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Safe and durable plastination of anatomical preparations

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Abstract

Many years of experience from researchers in plastination of anatomical objects are introduced. The method is particularly relevant now, when there is a shortage of corpse training material for students in medicine, dentistry, and veterinary medicine. The reasons for failures of the plastination are analyzed: reduced duration of the plastination phases, operating temperature, composition of the plastiation agent, and external contamination. Anatomical preparations made are absolutely safe for human health.

Key words: Plastination, Biodur, S10 technique, Anatomy, Education.

Безопасность и прочность пластинации анатомических препаратов

Внедряется многолетний опыт работы с исследователями в области пластинации анатомических объектов. Этот метод особенно актуален сейчас, когда не хватает трупов для обучения студентов-медиков, стоматологов и ветеринаров. Причины неудач пластинации проанализированы: сокращенная продолжительность фазы пластинации, рабочая температура, состав агента пластинации и внешние загрязнения. Изготовленные анатомические препараты абсолютно безопасны для здоровья человека.

Ключевые слова: пластинация, Биодур, техника S10, анатомия, образование.

Timeliness of the topic: The study of morphological features in human and animals on corpse materials is the basis of anatomical education for medical students. Preservation and long-term storage of biological material is a major problem facing anatomists worldwide for centuries. The application of conservation techniques over the millennia was based on the latest physical and chemical factors for that time, but the prepared anatomical preparations have many shortcomings – most notably damage to human health, which is why research in this area continues today. Using plastinated anatomical objects for teaching anatomy is expensive in the short term, but in a long-term strategy, it is financially advantageous, as established morphological preparations are virtually timeless and can be used for decades without any special storage conditions. They are absolutely safe for human health and therefore can be studied by students and trainees in medicine, dentistry, and veterinary, for a long time without using special protective equipment.

Material and methods

In the plastination process, two types of materials are used: organic matter (human and animal corpses or parts from them) and chemical agents (fixatives, dehydrating and impregnating agents, accelerators, colors, and gas-curing agents).

Physical and chemical changes that occur in the tissues after death hinder its preservation and exploration. Their organic ingredients are destroyed irreversibly by the action of microorganisms and the proteolytic enzymes present in cells whose function becomes uncontrollable after death. This resulted in the absence or insufficient protective measures into the decay and death of the tissue, and the destruction of anatomical teaching preparations that were made. Classic preservatives have a deleterious effect on the human body – causing inflammation and allergic reactions of the exposed mucous membranes, the respiratory organs, and airways.

In plastination methods, dehydrating and impregnating agents enter the dead tissue with a constantly changing cycle speed, and fill the tissue at a specific rate based on the tissues type.

The most commonly used technique for plastination, S10, is applied in its classical form, provided to us by the inventor of this method Gunther von Hagens, as well as our own modifications, differentially applicable to each case – on the eyeball, brain plates, lungs, and liver.

Results and discussion

With the S10 plastination technique, soft, elastic, durable, and safe for human health products could be produced. According to the classical method of plastination, this technique is primarily used for soft tissue plastination – organs, body parts, or whole corpses.

The plastination is not always successful – due to objective reasons sometimes the products could have some defects, obscure anatomy or gross profile and an atypical surface. The most common defects and their causes are:

1. A change in the volume of finished bodies;

Due to:

- Failure of the temperature control during the working process of the dehydration phase;
- Prolonged exposure to the air of the biological material after the impregnation phase;
- Too fast impregnation – impregnating agent entering the tissues slower than the exiting of the dehydrating agent.

2. A color change of manufactured preparations;

The most common reasons are:

- Drying out of the organic material during fixation or before it;
- Using formalin fixative – darkens the color;
- Contaminated containers or acetone during dehydration;
- Soiled impregnation containers or excesses of colors during impregnation – this causes expressed spots;
- Extended phase of drying – white spots appear.

3. Defects: deformation, cracking of the surface, rupture of nerves, blood vessels or parts of the body, stained preparations, wrinkling or rippling of the surface of the organ.

Due to:

- Careless handling of biological material;
- Change in the duration of plastination phases;
- Non-correlation between the components of impregnation material.

4. Loss of elasticity, high hardness, increased tearing apart or fragility of the model and a short period of existence are seen in insufficient quantity of tissue impregnation.

The most commonly due to:

- Brief impregnation phase;
- Failure of temperature;
- Prolonged drying.

In world literature, analysis of the causes for failures in the development of plastinated anatomical preparations are rarely performed, and therefore we can not compare our results with other authors.

In our modification, we made brain S10 slices (fig. 1) that retain their elasticity, had a lower cost and standard equipment was used, but little resistance to external mechanical impact.

Worldwide practice is that cerebral plates with high mechanical strength can be manufactured with R40 plastination technique that is more expensive, needs additional equipment and high precision work. Our modification made products with a lower price and clear delineation of brain features and with a sufficient mechanical strength to last for years when properly used for training in anatomy.

Through a combination of several plastination techniques, we managed to prepare an eye ball (fig. 2), but with this preparation, the major difficulty was maintaining the vital appearance of the iris – a problem that we have not yet solved. In available literature, we have not encountered information about attempts for plastination of an eyeball, so that we could not compare our results with other researchers. Solving the problem of preservation or restoration of the iris pattern would provide wonderful materials for training not only for medical students but also specializing in ophthalmology.

Plastination of the liver is not yet performed successfully worldwide. According to our modification of S10

plastination technique and changed ratio of dehydration and impregnation, we received excellent results in the plastination of that organ (fig. 3). Plastinated with the S10 technique, anatomical models of the liver could be used both for teaching anatomy to students, as well as for safe models for operations specializing in surgical diseases.

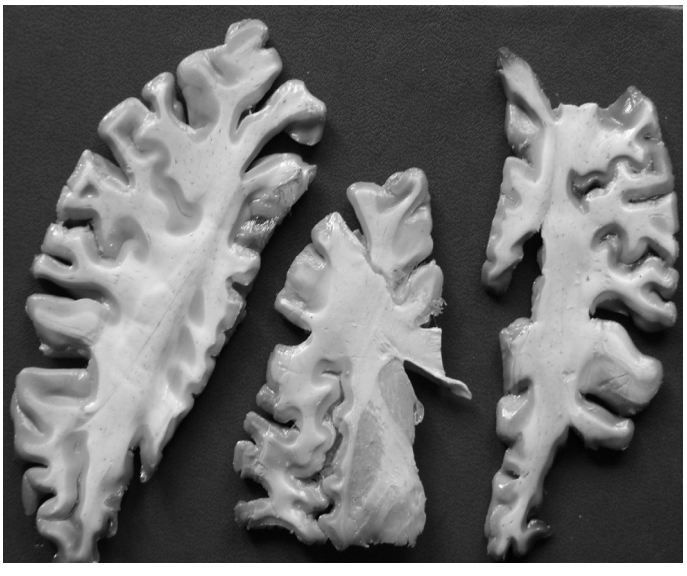

Fig. 1. S10 modification for brain slices.

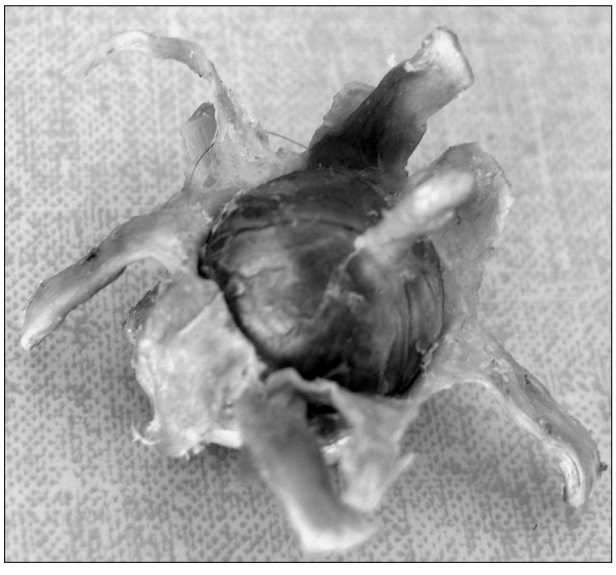

Fig. 2. Eyeball and muscles of the eye.

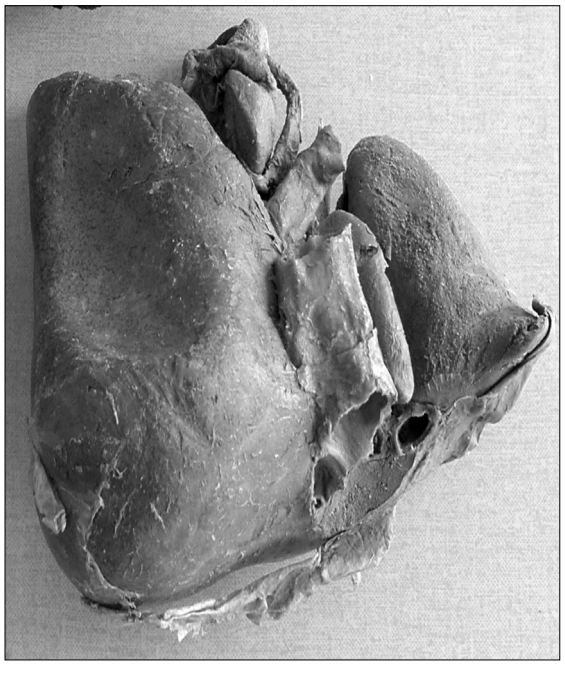

Fig. 3. S10 plastination of the liver.

Conclusions

1. The plastination technology is a revolutionary, modern, and promising protective method which can produce high quality and durable anatomical preparations, which use natural details in the morphological structure of biological material and removes the harmful health effects of classical preservative chemical agents.

2. Plastinated anatomical preparations are practically eternal – they are not self-destructible and may be used for decades for teaching anatomy or as a training model for implementing the operational techniques of students in surgical specialties.

3. Plastinated models are safe for human health. They are stored under normal conditions and can be touched by hand, without any detrimental effects on students.

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Morphological aspects of cerebral cortex plasticity in alcohol intoxication

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Abstract

The paper covers the experimental study of the morphofunctional organization of the CA_1 hippocampal field and the piriform region of a rat's brain cortex in alcohol intoxication, cuased by an intraperitoneal introduction of a 15% solution of alcohol. The results showed the morphogenetic mechanisms of nerve cells plasticity developing by the 600th min of alcohol intoxication. They manifest in the formation of hypochromic reparative regeneration, characterized by the increase of the volume of hypochromic neurons, containing two nucleoli and regenerative hypertrophy, characterized by intracellular hyperplasia of the organelles and nuclei.

Key words: cerebral cortex, plasticity, alcohol, neurons.

Морфологические аспекты пластичности коры головного мозга в состоянии алкогольного опьянения

В работе рассматриваются экспериментальные исследования морфофункциональной организации участка CA1 гиппокампа и грушевидной области коры головного мозга крыс при алкогольной интоксикации, вызванной внутрибрюшинным введением 15% раствора спирта. Результаты показали, что морфогенетические механизмы пластичности нервных клеток развиваются к 600-й минуте алкогольного опьянения. Они проявляются в формировании гипохромной репаративной регенерации, характеризуются увеличением объема гипохромных нейронов, содержащих два ядрышка и регенерационной гипертрофией, характеризующейся гиперплазией внутриклеточных органелл и ядра.

Ключевые слова: кора головного мозга, пластичность, алкоголь, нейроны.

Introduction

The use of ethyl alcohol is widespread among the population in the world. According to the Federal State Statistics Service, in Russia, from 1991 to the present time there is a tendency to an increase in populationabusing alcohol [7].

Alcohol as a neurotropic agent causing a variety of functional and morphological changes is poorly understood in terms of mechanisms for its effects on the brain.

A lot of research is devoted to study the influence of alcohol, both on the body as a whole, as well as directly on the brain. Analysis of the literature provides an extensive view of the direction of research in addressing both acute and chronic alcoholism. Among them are the studies of neurophysiological patterns [6], neurochemical and pharmacological manifestations of alcoholism [1] and biochemical abnormalities [10], chronobiological changes [3], and neurological symptoms [4, 15]. It should be noted that great importance is attached to the analysis of morphological and biochemical changes that develop in the organism in chronic alcoholism. Less studied in terms of metabolic manifestations, the question of the influence of acute alcohol intoxication on behavior and conditioned reflex activity remains unanswered.

It has been shown that ethanol at a dose of 0.3 g/kg body weight affects the risk of accidents, while the visible and pronounced signs of conscious motor activity occur at concentrations in the 0.5-0.6 g/kg [9]. Numerous medical and statistical studies have revealed a correlation of high concentrations of alcohol (> 1-2‰) in the blood with mortality in road traffic accidents, fires, falls from heights, and with the risk of injury at plants and factories [13, 14].