Assignment-1

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Five medical devices

1.MRI (Magnetic Resonance Imaging)

Magnetic resonance imaging (MRI) is a medical imaging technique used in radiology to form pictures of the anatomy and the physiological processes of the body. MRI scanners use strong magnetic fields, magnetic field gradients, and radio waves to generate images of the organs in the body. MRI does not involve X-rays or the use of ionizing radiation, which distinguishes it from CT and PET scans. MRI is a medical application of nuclear magnetic resonance (NMR) which can also be used for imaging in other NMR applications, such as NMR spectroscopy.

MRI is widely used in hospitals and clinics for medical diagnosis, staging and follow-up of disease. Compared to CT, MRI provides better contrast in images of soft-tissues, e.g. in the brain or abdomen. However, it may be perceived as less comfortable by patients, due to the usually longer and louder measurements with the subject in a long, confining tube. Additionally, implants and other non-removable metal in the body can pose a risk and may exclude some patients from undergoing an MRI examination safely.

MRI was originally called NMRI (nuclear magnetic resonance imaging), but "nuclear" was dropped to avoid negative associations.[1] Certain atomic nuclei are able to absorb radio frequency energy when placed in an external magnetic field; the resultant evolving spin polarization can induce a RF signal in a radio frequency coil and thereby be detected.[2] In clinical and research MRI, hydrogen atoms are most often used to generate a macroscopic polarization that is detected by antennae close to the subject being examined.

2.ECG

Electrocardiography is the process of producing an electrocardiogram (ECG or EKG[a]), a recording of the heart's electrical activity.[4] It is an electrogram of the heart which is a graph of voltage versus time of the electrical activity of the heart[5] using electrodes placed on the skin. These electrodes detect the small electrical changes that are a consequence of cardiac muscle depolarization followed by repolarization during each cardiac cycle (heartbeat). Changes in the normal ECG pattern occur in numerous cardiac abnormalities.

Traditionally, "ECG" usually means a 12-lead ECG taken while laying down as discussed below. However, other devices can record the electrical activity of the heart such as a Holter monitor but also some models of smartwatch are capable of recording an ECG. ECG signals can be recorded in other contexts with other devices.

In a conventional 12-lead ECG, ten electrodes are placed on the patient's limbs and on the surface of the chest. The overall magnitude of the heart's electrical potential is then measured from twelve different angles ("leads") and is recorded over a period of time (usually ten seconds). In this way, the overall magnitude and direction of the heart's electrical depolarization is captured at each moment throughout the cardiac cycle.[12]

There are three main components to an ECG: the P wave, which represents the depolarization of the atria; the QRS complex, which represents the depolarization of the ventricles; and the T wave, which represents the repolarization of the ventricles.[13]

During each heartbeat, a healthy heart has an orderly progression of depolarization that starts with pacemaker cells in the sinoatrial node, spreads throughout the atrium, and passes through the atrioventricular node down into the bundle of His and into the Purkinje fibers, spreading down and to the left throughout the ventricles.[13] This orderly pattern of depolarization gives rise to the characteristic ECG tracing. To the trained clinician, an ECG conveys a large amount of information about the structure of the heart and the function of its electrical conduction system.

Medical uses

Normal 12-lead ECG

A 12-lead ECG of a 26-year-old male with an incomplete RBBB The overall goal of performing an ECG is to obtain information about the electrical function of the heart. Medical uses for this information are varied and often need to be combined with knowledge of the structure of the heart and physical examination signs to be interpreted. Some indications for performing an ECG include the following

3.Infusion pump

An infusion pump infuses fluids, medication or nutrients into a patient's circulatory system. It is generally used intravenously, although subcutaneous, arterial and epidural infusions are occasionally used.

Infusion pumps can administer fluids in ways that would be impractically expensive or unreliable if performed manually by nursing staff. For example, they can administer as little as 0.1 mL per hour injections (too small for a drip), injections every minute, injections with repeated boluses requested by the patient, up to maximum number per hour (e.g. in patient-controlled analgesia), or fluids whose volumes vary by the time of day.

Because they can also produce quite high but controlled pressures, they can inject controlled amounts of fluids subcutaneously (beneath the skin), or epidurally (just within the surface of the central nervous system – a very popular local spinal anesthesia for childbirth).

The user interface of pumps usually requests details on the type of infusion from the technician or nurse that sets them up:

Continuous infusion usually consists of small pulses of infusion, usually between 500 nanoliters and 10 milliliters, depending on the pump's design, with the rate of these pulses depending on the programmed infusion speed. Intermittent infusion has a "high" infusion rate, alternating with a low programmable infusion rate to keep the cannula open. The timings are programmable. This mode is often used to administer antibiotics, or other drugs that can irritate a blood vessel. To get the entire dose of antibiotics into the patient, the "volume to be infused" or VTBI must be programmed for at least 30 CCs more than is in the medication bag; failure to do so can potentially result in up to half of the antibiotic being left in the IV tubing.

Patient-controlled is infusion on-demand, usually with a preprogrammed ceiling to avoid intoxication. The rate is controlled by a pressure pad or button that can be activated by the patient. It is the method of choice for patient-controlled analgesia (PCA), in which repeated small doses of opioid analgesics are delivered, with the device coded to stop administration before a dose that may cause hazardous respiratory depression is reached. Total parenteral nutrition usually requires an infusion curve similar to normal mealtimes. Some pumps offer modes in which the amounts can be scaled or controlled based on the time of day. This allows for circadian cycles which may be required for certain types of medication.
There are two basic classes of pumps. Large volume pumps can pump fluid replacement such as saline solution, medications such as antibiotics or nutrient solutions large enough to feed a patient. Small-volume pumps infuse hormones, such as insulin, or other medicines, such as opiates.

Within these classes, some pumps are designed to be portable, others are designed to be used in a hospital, and there are special systems for charity and battlefield use.

Large-volume pumps usually use some form of peristaltic pump. Classically, they use computer-controlled rollers compressing a silicone-rubber tube through which the medicine flows. Another common form is a set of fingers that press on the tube in sequence.

Small-volume pumps usually use a computer-controlled motor turning a screw that pushes the plunger on a syringe.

The classic medical improvisation for an infusion pump is to place a blood pressure cuff around a bag of fluid. The battlefield equivalent is to place the bag under the patient. The pressure on the bag sets the infusion pressure. The pressure can actually be read-out at the cuff's indicator. The problem is that the flow varies dramatically with the cuff's pressure (or patient's weight), and the needed pressure varies with the administration route, potentially causing risk when attempted by an individual not trained in this method.

4.CT scanner

A CT scan or computed tomography scan (formerly known as computed axial tomography or CAT scan) is a medical imaging technique used in radiology to obtain detailed internal images of the body noninvasively for diagnostic purposes. The personnel that perform CT scans are called radiographers or radiology technologists.[2][3]

CT scanners use a rotating X-ray tube and a row of detectors placed in the gantry to measure X-ray attenuations by different tissues inside the body. The multiple X-ray measurements taken from different angles are then processed on a computer using reconstruction algorithms to produce tomographic (cross-sectional) images (virtual "slices") of a body. The use of ionizing radiation sometimes restricts its use owing to its adverse effects. However, CT can be used in patients with metallic implants or pacemakers where MRI is contraindicated.

Since its development in the 1970s, CT has proven to be a versatile imaging technique. While CT is most prominently used in diagnostic medicine, it also may be used to form images of non-living objects. The 1979 Nobel Prize in Physiology or Medicine was awarded jointly to South African-American physicist Allan M. Cormack and British electrical engineer Godfrey N. Hounsfield "for the development of computer-assisted tomography".

Spinning tube, commonly called spiral CT, or helical CT, is an imaging technique in which an entire X-ray tube is spun around the central axis of the area being scanned. These are the dominant type of scanners on the market because they have been manufactured longer and offer a lower cost of production and purchase. The main limitation of this type of CT is the bulk and inertia of the equipment (X-ray tube assembly and detector array on the opposite side of the circle) which limits the speed at which the equipment can spin. Some designs use two X-ray sources and detector arrays offset by an angle, as a technique to improve temporal resolution.

5.Ambulance

An ambulance is a medically equipped vehicle which transports patients to treatment facilities, such as hospitals.[1] Typically, out-of-hospital medical care is provided to the patient.

Ambulances are used to respond to medical emergencies by emergency medical services (EMS). For this purpose, they are generally equipped with flashing warning lights and sirens. They can rapidly transport paramedics and other first responders to the scene, carry equipment for administering emergency care and transport patients to hospital or other definitive care. Most ambulances use a design based on vans or pickup trucks. Others take the form of motorcycles, buses, limousines, aircraft and boats.

Generally, vehicles count as an ambulance if they can transport patients. However, it varies by jurisdiction as to whether a non-emergency patient transport vehicle (also called an ambulette) is counted as an ambulance. These vehicles are not usually (although there are exceptions) equipped with life-support equipment, and are usually crewed by staff with fewer qualifications than the crew of emergency ambulances. Conversely, EMS agencies may also have emergency response vehicles that cannot transport patients.[2] These are known by names such as nontransporting EMS vehicles, fly-cars or response vehicles.

The term ambulance comes from the Latin word "ambulare" as meaning "to walk or move about"[3] which is a reference to early medical care where patients were moved by lifting or wheeling. The word originally meant a moving hospital, which follows an army in its movements.[4] Ambulances (Ambulancias in Spanish) were first used for emergency transport in 1487 by the Spanish forces during the siege of Málaga by the Catholic Monarchs against the Emirate of Granada. During the American Civil War vehicles for conveying the wounded off the field of battle were called ambulance wagons.[5] Field hospitals were still called ambulances during the Franco-Prussian War[6] of 1870 and in the Serbo-Turkish war of 1876[7] even though the wagons were first referred to as ambulances about 1854 during the Crimean War.
The history of the ambulance begins in ancient times, with the use of carts to transport incurable patients by force. Ambulances were first used for emergency transport in 1487 by the Spanish, and civilian variants were put into operation during the 1830s.[9] Advances in technology throughout the 19th and 20th centuries led to the modern self-powered ambulances.

Functional types Ambulances can be grouped into types depending on whether or not they transport patients, and under what conditions. In some cases, ambulances may fulfill more than one function (such as combining emergency ambulance care with patient transport:

Emergency ambulance – The most common type of ambulance, which provides care to patients with an acute illness or injury. These can be roadgoing vans, boats, helicopters, fixed-wing aircraft (known as air ambulances), or even converted vehicles such as golf carts. Patient transport ambulance – A vehicle, which has the job of transporting patients to, from or between places of medical treatment, such as hospital or dialysis center, for non-urgent care. These can be vans, buses, or other vehicles. Ambulance bus – A large ambulance, usually based upon a bus chassis, that can evacuate and transport a large number of patients. Charity ambulance – A special type of patient transport ambulance is provided by a charity for the purpose of taking sick children or adults on trips or vacations away from hospitals, hospices, or care homes where they are in long-term care. Examples include the United Kingdom's 'Jumbulance' project.[10] These are usually based on a bus. Bariatric ambulance – A special type of patient transport ambulance designed for extremely obese patients equipped with the appropriate tools to move and manage these patients. Rapid organ recovery ambulance collects the bodies of people who have died suddenly from heart attacks, accidents and other emergencies and try to preserve their organs."[11][12] New York City is launching a pilot program deploying one such ambulance.