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Anesthesia circuits

أسس التخدير العملي

المرحلة الثانية

محاضرة ٤

Introduction

- A breathing system is a tubing system that conducts gases such as oxygen and anesthetic agents to the patient and conducts waste gases such as CO2 away.
- The efficiency of a breathing system is defined by the lowest fresh gas flow that prevents the patient rebreathing CO2.
- Low fresh gas flows are desirable to reduce pollution and the amount of expensive volatile anesthetic that is used.

Function of Breathing systems must fulfill three objectives:

1.delivery of oxygen

2. removal of carbon dioxide from the patient

3. delivery of inhaled anesthetic agents.

These agents are predominantly eliminated by the lungs also, so the breathing system must be able to expel them as necessary.

Properties of the ideal breathing system

1. Simple and safe to use.

2. Delivers the intended inspired gas mixture.

3. Permits spontaneous, manual and controlled ventilation in all age groups.

4. Efficient, requiring low FGF rates.

5. Protects the patient from barotrauma.

6. Sturdy, compact and lightweight in design.

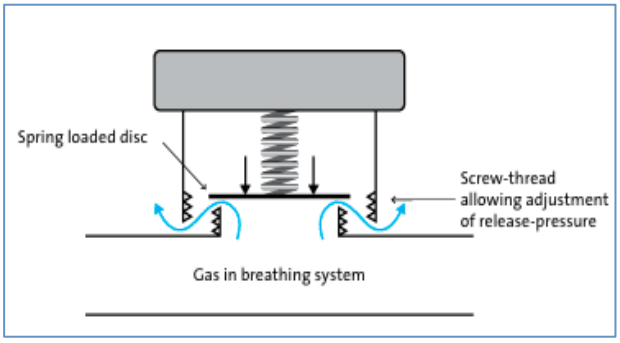
7. Permits the easy removal of waste exhaled gases.

8. Easy to maintain with minimal running costs.

Component of breathing system

1.Adjustable Pressure Limiting (APL) Valve 2. Reservoir bag. 3. Tubing system.

Adjustable Pressure Limiting (APL) Valve



This is a valve which allows the exhaled gases and excess FGF to leave the breathing system. It does not allow room air to enter the breathing system.

Mechanism of Action

- The valve consists of a lightweight disc which is held against the base by a spring, closing the valve. The pressure exerted by the spring may be adjusted by screwing the valve cap.
- When the pressure beneath the disc (i.e. the pressure in the breathing system) exceeds the pressure exerted by the spring, the valve will open, allowing gas to escape.
- When the valve cap is fully unscrewed, the pressure exerted by the spring is less than 1 cmH2O and gas vents easily.
- In order to protect against barotrauma, modern valves are designed so that the valve will open at pressures above 60 cmH2O even when the cap is screwed down and the valve fully ‘closed’.

Reservoir bag

- The reservoir bag is an important component of most breathing systems.

It is made of rubber or plastic.

- Designs tend to be ellipsoidal in shape.
- The standard adult size is 2 L. The smallest size for pediatric use is 0.5 L. Volumes from 0.5 to 6 L exist.

Mechanism of action :

1. Accommodates the fresh gas flow during expiration acting as a reservoir available for the following inspiration.

2. It acts as a monitor of the patient's ventilator pattern during spontaneous breathing. It serves as a very inaccurate guide to the patient's tidal volume.

3. It can be used to assist or control ventilation.

4. When employed in conjunction with the T-piece (Mapleson F), a 0.5liter double-ended bag is used. The distal hole acts as an expiratory port.

TUBINGS

- These connect one part of a breathing system to another.
- They also act as a reservoir for gases in certain systems.
- They tend to be made of plastic, but other materials such as silicone rubber and silver impregnated bactericidal plastics are available.
- The length of the breathing tubing is variable depending on the configuration of the breathing system used.
- They must promote laminar flow wherever possible and this is achieved by their being of a uniform and large diameter.
- The size for adults is 22 mm wide. However, pediatric tubing is 15 mm wide, to reduce bulk. The corrugations resist kinking and increase flexibility, but they produce greater turbulence than smooth-bore tubes.

Types of breathing circuit

1. Mapleson systems. (A, B, C,D, E, F).

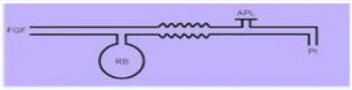
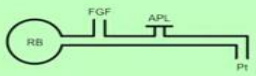
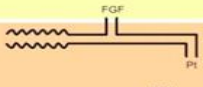
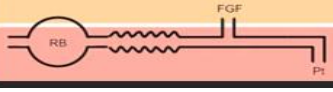
- Mapleson circuit need high FGF compare to circle system.
- Mapleson circuit don't have co2 absorbent but depend on FGF to washout co2.

2. Humphrey ADE breathing system.

3. Circle breathing system.

Component of mapleson circuit:

1.Apl valve. 2.Reservoir bag. 3. FGF inlet 4. Corrugated rubber or plastic tubing.

Classification	MNEMONIC		Example & Comment
A	**A**PL (Adjustable Pressure Valve) at patient's end.		Magill & Lack
B	**B**oth **APL** & **FGF** (Fresh gas flow) at patient's end.		Obsolete
C	**C**orrugation Absent		Used in Emergency Intubations.
D	**D**istal APL - APL located distal from patient's end.		Bain
E	**E**nd (Reservoir Bag) Eliminated WWW.OPENMED.CO.IN		Ayer's T-piece
F	**F**ree from APL (APL is Absent)		Jackson Rees

❖ Mapleson A

- Best for spontaneous ventilation
- FGF>> for spontaneous ventilation 1MV (80 ml\kg\min)
- FGF >>for controlled (IPPV) 2.5 MV
- It is not suitable for use with children of less than 25-30 kg body weight. This is due to the increased dead space.
- its disadvantage is the heaviness of the APL valve at the patient's end.
- Has a coaxial system with inner tube called lack circuit.

❖ Mapleson B and C

- Mapleson B IS NOW OBSELET not use.
- Both B and C systems are not efficient for spontaneous and controlled ventilation.

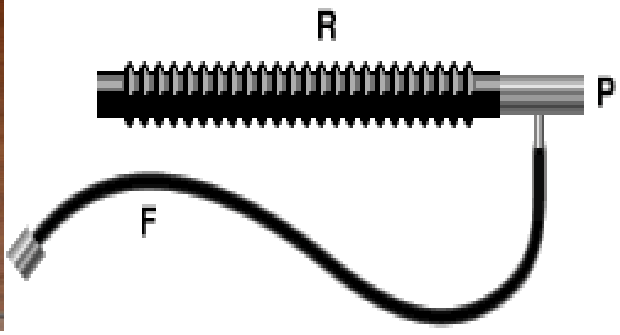
❖ Mapelson D

- Not efficient for spontaneous ventilation. need FGF 2MV .
- Efficient during controlled ventilation. Need FGF 1MV .
- Has a coaxial system with inner tube called bain circuit.

❖ Mapleson E(T-piece) and F(Jackson rees)breathing system:

- Used in pediatric patient up to 25–30 kg body weight.

- Requires a high FGF during spontaneous ventilation 2.5-3 MV.
- Offers minimal resistance to expiration.
- Valve less breathing system.
- Scavenging is difficult.



The circle breathing system and soda lime

- In this breathing system, soda lime is used to absorb the patient's exhaled carbon dioxide (Fig. 4.18). FGF requirements are low, making the circle system very efficient and causing minimal pollution.
- Component of circle system

1.A vertically positioned canister contains soda lime.

2.Inspiratory and expiratory tubings are connected to the canister.

3.a unidirectional valve.

4.Corrugated tubings

are used to prevent kinking.

5.An APL valve.

6.A vaporizer.

7.Reservoir bag.

8. FGF inlet.