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Using of plastinated anatomical preparations in preclinical and clinical education of medical students

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Plastination is a new technology for anatomical specimen preservation without toxic materials. Biodur S10 is a classic polymer for anatomical objects preservation. The process during eight weeks. The preparations are safety, non odorous, they can preserve at ordinary conditions and use for medical students education.

Plastinated organs can be used for anatomical training of medical students and the practical training of graduate students in clinical educational subjects. S10 plasination technique because of the low hardness of preparations allows small operations in the field of ophthalmology and oto-rhino-laryngology.

Keywords: Biodur, plastination, preservation, anatomy, brain slices.

Introduction

The Human Society needs of high level physicians and other medical specialists. The anatomy is a base of all medical educational subjects.

Dissection is a very important method in medical education from old ages to this day. Solution of formaldehyde 3-10% used for fixation is very noxious for humans. It causes inflammation of respiratory system, allergic reaction etc.

Plastination is a new revolutionary technology to create safe and durable anatomical preparations stored under normal conditions. Plastinated organs can be used for anatomical training of medical students and the practical training of graduate students in preclinical educational subjects as well as in clinics. S10 plasination technique because of the low hardness of preparations allows small operations in the field of ophthalmology and oto-rhino-laryngology too.

Material and Methods

We use S10 plastination technique for production of anatomical preparations for medical student education.

Fixation of **hearts, brains, livers, joins** etc. is in 10% formalin at room temperature. If specimen is tick infiltration is necessary. Dehydration, forced impregnation and curing phase are standard [12].

For plastination of the **eyeball** we used a combination of two different technologies – S10 plastination technique of von Hagens [12] and impregnation by Steinmann [10].

Replacing tissue water with polymer is performed by forced impregnation, but with polyethylene glycol – by the method of molecular substitutions.

Pig eyes were used for model development. Hylase (Farma Dessau, Gbm, Germany) 300 UI was injected into the vitreous chambers to help liquification of the vitreous body [6].

Fixation of specimen is necessary for successful plastination. We used standard fixation with formalin 5% for 4 days because eye walls are thin and fixative penetrates all parts of the object. Eye wall doesn't need of formalin infiltration but it is necessary to inject fixative into vitreous body.

Acetone 100% is dehydration liquid in stepwise freeze substitution. Procedure continues 5 days at -25°C. Acetone contains until 90% water at the first step, but no water at the last step.

Biodur S10/S3/S6 (100:1:0.7) silicone [6] was injected into the chambers until they were full. Specimens were then placed in the polyethylene glycol and stored at 5°C to permit the curing of the silicone.

For plastination of the **internal ear** we used applications of surgery techniques on human skull. The temporal bone was plastinated with S10 technique [9].

Results

After gas-curing durable, flexible and safety whole organs: hearts, brains, livers, joins etc. are made. We use them in anatomical education of medical students.

Vessels, valves and muscles of the heart are detailed. Papillary muscles, chordae tendineae and valves of the heart are discernable and coronaries are easy of access to study.

Full particulars of brain surface are pronounced. Whole brains keep their special features. Lobes, fissures, sulcus and gyri are in a good condition. The central and lateral sulcus are apparent and students can study the brain morphology on plastinated preparations.

The liver has a stable consistence and all its details are distinguish one thing from another. Gall bladder, ducts and portal vessels look like real. Four hepatic lobes and ligaments are with well-defined outlines and well preserved.

After drying, the eye specimens is soft, life-like and suitable to be used in the educational process. The appearance of the plastinated specimens is similar to their natural condition. Eye muscles and optical nerve are in good shape and students can study the eye morphology on plastinated preparations. The cornea of eye is damaged anytime.

Discusion

We can make whole organs and their parts in field of anatomy, pathology and forensic medicine [1] obey the rules of the ethics of using human remains [2]. We can plastinate whole brain and brain slices as well as joint and muscle preservations [8, 9, 12].

We use plastinated organs in medical education of first and second year students. Plastinated bones and joins are suitable for first year students as well as whole organs, brains and muscles for second year.

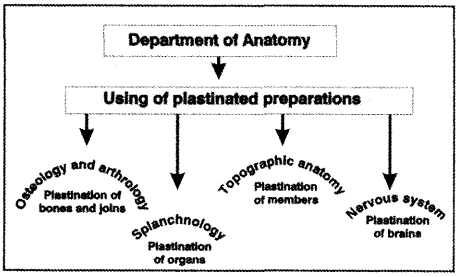

Fig 1. Using of plastinated preparations

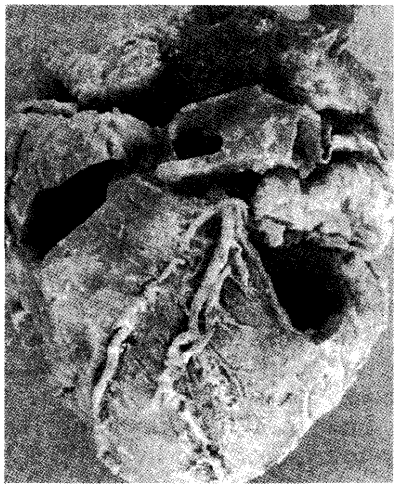

Fig 2. Heart plastination

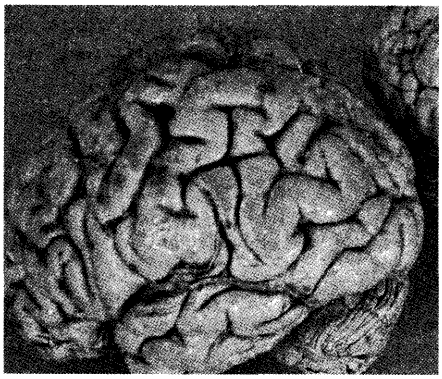

Fig 3. Brain plastination

Fig 4. Liver plastination

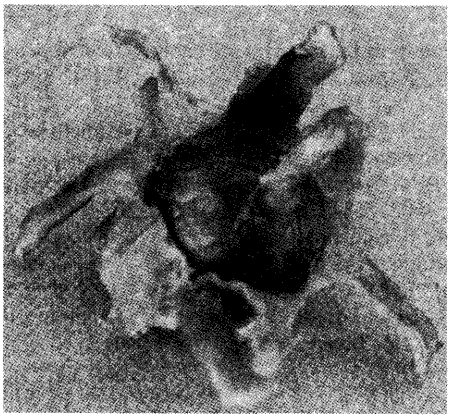

Fig 5. Plastination of eyeball

Fig 6. Damage of cornea

Our heart plastination results are according with experiments of other autors [5], but we combined two different methods for heart plastination. Some autors plastinated bones, joins and ligaments too [4, 7, 8]. Usually Biodur P40 is use for brain slices plastination [3, 11]. We used Biodur S10 and had good results – low price, good appearance and stability.

The vitreous body of eye was replaced by Biodur S10 and eyeball wall was impregnated by polyethylene glycol. The polymer prevents the retina from detaching when the eye is placed under vacuum during the subsequent phases of the impregnation process. This makes the pig eye a good surgery model similar to living human eyes.

We found the combination of the two different polymers as an excellent method for the preparation of the eyeball for education of medical students and specialists.

Plastinated internal ears are safe for student. They are suitable for storage at room temperature in ordinary conditions without submersion in formaldehyde-containing fixatives in glass jars.

Brain slices have all details. The polymer trace out the border between white and gray matter, nuclei and fibres.

Conclusion

The students can use anatomical preparations in their preclinical and clinic education. Preparations are safety, non odorous and they can preserve at ordinary conditions.

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