Medical Memoranda

Sphygmomanometer Cuff Calibrated for Corrected Blood-pressure Readings

Many practitioners who are constantly engaged in taking blood-pressure readings must from time to time have been puzzled by very high or very low readings in patients who are perfectly normal in health and symptom-free. There are, of course, many factors which can affect B.P. readings in people in normal health. These have been fully described by Professor Pickering (1955). One source of error which he describes, and which allows of immediate correction in reading the B.P., is the effect of differences in the arm circumference.

This phenomenon was originally described by Ragan and Bordley (1941), who compared a series of direct auscultatory B.P. readings in one arm with simultaneous ones recorded by arterial puncture and a Hamilton manometer in the other. Pickering *et al.* (1954) applied these findings to a population sample, deducing two formulae by which the systolic and diastolic variations could be expressed from the tables of Ragan and Bordley, and confirmed that their validity was unaffected by age, height, or other factors.

While being interested in eliminating this source of error, I found it to be somewhat tedious and time-consuming to have to measure each arm with a tape measure and then to refer to a table in order to arrive at the correct result in each case. Having recently acquired the new hook-type armlet made by Accoson, I thought that this difficulty could be overcome by calibrating the armlet for these corrections. The finished job, which is shown in the illustration, serves the purpose most effectively and is used constantly by me. The correct additions or subtractions for systolic and diastolic readings can be read off instantaneously.

The actual calibration of the cuff is not, however, a very simple matter. This hook-type armlet has a series of 13 steel ribs sewn transversely into the material of the cuff, and the other end of the cuff is clipped or hooked into these ribs with one of two hooks, one of which lies 0.5 cm. behind the other, thus giving a total of 26 different positions for the various arm circumferences. Mathematically there is a difficulty here in that the spacing of these ribs does not allow of a simple arithmetical progression of circumference, because, as the arm circumference gets smaller, the amount of material of the cuff which is folded underneath is greater; and this alters the differential between the external and internal circumference of the cuff when in position on the arm.

In order to equate arm circumference with the internal circumference of the cuff for the different positions of the hooks, I found it was necessary to hook the end of the armlet on to each rib with each of the hooks in turn, fold it flat, and measure the internal length with a straight ruler; clearly, this measurement doubled gives the internal circumference. After these measurements had been tabulated, it was found that they showed an irregularity in sequence, and that the best way to get an approximately accurate calibration for each position was to plot the readings on a piece of graph paper and draw a straight line between the two

end ones, when, by a stroke of good fortune, I found this line to run, more or less, through whole numbers and multiples of five centimetres. Once these measurements were obtained, it was then a simple matter to calibrate the arm band, not in centimetres, etc., but in the actual subtractions and additions laid down in Ragan and Bordley's tables. The calibrations were marked in indian ink on two strips of white tape sewn on to the cuff on both sides of the ribs, one side for diastolic corrections, the other for the systolic ones. When the appropriate hook is engaged with its rib, the figures left uncovered by, and just beyond, the overlying edge of the hooked end of the cuff indicate the corrections for this arm circumference.

Although the above method of calibration has been a convenient and quick means of translating measurements of arm circumference into armlet calibrations it is pointed out by Dr. G. S. C. Sowry (1958, personal

The calibrated armlet.

communication) that the most accurate way would be to carry it out on a series of living human arms under standard conditions—for example, tension of measuring tape. He also states that the error introduced by arm circumference is small compared with the time-to-time variation in any individual, that its main use would be in interpretation of data from groups, but that it might be of value for those doing insurance examinations.

It is felt, however, that armlets could be manufactured with these calibrations already inserted, so that the correction may be seen at a glance. Whether or not they should be applied in individual cases would be for each observer to decide for himself; their availability should add clinical interest.

For my own part I have been surprised, having used this cuff regularly for the last twelve months, how otherwise puzzling readings become much more explicable. As these tables are not yet in common use I make a note in my records of the fact that the readings are corrected, because there is often a considerable variation from the straight readings.

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