STUDY OF THE 3D VIEW OF SPLENIC ARTERY TO USE OF SILICONE GEL CAST.


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ABSTRACT
Background: The human spleen is a lymphatic organ and it is highly vascular and supplied by splenic artery, is a branch of coeliac trunk of abdominal aorta. It is tortuous and end artery. The knowledge of variational anatomy of splenic artery is importance for surgeons in splenectomy, splenomegaly, splenic infraction. The aim of this study was to accurately identify the 3D view of segmental branches of the splenic artery by the use of silicone gel cast. Materials and Methods: The spleen was dissected carefully. The splenic artery and its all branches were cleaned and traced. Silicone gel was used in the preparation of the cast. Silicone sealant was injected into the coeliac trunk after thoroughly cleaned the spleen with water and hydrogen peroxide (H2O2). After the sealant solidified the surrounding tissue was destroyed by concentrated sulfuric acid (H2SO4). Thus a luminal cast was prepared and the pattern was studied from obtained cast. Results: The result was a splendid luminal cast of the splenic artery was showed its 3D view of segmental branches and polar branches of spleen and Greater
pancreatic artery (Arteria pancreatica magna). Conclusion: The findings of this study are useful for surgeons, especially in partial splenectomy, Splenomegaly, Splenic infraction and Museum specimen.

KEYWORDS: Human Spleen, splenic artery, plastination, silicone gel cast, partial splenectomy.

INTRODUCTION

Human spleen is a lymphatic organ and it is highly vascular. It acts as a filter for blood and plays an important role in the immune responses of the body. Spleen is supplied by the splenic artery which is the largest branch of the coeliac trunk.\(^1\) Splenic branches of the splenic artery are end – arteries. The splenic artery is remarkably tortuous; probably the tortuosity regulates the blood flow to the spleen in different metabolic activities of life, allows movement of the spleen, and permits distension of the stomach without obstruction to the splenic blood flow.\(^2\) It is commonly considered that as the splenic artery approaches the spleen it divides into a superior and inferior terminal branch, in some cases middle terminal artery is also present. The branches of splenic artery entering into spleen through poles of the spleen are called polar arteries they are superior and inferior polar arteries. These branches supply a particular part of the spleen which is separated by an avascular area. These branches divide the spleen into definite arterial segments.\(^3\) The method of plastination is a novel technique to preserve the tissue of biological specimens, body parts or bodies without any health hazards like carcinogenicity and contact dermatitis that are associated with formalin. Plastination is a technique of preparation of dry, colored, nontoxic, durable, odorless, natural looking specimens.\(^4\) The method was first invented by Gunther Von Hagens who imagined as to what would happen if plastic was impregnated into substances.\(^5\) There are three types of methods of plastination- Whole organ plastination, Sheet plastination and Luminal cast plastination. Luminal cast plastination - This technique means to fill up the cavity or lumen of an organ with the solidifiable material, allowing it to set hard and after that removal of the surrounding soft tissue to obtain the cast. In this technique fresh organ is preferred because during preservation the interior structure of the organ will be altered by dehydration. Silicone gel is used in the preparation of the cast.

MATERIALS AND METHODS

Human spleen was obtained in the department of Anatomy before embalming cadaver and followed by the standard method of dissection described by Cunningham.\(^6\) It was preserved
in saline. The splenic artery was cleaned repeatedly with saline and Hydrogen peroxide (H$_2$O$_2$) until all the blood was drained out of the spleen. The silicone sealant was then injected into the splenic artery using a silicone gun. After injection, artery was tied by thread and kept for setting of injected material for 24 hours. The specimen was then left to dry until all the sealent solidified. The surrounding tissue was destroyed by concentrated sulfuric acid (H$_2$SO$_4$). Thus a plastinated luminal cast of the splenic artery was cleaned and photograph was taken.

RESULTS
Splenic artery was originated from the coeliac trunk and divided into polar branches and terminal primary branches (Fig.1). Present splenic artery cast showed that splenic artery divided into superior, middle and inferior terminal branches with two polar branches (figure 2). Another specimen of splenic artery cast showed two terminal branches superior and inferior and one polar branch with one occasional branch of posterior gastric artery (figure 3). Above branching pattern explained the splenic lobes where three terminal branches supply three lobes and two terminal branches supplied two splenic lobes. Additional lobes were supplied by the polar arteries. These segmental branches of the splenic artery divided the spleen into arterial segments. These segments were separated from each other by an avascular plane in all the spleen. Thus the splenic lobes could be varies from 2-3 in numbers.
Legends

Fig.1: Spleen showing divisions of splenic artery from fresh spleen specimen before embalming. ST: Splenic Trunk; APM: arteria pancreatica magna; SPo: Superior Polar branch; IPo: Inferior Polar branch; SP: Superior primary branch; MP: Middle primary branch; IP: Inferior primary branch.

Fig.2: Splenic artery cast showing three divisions of terminal primary branches. ST: Splenic Trunk; APM: arteria pancreatica magna; SPo: Superior Polar branch; IPo:
Inferior Polar branch; SP: Superior primary branch; MP: Middle primary branch ; IP: Inferior primary branch.

Fig.3: Splenic artery cast showing two divisions of terminal primary branches. ST: Splenic Trunk; APM: arteria pancreatica magna; SPo: Superior Polar branch; SP: Superior primary branch; IP: Inferior primary branch; PGA: Posterior gastric artery.

DISCUSSION
In the present study, the primary and the polar branches of the splenic artery were observed, which divided the spleen into definite segments. Two primary branches were found in spleen and three primary branches were found in another spleen specimen. Dequeurce et al have stated that Honore’ Fragonard the eminent French anatomist had prepared several dry anatomical specimens between 1766 and 1771 that have miraculously survived till today. In the eighteenth century most of the French anatomists injected the vascular system with a coloured mixture of wax, animal fat and plant resins and the body was dehydrated by immersion in a bath of alcohol. However the procedure of the classical technique was not revealed by Honore’ Fragonard.\[7\] Silva et al have described a technique for the study of vascular anatomy of the liver by injection & erosion methods. The vascular anatomy of liver of rat was demonstrated by injecting a solution of acrylic into the portal vein and inferior vena cava. The surrounding soft tissues were then eroded using hydrochloric acid. A vascular cast of liver vasculature was thus prepared.\[8\] Shashikala R. Londhe et al in their study of splenic artery cast noticed that in 90% spleens the splenic artery was divided into superior and inferior terminal branches and in 10% spleens divided into superior, middle and inferior terminal branches. In 26 spleens primary terminal branches were present without polar arteries and in 24 spleens primary terminal branches were present with polar arteries. In 33% spleens there was superior polar branches, In 54% spleens inferior polar branches and in 24.4% spleens both superior and inferior polar branches as in. Polar arteries were originated from splenic trunk.\[9\] According to Prashant NC et al the splenic artery terminated near the hilum by dividing into two or three primary branches. Of the 111 spleens, 95 [85.58%] had two primary branches and 16 [14.42 %] showed three primary branches. Polar branches were seen in 92 specimens. The superior polar branch was present in 32 [28.82 % ] specimens, the inferior polar branch was present in 47 [42.34 % ] specimens, both the superior and inferior branches were present in 13 [11.71%] specimens and no polar branch was observed in 19 [17.11%] of the total spleens.\[10\] Narat et al have provided an insight into the history of
preparation of corrosion casts. Their article states that Swammerdam (1670) is believed to be the inventor of the technique of solidifying injected specimens. The article also recollects the contributions of several others involved in preparation of corrosion casts. Govard Bidloo (1685) was perhaps the first to inject lungs with a complex alloy of bismuth and mercury. In 1906-1907 Robinson prepared paraffin casts of ureteral calyces.[11] Venkatesh GK et al compared to the pattern in sheep lungs and explained the only difference is in the extra lobe that is observed on the right side. The division of the two principal bronchi follow a common pattern in both, with equal number of secondary and tertiary bronchi.[12] Mikhail Y. et al reported two primary terminal branches of splenic artery in 77% of cases and three primary terminal branches in 23% of cases. They also reported polar branches, in 12% upper polar, in 50% lower polar and in 12% both upper and lower polar branches.[13] Guitierrez reported the presence of two segments in 90% of his series and three or four segments in the rest.[14] The importance of the spleen in protection from infection was found to be neglected and it was thought that the other lymphatic organs of the body could take over its functions. But a series of animal experiments and follow up studies of patients revealed its actual importance in protection from blood born sepsis, where its role as a blood filter was found to be very significant.[15,16]

CONCLUSION
The findings of this study are useful for surgeons, especially in partial splenectomy, Splenomegaly, Splenic infraction.

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Conflict of interest: The authors declare that they have no conflict of interest.

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