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AHA Scientific Statement From the Council on High Blood Pressure Research,
Professional and Public Education Subcommittee**

Theodore W. Kurtz, Karen A. Griffin, Anil K. Bidani, Robin L. Davisson and John E.
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Recommendations for Blood Pressure Measurement in Animals

Summary of an AHA Scientific Statement From the Council on High Blood Pressure Research, Professional and Public Education Subcommittee

Theodore W. Kurtz, Karen A. Griffin, Anil K. Bidani, Robin L. Davisson, John E. Hall

Accurate and meaningful measurements of blood pressure (BP) are often critical to the interpretation of studies of vascular biology, atherosclerosis, and other forms of cardiovascular disease. Although many research scientists have embraced advanced molecular technologies for studying cardiovascular function and disease pathogenesis, a surprising number of the same investigators continue to use suboptimal techniques for measuring BP in experimental animals. To address this problem and assist investigators in selecting optimal methods for BP monitoring, the American Heart Association (AHA) has developed a scientific statement on recommendations for BP measurement in experimental animals. These recommendations for BP measurement are briefly summarized in this article. The complete text and discussion of the recommendations are published online in *Arteriosclerosis, Thrombosis, and Vascular Biology* as well as in print in other AHA journals.¹ Comprehensive recommendations for BP measurement in humans have also been developed and are published in the AHA journal *Hypertension*.²

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BP Measurement Methods

The techniques for measuring BP in experimental animals have improved considerably over the past decade, and several methods are available that allow routine monitoring of BP profiles throughout the day and night over prolonged periods of time in conscious, unrestrained, unstressed animals. Techniques for measuring BP in experimental animals can be divided into indirect methods and direct methods, and the technical details of these methods along with their advantages and disadvantages are discussed in the full report.¹ The most commonly used indirect method for monitoring BP is the cuff technique, in which BP is measured in a tail or limb by determining the cuff pressure at which changes in blood flow occur during occlusion or release of the cuff. Radiotelemetry techniques or indwelling catheters connected to externally mounted transducers are widely used to make direct measure-

ments of BP. In many situations, methods for measuring blood pressure through externally connected, fluid-filled catheters can provide nearly all of the same advantages as the more recently developed radiotelemetry techniques. Most methods for measuring BP can be applied in a range of animals, although certain technical modifications may be required depending on the species under study. In most cases, the choice of method should be driven by the investigative objective rather than the species of animal being studied.

Selecting a BP Measurement Method

Although indirect techniques that permit only intermittent measurements of BP may be suitable for some purposes, methods for directly measuring BP are generally preferred because of their ability to monitor the highly dynamic nature of BP in a comprehensive fashion. Selection of the methods to be used should ultimately be guided by the study objectives to insure that the techniques chosen are appropriate for the experimental questions being explored. Therefore, recommendations have been developed for selecting the optimal technique for measuring BP based on the study objective and on the advantages and disadvantages of the various BP measurement methods (Tables 1 and 2). For example, if the primary objective is to determine whether a new drug protects against atherosclerosis or cardiovascular damage independent of any effects on BP, then the investigator should use a monitoring technique that provides a comprehensive measure of the total BP load on the vasculature. For this kind of study objective, techniques that provide only sporadic measurements of BP would be less useful or even potentially misleading no matter how accurate those measurements might be. Specific recommendations for selecting BP measurement methods are summarized in Tables 1 and 2 and are discussed in detail in the full report.¹

Effects of Environmental Factors Including Anesthesia

It should be emphasized that regardless of the method used for measuring BP, systemic anesthesia should be avoided

From the Department of Laboratory Medicine (T.W.K.), University of California, San Francisco; the Department of Internal Medicine (K.A.G., A.K.B.), Loyola University & Hines VA Hospital, Maywood, Ill; the Department of Anatomy and Cell Biology (R.L.D.), University of Iowa, Iowa City; and the Department of Physiology and Biophysics (J.E.H.), University of Mississippi, Jackson.

Correspondence to Theodore W. Kurtz, MD, Professor of Laboratory Medicine, University of California, San Francisco, Box 0134, 185 Berry Street, Suite 290, San Francisco, CA 94107. E-mail KurtzT@Labmed2.ucsf.edu

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TABLE 1. Recommendations for the Use of Indirect Methods for Measuring BP in Animals

Recommended for noninvasive detection or screening for:
Frank systolic hypertension
Substantial group differences in systolic BP
Substantial changes in systolic BP over time
Systolic BP changes in large numbers of animals (eg, high throughput genetic screens)
NOT recommended for:
Quantifying relationships between BP and other variables (eg, target organ damage)
Studying “BP-independent” effects of any intervention or variable (eg, drugs, diet, genotype, etc)
Ruling out intermittent or subtle forms of hypertension or changes in BP
Measuring BP variability
Measuring diastolic BP or pulse pressure in conscious rodents
Making inferences about BP in nonstressed, unrestrained animals

whenever feasible because of the well documented effects of anesthetics on cardiovascular function.³ It has long been recognized that commonly used anesthetics can affect multiple aspects of the circulatory system and that integrative cardiovascular responses often differ greatly in anesthetized versus conscious animals.³ A host of other external factors can also affect BP including, but not limited to, ambient room temperature, light cycle, noise levels, duration of human contact, number of animals per caging unit, proximity to other animals undergoing experimental procedures, cage unit size and design, and access to supplemental items such as toys, treadmills, and hiding spaces within the cage unit. Thus,

TABLE 2. Recommendations for the Use of Direct Methods for Measuring BP in Animals

Recommended for:
Quantifying the magnitude of hypertension or of changes in BP
Quantifying relationships between BP and other variables (eg, target organ damage)
Studying “BP-independent” and “BP-dependent” effects of different interventions or variables (eg, drugs, diet, genotype, etc)
Identifying intermittent or subtle forms of hypertension or changes in BP
Measuring BP continuously over time
Measuring BP variability
Determining BP in unrestrained animals (telemetry)
NOT recommended for:
Screening large numbers of animals for frank hypertension or big effects on BP

it is important to keep in mind that many environmental factors can have substantial effects on cardiovascular function, and these factors should also be considered when using either indirect or direct methods for measuring blood pressure.

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