

PRESSURE

Pressure is defined as force per unit area and is measured in Pascal [Pa = N/m²]. The term pressure is used when describing fluids (gases or liquids). For a solid the quantity force per unit area is referred to as “stress”

The most common method of indicating pressure in medicine **is by the height of column of mercury (Hg)**.the pressure (P) under a column of liquid can be calculated from

$$P = \rho g h$$

Where

ρ is the density of the liquid

g is the acceleration due to the gravity

h is the height of the column

Liquid pressure also depends on the density of the liquid.

The density of mercury is 13.6 g/cm³ .

The density of water (H₂O) =1.0 g/cm³ .

ABSOLUTE PRESSURE:

Many techniques have been developed for the measurement of pressure and vacuum. Instruments used to measure and display pressure in an integral unit are called **pressure gauges or vacuum gauges**.

Absolute pressure (Gauge ΔP)= pressure reading + Atmosphere pressure

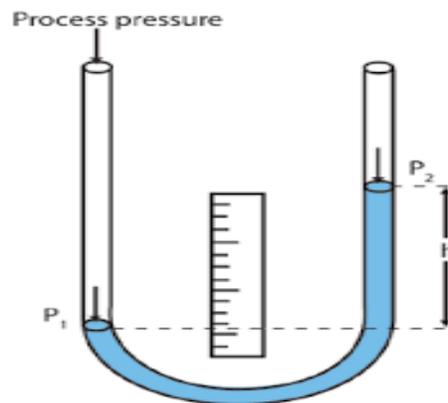
Negative pressure it's the pressure lower than the atmospheric pressure.

MESUREMENT OF PRESSURE IN HUMAN BODY

The classical method of measuring pressure is to determine the height of a column of liquid that produce a pressure equal to the pressure being measured.

An instrument that measures pressure by this method is called a “**Manometer**”

A common type and very simple device is the U-tube manometer. The name U-tube is derived from its shape. U-tube manometer is shown



The levels in the arms changes until the difference in the levels is equal to the pressure. This type of manometer can measure both positive and negative pressure. The fluid used is usually mercury, but water or other low density fluids can be used when the pressure is relatively small.

The most common clinical instrument used in measuring pressure in the body is “**Sphygmomanometer**” which measure blood pressure.

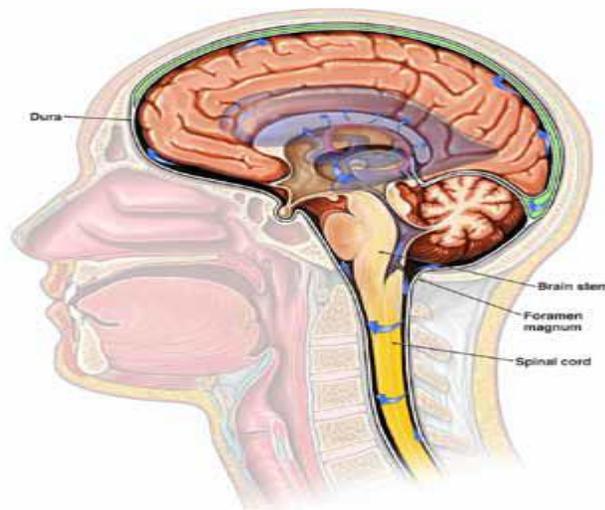
Two types of pressure gages are used in Sphygmomanometer:

- 1- In a **mercury type** pressure is indicated by the height of a column of mercury inside the glass tube.
- 2- In **aneroid type** the pressure changes the shape of the sealer flexible container, which causes a needle to move on a diode.

The pressure in the human body is different from organ to another

1-Pressure in the skull

The brain contains approximately 150cm^3 of cerebrospinal fluid (CSF) in a series of interference opening called ventricles. Cerebrospinal fluid (CSF) is generated inside the brain and flow through the ventricles into the spinal column and eventually into the circulatory system.

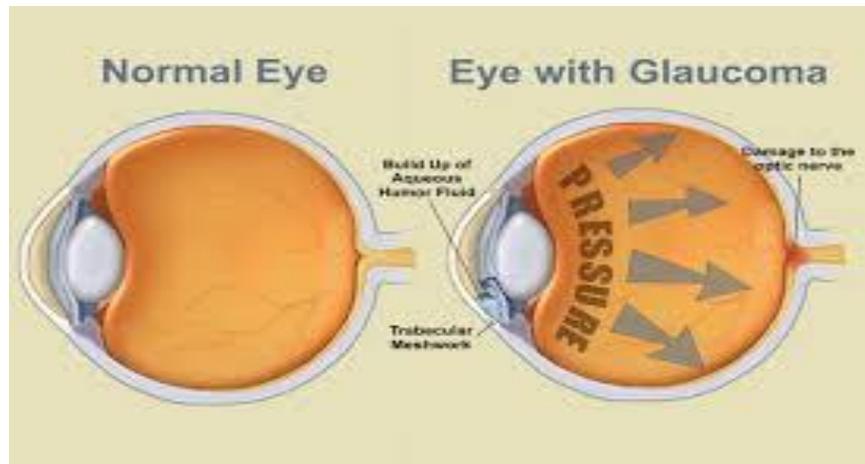


One of the ventricles the (Aqueduct) is especially narrow. If at brain this opining are blocked for any reason, the CSF is trapped inside the skull and causing increasing in the internal pressure. This increasing in the pressure causing **the skull to enlarge**. This serious condition called (*hydrocephalus*) or (water-head), it can be often corrected by surgically installing a by-pass draining system for the CSF.

It is not covenant to measure the CSF pressure directly. One rather convenient method is to measure the circumference of the skull just above the ears. Normal values for newborn infant are (32-37) cm and larger value may indicate hydrocephalus.

2- Eye Pressure:

The clear eyeball, that transmit the light to the retina are under pressure and maintain the eyeball in affixed size and shape, the pressure in the normal eye range from 12 to 23 mmHg.



The eye continually produces aqueous humor and drain system allows the surplus to escape. If a partial blocking of this drain system occurs, the pressure increasing and the increasing pressure can restrict the blood supply to the retina and thus affect the vision. This condition called “glaucoma” produces tunnel vision in moderated cases and blindness in sever case.

3- Pressure in the digestive system:

This pressure is greater than atmospheric pressure in most of gastrointestinal (GI) system except the esophagus; the pressure is coupled to the pressure between the lung and the chest wall.

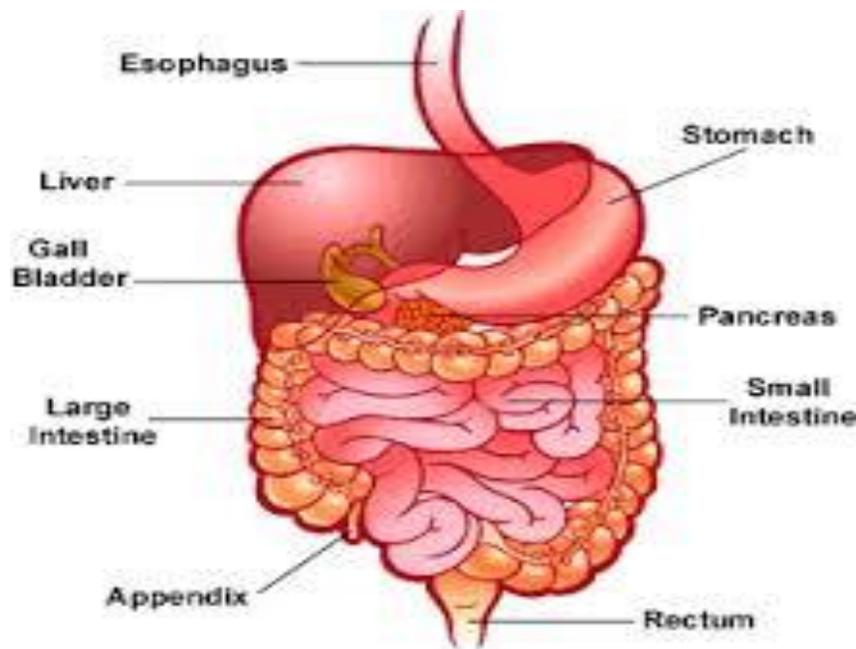
The increasing in the pressure inside the GI system is due to:

- 1- Accumulation of food inside the stomach layers.

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- 2- Swallowing the air during eating food. Air trapped in the stomach causes burping and belching.
- 3- The gas generation due to bacterial action increasing the pressure.
- 4- There are external factor increasing the pressure inside the stomach and these factor are

Belts, Girdles, Flying, Swimming



4- *Pressure in the skeleton:*

The skeleton system joints are the best bearing that any man can make.

Many parameters are designed to reduce the pressure on the joints.

- 1- The large area of the joints
- 2- The shape of the bone.
- 3- The lubrication by the synovial fluid.

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The finger bones are flat rather than the cylinder on the gripping side make the force separate over a large surface area and this reduce the pressure in the tissue over the bones.

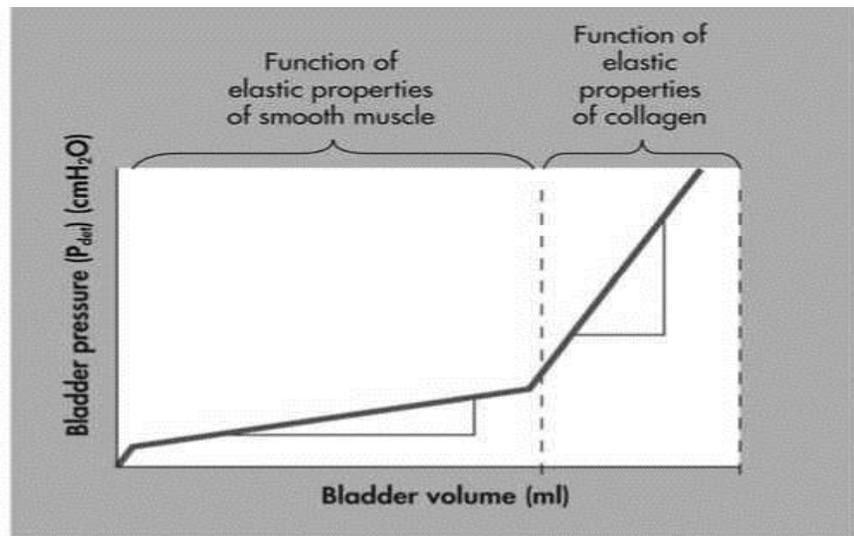
5-Pressure in the urinary bladder:

There are many factors that affect the pressure in the urinary bladder, internal and external factors.

The *internal factors* are due to the accumulation of urine inside the bladder. For adults, the maximum volume before voiding is 500ml. at pressure equal to (30 cm H₂O) .The resulting sizable muscular contraction in the bladder wall produces a momentary pressure up to 150 cmH₂O



MUSCULATURE



The pressure-volume relationship in the urinary bladder

The pressure in the bladder can be measured by

- 1- Passing a catheter with a pressure sensor into the bladder through the urinary passage.
- 2- Means of needle inserted through the wall of the abdominal directly into the bladder.

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The *external factor* that affects the bladder pressure can be coughing, straining, stressful situation and sitting up, during pregnancy, the weight of the fetus over the bladder increase the bladder pressure and cause frequent urination.

6-Pressure effect while diving:

Since the body is composed primarily of solid and liquids which are nearly incompressible. There are gas cavities in the body, when sudden pressure changes can produce profound effects.



The **middle ear** is one air cavity that exists within the body. The pressure in the middle ear should equal the pressure outside the eardrum. This equalization is produced by air flowing through the *Eustachian tube*. *When diving*, many people have difficulty obtaining pressure equalization and feel pressure on their ears.

The pressure in the **lungs** at any depth is greater than the pressure in the lungs at sea level. This means that the air in the lungs is denser underwater and that the partial pressure of the air is higher. The higher pressure of oxygen causes more O₂ molecules to be transferred into the blood and O₂ poisoning results if the partial pressure of O₂ gets too high.