NATIONAL INSTITUTE OF TECHNOLOGY RAIPUR

BIOMEDICAL ENGINEERING

ASSIGNMENT

Medical Devices

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Contents

1 Gamma Camera

A camera that detects the radiation from a radioactive tracer injected into the body and is used especially in medical diagnostic scanning.It is also known as Anger Camera.

1.1 Basic Components :

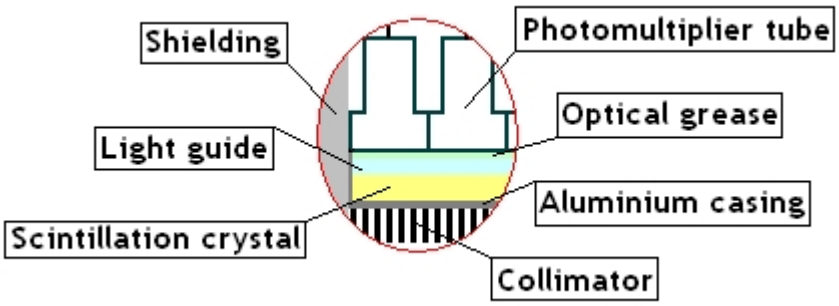

Figure 1: Basic Components

1.1.1 Collimator :

It is made from lead and it maintains the quality of image.

1.1.2 Scintillation :

The main function of crystal is to convert gamma ray to photons of visible light. The process of conversion is scintillation.
Example : NaI doped with Thallium NaI

1.1.3 Photomultiplier Tube :

It is an instrument that converts light to electrical signals.

1.2 Working :

Gamma Rays ⇒ Collimator ⇒ Sodium Iodide Crystal ⇒ Photomultiplier Tub ⇒ Display Output

1.3 Application :

1)Gamma Camera give structural and functional image of body organs.
2)It has been used to locate
i)cancerous tumours,
ii)minor bone fracture ,
iii)abnormal functioning of organs and other medical problems.
3)Iodine-131 is used to detect thyroids (a gland that absorbs Iodine) problems.

2 Bag Valve Mask

A bag value mask is a hand-held device commonly used to provide positive pressure ventilation to patients who are not breathing or not breathing adequately. It is also known as Ambu Bag (A.M.B.U = Artificial Manual Breathing Unit).

2.1 Basic Component :

2.1.1 Flexible Mask :

It seals over the patients face.

2.1.2 Filter and Valve :

It is to prevent backflow into the bag (prevents patient deprivation and bag contamination).

2.1.3 Soft Bag :

It is used to squeezed to expel air to the patient.

Figure 2: AMBU Bag

2.2 Working :

When the mask is pressed against the patient's respiratory system, air is forced into the lungs by pressing the bag. The bag then refills itself with air when released, lowering it to return to its original position. The bag can squeeze out again. It is also inhaled quickly and repeatedly to rejuvenate the patient and provide an oxygen, even if the patient is unable to breathe on his own.

- Squeezing the bag :
  ·once every 5 seconds for ADULTS.
  ·once every second for infant and child.

2.3 When to Use Ambu bag :

- Respiratory (lung) failure.
- Failed intubation (insertion of an artificial ventilation tube into the trachea).
- Patients undergoing anesthesia for elective surgery Apnea (slowed or stopped breathing).

2.4 Reported Complications :

- Gastric Insuflation (Vomiting,Aspiration)
- Barotrauma (lungs injury from over pressurization)
- Volutrauma (lung injury from overstreching)
- Mendelson's Syndrome(acute chemical pneumonitis caused by the aspiration of stomach contents in patients under general anesthesia).
- Hypoventilation (breathing that is too slow to meet the needs of the body).

3 Image Intensifier

A device used in radiology by means of which weak X-ray images obtained by low dosage radiation may be converted into television images and improved in brightness and contrast by purely electronic means.

3.1 Basic Component :

3.1.1 Glass Envelope :

Maintains tube vacuum to allow control of electron , has no functional role in image formation.

3.1.2 Input Phosphor and Photocathode :

It is a photoemissive metal (commonly combination of Sb and Cs).

3.1.3 Electrostatic Focusing Lens :

It is made up of a deries of positively charged electrodes . These electrodes focus the electron beam as it flows from the photocathode towards the output phosphor.

3.1.4 Accelerating Anode :

Its function is to accelerate electrons emitted from photocathode towards the output screen.

3.1.5 Output Phosphor :

It is silver activated Zn-Cd sulfide.

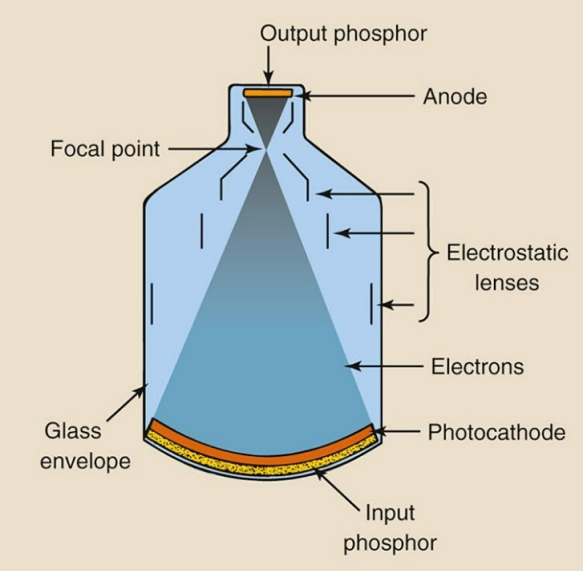

Figure 3: Image Intensifier

3.2 Working :

An image-intensifier system works by collecting photons.

Collecting photons through an objective lens⇒ converting them to electrons via a photocathode⇒increasing the electrical energy with a microchannel plate (MCP)⇒ converting the electrical energy back to light using a phosphor screen and presenting the image.

3.3 Application :

- Orthopaedic Imaging in theatre.
- Neurolgical Imaging in theatre.
- Endovascular Imaging in theatre (EVAR) Therapeutic Procedures in theatre (pain clinic).

4 Syringe Pump

A syringe pump is a small positive displacement pump used to deliver controlled quantities of fluids such as nutrients, drugs, and blood to patients. It is also used in chemical and biomedical research.

4.1 Basic Components :

4.1.1 Pusher Block :

It pushes the plunger which ejects the fluid from the syringe. Continuous flow can be achieved by using pumps with two syringes, where one pulls liquid and the other pushes liquid.

4.1.2 Syringe Holder :

It is designed to hold syringes that have been placed in a syringe shield. This unit can hold syringes from 2 to 20 cc.

4.1.3 Internal Stepper Motor

It is an electromechanical device it converts electrical power into mechanical power.

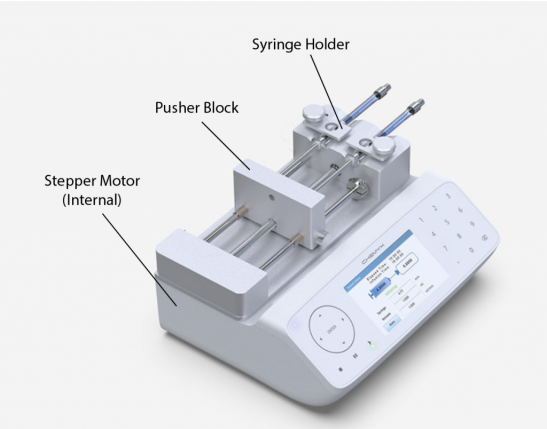

Figure 4: Syringe Pump

4.2 Working :

- The syringe pump usually consists of a tube connected to a piston.
- The piston is powered by an engine with an internal drive screw pushing the syringe in or out leading to a smooth flow.
- The syringe is inserted into the clamp frame and the plunger for the syringe is removed by the movement of the drum.
- User can set parameter as flow rate, output volume and syringe width.

4.3 Application :

- Research lab, syringe pumps can be used for almost any application that involves accurate measurement, especially in micro and nanoscale.
- Syringe pumps are helpful in speeding up research and reducing fluid errors in delivery in many areas of advanced research.
- It plays a major role in reducing errors in microanalysis fields as well metal figures, such as mass spectrometry (MS), high performance liquid chromatography (HPLC), and liquid chromatography-mass spectrom etry (LC-MS)
- Syringe pumps can also help provide accurate medical and biological research; for example, feeding small animals or bringing very little doses at specific sites in the brain in neuroscience research.

5 Hemodialysis Machine

A machine which do Hemodialysis. Hemodialysis is the process of purifying the blood of a person whose kidneys are not working normally.It is a method that is used to achieve the extracorporeal removal of waste product such as creatinine and urea and free water from the blood when the kidneys are in the state of renal failure.

5.1 Basic Components :

5.1.1 Dialysis Machine Blood Pump and Tubing :

A blood pump simply pumps the blood from the body into the machine through specially made tubes.

5.1.2 Dialyzer :

It is a large canister containing thousands of small fibers through which patient blood is passed.
The dialyzer is the key part of a dialysis machine where the cleaning of the blood takes place.

5.1.3 Pressure Monitor :

- Arterial pressure monitor : Detects the pressure between the blood access and blood pump.
- Venous pressure monitor : It normally detects positive pressures. If the venous pressure goes low,it probably due to disconnect/low blood flows in the circuit.

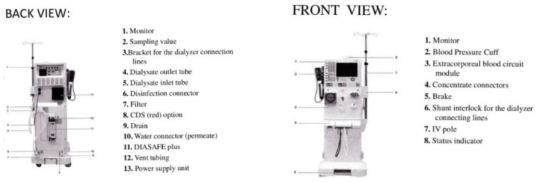

Figure 5: Hemodialysis Machine

5.2 Working :

- Through a vascular access that is placed in the patient's body by minor surgery, blood is removed and enters the dialysis machine.
- The blood flows through a dialysis tubing, a semipermeable membrane that contains pores large enough to allow diffusion—the movement of a substance from an area of high concentration to an area of low concentration.
- A blood thinner may be prescribed to keep one's blood from clotting while going through the dialysis machine.
- A pump and an arterial pressure monitor work hand-in-hand in keeping the blood flow at a right rate.
- The blood enters the dialyzer.
- A dialysate enters the dialyzer. Also called a dialysis solution, this is a fluid made up of water, electrolytes, and salts. Dialysate helps in cleaning up the blood by pulling out the waste products that are in it. How does this work? Through the process of diffusion. A renal patient's blood contains a high concentration of toxins, while dialysate contains a low concentration of toxins. Because of this difference, diffusion takes place wherein waste and excess fluids move from the blood across into the dialysate, creating an equal amount on both fluids.
- The used dialysate (now containing waste products removed from the blood) is pumped out of the machine and discarded. While the blood goes through another arterial pressure monitor and air trap to ensure that it's safe to return into the patient's body.
- The clean blood now returns to the body through the second vascular access.

5.3 Risks :

- Anemia.
- Hematocrit.
- Cramps,nausea,vomiting,and headaches.
- Hypotension.
- Infection.

6 References

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