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METHOD OF DETERMINATION OF AORTIC VALVE PARAMETERS FOR ITS RECONSTRUCTION WITH AUTOPERICARDIUM: AN EXPERIMENTAL STUDY

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Determination of aortic valve parameters is essential to fashioning of the pericardial patch. Many previous anatomic studies^{1,2} have been dedicated to this, but the problem persists.

In my previous study,³ I showed that the free margin length of the leaflet (L) has to be 20% more than the corresponding intercommissural distance ($\bar{l}$):

$$L = 1.2 \times \bar{l} \quad (1)$$

In this report I describe the method of determining all other parameters of the leaflets (the height, radius of the attached edge, and the commissural height).

The structure of the aortic root and valve was examined in normal autopsied adult hearts ($n = 20$) of 12 men and 8 women. Mean age was 47.5 years (range 23-63 years). The hearts were prepared for measurements by trimming the ascending aorta to 1 cm above the sinotubular junction. In all cases the leaflets were still intact and the root anatomy was normal. I examined the equilateral triangle of the root, which has the same base as the interleaflet triangle, although its height is equal to the height of the interleaflet triangle plus the commissural height. The leaflets were excised from the root, and the height (16.3 ± 1.68) and free margin length (23.3 ± 2.35) of each leaflet were measured. Then the intercommissural distances (19.25 ± 2.17), the side of the mentioned triangle (19 ± 2.13) of aortic root, and the commissural height (5.6 ± 0.59) of the root were measured. The sizes of the mentioned parameters were taken with the calipers and compared to a ruler (to the nearest 0.5 mm).

The differences between the measured and calculated parameters were assessed by the χ^2 test.

I calculated the mean intercommissural distance ($\bar{l}$) of the root for each heart:

$$\bar{l} = (l_{\text{right}} + l_{\text{left}} + l_{\text{noncoronary}})/3 \quad (2)$$

where l_{right} , l_{left} , and $l_{\text{noncoronary}}$ are corresponding intercommissural distances of the root.

It became obvious that the side (AB) of the mentioned equilateral triangle of the root (19 ± 2.13) was equal to the mean intercommissural distance (19.2 ± 2.11) of this root ($P > .995$) in each case:

$$AB = \bar{l} \quad (3)$$

The height of the equilateral triangle of the root (H_{Δ}) can be calculated as follows:

$$H_{\Delta} = 0.866 \times AB \quad (4)$$

Substitution of equation 3 into 4 yields the following:

$$H_{\Delta} = 0.866 \times \bar{l} \quad (5)$$

I calculated the height of the mentioned triangle for each root using equation 5. It became obvious that the calculated height of this triangle (16.6 ± 1.84) was equal to the directly measured height (16.3 ± 1.68) of the leaflets for each heart ($P > .995$). Thus the height of the leaflets can be determined by equation 5. The attached edge of each leaflet is the hemicircumference. The radius of this edge (R) is equal to the half of the free margin length (L). The mean radius ($\bar{R}$) is calculated for each valve as follows:

$$\bar{R} = \bar{L}/2 = (1.2 \times \bar{l})/2 = 0.6 \times \bar{l} \quad (6)$$

where $\bar{L}$ is the mean free margin length of the leaflet and $\bar{l}$ is the mean intercommissural distance of the root.

I also calculated the radii of the attached edge for each leaflet ($R = L/2$). It became obvious that the mean radius (11.5 ± 1.28) is very close ($P > .995$) to the radius of the attached edge of each leaflet ($R_{\text{right}} = 11.7 \pm 1.24$; $R_{\text{left}} = 11.48 \pm 1.14$; $R_{\text{noncoronary}} = 11.8 \pm 1.19$). Thus the hemicircumfer-

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ence of three leaflets can be assumed to be the same as the mean radius calculated by equation 6.

The mean commissural height ($\bar{K}$) of the aortic root can be calculated as follows:

$$\bar{K} = H_{\Delta} - \bar{R} \quad (7)$$

Substitution of equations 5 and 6 into 7 gives:

$$\bar{K} = 0.266 \times \bar{l} \quad (8)$$

It became obvious that the mean commissural height of the aortic root calculated by equation 8 (5.1 ± 0.56) was very close ($P > .995$) to the directly measured commissural height of the root in each heart (5.6 ± 0.59). Thus equations 5, 6, and 8 let us determine leaflet height, mean radius of attached edge, and mean commissural height, respectively, using only the mean intercommissural distance of the root, which can be easily calculated by equation 2.

Leaflet shrinkage makes direct measurement of the leaflets impossible during the operation. The described method makes possible the determination of all parameters of aortic valve leaflets without their direct measurement during the operation with the use of only the dimensions of intercommissural distances, which can be easily measured after the excision of the diseased valve.

We have performed aortic valve reconstruction (control operations) in 5 cadaver hearts. An aortotomy was used and the native valve was excised. Three intercommissural distances were measured and all parameters for each leaflet

were determined by means of equations 1, 5, 6, and 8. Autologous pericardium was fixed in 0.6% glutaraldehyde solution for 10 minutes.⁴ The cusps were fashioned and marked on the pericardium. The pericardial patch was tailored along the marked line, leaving 2 to 3 mm of tissue for the sutures. The patch was sutured to the semilunar lines of the leaflet attachments with continuous 4-0 polypropylene suture (Prolene; Ethicon, Inc, Somerville, NJ) as described in my previous study.³

Checking the competence of the newly created aortic valves showed complete coaptation of the leaflets with no regurgitant jet. The only prerequisite to this method is the absence of significant distortion of aortic root geometry in hearts with severely diseased valves.

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