Assignment on any 5 Biomedical Equipments

Name-Md.Uruj Akbar Rahman
Roll No-21111029
Email-mduruj9599gmail.com
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1 Apnea Monitor

1.1 Introduction

A home apnea monitor is a machine used to monitor a baby's heart rate and breathing after coming home from the hospital. Apnea is breathing that slows down or stops from any cause. Apnea monitors detect the cessation of breathing (apnea) in infants and adults who are at risk of respiratory failure and alert the parent or attendant to the condition. Some prolonged respiratory pauses result in low oxygen concentration levels in the body, which can lead to irreversible brain damage and death in svere cases.

Figure 1: APNEA MONIOR SYSTEM

1.2 Principle and function

Apnea monitor use the application of magnetic flux to detect if the patient are still breathing or not. When the device was turned on, it produces the magnetic field and induced voltage.The device is coiled around the patient's chest to monitor the breathing rate and heart beats. When the patience is breathing, the chest expends and the device will measure the rate of change of induced voltage. If the patience stops breathing, the pattern of induced voltage will stabilize an no reading will be made, the sensor will not detect any reading and the device will trigger an alarm.

In addition to that, the magnetic flux released by the device will lower the thickness of the blood and increase the rate of blood stream in the vessel. The

increasing rate of flow of the oxygenated blood in the vessel means the blood will transfer the oxygen to entire body effectively. This means that the brain will receive enough oxygen to fully control the respiratory system so that the patient can breathe without any interruption.

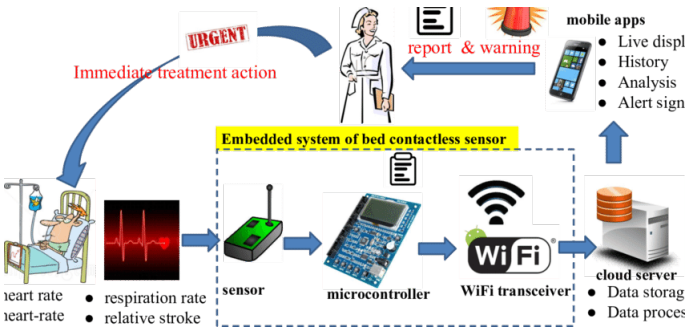

Figure 2: WORK MODEL FOR AN APNEA MONITOR

1.3 What are it's uses in medical field?

Sudden infant death syndrome (SIDS) is the unexplained death, usually during sleep, of a seemingly healthy baby less than a year old. SIDS is sometimes known as crib death because the infants often die in their cribs.

Although the cause is unknown, it appears that SIDS might be associated with defects in the portion of an infant's brain that controls breathing and arousal from sleep.

1.3.1 Factors involved in SIDS

a)Brain defects - In many of these babies, the portion of the brain that controls breathing and arousal from sleep hasn't matured enough to work properly. b)Low birth weight - Premature birth or being part of a multiple birth increases the likelihood that a baby's brain hasn't matured completely, so he or she has less control over such automatic processes as breathing and heart rate. c) Respiratory infection Many infants who die due to SIDS suffers from cold, which might contribute to breathing problems. d) Sleeping on stomach or on sides babies placed in these positions to sleep might have more difficulty breathing than those placed on their backs. e) Sleeping on a soft surface Lying face down on a fluffy comforter, a soft mattress or a waterbed can block an infant's airway. f)Sharing a bed While the risk of SIDS is lowered if an infant sleeps in the same room as his or her parents, the risk increases if the baby sleeps in the same bed with parents, siblings or pets. g) Overheating Being too warm while sleeping can increase a baby's risk of SIDS.

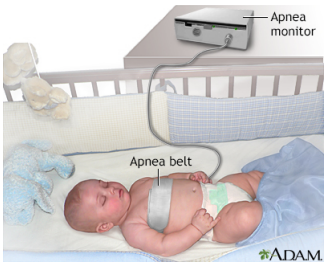

Figure 3: APNEA MONITOR FOR SIDS IN BABIES

1.3.2 Factors involved in Apnea

Apnea is the most common form of different types of sleep-related breathing disorders. It is characterized by repetitive cessations of respiratory flow during sleep, which occurs due to a collapse of the upper respiratory airway.Apneas are defined as pauses in breathing of more than 10 seconds while asleep. These occur at regular intervals throughout the night. The subject is rarely aware of their difficulty breathing even upon awakening, and the condition may go undetected for years until noticed by someone else. Sleep apnea (SA) in the form of Obstructive sleep apnea (OSA) is becoming the most common respiratory disorder during sleep. The most frequent night symptoms of SA can include snoring, nocturnal arousals, sweating and restless sleep. Moreover, like all sleeping disorders, symptoms of sleep apnea do not occur just during the night. Daytime symptoms can range from morning headaches, depression, impaired concentration and excessive sleepiness which cause mortality from traffic and industrial accidents. However, these symptoms are not definitive to detect SA syndrome.

a)Excess weight- Most but not all people with obstructive sleep apnea are overweight. Fat deposits around the upper airway can obstruct breathing. Medical conditions that are associated with obesity, such as hypothyroidism and polycystic ovary syndrome, also can cause obstructive sleep apnea. b)Older age- The risk of obstructive sleep apnea increases as you age but appears to level off after your 60s and 70s. Narrowed airway. You might inherit naturally narrow airways. Or your tonsils or adenoids might become enlarged and block your airway. c)High blood pressure (hypertension)- Obstructive sleep apnea is relatively common in people with hypertension. Chronic nasal congestion. Obstructive sleep apnea occurs twice as often in those who have consistent nasal congestion at night, regardless of the cause. This may be due to narrowed airways. d)Smoking- People who smoke are more likely to have obstructive sleep apnea as compared to non smokers. e)Diabetes- Obstructive sleep apnea might be more common in people with diabetes. f)Sex- In general, men are twice or three times as likely as premenopausal women to have obstructive sleep apnea. The frequency of obstructive sleep apnea increases in women after menopause.

Figure 4: APNEA MONITOR FOR ADULTS

1.4 Conclusion

The data suggest that monitor use is more dependent on physician preference than medical indication and is not associated with earlier hospital discharge.

2 Prosthesis for Joints and Hips

2.1 Introduction

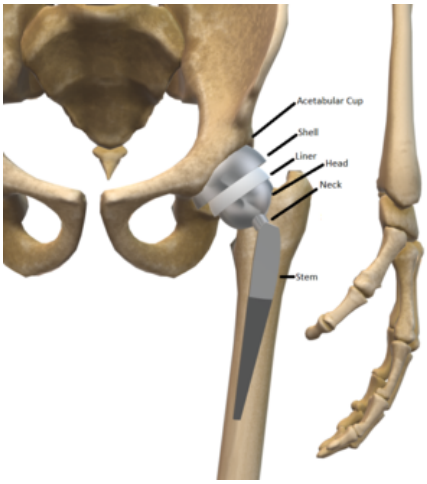

Figure 5: DETAILED CROSS SECTION OF A HIP PROSTHETIC

A Prosthetic implant is an artificial device that replaces a missing body part, which may be lost through trauma, disease, or a condition present at birth (congenital disorder). Prostheses are intended to restore the normal functions of

the missing body part.A person's prosthesis should be designed and assembled according to the person's appearance and functional needs. For instance, a person may need a transradial prosthesis, but the person need to choose between an aesthetic functional device, a myoelectric device, a body-powered device, or an activity specific device. The person's future goals and economical capabilities should be the basis of choice between one or more devices.

RAW MATERIALS USED FOR PROSTHETIC MANUFACTURING ARE :- Plastics: Polyethylene Polypropylene Acrylics Polyurethane Wood (early prosthetics) Rubber (early prosthetics) Lightweight metals: Titanium Aluminum Composites: Carbon fiber reinforced polymers

2.2 Hip replacement prosthetics

A joint is formed where two or more bones meet. The hip joint is considered a ball-and-socket type joint. It is formed where the thigh bone (femur) meets the hipbone (pelvis). The thighbone has a ball-shaped knob on the end (head of femur) that fits into a socket formed in the hipbone (acetabulum). A smooth cushion of articular cartilage covers the ends of the bones. This cartilage is kept slippery by fluid (synovial fluid) made in the joint lining (synovial membrane). Since the cartilage is smooth and slippery, the bones move against each other easily and without pain. Large ligaments, tendons, and muscles around the hip joint hold the bones in place.

2.2.1 Causes of hip replacement

ARTHRITIS:- Arthritis is the swelling and tenderness of one or more joints. The main symptoms of arthritis are joint pain and stiffness, which typically worsen with age. The most common types of arthritis are osteoarthritis and rheumatoid arthritis.

Osteoarthritis causes cartilage — the hard, slippery tissue that covers the ends of bones where they form a joint — to break down. Rheumatoid arthritis is a disease in which the immune system attacks the joints, beginning with the lining of joints.As the cartilage wears away, the raw bones rub together whenever the joint moves.This causes extreme pain and roughening of the surface of the bones.

Uric acid crystals, which form when there's too much uric acid in your blood, can cause gout. Infections or underlying disease, such as psoriasis or lupus, can cause other types of arthritis.

AVASCULAR NECROSIS:- Avascular necrosis is a disease that results from the temporary or permanent loss of blood supply to the bone. It happens most commonly in the ends of a long bone. Avascular necrosis may be the result of injury, use of medicines, or alcohol. Symptoms may include joint pain and limited range of motion.

2.3 Use in Medical field

Total hip replacement is most commonly used to treat joint failure caused by osteoarthritis. Other indications include rheumatoid arthritis, avascular necrosis, traumatic arthritis, protrusio acetabuli, certain hip fractures, benign and malignant bone tumors, arthritis associated with Paget's disease, ankylosing spondylitis and juvenile rheumatoid arthritis. The aims of the procedure are pain relief and improvement in hip function. Hip replacement is usually considered only after other therapies, such as physical therapy and pain medications, have recently failed.

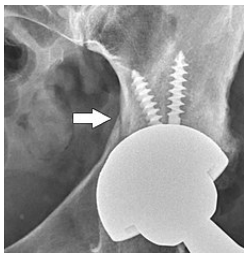

Figure 6: INTRAOPERATIVE FRACTURE

2.4 Complications involved;

*INFECTION:- Infection is one of the most common causes for revision of a total hip replacement, along with loosening and dislocation. The incidence of infection in primary hip replacement is around 1

*DISLOCATION:-Dislocation is the most common complication of hip replacement surgery. The most common causes vary by the duration since the surgery. Hip prosthesis dislocation mostly occurs in the first three months after insertion, mainly because of incomplete scar formation and relaxed soft tissues.[6] It takes eight to twelve weeks for the soft tissues injured or cut during surgery to heal. During this period, the hip ball can come out of the socket. The chance of this is diminished if less tissue is cut, if the tissue cut is repaired and if large diameter head balls are used.

*FRACTURE:- Intraoperative fractures may occur. After surgery, bones with internal fixation devices in situ are at risk of periprosthetic fractures at the end of the implant, an area depended by implant for high mchanical support and stress.

*OSTEOLYSIS:- Many long-term problems with hip replacements are the result of osteolysis. This is the loss of bone caused by the body's reaction to polyethylene wear debris, fine bits of plastic that come off the cup liner over time. An inflammatory process causes bone resorption that may lead to subsequent loosening of the hip implants and even fractures in the bone around the implants. In an attempt to eliminate the generation of wear particles, ceramic bearing surfaces are being used in the hope that they will have less wear

and less osteolysis with better long-term results. Metal cup liners joined with metal heads (metal-on-metal hip arthroplasty) were also developed for similar reasons. In the lab these show excellent wear characteristics and benefit from a different mode of lubrication. At the same time that these two bearing surfaces were being developed, highly cross linked polyethylene plastic liners were also developed.

*METAL SENSITIVITY:- Concerns are being raised about the metal sensitivity and potential dangers of metal particulate debris. New publications have demonstrated development of pseudotumors, soft tissue masses containing necrotic tissue, around the hip joint. It appears these masses are more common in women and these patients show a higher level of iron in the blood. The cause is unknown and is probably multifactorial. There may be a toxic reaction to an excess of particulate metal wear debris or a hypersensitivity reaction to a normal amount of metal debris.

*METAL TOXICITY:- Most hip replacements consist of cobalt and chromium alloys, or titanium. Stainless steel is no longer used. All implants release their constituent ions into the blood. Typically these are excreted in the urine, but in certain individuals the ions can accumulate in the body. In implants which involve metal-on-metal contact, microscopic fragments of cobalt and chromium can be absorbed into the person's bloodstream. There are reports of cobalt toxicity with hip replacement, particularly metal-on-metal hip replacements, which are no longer in use.

*CHRONIC PAIN:-

A few patients who have had a hip replacement suffer chronic pain after the surgery. Groin pain can develop if the muscle that raises the hip (iliopsoas) rubs against the edge of the acetabular cup. Bursitis can develop at the trochanter where a surgical scar crosses the bone, or if the femoral component used pushes the leg out to the side too far. Also some patients can experience pain in cold or damp weather.[citation needed] Incision made in the front of the hip (anterior approach) can cut a nerve running down the thigh leading to numbness in the thigh and occasionally chronic pain at the point where the nerve was cut (a neuroma).

2.5 Conclusion

Hip replacement is one of the most successful operations ever devised. It not only relieves pain and restores function; it has also been shown to extend life.

3 Nuclear Magnetic Resonance(NMR)

3.1 Introduction

Of all the technologies employed by medical professionals, NMR Spectroscopy is one of the most valuable. Officially known as Nuclear Magnetic Resonance Spectroscopy and sometimes referred to as Magnetic Resonance Spectroscopy

(MRS), the advanced analytical technique allows medical scientists to observe, map and study the magnetic fields surrounding an atomic nucleus. By observing the behaviour of these magnetic fields and analysing the changes triggered by an external magnetic field, scientists can unlock detailed insight into the molecular structures and compositions of medical samples.

3.2 Principles

NMR Spectroscopy is underpinned by the basic principle that most nuclei spin on an axis, are positively charged and create an electric field. By applying an external magnetic field via an NMR instrument, medical researchers can prompt an energy transfer between local magnetic fields around the atomic nucleus and the external radiation source.

After the magnetic energy transfer takes place, the resonant frequencies of the atomic nucleus are measured and recorded by the NMR instrument. Data is then converted into an NMR spectrum chart that displays frequencies as sharp peaks. This data is then used to generate detailed information about the molecular structures, characteristics, components and behaviours of a medical sample.

Creating an external magnetic field is a fundamental stage of NMR Spectroscopy. Scientists rely on advanced NMR instruments to trigger the all-important energy transfer between the external magnetic field and the local magnetic fields surrounding the atomic nucleus.

After the sample is placed in a static magnetic field created by the NMR instrument, pulsed electromagnetic waves are used to excite the magnetic fields around the nucleus and create NMR signals. When the radiation has been switched off, ultra-sensitive radio receivers are used to detect signals emitted by the magnetic fields around the nucleus and measure changes in resonance frequency. This reveals detailed information about the electronic structure of a molecule and the unique functional groups it contains.

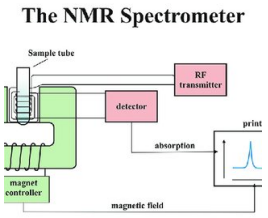

Figure 7: BASIC FRAMEWORK MODEL OF NMR

3.3 3 stages of NMR spectrometery

NMR Spectroscopy can be divided into three main stages: alignment, agitation and analysis.

Alignment:- This stage sees the atomic nucleus placed in an NMR instrument where it's free to spin freely and create its natural magnetic field.

Agitation:- When the atomic nucleus has been aligned, an external oscillating magnetic field is used to agitate the local magnetic fields surrounding the atomic nucleus. This magnetic field is also known as a Radio-Frequency (RF) pulse.

Analysis:- After the local magnetic fields have been excited, the NMR instrument measures the electromagnetic waves emitted by the atomic nucleus.

3.4 Application

CANCER TREATMENT :- MR Spectroscopy has also emerged as a valuable tool for cancer diagnosis and therapy. Abnormal behaviour in the cellular metabolism is widely accepted as a driver of many life-threatening diseases, including cancer. The link between cancer and the metabolism was first discovered in the 1920s by German physiologist Otto Heinrich Warburg, who proposed that mutations in cancer genes and the subsequent changes in cellular signals can prompt changes to the metabolism.

The ability to observe the molecular structures of cells is incredibly useful for investigating identifying metabolite-based biomarkers that reveal the presence of cancers. Analysing the cellular metabolism also allows researchers to track destructive processes like progression, proliferation, transformation and metastasis.

3.5 Conclusions

considering the potential advantages of the NMR technique, it can be concluded with authority that it has become a preferred choice of technique for any diagnosis, treatment planning, maintenance of treatment and also to see the behavior of foreign materials interaction with the human body. NMR is still a growing technology, and it is being anticipated that few discoveries are now just around the corner.

4 Picture archiving and communication system(PACS)

A picture archiving and communication system (PACS) is a medical imaging technology which provides economical storage and convenient access to images from multiple modalities (source machine types). Electronic images and reports are transmitted digitally via PACS; this eliminates the need to manually file, retrieve, or transport film jackets, the folders used to store and protect X-ray film. The universal format for PACS image storage and transfer is DICOM (Digital Imaging and Communications in Medicine). Non-image data, such as scanned documents, may be incorporated using consumer industry standard

formats like PDF (Portable Document Format), once encapsulated in DICOM.

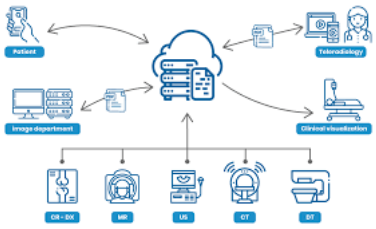

Figure 8: BASIC CLOUD FRAMEWORK OF PACS

4.1 Types of images

Most PACS handle images from various instruments, including ultrasound (US), magnetic resonance (MR), Nuclear Medicine imaging, positron emission tomography (PET), computed tomography (CT), endoscopy (ES), mammograms (MG), digital radiography (DR), phosphor plate radiography, ophthalmology, etc. Additional types of image formats are always being added. Clinical areas beyond radiology; cardiology, oncology, gastroenterology, and even the laboratory are creating medical images that can be incorporated into PACS.

4.2 uses

The benefits of PACS are: direct cost saving, decreased consumption of radiographic film, decreased labor cost, increased integration between departments and facilities, productiv improvements, bettar image quality, simultaneous vieing of the same images in multiple locations, and decreased time to communicate diagnosis.

"All images in the PACS database are automatically grouped into the correct examination, are Chronologically ordered, correctly oriented and labeled, and can be easily retrieved which is not necessarily the case without the PACS system." The pediatrics and neonatal unit were among the first clinical specialties to start using the PACS system. Radiographic images play a big role in these departments. Time is very crucial in these units so it is a great advantage that you don't have to go to the radiology department to retrieve these images. This is one good example how the PACS system can save lives and why the hospital should be using this system.

4.3 Disadvantages

There are some disadvantages to the PACS system as well as with any system that you may choose to . One disadvantage to the PACS system is cost of istalling the PACS system in the hospital setting. In the year 1999 the cost

of intalling the PACS system was one to two million dollars with a six percent annual maintenance. Studies have shown that PACS would payed for itself in five years. Another disadvantage is once you have gone filmless there is risk that the PAkS system could have a system failure with this in mind as long as the data is backed up daily. One other potential problem of PCS is that the staff may not have the knowledge to be able to use the PACS system.

4.4 Conclusion

conclusion, healthcare technology is going to computerization and there is no stopping it. We are in an era where computers are an important part of daily life not just in the healthcare field. Learning how to use computers and there software is crucial for survival.

PACS is the healthcare technology of the future. "A picture archiving and communication system (PACS) is a computerized means of replacing the role of conventional radiological film: images are acquired, stored, transmitted, and displayed digitally." PACS is not just used in the radiology department it can be used all over the hospital in any location, anytime, anywhere and even be used with other hospitals, between different physicians.

5 Electrosurgical unit (ESU)

5.1 Introduction

Figure 9: ELECTROSURGICAL UNIT

Electrosurgery is a technique often used in surgery to control bleeding and to rapidly dissect soft tissue in surgery. The electrical resistance of these soft tissues to an electromagnetic current generates heat. The endpoints of electrosurgery vary based on the waveform, power used, and surgical technique. This results in a variety of effects on the target tissue.

5.2 equipments

The equipment necessary for electrosurgery includes the electrosurgical device itself and sterile sleeves to place over the handle and disposable electrode tips. A smoke evacuator is an essential tool when performing electrosurgery, as it safely removes the smoke plume, which has been proven to be mutagenic.

5.3 prerquisites

The surgical team should have a good understanding of the principles of electrosurgery and tissue effects to avoid complications. The risk of complications is linked to the surgeon's fundamental knowledge of instruments, surgical technique, biophysics, relevant anatomy, and safe technical equipment.If applied properly electrosurgery is safe and effective.

Figure 10: SURGEONS OPERATE USING ELECTROSURGICAL PENCIL

I=V/R is the basic relationships of properties of electrosurgical unit

5.4 Risks

Electrothermal injury may result from the following situations: direct application, direct coupling, insulation failure, capacitive coupling, and so on.

5.5 Conclusion

Principls of electrosurgery must bethoroughly undertood by ll operating rom personnel. This forms the basis for patient safety ad helps i early recognition of possible complicatins.42 The advantges and diadvantages of vrious forms of electrosurgery must be born in mind whileusing a particular modality. Newer technologies ith mre efficent hemostatic properties must be used whenever appropriate.