PERCUTANEOUS AORTIC VALVE REPLACEMENT

I. Anatomy

The aortic valve is a structure whose function is to direct the flow of blood from the left ventricle into the systemic circulation through the aortic artery. It accomplishes this function by opening during the contraction of the left ventricle and closing when the left ventricle relaxes. The aortic valve is a tricuspid structure and each cusp folds up toward the aorta during the contraction phase and then fold back against each other in the relaxation phase. **(figure 1 show a picture)**. However, the aortic valve is a complex structure with integral relationships beyond merely a three leaflet valve. For instance, each leaflet sits directly opposite an outpouching of the proximal aorta. This dilated segment is called the sinus of valsalva, and it is this anatomic relationship that assists the valve to open and close repetitively while minimizing the stress upon any point within this valvular apparatus. Further, the proximal porion of the aortic valve is highly elastic and with ~~this elasticity it can~~ dilate during the contracion phase of the left ventricle. Historically, it has been theorized that this reduces the amount of work that the left ventricle performs. ~~As with anything in nature it is much more complex.~~ The valvular structures are integrally related to the coronary arteries. The function of the coronary arteries are to supply blood ~~supply~~ to the heart. These, as represented **in figure 2,** are located within 2 of the sinuses. In a normally functioning valve, the cusps open widely to allow the unimpeded transference of blood, and then close tightly ~~not allowing any to regurgitate~~ back into the left ventricle. When there is significant restriction to blood flow, this is called stenosis and when it allows blood back into the left ventricle it is regurgitation. Thus, each component plays a vital role in the function and durability of the valve.

The first components of the valve I would like to discuss are the leaflets. Interestingly, the number of ~~the~~ leaflets within a normal aortic valve does not vary to a significant degree. When there are less than three valves, the valve undergoes rapid stenosis and restriction. Among congenital alterations upon the valve number the most frequently encountered is a bicuspid aortic valve. This condition is the most common defect that is survived into adult hood. However, this valve predictably becomes more and more stenotic and regurgitant by the 4th and 5th decade. Unfortunately, this usually results in the need for surgical replacement. A unicusped valve rarely survives beyond the first year of life **(figures 3 and 4)**. Rarely a quadricusped valve will be shown to survive into adulthood. This design also results in marked stenosis. Further, the cusps are shaped in a defined convexity. This design permits the dispersion of pressure over a larger surface area. This dispersion resists the exhaustion of the valve in any one particular place. Moreover, this curvature allows the leaflet to reverse curvature. An ability needed in order to fold and allow the maximum opening diameter during contraction. Finally, a curved design allows a redundancy in the coaptation site of the leaflets. The area of coaptation is the edge of the valves that must meet and close in order ~~for there not to be~~ regurgitation. Hence, both the number of leaflets and their overall shape is important in the function and durability of the valve.

As mentioned earlier, the valve leaflets have a direct relationship to the sinus's of valsalva. The sinus diameter is almost twice that of the aorta. This cavity plays an important role in the mechanism of valve closure (referenced Mano Thubrikar). An