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# Aortic Valve Surgery

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After successful operations had been done on the mitral valve it was logical that attempts should be made to treat aortic valve disease surgically. Though the problems have been greater here, some progress has been made. At first, blind operations were employed and a few surgeons still defend their use. The transventricular approach of Bailey[1] has been tried by many, and though it has been abandoned by its originator, others[3,4] continue this approach with a modified, less traumatic dialator and report a decreased mortality rate. The blind transaortic approach to the aortic valve, strongly advocated a few years ago, and still used by some,[5] is not widely employed today. As the inadequacy of these blind operations has become more apparent, and as methods for doing open operations have improved, more surgeons have studied and utilized open techniques for the aortic valve.

We have used an open, direct vision operation for over three years and can report that progress has been made both in methods that permit open surgery in this area and in techniques for altering the diseased valve. Certainly, the open approach is more rational than a closed operation, for — in contrast with blind techniques — it permits the surgeon to do a meticulous operation on the diseased valve. Success has been gratifying in selected cases and many more patients with this disease will be benefited in the future.

### Methods For Open Surgery on the Aortic Valve

Hypothermia: The first successful open operations on the aortic valve were done with hypothermia and this may still be the best way to do this type of surgery in some patients. With the patient cooled to 28°C.—30°C. by surface cooling, or a combination of surface and intragastric cooling, the chest is opened through a transverse or midline incision and the heart exposed. After occlusion of the caval and pulmonary inflow, the ascending aorta is occluded just proximal to the inominate artery and then opened with a longitudinal incision extending down to the aortic valve. With this incision a good exposure of the aortic valve is obtained and the fused cusps may be separated accurately with a knife or scissors.

Since our first use of this technique in December 1955[6] we have employed it on eight cases. There were two operative deaths but the other six have shown significant clinical improvement. The operation is best for congenital stenosis in which there is little or no valve calcification and here the results may be dramatic. In acquired stenosis the results may be excellent if there is only minimal valve calcification.

The limited time for the open procedure allowed by hypothermia (8-10 min.) has not seemed restrictive. There is not a great deal to do if the objective of the operation is simply to open the fused commissures accurately. This can be performed in a few minutes. Nonetheless, the short time is a serious limitation if more extensive valve revisions are to be attempted. Furthermore, with hypothermia, the heart may not pump effectively immediately after circulation has been restarted. Additional circulatory support would be desirable at this time, particularly for patients with coronary sclerosis in addition to the aortic valve disease. Recently, in order to permit more time and add circulatory support, we have used a pump-oxygenator plus antigrade coronary perfusion in three operations for aortic stenosis.

Pump-Oxygenator: The pump-oxygenator we have used is a new type of membrane oxygenator which we think has some advantages over other machines.[7] During the by-pass the blood has

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been cooled with a cooling coil to take advantage of the reduced metabolic rate provided by hypothermia.

The ascending aorta is opened to expose the valve and the necessary cusp separation then performed. Here, particularly if a longer period of inflow occlusion is to be used, some coronary perfusion is required. This has been accomplished simply by perfusing into the orifice of the left coronary artery with a cannula attached to a reservoir of heparinized blood hanging 100 cm. above the operative field. When the aortic valve procedure has been completed the heart is filled with blood or saline, the sortic incision is closed, and circulation is resumed. With the pump-oxygenator, valuable circulatory support can be added during the period just after circulation has been restarted. This type of circulatory support also could be provided with pumps alone and no oxygenator. We have been exploring such a system experimentally.

Pump By-Pass: This method of doing open aortic valve surgery without an oxygenator requires two pumps. One pump by-passes the right heart and the other by-passes the left. Blood is drained by gravity from the right atrium into a reservoir and an automatic pump returns this blood to the pulmonary artery. Left atrial blood also drains by gravity into a second reservoir and the second automatic pump returns this blood into a systemic artery. Cannulation is relatively easy and with an automatic pumping system there is no problem in balancing the right and left circulations. This system may prove to be a better method for doing open aortic valve surgery than that provided by the pump-oxygenator.

It is clear that methods for allowing open surgery on the aortic valve will change and improve. Even now, good workable techniques are available and in clinical use. It would seem that the problem of what may be done to correct a deformed valve actually is a more challenging one, yet progress is being made here also.

### Techniques For Correcting Deformed Valves

Surgical accomplishment on the aortic valve depends greatly upon the pathological anatomy of the particular deformity. At present, the only consistently satisfactory results are among patients with minimal valve calcification. Cases of congenital stenosis are of this type and among them results of open valve surgery have been excellent. All that need be done is to divide the commissures accurately. Since the valve is flexible, accurate opening of the commissures will return its function to normal or nearly normal.

In some cases of acquired stenosis, especially among younger adults, the massive calcium deposits that are characteristic of the disease in older patients (60 years of age and older) have not yet developed. Division of the fused commissures may be effective among these patients and lead to an excellent result. The degree of success is inversely correlated with the amount of calcium present in the valve.

A formidable surgical problem is presented by valves with very heavy calcium, no remaining flexibility, and a small amount of regurgitation added to the stenosis. We would be inclined at present to forego surgery when the situation can be satisfactorily identified preoperatively. Special X-ray studies may be helpful in this respect. Some surgeons continue to use a blind transventricular operation in these cases. Because they do not often see the results of their work, many fail to realize how little can be accomplished in this type of lesion with simple mechanical dilatation. Other surgeons are trying to excise this calcium and to make some sort of plastic reconstruction of the remaining valve. For the future, and this is the possibility that continues to intrigue cardiac surgeons, it may be possible to remove the stenosed valve and replace it with an artificial valve. Despite the tremendous amount of interest in this possibility, replacing a stenotic valve with a satisfactory artificial one has not yet become feasible. It is a difficult region in which to place a prosthesis and a valve placed accurately may not remain exactly in the same position and continue to function as it was intended to. For the present and immediate future the concept of a plastic revision of the valve tissue is more attractive than that of putting in a new valve. This concept of a plastic revision also has merit in the surgical treatment of aortic insufficiency.

Aortic Insufficiency: For insufficiency, the most attractive new idea is that of removing or defunctionalizing the noncoronary cusp to convert the aortic valve into a bicuspid structure. In this procedure the circumference at the valve is reduced by one-third, thus decreasing the area at the valve orifice to approximately four-ninths the original area. As only one leaflet is removed

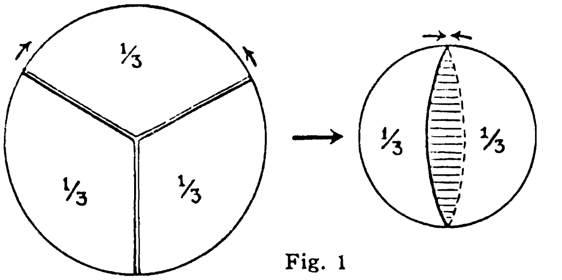


Fig. 1

Orifice area = 1 Orifice area = 4/9
Leaflet area = 1 Leaflet area = 2/3

**Figure 1: Diagrammatic illustration of the relative changes in valve and orifice areas produced by bicuspidization of the aortic valve.**

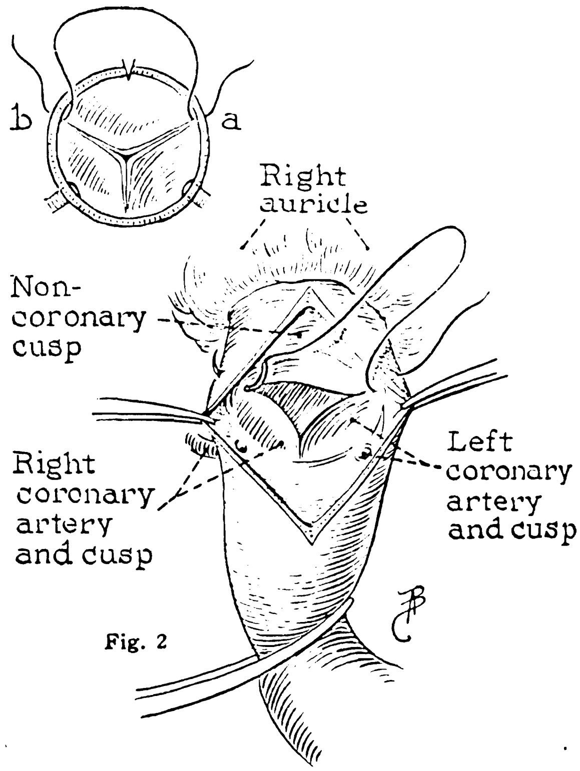


Fig. 2

**Figure 2: Illustration of the technique for bicuspidization of the aortic valve. The upper figure shows a cross-sectional view of the placement of the first stitch which defunctionalizes the non-coronary cusp. The larger figure shows the actual appearance of the operative field.**

or defunctionalized, the area of available valve tissue remaining should be two-thirds of the original valve, resulting in a gain in the amount of valve in relationship to the orifice size (Figure 1). Because the ultimate anatomic deficiency in many forms of aortic regurgitation is a disparity between leaflet area and valve orifice area, this operation may have considerable applicability in treating clinical valvular insufficiency. The ideal case would be one in which the valve leaflets and the annulus are not heavily calcified.

The details of aortic bicuspidization are shown in Figure 2. A linear incision is made in the aorta and extended into the non-coronary sinus of Valsalva. Under direct vision, the annulus of the noncoronary cusp and a sliver of the adjacent aorta is removed and a bicuspid valve is reconstructed. Approximately 10 minutes of open cardiac time are required.

In experimental animals, the procedure is attended with a low mortality (less than 10 per cent). There is no immediate or delayed evidence of insufficiency. The relative aortic stenosis produced by valve bicuspidization is well tolerated. A recent report by Bailey indicates that the principle of aortic valve bicuspidization has been tested in the treatment of patients with aortic insufficiency with encouraging results.[2]

#### Importance of Accurate Diagnosis

Until the surgeon can repair satisfactorily almost anything he encounters in the aortic valve, accurate diagnosis is essential. Through the use of new and complex techniques, considerable improvement has been made in the ability to make a precise diagnosis. With combined right and left heart catheterization, a sound evaluation of the degree of stenosis is possible. Insufficiency is more difficult to evaluate but methods for making this diagnosis are much better than they were. X-ray studies give the only method for distinguishing the amount of calcium present and these methods are now fairly reliable. When cardiac catheterization and a careful X-ray examination are added to the clinical evaluation, a sound recommendation to offer or withhold surgery can be made.

#### SUMMARY

1. In preference to the blind transventricular or transaortic approaches to the aortic valve, we favor an open operation that allows the surgeon to see the aortic valve.

2. There are three techniques by which open operations can be done on the aortic valve: hypothermia, pump-oxygenator, or a pump system without the oxygenator.

3. Surgery is effective in relieving congenital aortic stenosis and acquired stenosis in which

valve calcification is not heavy. At present, surgery is unsatisfactory for the heavily calcified valve.

4. For aortic insufficiency, the most promising new operation is one in which one cusp is removed to convert the valve into a bicuspid valve.

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## Methamphetamine for epilepsy

Methamphetamine sulfate and probably other amphetamines should be considered as an adjunct in the management of seizure patients manifesting nocturnal epileptic attacks. A report in the literature of one patient with nocturnal seizures controlled with Benzedrine is in accordance with our observation. Since our preliminary work suggested aggravation of diurnal seizures by methamphetamine, no attempt was made either to give this drug during the day or to withdraw the previous medication, except in two cases. It was found of advantage to administer the drug just prior to the time the patient falls asleep. It has been our experience that patients with nocturnal seizures rarely complain of any disturbances in the pattern of sleep if the drug is administered in this manner.

The electroencephalographic changes in the majority of our patients, characterized by bilateral paroxysmal patterns, suggest the presence of deep-seated epileptogenic lesions discharging to both hemispheres. We were unable, however, to distinguish any electrical abnormality pathognomonic for nocturnal epilepsy.

The mechanism by which amphetamines are effective in treating nocturnal seizures, as well as the possible pathophysiologic patterns involved in nocturnal epilepsy, were discussed extensively in our preliminary report. As more recent studies indicate, the site of action of amphetamines appears to be at the brain stem reticular activating system. It is possible, therefore, that the indirectly induced dissynchronization of electrocortical activity by stimulation of the activating reticular system by the amphetamines, produces a lighter sleep and consequently maintenance of cortical inhibition over subcortically-arising epileptic discharges. *John Logothetis, M. D. Methamphetamine Sulfate in the Treatment of Nocturnal Epileptic Seizures. Minnesota Med. March 1959.*