**The pressure system of the body**

**The pressure P is defined by the amount of force F on a certain area A :**

**P=F/A**

**The international standard unit for pressure is the Pascal:**







**The density of mercury is 13.6 g/cm3, a column of water has 13.6 times higher than a given column of mercury in order to produce the same pressure.**

**common units used to measure pressure**







**The atmospheric pressure is about 105 N/m2 or 760 mmHg. since we live in a sea of air with a pressure 1 atm. It is easier to measure pressure relative to atmospheric pressure, pressure lower than atmospheric or negative :**

**\*when we breath (inspire) the pressure in the lung must be lower than atmospheric or the air would not flow in.**

**\*when person drinks through straw .**

**Example: what height of water will produce the same pressure as 120 mmHg?**

**solution:**

**P(120mmHg)=ρgh=(13.6\*980\*12)=1.6\*105dynes/cm2**

**for water**

**1.6\*105dynes/cm2=1\*980\*h**

**=163cm (height of mercury \*13.6)**

**pressure inside skull:**

**The brain contains approximately 150 cm3 of cerebrospinal fluid (CSF) in series of interconnected opening called ventricles, at birth this opening blocked for any reason. CSF is trapped inside skull and increase internal pressure causes skull to enlarge this called hydrocephalus is common in infant.**

**the crude method of detected hydrocephalus is to measure circumference of skull just above the ears, normal value of new born infants are from 32-37 cm, large value indicate hydrocephalus.**

**Eye pressure:**

**the fluids in the eyeball (aqueous and vitreous humors) that transmit light to retina. the dimensions of eye are critical to good vision , a change of 0.1mm in its diameter has effect on clarity of vision).**

**pressure in normal eye 12-33 mmHg. the eye continuously produce aqueous humor and the drain system allows surplus to escape. if partial blockage of this drain system occurs, the pressure increases and restrict the blood supply to retina, and thus effect vision, this condition called glaucoma produces tunnel vision in moderate cases and blindness in severe cases. the instrument used for measure eye pressure is tonometers to measure the amount of indentation produced by a known forces.**

**pressure in the digestive system:**

**The pressure is greater than atmospheric into gastrointestinal system. The pylorus valve prevent the flow of food back into stomach from small intestine, occasionally blockage forms in small or large intestine and pressure builds up between blockage and pylorus, this pressure become greater enough to restrict blood flow to critical organs. It can cause death.**

**Intubation the passing of hollow tube through the nose , stomach , and pylorus is usually used to relieve the pressure.**

**If the intubation dose not work its necessary to relieve the pressure surgically.**

**Pressure in the skeleton**

**Since the pressure is the force per unit area, the pressure is reduced as the area increased. The surface area of bone at joint greater than its area above or below the joint , thus reducing pressure.**

**Finger bones are flat rather than cylindrical on the gripping side, and the force spread over large surface this reduces pressure in the tissues over bones.**

**Pressure in the urinary bladder:**

**There are internal pressure in bladder due to accumulation of urine. For given increase in radius R, the volume increases as R3 while pressure increases as R2. for adults the maximum volume in bladder before voiding is 500 ml.**

Volume ml

P cm. H2O

150

30

**In men who suffer prostatic obstruction of urinary passage it may be over 100 cm.H2O . the bladder pressure increases during coughing and sitting up, pregnancy , the weight of fetus over bladder increases the pressure and causes frequent urination. A stressful situation may also produce pressure increases.**

**Pressure effect while diving:**

**The body composed of solids and liquids in compressible so pressure changes not effect. There are gas cavities where sudden pressure changes can produce effects. Boyles law for fixed quantity of gas at fixed temperature the product pv=const.**

**The middle ear is one air cavity exist within the body when diving many people have difficulty in pressure equalized and feel pressure in the ears. A pressure of 120 mmHg across the eardrum to rupture. Rapture can be serious since cold water in the middle ear can affect the vestibular or balance mechanism and cause nausea and dizziness .**

**If a diver has cold , the sinus cavities in the skull become closed off and not equalize of pressure causing pain. Another pain for small volumes of air trapped beneath filling in the teeth. Breathing air at depth of 30 m is dangerous because there is excess nitrogen in the blood and tissues. Nitrogen is dissolved in the blood and tissues.**

**Henry law :**

**The amount of gas that will dissolved in a liquid is proportional to the partial pressure of gas in contact with the liquid. Thus more nitrogen is dissolved as deeper, when the diver ascends, the extra nitrogen inside tissue, must be removed via the blood and lungs other problems occur during ascent. One of the membrane that separate air and blood in the lung can burst allowing air to go directly into the blood stream (air embolism). Air becomes trapped under the skin a round the base of the neck or in the middle of the chest. These problem best treated by a physician. Viscosity of blood is decreasing when shear stress increasing, the pure liquids have Newton's behavior and the suspension liquids are non Newton's behavior, the blood belongs to the later types.**

**1. Calculate the pressure in mm.Hg of mercury equal to pressure of 20 cm. H2O?**

**2. A container is placed 1m above a vein with a venous pressure of 2 mm.Hg , if the density of blood is 1.04g/cm3 what is the net pressure acting to transfer the blood into the vein?**

**Application of Boyels law**

**What volume of air at an atmospheric pressure of 1.01\*105N/m2 is needed to fill a 14.2 liter (0.5 ft3) scuba tank to a pressure of 1.45 \*107N/m2**