD PRESSURES

The values of and indications for home blood pressure recordings are still somewhat controversial (Table 1–4). Obviously, home blood pressures are not necessary in the vast majority of hypertensive subjects. In fact, when blood pressure control is excellent, there is little reason to get additional readings, and some anxious patients do better when not continuously reminded about their hypertension. On the other hand, home blood pressure recording can prove helpful in patients with marked lability of blood pressure, particularly if it turns out that the pressures are elevated only in the doctor's office (so-called office hypertension). Additional advantages may obtain in patients with very poor blood pressure control as an aid to readjustment of dosing or timing of drug administration. Finally, certain patients become more compliant when asked to take part in their own care by recording their blood pressures in a systematic fashion.

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*For simplicity and easy reading, we have made no attempt to be all-inclusive with regard to references and have not cited them directly in the text. Rather a limited number of important and current references are cited at the end of each chapter. These follow the sequence of subject matter within the chapters and in many instances are subdivided by headings.

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