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Recent Advances in Gross Anatomical Techniques

P.J Kapadnis
Department of Veterinary Anatomy and Histology
College of Veterinary Science and Animal Husbandry ,Mhow.(M.P.)
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Introduction

Students in various fields like Veterinary, Medical and Ayurveda have to do dissections on human cadavers and animals during their study in the first year course to learn anatomy. The animals and human cadavers are preserved in the chemical formalin which is used as a disinfectant and preservative agent. In 1867, the German chemist August Wilhelm Von Hoffman identified formalin as a preservative agent. Formalin, an aqueous solution of formaldehyde gas is the chemical most commonly used for embalming and preserving the specimens. After embalming the bodies are preserved in the tank filled with 10% formalin. Formaldehyde has an apparent deleterious effect with a different degree of tolerance. Eye irritation, tears, nose burning and loss of odour sensation are common in most individuals. There can be an adverse reaction of hypersensitivity also. Thus techniques for non-formalin specimen preparation were sorted for.

Formalin and non-formalin specimen preparation

Keeping the deleterious effects of formalin and health hazards in view, scientists are trying hard various methods to preserve the body in a solution free from formalin for dissection. Acetic acid is one of the oldest fixatives on record. In the Eighteenth century vinegar (4-10%) was used to preserve hydras. In modern techniques, it is hardly used alone, but it is an important component of many fixatives. It does not harden tissue; it swells collagen and counteracts shrinkage caused by other fixative. Ralph Rolland langner (US Patent No.1, 113459-May, 15, 1968) used quaternary ammonia salt of hexamethylenetetramine sale or hexamine pure (cat no 81451) for the preservation of animal tissues. Hexamine slowly releases formaldehyde without odour and fixes the tissue. Ten percent 10% solution of hexamine, 3.78 liters, will preserve in same the degree as of 18.9 litres of 10% formalin. C.R. Fremling (US Patent No.3573082 date March 30, 1971) in the article. Biological specimens and process of preserving the same, has discussed that formalin is commonly used for preservation, although alcohols, phenol, pieric acid, acetic acid,

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chromic acid and other agents are used for preservation. Fixation results in coagulation of proteins in tissue specimens and immobilization and destruction of decaying agents, bacteria, fungi in order to halt decaying process. The specimen fixed in formalin is washed for 24 hours. After washing, the specimen is immersed in glycol water solution for 7 days. It may be noted that glycol undergoes a chemical reaction with formalin and helps in germicidal act. Formalin fumes by agitation helps in reducing concentration, and is replaced by Ethylene glycol. Ethylene glycol was preferred, as it was non greasy, have small molecules to diffuse fast. It leaves no formalin smell, maintains flexibility, shrinkage, colorless and easy to dissect. Normally 40% Ethylene glycol and 60% water is preferred.

There are many more chemicals with different combinations which can be tried for formalin in free preservation of animals and human cadavers. Phenoxyethanol is shown as a nontoxic substitute for formaldehyde in long-term preservation of human anatomical specimens for dissection and demonstration purposes. Formaldehyde has recently been declared a potential carcinogen. In the fluid, 1% phenoxyethanol in tap water, material has remained soft and flexible with a consistency and colour retention suitable for dissection and demonstration purposes for upto 10 years. Fungal attacks were rare and have been unable to raise bacteria from such specimens. Even the microscopic structure of most tissues remains satisfactory after 5 years in 1% phenoxyethanol. The unpleasant and irritating smell traditionally felt in dissection rooms was almost absent. From the theoretical point of view one should distinguish between initial fixation and long term preservation of animal tissue for dissection or exhibition purposes. The primary aim of the initial fixation is to arrest the tissue structures in a life resembling fashion or to largely inactivate autolytic enzymes.

On the contrary, over the decades it has been noted, there are overwhelmingly strong reasons to exclude most widely used fixatives, like formaldehyde and phenol, from long term preservation fluids. Both substances have prominent toxic, pungent and unpleasant properties. In addition, the evidence for carcinogenic properties of formaldehyde is rapidly growing. Formaldehyde has been shown to cause mutation in various primitive organisms and in cultured mammalian cells according to many studies. Furthermore, inhaled formaldehyde caused nasal carcinoma in rats and mice and subcutaneously injected formaldehyde caused sarcoma in rats. Recent epidemiologic surveys among embalmers and

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industrial workers exposed to formaldehyde may indicate an increased cancer risk even to humans.

Bronchial case

In addition to above there are various methods to preserve parts of cadavers as dry specimens for the teaching of anatomy. One of them will be the use of Silicone which is of great help to prepare dry specimen as a cast. The bronchial air ways has been described using silicone sealant, Silsatic 734 RTV (Room Temperature Vulcanizing), with help of a caulk gun. Following digestion with protease and corrosion with potassium hydroxide, a broncho-alveolar cast was recovered giving detail as shown using scanning electron microscopy or conveniently seen by stereo light miscroscopy. This method should be useful for micro anatomy studies of a normal and diseased lungs.

Silicon was used with durometer shore 30A hardness silicon, coloured with red pigment was used to fill the reproductive arterial supply in situ via the abdominal aorta in a 122 kg, one year old nulliparous lioness. After the silicone polymer-mix cured, the organs were removed and macerated yielding a flexible arterial cast of the female reproductive organs. The cast endured handling well and showed good flexibility. In situ casting has the advantage of minimal leakage since no vessels are cut in the system to be studied. Similarly, the sealant material "WACKER GP" a general purpose silicone sealant, (Wacker ® Wacker Chemie AG Munich, Germany) which is low in cost and easily available in hardware shops for corrosion cast of bronchial tree. The method adopted to inject the silicone using an injection gun is relatively very easy. After injection the lung is hanged for a day, later the lung is digested in concentrated HCL and the cast was recovered. The prepared bronchial tree cast was found to be safe to handle, soft, flexible and long lasting durability. Likewise silicon gel, silicon gun and dissection box can also be used for kidney with renal artery, arch of aorta with its branches and bronchus with lung for the study. Silicon gel was injected through the lumen with the help of the silicon gun. The specimen was dried. Once the silicon gel got hardened, the remaining part of the organ was dissected and removed.

Dry lung preparation

Dry lungs can be prepared by using air compressor pump. The air is inflated into the lung for three days through the automatic compressor pump until the lung becomes dry and light in weight. Likewise there are previous studies on lung preparations with compressor

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pump. These specimens have proven valuable in anatomy radiology, pathology medicine and surgery departments.

Dry stomach preparation

Preparation of hollow organs such as stomach, intestines, uterus from animals and humans can be of immense use to understand anatomy as these specimens are dry and can be viewed as 3 dimensional in inflated form. The inner contents of hollow organ are flushed out and then they are inflated using birthday balloons inflated by the inflation pump. Once the organs were inflated the balloons along with the ends of the organ were tightened and allowed to remain inside. Once the specimens get dried the balloons were removed. Later the specimens were given varnish coat to give the final shape and appearance.

Sheet plastination

Sheet plastination is a type of plastination which is considered to be a viral tool in the enhancement and clarification of concepts of cross sectional anatomy and relationships which was previously often difficult to appreciate. Some studies have shown good correlation between the sections prepared by sheet plastination (E12 epoxy resin method and BIODUR PEM 11 method) and CT and MRI images. Dr. V. Ramkrishna has invented a very low cost method of doing sheet platination for sections using jelly wax. Jelly wax should be heated to 60^0C to melt, then the section is immersed in this solution for 5 minutes and then taken out. Later and immersed section is placed in a cardboard box of same measurement and the jelly wax is poured over it and is allowed to cool. It is made from paraffin wax, transparent and can be kept under room temperature as a jelly. Melting point is 60-70^0C. On cooling it is more soft and pliable. Viscosity is much less than the paraffin wax therefore it has got a better infiltration property.

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