Volume 86, Number 3 *September 1983*

The Journal of THORACIC AND CARDIOVASCULAR SURGERY

J THORAC CARDIOVASC SURG 86:323-337, 1983

Honored Guest's Address

Cardiac valve surgery—the "French correction"

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Mr. President, I would like to begin by expressing my gratitude to the Association for the priviledge of presenting the Honored Guest Lecture at the Sixty-third Annual Meeting of The American Association for Thoracic Surgery. What surprises me the most in this meeting is my presence on this podium, since this honor is usually reserved for more senior and preeminent figures in thoracic surgery. I suppose that you wanted to distinguish a team rather than a man, so that I would like to share this honor with my co-workers who are present in this room: Drs. Deloche, Fabiani, Chauvaud, Relland, Lessana, Lapeyre, Mrs. Chauveau, Mrs. Menissier, Mrs. Veneziani, and with my wife, Sophie, who has participated in my laboratory work throughout the years. I also would like to pay special tribute to my respected teacher, Professor Charles Dubost, and to mention my two colleagues, Professors Blondeau and Claude d'Allaines, who are unfortunately not with us today.

Members of the Association, in the past 14 years, I have attended the annual meeting of your Association 14 times with the priviledge of having presented a paper 10 times. All through these years, wearing a pink identification badge, I observed with great admiration and respect the famous people wearing a white printed badge and seated in a carefully delineated area of reserved seats! Permit me to tell you how proud I am to enter your prestigious circle.

Guests, you are seated outside this circle, but only temporarily! I address you specifically, since you represent the future of thoracic surgery and the future of this august Association.

Members and guests, cardiac surgery has achieved remarkable progress in the past 10 years. Safer techniques of anesthesia and postoperative care, improved extracorporeal circulation and myocardial protection, and sophisticated surgical techniques are new tools which have been instrumental in reducing hospital mortality and increasing the efficiency of our operations. New surgical tools impose new surgical goals. Its not enough to save patients' lives; we must also take into consideration the quality of life given to the patient and the socioeconomic impact of our surgical actions. There already have been some trends in this direction, such as operating for congenital malformations at an earlier stage and the development of reconstructive operations to replace palliative techniques. Reconstructive valve surgery can very well be considered another example of this *nouvelle chirurgie* which justifies making it the subject of today's lecture.

Since everything we do in life has some visible or obscure relationship to the environment in which it

From Hôpital Broussais, Paris, France.

Read at the Sixty-third Annual Meeting of The American Association for Thoracic Surgery, Atlanta, Ga., April 25-27, 1983

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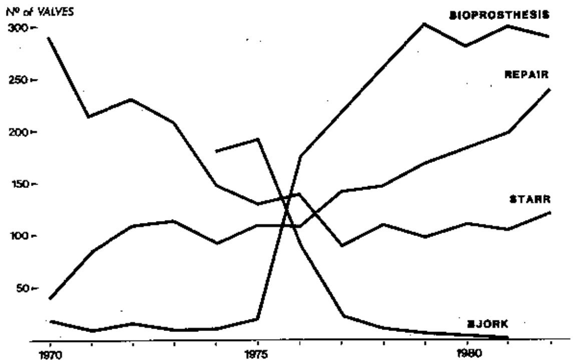

Fig. 1. Mitral valve procedures per year used at the Hôpital Broussais from 1970 through 1980 (see text).

develops, I would first like to say a few words about my place of work, its people, and its activities. Hôpital Broussais is situated on the left bank of the Seine River in Paris not far from the Latin Quarter, where are concentrated most of the universities and reputed schools. It is a medium-sized hospital of 732 beds specializing in cardiovascular diseases. Cardiac surgery is located in a six story building named Clinique Leriche, which was built in 1960 from private funds raised at the instigation of Professor François de Gaudart d'Allaines, who became the first chief of service and was followed by Professor Charles Dubost from 1964 to 1982. Clinique Leriche comprises 100 beds, five operating rooms, a 16 bed intensive care unit, five full-time surgeons, one part-time surgeon, three senior residents, five residents, seven foreign residents, 12 anesthesiologists (who also take care of the intensive care unit), seven part-time cardiologists, 162 nurses, one research laboratory, six sheep, and 200 rats.

With these facilities, the Clinique accommodates slightly more than 2,000 cardiovascular operations per year with an average of seven to nine operations per day. Valve operations represent 46% of the activity, coronary artery operations 28%, congenital procedures 11%, and major vascular procedures 15%, with hospital mortalities of, respectively, 4%, 4.2%, 3.9%, and 4.1% in the past year.

The surprisingly high proportion of valve disease is explained by a selective referral of patients from our cardiologists as well as by the great number of foreign patients, in particular those from North Africa, Italy, and various other Mediterranean countries in which rheumatic fever has not been completely eradicated (Table I). Degenerative valve disease is being seen with increasing frequency in other European countries such

Table I. *Mitral valve diseases*

Etiology		*Incidence (%)*
Rheumatic		60
Degenerative		21
Barlow's disease	11	
Fibroelastic deficiency	9	
Marfan's disease	1	
Congenital		13
Bacterial endocarditis		4
Ischemic		2

as France and particularly in elderly patients. Bacterial endocarditis is also seen with increasing frequency.

The broad geographic origin of our patients (some coming from areas where adequate anticoagulation is not possible), the young age of many of them, and the specific risks associated with anticoagulation stimulated our interest in nonthrombogenic techniques, which in turn led us to an eclectic use of the various types of valve operations.

Fig. 1 traces the evolution of our policy during the past 12 years with regard to the use of mitral valve reconstruction, bioprosthetic valve replacement, and mechanical valve replacement. As seen in Fig. 1, during 1975 and 1976 the use of these four techniques depended upon the preference of the individual surgeon. Utilizing these patients, Perier[1] compared the results of four series of 100 consecutive patients at 7 to 8 years (Fig. 2).

Our current indications for reconstructive valve operations vary according to the valve orifice involved: mitral, tricuspid, or aortic.

Mitral valve disease and reconstruction

The great pathologist Maurice Lev once stated, "Mitral valve diseases are like women; the more you study them the less you understand them!" I do not share his opinion, at least with regard to the valves. It is true that the variety of diseases and the complexity of the lesions which affect the mitral valve render the analysis of valve pathology difficult and consequently also the indications for valve reconstruction. This already complex situation has been further complicated by an extreme confusion in the terminology used by various authors and by our own early contributions. Between 1968 and 1978, I thought it was necessary to carefully describe the numerous mitral valve lesions that were encountered and to develop various techniques adapted to these lesions. My co-worker, Dr. Chauvaud,

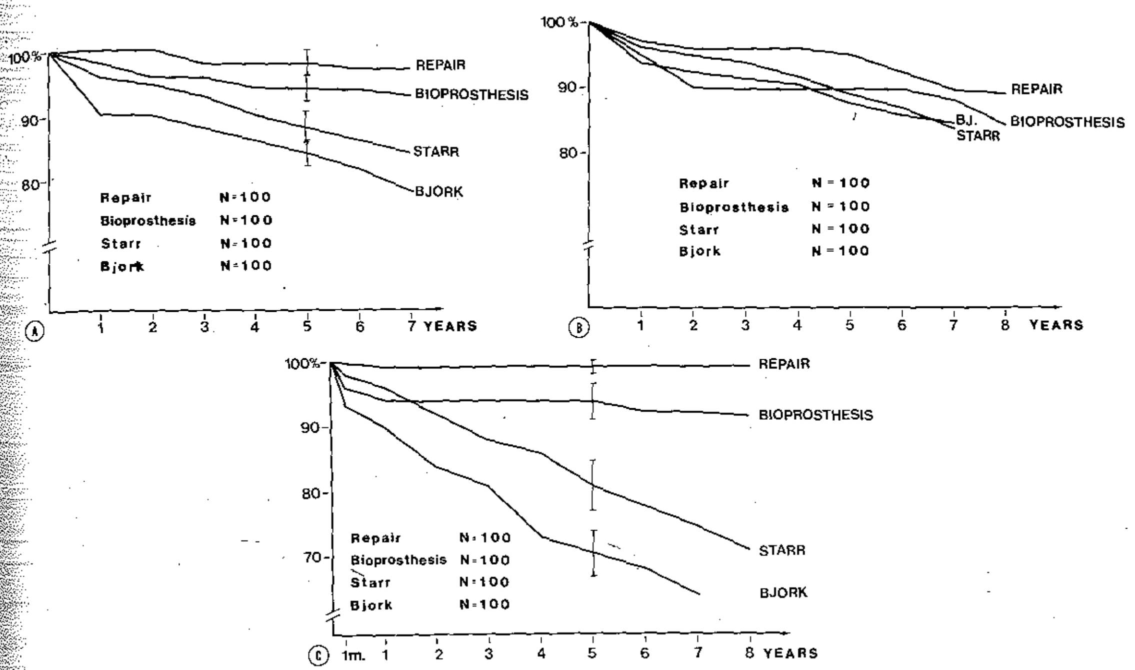

Fig. 2. Comparative evaluation of four different procedures for mitral valve surgery consecutively performed at the Hôpital Broussais between 1974 and 1976. *A,* Valve-related mortality. *B,* Freedom from reoperation. *C,* Freedom from thromboembolism.

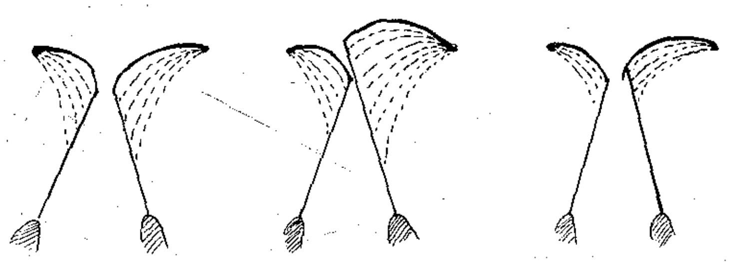

Fig. 3. Physiopathological classification. Diagrammatic representation. Drawings represent a mitral valve apparatus with the mural leaflet *(left),* the anterior leaflet *(right),* two papillary muscles, and the chordae. *Dotted lines* represent the course of the leaflets between opening and closing positions.

and I described no less than 10 acquired and 14 congenital valve lesions. The complexity of both the lesions and the techniques was a deterrent to their widespread use. This led us to approach the problem from a different angle by disregarding the lesions and concentrating on the function of the valve apparatus.

The "functional approach." Surgeons are not basically concerned with lesions. We care more about function. Therefore one may define the aim of a valve reconstruction as restoring normal valve function rather than normal valve anatomy. This functional approach has led to a significant simplification. There are only two functional anomalies: The opening and closing motions of each leaflet are either increased as with *leaflet prolapse* or diminished as with *restricted leaflet motion* (Fig. 3).

Leaflet prolapse is present when the free edge of the leaflet overrides the plane of the orifice during systole. This condition must be clearly separated from the billowing valve described by Barlow, in which excess

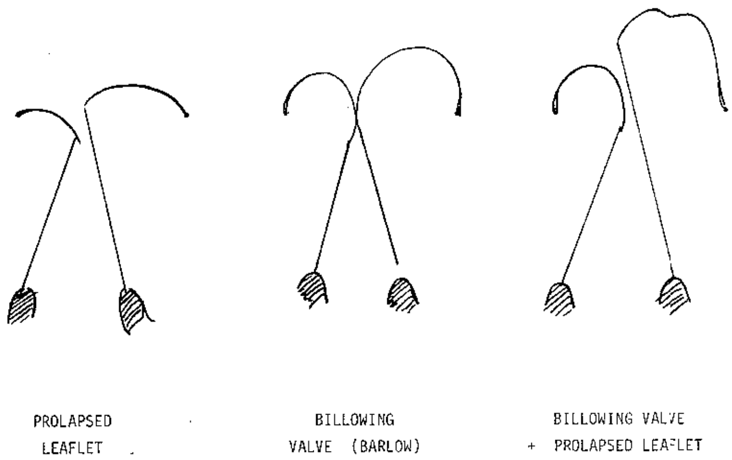

Fig. 4. Nosologic definition of prolapsed valve, billowing valve (Barlow), and prolapsed billowing valve (see text).

Table II. *Types of valve diseases*

Type	*Description*
Type I	Normal leaflet motion
	Annular dilatation
	Leaflet perforation
Type II	Leaflet prolapse
	Chordal rupture
	Chordal elongation
	Papillary muscle rupture
	Papillary muscle elongation
Type III	Restricted leaflet motion
	Commissure fusion, leaflet thickening
	Chordal fusion/thickening

leaflet tissue protrudes into the atrium during systole with the free edge of the leaflets remaining in apposition below the plane of the mitral valve anulus. Note that a prolapse may complicate the course of a billowing mitral valve (Fig. 4).

The term "restricted leaflet motion" defines a condition in which a leaflet does not open normally during diastole. Leaflet prolapse and restricted leaflet motion may be associated. Each may affect one of the two leaflets; for example, prolapse of the anterior leaflet combined with restricted motion of the posterior leaflet.

Valve analysis is simplified with the functional approach, since it is necessary only to determine whether the motion of each leaflet is normal (type I), prolapsed (type II), or restricted (type III). This classification is helpful in recognizing the lesions that produce this dysfunction (Table II). Thus prolapsed leaflet may result from chordal rupture or elongation or from papillary muscle rupture or elongation. Restricted leaflet motion may result from commissural fusion, leaflet thickening, chordal fusion, and/or chordal thickening. Several lesions are usually associated. When the motion of the two leaflets is normal, mitral valve incompetence may be due to leaflet perforation or pure annular dilatation. I will follow this classification in describing the various steps of the operation and the various techniques used.

Exposure. Adequate exposure is a fundamental requirement and a sine qua non condition for the operation. The patient is cooled to 22° C. Once the heart fibrillates, the left atrium is opened without cross-clamping the aorta. The left atrial incision should extend posteriorly beneath both venae cavae. A self-retaining retractor is used for optimal exposure of the mitral valve. Whenever necessary, the papillary muscles are exposed by placing a laparotomy pad within the pericardial sac and/or by traction on the base of the papillary muscle.

Valve analysis. Valve analysis requires the surgeon to be technically and psychologically prepared to perform a valve reconstruction rather than a valve replacement and therefore to be ready to spend a few minutes to carefully examine the valvular apparatus. There may be some exceptions to this rule, as I experienced some years ago. I was invited to the Texas Heart Institute to give a lecture on valve reconstruction. After the lecture, Denton Cooley invited me to watch him operate upon a patient with mitral valve insufficiency. He opened the atrium in 2 seconds, took out the valve in another 2 seconds, and then, with the valve in his hand, said: "Let's see what we can do to repair this valve, now." For mere

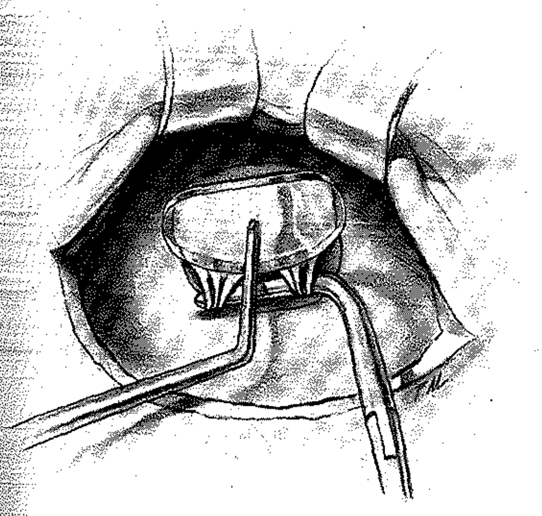

Fig. 5. Ring selection is based on the measurement of the surface area of the anterior leaflet (see text).

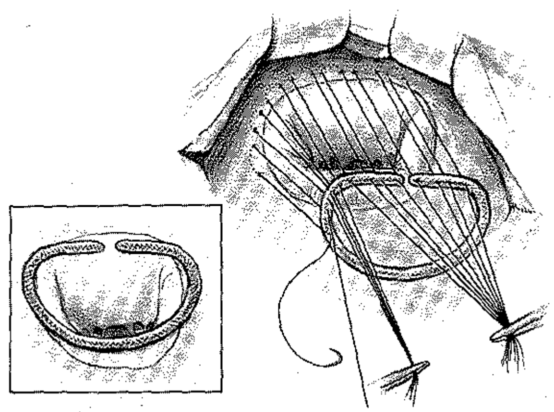

Fig. 6. Annular remodeling using prosthetic rings. The prosthetic ring restores not only the size but also the shape of the orifice *(inset)*.

ordinary surgeons such as myself, valve analysis requires more time and should be carried out step by step. First, the atrium is examined to determine whether a jet lesion is present, which would indicate a prolapse of the opposing leaflet. The anulus is evaluated for annular dilatation, which is most common. The leaflet tissue is then mobilized with a nerve hook to assess leaflet pliability and to check for leaflet prolapse or restricted leaflet motion. Precise measurement of leaflet prolapse may be obtained by the "reference point" method. Exerting traction with a nerve hook on different points of the free edge of the leaflets makes it possible to find a nonprolapsed area, usually on the mural leaflet adjacent to the anterior commissure. With this as a reference point, it is possible to measure the degree of prolapse of other areas: the anterior half and posterior half of the anterior leaflet and the middle scallop and posterior scallop of the mural leaflet. Precise measurement is facilitated by using a prolapsemeter, which has recently been designed for this purpose.

Techniques of repair.

Prosthetic ring annuloplasty. Prosthetic ring annuloplasty is one of the major steps of valve reconstruction and is mandatory in almost all cases of mitral valve insufficiency. Two important characteristics separate this technique from other types of annuloplasty. First, the annuloplasty is based on precise measurement of the valve apparatus so as to restore an optimal orifice area. Second, the prosthetic ring restores not only the size but also the shape of the orifice, so that stenosis, leaflet plication, and resultant valve dysfunction are avoided.

Proper ring selection is based on measuring the surface area of the anterior leaflet with sized obturators after unfurling the leaflet by means of a right-angle clamp passed around the major chordae of the leaflet (Fig. 5). Ring implantation is achieved with 2-0 Tevdek mattress sutures placed through the anulus 1 to 2 mm outside the junction between the leaflet and the atrium and then through the sewing ring. Two pilot mattress sutures should be placed on either side of the middle of the attachment of the anterior leaflet. Suture placement is facilitated by firmly grasping the body of the leaflet tissue with tissue forceps. Sutures are passed through the prosthetic ring with care taken to match them adequately. The same space interval must be maintained between sutures of the anterior leaflet and the corresponding portion of the prosthetic ring. Spacing is reduced for sutures of the posterior leaflet and the commissures (Fig. 6). The ring is lowered into position and the valve is tested before the sutures are tied. Saline is injected into the ventricular cavity through the valve with a bulb syringe after the aortic root has been vented to prevent air embolism into the coronary arteries (Fig. 7). Repair is judged to be satisfactory if the line of leaflet closure is parallel to the mural part of the ring, since this indicates a good apposition of the leaflets (Fig. 8). An asymmetric line of closure means that some leaflet prolapse or restricted leaflet motion persists. Remaining anomalies can still be corrected at this time by pulling up the ring.

Repair of mural leaflet prolapse. Prolapse of the mural leaflet, whether the result of ruptured chordae or elongated chordae, is treated by *extensive rectangular resection* of the prolapsed portion, annular plication in

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