ASSIGNMENT -1 BIOMEDICAL EQUIPMENTS

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1 Anesthesia Machine

1.1 Introduction

The most important piece of equipment that the anaesthesiologist uses is the anaesthesia machine. Safe use of anaesthesia machine depends upon an interaction between the basic design of the machine with its safety features and the knowledge and skills of the anaesthesiologist. The basic function of an anaesthesia machine is to prepare a gas mixture of precisely known, but variable composition. The gas mixture can then be delivered to a breathing system. Anaesthesia machine itself has evolved from a simple pneumatic device to a complex array of mechanical, electrical and computer – controlled components. Much of the driving force for these changes have been to improve patient safety and user convenience.

1.2 History and evolution

After anaesthesia was invented and introduced with the public demonstration of ether anaesthesia by WTG Morton in 1846, for many years an anaesthesia machine was not required for providing anaesthesia to the patients until oxygen (O2) and nitrous oxide (N2O) were introduced as compressed gases in cylinders by the late 19th century.A metal skeleton was required for mounting these cylinders.

Boyle's machine was invented by Henry Edmund Gaskin Boyle in 1917. His machine was a modification of the American Gwathmey apparatus of 1912 and became the best known early continuous flow anaesthetic machine.

1.3 Function of anesthesia machine

The machine performs four essential functions: Provides O2,
Accurately mixes anaesthetic gases and vapours,
Enables patient ventilation and
Minimises anaesthesia related risks to patients and staff.

2 Centrifuge

2.1 What is centrifuge

A centrifuge is a device that uses centrifugal force to separate various components of a fluid. This is achieved by spinning the fluid at high speed within a container, thereby separating fluids of different densities (e.g. cream from milk) or liquids from solids. It works by causing denser substances and particles to move outward in the radial direction. At the same time, objects that are less dense are displaced and move to the centre. In a laboratory centrifuge that uses sample tubes, the radial acceleration causes denser particles to settle to the bottom of the tube, while low-density substances rise to the top.A centrifuge can be a very effective filter that separates contaminants from the main body of fluid.

2.2 History of centrifuge machine

English military engineer Benjamin Robins (1707–1751) invented a whirling arm apparatus to determine drag. In 1864, Antonin Prandtl proposed the idea of a dairy centrifuge to separate cream from milk. The idea was subsequently put into practice by his brother, Alexander Prandtl, who made improvements to his brother's design, and exhibited a working butterfat extraction machine in 1875.

2.3 Uses

A wide variety of laboratory-scale centrifuges are used in chemistry, biology, biochemistry and clinical medicine for isolating and separating suspensions and immiscible liquids. They vary widely in speed, capacity, temperature control, and other characteristics. Laboratory centrifuges often can accept a range of different fixed-angle and swinging bucket rotors able to carry different numbers of centrifuge tubes and rated for specific maximum speeds. Controls vary from simple electrical timers to programmable models able to control acceleration and deceleration rates, running speeds, and temperature regimes. Ultracentrifuges spin the rotors under vacuum, eliminating air resistance and enabling exact temperature control

3 Laser Surgery

3.1 Introduction

Laser surgery is commonly used on the eye. Techniques used include LASIK, which is used to correct near and far-sightedness in vision, and photorefractive keratectomy, a procedure which permanently reshapes the cornea using an excimer laser to remove a small amount of the human tissue.

Types of surgical lasers include carbon dioxide, argon, Nd:YAG laser, and potassium titanyl phosphate, among others.

3.2 Effect of laser surgery

Photochemical effect: clinically referred to as photodynamic therapy. Photosensitizer (photophrin II) is administered which is taken up by the tumor tissue and later irradiated by laser light resulting in highly toxic substances with resultant necrosis of the tumor.
Photodynamic therapy is used in palliation of oesophageal and bronchial carcinoma and ablation of mucosal cancers of Gastrointestinal tract and urinary bladder.
Photoablative effect: Used in eye surgeries like band keratoplast, and endartectomy of peripheral blood vessels.
Photothermal effect: this property is used for endoscopic control of bleeding e.g. Bleeding peptic ulcers, oesophageal varices
Photomechanical effect: used in intraluminal lithotripsy

3.3 Applications

Soft-tissue laser surgery is used in a variety of applications in humans (general surgery, neurosurgery, ENT, dentistry, orthodontics, and oral and maxillofacial surgery) as well as veterinarysurgical fields. The primary uses of lasers in soft tissue surgery are to cut, ablate, vaporize, and coagulate. There are several different laser wavelengths used in soft tissue surgery. Different laser wavelengths and device settings (such as pulse duration and power) produce different effects on the tissue. Some commonly used lasers types in soft tissue surgery include erbium, diode, and CO2. Erbium lasers are excellent cutters, but provide minimal hemostasis. Diode lasers (hot tip) provide excellent hemostasis, but are slow cutters. CO2 lasers are both efficient at cutting and coagulating.

Dermatology and plastic surgery Edit A range of lasers such as erbium, dye, Q switch lasers, and CO2 are used to treat various skin conditions including scars, vascular and pigmented lesions, and for photorejuvenation. The laser surgery for dermatology often bypasses the skin surface. The principle of laser surgery for dermatologic problems is based on SPTL (selective photothermolysis). The laser beam penetrates the skin until it encounters chromophore which absorbs the laser beam. After absorption of the laser beam, heat is generated

to induce coagulation, necrosis of the targeted tissue, this results in the removal of unwanted tissue by laser surgery.

Laser resurfacing is a technique in which covalent bonds of a material are dissolved by a laser, a technique invented by aesthetic plastic surgeon Thomas L. Roberts, III using CO2 lasers in the 1990s.

Lasers are also used for laser-assisted lipectomy.

Eye surgery Edit Various types of laser surgery are used to treat refractive error. LASIK, in which a knife is used to cut a flap in the cornea, and a laser is used to reshape the layers underneath, is used to treat refractive error. IntraLASIK is a variant in which the flap is also cut with a laser. In photorefractive keratectomy (PRK, LASEK), the cornea is reshaped without first cutting a flap. In laser thermal keratoplasty, a ring of concentric burns is made in the cornea, which causes its surface to steepen, allowing better near vision. ReLEx SMILE is the latest advancement in laser vision correction technology. In SMILE surgery, ZEISS VisuMax

4 Ergometer

4.1 What does Ergometer refers ?

Ergometer may refer to:
Exercise machine, equipped with an apparatus for measuring the work performed by exercising Indoor rower, called an ergometer by rowers An instrument for measuring the amount of work done by human muscles
Ergometer comes from the Greek words ergon , meaning work, and metron , meaning measure. "Ergometer", therefore, literally means "work measurer". A bike, fitted with mechanical work measurement devices is also an ergometer.

4.2 Benefits of Ergometer

The benefits of using ergometers are the same as with using any other cardio workout equipment. The heart, lungs, bones and muscles all benefit from the use of ergometers. Stress release, weight loss, toning leg and arm muscles are a few examples of what an ergometer can do for you. Ergometers have been become popular in physical therapy for people who have physical disabilities like individuals that are confined to a wheelchair or those who are not physically capable of performing more conventional workouts.

4.3 Types of Ergometer

There are different types of ergometer machines, some of which only work out the arms, others that work out the legs, and some that do both at the same condition

Upper Extremity Ergometer

If you've ever seen a physical therapist for an upper extremity injury such as, rotator cuff surgery or shoulder bursitis, proximal humerus fracture, radial head or elbow fracture, Colles or Smiths fracture, tennis elbow or golfer's elbow, clavicle fracture, shoulder dislocation or labrum tear, chances are your physical therapist had you use an upper extremity ergometer to measure how much work your upper body muscles are doing. This is done by grasping the the handles and turning them in a circular motion. People that can also benefit from the upper extremity ergometer are individuals that can't use their legs and still want to get a cardiovascular workout. Upper extremity machines have different settings to increase or decrease resistance. They also have an adjustable seat, and many allow you to use the machine while standing up. Examples of these are the SciFit Pro1000, SciFit Pro1 and Technogym Excite UBE.

Lower Extremity Ergometer

A lower extremity ergometer is pretty much the opposite of a upper extremity ergometer. A lower extremity ergometer focuses on the lower body muscles like the gluteus maximus and the hamstrings through the use of pedaling while increasing or decreasing resistance. Physical therapists usually have their patients exercise on a lower extremity ergometer if they have sustained a lower body injury. Lower extremity ergometer helps patients regain range of motion and strength in their lower body. People that have lost the use of their arms can also benefit from the lower extremity ergometer to get a cardiovascular workout. Lower extremity ergometers usually have handle bars for the user to hold on to while using the machine.

5 Implanted devices

5.1 What are Implanted devices

An implant is a medical device manufactured to replace a missing biological structure, support a damaged biological structure, or enhance an existing biological structure. Medical implants are man-made devices, in contrast to a transplant, which is a transplanted biomedical tissue. The surface of implants that contact the body might be made of a biomedical material such as titanium, silicone, or apatite depending on what is the most functional.In some cases implants contain electronics, e.g. artificial pacemaker and cochlear implants. Some implants are bioactive, such as subcutaneous drug delivery devices in the form of implantable pills or drug-eluting stents.

5.2 Classification

Medical devices are classified by the US Food and Drug Administration (FDA) under three different classes depending on the risks the medical device may impose on the user. According to 21CFR 860.3, Class I devices are considered to pose the least amount of risk to the user and require the least amount of control. Class I devices include simple devices such as arm slings and hand-held surgical instruments. Class II devices are considered to need more regulation than Class I devices and are required to undergo specific requirements before FDA approval. Class II devices include X-ray systems and physiological monitors. Class III devices require the most regulatory controls since the device supports or sustains human life or may not be well tested. Class III devices include replacement heart valves and implanted cerebellar stimulators. Many implants typically fall under Class II and Class III devices.

5.3 Application

Sensory and neurological
Sensory and neurological implants are used for disorders affecting the major senses and the brain, as well as other neurological disorders. They are predominately used in the treatment of conditions such as cataract, glaucoma, keratoconus, and other visual impairments; otosclerosis and other hearing loss issues, as well as middle ear diseases such as otitis media; and neurological diseases such as epilepsy, Parkinson's disease, and treatment-resistant depression. Examples include the intraocular lens, intrastromal corneal ring segment, cochlear implant, tympanostomy tube, and neurostimulator.

Cardiovascular
Cardiovascular medical devices are implanted in cases where the heart, its valves, and the rest of the circulatory system is in disorder. They are used to treat conditions such as heart failure, cardiac arrhythmia, ventricular tachycardia, valvular heart disease, angina pectoris, and atherosclerosis. Examples include

the artificial heart, artificial heart valve, implantable cardioverter-defibrillator, cardiac pacemaker, and coronary stent.

Orthopedic

Orthopaedic implants help alleviate issues with the bones and joints of the body.They're used to treat bone fractures, osteoarthritis, scoliosis, spinal stenosis, and chronic pain. Examples include a wide variety of pins, rods, screws, and plates used to anchor fractured bones while they heal.

Metallic glasses based on magnesium with zinc and calcium addition are tested as the potential metallic biomaterials for biodegradable medical implants.

Patient with orthopaedic implants sometimes need to be put under magnetic resonance imaging (MRI) machine for detailed musculoskeletal study. Therefore, concerns have been raised regarding the loosening and migration of implant, heating of the implant metal which could cause thermal damage to surrounding tissues, and distortion of the MRI scan that affects the imaging results. A study of orthopaedic implants in 2005 has shown that majority of the orthopaedic implants does not react with magnetic fields under the 1.0 Tesla MRI scanning machine with the exception of external fixator clamps. However, at 7.0 Tesla, several orthopaedic implants would show significant interaction with the MRI magnetic fields, such as heel and fibular implant.

Electric Edit

Electrical implants are being used to relieve pain and suffering from rheumatoid arthritis.The electric implant is embedded in the neck of patients with rheumatoid arthritics, the implant sends electrical signals to electrodes in the vagus nerve.The application of this device is being tested an alternative to medicating sufferers of rheumatoid arthritis for their lifetime.

Contraception

Contraceptive implants are primarily used to prevent unintended pregnancy and treat conditions such as non-pathological forms of menorrhagia. Examples include copper- and hormone-based intrauterine devices.

Cosmetic

Cosmetic implants — often prosthetics — attempt to bring some portion of the body back to an acceptable aesthetic norm. They are used as a follow-up to mastectomy due to breast cancer, for correcting some forms of disfigurement, and modifying aspects of the body (as in buttock augmentation and chin augmentation). Examples include the breast implant, nose prosthesis, ocular prosthesis, and injectable filler.

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