

Blood Pressure: Definition, Associated Diseases and Measurement Methods

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Abstract- Blood pressure (BP) is considered recently as one of the most famous diseases of the modern age. It affects people of different ages and different races. Due to its importance, it became recently an essential part of routine medical practice[1][2].

Index Terms- Blood Pressure. Hypertension, Hypotension and Normal Ranges

I. INTRODUCTION

By definition, the blood pressure is the pressure of blood flows against the vessels walls. The blood as it is flow continuously in the vessels, it will imply a force that pushes the walls out[3]. Besides, blood pressure is usually measured by the medical stuff, but in modern methods, it might be measured by the patient him/her self. The blood pressure is always written as two numbers, one in the top of the other number and is measured in milli meter Mercury unit (i.e. mmHg). The first number is called the systole and refers to the pressure when the heart beats and written always on top, on the other hand, the second number is called the diastole, refers to the pressure when the heart rests between beats and written always down. For example, if a person has a blood pressure of 120/80, then the systolic pressure is 120 mmHg and the diastolic pressure is 80 mmHg[4].

Recently, the ranges of blood pressure are considered to be very risky to patients as well as with great importance. Moreover, normal ranges of systolic blood pressure are 120-139 mmHg, besides normal ranges of diastolic blood pressure are 80-90 mmHg. There are some diseases related to the changes in the normal ranges of the blood pressure. The first disease associated with the blood pressure is called hypertension, and this is happened due to two reasons that might happened simultaneously or separately. When the reading of the diastolic blood pressure exceeds 90 mmHg, and/or the reading of the systolic blood pressure exceeds 139 mmHg. Indeed, in this case, the patients considered as a patient with high blood pressure, and it is a very dangerous case, because the patient always has no symptoms to suffer from. According to CNN, in 2015, there were more than 1 billion people living with hypertension worldwide. There are some categories of people most susceptible to hypertension than others such as:

1. People who have blood relatives that are relatively close and suffer from hypertension.

2. Overweight people including pregnant women.
3. People who aren't doing physical activities frequently.
4. People who eat too much meals with salt.
5. People who drink too much alcohol.
6. People who suffer from certain diseases such as diabetes and kidney diseases.

People with hypertension may suffer from the following problems and diseases more than others:

1. Stroke: which is defined as the sudden death of the cells of the brain and this is happened because of the shortage of oxygen.
2. Heart problems such as heart failure and Peripheral Arterial Disease (PAD).
3. Kidney failure and this is occurred with high probability due to the fact that kidney is the organ responsible for regulating the blood pressure[3].

The second disease associated with the blood pressure is called hypotension. Hypotension is happened when the diastolic blood pressure is less than 60 mmHg, and/or the systolic blood pressure is less than 90 mmHg[5]. There are some reasons that cause low blood pressure (i.e. hypotension) such as dehydration, serious medical disorders, serious surgical disorders, heart problems, endocrine problems and blood loss. Moreover, people who suffer from hypotension may have the following symptoms:

1. Giddiness.
2. Eye's problems.
3. Squeamishness.
4. Exhaustion and tiredness[4].

II. MEASUREMENTS

Due to its importance as a vital sign, there are many ways followed to measure the blood pressure. The typical position to measure the blood pressure is the brachial artery as it is shown in figure (1) below:



Fig (1): The Brachial Artery

One of the eldest ways to measure the blood pressure is by using the auscultatory method. It was invented before more than 100 years. This method depends primarily in the Korotkoff's sound. The readings are taken mainly using the intra-arterial pressure, so when the reading is less than the intra-arterial pressure, then it is a systolic pressure whereas when the pressure is higher than the intra-arterial pressure it is a diastolic pressure. The diastolic pressure is the main challenge for this method, as there is no agreement to what phase the Korotkoff sound must be used[6][7].

Another way to measure the blood pressure is by using the oscillometric technique. The establisher for this techniques is the well-known Marey and this invention was exactly happened in 1876[8]. In this method the oscillation starts when the systolic pressure begins and continue below diastolic. The main limitation for this method is the movement artifacts and this is happened while the patient is doing the physical activities [9].

Recently, ambulatory blood pressure (ABP) is considered as one of the modern techniques to measure the blood pressure. The person can perform his/her normal life while wearing the equipment involved with this technique. In this method, a small digital blood pressure device is equipped to a belt around the body, simultaneously a cuff around the upper arm is connected to the device. Using this method, the blood pressure is measured in regularized intervals during the day. The doctors may ask for this method to measure the blood pressure due to the following reasons:

1. White Coat Effect.
2. To see how the medications work with the patient over 24 hours.

The main advantage for this method that the blood pressure can be measured without the presence of any of the medical staff. The patient has just to wear the device around the body. Not only this, the patient can also do his/her usual works and even sleep with it.

The ultrasound technique is also used as a modern method to measure the blood pressure. In this method an ultrasound transmitter as well as an ultrasound receiver are placed over the brachial artery under a sphygmomanometer cuff. When the cuff is deflated, the arterial wall will move at systolic pressure making a Doppler phase change in the reflected ultrasound, while the diastolic pressure is registered as the stage at which decrease of arterial motion happens[10].

Penaz invented the motivating method of the finger cuff. This method depends on the photo-plethysmograph which is put under a pressure cuff. In this method the arterial pulsation is registered and the output of the photo-plethysmograph is used to begin a servo-loop, which rapidly alters the cuff pressure to keep the output constant [11]. In this method, the cuff can be kept inflated for about 2 hours, not only this, the oscillations of pressure in the cuff have been found to simulate the intra arterial pressure wave in most subjects.

It is very important to mention that there are some sources of error associated with measurements from the upper arm such as:

1. Effects of position. Researchers always recommend measuring the blood pressure while the patient is setting down.
2. The position of the arm.
3. Cuff inflation hypertension
4. Cuff size: It is so relative to the diameter of the arm. However, if the size of the cuff is too small and tied very well, then the result will be an overestimation of the pressure. In the other hand, when the cuff is large, then the stethoscope will not detect the Korotkoff's sounds precisely[12].

The American heart Association (AHA) recommends several sizes to the cuff according to the size of the arm. AHA recommends using the newborn cuff, which has the following features:

1. Arm circumference is less than 6 cm.
2. The bladder width is 3 cm and the length are 6 cm.

Another type of cuffs is the infant cuff, which is characterized by having the next features:

1. Arm circumference is in the interval of 6- 15 cm.
2. The bladder width is 5 cm and the length are 15 cm.

There are other types of cuffs such as child cuff, small adult, adult, large adult and adult thigh, each of which is with certain specifications and features.

III. RESULTS AND DISCUSSIONS

This paper provides clear definitions about the blood pressure from several different resources. It also presents some of the defects associated with the blood pressure and the people more susceptible to these defects more than others. In addition, this paper provides several measurements used to measure the blood pressure and the sizes of cuffs recommended by the AHA.

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