Original Research Article

AN INNOVATIVE METHOD TO PREPARE FORMALIN FREE MODELS BY PARAFFIN IMPREGNATION OF HUMAN ORGANS- HEART, BRAIN, SPLEEN AND LIVER

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ABSTRACT

Background: Although formalin preserved organs in dissection- hall are used for teaching purpose but the odour and carcinogenic effect of formalin has made us to search for some alternate method for preparing teaching models. One of such methods is plastination but it requires well equipped laboratory and costly chemicals. So our objective was to develop a cheap and easy and feasible method of preparing formalin free teaching models of organs.

Materials and Methods: Heart with great vessels, brain, spleen and liver were removed from cadavers and a fine dissection was done to clear arteries and veins. Organs were washed thoroughly in running tap water to remove small blood clots and formalin. Volume of each organ was measured and recorded in millilitres (ml) by dipping the fresh organ in water and raised of water column was measured. Organs were then dehydrated in three subsequent change of absolute alcohol. Each bath lasted for 3-7 days according to size of organs. They were then put in two subsequent baths of xylene; each lasted for 1-3 days. After xylene bath organs were put in melted wax at 65 degree Celsius. Three changes of wax penetrated the tissue. Again volumes were taken by the same method and recorded. They were coloured for a better differentiation. Varnish paint was applied on the prepared models. Dry and formalin free models were thus ready for demonstration and study purposes.

Results: Models maintained their original shape and had shown shrinkage of 04.54 percent in heart, 43.7 percent in one half of brain, 38.4 percent in spleen, and 47 percent in liver. Results of this method were highly appreciable.

Conclusion: This method was helpful in preservation of valuable human organs in their original shape like a bone for the study of students. Models prepared with this technique were lively in appearance; odour free and without any carcinogenic property so therefore could be safely used for study purposes. Teaching models prepared with this technique no longer needed any preservative material for their storage.

KEY WORDS: Anatomy, Museum, Cadaver, Teaching Model, Wax.

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INTRODUCTION

Models from organs have always been subject of interest for anatomist in order to make teach-

ing interesting and lively. Many researchers had developed different methods to prepare teaching models from organs. Dry specimens of slab

of brain, kidney, suprarenal gland and ovary were prepared by paraffin – naphthalene impregnation method [1]. One of such method is plastination, but it is costly, time consuming and technically demanding [2]. Kumar A., kazi S.N. developed an innovative method of making anatomy teaching model of Spleen by drying formalin fixed organs in shade [3]. Rohmehttra M., Kazi S.N. developed an innovative way of making a model of kidney for anatomy teaching by drying formalin fixed organs in shade [4]. PATIL Y, KAZI S. N. developed an innovative way of making a model of Brain for anatomy teaching by drying formalin fixed organs in shade [5]. Kazi S.N., Manvikar P.M. developed an innovative method making anatomy teaching model of arterial system of the body by drying formalin fixed organs in shade [6]. Jain LK, Gangrade PR, Vijay N developed a new technique for preparation of dry specimen using discarded cadaveric parts [7]. Jain L.K., Babel H. developed a new technique to mount specimen in the formalin filled jar for Anatomy Museum with almost invisible support but these methods were developed to prepare wet specimens only [8].

Jain L.K., Babel H. developed a method of colouring wet specimen in anatomy but these methods were developed to prepare wet specimens only [9]. For the preservation of wet specimen formalin is used which is carcinogenic. Sar m, bose k, de a studied the effect of formaldehyde on lungs of albino rats [10].

Though various methods have been adopted for preparation of teaching models, e.g. use of glass, fibre, plaster of Paris, and clay etc., still anatomist are in search of innovative methods. So the following method was developed to fulfil the need.

MATERIALS AND METHODS

Study of the design: Descriptive type

Materials required in this technique:- 1. Cadaveric organs, 2. Instruments – scalpel, scissors, forceps, jar. 3. Cotton sheets 4. Absolute alcohol 5. Xylene solution

6. Paraffin wax (Melting point of 55 degree)

7. Acrylic oil paints of different colours

8. Varnish paint with brush

Proper Ethical clearance was taken from the

ethical committee of our institute to perform and publish all this work. Heart with its great vessels, spleen and liver were removed during routine dissection of cadavers. All the arteries, veins and nerves were cleaned by fine dissection. Brain was cut into 2 equal halves by a midsagittal section so that medial surfaces of cerebrum, cerebellum and brain stem were visible. Arachnoid mater was removed to expose the fissures.

Various steps in preparation of model were: (2.1) Measuring volume of wet organ. (2.2) Irrigation. (2.3) Packing. (2.4) Dehydration. (2.5) clearing. (2.6) Paraffin impregnation. (2.7) measuring volume of dry specimen. (2.8) colouring. (2.9) varnish coating

Stage I: Measuring volume of wet organ:

Volume of each organ was measured in millilitres by dipping the fresh organ in water filled jar and raised of water column was measured and recorded.

Stage II: Irrigation: Second step in preparation of model was thorough irrigation of specimen in running tap water to remove blood clots and formalin as much as possible. Great vessels were cleaned manually also. To clean the cavities of heart, small incisions were given to chambers and blood clots were removed. Incisions were such that they were not visible externally and the shape of organ was maintained.

Stage III: Packing: After thorough cleaning, third step in the procedure was packing of cavities of Heart, Great vessels and in case of liver tubes of portahepatis and inferior venae cava and all fissures of brain were packed with thin sheets of cotton. This packing help maintained the shape of hollow parts of the organs and prevented their shrinkage. Incisions given earlier helped in complete packing. After packing, incisions were finely sutured to maintain the shape.

Stage IV: Dehydration: After packing, next step was to dehydrate the organs. For dehydration three subsequent baths of absolute alcohol for 3 days to 7 days in each bath were given according to size of the organ e.g. larger organs were given bath for up to 7days.

Stage V: Clearing: After dehydration, two xylene baths were given for 1-3 days each time.

This removed all the alcohol and made the tissue clear.

Stage VI: Paraffin Impregnation: After clearing in xylene organs were transferred to bath of melted paraffin wax at 65 degree Celsius in incubator for 3 changes each lasting for 24 hours. The paraffin penetrated the organs and prevented their shrinkage. It also entered the cotton packed cavities. Now the organs were allowed to dry for a day. Surface wax was removed by putting organs in hot air oven for a day or two at 70 degree Celsius which removed some extra wax and then were allowed to dry.

Stage VII: Measuring volume of dry specimen: Volume of each organ in millilitres was measured by dipping the organ in water filled jar and raised of water column was measured and recorded.

Stage VIII: Packed cotton was removed to visualise the cavity if it has to keep open.

Stage IX: Colouring: The models could be used as such for demonstration but for better differentiation various structures were coloured. We used commercially available acrylic colours to colour various structures. Anatomically correct colours were used to colour various structures e.g. red for arteries, blue for veins etc [9].

Stage X: Varnish Coating: After colouring, the organ models were painted with varnish. Varnish coating provided a protective layer to the organs and gave shining to the model.

RESULTS AND DISCUSSION

Fig. 1: Shows heart after wax impregnation with almost normal size and shape.

Fig. 2: Shows mid sagittal sections of brain after wax impregnation.

Fig. 3: Shows spleen after wax impregnation.

Fig. 4: Shows liver after wax impregnation.

Table 1: Shows volumes of organs before and after wax impregnation.

S. No.	Organ	Volume of wet organ(ml)	Volume of dried organ (ml)	Shrinkage In Volume in percentage (%)
1	HEART	740	710	4.54
2	BRAIN	650	370	43.07
3	SPLEEN	195	120	38.46
4	LIVER	1400	740	47.14

Volumes of various wet and dry organs are shown in table number 1. Organ Models prepared by us showed shrinkage 38 – 48 % in the case of solid organs but only 04.54 % in the case of heart and original shape of organs were maintained. Organ Models prepared with this technique are lively in appearance; odour free without any carcinogenic property so can be safely used for study purposes. This method is helpful in preservation of valuable human organs in its original shape for the study of students. Results of this method were highly appreciable.

Although model prepared by plastination method are very good and resembles original organs but this method needs vacuum chambers and silicon polymers which increase the cost. So this method has its limitations and cannot be used in all institutions. Moreover this method does not require any special material or machines; hence it's very cost effective. There is no need of any preservative solution for storage of these models. Use of formalin could be carcinogenic [10]. So they are free from odour and carcinogenic effect of formalin. As these are very safe and easy to handle, they are much appreciated by students. This technique may be effectively used to prepare models of any solid or hollow organs as well as prepare dry specimen of anybody region. Since it is a preliminary study it required some more study and better results by setting appropriate time and change of dehydration, clearing in xylene and wax impregnation. Suitable time of dehydration has to be evolved by future experiments. The technique can be named paraffin impregnation of cadaveric organs.

Cares to be taken:

1. Viscera having cavity e.g. brain, the cavity should be packed with cotton to prevent shrinkage of viscera after drying thus size and shape of the viscera are maintained with minimum

alteration.

2. Suitable time of dehydration for each organ should be evolved by future experiments.

CONCLUSION

We have developed simple and cheap method for preparation of formalin free dry models from organs removed from cadavers and it does not need any sophisticated mechanism and materials. Results of this method are highly appreciated.

ABBREVIATIONS

mm – millimeter

% - percentage

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Conflicts of Interests: None

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