

CLINICAL KNOWLEDGE AND DEVICE OPERATION NON INVASIVE BLOOD PRESSURE (NIBP) MONITOR

START



Measurement of blood pressure is an important diagnostic and monitoring procedure.

Wee Soo Lee

DIA

PULSE



NON INVASIVE BLOOD PRESSURE (NIBP) MONITOR

AND DEVICE OPERATION

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CLINICAL KNOWLEDGE AND DEVICE OPERATION - NON INVASIVE BLOOD PRESSURE (NIBP) MONITOR

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PREFACE

The heart supplies the organs and tissues of the body with blood. With every beat, it pumps blood into the large blood vessels of the circulatory system. As the blood moves around the body, it puts pressure on the walls of the vessels. Blood pressure readings are made up of two values such as Systolic blood pressure is the pressure when the heart beats - while the heart muscle is contracting (squeezing) and pumping oxygen-rich blood into the blood vessels. Diastolic blood pressure is the pressure on the blood vessels when the heart muscle relaxes. The diastolic pressure is always lower than the systolic pressure. Blood pressure is measured in units of millimeters of mercury (mmHg). The readings are always given in pairs, with the upper (systolic) value first, followed by the lower (diastolic) value. So someone who has a reading of 132/88 mmHg (often spoken "132 over 88") has a systolic blood pressure of 132 mmHg, and a diastolic blood pressure of 88 mmHg.



LIMITED BOOK - 2023

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CHAPTER ONE



INTRODUCTION

NIBP is Non-Invasive Blood Pressure.

Non-Invasive means **no break in the skin** is created and there is no contact with the mucosa and internal body cavity beyond a natural or artificial body orifice.

Pressure is defined as Force per Unit Area P = F/A

The pressure exerted on the surface of earth by the air forming the atmosphere is **1 atmosphere (atm)**.

Units of Pressure : Newton/Meter2, pascal,

bar, mbar, kp/cm2, atm, Torr, mmws, psi, mmHg



CHAPTER TWO



Blood Pressure is the measurement of force applied to artery walls.



Pressure exerted by the Blood on the Walls of the Artery.



Types of Blood Pressure



Arterial Blood Pressure - Non-invasive method (NIBP)

Pulmonary Artery Blood Pressure

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- Invasive method (IBP)

Central Venous Pressure - Invasive method (IBP)





Systolic Pressure **Diastolic** Pressure Mean Arterial Pressure (MAP)



The maximum pressure exerted by the blood on the walls of the Artery when the Ventricles contract.



Normal Range 100 to 140 mmHg





The **minimum** pressure exerted by the blood on the Artery wall when the Ventricles relax.

Normal Range 60 to 90 mmHg

Mean Airway Pressure (MAP)



The **average pressure** exerted by the blood on the artery during the complete cycle of Ventricles contracting and relaxing.



Normal Range 100 mmHg

Calculation of MAP :

MAP =1/3 Pulse Pressure + Diastolic Pressure Pulse Pressure = Systolic - Diastolic



The normal blood pressure in adults is **120 (systolic)/80 (diastolic)**.



The normal blood pressure in neonate is 67 (systolic)/35 (diastolic)



The Arterial Pulse



The arterial pulse is a measurement of the heart's contraction rate because a pulse wave is created when the left ventricle contracts.



Pulmonary Artery Pressure (Invasive Method)

Collar Bone -

The pressure is measured in the Pulmonary Artery and reflects the pressure under which the blood is returned to the Lungs.

> Exit Site out of Skin Vein Entry Catheter Tail Cap

Central Venous Pressure (Invasive Method)

Vein Entry_

Port

End of Catheter This is the pressure measured in the Superior Vena Cava and reflects the pressure under which the blood is returned to the Right Atrium

CHAPTER THREE

CIRCULATION SYSTEM

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Pulmonary Circulation

Systemic Circulation

2

3

Cardiac Circulation



Pulmonary Circulation

This is the flow of the blood from the heart to the **lungs and back to the heart again**.

Pulmonary system is the portion of the circulatory system which carries deoxygenated blood away from the right ventricle of the heart, to the lungs and returns oxygenated blood to left heart.

Systemic Circulation



This is the flow of **blood through all the tissues** in the body except Heart and Lung

Systemic circulation, blood travels out of the left ventricle, to the aorta, to every organ and tissue in the body and then back to the right atrium.

Systemic Circulation and Pulmonary Circulation





Pulmonary circulation moves blood between the heart and the lungs.

Systemic circulation moves blood between the heart and the rest of the body.





This is the **movement of blood** through the tissues of the heart





Connecting Between Artery, Vein and Capillaries



The **arterial system** carries blood at **high pressure** from the heart to the tissue and organs.



The **venous system** carries blood at **low pressure** back to the heart.



The **normal** blood pressure in **adults** is **120** (systolic)/**80** (diastolic).



The **normal** blood pressure in **neonate** is **67** (systolic)/**35** (diastolic).



CHAPTER FOUR





Elastic Arteries

Muscular Arteries

Heart Attack

Heart Failure

PROBLEMS OF BLOOD PRESSURE

PROBLEMS OF BLOOD PRESSURE



Hyper Tension or High BP

Hypo Tension or Low BP



Hyper Tension or High BP

If the blood pressure remains over 140/90 mmHg over a period of time then the condition is called Hyper tension or High Blood Pressure.





Makes heart work harder Enlarges the heart Increases risk of heart attack, strokes, kidney failure Damages arteries and arterioles



Hypo Tension

If the Blood Pressure remains below 90/60 over a period of time then the condition is called Hypo Tension or Low Blood Pressure

Within certain limits, the lower your blood pressure reading is, the better.

Symptoms are lightheadedness or fainting.



Certain nerve disorders or endocrine disorders or decreases in blood volume due to severe bleeding (hemorrhage) or dehydration can lead to hypotension.





Hypertension Hypotension

High blood pressure

140 mmHg systolic, 90 mm Hg diastolic Low blood pressure

90 mmHg systolic, 60 mmHg diastolic

Cause cerebral hemorrhage, coronary infarction, hemorrhage of renal blood vessel and poor vision from burst blood vessels in retina Cause dizziness and fainting or indicate serious heart, or neurological disorders or shock (not enough O2 and nutrients to cellular metabolic)



CHAPTER FIVE

O∕I START

DEVICE OPERATION

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PULSE



DEVI OPERA

Principle of NIBP

Auscultatory Method: Sphygmomanometer

- mercury, aneroid
- Korotkoff sound

(When a blood pressure cuff changes the flow of blood through the artery. The first Korotkoff sounds occur when the systolic pressure, the highest pressure reached when the ventricles contract and eject blood)

Oscillometric Method

24

Doppler ultrasound

3

Auscultatory

Based on the sounds caused by **the blood flow through the artery that is surrounded by a cuff** (this sound is called Korotkoff sound).



Korotkoff are the sounds that medical personnel listen for when they are taking blood pressure using a non-invasive procedure.



(b)

They are named after **Dr. Nikolai Korotkoff**, a Russian physician who described them in 1905, when he was working at the Imperial Medical Academy in St. Petersburg.

> When the cuff is inflated so that it stops arterial blood flow, no sound can be heard through a stethoscope placed over the brachial artery distal to the cuff.

R

Korotkoff sounds are created by pulsatile blood flow through the Mechanism of production of Korotkoff





When the **pressure decreases** in the cuff, **the artery starts to emit a noise**: the pressure then measured defines the maximal blood pressure or systolic blood pressure.

Then, the noise continues to be heard during the decrease of the pressure in the cuff, until the noise disappears: the pressure then read defines the minimal blood pressure or diastolic blood pressure.

Korotkoff sounds



k-1 (phase 1): The appearance of the clear tapping sounds as the cuff is gradually deflated. The first is defined as the systolic pressure.



k-2 (phase 2): The sounds in k-2 start to soften and are characterized by a swishing sound since the blood flow in the artery increases.



k-3 (phase 3): The sounds become crisper and louder in k-3, similar to the sounds heard in k-1.



k-4 (phase 4): As the blood flow becomes less turbulent, the sounds in k-4 are muffled and softer. Diastolic pressure is recorded at the end of phase 4.



k-5 (phase 5): In k-5, the sounds disappear completely since the blood flow through the artery has returned to normal.





Pulse pressure variation (PPV) in different arteries and veins 250 Diastolic Systolic 200 133/76 150 100 50 0





Auscultatory method mercury sphygmomanometer with stethoscope









Based on the changes in cuff pressure that is caused by the flow of blood through the artery.

It is similar to the auscultatory method, **moreover an electronic pressure sensor** (transducer) is fitted in to detect blood flow.

Automated oscillometric machines differ with respect to their algorithms, transducers, inflation and deflation rates, cuff sizes and materials

When the artery is **compressed**, little or **no pulsation is perceived** by the cuff, then when the **pressure decreases** in the cuff, the artery starts to emit pulsations: the pressure then induced on the cuff defines the maximal blood pressure or systolic blood pressure.



During the **pressure decreases** in the cuff, the **oscillations will become increasingly significant,** until a maximum amplitude of these oscillations defines





Then, the oscillations can still be seen during the decrease of the pressure in the cuff, until they disappear: the pressure then induced on the cuff defines the minimal blood pressure or diastolic blood pressure.







Ultrasound Method

Uses Doppler effect

It detects the motion of blood vessels in various states of occlusion

The difference **between the transmitted and received signals** is proportional to the **velocity of wall motion**

As cuff **pressure increase**, at one point the time between closing and opening of blood vessel coincide and that point **is Systolic Pressure**

As cuff **pressure is decreased**, at one point the closing pulse of one signal coincide with the opening pulse of another signal and that point **is Diastolic Pressure**





Types of Blood Pressure (Technical)

think C

without coupling directly with the Arterial Blood

Non-Invasive Blood

Pressure

NIBP

measurement of

blood pressure

This is the

Invasive Blood Pressure



In this type a **catheter is directly introduced into the Artery** whose blood pressure is to be measured



The catheter may contain **a pressure transducer at the tip** or may be fluid filled and couple the blood pressure through the **fluid to an external transducer**

Types of Blood Pressure Machine



Types of Non-Invasive Blood



Techniques of Blood Pressure Measurement



How many times?





Cuff Size



The size of the cuff **should match** the size of the arm.



If the **cuff is small then a false high blood pressure** reading will be obtained.



If the **cuff is too big** the pressure reading **will be too low.**



The width of the bladder must be equal to at least 40% of the circumference of the arm.

	Cuff denomination	Arm circumference (cm)	Cuff width (cm)	Bladder length (cm)	
	Infant	6-15	5	15	
	Child	16-21	8	21	
	Small adult	22-26	10	24	
	Adult	27-34	13	30	
	Large adult	35-44	16	38	
	Thigh	45-52	20	42	
thig	h adult Adu				
	6 differents size	blood pressure cuff		5	R R



AHA Recommended Bladder Dimension

Arm Circumference (CM)	Cuff Type	Bladder Dimension Length x Width (CM)
< 6	Newborn	6 x 3
6 to 15	Infant	15 x 5
16 to 21	Child	21 x 8
22 to26	Small Adult	24 x 10
27 to 34	Adult	30 x 13
35 to 44	Large Adult	38 x 16
45 to 52	Adult Thigh	42 x 20





Operation

Common Parameter displayed on screen.





Block Diagram of NIBP

Block Diagram of NIBP



Blocks of NIBP





Pneumatics Assembly



Which is the smallest blood vessel?

MIZZ!

a) Capillary
b) Arteriole
c) Artery
d) Vein

Blood pressure is the force exerted by blood against?

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answer

auestion

a) Brain
b) Artery Wall
c) Kidney
d) Non of the above

Blood pressure is measured in terms of:

a) mmHg
b) mm
c) cmHg
d) Hg



Exchange of gases and nutrients occurs by diffusion between the

a) arterioles and venules.

b) arterioles and tissue cells.

c) arteries and veins.







Which event of the cardiac cycle occurs when systolic blood pressure is measured?

a) The atria contract while blood flows into the relaxed ventricles.

b) The atria and ventricles contract simultaneously.

c) Blood flows into the relaxed atria while the ventricles contract.

d) The atria and ventricles are relaxed, and blood flows into the atria.



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Low Blood Pressure is known as:

a) Hypertensionb) Hypotension

Which of the following variables can have an effect on NIBP measurement?
a) Cuff size
b) Technique
c) Cuff Placement
d) Patient movement
e) All of the above







What is the oscillometric method of blood pressure measurement?

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Structured questions



What causes Korotkoff sounds?

The Oscillometric method of blood pressure measurement uses ______ and ______ in the cuff to determine blood pressure.

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