Blood pressure (BP)

see High blood pressure.

Blood pressure is the force of blood pushing against the walls of the arteries as the heart pumps out blood.

The increase in mean arterial blood pressure (MABP) during global cerebral ischemia constitutes a compensatory and protective mechanism, regulated by the Central Nervous System, in response to the accumulation of different toxic compounds in the brainstem [1)]

Sometimes referred to as arterial blood pressure, is the pressure exerted by circulating blood upon the walls of blood vessels, and is one of the principal vital signs. When used without further specification, “blood pressure” usually refers to the arterial pressure of the systemic circulation. During each heartbeat, blood pressure varies between a maximum (systolic blood pressure) and a minimum (diastolic) pressure.

The blood pressure in the circulation is principally due to the pumping action of the heart.

Differences in mean blood pressure are responsible for blood flow from one location to another in the circulation. The rate of mean blood flow depends on the resistance to flow presented by the blood vessels. Mean blood pressure decreases as the circulating blood moves away from the heart through arteries and capillaries due to viscous losses of energy.

Mean blood pressure drops over the whole circulation, although most of the fall occurs along the small arteries and arterioles.

Gravity affects blood pressure via hydrostatic forces (e.g., during standing), and valves in veins, breathing, and pumping from contraction of skeletal muscles also influence blood pressure in veins.

Measurement

Blood pressure is summarised by two measurements, systolic and diastolic, which depend on whether the heart muscle is contracting (systole) or relaxed between beats (diastole). This equals the maximum and minimum pressure, respectively.

In most patients having noncardiac surgery, blood pressure is measured with the oscillometric upper arm cuff method. Although the method is noninvasive and practical, it is known to overestimate intraarterial pressure in hypotension and to underestimate it in hypertension. A high-fidelity upper arm cuff incorporating a hydraulic sensor pad was recently developed. The aim of the present study was to investigate whether noninvasive blood pressure measurements with the new high-fidelity cuff correspond to invasive measurements with a femoral artery catheter, especially at low blood pressure.

Methods: Simultaneous measurements of blood pressure recorded from a femoral arterial catheter and from the high-fidelity upper arm cuff were compared in 110 patients having major abdominal

surgery or neurosurgery.

Results: 550 pairs of blood pressure measurements (5 pairs per patient) were considered for analysis. For mean arterial pressure measurements, the average bias was 0 mmHg, and the precision was 3 mmHg. The Pearson correlation coefficient was 0.96 (P < 0.0001; 95% CI, 0.96 to 0.97), and the percentage error was 9%. Error grid analysis showed that the proportions of mean arterial pressure measurements done with the high-fidelity cuff method were 98.4% in zone A (no risk), 1.6% in zone B (low risk) and 0% in zones C, D, and E (moderate, significant, and dangerous risk, respectively). The high-fidelity cuff method detected mean arterial pressure values less than 65 mmHg with a sensitivity of 84% (95% CI, 74 to 92%) and a specificity of 97% (95% CI, 95% to 98%). To detect changes in mean arterial pressure of more than 5 mmHg, the concordance rate between the two methods was 99.7%. Comparable accuracy and precision were observed for systolic and diastolic blood pressure measurements.

Conclusions: The new high-fidelity upper arm cuff method met the current international standards in terms of accuracy and precision. It was also very accurate to track changes in blood pressure and reliably detect severe hypotension during noncardiac surgery [2)].

Normal blood pressure

Normal blood pressure at rest is within the range of 100-140mmHg systolic (top reading) and 60-90mmHg diastolic (bottom reading). High blood pressure is said to be present if it is often at or above 140/90 mmHg.

Importance

One of the factors that determines cerebral perfusion pressure.

Elevated blood pressure (BP) is a strong predictor of poor outcome in both intracerebral hemorrhage (ICH) and subarachnoid hemorrhage (SAH). Data from a landmark clinical trial INTERACT 2, wherein 2839 participants enrolled with spontaneous ICH were randomly assigned to receive intensive (target systolic BP <140 mmHg) or guideline recommended BP lowering therapy (target systolic BP <180 mmHg), showed that intensive BP lowering was safe, and more favorable functional outcome and better overall health-related quality of life were seen in survivors in the intensive treatment group. These results contributed to the shift in European and American guidelines towards more aggressive early management of elevated BP in ICH. In contrast, the treatment of BP in SAH is less well defined and more complex. Although there is consensus that hypertension needs to be controlled to prevent rebleeding in the acute setting, induced hypertension in the later stages of SAH has questionable benefits [3)].

Evidence supports early intensive blood pressure (BP) lowering in acute intracerebral hemorrhage, but uncertainty persists over whether potential benefits and harms vary according to the magnitude of BP reduction.

BP variability is independently and linearly associated with the development of neurologic deterioration in acute stage of ischemic stroke [4)].

BP is positively associated with risk of vascular dementia, irrespective of preceding transient ischemic attack or stroke. Previous reports of inverse associations in old age could not be confirmed [5)].

Monitoring

Blood pressure monitoring

Management

Blood Pressure Management

1)
Herguido M, Carceller F, Madero R, Roda J. Animal survival related to acute blood pressure response in global cerebral ischemia in rats. Neurol Res. 1997 Aug;19(4):417-419. PubMed PMID: 27819547.
2)
Briegel J, Bähner T, Kreitmeier A, Conter P, Fraccaroli L, Meidert AS, Tholl M, Papadakis G, Deunert A, Bauer A, Hoeft A, Pfeiffer UJ. Clinical Evaluation of a High-fidelity Upper Arm Cuff to Measure Arterial Blood Pressure during Noncardiac Surgery. Anesthesiology. 2020 Nov 1;133(5):997-1006. doi: 10.1097/ALN.0000000000003472. PMID: 33048167.
3)
Carcel C, Sato S, Anderson CS. Blood Pressure Management in Intracranial Hemorrhage: Current Challenges and Opportunities. Curr Treat Options Cardiovasc Med. 2016 Apr;18(4):22. doi: 10.1007/s11936-016-0444-z. PubMed PMID: 26909816.
4)
Chung JW, Kim N, Kang J, Park SH, Kim WJ, Ko Y, Park JH, Lee JS, Lee J, Yang MH, Jang MS, Oh CW, Kwon OK, Jung C, Kim BJ, Han MK, Gorelick PB, Bae HJ. Blood pressure variability and the development of early neurological deterioration following acute ischemic stroke. J Hypertens. 2015 Jul 31. [Epub ahead of print] PubMed PMID: 26237556.
5)
Emdin CA, Rothwell PM, Salimi-Khorshidi G, Kiran A, Conrad N, Callender T, Mehta Z, Pendlebury ST, Anderson SG, Mohseni H, Woodward M, Rahimi K. Blood Pressure and Risk of Vascular Dementia: Evidence From a Primary Care Registry and a Cohort Study of Transient Ischemic Attack and Stroke. Stroke. 2016 Jun;47(6):1429-35. doi: 10.1161/STROKEAHA.116.012658. Epub 2016 May 10. PubMed PMID: 27165956.