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Human Embalming Techniques: A Review

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Abstract

Embalming in most modern cultures is the art and science of temporarily preserving human remains to forestall decomposition and make it suitable for display at a funeral. Human embalming started in Egypt about 3,000 (three thousand) years ago when the Egyptian noticed the preservation and mummification which took place when they left their human bodies in the desert. The two methods of preserving human cadavers are: the natural method and non-natural method. The ingredients that can be used for making up human embalming fluids are: formalin, phenol, methylated spirit, Glycerin and water. Certain factors like temperature, access by insect and access by carnivores can affect an embalmed body. Measures to follow when carrying out human embalming are to always wear laboratory coat, hand (surgical) gloves and rain boots. It has also been recommended that human embalming should be carried out in a place that is equipped with an extractor fan or a well-ventilated area.

Keywords: Mummification, Embalming, Cadavers, Glycerin, Formalin, Phenol, Ingredients

1. Introduction

Embalming in most modern cultures is the art and science of temporarily preserving human remains to forestall decomposition and make it suitable for display at a funeral [1]. It involves the use of fixative (embalming fluid is introduced or perfused into the cadavers, through the arterial system to prevent autolysis and putrefaction). The three major goals of embalming are thus,

preservation, sanitization and presentation (or restoration of a dead body). Human embalming has a very long and cross cultural history, with many cultures giving the embalming process a great religious meaning. Human embalming started in Egypt; the ancient Egyptians raised the process of embalming to a fine art in the production of their mummies. Initially human embalming was carried out mainly in medical colleges in the western world before extending to other parts of the world. In 1832 and 1871, the anatomy acts passed into law permitted dead bodies to be embalmed and then dissected for the purpose of teaching students of medicine, dentistry, physiotherapy, Medical Laboratory ciences and for anatomical research [2].

Today human embalming is also employed so that a body can be transported long distance and funeral rites can be conducted with due measures.

2. History of Human Embalming

Egypt is credited with being the land where embalming began. According to the records in the Holy Bible, in Genesis chapter 50 verses 2 (And Joseph commanded his servants the Physicians to Embalm his father and the physician embalmed Israel also called Jacob KJV) and in Genesis chapter 50 verse 26 (So Joseph died being an hundred and ten years old and they embalmed and he was put in a coffin in Egypt KJV) During the period from 6000 BC to 600 AD approximately 400,000,000 bodies were mummified [2]. Embalming in Egypt was done for two reasons: (1) Religious (2) Sanitation

(1) Religious:Greek historian Herodotus maintained that the Egyptians were the first people to believe in the immortality of the soul. They believed that the soul would never fully forsake the body as long as the body remained intact. Embalming was for the purpose of preserving the body so that the soul could return to it after the completion of the “circle of necessity.” This "circle of necessity" was a 3,000 year journey, the soul was required to make before it could return to the body. At that time, the whole man would arise from the dead and live with the gods forever [2].

(2) Sanitation: The writer Cassius, maintained that embalming was developed to provide a solution to the problem of trying to bury the dead in the Nile valley which would be inundated on a frequent basis. The Egyptians apparently also noted that this unsanitary condition caused more deaths [2].

2.1 The Egyptian Embalming Method

The Egyptian embalmers were members of the priesthood. Some believe that their embalming method is a “lost art” but in fact it was rather crude and rather than lost, well known and documented. Much of their success was undoubtedly due to the dry hot climate. Dead bodies are destroyed by the action of bacteria. Heat and lack of moisture are natural enemies to bacterial survival and growth [3]. The Egyptians practiced three methods of embalming based upon the wealth of the individual. The most expensive method was comprised of 5 steps, which are:

Step 1. Removal of the brain. The skull was then repacked with resin.

Step 2. Evisceration. The internal organs were removed through an abdominal incision. The organs were either washed and mixed with resins and spices and returned to the body or were placed in separate burial vases called canopic jars.

Step 3. Immersion. The body was immersed in natron (sodium salt). The caustic action of the solution (sodium salt) would cause the fingernails and toe nails to be removed. This immersion lasted for 20-70 days.

Step 4. Dehydration. The body was cleansed, straightened and allowed to dehydrate in the sun.

Step 5. Wrapping. About 1200 yards of 3 1/4 inch bandage was used to wrap the body. Gum or glue held the cloth together and helped in fitting it around the body while it was still damp. The body was then placed in a sarcophagus and returned to the family [4].

2.2 Other Early Practices of Human Embalming

The Egyptians were not the only people to practice some type of preservation of the dead.

Ancient Ethiopian tribes preserved their dead in a manner similar to the Egyptians.

Aboriginal inhabitants of the Canary Islands from 900 BC practiced mummification of their dead [4].

Babylonians, Persians, and Syrians preserved their dead by placing them in jars of honey or wax. By depriving the bacteria in the body of air, decomposition was prevented.

Peruvians practiced mummification 1000 years prior to being conquered by Spain in the early 16th century [3].

The Greeks believed that the deceased must make a journey across the river Styx to the land of eternity. A coin was placed in the mouth of the deceased to pay passage over the river. A cake of honey was placed next to the body to appease the three headed dog, Cerebus, who guarded the entrance to Hades. Interment was delayed three days to prevent premature burial. Cremation came into practice in about 300 BC.

The Romans also did not practice embalming as such. The body would be washed daily for seven days with hot water and oil. This delay also was to prevent premature burial. A group of slaves called pollinctores performed this function. Funeral processions were held at night to avoid defilement of the living. The procession was managed by a Designator, who functioned much like the modern day funeral director. Burial later gave way to cremation. At one point cremation was forbidden within the gates of Rome because of the smoke pollution of so many bodies being burned at once [2].

2.3 Influence of Scientific Developments

During the "dark ages" in Europe, embalming was generally not practiced. During this period, great advances were being made in medicine and bodies were needed for dissection purposes. For this sole purpose, some embalming was done and techniques perfected. Also during this time, discoveries made in the world of medicine would have a great influence in the development of modern embalming technique [5].

Leonardo DaVinci (1452-1519) produced hundreds of anatomical plates as a result of his dissection of the human body. He undoubtedly used arterial injection to preserve his specimens.

Dr. Frederick Ruysch (1665-1717) is generally considered the father of embalming with his discovery of the first successful system of arterial embalming.

Dr. William Harvey (1578-1657) was the English physician who discovered the circulation of blood.

Dr. William Hunter (1718-1783) is credited with being the first to successfully adopt arterial injection as a means of preservation.

Jean Gannal (1791-1882) began as an apothecary's assistant and became the first to offer embalming to the French general public.

Anthony Van Leeuwenhoek (1632-1723) manufactured the microscope and discovered bacteria in 1683.

Alexander Butlerov (1828-1866) and Wilhelm von Hofmann (1818-1892) are credited with the discovery of formaldehyde.

Dr. Thomas Holmes (1817-1900) is generally considered the father of modern embalming. He experimented with preservative chemicals while working as a coroner assistant in New York and later began offering his services to the public [2].

2.4 Early American Embalming

Modern embalming really got its start during the Civil War period. Dr. Thomas Holmes received a commission as a captain in the Army Medical Corps and was assigned to Washington, D.C. where he embalmed many army officers killed in battle. He reportedly embalmed over 4,000 soldiers and officers. President Lincoln took a great interest in embalming and directed the Quartermaster Corps to utilize embalming to allow the return of Union dead to their home towns for proper burial. When he realized the commercial potential of embalming, Holmes resigned his commission and began offering embalming to the public for $100. After the Civil War, embalming fell into disuse because of lack of demand for it [2].

2.5 Twentieth Century Practices

By the turn of the century, wooden coffins were being made to order by the local carpenter or cabinet maker. A few even made coffins beforehand but met with criticism by the public for their boldness. The cabinet maker rarely became involved in any aspect of the funeral other than providing the coffin. Even the conveyance of the deceased was done by someone else, the livery man. With the passing of time, these men became more and more involved in providing other services and advise to those planning the funeral. Eventually the person who would "undertake" to manage all funeral details and provide funeral merchandise became known as an "undertaker." He eventually obtained and provided all the necessary items for the funeral including the hearse, door badges, coffin

rests, etc. Once it became possible for the undertaker to provide embalming services, the haste was taken out of the burial process and people were given ample time to arrange and prepare for the funeral. The first embalming preparations were arsenic solutions that were rapidly replaced when formaldehyde became available. Representatives for embalming fluid companies would travel the country presenting one or two day schools of instruction in the use of their product. For attending these classes and purchasing a quantity of fluid, an undertaker received a certificate as an embalmer. It wasn't until the 1930's that state licensing became almost universal. While this education seems wholly inadequate, it should be remembered that physicians and dentists of the day did not have much education either prior to practicing their profession. From the cabinetmaker who simply supplied a coffin, the funeral director today provides over 130 separate services to a family [6].

2.6 Methods of Carrying Out Human Embalming

Natural Method
a)Mummification
b)Preservation in cold or icy condition
Non-natural method
a)Conventional method of embalming
b)Refrigeration
c)Plastination
d)Thiel's method of embalming

2.6.1 Natural Method

(a) Mummification.

Mummification is the preservation of a cadaver. Some mummies are preserved wet, some are frozen, and some are dried. It can be a natural process or it may be deliberately achieved. The Egyptian mummies were deliberately made by drying the body. By eliminating moisture, you have eliminated the source of decay. They dried the body by using a salt mixture called natron. Natron is a natural substance that is found in abundance along the Nile river. Natron is made up of four salts: sodium carbonate, sodium bicarbonate, sodium chloride, and sodium sulfate. The sodium carbonate works as a drying agent, drawing the water out of the body. At the same time the bicarbonate, when subjected to moisture, increases the pH that creates a hostile environment for bacteria. The Egyptian climate which is both hot and dry, encourages and favors the process of mummification to take place [7].

Reasons Why Ancient Egyptian Mummify Their Dead:

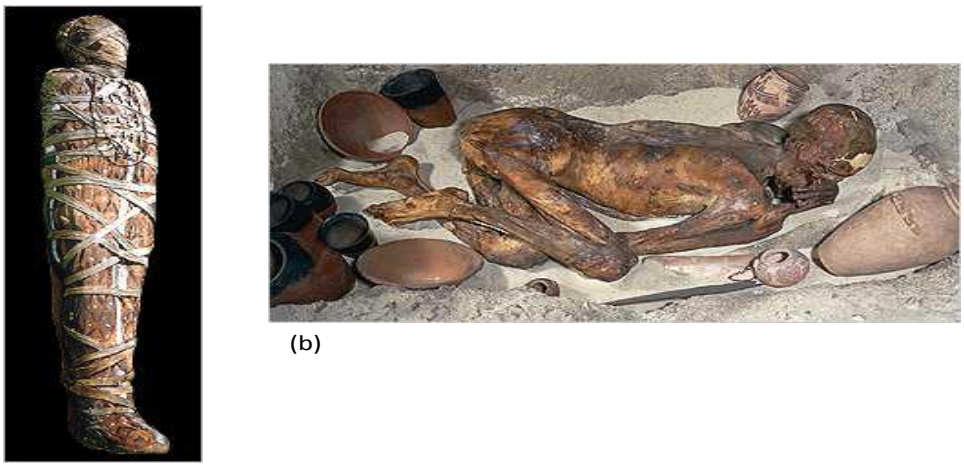
The ancient Egyptians believed in the resurrection of the body and life. This belief was rooted in what they observed each day. The sun fell into the western horizon each evening and was reborn the next morning in the east. New life sprouted from grains planted in the earth, and the moon waxed and waned. As long as order was maintained, everything was highly dependable and life after death could be achieved provided certain conditions were met. For example, the body had to be preserved through mummification and given a properly furnished tomb with everything needed for life in the afterworld [4].

Mummification, the preservation of the body, was described in the ancient Pyramid Texts. With the death of Osiris, god of the dead, the cosmos fell into chaos and the tears of the gods turned into materials used to mummify his body. These materials included honey, resins and incense. Before mummification evolved, the corpse was placed in a sleeping fetal position and put into a pit, along with personal items such as clay pots and Jewelry. The pit was covered with sand, which absorbed all the water from the body, thus preserving it. Burial pits were eventually lined with mud bricks and roofed over, and the deceased were wrapped in animal skins or interred in pottery, basket ware or wooden coffins. With these "improvements", decay was hastened because the body no longer came in contact with the hot sand. To solve this problem, the internal organs of the deceased were removed and drying agents were used to mummify the body [4]. The Egyptians believed that there were six important aspects that made up a human being: the physical body, shadow, name, ka (spirit), ba (personality), and the akh (immortality). Each one of these elements played an important role in the well being of an individual. Each was necessary to achieve rebirth into the afterlife. With the exception of the akh, all these elements join a person at birth. A person's shadow was always present. A person could not exist without a shadow, nor the shadow without the person. The shadow was represented as a small

human figure painted completely black. A person's name was given to them at birth and would live for as long as that name was spoken. This is why efforts were made to protect the name. A cartouche (magical rope) was used to surround the name and protect it for eternity [8].

The ka was a person's double. It is what we would call a spirit or a soul. The ka was created at the same time as the physical body. The doubles were made on a potters wheel by the ram-headed god, Khnum. The ka existed in the physical world and resided in the tomb. It had the same needs that the person had in life, which was to eat, drink, etc. The Egyptians left offerings of food, drink, and worldly possessions in tombs for the ka to use. The ba can best be described as someone's personality. Like a person's body, each ba was an individual. It entered a person's body with the breath of life and it left at the time of death. It moved freely between the underworld and the physical world. The ba had the ability to take on different forms. The akh was the aspect of a person that would join the gods in the underworld being immortal and unchangeable. It was created after death by the use of funerary text and spells, designed to bring forth an akh. Once this was achieved that individual was assured of not "dying a second time" a death that would mean the end of one's existence. An intact body was an integral part of a person's afterlife. Without a physical body there was no shadow, no name, no ka, ba, or akh. By mummification, the Egyptians believed they were assuring themselves a successful rebirth into the afterlife [8].

Materials used in mummificationinclude; linen, sawdust, lichen, beeswax, resin, natron, onion, Nile mud, linen pads and frankincense [4]



(a) (b)

Fig 1.0 MUMMIFIED BODIES. (Courtney and Boxall, 1971)

Fig1:modern mummy (mumab i)

(b) Preservation in cold or icy conditions

This is a natural form of preservation of the dead body in which the body is kept in a very cold atmosphere as in the highland of Peru and Incas in South America [2].

2.6.2 Non-natural method

(a) Conventional method of human embalming

Embalming as practiced in the funeral homes of the western world uses several steps. Modern embalming techniques are not the result of a single practitioner discovery, but rather the accumulation of many decades' even centuries of researches, trials and errors and inventions. The modern practice of embalming utilizes the so called arterial embalming technique [8]. Arterial embalming consists of injection of an embalming fluid into the arterial system of the cadaver and utilizing the whole vascular system. A standardized system follows below but variation on technique is very common [10].

The first thing an embalmer does, is to verify the identity of the deceased [normally via wrist or leg tag] and perform basic test for signs of death.

Such as lividity and rigor mortis. While a person awakening on the mortuary is largely the province of horror fiction and urban myth, testing for death is still a final additional precaution. Any clothing on the corpse is removed and set aside. A modesty cloth is then placed over the deceased genitalia for dignity. Following this, the corpse is washed in disinfectant and germicidal solutions, shaved and groomed. The embalmer bends, flexes and massages the arms and legs to relieve rigor mortis [9]. The eyes are closed and kept closed with an eye cap that keeps them shut and in proper expression. The mouth may be closed via suturing with a needle via ligature using an adhesive wire or a needle injector, a specialized device most commonly utilized in north America and unique to mortuary practice care is taken, to make the expression look as natural and relaxed as possible, a recent photograph of the deceased while still living is used as a template. The process of closing the mouth, eyes, shaving e.t.c is collectively known as “setting the features”. The actual embalming process normally involves these four parts [11].

Arterial Embalming: Which involves the injection of embalming chemicals into the blood vessels, usually via the right common carotid artery or via the femoral artery, blood is displaced from the right jugular vein. The embalming solution is injected through a mechanical pump and the embalmer massages the corpse to ensure a proper distribution of embalming fluid. In case of poor circulation, other injection points are used [10].

Cavity Embalming: The internal fluid of the corpse is being suctioned; thereafter there is an injection of embalming chemicals into the body cavities using an aspirator and trocar. The embalmer makes a small incision just above the navel and pushes the trocar in the chest and stomach cavities to puncture the hollow organs and aspirate their contents. The cavity is then filled up with concentrated chemicals that contain formaldehyde. The incision is either suctured close or a "trocar button" is screwed into place [1].

Hypodermic Embalming: This involves injecting the embalming chemical under the skin as needed.

Surface embalming: This supplements the other methods especially visible injured body parts [1].

2.7 Opening the Femoral Artery

The subject is usually placed on anatomical position on a flat surface; there are four possible sites for inserting the perfusing cannulae. These are both femoral and common carotid arteries. If blockage of one of the arteries prevents a satisfactory flow of fluid into the body then the other are tried in turn. If none of these sites gives a satisfactory flow, the body is unsuitable for perfusion. In this case the last resort is liberal intermuscular with embalming needles and syringes.

A line is drawn with skin pencil from the anterior superior iliac spine to the medial condyle of the tibia, this approximately the line on the underlying satorious muscle, a second line is drawn from the anterior superior aspect of the symphysis pubic, and this approximately overlies the inguinal ligament which is the lower boundary of the anterior front abdominal wall. Finally the mid-point of the two lines are joined 3cm below inguinal ligament or a little above the center of the third line, an incision (out) about 8cm long made through the skin and underlying fatty tissue, the cut is opened and searched for the femoral sheath by inserting the blunt pair of forceps. Then the femoral sheath is raised by inserting a scapular, a pair of forceps, the femoral sheath is opened and the artery and vein are identified. The vein has relatively thin walls and normally contains valves and bead-like blood clots which can usually be palpated (felt) easily, the artery has much thicker walls which feel smooth if rolled between the finger and the thumb [13].

2.8 Perfusion

To avoid introducing air, the rubber tube linking the anatomical bottle (aspirator bottle) and the two cannulae must be filled with the embalming fluids before the cannulae are inserted into the artery. The two cannulae are inserted into the artery pointing the opposite direction and the embalming fluid begins to enter the femoral artery. The fluid is ran in by gravitational force or flow from the height of about 3m, usually the artery remains opened after death and are relatively free from obstruction and permit the circulation of embalming fluid all over the whole body. As the embalming fluid circulates, the skin becomes pallid. The extent of this change indicates the extent at which the fixatives have

circulated. On completion, the instruments are disconnected and the incision stitched. Between one (1) and three (3) days, the body should be inspected and any area found soft and still maintaining its original colour of the skin is not properly perfused and can be locally injected [2].

2.9 Specialist Embalming

Decomposed bodies, trauma cases, frozen and drowned bodies and those to be transported for long distances also require special treatment beyond that for the "normal" case. The recreation of bodies and features damaged by accident or disease is commonly called restorative act and is a sub-specialty inside embalming, although all qualified embalmers have a degree of practice or training in it. It is startling apparent, however many people have unreal expectation of what a dead body should look like due to seeing many dead bodies on television shows and unreasonably expect a body two weeks decomposed or having crashed in an airplane from 30,000 Feet to look as they look in life. The work of a so called embalmer often results in the deceased appearing natural enough. Embalming autopsy cases differ from standard embalming because the nature of the post mortem irrevocably disrupts the circulatory system with the removal of organs for examination. In this case, a six-point injection is made through the femoral arteries, axillary vessels and common carotids with the viscera treated separately with cavity fluid in a viscera bag [12]. Long term preservation requires different techniques, such as using stronger preservative chemicals, multiple injection sites to ensure thorough saturation of body tissues and in case of a body to be used for anatomical dissection, taking no blood drainage and doing no separate cavity treatment of the internal organs. It should be remembered that embalming is only meant to temporarily preserve the body of a deceased person. Regardless of whether embalming is performed, the type of burial or entombment, and the materials used such as wood or metal casket or Coffin used, the deceased will eventually decompose. Modern embalming is done to delay decomposition so that funeral services may take place [8].

2.10 Plastination

Plastination is a technique or process used in anatomy to preserve bodies or body parts, first developed by Gunther von Hagens in 1977. The water and fat are replaced by certain plastics, yielding specimens that can be touched, do not smell or decay, and even retain most properties of the original sample [14].

2.11 History of Plastination

In November 1979, Gunther von Hagens applied for a German patent, proposing the idea of preserving animal and vegetable tissues permanently by synthetic resin impregnation. Since then, von Hagens has applied for further US patents regarding work on preserving biological tissues with polymers [15].

With the success of his patents, von Hagens went on to form the Institute for Plastination in Heidelberg, Germany in 1993. The Institute of Plastination, along with von Hagens made their first showing of plastinated bodies in Japan in 1995, which drew more than three million visitors. The Institute maintains three international centres of plastination: in Germany, Kyrgyzstan and China [14].

2.12 Process of Plastination

There are four steps in the standard process of plastination: fixation, dehydration, forced impregnation in a vacuum, and hardening. Water and lipid tissues are replaced by curable polymers. Curable polymers used by plastination include silicone, epoxy and polyester-copolymer [16]. The first step of plastination is fixation. Fixation, frequently utilizing a formaldehyde based solution, serves two functions. Dissecting the specimen to show specific anatomical elements can be time consuming. Formaldehyde or other preserving solutions help prevent the decomposition of the tissues. They may also confer a degree of rigidity. This can be beneficial in maintaining the shape or arrangement of a specimen. A stomach might be inflated or a leg bent at the knee for example. After many necessary dissections must have taken place, the specimen is then placed in a bath of acetone. Under freezing conditions, the acetone draws out all the water from the cells [17]. In the third step, the specimen is then placed in a bath of liquid polymer, such as silicone rubber, polyester or epoxy resin. By

creating a vacuum, the acetone is made to boil at a low temperature. As the acetone vaporizes and leaves the cells, it draws the liquid polymer in behind it, leaving the cell filled with liquid plastic. The plastic must then be cured with gas, heat, or ultraviolet light, in order to harden it [18]. A specimen can be anything from a full human body to a small piece of an animal organ, and they are known as 'plastinates' Once plastinated, the specimens and bodies are further manipulated and positioned prior to curing (hardening) of the polymer chains [7].

2.13 Other plastination methods

Other methods have been in place for thousands of years to halt the decomposition of the body. Mummification used by the Egyptians is a widely known method which involves the removal of body fluid and wrapping the body in linens. Prior to mummification, Egyptians would lay the body in a shallow pit in the desert and allow the sun to dehydrate the body [7]. Formalin, an important solution to body preservation, was introduced in 1896 to help with body preservation. Soon to follow formalin, color preserving embalming solutions were developed to preserve lifelike color and flexibility to aid in the study of the body [13]. Paraffin impregnation was introduced in 1925 and the embedding of organs in plastic was developed in the 1960s. Body preservation methods current to the twenty-first century are cryopreservation, which involves the cooling of the body to very low temperatures to preserve the body tissues, plastination and embalming [14]. Other methods used in modern times include the Silicone S10 Standard Procedure, the Cor-Tech Room temperature procedure, the Epoxy E12 procedure, and the Polyester P35 procedure. The Silicone S10 is the procedure most often used in plastination and creates opaque, natural-looking specimen. Dow Corning Corporation's Cor-Tech Room Temperature Procedure is designed to allow plastination of specimen at room temperature to various degrees of flexibility using three combinations of polymer, cross linker and catalyst. According to the International Society for Plastination, the Epoxy E12 procedure is utilized "for thin, transparent, and firm body and organ slices", while the Polyster P35 preserves "semitransparent and firm brain slices". Samples are prepared for fixation through the first method by deep freezing, while the second method works best following 4-6 weeks of preparation in a formaldehyde mixture [7].

2.14 Uses of plastinated specimens

Plastination is useful in anatomy as well as serving as models and teaching tools [18]. Plastination is used at more than 40 medical and dental schools throughout the world as an adjunct to anatomical dissection. Students enroll in introductory animal science courses at many universities learn animal science through collections of multi-species large-animal specimens. Plastination allows students to have hands on experience in this field, without exposure to chemicals such as formalin. For example, plastinated canine gastrointestinal tracts are used to help in the teaching of endoscopic technique and anatomy. The plastinated specimens retain their dilated conformation by a positive pressure air flow, which allows them to be used to teach both endoscopic technique and gastrointestinal anatomy [17]. With the use of plastination as a teaching method of animal science, fewer animals have to be killed for research, as the plastination process allows specimens to be studied for a long time [17].

The University of Texas Health Science Center at San Antonio was the first school in the United States to use this technique to prepare gross organ specimens for use in teaching. The New York University College of Dentistry, University of Warwick and University of Northumbria use collections of plastinates as teaching aids. The University of Vienna has its own plastination laboratory [19].

2.15 Thiel's method of human embalming

Using a process developed over several decades, the so-called Thiel soft-fix embalming method retains the body's natural look. Skin and muscles remain flexible, allowing the limbs to be moved, while the body's internal organs are clearly identifiable and respond to the surgeon's scalpel as if alive [20]. Conventional methods of preservation using formaldehyde leave the body stiff and fragile, and complicate the understanding of how the body will respond to a particular surgical procedure. The

benefits for surgeons are absolutely massive, head of the Centre for Anatomy and Human Identification at Dundee University, which recently brought the Thiel's technique to the UK. "There is no doubt that surgical skill-sets are incredibly enhanced, while it also allows for innovation,"she says. Prof. Black says patients will benefit from the more rapid adoption of new surgical products and methods. Until 2006 it was illegal in the UK to practice surgery on cadavers. This meant that surgeons had to practice their skills on synthetic models or the carcasses of animals such as cats, dogs, rabbits and pigs. Frozen body parts were also used, but they carry a high risk of infection and disintegrate in a day or two. Prior to 2006, cadavers could be used for dissection but not practicing surgery, out of respect for the deceased [8].

Using animal is never ideal as their anatomy is not always a good match for the human body. Similarly, bodies preserved using formaldehyde, a toxic solution, are never as good as the real thing. "A formaldehyde-preserved body is not like a real body," says Dr Lena Vogt, a foot surgeon from Germany. "It starts with the skin. You just touch it lightly with the scalpel and it falls apart." She says that the bodies lack colour and the layers of tissue stick together making it "difficult to decide if (it) is a nerve, an artery or a vein."Typically, a break is needed every 20 minutes to escape the fumes. The ones from the Austrian institute which pioneered the technique are far superior, she says. "They look more like in the operating room. It is close to reality. You have the opportunity to understand the body much better; that helps you do surgery much better. Surgery is all about practice."Up until the late 19th century, bodies had been preserved using arsenic, a very toxic poison. This was replaced with formaldehyde after its discovery in 1867 by German chemist August Wilhem von Hofman [8]. However, it is highly toxic and carcinogenic. Its use is restricted in many countries and discouraged by a 2007 EU ruling. In the early 1960s, an Anatomist called Walter Thiel, who was head of the Graz Anatomy Institute in southern Austria, began to look for an alternative. His starting point was his local butcher's shop where he noticed that local "wet cured" ham preserved in a solution of salts had a superior texture to the formaldehyde-preserved flesh in his lab. It took 30 years to perfect, starting with prime cuts of beef, more similar to human flesh than pork according to Thiel, before progressing to whole human bodies. In all it took at least 1,000 donated bodies to get it right, says Friedrich Anderhuber, the late Prof Thiel's protégé and successor as head of the institute. It was a lengthy matter of trial and error. A body would be injected with a preserving fluid and then soaked in the liquid for two years. It was a matter of finding the right compromise between preserving of one part of the body and another, says Anderhuber."If you feel a muscle or a liver of a cadaver, it must feel like a muscle or a liver," says Anderhuber. The joints and tendons must also move like those of a living body he says, so surgeons can understand how they work [8].

Thiel eventually settled on a colourless and almost odourless solution of salts, antiseptic boric acid, ethylene glycol, an anti-freeze, and a very low level of formaldehyde. It is so effective in killing bacteria and fungi that it is safe to dissect the body without gloves and the cadavers can be kept at room temperature [20].

3. Embalming Chemicals

Embalming chemicals are a variety of preservatives, sanitizing, disinfecting agents and additives used in modern embalming to temporarily prevent decomposition and restore a natural appearance for viewing a body after death [2].

Embalming fluids acts to "fix" (technically denature) cellular proteins which means they cannot act as a food source for bacteria and it also kills the bacteria themselves. Modern embalming is not done with a single fluid rather various different chemicals are used to control a mixture called an arterial solution which is generated specifically for the need of each case. For example, when a body has to be repatriated overseas, it needs a higher index [percentage of diluted preservative chemical] than one for simple viewing [known in the United States and Canada as a funeral visitation] at a funeral home before cremation [10].

Potential ingredients in an arterial solution include

Preservative [arterial] chemical: These are commonly a percentage [normally 18%-35%] based mixture of formaldehyde, gluteraldehyde or in some

cases phenol which are then diluted to gain the final index of the arterial solution. Methanols are also added to formaldehyde in solution. Formalin refers specifically to 40% aqueous formaldehyde and it is not commonly used in funeral embalming but rather in the preservation of anatomical specimens [12].

Water Conditioner: These are designed to balance the "hardness" of water [the presence of other trace chemicals that changes the water's pH or neutrality] and to help reduce the deceased acidity, a by-product of decomposition as formaldehyde works best in an alkaline environment.

Cell Conditioner: These chemicals act to prepare cells for absorption of arterial fluid and helps break-up clots in the bloodstream.

Dyes: These are used to restore someone's natural coloration and counter stain against conditions such as jaundice as well as to indicate distribution of arterial fluids.

Humectants: These are added to dehydrated and emaciated bodies to help restore tissue to a more natural and hydrated appearance.

Anti-Endemic Chemicals: The opposite of humectants, these are designed to draw excessive fluid [Edema] from a body.

Additional Disinfectants: For certain cases, such as tissue gas, specialist chemicals normally use topically such as dis-spray are added to an arterial solution.

Water: Most arterial solutions are mixtures of some of the preceding chemicals with tepid water. Cases done without the addition of water are referred to specifically as "waterless". Waterless embalming is very effective but not economically viable for everyday cases.

Cavity Fluid: This is a generally a very high index formaldehyde or glutaraldehyde solution injected undiluted directly via the troca incision into the body cavities to treat the viscera. In cases of tissue gas phenol based products are often used instead [21].

The ingredients recommended for making up embalming fluids are:

1)Formalin phenol.

2)Menthylated spirit.

3) Glycerin.

4)Water.

The proportions of these ingredients are varied according to local climatic conditions. In hot countries, the concentration of the mixed ingredients is greater.

Formalin and spirits are fixatives. The effects of these chemicals is to transform [denature and coagulate] the protein which forms the basis of all tissues so that while still retaining their normal form, they become firm in constituency. They also sterilize tissues. Methylated Spirit is unique among fixatives in its power of diffusing through the tissues when arterial flow is impeded, it penetrates more superficially, but acts quickly. Formalin penetrates deeply and it is an excellent fixative provided it reaches all parts. But it has a relatively slow action. Formalin when used in excess burn the body by making it hard and black. Phenol is an anti-bacterial and antifungal agent (preservative) under climatic conditions where fungal attacks present a serious problem, the percentage of phenol included in the embalming fluid may be increased. In excessive concentration, it may damage the skin during dissection and turn the body to black. Glycerin does not allow tissues to dry up, it also make tissues more pliable [10].

Constituents of Embalming Fluids:

In the gravity tank.

1 gallon of isopropyl alcohol.

2 gallons of propylene glycol.

¼ gallon of amphyl

½ gallon of 10% buffered formalin.

500 litres of liquefied phenol.

After the fluid is added, the gravity tank is filled with water to reach the tank capacity of ten gallons.

NOTE 1gallon = 4litres [6].

Embalming apparatus:

The basic apparatus that are normally used for embalming are listed below

1] Anatomical bottle [aspirator bottle] plastic type preferable.

2] Scapel blade [surgical blade]

Other apparatus that can be used are the following

1.Hand gloves

2.Laboratory coat

3. Rubber boot shoe [6].

Embalming and Different Religions:

There is much difference of opinion amongst different faiths as to the permissibility of embalming. A brief overview of some of the larger

faith positions are examined here. All of the major branches of the Christian faith including catholic denomination allow embalming with the exception of the Eastern Orthodoxy, which only allows embalming if required by law or other necessity.

The book of Mammon and the church of Jesus Christ of the latter day saints do not profess against human embalming [they allow embalming]. Buddhism and Taoism belief accept embalming as a valid practice. Many authorities hold Hinduism does not accept embalming. In practice, this is not an adamant prohibition and embalming for those of hindu faith are known to happen, generally for repatriation to India or the south pacific and for the purpose of viewing and funerary rites at the family home. People of the Bahai faith are not embalmed, the body is washed and then placed in a shroud of white clothes (silk preferably). The body must be buried in a cemetery that is no more than an hour travel from the place of death.

Zoroastrains traditionally hold a sky burial within structures known as Towers of Silence in which the body is exposed to the weathering and predation to dispose off the remains, and thus embalming the body is contrary to their funeral designs. This is due to the fact that the Zoroastrian belief that the dead body is unclean and the pure element of earth and fire should not be allowed to come into contact with it. This practice is not universally performed anymore and many Zoroastrians perform traditional cremations and burials instead [2].

Muslims are required to be buried within 24 hours of death if possible. Embalming is forbidden. The body is still washed and prepared specifically for interment. This procedure is to be done according to the last will of the deceased preferably by the spouse or by a close relative of the deceased who is of the same gender. He or she is then dressed in a plain white burial shroud (for women the hair, ears, and neck are covered as if they were in life, preserving her dignity before men who are not closely related; men are buried in their Ihram or pilgrims grab as worn during Hajj in Mecca). Muslims believe that the spirit remains with the body from death until after burial which is the aforementioned procedures; the body is treated with the same care and respect so as not to cause undue stress to the deceased. For the same reasons, cremation is also forbidden. Prayers and readings from the Holy Quran are spoken aloud to give comfort to the deceased and the body is not left alone even for a time following the burial during which the deceased is buried [preferably without a casket] on his or her right side, facing Mecca [2].

Traditional Jewish law generally forbids embalming and burial is to be done as soon as possible, preferably within 24 hours. However, under certain circumstances, embalming may be permitted if it is impossible to bury a person immediately (such as a crime victim) or to permit the deceased to be buried in Israel. Guidance of a Rabbi or the local Chevra Kadisha (Jewish Burial Society) should be sought regarding any questions, as particular circumstances may justify leniencies. Notably the biblical Jacob and Joseph were embalmed (Genesis 50 vs. 2 and vs. 26)

Care of the body after embalming:

1.Do not allow water to pour on embalmed body

2.Keep it in a clean dry place. You may put it in a refrigerator or air conditioned room.

3.Keep off rat, cockroaches and ants from the room where embalmed body is stored.

4.As soon as mould appears on the body, it should be cleaned off with dry tissue paper, or cotton wool or cloth if the growth is too much, use 10% formalin in cleaning it. If the area is soft and peel, inject with the formalin mixed with phenol.

5.During hammattan or dry season, the body may be coated with pomade to reduce dehydration. This also inhibit/retard the growth of mould.

6.There should be a routine check on the body [11].

Precautions to observe when embalming:

1)Do not eat or drink where embalmment is carried out.

2)Do not allow the embalming fluid to come in contact with your skin, body, mouth or eyes, and if it does accidentally, wash the affected part thoroughly with water.

3)Always wear laboratory clothing like hand [surgical] gloves, laboratory coat, and rain boots where necessary.

4)Tidy up the corpse with disinfectants before embalmment commences.

5)Make sure that the correct instruments are used as these make it simple and easier.

6)For health reasons, it is always advisable to embalm bodies in areas where there is ventilation.

7)Always mask your selves whenever you are embalming.

8)Wash and sterilize embalming instruments after use.

9)Wash your hands very well before using the hand to eat.

There must be periodical and regular medical check up for those working in mortuary [2].

Factors That Facilitate Body Decomposition:

The rate and the manner in which a human body decompose are strongly affected by a number of factors. In a roughly descending degree of importance those factors include:-Temperature, access by insects, burial and depth of burial, access by carnivores or rodents, trauma including wound, humidity or dryness, rainfall, body size and weight, prior embalming, clothing, the surface in which the body rest on.

Decomposition begins at the moment of death. At this stage, it is caused by two factors: autolysis; the breaking down of tissue by the body's own internal chemicals, enzymes and putrefaction: (The breaking down of tissue by bacterial). These processes release gases that are the chief source of the characteristic odors of the dead bodies [2]. Insects and other animals are typically the next agents of decomposition, assuming the body is assessable to them. The most important insects that are typically involved in the process include the flesh flies (sarcophagidae) and blowflies (calliphoridae). The green bottle fly seen in the summer is a blowfly. Other animals including coyotes, dogs, wolves, foxes, rats and mice may eat a body if it is accessible to them. Some of these animals will also remove and scatter bones.

Embalming affects the process, slowing it somewhat but does not forestall it indefinitely. Embalmers typically pay the greatest attention to the parts of the body seen by the mourners, such as the face and hands. The chemicals that are used in embalming will repel most insects and slow the process of putrefaction but will not serve a corpse indefinitely. In sufficiently dry environment, an embalmed body may end up mummified [2]. The time for an embalmed body to be reduced to a skeleton varies greatly. An unembalmed adult body buried six feet deep in ordinary soil without a coffin normally takes ten to twelve years to decompose fully to a skeleton given a temperate climate. Immerse the body in water and skeletonization occurs approximately four times faster, exposed to air and it occurs eight times faster. The skeleton itself is not permanent; acids in soils can reduced it to unrecognizable components as well as bodies exposed to cool, damped soil may develop a waxy substance called adipocere, caused by the action of soil chemicals on the body's proteins and fats. The formation of adipocere shows decomposition by inhibiting the bacteria that causes putrefaction [2].

4. Recommendation

Since death is an inevitable stage in life, I hereby recommend that religion and countries who believe in human embalming should try and continue with the practice (human embalming) so that proper plans can be made for funeral and other investigations like autopsy can be carried out when necessary.

5. Conclusion

Embalming fluids act to fix a cellular protein, which means that it cannot act as a nutrient source for bacteria and it also kills the bacteria themselves. Modern embalming is not done with singular fluid; rather various different chemicals are used to create a mixture called an arterial solution which is generated specifically for the need of each case [22]. For example a body that is needed to be repatriated overseas, needs a higher index (percentage of diluted preservative chemicals) than the one which is meant for simply viewing (known in the United States and Canada as a funeral visitation) at a funeral home before cremation. Embalming is not routinely required by law, but may be necessary if death is due to certain disease, if final disposition is not made within a prescribed period of time, if registration or immediate burial is not available or before a body is transported between states or internationally in a common carrier [23]. Though many religions like Hinduism, Bahai Faith, Neopagans, Zoroastrians and Muslims do not allow human body to be embalmed after death because it is against their believe and their religion.

Additionally, embalming restores the body to an acceptable physical appearance for viewing following a traumatic death or devastating illness. Many bereavement experts agree that viewing the deceased confirms the reality of death and helps survivors take an important step towards recovering from their loss [2].

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