BIFURCATION OF THE AORTA: A TOPOGRAPHICAL STUDY

Bondalapati Lalitha

Associate Professor, Department of Anatomy, Sri Lakshmi Narayana Institute of Medical Sciences, Pondicherry – 605502

Corresponding Author: Dr.Bondalapati Lalitha
Associate Professor,
Department of Anatomy,
Sri Lakshmi Narayana Institute of Medical Sciences,
Osudu, Agaram Village, Pondicherry - 605502

Date of Publications: 01-03-2021 to 01-11-2022

ABSTRACT

It is imperative that gynecologists, surgeons, and radiologists know the topography of the aortic bifurcation when operating in the retroperitoneal area. Aortic-iliac atherosclerosis can also be affected by it. Data from different populations are scarce, but it shows ethnic variations. Aortic bifurcation topography in rural populations was investigated in this study. To expose the termination of the abdominal aorta, abdominal viscera, peritoneum, and fibrolipid connective tissue were removed. In addition, our study recorded the level of the vertebral bifurcation, its angle and asymmetry. These tables and bar charts present the results of data analysis using SPSS version 17.0 for Windows. In the iliac arteries, all aortae bifurcate. Bifurcations at L4 were most common. Three hundred seventy-three percent of the cases resulted in bifurcations below L4. In over 20% of the individuals studied, the topography of the aortic bifurcation differed from conventional descriptions. Radiologists and surgeons should be conscious of this to avoid inadvertently injuring arteries. These findings suggest a greater vulnerability to abdominal aortic atherosclerosis due to higher bifurcation angles and asymmetry. Atherosclerosis should be assessed preoperatively and monitored postoperatively.

DOINumber:10.48047/nq.2022.20.22.NQ10190 **NeuroQuantology2022;20(22):2024-2027**

INTRODUCTION

In order to prevent inadvertent vascular injury in the retroperitoneal area, interventional radiologists, gynecologists, vascular, orthopaedic and general surgeons must understand the topography of the aortic bifurcation [1-4]. As a result, atherosclerosis may occur more frequently [5-7]. In explaining differences in the occurrence of atherosclerosis, these parameters show age [8], gender, ethnicity] variations. Thus, we sought to describe the geometric features of aortic bifurcation in a rural population in this study.

MATERIALS AND METHODS

The aortas of 53 adults were dissected using cadaveric dissection; 33 males, 20 females. A midline incision was made to open the abdomen. An open procedure was used to expose the aorta's terminal part after removing the abdominal viscera, peritoneum, fibrofatty tissue, and inferior vena cava, along with their tributaries, were dissected away. A sacral promontory was used to count vertebrae. In addition to cases of lumbarization and sacralization, the study did not include cases of grossly visible aneurysms. Counting vertebral bodies and recording them to the nearest whole vertebra determined the level of aortic bifurcation. Using dividers, we measured the angle of the aortic bifurcation and the degree of asymmetry. In order to determine frequencies, means, and standard deviations, we used the statistical program for social scientists (SPSS) version 17.0 for windows. Tables and bar charts are used to present the data.

RESULTS

All cases of aortic bifurcation were observed. It was evident, however, that bifurcations varied in asymmetry, angle, and level according to gender.

The bifurcation level

In most cases (73.57%), the termination was at L4, while in 37.73% at the lower part of the spinal column and 35.84 % at the upper part. Bifurcation occurred below L4 in 13.20% of cases. Table 1 shows that it occurred only in 5.66 percent of cases above L4 (Table 1).

Bifurcation angle

A male with a bifurcation angle (56), compared to a female with a bifurcation angle (55) [range 23-780]. There were majorities over 250, and majorities below 200 (Table 2).

Asymmetries associated with bifurcations

In comparison with females (4.30), males (4.40) had a slightly higher value. There was an asymmetry below 5 in half of the cases (50%) of the sample. Asymmetry above 100 was present in only 6.6% of cases (Table 3).

Table1: Level of bifurcation at the cervical level of aorta among rural populations

THE BIFURCATION LEVEL	FREQUENCY			PERCENTAGE
	MALE	FEMALE	TOTAL	
L3/4	01	2	03	5.66
Upper L4	12	7	19	35.84
Lower L4	14	6	20	37.73
L4/5	04	03	07	13.20
L5	02	02	04	7.57
Total	33	20	53	100

Table 2: Aortic bifurcation angle in rural populations

ANGLE RANGE	FREQUENCY			PERCENTAGE
	MALE	FEMALE	TOTAL	
21 – 30	01	02	03	5.66
31 – 40	04	02	06	11.32
41 – 50	07	06	13	24.52
51 – 60	12	04	16	30.18
61 – 70	07	04	11	20.75
71 - 80	02	02	04	7.54
Total	33	20	53	100

Table 3: Asymmetry of bifurcations

RANGE	FREQUENCY			PERCENTAGE
	MALE	FEMALE	TOTAL	
0 – 5	16	10	26	49.05
6 – 10	08	05	13	24.52
11 – 15	04	02	06	11.32

16 – 20	02	02	04	7.54
21 - 25	02	01	03	5.66
	01	00	01	1.88
Total	33	20	53	100

DISCUSSION

The geometric characteristics of the aortic bifurcation vary greatly, as shown by the current study. Earlier reports [9, 11] support this conclusion. Asymmetry, angle, and level are the three most notable ones studied. Atherosclerosis is also influenced by these factors [5].

The level at which the vertebrae bifurcate

An important factor during surgical intervention in this region is the level of aortic termination. There are two common iliac arteries that stem from the aorta, which are usually bifurcated at L4 [10]. However, various studies have shown that substantially more than half of various populations do not have a bifurcation at L4. According to these figures, L4 terminations take place at varying rates. A variety of ages and sexes may account for the differences. A recent study suggests that bifurcations shift caudally with age as well as based on gender [8]. Bifurcation below the fourth limb was observed in 35.84 % of cases in the current study. Bifurcation angles are broader below L4 when the bifurcation is below L4. Accordingly, this percentage of the population studied would have a wide bifurcation angle and would thus be more likely to develop atherosclerosis as a result.

Aspect bifurcating

Aortoiliac atherosclerosis is associated with a wide variation in bifurcation angle [7, 11]. As a result of the current study, we observed a significant increase in the mean bifurcation angle, which is higher than the mean observed in most other studies.

There is a wide variation in the angle [11]. Observations of higher angles suggest this population is more susceptible to atherosclerosis than the other groups based on the association between higher angles and atherosclerosis [7]. It's plausible that geometry-induced haemodynamic alterations cause abnormal vascular remodeling, which in turn predisposes to atherosclerosis [12]. Additionally, the mean bifurcation angle varies with age and gender [7, 10], as the subject's studies may have taken place when he or she was young.

Bifurcation of the aorta with asymmetry

A literature review revealed 2.20 and 3.80 [7, 11], respectively. Flow fields near the bifurcation are significantly affected by this geometric characteristic [5]. Those branches with no concomitant angular asymmetry experience an excessively high shear stress along the lateral aortic wall, while those farther from the flow divider experience a low shear stress, resulting in higher rates of atherosclerosis [13, 14]. Observed asymmetry suggests higher atherosclerotic vulnerability in the population studied in the present study.

According to our findings, over 20 percent of the rural population has a different topography of the aortic bifurcation from what is conventionally described. Inadvertent vascular injury is a serious concern for surgeons and radiologists. It is likely that rural populations are at greater risk of abdominal aortic atherosclerosis because their bifurcation angles are higher and their asymmetry is more pronounced. Atherosclerosis must be evaluated and controlled before surgery on the terminal aorta.

REFERENCES

1. Kornreich L, Hadar H, Sulkes J, Gornish M, Ackerman J, Gadoth N (1998). Effect of normal agency on the sites of aortic bifurcation and inferior vena cava confluence. A CT study .SurgRadiolAnat, 20: 63 – 68.
2. Pirro N, Ciampi D, Champsaur P, Di Marino V (2005). The anatomical relationship of the iliocaval junction to the lumbosacral spine and the aortic bifurcation. SurgRadiolAnat, 27: 137 – 141

3. Lakchayapakorn K, Siriprakarn Y (2008). Anatomical variation of the position of the aortic bifurcation, iliocaval junction and iliac veins in relation to the lumbar vertebra. J Am Assoc Tsai, 91: 1564 – 1570.
4. Khamanarong K, Sae-Jungs S, Supa-Adirek C, Teerakul S, Prachaney P (2009). Aortic bifurcation: a cadaveric study of its relationship to the spine. J Med Assoc Thai, 92: 47 – 49.
5. Friedman MH, Deter OJ, Mark FF, Bargeron CB, Hutchins GM (1983). Arterial geometry affects hemodynamics. Atherosclerosis 46: 225 – 231.
6. Smebdy O (1996). Geometric risk factors for atherosclerosis in the aortic bifurcation: A digitized Angiography study. Ann Biomed Eng, 24: 481- 488.
7. Shakeri AB, Tubbs RS, Shoja MM, Nostratinia H, Oakes WJ (2007). Aortic bifurcation angle as an independent risk factor aorto iliac occlusive disease. Folia Morphol; 66: 181 – 184.
8. Vobril R (2001). Location of the aortic bifurcation in man and its practical significance in vascular surgery. Zentralbl; 126: 93 – 96.
9. Sun H, Kuban BD, Schmalbrock P, Friedman MH (1994). Measurement of the geometric parameters of the aortic bifurcation from magnetic reasonance images. Ann Biomed Engineering; 22: 229 – 239.
10. Klepacki M, Cendrowska-Pinkosz M, Madej B, Hermanowicz-Dryka T, Dworzanski w, Krauze M, Dyndor K, Burdan F (2011). Morphology of the subaortic angle in different periods of human life. Ann UniversMariae-Curie Sklod Lublin-pol, 25: 177 – 183.
11. Bargeron CB, Hitchins GM, Moore GW, Deters OJ, Mark FF, Friedman MH.(1986) Distribution of geometric parameters of human aortic bifurcations. Arteriosclerosis 6: 109 – 113.
12. Ortiz-Velasquez RI, Caldas JGMP, Lobo BCR, Santos-Franco JA, Mercado-Pimentel R, Revnelta R (2010). Effects of the modification of the aortic bifurcation geometry: A technical note regarding a novel mode for experimental atherosclerotic and aneurismal lesions. Clinics, 65: 345 – 346.
13. Cheng C, Tempel D, VanHaperen R, van der Baan A, Grosveld F, Daemen MJAP (2006). Atherosclerotic lesion size and vulnerability are determined by patterns of fluid shear stress. Circulation 113: 2744 – 2753.
14. Coppola G, Caro C (2009). Arterial geometry flow pattern wall shear and mass transport: potential physiological significance. J R Soc. Interface, 6: 519 – 528.