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Morphometrical Analysis of Aortic Valve & Coronary Ostia in Cadaveric Hearts

KEYWORDS: Coronary Ostia, Aortic valve. Annulus, Commissural line

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ABSTRACT *The aortic valve of heart shows 3cusps with the annulus. Though many reports suggest the morphometrical analysis of aortic valve for performing valve replacement surgeries, it was found that they vary considerably from individual to individual. Hence, our main objective is to find out the normal morphometrical measurement of aortic valves as well as number of Ostia present in each cusp. Total 25 Hearts were included in present study. The aortic valve with 3 cusps & annulus was flattened out in a single plane & its ring is divided from one point and measured. The mean circumference of annulus is 8.9cm. The depth of the cusps in the region with the ventricular septum also varies & mean depth of each cusp was 1.8cm. The left coronary ostium may be located either above or below inter commissural line. The right coronary ostium is predominantly located below inter commissural line.*

Introduction:
The aortic valve of heart shows 3cusps with the annulus. There have been variable report of annular circumference & depth of the cusps of aortic valve in the past literature. Above each cusp the ascending aorta presents a dilatation known as the aortic sinus of Valsalva. Anterior aortic sinus provides origin to the right coronary artery, & the left posterior aortic sinus gives origin to the left coronary artery. The aortic valves consisted principally of 3 semilunar cusps, aortic annulus, aortic valve, aortic root valsalva sinus & sinotubular junction.1 Specific studies on the aortic heart valve of human heart were carried out. According to Akhtar S. et al, the aortic valve is one of the valves of the heart. It is normally tricuspid, although in 1% of the population it is found to be congenitally bicuspid. Patients with significant native heart valve disease (HVD) often experience valvular stenosis, incompetence, or both, leading to progressive cardiac changes as well as secondary organ involvement. In cases where native valve repair is not possible, patients must be treated by valve replacement.2 Though many reports suggest the morphometrical analysis of aortic valve for performing valve replacement surgeries, it was found that they vary considerably from individual to individual. Hence, our main objective was to find out the normal morphometrical measurement of aortic valves as well as number of ostia present in each cusp.

Materials and Methods:
Total 25 Hearts were included in present study. These hearts were taken from human cadavers in Anatomy Department, MGM Medical College, Kamothe, Navi Mumbai. The aortic valve description, measurement & analysis of Ostia were based upon observation made during dissection of cadaveric hearts. The hearts were dissected, the pericardium involving the root of the aorta was removed, and the origin of the right and left coronary arteries was isolated. Then, the ascending aorta was transversally sectioned approximately 1 cm above the commissures of the aortic leaflets. Next, the aorta was longitudinally opened at the level of the posterior aortic sinus (noncoronary sinus) to enable the visualization and analysis of the right and left aortic leaflets and their respective coronary ostia. In addition, the coronary arteries were sectioned at the level of their origins in the aortic wall (juxtamural portion of the coronary arteries).The aortic valve with 3 cusps & annulus was flattened out in a single plane & its ring is divided from one point. The open out valves were then pinned to white thermocol sheet. Measurements were made with ordinary metric ruler. The total circumference of the annulus of aortic valve, number of ostia present in each cusp, depth of the each cusp was measured and statistical analysis was performed.

Results:
The mean dimensions of all parameters were shown in Table-1. The maximum aortic circumference was noted as 10.2 cms (table-2), which was found in 4% cases. The minimum circumference was 6cms, found in 4% cases. The maximum percentage ie., 20% cases had shown aortic circumference of 7.8cms and in 16% of cases, a circumference of 7.5cms was noted.

The maximum depth of anterior aortic cusp was noted as 2.3cms which was found in 4% cases, whereas the maximum number of cases i.e., 40% had shown 2cms depth and the minimum depth was noted in 4% cases which was 1.6cms (table-3). The maximum depth of left posterior cusp of aortic valve was found to be 2.2cms in around 4% cases, whereas the maximum percentage of cases i.e., 40% had shown 2cms as a depth of left posterior cusp. The minimum depth in this cusp was noted as 1.2cms, found in 4% cases (table-4). The maximum depth of right posterior cusp was noted as 2.2cms in 8% cases, the maximum number of cases, around 44%, had shown depth of 1.8cms, where the minimum depth was noted as 1.2cms found in 8% cases (table-5).

In 44% cases, total 2 coronary ostia were found, where as in 36% cases 3 ostia and in 20% cases 4 ostia were found (table-6).

Discussion:
Adequate irrigation of the heart depends fundamentally on the good morphological conditions of the right and left coronary arteries. These arteries have the peculiarity of being the only ones filled during the diastolic phase of cardiac rhythm. For this to happen properly, some conditions, such as anatomic integrity of the aortic valve, absence of valvular malformations and anatomic malformations of the coronary arteries that result in a reduction in blood flow to the myocardium, are required.[3-7] Knowledge of location of coronary ostia is im-

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portant for performing successful coronary angiography. The origin of coronary arteries shows great variability. The most frequent variation is the presence of an accessory orifice for the conal artery in the any of the aortic cusps. Other factors may be involved in the possible reduction in coronary blood flow, such as depth of the aortic sinus ostia in relation to the aortic leaflets and the circumference of the annulus of bicuspid valve. [8-11]

Considering the hypotheses formulated by these authors that changes in coronary flow may be due to changes in circumference, depth, and anatomic relations of the coronary ostia, this study aimed at investigating these factors, emphasizing their possible implications in functional order. The aortic circumference plays an important role in adjusting the replaced valve. The mitral annulus undergoes significant geometric changes immediately after aortic valve replacement (F. Mahmood et al, Beth Israel Deaconess Medical Center).[12] Hence, the dimensions of aortic annulus were considered important to understand the changes occurring in the mitral valve post replacement surgeries. Apart from previous literature available on aortic valve, the depth of the aortic annulus was not discussed in detail. The knowledge on depth of the aortic valve may become an important feature to understand aortic regurgitation and valve dysfunction.

Conclusions: The anatomical knowledge on aortic valve is of great importance for performing valve replacement surgeries and depth of the aortic valve may play a crucial role in valvular dysfunction.

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Tables:

Table-1: Mean dimensions of all parameters.

	Total No.	Range	Minimum	Maximum	Mean		Std. Deviation
Mean dimensions (in cms)	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
Circumference of Annulus	25	4.20	6.00	10.20	7.9040	0.1815	0.9076
Depth of Anterior cusps	25	0.70	1.60	2.30	1.9520	0.0379	0.1895
Depth of Left posterior cusps	25	1.00	1.20	2.20	1.8400	0.0461	0.2309
Depth of Right posterior cusps	25	0.80	1.40	2.20	1.8800	0.0383	0.1914

Table-2: Aortic Circumference measured at the annulus.

	Aortic Circumference (cm)	Frequency	Percentage
	6.00	1	4.0
	6.20	1	4.0
	7.10	2	8.0
	7.50	4	16.0
	7.60	2	8.0
	7.80	5	20.0
	8.00	2	8.0
	8.40	2	8.0
	8.50	2	8.0
	8.60	2	8.0
	9.80	1	4.0
	10.20	1	4.0
	Total	25	100.0

Table-3: Depth of the anterior aortic cusp.

Depth of anterior cusp in cms		Frequency	Percentage
	1.60	4	16.0
	1.80	2	8.0
	1.90	2	8.0
	2.00	10	40.0
	2.10	5	20.0
	2.20	1	4.0
	2.30	1	4.0
	Total	25	100.0

Table-4: Depth of left posterior aortic cusp.

	Depth of Left posterior cusp in cms	Frequency	Percentage
	1.20	1	4.0
	1.40	2	8.0
	1.60	1	4.0
	1.70	1	4.0
	1.80	6	24.0
	1.90	3	12.0
	2.00	10	40.0
	2.20	1	4.0
	Total	25	100.0

Table-5: Depth of right posterior aortic cusp.

	Depth of Right posterior Valve in cms	Frequency	Percentage
	1.40	2	8.0
	1.80	11	44.0
	2.00	10	40.0
	2.20	2	8.0
	Total	25	100.0

Table-6: Total number of coronary ostia.

Total No of Ostia	Frequency	Percentage
2.00	11	44.0
3.00	9	36.0
4.00	5	20.0
Total	25	100.0

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