

Study of vascular pattern in human spleen by corrosion cast method

Shashikala R. Londhe*

Department of Anatomy, Al Ameen Medical College, Athani Road, Bijapur-586108 Karnataka, India

Abstract: *Background:* The aim of the present work was to study the parenchymal distribution of the splenic artery and clarify the avascular planes in human spleens. *Observation:* Splenic vascular pattern was studied in fifty human spleens, Cellulose Acetate Moulding Granules were used as casting media, injected in the splenic trunk. Soft tissue corrosion was done in the concentrated Potassium Hydroxide and the pattern was studied from obtained cast. Number of segments varied from two to five based on the observation of the terminal and polar splenic branches by corrosion cast and taking account of the ideas reported in the literature, proposed that the spleen is divided in arterial segments and sub segments. Primary segments are territories corresponding to primary branches and polar segments corresponding to polar arteries. *Result:* There were two primary segments in 90% spleens and three primary segments in 10% spleens. Associate to that in 32% spleens there was superior polar segments, in 56% inferior polar segments and in 12.4% both superior and inferior polar segments. *Conclusion:* Maximum number of spleens were divided into two lobes and less number of spleens were divided into three lobes, along with that additional lobes were also present when additional arteries present.

Keywords: Human spleens, casting media, corroding chemical, cast.

Introduction

The spleen is supplied by the terminal branches of the splenic artery. 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 terminal branches undergo several subdivisions, finally giving the hilar arteries which penetrate into the spleen. The branches of splenic artery entering into spleen through poles of the spleen are called polar arteries i.e. superior and inferior polar arteries [1]. Since the pioneering studies of Kyber, numerous researches have shown that the spleen is divided into vascular compartments, with each compartment or segment being supplied by segmental artery. The spleen shows segmentation due to the fibrous septae [2]. However, the nature and precise pattern of the arterial splenic segments are still controversial. In addition to its basic interest, research on this topic could increase the success of partial splenectomies, which are specially indicated in some surgical repair of the spleen in children [3].

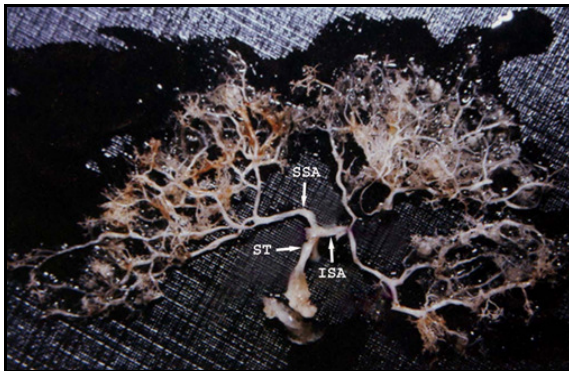
Three major ideas have been reported about this question. The first detailed accounts using casts and radiographs [4-6] showed that the human spleen was composed of segments corresponding to the hilar arteries, the number of segments thus being identical to the number of penetrating arteries. The segments were superimposed and separated from each by avascular planes oriented perpendicularly to the major axis of the spleen. Partial splenectomy was first performed in 19th century and their post operative sequel and complication were observed [7].

Thus application of conservative surgery of partial splenectomy become a worldwide practice. The application of the conservative splenic surgery, require a detailed knowledge of the avascular plane of the spleen and its segmental pattern in both sexes [8-9]. Splenic segments in corrosion casts of splenic artery and its branches were demonstrated by [10-11]. Likewise the present study reported on segmentation in human spleen after making corrosion casts of splenic artery its branches.

Material and Methods

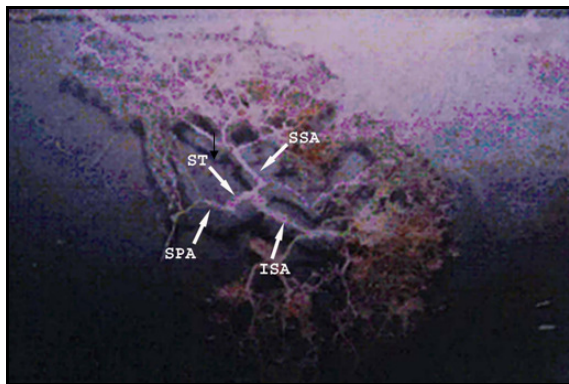
50 spleens were studied by corrosion cast method. Spleens were obtained from anatomy and forensic medicine department of Dr. V. M. government medical college Solapur. In this procedure Cellulose Acetate Moulding Granules, 12 gram% were dissolved in 100 ml of Acetone for 72 hours, stirred well and made homogenous solution. Prepared solution was injected into splenic artery through disposable branula of various numbers according to caliber of artery. After injection, artery was tied by thread and kept for setting of injected material for 24 hours. Injected spleens were kept in concentrated Potassium Hydroxide solution for corrosion and observed till complete maceration occur. Obtained cast were studied by spreading the cast on glass plate as shown in (figure1,2,3).

Figure-1: Showing two divisions of splenic artery



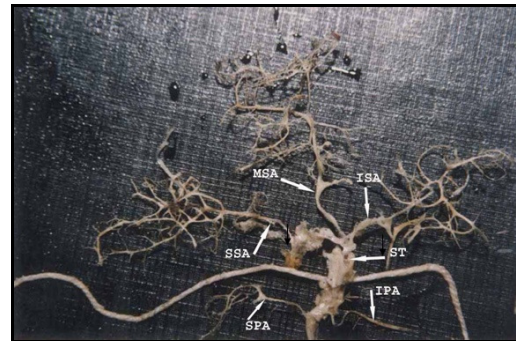
(ST: Splenic Trunk. SSA: Superior Splenic Artery. ISA: Inferior Splenic Artery)

Figure-2: Showing two divisions of splenic artery with arrow showing superior polar artery



(ST: Splenic Trunk. SSA: Superior Splenic Artery. ISA: Inferior Splenic Artery. SPA: Superior Polar Artery)

Figure-3: Showing three divisions of splenic artery with left arrow showing superior splenic artery & right arrow showing inferior splenic artery



(ST: Splenic Trunk. SSA: Superior Splenic Artery. MSA: Middle Splenic Artery. ISA: Inferior Splenic Artery. SPA: Superior Polar Artery. IPA: Inferior Polar Artery)

Results

Splenic artery was originated from the coeliac trunk in all spleens. Splenic artery was divided into terminal primary branches at the hilum. From splenic artery cast, it was clear that in 90% spleens the splenic artery was divided into superior and inferior terminal branches as in (figure1,2) and In 10% spleens divided into superior, middle and inferior terminal branches as in (figure3). However further subdivisions of branches exhibited such variation that no two had exactly the same morphological appearance. In 26 spleens primary terminal branches were present without polar arteries as in (figure1) and in 24 spleens primary terminal branches were present with polar arteries. In 33% spleens there was superior polar branches as in (figure2) , in 54% spleens inferior polar branches and in 24.4% spleens both superior and inferior polar branches as in (figure3). Polar arteries were originated from splenic trunk.

According to this branching pattern the spleen had two lobes, when there were superior and inferior terminal branches and three lobes, when there were superior, middle and inferior terminal branches, additional lobes, when there were polar arteries present. Thus the splenic lobes could be varies from 2-5 in number.

Discussion

Simionescu et al and Cayotte et al considered the spleen as divided into two lobes, superior and inferior each composed of two segments superior polar and superior mesosplenic for the superior lobe, and inferior polar and inferior mesosplenic for the inferior lobe [8-9]. Gupta et al proposed that the segmentary arteries are the primary branches of the splenic artery. In 84% of the cases, the splenic artery gives off two primary branches, and so, two segments superior and inferior are present. In the remaining 16% of cases splenic artery gives off three primary branches and so, three segments superior middle and inferior [10]. Clausen showed the presence of two segments in 80% of cases [11]. Gutierrez reported the presence of two segments in 90% of his series and three or four segments in the rest [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].

According to Michel's criteria a vessel was considered as a polar artery when it penetrated one of the splenic poles, not the hilum, independently of its origin. He noticed two divisions of splenic artery in 80% spleens and three divisions in 20% spleens, along with this superior polar arteries in 65% and inferior polar arteries in 82% spleens. He also reported the occurrence of multiple polar arteries to inferior pole of the spleen [14]. Garcia JA observed two primary splenic branches in 92.82%, three primary splenic branches in 7.18% and superior polar arteries in 28.28%, inferior polar arteries in 44.75% and both polar arteries in 10.49% of cases [15]. In the present study two primary splenic branches were present in 90%, three primary splenic branches in 10% spleens and superior polar arteries in 33%, inferior polar arteries in 54% and both polar arteries in 12.4%. This knowledge of vascular pattern helps in identification of lobes or segmentation in spleen, which is important in partial splenectomy and surgical repair of spleen injuries.

References

1. Susan standing. In: Gray's Anatomy 40th edition. *Churchill Livingstone*, 2008;1193.
2. Kyber E. Uber die Milz des Menschen und einiger Säugetiere. *Arch microsk. Anat. Entw Mech* 1870; 6: 540-570.
3. Burrington JD. Surgical repair of a ruptured spleen in children. *Archs Surg* 1977;112: 417-420.
4. Da Costa JC. Novos aspectos da circulacao esplenica. *Gazeta med. port* 1951;4:1107-1138.
5. Nguyen-Huu Les territoires arteriels de la rate par la methode des injections plastiques. *Archs Mal Coeur* 1952;9:792-799.
6. Dreyer BJ. van. The segmental nature of the spleen. *Blood* 1961;18:468-476.
7. Greco RS. Alvarez FE. Protection against pneumococcal bacteria by partial splenectomy. *Surgery Gynaecology Obstetrics* 1981;152:67-69.
8. Simionescu U, Aburel V, Ciobanu M, Curelaru I, Marin I. Arterial segments on the spleen in man (anatomical basis of controlled partial splenectomy). *Rum. Med. Rev* 1959; 3:6-9.
9. Cayotte JL, Renard M, Rossinota B, Kaiffer M, Massotte JL, Hilly JP. Essai sur l'organisation vasculaire de la rate. *C. r. Ass. Anat* 1970; 197:591-661.
10. Clausen E. Cited by Goldby F, Harrison RJ. In: *Recent Advances in Anatomy*, 2nd edition. London, *J and A Churchill Ltd* 1961;392.
11. Gupta CD, Gupta SC, arora AK, Jeya Singh P. Vascular segments in the human spleen. *J. Anat* 1976; 121: 613-616.
12. Gutierrez Cubillos C. Segmentation esplenica. *Revta esp. Enferm. Apar. dig. Nutr* 1969; 29: 341-350.
13. Mikhail Y. Kamil R. Nawar NNY. Rafla MFM. Observations on the mode of termination and parenchymal distribution of the splenic artery with evidence of splenic lobation and segmentation. *J. Anat* 1979; 128(2): 253-258.
14. Michels NA. The variational anatomy of spleen and splenic artery. *American Journal of Anatomy* 1942; 70: 21-72.
15. Garcia-Porrero JA, Lemes A. Arterial segmentation and subsegmentation in the human spleen. *Acta anat* 1988; 131: 276-283.

*All correspondences to: Dr. Shashikala R. Londhe, Block No-14 Karuna Co- Operative Housing Society, Kumtha Naka, Solapur-413003 Maharashtra, India. Email: dr.shashilondhe@gmail.com