

# Importance Of Blood Pressure Monitoring: A Review

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## Abstract

*This paper briefly discusses what is blood pressure along with its classification, blood pressure variations with gender/age and finally discusses the importance of blood pressure monitoring for management of cardiovascular diseases and also during surgical procedure.*

## 1. Introduction

Circulation of blood is very important for a living body to survive, as it provides nutrition, oxygen and waste clearance to all tissues of the body. It is utmost necessary to maintain a pressure gradient in different parts of the circulatory system for smooth functioning, which necessitates measurement and monitoring of blood pressure.

It is a hard and challenging task to quantify arterial blood pressure in the human circulatory system. The branching network of blood vessels creates a structure that exhibits both lumped and distributed dynamic behavior. The time varying attributes of circulation additionally increase the complexity of system. As a result, measurements of blood pressure are not static but undergo natural variations from one heart beat to another, through the day, and in response to many factors such as disease and stress [1].

## 2. Blood Pressure - Definition and Classification

Blood pressure is defined as the pressure exerted by the blood against blood vessel's wall and comes from two forces: one is the force created by heart as it pumps blood into the vessels and through the circulatory system, and the other is force of the vessels as it resists the blood flow. Usually, blood pressure refers to systemic arterial blood pressure, i.e. the pressure in large arteries delivering the blood to the body parts other than lungs. Peak pressure in the arteries during cardiac cycle is defined as systolic blood pressure (SBP); lowest pressure is the diastolic blood pressure (DBP). Blood pressure also has two other components: steady i.e. mean arterial pressure (MAP) and pulsatile i.e. pulse arterial pressure (PP). Typical values for resting healthy adult human are approximately 120 mm Hg for SBP and 80 mm Hg for DBP written as 120/80 mm Hg, with large individual variations. Hypertension is defined as abnormally increased blood pressure, more specially; when a person under rest condition has a

blood pressure exceeding 140/90 mm Hg, the person is said to have high blood pressure or hypertension. Classification of blood pressure for adults is shown in Table 1 [2].

**Table 1** Classification of blood pressure for adults

BP Classification	SBP mm Hg	DBP mm Hg
Normal	< 120	and < 80
Prehypertension	120-139	or 80-90
Stage 1 hypertension	140-159	or 90-99
Stage 2 hypertension	≥ 160	or ≥ 100

Abnormal BP readings and/or BP fluctuations over time are indicative of heart or circulatory disorders. Hypertension is one of the most common diseases in the adult population, often accompanied by secondary cardiovascular damage. In addition, prolonged reduction or loss of pressure severely limits the amount of tissue perfusion and could therefore result in damage to, or even death of the tissue. Although some tissues can tolerate hypoperfusion for fairly long periods of time, the brain, heart and kidneys are very sensitive to reduction in blood flow.

## 3. Dependence of Blood Pressure on Age and gender

Arterial stiffness is a major determinant of systolic pressure in central blood vessels, left ventricular load, oxygen requirements and of the damaging stresses on arterial walls. Increased arterial stiffness increases systolic pressure in two ways: first, by increasing amplitude of the initial pressure wave generated by ventricular ejection and second, by causing reflected waves from the periphery to return during systole and so augment the initial wave. Both mechanisms contribute almost equally to the increased SBP, which is seen with aging and in hypertension [3-6]. On the basis of cross-sectional and longitudinal studies by Franklin S. S. et al. and Kanell et al., there is epidemiological evidence that SBP and DBP increase with age. However, after the age of 50-60 years, the rise in DBP tends to disappear, and DBP may even decrease with age. Thus PP increases more markedly with age than MAP [7, 8].

Men are generally considered to have higher blood pressure than women, but this seems to only be true in younger age. Body size alters arterial function, influencing pressure wave propagation and amplification in peripheral and central arteries. It

has been proved that body height is positively correlated with systolic pressure amplification from central to peripheral arteries and inversely correlated with the effect of wave reflections in central arteries. Shorter body heights in women result in less peripheral systolic pressure amplification, with lower peripheral but not central systolic pressure. Greater arterial distensibility in pre-menopausal women partially offsets the effect of shorter body height. After menopause, arterial distensibility is similar to that of age-matched men and does not compensate for smaller body size, resulting in a persisting increased effect of wave reflections in central arteries. Premenopausal women's SBP is lower than in age-matched men. As a consequence, sex is an important factor to be considered in research into blood pressure in both young and old age [6, 9-11]. Azran et al. observed that body weight was related to SBP, DBP, MAP and PP with  $r = 0.499, 0.337, 0.424$  and  $0.394$  respectively [11].

#### 4. Need of Blood Pressure Monitoring

In recent decades cardiovascular diseases are one of the leading causes of mortality almost in all regions of world. Diseases can be divided into coronary, cerebral or peripheral artery diseases. The main cause of cardiovascular diseases is atherosclerosis, in which arterial compliance decreases dramatically with the result that arterial stiffness increases [12, 13], which serves to increase the patient's death risk.

Raised blood pressure changes the structure of the arteries. As a result, risks of stroke, heart disease, kidney failure and other diseases increase, not only in people with hypertension but also in those with average, or even below-average blood pressure. Diet especially too much salt, alcohol, lack of exercise and obesity all raise blood pressure, and these effects accumulate with age. In developing and developed countries, most adults' blood pressure is higher than the ideal level. Average blood pressure levels are particularly high in middle-income European countries and African countries [14].

Globally 51% of stroke (cerebrovascular disease) and 45% of ischemic heart disease deaths are attributable to high systolic blood pressure. At any given age, the risk of dying from high blood pressure, in low and middle-income countries is more than double than that in high-income countries. In the high-income countries, only 7% of deaths caused by high blood pressure occur under age 60; in the African region, this increase to 25%. Hypertension causes 7.5 million deaths per year (12.8 % of total deaths) worldwide and abnormal BP is the number one attributable risk for death throughout the world [14].

Each component of blood pressure is associated with risk for congestive heart failure, but pulse and

systolic pressure have greater risk than diastolic pressure. Increased pulse pressure may help identify hypertensive patients at high risk for CHF, who are candidates for aggressive blood pressure control. Thus accurate measurement and display of arterial blood pressure is essential for management of cardiovascular diseases [2, 15].

During and after surgery, blood pressure is affected by the type of surgery and physiological factors such as the body's response to the surgery. Moreover, during and after surgery, blood pressure is maintained and controlled using various medications. Often, these physiological factors and the given medications result in a situation requiring immediate blood pressure measurement and corrective action. In some clinical situations, dramatic changes in blood pressure can occur instantly. For example, a sudden change in pressure may occur due to a reaction to drug therapy. Also, patient reactions to the surgery, sudden occlusion of an artery due to embolism, or even sudden cardiac arrest are a few possibilities. It is very important to detect these sudden changes immediately and to ensure that the detection and extent of the changes be accurate within certain limits. Due to these reasons, continuous monitoring of blood pressure of a patient is necessary [16].

#### 5. Discussion

Thus, BP is frequently monitored both routinely for management of cardiovascular diseases and also during surgical procedures. For this intra-arterial catheter system is considered to be the "gold standard" of arterial BP measurement in patients, who may experience rapid changes in hemodynamic status. Despite its obvious advantages, the use of the intra-arterial catheter has limitations for using this technique includes difficulty of insertion, thrombosis and occlusion of the vessel with limb ischemia, haemorrhage, and infection. In view of these problems, investigators have been developing non-invasive methods. Some of the commonly used devices in this category include systems based on auscultatory, oscillometry, arterial tonometry, Penaz/Wesseling method and methods based on pulse transit time. The performance of these devices in clinical practice is still under investigations. Although some of these systems have been shown to be reasonably accurate, a number of limitations have interfered with their widespread acceptance in clinical practice.

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