ABC of Blood Pressure Measurement

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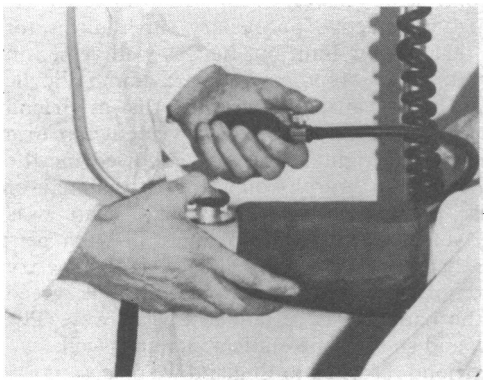
TECHNIQUE



Indirect blood pressure measurement by auscultation is susceptible to several errors, which may originate with the observer, the sphygmomanometer, the patient, or a combination of these factors.

By careful attention to detail blood pressure measurement with a sphygmomanometer can give systolic and diastolic pressures within 4 mm Hg of intra-arterial pressures.

Korotkoff sounds

Shortly after Scipione Riva-Rocci had invented the sphygmomanometer a Russian surgeon, Dr N C Korotkoff (left), reported that by placing a stethoscope over the brachial artery at the antecubital fossa distal to the Riva-Rocci cuff sounds could be heard. He documented the phases, and thus introduced the indirect auscultatory method of recording blood pressure.

Although the origin of the Korotkoff sounds is still not clear, vibratory and flow phenomena are probably responsible.

The phases are:

Phase 1—The first appearance of faint clear tapping sounds which gradually increase in intensity. The systolic pressure is heard for at least two consecutive beats, and this correlates well with intra-arterial pressure.

Phase 2—The softening of sounds, which may become swishing.

Phase 3—The return of sharper sounds, which become crisper but never fully regain the intensity of phase 1 sounds. Neither phase 2 nor phase 3 has any known clinical importance.

Phase 4—The distinct abrupt muffling of sounds, which become soft and blowing.

Phase 5—The point at which all sounds disappear completely.

Diastolic dilemma

Recommendations

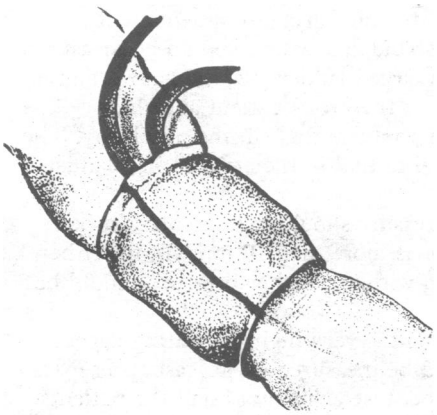
		Phase
1939	Cardiac Society of GB and Ireland and American Heart Association (AHA)	4
1951	AHA	5
1959	Build and Blood Pressure Study	5
1962	WHO	4&5
1967	AHA	4
1970	Veterans Administration Study	5
1972	Hypertension Detection and Follow-up Study	5
1974	Framingham Study	4
1975	Medical Research Council	5

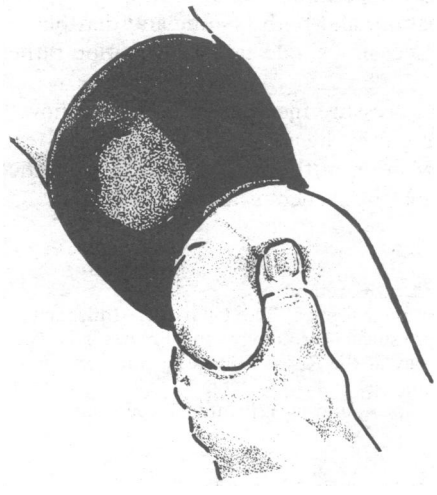
Recommendations on blood pressure measurement have vacilated for many years on the issue of the diastolic endpoint. In the USA doctors have tended to favour the silent endpoint (phase 5), whereas in Britain and Ireland they have favoured the muffled endpoint (phase 4). In 1962 the World Health Organisation recommended that both phases 4 and 5 should be recorded. Inability to decide on an empirical matter of such importance is a source of inaccuracy and confusion.

Muffling and the disappearance of sounds may be synchronous, but usually there is a difference of 5 to 10 mm Hg. Phase 5 correlated best with intra-arterial pressure, but general acceptance of the silent endpoint has been resisted because patients in whom flow within the arterial circulation is increased—for example, after exercise and in other high-output states—may have a silent endpoint greatly below the muffling of sounds. In some patients sounds may be audible when cuff pressure is deflated even to zero. On the other hand, some patients do not have a distinct muffled endpoint.

There is greater agreement between observers using the silent rather than the muffled endpoint—a matter of importance in training observers, be they patients, nurses, or doctors. We recommend that the silent endpoint (phase 5) should be taken as the diastolic pressure. To avoid confusion, however, we support the suggestion that the fourth and fifth phases should always be noted—for example, 160/95/65 mm Hg, or when only the fourth or fifth phase has been recorded 160/95/- mm Hg or 160/-/65 mm Hg respectively.

Technique



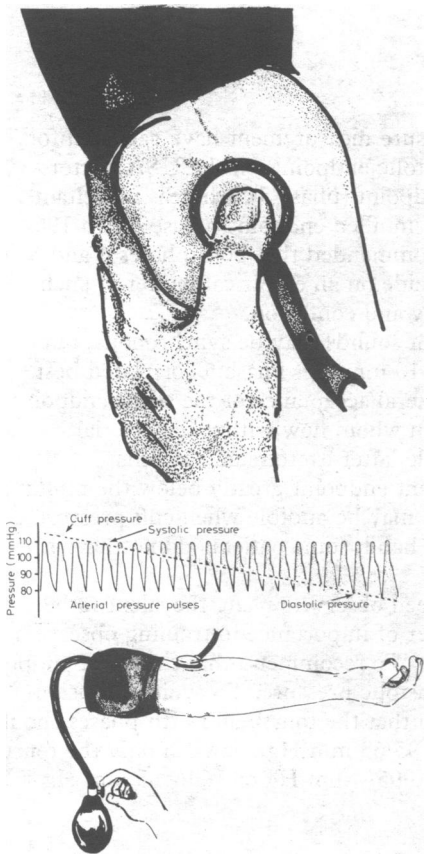


Firstly, the factors already discussed in relation to the observer, the instrument, and the patient should be taken into account.

Secondly, all clothing should be removed from the arm. If a blouse, shirt, or pyjama jacket is not to be removed it is better to leave the cloth under the cuff than roll the sleeve into a constricting band. If the cuff is not applied snugly to the arm falsely high blood pressures will be recorded, and if the cuff is too tight errors will also occur.

Thirdly, the cuff should be wrapped round the arm ensuring that the bladder dimensions are accurate. If the bladder does not completely encircle the arm the centre of the bladder must be over the brachial artery. The rubber tubes from the bladder are usually placed inferiorly, often at the site of the brachial artery, but we suggest that they should be placed superiorly or, with completely encircling bladders, posteriorly, so that the antecubital fossa is easily accessible for auscultation.

Fourthly, the brachial artery should be palpated with one hand, and the cuff rapidly inflated to about 30 mm Hg above the disappearance of the pulse and then slowly deflated. The observer should note the pressure at which the pulse reappears. This is the approximate level of the systolic pressure, and because phase 1 sounds sometimes disappear as pressure is reduced and reappear at a lower level (the auscultatory gap), the systolic pressure may be underestimated unless already determined by palpation. (The radial artery is often used for palpatory estimation of the systolic pressure but by using the brachial artery the observer also establishes its location before auscultation.)



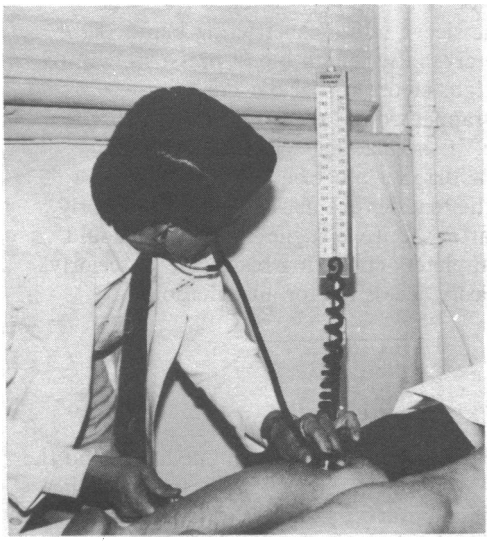
Fifthly, the stethoscope should be placed over the brachial artery. A bell endpiece gives better sound reproduction, but a diaphragm is easier to secure with the fingers of one hand and covers a larger area. The stethoscope should be held firmly and evenly but without excessive pressure. Too much pressure may distort the artery, producing sounds below diastolic pressure. To avoid friction sounds the stethoscope endpiece should not touch the clothing, cuff, or rubber tubes.

Sixthly, the cuff should be inflated as fast as possible to about 30 mm Hg above the palpated systolic pressure and deflated at a rate of 2 to 3 mm Hg per heart beat (or per second).

Seventhly, the appearance of sounds (phase 1) should be recorded as the systolic pressure, and the disappearance of sounds (phase 5) as the diastolic. Ideally both phases should be recorded but this is especially important if the difference between phases is over 10 mm Hg.

Finally, pressures should be recorded to the nearest 2 mm Hg. When all sounds have disappeared the cuff should be deflated rapidly and completely before repeating the measurement to prevent venous congestion of the arm.

Repeated measurements



If the blood pressure is raised on first measurement the recording should be repeated at least twice in the same arm. In patients with suspected coarctation of the aorta the blood pressure should be measured in the leg. A thigh cuff containing a large bladder (18 × 24 cm for adults) should be wrapped round the thigh of the prone patient and the Korotkoff sounds auscultated in the popliteal fossa in the usual way. The pressure in the legs is normally equal to that in the arms if the bladder is adequate in size.

At an initial examination blood pressure should be measured in both arms. If the difference between arms is more than 10 mm Hg for either systolic or diastolic pressure the arm with the higher pressure should be used for future measurements.

Except when the initial measurement is very high, indicating urgent treatment, the blood pressure should be measured on at least two separate occasions before starting treatment because as many as half the patients with raised blood pressures on initial examination will become normotensive on subsequent examination, and both systolic and diastolic pressures will be overestimated if based on a single casual estimation rather than repeated examination.

Ideally, therefore, records of blood pressure measurement should show the systolic pressure, the diastolic pressure, the endpoint used, the limb used and whether right or left, the position of the patient, and the presence of any arrhythmias or unusual circumstances such as anxiety or confinement to bed.

We thank Dr H Segall for the photograph of Korotkoff.

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This is the fourth of a series of seven papers, and no reprints will be available from the authors.