Demise of the mercury sphygmomanometer and the dawning of a new era in blood pressure measurement

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After a little more than a century of use, the conventional Riva-Rocci/Korotkoff technique of measuring blood pressure with a mercury sphygmomanometer and stethoscope, is now being relegated to the museum shelves. Affectionately attached though we may be to this clinical measurement, we must acknowledge that the technique is fraught with inaccuracy and that the age of technology has brought more accurate alternative methodologies. However, we must ensure that the automated devices that are replacing the conventional technique are validated independently for accuracy. The Working Group on Blood Pressure Monitoring of the European Society of Hypertension has recently published an International Protocol to facilitate the validation of more automated devices than was possible with the earlier more complicated protocols. *Blood Press Monit* **8:19–21 © 2003 Lippincott Williams & Wilkins.**

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Introduction

The technique for measuring blood pressure was introduced into clinical medicine in 1896 and it has survived largely unchanged for over a century, despite being an inherently inaccurate technique [1]. However, the future of conventional sphygmomanometry is now under serious threat, not because of its many shortcomings, but rather because of a growing environmental move to ban mercury from clinical use [2].

The traditional technique is dependent on the operator possessing the clinical skill necessary to palpate the systolic pressure as originally described by Riva-Rocci and to auscultate and interpret the Korotkoff sounds. But if automated devices can provide neat printed summaries of measurement complete with date, time, and even graphic presentation together with the facility to download to computers, is there a need for the clinical skill to survive, or put another way, can a clinical skill endure if it is not practiced?

Inaccurate measurement in practice

Why, we might ask, have we connived for so long in perpetuating inaccurate measurement in both clinical practice and hypertension research? The technique has had problems from the outset. Within a year of its introduction Heinrich von Recklinghausen showed that the cuff used by Riva-Rocci, being only 5 cm in diameter, was causing serious errors and the cuff controversy has raged ever since [3]. In 1904, Theodore Janeway in an authoritative monograph warned against relying on casual blood pressure readings. His message went largely unheeded until it was taken up again by Sir George Pickering in the sixties, who using automated technology beyond the dreams of Janeway, showed the remarkable variability of blood pressure and cautioned against making our patients miserable by prescribing unneeded drugs [4]. The identification of white-coat hypertension and the realization that many patients are being treated needlessly with blood pressure lowering drugs is the latest factor in the growing case against the traditional technique of blood pressure measurement [5].

Inaccurate measurement in research

Whatever mitigating circumstances may be invoked to excuse the many doctors and nurses measuring blood pressure in busy clinical practice accepting inaccurate blood pressure readings, the failure of research scientists to address this issue is debasing to the ethic of scientific enquiry. Not alone have specialists in hypertension accepted the inaccuracy of the technique—systematic error, terminal digit preference, and observer prejudice—as clearly enunciated by Geoffrey Rose in 1964 [6], they have, in addition, been prepared to use instruments, which have been damned for their inaccuracy [7]. As if this were not enough, editors of prestigious journals by ignoring their own standards, have perpetuated what can best be called a scientific lottery, but alas, one on which decisions of considerable global social and economic importance are based. In 1980 after reviewing this issue, we wrote: "…in the interests of scientific accuracy and comparability editors and referees must apply to blood

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pressure measurement reporting the same critical standards given to other measurement methods" [8]. A decade later a survey of papers on hypertension in leading medical journals showed that one-third of the papers surveyed failed to provide necessary detail on the technique of measurement and less than five percent of the papers made reference to the accuracy of the device used to measure blood pressure. "Why", we asked, "do editors of prestigious scientific medical journals demand (quite correctly) the exact methodology of a hormonal assay technique but disregard the detail of methodology of blood pressure measurement on which may depend, for example, the acceptance (or rejection) of an antihypertensive drug in clinical practice?" [9].

Validation of devices

Against this litany of collective irresponsibility some progress can be claimed in one area at least, namely, reducing the error introduced to blood pressure measurement by inaccurate devices. In 1987, the Association for the Advancement of Medical Instrumentation published a standard for Electronic or Aneroid Sphygmomanometers, which included a protocol for the evaluation of the accuracy of devices, and this was followed in 1990 by the protocol of the British Hypertension Society. Both protocols were revised in 1993 [10]. These protocols, which differed in detail, had a common objective, namely the standardization of validation procedures to establish minimum standards of accuracy and performance, and to facilitate comparison of one device with another.

A large number of blood pressure measuring devices have now been evaluated according to one or both protocols [11]. However, experience has demonstrated that the conditions demanded by the protocols are extremely difficult to fulfil because of the large number of subjects with extreme levels of blood pressure that have to be recruited. These factors have made validation studies difficult to perform and very costly, with the result that fewer centres are prepared to undertake them. This is particularly unfortunate as more devices are in need of independent validation than ever before.

Aware of this problem the Working Group on Blood Pressure Monitoring of the European Society of Hypertension set itself the task of drafting a much-simplified protocol that would not sacrifice the integrity of the earlier, protocols and this International Protocol has been published recently [12]. In setting about its task the Working Party examined and re-analyzed the data from 19 validation studies performed according to the earlier, more protracted protocols to determine the effect any rationalization and simplification of validation procedures might have on the accuracy assessment. The result is a much simplified workable protocol, which, it is hoped, will facilitate manufacturers to submit their products for validation so as to obtain the minimum approval necessary for a device to be used in clinical medicine. Moreover, it is anticipated that in time, most devices on the market will be assessed according to the protocol for basic accuracy.

Measurement in the future

So what does the future hold for blood pressure measurement? A number of predictions can be made. First, in clinical practice, the mercury sphygmomanometer is destined for the museum shelves. With its passing, the mainstay of the medical argument for retaining the millimetre of mercury as a unit of measurement, namely that we measure what we see, will also disappear and there will then be no scientific (as distinct from a clinical) argument against its replacement with the kilopascal [13]. The advent of accurate automated devices will render the auscultatory technique obsolete and it will disappear from clinical practice in time. The increasing use of ambulatory and self blood pressure measurement to provide profiles of blood pressure will limit further the role of traditional blood pressure measurement in clinical practice. Second, those involved in hypertension research (and this includes editors and referees of specialist and general journals) must recognize at last the empirical importance of accurate blood pressure measurement. Indeed, at least in genetic medicine the importance of the accurate phenotyping of blood pressures is being sought. The lamentable disregard for accuracy in clinical research must not be repeated in genetic research and a well-standardized blood pressure phenotype in relation to genetic polymorphism has not only been proposed, but has been shown to be applicable [14]. Given that blood pressure measurements may differ between centres in epidemiological studies by as much as 10 mmHg for procedural reasons alone, it is hardly surprising that a plea has been made for standardization of blood pressure measurement in multi-centre epidemiological studies [14]. Indeed, the principle of the CONSORT (Consolidated Standards of Reporting Trials) statement [15] might well serve as a model for laying down an international consensus for blood pressure measurement in hypertension research.

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