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Original Article

Anatomy Section

Variational Anatomy of the Segmental Branches of the Splenic Artery

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ABSTRACT

Background: The human spleen is highly vascular and friable and so it cannot be sutured. Total splenectomy is commonly done after a splenic injury, but it leads to a decrease in the immunity and thus it creates an altered haematological picture. To avoid this, partial splenectomy can be done by ligating a particular segmental branch of the splenic artery. So, the aim of this study was to accurately identify the segmental branches of the splenic artery.

Materials and Methods: 111 human spleens were studied. Each spleen was dissected carefully by piece-meal dissection. The splenic artery and its branches were cleaned and traced. Any variation in the form of the number of the segmental branches and intersegmental anastomosis, if present, was noted. Other branches of the splenic artery which were not supplying the spleen were not taken into consideration.

Results: The number of branches of the splenic artery which divided the spleen into arterial segments, varied between two to five. Two segmental branches were found in 13.51% specimens, three were found in 60.66% specimens, four were found in 17.11% specimens and five segmental branches were present in 2.7% of the total spleens. The parts of the spleen which were supplied by these segmental branches were separated by an a vascular zone, except in 1.80% spleens in which an inter-arterial anastomosis was found between the arteries of the adjacent segments.

Conclusion: The findings of this study are useful for surgeons, especially in partial splenectomy.

Key Words: Spleen, Polar branches of splenic artery, Splenic segments, Partial splenectomy

INTRODUCTION

In humans, the spleen is the largest lymphatic organ. It is connected to the blood vascular system. It consists of a large encapsulated mass of lymphoid and vascular tissues. The blood supply to the spleen is made by a splenic artery which is a branch of the coeliac trunk [1]. The human spleen is highly vascular and friable and so it cannot be sutured [2]. Total splenectomy is commonly done after a splenic injury. As the spleen performs important immunological and haematological functions, total splenectomy leads to a decrease in the immunity and altered haematological features [2]. To avoid this, partial splenectomy can be done [2]. Kehila and Abderrahim [3] reported the practice of partial splenectomy in cases of major trauma, to perform a subtotal splenectomy after the splenic vessel ligation. The application of the conservative splenic surgery requires a detailed knowledge of the avascular plane of the spleen and its segmental pattern [4].

According to Michel [5], the splenic artery terminates by dividing into 2 or 3 terminal branches which are named as the superior, middle and the inferior primary branches. The primary branches enter the spleen through its hilum. In some spleens, the splenic artery itself or its primary branch gives an artery which does not pierce the hilum, but goes to one of the poles of the spleen. It can be named as the superior or the inferior polar branch. These branches supply a particular part of the spleen which is separated by an avascular area. Thus, these branches divide the spleen into definite arterial segments.

The aim of this study was to accurately identify the segmental branches of the splenic artery, to find the variations in the number of the segmental branches and to find out any inter-segmental anastomosis, if they were present.

MATERIALS AND METHODS

This study was conducted in the Anatomy Departments of Shri Vasantrao Naik Government Medical College, Yavatmal, India and the Indira Gandhi Government Medical College, Nagpur, India. For this study, 111 human spleens of both the sexes were used. Out of the 111 spleens, only 15 spleen specimens belonged to female cadavers. As only a very less number of spleens of female cadavers were available, it was difficult to do a comparative study between the males and females. So, the spleens from both the sexes were added together and a statistical analysis was done, without considering the sexual dimorphism.

To remove the spleens from the abdominal cavity, they were detached from their various attachments and the splenic vessels were cut, a minimum of 5 cm away from the hilum of the spleen. Then, they were washed with tap water to clean the debris and the fatty tissue. In each spleen, the splenic artery and its branches were identified and cleaned. Each spleen was dissected carefully along the course of the branches of the splenic artery by a piece meal dissection. The branches of the splenic artery which did not supply the spleen were not taken into consideration. The total number of the primary and the polar branches of the splenic artery was noted. Any variations in the form of the number of segmental branches of the splenic artery and intersegmental anastomosis, if they were present between the branches of the splenic artery, were noted.

RESULTS

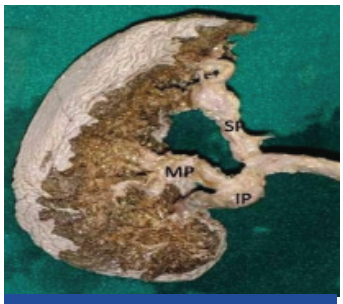
The splenic artery terminated near the hilum by dividing into two or three primary branches. Of the 111 spleens, 95[85.58%] had two primary branches [Table/Fig-1] and 16[14.42 %] showed three primary branches [Table/Fig-2]. Polar branches were seen in 92 specimens. The superior polar branch was present in 32[28.82 %] specimens [Table/Fig-3], the inferior polar branch was present in 47[42.34 %] specimens [Table/Fig-4], both the superior and inferior branches were present in 13[11.71%] specimens [Table/Fig-5], [Table/Fig-6] and no polar branch was observed in 19[17.11%] [Table/Fig-1] [Table/Fig-2] of the total spleens.

Then we found out an association between the polar and the primary branches [Table/Fig-7]. From this, the numbers of the segmental branches of the splenic artery were counted. From [Table/Fig-7], it becomes clear that the number of segmental branches which were present in this study were two in 15 [13.51%] cases, three in [26+44+4=74 i.e.(66.66%)], four in [6+3+10 i.e. (17.11%)] and five branches in 3(2.70%) of the total spleens. 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 but two specimens [Table/Fig.8]. In those two specimens [1.80%], an inter-arterial anastomosis was found between the arteries of the adjacent segments.

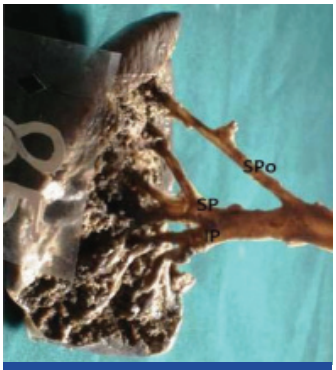
DISCUSSION

The anatomy of the segmental branches of the splenic artery is revealed better by dissection than by investigative procedures, since the complete exposure of the organ during dissection provides a ready accessibility for its detailed study.

[Table/Fig-1]: Two primary branches of splenic artery
SP = superior primary branch
IP = inferior primary branch



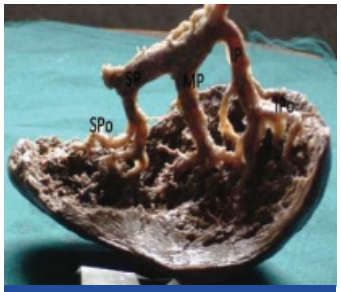
[Table/Fig-2]: Three primary branches of splenic artery
SP = superior primary branch
MP = middle primary branch
IP = inferior primary branch



[Table/Fig-3]: Superior polar branch arising from splenic artery
SP = superior primary branch
IP = inferior primary branch
SPo = superior polar branch

[Table/Fig-4]: Inferior polar branch arising from splenic artery
SP = superior primary branch
IP = inferior primary branch
IPo = inferior polar branch

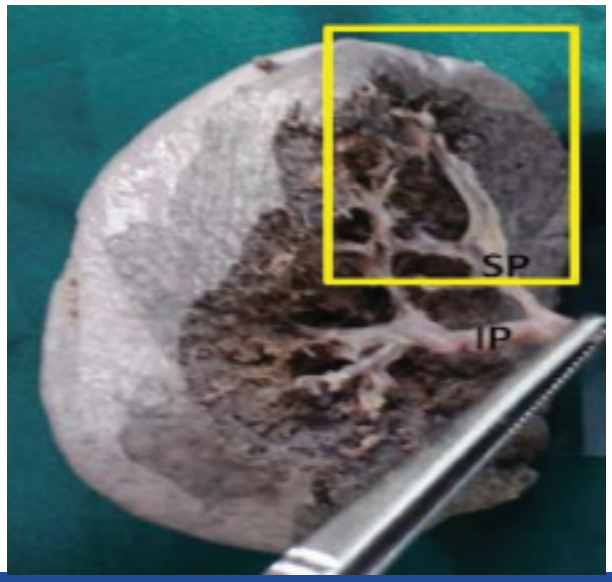
[Table/Fig-5]: Two primary branches and two polar branches
SP = superior primary branch
IP = inferior primary branch
SPo = superior polar branch
IPo = inferior polar branch



[Table/Fig-6]: Two primary branches and three polar branches
SP = superior primary branch
MP = middle primary branch
IP = inferior primary branch
SPo = superior polar branch
IPo = inferior polar branch

Primary branches	Polar branches			
	Superior	Inferior	Both	Nil
Two (n=95)	26	44	10	15
Three (n=16)	6	3	3	4

[Table/Fig-7]: Association between polar branches and primary branches



[Table/Fig-8]: Anastomosis between segmental branches of splenic artery
SP = superior primary branch
IP = inferior primary branch

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 85.58% and three primary branches were found in 14.42% specimens. Earlier, Katritsis et al [6] had found two and three primary branches in 85.70% and 14.30% specimens respectively, Gupta et al [7] found them in 84% and 16% specimens, while Michels [5] observed them in 80% and 20% specimens respectively. In other studies which were done by Mikhail et al [8] and Garcia- Lemes [9], the incidence of the primary branches was in accordance with that of the above mentioned studies. In our study, the superior polar branch was observed in 45 [32+13] i.e. in 40.53% specimens, while the inferior polar branch was observed in 60 [47+13] i.e. in 54.06% specimens. These were found in 39.77% specimens and in 55.24% specimens respectively, in the studies which were done by Garcia-Lemes [9]. Thus, their findings were in accordance with those of the present study. The incidence of the superior and the inferior polar branches was 65% and 82% respectively in the study which was done by Michel [5]. It was 60% and 80% respectively

in the study which was done by Katritsis et al [6], while they were found in 24% and 62% cases respectively in the study which was done by Mikhail et al [8]. Thus, the incidence of the polar branches varied in the previous studies which were done by different authors, but in all of them, the number of the segmental branches of the splenic artery ranged between two to five, which was the finding in our study also.

In most of the previous studies [5,6,7,8], the splenic segments were separated from each other by an avascular plane, except in the studies which were done by Garcia-Lemes [9], Manderim et al[10] and Ignjatovic et al [11], who found an arterial anastomosis between the adjacent segmental branches in 16.7%, 19.8% and in 25% of the splenic specimens respectively. Such an inter-segmental anastomosis was observed in 1.80% of the total specimens in the present study.

Though the spleen is the centre where both the B and T lymphocytes multiply and play an important role in the immune responses [12] and as it filters the unwanted elements from blood by phagocytosis [13], 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 [14,15].

Hence, now-a-days, despite the overwhelming indications for splenectomy, the tendency of the surgeons is to conserve as much splenic tissue as possible, by removing only the affected segment of the spleen. For this, a detailed knowledge of the segmental branches of the splenic artery is very important.

Thus, from the above findings, we have concluded that the splenic artery gives primary and polar branches to the spleen. These branches divide the spleen into definite arterial segments which are separated by an avascular plane. So, they are called as segmental arteries. The number of such segmental arteries varies between 2 to 5. These findings of our study will be helpful to the surgeons while they perform segmental resection of the spleen.

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