Original Article

Indian Journal of Anatomy
Volume 5 Number 2, May - August 2016
DOI: http://dx.doi.org/10.21088/ija.2320.0022.5216.8

A Novel and Innovative Teaching Tool Using Low-Cost Luminal Cast Plastination of the Trachea-Bronchial Tree

Fatima M. DeSouza*, Prashant E. Natekar, Nandini M. Karapurkar*****

Abstract

Plastination of human tissues is one of the techniques that involve preservation by replacing water and liquids with polymers which are subsequently hardened. Luminal cast plastinated specimens are not only suited for our routine anatomical teaching and serve as base images for animation, but also provide excellent source to understand the three dimensional anatomical structure and its variations.

The present study is being done to create an awareness of the simple technique with very low cost in preparation of luminal cast plastinated specimens of trachea-bronchial tree using general purpose silicon sealants in sheep lungs. These specimens contribute to our teaching aids to understand the three dimensional concept of trachea-bronchial tree in lungs and also additional information to our existing knowledge to arrive at a diagnosis of various bronchopulmonary anomalies, before any surgical interventions.

Keywords: Plastination; Tracheo-Bronchial Tree; Luminal Cast; Innovative Teaching.

Introduction

Plastination is derived from the Greek word "Plassein"= to shape, to form. The term in fact, a creation of Gunther von Hagens of University of Heidelberg [1]. Plastination helps us to preserve individual organs from the body after death or to preserve the entire body as well. Cadavers remain a principal teaching tool for anatomists and medical educators teaching gross anatomy. Dissection of cadavers has provided us a strong edifice so that we can express our surgical talents for independent learning and thinking, perform psychomotor skills and exchange our views. Dissection can thus play many roles in the educational process. Unfortunately the specimens used for teaching and learning are unpleasant due to odors and irritation to the eyes, nose and skin causing conjunctivitis, rhinitis and dermatitis. In order to overcome these hazardous effects of formalin fixed specimens, low cost luminal cast plastination process has an important role in producing specimens which are dry, odorless, life like, maintenance free, durable, natural looking and non-hazardous. In luminal cast plastination, using general purpose silicone sealant, a replica or mold of any tubular structure like tracheo-bronchial tree, arteries, veins, ducts, hollow organs including bony passages or cavities can be studied including anatomical variations. Earlier studies reveals production of tracheobronchial cast by injecting the trachea with ERTV silicone [2]. However resins used in anatomical corrosion specimens were brittle, which often shatter and may be totally destroyed if dropped [3]. Various studies reveal the use of silicon sealants for luminal cast plastination [4-8].The aims and objectives of the present study is to provide a low cost simple technical procedure of luminal cast plastination so as to keep ourselves abreast with the existing knowledge and also before any surgical interventions, procedures which are therapeutic and diagnostic.

Author's Affiliation: *Associate Professor, **Director Professor & Head, ***Assistant Lecturer, Department of Anatomy, Goa Medical College, Bambolim Goa-403202.

Corresponding Author: Prashant E. Natekar, Director Professor & Head, Department of Anatomy, Goa Medical College, Bambolim, Goa-403202.

E-mail:drpenatekar@hotmail.com

Material and Method

The present study was carried out in the department of anatomy at Goa Medical College Bambolim Goa, India. Four freshly cut sheep lungs were obtained from the slaughter house. Each

specimen was carefully examined and cleaned. They were then washed thoroughly in continuous running tap water so as to remove the blood and mucus. The excess water was removed by gently pressing the specimen. This procedure was repeated several times until clear water flowed from the trachea. The specimens were kept inclined, with the trachea at a lower level. So as to ensure complete drainage 280 ml General purpose silicone sealant from ABRD and Araldite brand was injected slowly under pressure into the lumen of trachea of each specimen so as to fill the entire tracheo-bronchial tree. The luminal end of trachea was tied and the specimens were immersed in a bucket of water overnight. The specimens were transferred to a vessel containing boiling water and were kept boiling for nearly one hour and were removed once the lung and tracheal tissue started separating from the cast. They were then allowed to cool and the lung tissue was separated carefully. These plastinated casts were washed in soapy water and displayed.

Observation and Results

In our present study, four specimens were made by using general purpose silicon sealant. One of the specimens showed only bronchopulmonary segments showing trachea, principle bronchi, secondary bronchi and tertiary bronchi (Figure 1), whereas the others showed the entire tracheobronchial tree (Figure 2)

The sheep lung has two lobes on the right and one lobe on the left. The additional bronchus of the right lung divides into two bronchi (Figure 1). Two principle bronchi (right and left) are seen. Each principle bronchus divides into three secondary bronchi in the right lung and two secondary bronchi in the left lung. These secondary bronchi further divides into tertiary bronchi in both the lungs. The tertiary bronchi of right and left lungs are as follows:

1 Right additional bronchus dividing into two
2 Right superior lobar bronchus
3 Right middle lobar bronchus
4 Right basal anteromedial bronchus
5 Right basal lateral bronchus
6 Right apical
7 Right posterior basal
8 Left apical
9 Left posterior
10 Left anterior
11 Superior lingular
12 Inferior lingular

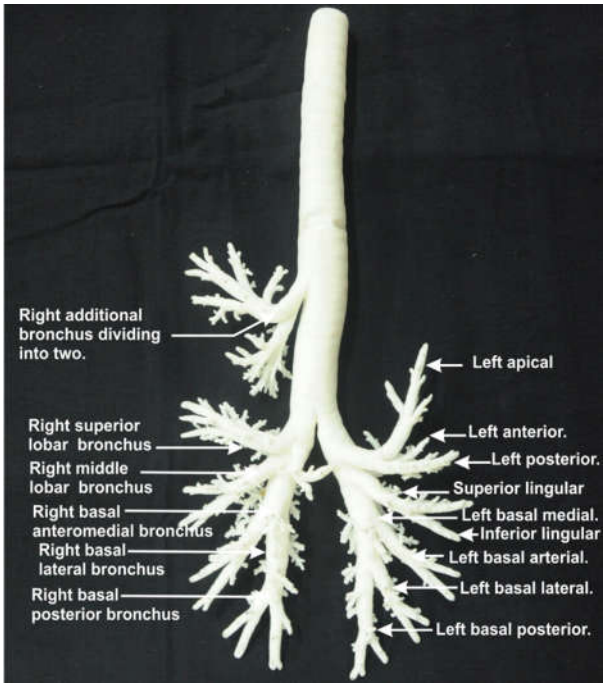

Fig. 1: Bronchopulmonary segments of sheep lung

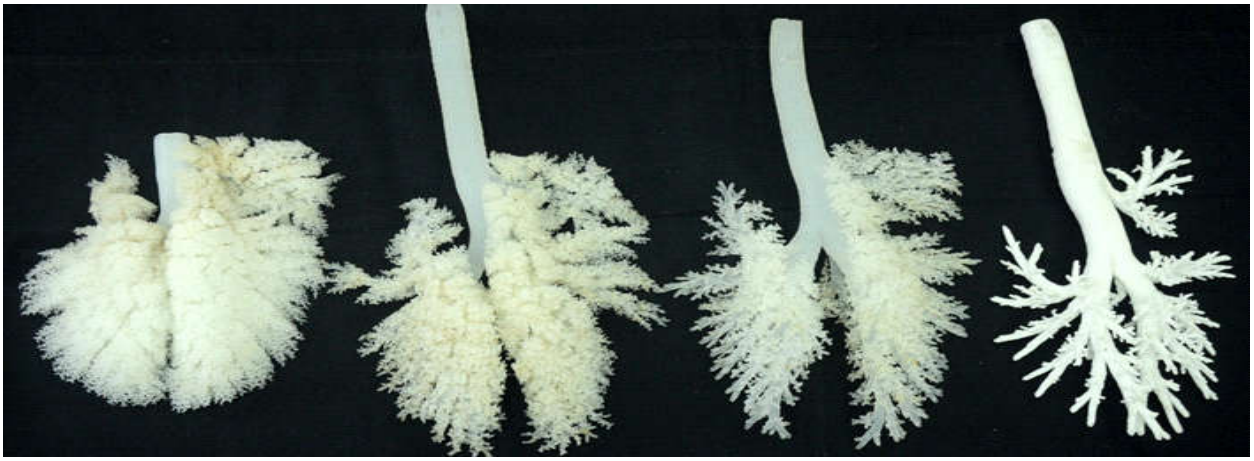

Fig. 2: Showing specimens of tracheobronchial tree of sheep lung

13 Left basal apical
14 Left basal medial
15 Left basal anterior
16 Left basal lateral
17 Left basal posterior

Discussion

Clinically significant developmental anomalies of the bronchopulmonary segments are rarely seen during the routine dissections. Several researchers have revealed preparation of corrosion casts Frederick Ruysch (1653-1731), Boyle, Pecquet, Leiberkuhn (1748), Hyrtl (1860), Schiefferdecker (1882), Huntington (1897) [9]. Earlier studies reveal paraffin casts of ureteral calyces [9], vascular casts using vinylite resins [10], vascular casts of liver [11], tracheobronchial tree in horses [12], tracheobronchial casts of cat, dog, horse, pig and ox [13] splenic artery in human [14], Human heart, ventricles of brain [15]. Earlier study found that all the plastinated resources available were heavily used and deemed useful by students and concluded that traditional material should be used in conjunction with plastinated resources [16]. Studies also reveal that similar cast made from vinylite and latex were not durable as silicone cast [17].

Plastinated luminal casts specimens has advantages over the wet museum specimens as they are easy to carry, interpret, non-toxic, noninfectious low cost of preparation and storage. Plastination by luminal cast also provide useful alternative to artistic rendering to serve as basic image for animation. Although immersive VR systems are unlikely to replace cadaveric dissection [18], these low cost plastinated luminal casts tracheobronchial specimens has an advantage of providing dynamic information which otherwise is not being observed by the students.

In our low cost luminal cast plastination the cost of general purpose silicon sealant was one hundred and thirty each and cost of sheep lung was fifty rupees. There was no other additional cost of potassium hydroxide, hydrogen peroxide. The advantage of silicone sealant is that the procedure has to be carried out slowly and carefully as there was no immediate hardening which is caused due to epoxy resins and sine the specimens were kept immersed overnight in a bucket of water there was no decomposition. Hence this has been cheapest method of preparation of luminal cast specimen. This study has contributed dramatically to the development and delivery of two and three dimensional anatomical structure for anatomy education in the medical curriculum and also to understand the variations before any procedures and surgical interventions.

References

1 Lischka M, Prihoda M. Establishing and operating a plastination laboratory at the Institute of anatomy, University of Vienna. J IntSoc Plastination.1987; 1: 12-6.
2 Lee AC. Tracheobronchial cast production and use in an undergraduate human anatomy course. Anat Sci.Ed. 2007; 1: 23-26.
3 Tucker JL, Krementz ET. Anatomical corrosion specimens. Anat Rec 1957; 127: 655-676.
4 Frank NR, Yoder RE. A method of making flexible cast of the lung. J Appl Physiol. 1966; 21: 1925-1926.
5 Kamath VG, Shetty R,Asif M and A Ramkrishna. Intl J Anat Res. 2013; 1(3): 161-164.
6 Dahiphale VP, Porwal SS and Gore SA. Luminal cast plastination-A study tool in anatomy.JIARM. 2013; 1(4): 13-17.
7 Shamasundar NM. Low cost plastination technique for developing countries. Journal of International society of plastination. 1996; 11: 8-13.
8 V. Rakesh Narayan. Preparation of low cost bronchopulmonary airway cast. J.Anat.Soc. India. 2015; 64(2): 162-165.
9 Narat KJ, Loef JA and Narat M. On the preparation of multicolored corrosion specimens. Anat Rec.1936; 64: 155-160.
10 Puckett WO and Neumann CP. Vinilyte resin in the preparation of corrosions of anatomical specimens. Anat Rec. 1940; 78(1): 105-111.
11 Silva VA, Miranda JS, and Brito MVH. Preparation technique for angioarquitetonic liver models in rats. Acta Cir. Bras. 2000; 15: 3.
12 Menaka R ThanviP,and Joshi H. Luminal corrosion cast of tracheobronchial tree of equine lung. Veterinary Research International. 2015; 3(3): 68-70.
13 Henry WR. Silicone tracheobronchial cast. J IntSoc Plastination.1992; 6: 38-40.
14 Gaur N, SoniJ,Ghosh B, Gaur S and Chaudhari H. Study of 3D view of splenic artery to use of silicone gel cast. EJBPS. 2015; 2(4): 1196-12012.
15 Aultman A. et al. Enhancing the value of organ silicone casts in Human gross anatomy education. Journal of International Society of Plastination. 2003; 18: 9-13.
16 Rafel M. et al. How useful is plastination in learning anatomy? Journal of Veterinary Medical Education 2007; 34(2): 172-176.
17 Mclaughlin RF, Tyler WS, Canada RO. A study of subgross pulmonary anatomy in various mammals. Am.JAnat 1961; 108: 149-165.
18 Aziz MA,McKenzie JC, Wilson JS Cowie RJ, Ayeni SA, Dunn BK. The human cadaverin the age of biomedical informatics. Anat Rec (New Anat) 2002; 269: 20-32.