VOLUME-9, ISSUE-6, JUNE-2020 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Anatomy

OBSERVATIONS ON THE MODE OF TERMINATION OF THE HUMAN SPLENIC ARTERY, ITS TORTUOSITY AND SPLENIC DIMENSIONS.

Mala Amrish Jalundhwala

Jr. Scientific Officer, K.E.M. Hospital, Department of Anatomy, Seth G.S. Medical College & K.E.M. Hospital, Parel, Mumbai.

ABSTRACT

61 embalmed cadavers were dissected. The splenic artery was dissected out from the celiac trunk to the splenic hilum. The direct length of the splenic artery-X cm and the curvaceous length of the splenic artery-Y cm from the point of its origin to bifurcation/trifurcation at the splenic hilum was measured in situ. The tortuosity index-T.I. calculated.

The branches of the splenic artery to the pancreas and the stomach were dissected. The point of division of the splenic artery into the splenic hilum was observed and the spleens classified as bifurcating or trifurcating and also noted for Y-type or T-type branching. The splenic artery was divided at the point of bifurcation/trifurcation. The length, breadth and thickness of the spleens was measured in centimeters. The weight of the spleens was measured in grams. These parameters were then correlated with the tortuosity index.

KEYWORDS : Splenic Artery, Tortuosity Index, T-type, Y-type.

INTRODUCTION

Sir Richard Blackmore, in 1725 wrote the following about spleen:

'It is impossible to inspect and contemplate this large organ, without concluding that it must have some important office in the animal administration and that it is not a superfluous and impertinent fungus, or an error or sport of nature' (Gilchrist and Trunkey, 1990). If the organ evokes such a response, the artery supplying the organ can be even more interesting.

According to Michels (1942), the tortuosity of the splenic artery was described for the first time by Julius Caesar Arantius of Vienna in 1571 as *"arteriae lienis, ductum obliquum ac flexuosum, anguis in modum"*, who described it as a duct, oblique and tortuous, like a snake (Sylvester et al, 1995).

Knowledge of the normal anatomic pattern is indispensable in order that correct, fairly bloodless incisions be made and life-sustaining arteries be preserved. Hence a cadaveric study was undertaken to know the anatomy of the tortuosity of the splenic artery and its possible relations with the mode of termination into the splenic hilum as well as the splenic dimensions.

MATERIALS AND METHODS

61 embalmed (10% formalin-fixed) cadavers were dissected in the dissection hall of the Department of Anatomy, Seth G.S. Medical College and K.E.M. Hospital, Parel, Mumbai, India. The abdomen was opened by a midline incision. All the layers of the anterior abdominal wall were cut. After opening the peritoneal cavity, the stomach and the greater omentum were identified. The greater omentum was divided and the stomach was lifted up. At the upper border of the pancreas, the celiac trunk was located; the splenic artery was then dissected out from the celiac trunk to the splenic hilum (Romanes G.J., 1992). The branches of the splenic artery to the pancreas and the stomach were dissected and the termination pattern of the splenic artery (Y-type or T-type or any other) and bifurcation/trifurcation at the splenic hilum was also noted down.

The direct length of the splenic artery (X cm) from the point of its origin from the celiac trunk to bifurcation/trifurcation was measured *in situ* with the help of a twine thread and a calibrated scale. The curvaceous length of the splenic artery (the twine thread was made to follow all the tortuous curves of the splenic artery from the point of its origin to bifurcation/trifurcation at the splenic hilum-Ycm) was also measured *in situ*. The tortuosity index (T.I.) was calculated as the ratio of the curvaceous length and the direct length of the splenic artery (Y/X) and the average T.I. found.

The splenic artery was divided at the point of bifurcation/trifurcation. The length, breadth and thickness of the cadaveric spleens (n=61) was measured and noted down in centimeters with the help of a measure tape, divider and a calibrated scale. The weight of the spleens was measured in grams using a weighing scale. The Pearsons correlation coefficient (r) between the tortuosity index and the length, breadth, thickness and weight of the cadaveric spleens was statistically calculated and the probability value for its significance then found out from the't' test.

RESULTS

The straight length of the splenic artery (n=61) from its origin to the point of hilus branching (X cm) was found to vary from 4.2 to 9.5 cm with an average of 7.03 S.D.$\pm$1.07 cm. The total uncoiled (curvaceous) length of the splenic artery from its origin to the point of hilus branching (Y cm) was found to vary from 6.05 to 23.2 cm with an average of 11.39 S.D.$\pm$2.79 cm.

The range of the tortuosity index (T.I.) was found to vary from 1.01 to 2.67, with an average of 1.62 S.D.$\pm$0.31. The median of the tortuosity index ratio was found to be 1.56. T.I. of less than 1.5 was observed in 25 cadavers (40.98%); T.I. of 1.5 to 2.0 was observed in 29 cadavers (47.54%); T.I. of 2.1 to 2.5 was observed in 6 cadavers (9.84%); T.I. of more than 2.5 was observed in 1 cadaver (1.64%).

The weight of the cadaveric spleens (n=61) was found to vary from 60 to 725g, the average being 211.15g S.D.$\pm$142.31 (Table 1). The correlation coefficient (r) between the weight of the spleens and the tortuosity index was 0.29, which had a significant relation ($p<0.05$).

Table 1: Weight Of The Spleens

Weight(grams)	n	%
0-100	9	14.75
101-200	30	49.18
201-300	11	18.03
301-400	6	9.84
401-500	1	1.64
501-600	2	3.28
601-700	1	1.64
701-800	1	1.64

n= Number of cases in 61 observations.

The length of the cadaveric spleens (n=61) ranged from 10.2 to 29.4 cm, with an average of 16.65cm, S.D.±4.01 (Table 2). The correlation coefficient between the length of the cadaveric spleens and tortuosity index was found to be 0.15, which was not statistically significant.

Table 2: Length Of The Spleens

Length(cm)	n	%
10.1-15	26	42.62
15.1-20	24	39.34
20.1-25	9	14.75
25.1-30	2	3.28

n= Number of cases in 61 observations.

The breadth ranged from 6.0 to 16.4 cm, with an average of 10.31 cm S.D.±2.56 (Table 3). The correlation coefficient between the breadth of the cadaveric spleens (n=61) and tortuosity index was found to be 0.12, which was not statistically significant.

Table 3: Breadth Of The Spleens

Breadth(cm)	n	%
6.1-8	12	19.67
8.1-10	23	37.70
10.1-12	12	19.67
12.1-14	9	14.75
14.1-16	2	3.28
16.1-18	3	4.92

n= Number of cases in 61 observations.

The thickness ranged from 2.9 to 9.6 cm, with an average of 5.05 cm S.D.±1.46. The correlation coefficient between the thickness of the cadaveric spleens (n=61) and tortuosity index was found to be 0.20, which was not statistically significant. Bifurcation at the splenic hilum was frequent, n=57 (93.44%) than trifurcation n=4 (6.56%).

The Y-type was frequent n= 59, (96.72%) than the T-type n=2, (3.28%) branching.

DISCUSSION

Among all the arteries the splenic artery is uniquely noted and debated on for its tortuous course. Sylvester et al. (1995), quoting Michels have put forth various reasons for the tortuosity of the splenic artery like respiratory movement and volumetric changes in the spleen; growth of the arteries tethered by its branches and associated atheroma etc.

According to Michels, as the age increases the average length of the splenic artery increases from 10 to 32 cm (Javors B.R., 1999). In our study (n=61) the straight length of the splenic artery was found to vary from 4.2 to 9.5 cm while the curvaceous length of the splenic artery was found to vary from 6.05 to 23.2 cm.

Patel and Fry (1966), attach a lot of importance to tethering and the behavior of the tethered segment of the vessel wall as it can alter the vascular dynamics. According to Dobrin et al(1988), if a straight vessel is forced to elongate between its branches, which are tethered, the intervening segments enlarge and buckle, causing loops or tortuosity.

Malinovsky (1997) has quoted his own earlier work and mentioned that age-related pathological changes in the elastin content of the vessel wall could be a cause of tortuosity. Alan Burton (1972) has however noted that there is an increase in the total content of collagen fibers in the arterial wall as age advances and this leads to diffuse fibrosis and increased stiffening of the vessel wall.

Mikhail et al (1979) had found bifurcation of the splenic artery in 77% of cases. Gupta et al (1986) had found bifurcation in 84% of 42 specimens. Garcia-Porrero and Lemes (1988) found bifurcation in 92.82% of their cases and 7.18% of their cases had trifurcation. Sahni et al (2003) found bifurcation and trifurcation of the splenic artery to be in the ratio of 4:1. Our findings in the present study corroborates with most of the findings mentioned above.

Nguyen et al (1982) classifies branching of the hilar vessels into 'Y-type', where hilar branching is quite some distance away from the hilum and 'T-type', where it is close to the hilum. In our study (n=61) only 2 showed a 'T-type' of branching.

CONCLUSIONS

- Majority of the specimens showed the tortuosity index to vary from 1.0 to 2.0.
- Bifurcation was more frequent than trifurcation at the splenic hilum.
- Y-type branching of the splenic artery was more common than the T-type branching.
- The length, breadth, and thickness of the cadaveric spleens (n=61) did not show any significant relation with the tortuosity index.
- The weight of the cadaveric spleens (n=61) was found to have a significant relation with the tortuosity index.

ACKNOWLEDGMENT:

I whole-heartedly thank my devoting and caring guiding teacher, Dr. Lopa A. Mehta, Professor and Ex-Head, Department of Anatomy, Seth G.S. Medical College and K.E.M. Hospital for giving me a very interesting topic for research.

I will never be able to repay back for the profound knowledge and valuable co-guidance of Dr. (Mrs.) Lakshmi Rajgopal, Ex-Associate Professor, Department of Anatomy, Seth G.S. Medical College and K.E.M. Hospital. I thank the esteemed Medical College to give me an opportunity to dissect cadavers.

REFERENCES

1. Burton A.C.: Physiology & Biophysics of the Circulation; 1972; 2nd ed.; pp 63-74.
2. Dobrin P.B., T.H.Schwarcz, and W.H.Baker: Mechanisms of arterial andaneurysmal tortuosity: Surgery; 1988; 104: 568-71.
3. Garcia-Porrero J.A., A.Lemes: Arterial Segmentation and Subsegmentation in the Human Spleen: Acta.Anat.; 1988; 131: 276-283.
4. Gilchrist B.F. and Trunkey D.D 'Injuries to the spleen and pancreas' *In*: Emergency Abdominal Surgery, edited by Williamson R.C.N. and Cooper M.J., Churchill Livingstone, U.K., 1990, vol. 17, pp. 36-9.
5. Gupta C.D., S.C.Gupta, A.K.Arora, and P.J.Singh: vascular segments in the Human Spleen; J.Anat.; 1976;121: 613-616.
6. Javors, B.R.: Reply to the editor-in-chief, 'The query corner': Tortuosity of the splenic artery; Abdominal Imaging; 1999; 24: 313-4.
7. Malinovsky L., C. Cavallotti, V.D' Andrea: Comment on the paper, Tortuosity of the Human Splenic Artery-A letter to the Editor, Clin.Anat.; 1997; 10 (2): 142-3.
8. Mikhail Y., R. Kamel, N.N.Y.Nawar and M.F.M.Rafla: 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.
9. Nguyen H.H.P., R.Hong, B.V., and Nguyen H.Vu: Anatomical Approach to the Vascular Segmentation of the Spleen (Lein) Based on Controlled Experimental Partial Splenectomies; Clin.Anat.; 1982; 4:265-77.
10. Patel D.J., and D.L.Fry: Longitudinal Tethering of Arteries in Dogs; Cir.Res.1966; 19:1011-13.
11. Romanes G.J.: *In* 'The Abdomen' Cunningham's manual of Practical Anatomy; vol. 2: Throrax and Abdomen; ELBS, Oxford Univ. Press, Walton Street, 1992; 15th ed.; pp.83-128.
12. Sahni A.D., B. Indrajit, Gupta C.N.M., D. M. Gupta, E.Harjeet: Branches of the Splenic Artery and Splenic Arterial Segments; Clin. Anat.; 2003; 16: 371-7.
13. Sylvester P.A., R. Stewart, and H. Ellis: Tortuosity of the Human Splenic Artery; Clin. Anat.; 1995; 8: 214-8.