

CRITICAL CARE MEDICINE

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OUTLINE

- Introduction
- What is critical care?
- ICU multidisciplinary team
- Hemodynamic monitoring
- Ventilation
- ICU assessment and documentation
- Who gets ICU admission
- Common ICU scenarios

CRITICAL CARE

- Historically, we recognized that the needs of patients with acute, life-threatening illness or injury could be better treated if they were grouped into specific areas of the hospital.
- Intensive care began in the United States in 1920's, when W.E. Dandy established the first 3-bed neurosurgical ICU at Johns Hopkins Hospital in Baltimore.

CRITICAL ILLNESS

- Acute life threatening conditions that require close and frequent assessment and multi-disciplinary care.
 - Trauma
 - Sepsis
 - Respiratory failure
 - ACE acute coronary syndrome
 - ETC.

life-threatening conditions need reassessments by many specialists. such as open fracture, head injury, lung contusion.

CRITICAL CARE UNIT

- A section in the hospital that is equipped to deal with critically ill patients.
 - General ICU
 - Surgical ICU
 - Medical ICU
 - Neuro ICU
 - ETC.

ADVANTAGES/DISADVANTAGES OF CRITICAL CARE UNIT

- The chief advantage is that it provides better and more organized care
More imp is bein organized as ICU physicians & team.
- The main disadvantage is of a hostile environment contributing to anxiety, emotional stress, loneliness, fear and a greater risk of developing nosocomial infections.

If a patient has terminal incurable cancer, dont put him in ICU doing aggressive measurements as it may add to his miseray for no reason. ICU for patients who can benefit from it. as acute life threatening illness that reversible.

ICU MULTIDISCIPLINARY TEAM

- ICU medical team, (consultant, assistants, residents, etc.)
- Nursing, (specialized in critical care, 1:1 ratio ideally) Every patient has one nurse. Maybe 1 nurse for 2 patient but above 2 count as below standard.
- Respiratory therapy.
- Dieticians
- Clinical pharmacists
- Physiotherapy
- Occupational therapy.
- Social worker
- Consultation services, (Radiology, ENT, Surgery, Nephrology, etc.)

ICU MULTIDISCIPLINARY TEAM

- Provide advanced care to ICU patients
 - Multi-disciplinary management plan.
 - Advanced and tight monitoring of vital signs.
 - Resuscitation and maintaining vital functions during critical illness.
 - Provision of life-saving treatment modalities.

HEMODYNAMIC MONITORING

- Monitoring provides an early warning of adverse changes or trends before irreversible damage occurs.
- Monitoring
 - reflects physiologic homeostasis
 - allows prompt recognition of responses to therapeutic interventions
 - allows prompt recognition of adverse changes.
- What is the most important monitor?
 - Vigilance! best monitor

hemodynamic monitoring can be done in OR but mainly in ICU. for patient unstable hemodynamically or stable but at risk to be unstable as having big surgery.

MONITORING MODALITIES

- Vigilant Physicians (**Subjective data**)
 - Monitors
 - (Visual, Tactile, Auditory, Olfactory)
- Standard Monitoring Equipment (**Objective Data**) something has numbers
 - Pulse Oximetry
 - Capnography not in every hospital but if its there then its imp to do it.
 - Body Temperature
 - ECG not full 12 leads ECG. but he must has constant ECG to catch any arrythemia
 - Systemic Blood Pressure

the doc went through it fast

MONITORING THAT REQUIRES NO INSTRUMENTATION

- Inspection
 - Skin (Is there normal capillary refill? Delayed return suggests abnormality in regional or systemic circulation)
- Palpation
 - Skin (Is the patient warm or cold and clammy)
 - Pulse (Presence/Absence of pulse)
 - Skeletal muscle (Are muscles fasciculating)
- Auscultation
 - Chest (Listen for breath sounds over both lung field, is there paradoxical breathing)
 - Heart (Are sounds muffled, or murmurs present)

NON-INVASIVE HEMODYNAMIC MONITORING

- Noninvasive BP
- Heart Rate, pulses
- Mental Status and urine output are end organs perfusion. از ذي شغاله كويس then im very happy
- Skin Temperature
- Capillary Refill
- Urine Output

MINIMAL MONITORING STANDARDS

- Oxygenation (inspired gas and saturation of arterial blood (SpO₂))
- Ventilation (capnography and clinical assessment) or by GCS (Glasgow Coma scale)
- Circulation (ECG, arterial blood pressure)
- Temperature
- Neuro-vitals (GCS, mental status)

as u get a patient in ICU due to hemodynamically monitoring then i have to have these 5 checked in ICU.

ممکن الکا بنوغرافی مہ موجود ولکن البقیہ لازم یتواجدوا. اذ ما قدرنا نحسب الساتوریشن علی کذا ال ICU is useless

PULSE OXIMETRY

- Assess the oxygenation of blood
 - Reduced (or deoxygenated) hemoglobin (Bluish)
 - Oxygenated hemoglobin (Red)
- How it works?
 - A probe send light impulses into a finger and collects the light that pass through it.
 - The units estimates the proportion of oxyhemoglobin to reduced hemoglobin

very important

- SpO₂ – the saturation based on pulse oximetry
- SaO₂ – the saturation obtained from direct arterial blood sample

نأخذ عينه من الartery ونرسله للماشين ويطلع لنا بالضبط كم فيه saturation

accurate measurements are approximately the same

بس فيه اشياء تخرب على الpulse oximetry فممايعطيك قراءة صحيحة. امثاله بالسلايد القادمة.

one of most imp thing to follow in ICU

PULSE OXIMETRY

- Acceptable readings depend on the clinical condition, and trends must be considered.
- Limitations:
 - Cannot differentiate between different forms of hemoglobin.
 - Environmental interference: vibration at 0.5-3.5 Hz, excessive movement and perhaps high level of ambient light, including infrared heat lamps.
 - Cold hands
 - Poor perfusion.
 - Nail polish.
 - Intravascular dyes

O₂ saturatione different from patient to patient but above 92% is acceptable. for example COPR and chrong lung disease can tolerate from 88% to 92%.

But u have to know the trend, if a patient has been 100% saturated but suddenly drop to 92% u have to investigate. as the trend of this patient was 100%

ELECTROCARDIOGRAM (ECG)

- Provides information on
 - cardiac arrhythmias
 - myocardial ischemia/infarction
 - electrolyte changes, particularly potassium
- ECG is not a measure of heart function
- ECG reflects only the electrical activities occurring in the heart

ECG

- Lead V5 is the most sensitive lead for detecting ischemia
- Lead II is the most sensitive lead for detecting arrhythmias
- P waves are best seen on Lead II
 - best to observe the cardiac rhythm.

BLOOD PRESSURE (BP) MONITORING

- BP monitoring is commonly performed either:
 - Indirectly – noninvasive cuff around extremity
 - Directly – inserting catheter into artery

BLOOD PRESSURE (BP) MONITORING

- Systolic Blood Pressure (SBP)
 - Pressure which ejected blood will overcome to perfuse vessels distally
- Diastolic Blood Pressure (DBP)
 - Pressure under which the blood flow will be laminar
- Pulse Pressure = SBP – DBP Pulse pressure is when heart pumps strongly, systolic will be higher than diastolic which is normal. but when they r almost equal then its no good.
- Mean Arterial Blood Pressure (MAP)
 - Time weighted average of arterial pressures during a pulse cycle
 - $MAP = [SBP + (2 \times DBP)] / 3$

In ICU we target MAP above 65, sometimes we need higher target as in neurosurgery as we need more perfusion but most of the time 65 is per minimal that we need to consider the patient is well.

NON-INVASIVE BP MONITORING

- Mechanical deformation from the blood pressure cuff of an artery leads to the creation of Korotkoff sounds result from turbulent flow
- The appearance of the first Korotkoff sound is the systolic blood pressure
- The disappearance of the Korotkoff sound signals the diastolic blood pressure.

NON-INVASIVE BP MONITORING

- American Heart Association recommends
 - Bladder width: approximately 40% of the circumference of the extremity
 - Bladder Length: sufficient to circle at least 60% of the extremity
- Falsely low estimates occur:
 - after quick deflation
 - when the extremity is above the heart
 - when cuffs are too large
- Falsely high estimates occur when:
 - cuffs are applied too loosely
 - when the extremity is below heart level
 - when cuffs are too small

They may report a case with low BP and the patient is on epinephrine.
ولا بالطريقة الصحيحة non-invasive وبتشوف بعدين يستخدمون

NON-INVASIVE BP MONITORING PROBLEMS

- Hematomas results due to increase venous pressure after failure to deflate the cuff
لان بال ICU نحسب الضغط كل دقيقتين فتلقاه يقفل ويفتح يقفل ويفتح على عكس الجناح قراءة وحده وخلص.
- Delayed cuff deflation can result from shivering and tremors
- Ulnar neuropathy can occur due to compression of the ulnar nerve
مب معناته ان استخدمت non-invasive يعني كل شيء تمام. بتظل فيه كومبليكيشنز.

INVASIVE BP MONITORING

- Provide beat to beat blood pressure reading (real time)
- Reliable access for analysis of arterial blood gases, pH, and/or electrolytes
- New technologies enable cardiac output estimation from invasive BP monitoring

very important

افضل طريقة لحساب الضغط، مع كل نبضة قلب يتغير الضغط ويحسبك بدقه عالية. سواء للبلود غازز او
البيشنت على vasopressin, or epinephrine

INVASIVE BP MONITORING

- Expected rapid changes in hemodynamic stability (shock)
- Induced hypotension, acute hypotension
- Inability to achieve noninvasive monitoring
- Use of Vasoactive drugs
- Frequent blood gas monitoring.

البيشنت الي بالشوك متوقعين انه يتغير الضغط خلال
نص ساعه لذلك نراقبهم. فأضل شيء انك تخليه على
constant monitoring

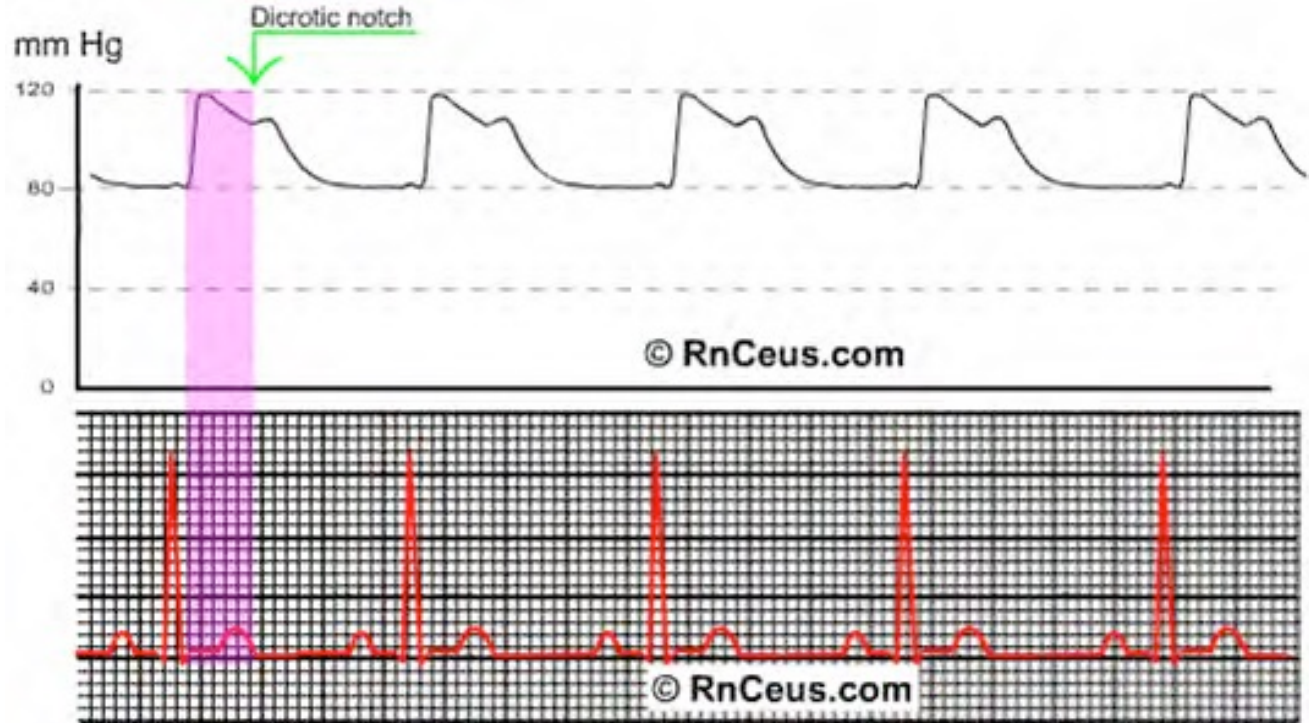
حتى لو البيشنت ضغطه طبيعي وماعنده اي ايشوز، لكن كل شوي احتاج اخذ بلود غاز مثل المحتاجين لـ ventilation بسبب
كورونا. البلود غاز يتغير كل شوي.

INVASIVE BP MONITORING

- Radial artery is the most frequent site
may cause hand ischemia or in femoral causing lower limb ischemia.
- Can be at femoral artery or brachial artery
- Dorsalis pedis rarely.

INVASIVE BP MONITORING

- Rate of upstroke indicates contractility
- Rate of the downstroke indicates peripheral vascular resistance
- Dicrotic notch reflects the closure of the aortic valve
- The farther out the dicrotic notch the lower the SVR or peripheral vascular resistance



INVASIVE BP MONITORING: COMPLICATIONS

- Hematoma
- Bleeding
- Vasospasm
- Arterial Thrombosis ممکن احد مايدري ان ذا الارتيريال لاین وانجکت درقز بالالین. جداً سيء بيسبب necrosis
- Distal Emboli مفترض تدخل على ال vein وتروح للقلب وتطلع diluted لكن لما تنحط بالارتري بتتمركز بالليمب وتكون toxic
- Infection and Necrosis
- Air embolism
- Unintentional intraarterial drug injection
- Pseudoaneurysm
- Damage to adjacent nerves

CENTRAL VENOUS ACCESS

- **Monitoring central venous pressure (CVP)**
- Rapid administration of fluid to treat hypovolemia and shock (i.e. acute hemorrhaging) so important as it monitor patient fluid resuscitation.
- Infusions of drugs
- Long-term IV Feeding (i.e. Hyperalimentation)
- Insertion of Transcutaneous pacing leads
- Venous Access in patients with poor peripheral veins

CENTRAL VENOUS PRESSURE

- Central venous pressure parallels right atrial pressure.
- Normal pressures might range from -2 to 12 mmHg in a spontaneously breathing patient.
- Pressures of 6 to 15 mmHg (or more with high peak inspiratory pressures) can be expected on mechanical ventilation.
- The shape of the central venous waveform corresponds to the events of the cardiac contractions.

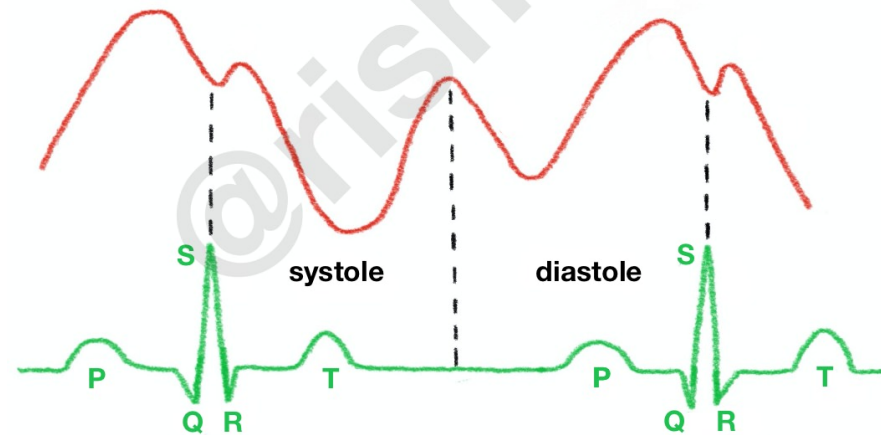
يحسب الضغط جوا الصدر فببتغير مع التنفس ومع cardiac arrhythmia, valve abnormality بس مب اكيوريت.

CENTRAL VENOUS PRESSURE

Three peak (a,c, and v waves) and two descents (x,y) can be seen in a normal CVP waveform.

RA/CVP WAVEFORM INTERPRETATION

<p>'a' wave (end diastole) right <u>atrial</u> (RA) contraction</p> <p>Lost in atrial fibrillation/flutter</p> <p>↑ 'a' wave in tricuspid/pulmonic stenosis and RV failure due to ↑ resistance to forward flow</p> <p>"Canon" 'a' waves in junctional rhythm, V-tach, 3° block from RA contraction against closed tricuspid valve (TV) generating large reflection wave back into RA</p>	<p>'c' wave (early systole) TV <u>cusps</u> bulging into RA</p> <p>Tricuspid regurgitation (TR) causes fusion of 'c' and 'v' waves with blunting of 'x' descent</p>	<p>'v' wave (late systole) rapid filling of RA</p> <p>↑ 'v' wave in TR (reaches RVSP) from regurgitant jet ↑ RA pressure</p>
<p>'x' descent (mid systole) RA relaxation</p> <p>↑ 'x' descent in constrictive pericarditis</p> <p>↓ 'x' descent with TR as this jet ↑ RA pressure. Suggests RV dysfunction due to ↓ apical motion</p>	<p>'y' descent (early diastole) early ventricular filling</p> <p>↑ 'y' descent in constrictive pericarditis</p> <p>↓ 'y' descent in tamponade due to pericardial fluid pressure impairing caval inflow to RA and RV filling</p>	



we dont use it much as we have better routes & besides being very inaccurate.

بس افهموا الي يآثر عليهم , i wont ask about what is the X descent or y descent

What causes False elevation in CVP

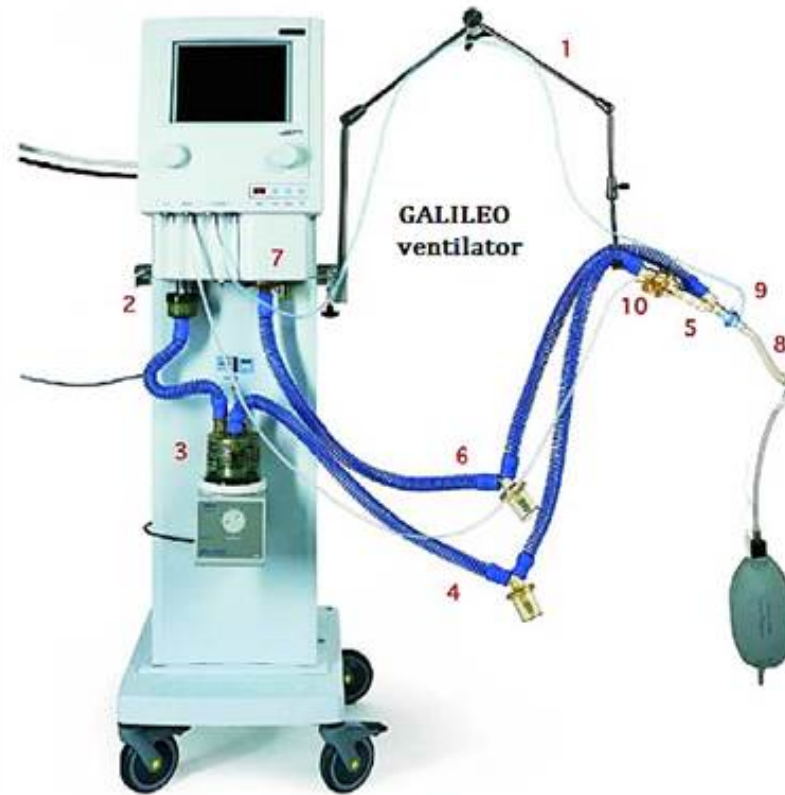
ELEVATED CENTRAL VENOUS PRESSURE

- Tricuspid Stenosis
- Tricuspid Regurgitation
- Pulmonary Hypertension
- Mitral Stenosis
- Mitral Regurgitation
- LV Failure
- Volume Overload
- Cardiac Tamponade
- Arrhythmias as arrhythmia cause elevation in CVP and u think the pt doesnt need fluid but haha ur wrong.
- Increased PVR (Anxiety, Pain)

MECHANICAL VENTILATION

- Delivery of ventilation and supplemental Oxygen with a mechanical ventilator to support a patient experiencing Respiratory Failure.

The corner stones of ICU are hemodynamic & ventilation.

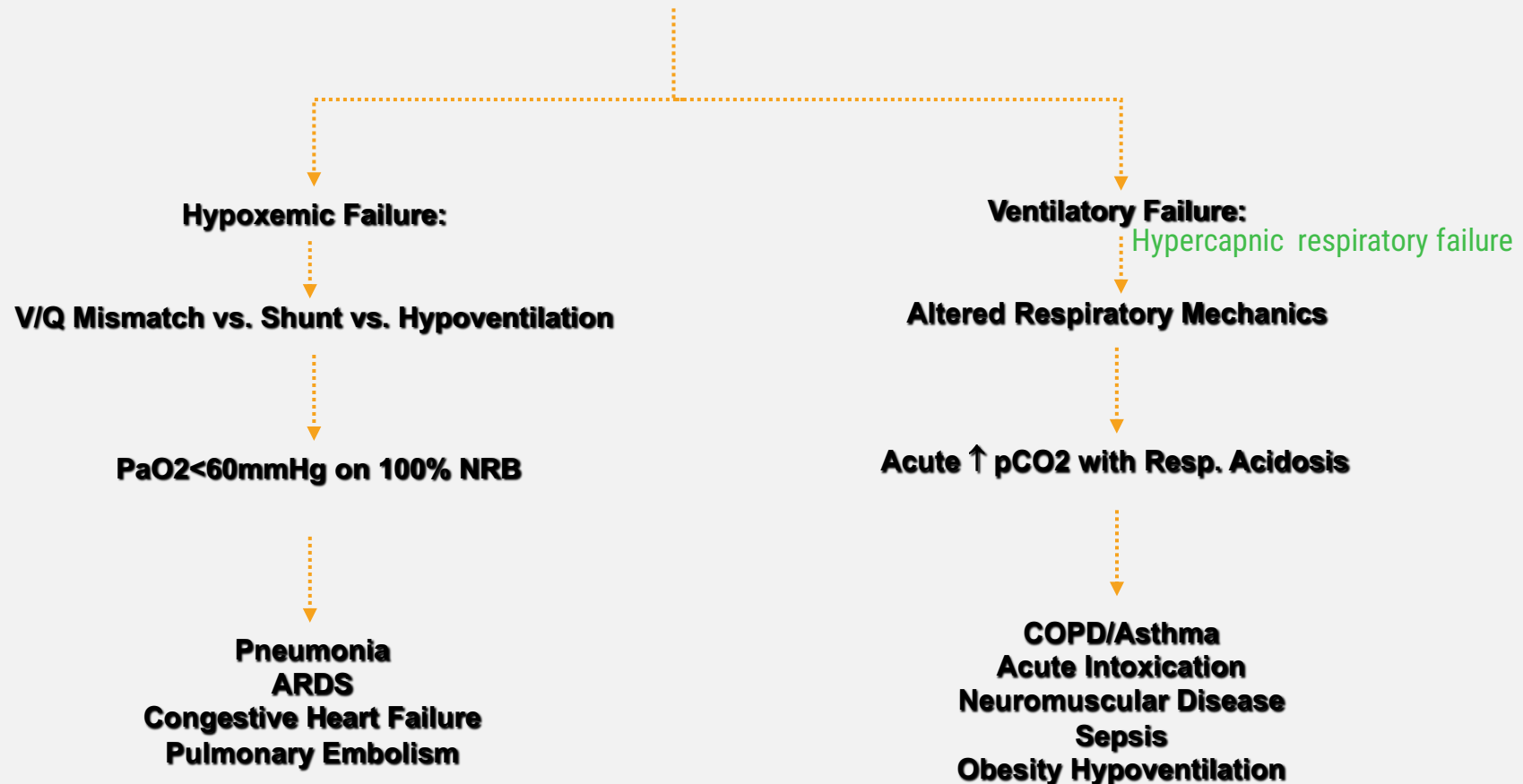


1. Support arm
2. Inspiratory port with filter
3. Active humidifier
4. Inspiratory line with watertrap
5. Y-piece
6. Expiratory line with watertrap
7. Expiratory port
8. Flexible connector
9. Proximal flow-pressure sensor
10. Nebuliser

Fig - A mechanical ventilator for intensive care, with the external circuit

MECHANICAL VENTILATION: INDICATIONS

Respiratory Failure:



RESPIRATORY FAILURE

- Arterial Blood Gas Abnormalities:
 - Hypoxemia:
 - PaO₂<60mmHg or O₂ sat < 90% on 100% NRB
 - Hypercapnea:
 - Acute: pH Δ 0.08 for pCO₂ Δ 10mmHg
 - Chronic: pH Δ 0.03 for pCO₂ Δ 10mmHg
- Clinical Impression:
 - Use of Accessory Muscles
 - Inability to Speak in Full Sentences
 - Paradoxical Respirations
 - Altered Mentation
 - Cardiopulmonary Arrest: When Respirations and Pulse Cease

STARTING MECHANICAL VENTILATION

- 1. Need a Conduit:
 - Endotracheal Tube: Invasive Mechanical Ventilation
 - Face Mask: Noninvasive Mechanical Ventilation (NPPV)
- 2. Deliver Cyclical Positive-Pressure 'Breaths'.
- 3. Provide Supplemental Oxygen.
- 4. Minimize Complications.

ASSESSMENT OF A PATIENT IN THE ICU

- The Flow Sheet: Recording round the clock information of different organ systems.

-Vital signs

-Neurological Status

-Haemodynamic Parameters

-Ventilation settings

-Respiratory parameters

-Input/output

-Laboratory Data

-Medications

Flow sheet: it will show informations about the pt هو الاسبمنت بالICU لكل شيء البيشنت عليه من امس الى اليوم.
from head to toe

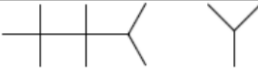

لكن بيشت بالICU عنده فلو شيت وزى البراغراف يعطيك جميع القراءات من امس الى اليوم.
هذا الفرق بين الجناح والعناية المركزة ان القراءات موجودة على مدار الساعة بينما بالجناح بس مره

ASSESSMENT OF A PATIENT IN THE ICU

- Systematic daily oriented team rounds with accurate transmission and discussion of all clinical information from head to toe.
 - Identification/problem list
 - Major events during the last 24 hrs
 - By system approach; CNS, Cardiovascular, Respiratory, GI, Renal/metabolic, Heme/ID, tubes, etc.
- Documented note containing problem list and plan for all of the above.

The ICU is the ultimate care, if one note is missing is not acceptable.

Name & Room No:		Things to do/ Plan	
Hospital Day # ICU Day #			
Vitals:	Temp P BP Pulse Ox: R		
Neuro	EVD @ 24 h output ICP (last 24h) Imaging (last 24h) TCD EEG		
Resp	Vent settings ABG Secretions: scant/copious; thin/thick; white/putrid CXR: ETT - Lung parenchyma -		
CVS	I/O Balance Wt: Fluids Labs Echo		
GI/ Endo	TF: Goal - ml/h; Type - Residuals (vol - 24h) - BM (last 24h) Y/N GI Ppx - Y/N Labs: LFT AST ALT BG - SSI - q h Prealbumin		

Renal		
	1:1 fluid matching Y/N	
Inf.	Lines - Foley - T _{max} - Micro - Abx (with day) - Antipyretics - Tylenol/Ibuprofen	
Heme/ Skin	 Coags - TEDs/SCD - Y/N Heparin/Lovenox - Y/N Ulcers - Y/N	

ICU NOTE

WHO GET ICU ADMISSION

- Acute life-threatening illnesses which are potentially reversible
- Acute illnesses with potential and likely to occur life-threatening complications
- Monitoring of vital parameters of patients with symptoms/signs that suggest the possibility of an evolving life-threatening illness.

As pt with IM and the only symptom is chest pain, he got better after aspirin and hes stable. and yet he should get into ICU cuz we expect in first 24-48h after ACS he has risks for developing Arrythmia, another IM so its better to catch it earlier.

COMMON SCENARIOS IN ICU

- A 73 year old lady with a history of ischemic heart disease, HTN, DM II presents to the ED with altered mental status. She is febrile to 39.4, hypotensive (BP 80/40) with a widened pulse pressure, tachycardic (HR 121), with warm extremities and decreased urine output.
- How would you manage this patient?

Septic shock managed by ICU

Stabilize her & treat sepsis then you can send her to wards

SEPTIC SHOCK

- ICU admission
- Hemodynamic monitoring.
- Resuscitation with fluids, vasopressors.
- Pan cultures, looking for source of sepsis
- Treatment and reversal of condition. (antibiotics, drainage, etc.)
- Monitoring and prevention of complications. (respiratory failure, ARDS, multiorgan failure, etc.)

COMMON SCENARIOS IN ICU

- A 71 year old gentleman with a history of ischemic heart disease, HTN, DM II presents to the ED with altered mental status and slurred speech since morning. His BP is 190/90, HR 111/min. On exam he has right facial drop, slurred speech and left sided arm weakness.
- How would you manage this patient?

Stroke, his GCS not bad & blood pressure is elevated which is good in stroke cases. He's good but he should get into ICU cuz it may have life threatening complications.

STROKE

- ICU admission
- Hemodynamic and neurovitals monitoring.
- Blood pressure control.
- Workup of possible stroke, type, risk factors etc.
- Monitoring and prevention of complications. (hemorrhage, re stroke, seizures, respiratory failure, etc)

COMMON SCENARIOS IN ICU

- A 63 year old lady with a history of DM, IHD and previous stroke with no deficit has just had a Whipple procedure for pancreatic carcinoma. The surgery lasted for 6 hours and was complicated with major bleeding requiring multiple transfusions.
- How would you manage this patient?

Got her into ICU as complicated surgery with major bleeding. and risks to develop MI & stroke. observe her for 1-2 day at least.

BLEEDING

- ICU admission
- Hemodynamic monitoring.
- Resuscitation with fluids, blood products, and vasopressors.
- Monitoring and prevention of complications.
 - recurrent bleeding.
 - leak
 - compartment syndrome
 - fluid overload
 - Post op acute coronary syndrome.

"مارح اقول ايش هي ال 7Cs للكريتيكال كير. بس للريفيرنس وتعرفوا ايش تتطلب الكريتيكال كير

SEVEN 'C'S OF CRITICAL CARE

- **Compassion**
- **Communication** (with patient and family).
- **Consideration** (to patients, relatives and colleagues) and avoidance of Conflict.
- **Comfort** : prevention of suffering is essential to hopeless cases as malignant tumore not responding to chemo and unresectable.
- **Carefulness** (avoidance of injury)
- **Consistency**
- **Closure** (ethics and withdrawal of care).

(Closure) to know if this is working & this is not working, we are losing the patient. we have to make the patient comfortable.

END