INTRODUCTION TO ICU

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ICU ROOM

INRO TO ICU :

An intensive care unit (ICU), also known as an intensive therapy unit or intensive treatment unit (ITU) is a special department of a hospital or health care facility

that provides intensive care medicine service for Patients who are very ill and can be benefit from more detailed observation and treatment

It is generally available in standard wards and departments

- Highest level of continuous patient (maintenance, care, treatment)
- nurse :patient 1:1
- nurse in charge 24 hr resident doctor 24 hr
- consultant frequent (visit 2-4hr) .
- facilities to support organ system
- failure with full monitor care.

- The main functions of any ICU :
- Provide optimum life support.
- Provide adequate monitoring of
- vital functions.

WARD

- Block forming a division of a hospital (or a suite of rooms) shared by patients who need a similar kind of care.
- nurse :patient : NURSE/shift
- nurse in change : NURSE/room
- resident doctor available
- consultant frequent: per call or round
- facilities to support organ system failure: not necessary

DIFFERENT UNITS

- There are verity of names depends on specific purpose and the degree of dependency of the patient Many different hospitals have many different terms. Frequently seen are :

MICU	=	Medical ICU
SICU	=	Surgical ICU
TICU	=	Trauma ICU orTransplant ICU
NICU	=	Neuro ICU or NeonatalICU
PICU	=	Pediatric ICU
CVICU	=	Cardiovascular ICU
CCU	=	Coronary CareUnit
CICU	=	Cardiac ICU
BICU	=	Burn ICU
RCU	=	Renal care unit

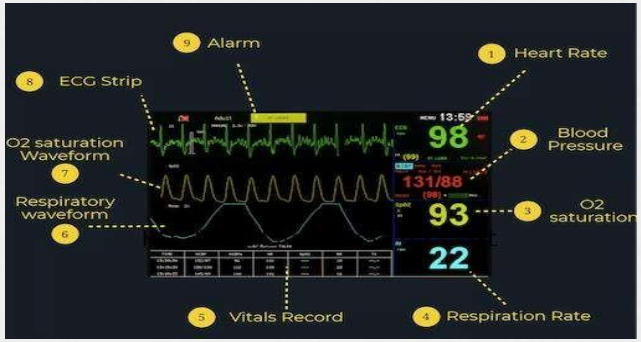
PREPRATION OF THE UNIT

- The unit should be kept ready all the time which should include the following:

1.special bed having the following facilities

- Head board should be detachable to facilitate intubation (in case of cardio pulmonary arrest)
- -Bed should be firm and non yielding to facilitate cardiac massage
- -Should have a tilting mechanism (to keep position of patient)
- -Should have side rails to prevent falling (psychiatric and anxious patient)

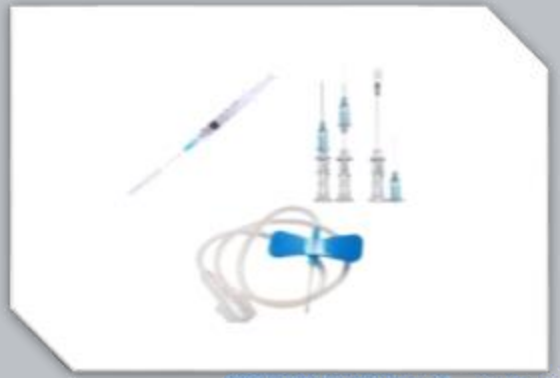
2.Cardiac monitor system with alarm that may be connected to the central console



3.Oxygen and suction apparatus (preferably pipe line model)

4.Resuscitation unit containing the following:

•Syringes, needles, IV cath, intravenous administration sets, blood sets, scalp vein sets and intra venous fluid



•Airways, endotracheal tubes and laryngoscopes of different sizes and types.

4.Resuscitation unit containing the following:

Ambu bag and suction catheters

Oxygen cylinder's special trays such as tracheostomy tray, and catheterization tray

Drugs such as (antiarrhythmics, antianginals, antihypertensive, diuretics, anticoagulants, antibiotics, anticonvulsants etc...

Infusion pump

- **The following equipments should be easily available:**

01 Defibrillator in working mode with electrodes and gel

02 Cardiac pacemaker with pacing catheters in the sterile tray

03 Mechanical ventilators (to support the patient)

04 Facility for invasive and non invasive procedure like (CVP line, intra arterial pressure monitor)

05 Portable X-Ray machine

06 ECG machine and Oxygen therapy

INDICATIONS FOR ADMISSION

- Pre and post-operative patients and who underwent major surgeries.
- craniotomy patients.
- Thoracotomy patients.
- Ultra major surgeries.
- Unstable multiple trauma patients.
- Patients with head or spine trauma requiring mechanical ventilation.
- Any surgical patient who requires continuous monitoring or continuous life support

ICU PATIENTS

- critical patients (multiple diagnoses, multi-organ failure, immunocompromised and major trauma and post surgery)
- hypotension
- Malnourished
- Glasgow coma scale ≤ 12
- organ failure

ADMITTED TO ICU CRITERIA IN GENERAL

Compromised airway

GCS ≤ 12

Unstable vital sign

pH ≤ 7.2

..or 7.5

Paco2 > 45- 55

Pao2 < 60 (HYPOXIA)

need of vasopresser

HYPOXIA CLASSIFICATION (PAO2 < 60MMHG)

Hypoxic Hypoxia in inadequate ventilation and oxygenation. (altitude ,asthma, Resp. disease)

Anemic Hypoxia in inadequate hemoglobin content OR function. (anemia, Carboxyhemoglobin, methemoglobin)

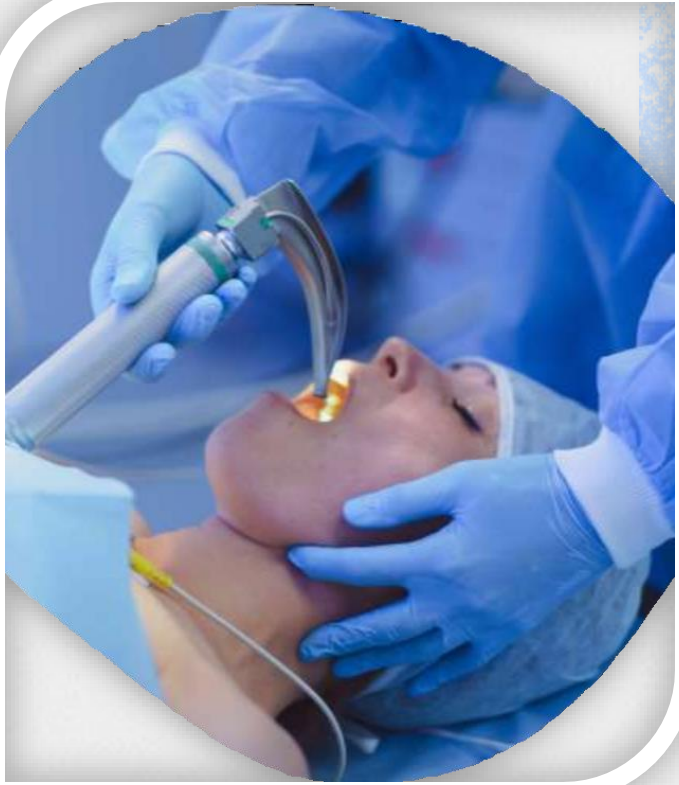
Circulatory Hypoxia in inadequate perfusion. (CHF)

Histotoxic Hypoxia in inability of the cells to utilize oxygen. (Cyanide, salicylic acid poisoning)

DEMAND HYPOXIA increase O2 requirement. (fever, seizure)

- **Hypoxemia S&S:**
  - restlessness , tachycardia ,tachypnea, cyanosis
  - (Cardiac irritability → Obtundation → Bradycardia → Hypotension and Ischemia → cardiac arrest).

- **Hypovolemia S&S:**
  - Dehydration+ Decrease B.P,
  - Orthostatic hypotension ± decrease Hb level or blood volume



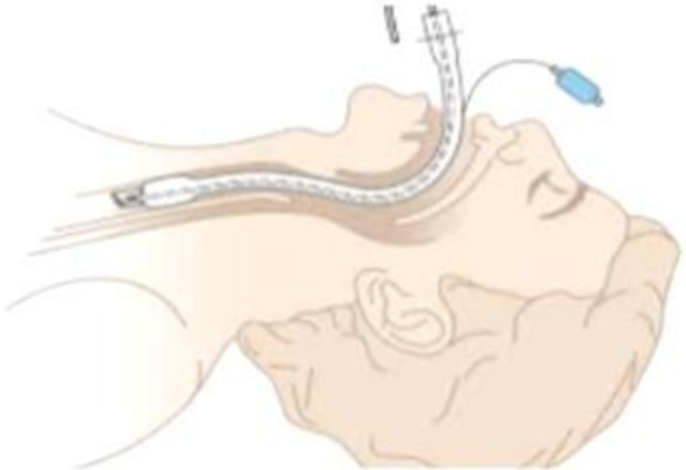
02

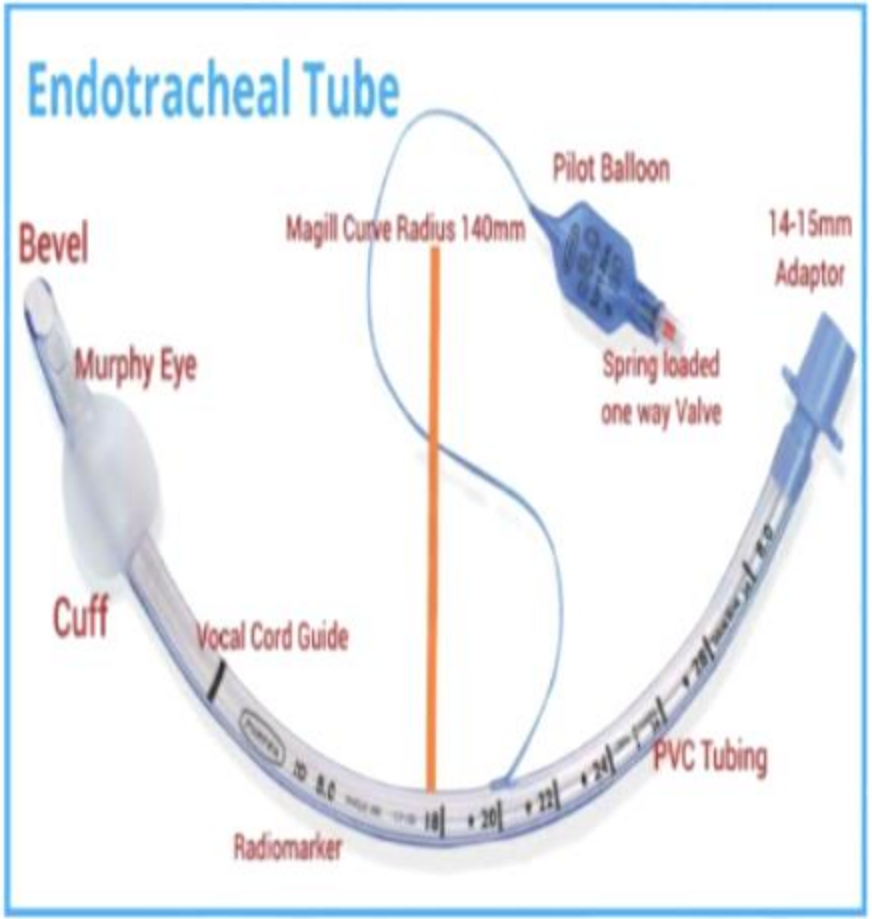
INTUBATION

INTUBATION:

Intubation is the process of inserting a tube, called an endotracheal tube (ET), through the mouth and then into the airway.

When it is done the patient can be placed on a
ventilator to assist with breathing during anesthesia, sedation, or severe




Endotracheal Tube
Pilot Balloon
Magill Curve Radius 140mm
14-15mm
Adaptor
Bevel
Murphy Eye
Spring loaded
one way Valve
Cuff
Vocal Cord Guide
PVC Tubing
Radiomarker

INTUBATION INDICATIONS

1- apnea as in:

Central decrease GCS ≥ 8 → Absent gag reflex.

Induced apnea →General anesthesia.

Poisoning.

2- .Respiratory failure:

drugs arrest.

diseases (ARDS, COPD, Asthma, sepsis).

3- .Respiratory airway protection:

risk of aspiration.

burn patients.

4- .Respiratory obstruction:

trauma, tumor, laryngeal edema, epiglottitis, foreign body.

5- .hemodynamic instability:

shock, cardiac arrest, sever hypothermia.

ESSENTIAL MANAGEMENT IN ICU: (FAST HUG)

F .sgnideef :

A .aiseglana :

S .noitades :

T : Thrombo embolism prophylaxis

H noitavele deb fo daeh : (30-45)

U .sixalyhporp reclu :

G lortnoc esoculg :

Monitoring System Topics:

1 -Non-Invasive BP measurement
2 -Central line (central venous catheter)
3 -Invasive arterial line
4 -Capnography
5 -Pulse oximeter
6 -Arterial Blood Gas (ABG)
7 -Temperature
8 -Oxygen analyzer
9 -Urine catheter
10 -ECG

One of the most important stuff to be managed in the ICU is
BLOOD PRESSURE.

What is blood pressure?

is a measure of the force that your heart uses to pump blood
around your body.

How do we measure BP?

1- Non-Invasive technique:

Provides either Continuous readings Or Provides Intermittent
readings

example for Intermittent readings occluding upper arm cuff

How do we obtain those readings and results?

Manually :
1- auscultation of Korotkoff
2- palpation

Automatically : oscillometry

Cuff bladder width should equal 40 %and the length should equal/exceed 60 %extremity circumference.

Why measuring bp is important in the ICU?

1- It Provides data for therapeutic decisions.

2- Important for determining organ perfusion.

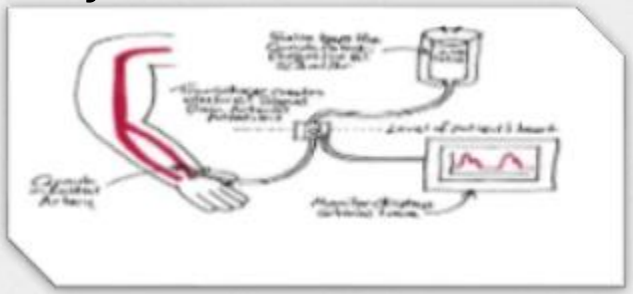
3- One of the vital signs.

We measure bp every 4 hours in the ICU.

2 -Invasive blood pressure technique (IBP):

Invasive (intra-arterial) blood pressure (IBP) monitoring is a commonly used technique in the Intensive Care Unit (ICU) and is also often used in the operating theatre.

This technique involves direct measurement of arterial pressure
by inserting a cannula needle in a suitable artery.



Arterial Line (art-line):

is a thin catheter inserted into an artery.

Arterial lines are commonly used in critical care.

They allow us to draw blood easily from (IBP) without having to stick the patient with a needle.

Most commonly used in I.C.U and anesthesia to monitor the BP.

it's more accurate than measurement of BP by noninvasive means, and to obtain continuous samples for ABGs.

Arterial lines can be placed in multiple arteries, including: Radial, Ulnar, Brachial, Axillary, Posterior tibial, Femoral, and Dorsalis pedis.
Mostly inserted in Radial artery because its large and more superficial with Low complication.
The second Most common is Femoral artery: larger and strong pulsation.

Arterial cannulation is used to :

- to access arterial blood sample, for checking ABG.

- for arterial pressure monitoring.

- But not for intra vascular drug administration.

- A saline-filled tube is used to connect the cannula to the transducer, to the display, It measures IBP on beat to beat basis.

Allen's test:

Allen's test is medical sign used physical examination of arterial blood flow.

It is used to determine collateral circulation between the Ulnar and Radial arteries to the hand.

recommended to do it before insertion radial arterial line.

Collateral flow should retain within 5-10 sec.

More than 10 sec >> insufficient collateral blood flow.

Disadvantage: Need Cooperation with the patient.

Alternatives: Doppler probe, Pulse oximeter , plethysmography.

Technique:

The hand is elevated and the patient is asked to clench their fist for about 30 seconds

then pressure is applied over the ulnar and the radial arteries so as to occlude both of them.

While the hand is still elevated, ask the patient to open his hand and compare color, it should appear blanched (pallor may be observed at finger nail).

Now release the ulnar pressure while maintaining the radial → the red color should return quickly.

If red color fails to return, the test is considered abnormal and it suggests that the ulnar artery supply to hand is not sufficient

03

CENTRAL VENOUS PRESSURE (CVP)

Central venous access is a commonly performed procedure with approximately 8 percent of hospitalized patients requiring central venous access to place a central venous catheter during the course of their hospital stay.

The CVP cannula is inserted in to the internal or external jugular vein or subclavian vein or femoral vein(large veins)

_The tip is situated approximately 2cm above the right atrium in the superior vena cava

•Normal range 0-8 CMH20

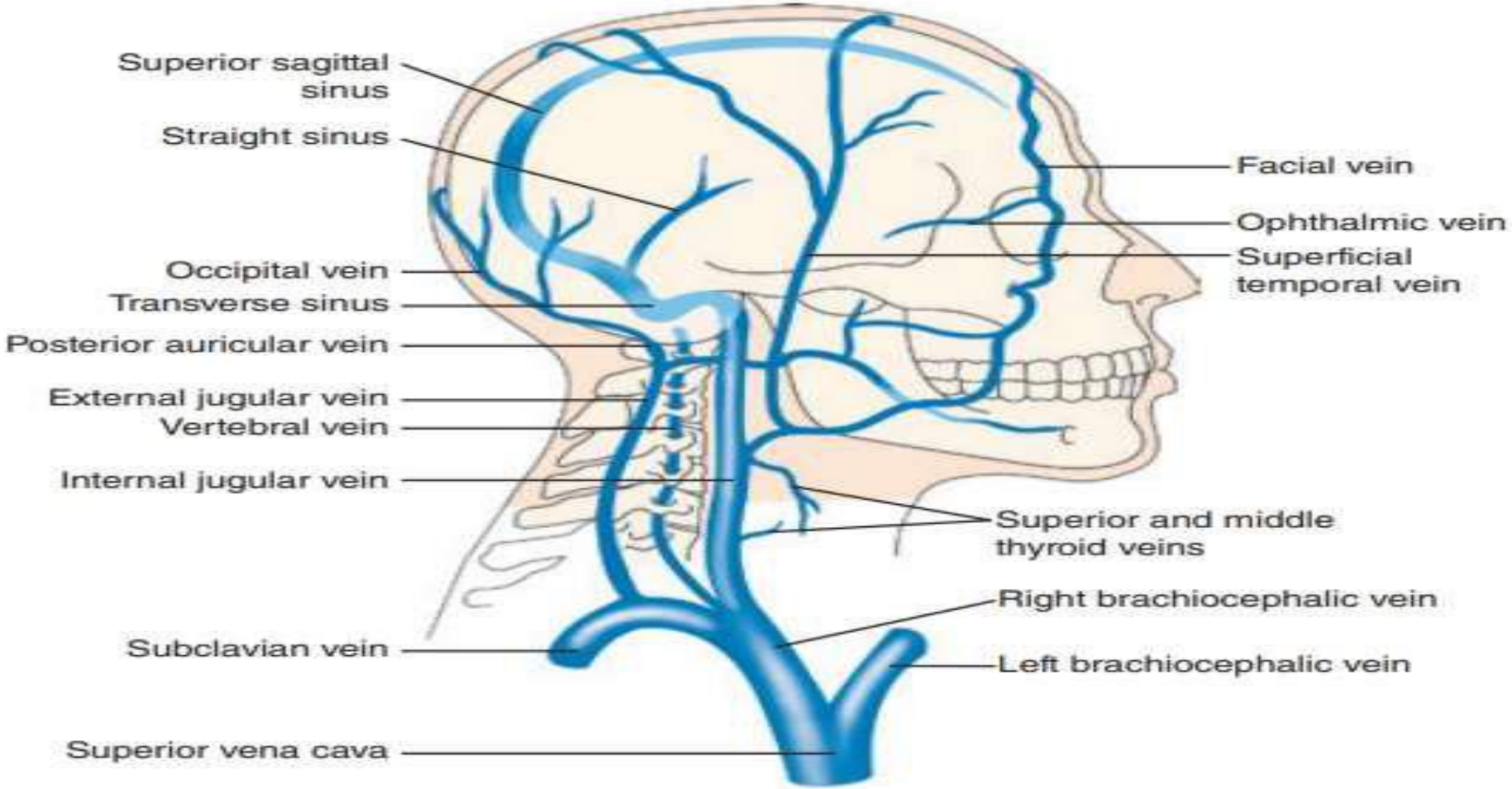


FIGURE 19-15 Head and neck veins.

INDICATIONS:

Common indications for the placement of central catheters include :

1. Administration of noxious(irritant) medications – Medications such as vasopressors, chemotherapy.
2. parenteral nutrition are given by central venous catheters because they can cause vein inflammation (phlebitis) when given through a peripheral intravenous catheter.
3. Hemodynamic monitoring – Central venous access permits measurement of the central venous pressure, venous oxyhemoglobin saturation and cardiac parameters (via pulmonary artery catheter).
4. Plasmapheresis, apheresis, hemodialysis, or continuous renal replacement therapy.
5. Poor peripheral venous access.

Contraindications:

Are relative and depend upon the urgency and alternatives for venous access. Cannulation is generally avoided at sites with:

1. **anatomic distortion**
2. **other indwelling intravascular hardware, such as a pacemaker, or hemodialysis catheter.**
3. **Injury proximal to the insertion site**
4. **Coagulopathy**
5. **Site of infection**
6. **Morbid obesity**
7. **arrhythmia**

Complications:

Immediate
Bleeding
Arterial puncture
Arrhythmia
Air embolism
Thoracic duct injury (with left SC or left IJ approach)
Catheter malposition
Pneumothorax or hemothorax
Delayed
Infection
Venous thrombosis, pulmonary emboli
Catheter migration
Catheter embolization
Myocardial perforation
Nerve injury

04

Arterial catheterization

Arterial catheters (also called intra-arterial catheters or A-lines) are common in critically ill patients. They can be used to obtain arterial blood for laboratory testing, and for direct measurement of blood pressure and cardiac output it's mainly inserted in (radial, ulnar, femoral, posterior tibial and dorsalis pedis artery). However, insertion of an arterial catheter is an invasive procedure and complications can occur.

Indications:

Advantages of an indwelling arterial catheter include **continuous access to arterial blood and the ability to continuously measure the blood pressure**. As a result, arterial catheterization is indicated when:

1. Frequent blood gases are necessary, such as with acute respiratory failure.
2. The blood pressure must be monitored closely, such as during shock, major surgery, hypertensive emergency, or vasopressor therapy (hemodynamic instability) .
3. Continuous monitoring of cardiac output and stroke volume

- **Surgical considerations:**

-Cardiac Surgery.
-Major surgery on aorta or carotid artery.
-Neurosurgery as craniotomy or aneurysm clipping.

- **Anesthetic considerations:**

-Controlled hypotensive technique.
-Inability to measure blood pressure non-invasively

Arterial line Contraindications

Absolute Contraindications	Relative Contraindications
Absent Pulse	Hemorrhage
Thromboangitis obliterans	Angiopathy
Full thickness burns over the cannulation site	Coagulopathy
Raynaud syndrome Infection on site	Atherosclerosis

Complication of Arterial line insertion

- **Common complications** of arterial line placement are as:
- Temporary radial artery occlusion (19.7%)
- Hematoma /Bleeding (14.4%)
- **Less common and rare complications** include the following:
- Localized catheter site infection
- Air embolism
- Carpel tunnel syndrome
- Permanent ischemic damage -
- Thrombosis
- Arteriovenous fistula
- Sepsis

05

-Oxygen saturation SpO2
-Pulse oximeter

The pulse oximeter measures the oxygen saturation.

- It is non-invasive and risk free when used properly, the pulse oximeter should be used in all clinical settings in which there is a potential risk of arterial hypoxemia

- It provide an early and immediate warning of hypoxaemia

- If SpO2 is below 92% means the O2 delivering system is inadequate to meet the needs of the tissue or poor cardiac output

- Start O2 if SPO2 less than 95%

Factors affecting pulse oximeter readings:

1-poor circulation
2-thick skin
3-skin temperature is cool
4-nail polish or artificial nails

Currently available oximeters use two light-emitting diodes (LEDs) that emit light at the 660 nm (red) and the 940 nm (infrared) wavelengths Red (660-nm) and infrared (940-nm)wavelengths of light are used to determine the ratio oxygenated to deoxygenated blood. Deoxygenated blood absorbs more red light, whereas oxygenated blood absorbs more infrared light.

06

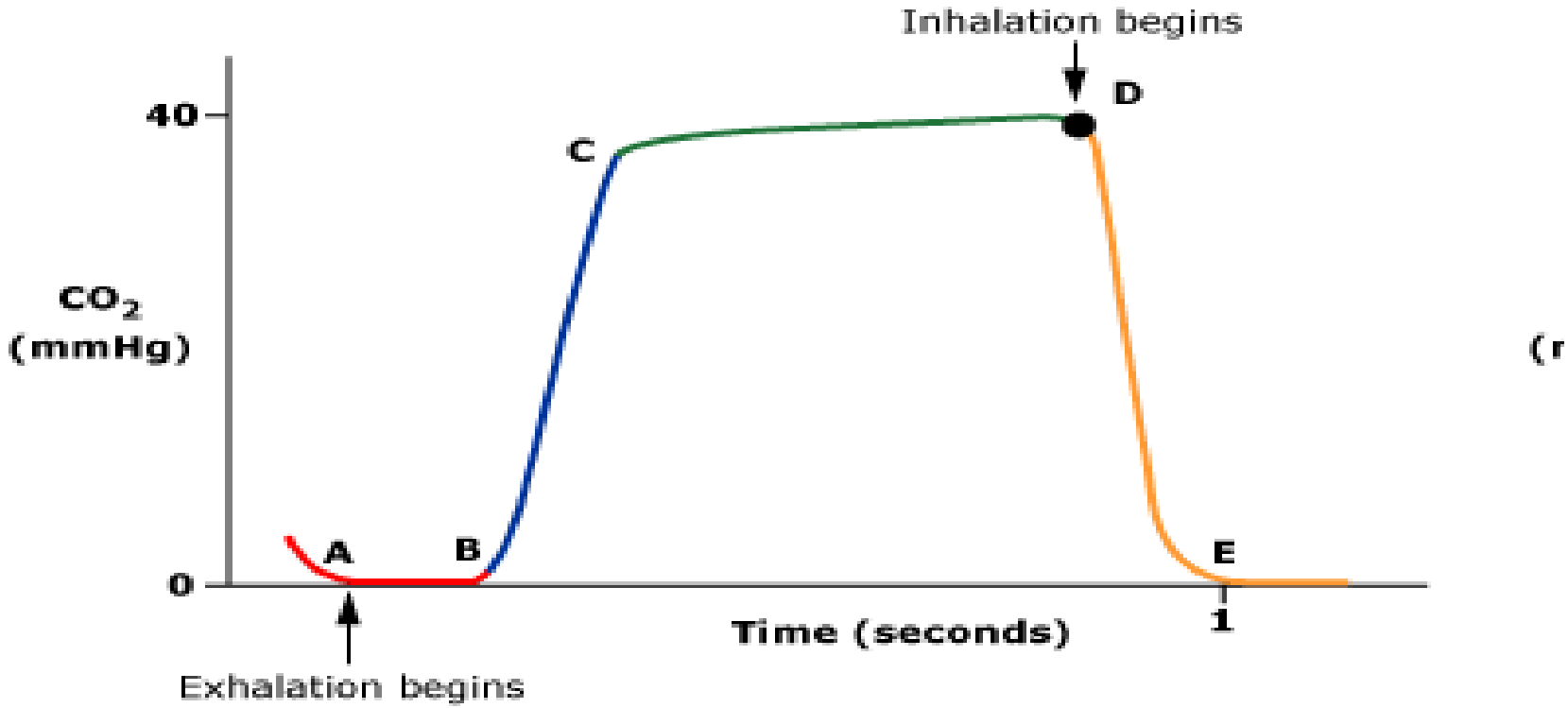
Carbon dioxide monitoring (capnography)

The term **capnography** refers to the non-invasive measurement of the partial pressure of carbon dioxide (CO_2) in exhaled breath expressed as the CO_2 concentration over time. The relationship of CO_2 concentration to time is graphically represented by the CO_2 waveform, or capnogram. Changes in the shape of the capnogram are diagnostic of disease conditions, while changes in end-tidal CO_2 ($EtCO_2$), the maximum CO_2 concentration at the end of each tidal breath, can be used to assess disease severity and response to treatment. Capnography is also the most reliable indicator that an endotracheal tube is placed in the trachea after intubation.

- Capnographs in common use rely on the absorption of infrared light by CO_2.

- As with oximetry, absorption of infrared light by CO_2 is governed by the Beer–Lambert law.

Normal CO2 waveform



End-Tidal CO2 Monitoring(ETCO2):

•is the partial pressure or maximal concentration of carbon dioxide (CO2) at the end of an exhaled breath, which is expressed as a percentage of CO2 or mmHg.

•The normal values are 5% to 6% CO2, which is equivalent to 35-45 mmHg.

Indications for Use -End-Tidal CO2 Monitoring:

1-Validation of proper endotracheal tube placement

2-Detection and Monitoring of Respiratory depression

3-Hypoventilation

4-Obstructive sleep apnea

5-Adjustment of parameter settings in mechanically

ETCO2 Less Than 35 mmHg	ETCO2 Greater Than 45 mmHg
Hypocapnia	**Hypercapnia**
Respiratory Alkalosis	**Respiratory Acidosis**

07

Arterial Blood Gas (ABG)

ABG : Analysis is an essential part for diagnosis and managing the patient **oxygenation** status ,**ventilation** status and **acid base balance**.

-ABG test measure the acidity (PH) and the level of oxygen and carbon dioxide in the blood from **an artery**.

-This test is used to check how well your lungs are able to move oxygen in to the blood and remove carbon dioxide from the blood

-Drawn from arteries(Radial , Brachial and Femoral).

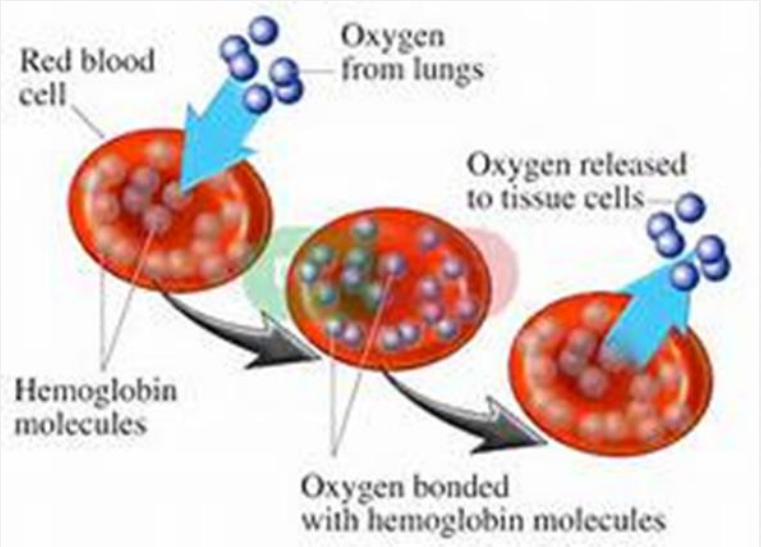
-Blood drown from an artery , where the oxygen and carbon dioxide levels can be measured before they enter body tissues.

-The **radial artery** is superficial, has collaterals and is easily compressed. It should almost always be the **first choice**.

-Other arteries (femoral, dorsalis pedis, brachial) can be used in **emergencies**

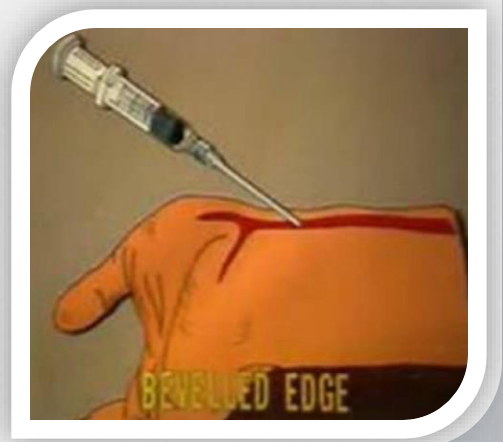
Normal ABG values:

- PO2 80 – 100 mmHg
- PCO2 35 – 45 mmHg
- pH 7.35 – 7.45
- HCO3 22 – 26 mmol/L
- SaO2 >95%



Contraindication:

- Bleeding diathesis
- AV fistula
- Severe peripheral vascular disease, absence of an arterial pulse



Complication :

- The most common complication

from an arterial puncture is :

- **Hematoma** at the site.

- Less common but important complications are **thrombus** in the artery and **infection** at the site

08

Patient Temperature

Patient Temperature :

- Temperature regulation is important to the survival of the patient.
- Although uncommon, **hypothermia** below 32° C is ominous
- Ventricular irritability increases, and if the temperature decreases to 28° C **cardiac arrest** is likely.
- **shivering** can increase oxygen demand 135% to 468%,when respiratory and cardiovascular systems may be unable to respond normally to the increased demand.

Sites for monitoring body temperature :

- Oral.
- Rectal
- Axillary
- Tympanic membrane
- Esophageal
- Nasopharyngeal
- Pulmonary arterial blood
- Bladder
- Forehead

Hypothermia :

- Hypothermia is defined as a potentially dangerous drop in body temperature below 35°C (95°F), and can be the result of :

- environmental forces (accidental hypothermia)
- metabolic disorder (secondary hypothermia)
- therapeutic intervention (induced hypothermia)

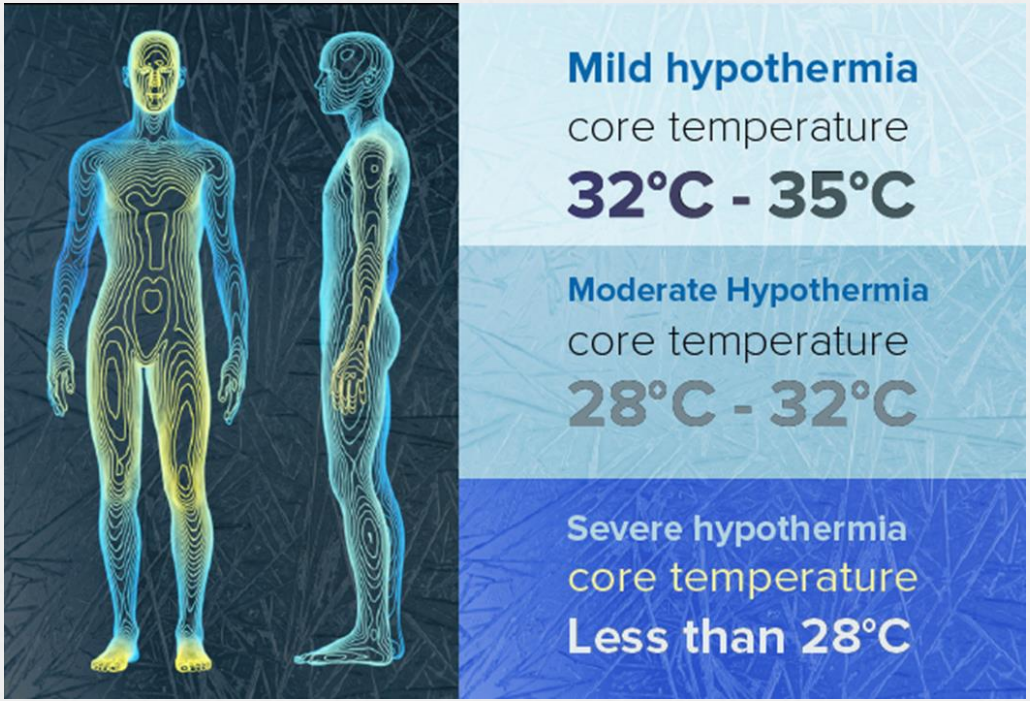
- usually it caused by prolonged exposure to cold temperatures.

What causes hypothermia:

- Cold exposure

- Certain medical conditions such as **diabetes** and **thyroid conditions**, some **medications**, **severe trauma**, or **using drugs** or **alcohol** all increase the risk of hypothermia.

Types of hypothermia :



Mild Hypothermia(32 – 35°C)

- shivering – not under voluntary control

- Cold ,pale skin from vasoconstriction to periphery (fingers, toes etc)

- Confusion

- Tachycardia

Moderate hypothermia (28 – 31.9°C)

- reduced level of consciousness
- loss of fine motor coordination, particularly in hands due to restricted peripheral blood flow
- slurred speech
- violent shivering
- Bradycardia
- Bradypnea
- Lethargy

Severe hypothermia (< 28°C)

- casualty falls to the ground, curls up into a fetal position to conserve heat
- muscle rigidity develops because peripheral blood flow is reduced and due to lactic acid and carbon dioxide buildup in the muscles
- the skin becomes pale
- Patients are usually obtunded or comatose with dilated, fixed pupils
- pulse rate decreases
- No shivering
- Hypotension
- Oliguria
- Edema
- Arrhythmias

What Is the Management for Hypothermia ?

Hypothermia is a potentially life-threatening condition that needs emergency medical attention:

1)EXTERNAL REWARMING

a) Remove any wet clothes, hats, gloves, shoes, and socks.

b) Protect the person against wind, drafts, and further heat loss with warm, dry clothes and blankets.

c) Move gently to a warm, dry shelter as soon as possible.

d) Begin rewarming the person with extra clothing. Use warm blankets.

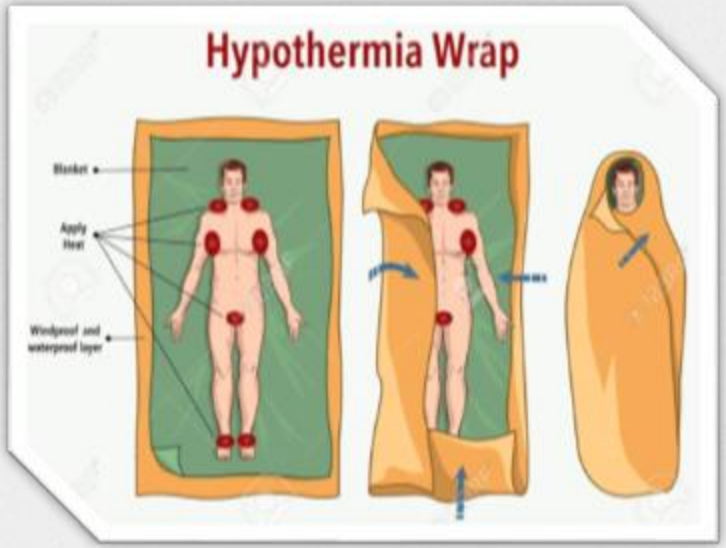
e) Take the person's temperature if a thermometer is available.

f) Offer warm liquids, but avoid alcohol and caffeine, which speed up heat loss. Don't try to give fluids to an unconscious person.

g) CPR should be continued, in the absence of signs of breathing or a pulse.

2)INTERNAL REWARMING:

rewarm the core temperature.
Hypothermia treatment may include warmed IV fluids, heated and humidified oxygen,
peritoneal lavage (internal "washing" of the abdominal cavity), and other measures.



09

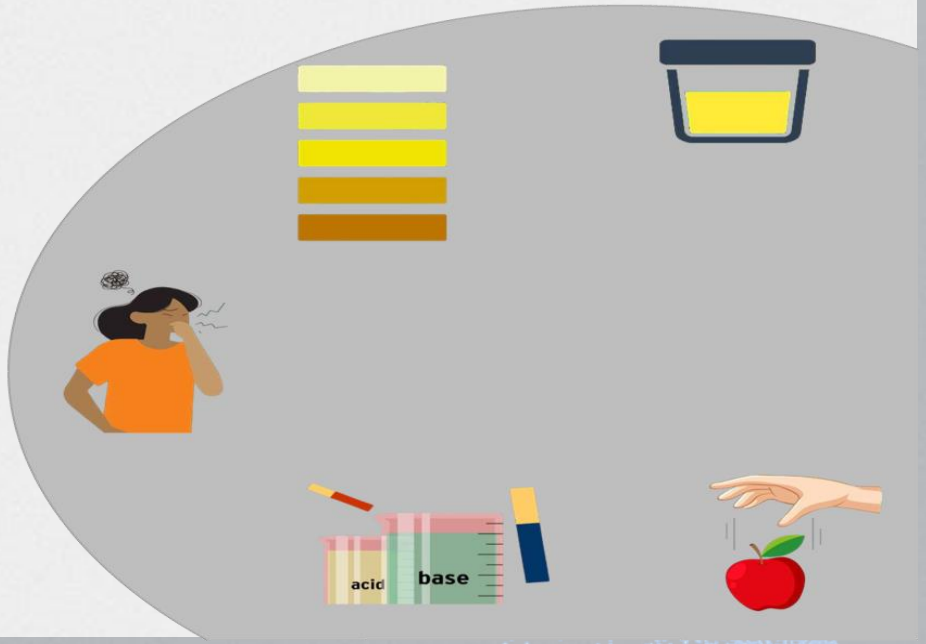
Monitoring the urine output

Monitoring the urine output :

Urine output is the best indicator of the state of the patient's kidneys.

If the kidneys are producing an adequate amount of urine, it means that they are well perfused and oxygenated. Otherwise, it is a sign that the patient is suffering from some complication

Physical Characteristics of urine examination



1) Volume:

Normal- 1 - 2.5 L/day.

Oliguria- Urine Output < 400ml/day.
Seen in – Dehydration – Shock – Acute glomerulonephritis – Renal Failure – burns

Polyuria- Urine Output > 2.5 L/day.

Seen in – Increased water ingestion – Diabetes mellitus, insipidus, excessive use of diuretics, excess caffeine or alcohol.

Anuria- Urine output < 100ml/day.

Seen in renal shut down Volume, obstruction, such as kidney stone, prostate enlargement .

2) Color:

normal – pale yellow in colour due to pigments : urochrome, urobilin and uroerythrin.

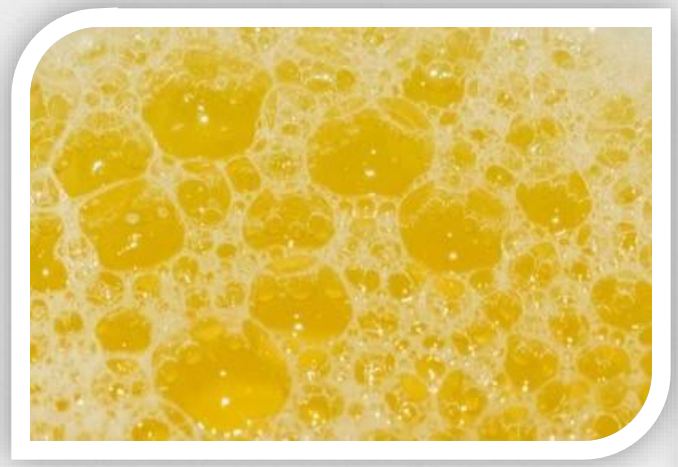
Cloudiness may be caused by excessive cellular material or protein, crystallization or precipitation of non- pathological salts upon standing at room temperature or in the refrigerator, also can be caused by urinary tract infections or obstructions.

Color of urine depending upon its constituents.

Abnormal colors:

Colorless – diabetes, diuretics.
Deep Yellow – concentrated urine, excess bile pigments, decrease of water intake or dehydration , jaundice Color
Red urine (pink) - (hematuria) indicates red blood cells within the urine, a sign of kidney damage and disease
Green urine (rare) : bacterial infection

Color



3) Odor

Normal - aromatic due to the volatile fatty acids, on long standing (aged urine) – ammonical (decomposition of urea forming ammonia which gives a strong ammonical smell)

Foul, offensive - pus or inflammation

Sweet - Diabetes

Fruity - Ketonuria

4) PH

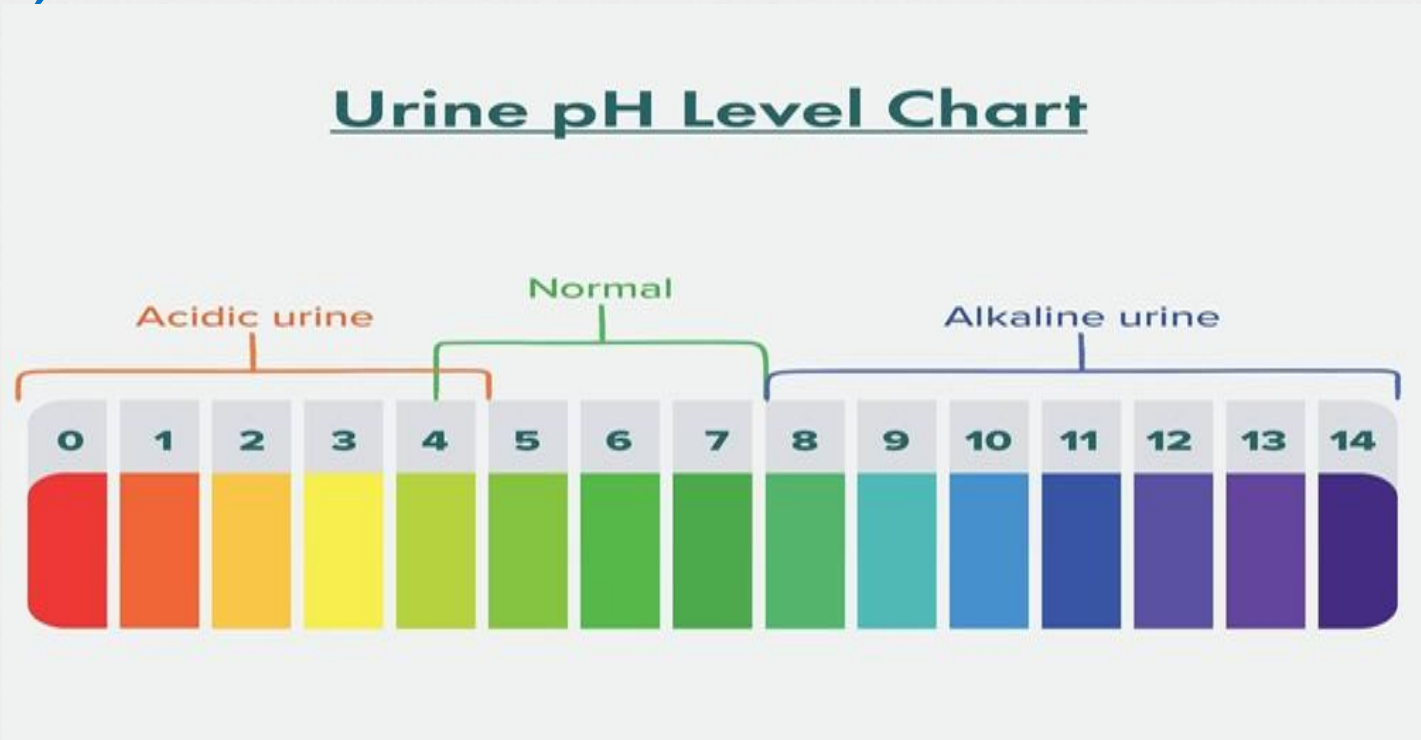
- Reflects ability of kidney to maintain normal hydrogen ion concentration in plasma & ECF

- Normally it is slightly acidic lying between 6 –6.5.
- **Acidic Urine** –Ketosis (diabetes), UTI- E. coli
- **Alkaline urine -**
- kidney failure ,UTI with urease-producing bacteria (typically Staphylococcus or Proteus spp.

- Much of the variation occurs due to diet.

- For example, high protein diets result in more acidic urine, but vegetarian diets generally result in more alkaline urine Chronically high or low pH can lead to disorders, such as the development of kidney stones or osteomalacia

4) PH


Urine pH Level Chart
Acidic urine
Normal
Alkaline urine
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14

5) Specific gravity

- the ability of the kidney to concentrate the urine relative to the plasma from which it is filtered.
- Normal :- 1.001- 1.040
- Increase in Specific Gravity: - Low water intake, Diabetes mellitus, Albuminuruia, Acute nephritis.
- Decrease in Specific Gravity - Absence of ADH, Renal Tubular damage.

- To measure urine output in critical care units—> a **Foley catheter** is
- introduced through the patient's urethra until it reaches his/her bladder, the
- other end of the catheter is connected to a graduated container that collects the urine.

- Periodically the nursing staff manually records the reading of the container of every patient and operates a valve which releases the urine into a larger container

• To avoid -**urine reflux-** and minimize the risk of infection, the chamber should remain at a level below the bladder

- ******Keep the urinary catheter bag lower than the patient!!!**

- often only burn patients —for whom urine output monitoring is of paramount importance— have this parameter recorded every hour

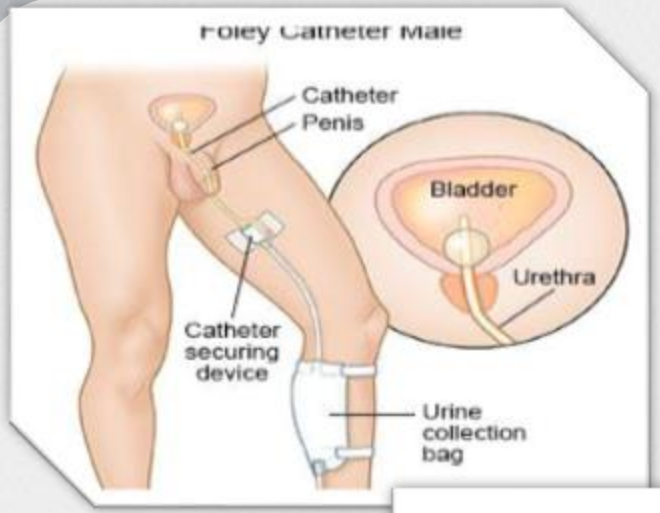
- -while the remaining critical patients have it recorded every 2 or 3 hours.

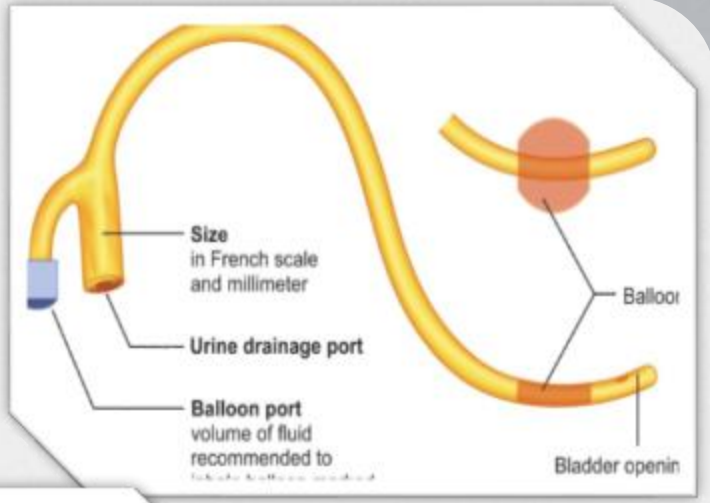
Complications of catheterization, urethral trauma & UTI

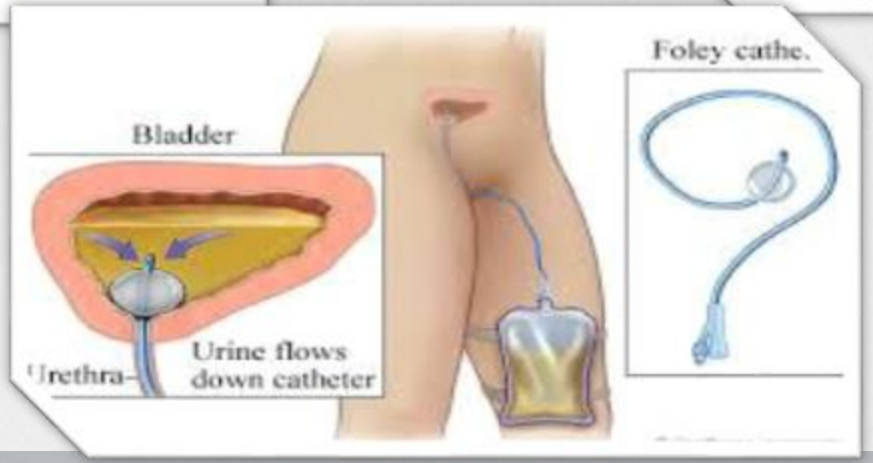
- Rapid decompression of a distended bladder can cause
- hypotension.

- An additional advantage of placing Foley catheter is the ability to include a '' thermistor '' in the catheter tip so that bladder temperture can be monitored.

- As long as urinary output is high, bladder temperture accurately reflects core temperture


Foley Catheter Male
Catheter
Penis
Bladder
Urethra
Catheter securing device
Urine collection bag


Size
in French scale and millimeter
Urine drainage port
Balloon port
volume of fluid recommended to
Balloon
Bladder openin


Bladder
Urethra
Urine flows down catheter
Foley cathe.