Aortic Valve Annuloplasty: New Single Suture Technique

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Reconstruction strategies for aortic valve insufficiency in the presence of aortic annulus dilatation are usually surgically challenging. We demonstrate a simple, modified Taylor technique of downsizing and stabilization of the aortic annulus using a single internal base suture.

Different techniques have been described to correct aortic valve insufficiency (AI) [1–3]. Shortening the free margin of the leaflets, plication, and triangular resection are used to repair aortic valve leaflet prolapse. Aortic valve annuloplasty methods currently proposed using external or subvalvular rings and strips are infrequently applied. We demonstrate a simple, modified Taylor technique [3] of internal suture running around the leaflet attachment line. To facilitate precise interpretation of the technique described we applied nomenclature of the aortic root components according to Sievers and colleagues (Fig 1) [4].

Technique
Prior to surgery, patients with AI underwent transesophageal echocardiography (TEE) to assess aortic valve morphology. Patients with moderate or severe central AI but without moderate or severe valve calcification were scheduled for aortic annulus reconstruction.

After aortic cross-clamping and aortotomy, the aortic valve diameter was measured using the standard Hegar dilator (Aesculap, Tuttlingen, Germany). The largest possible dilator passing through the aortic valve was defined as its diameter.

The aortic annulus was reconstructed using a single CV-3 GoreTex suture (W. L. Gore and Associates, Flagstaff, AZ) characterized by its extraordinarily smooth surface, breaking strength, and resistance to stretch forces proven in the mitral valve neochordae reconstruction. The suture, reinforced with a single Teflon pledget, was started near the middle of the noncoronary sinus nadir immediately above the leaflet attachment passing out-in the aorta. Subsequently, in the distance of about 3 to 4 mm the tip of the needle was positioned above and perpendicular to the leaflet attachment line and advanced through the aortic wall, exiting underneath the leaflet attachment line. Afterward, similarly in the distance of 3 to 4 mm toward the commissure, the needle was passed perpendicularly down-up through the leaflet attachment line. In the same manner the suture passed the entire circumference, being placed in turn above and underneath the leaflet attachment line (Fig 2A). At the level of the commissure the suture passed through the interleaflet triangle and at the level of the sinus nadir the suture was placed above the leaflet attachment. The suture ended in the noncoronary sinus running finally in-out the aorta and through the Teflon pledget (Fig 2B). When the circumferential suture was completed, the Hegar dilator (10% to 15% smaller than the previous aortic diameter depending on the valve morphology) was placed in the aortic annulus and the suture was pulled tight and knotted, increasing the coaptation of aortic valve leaflets. To restore the aortic valve symmetry, the distribution of the suture was corrected using a nerve hook after removing the Hegar dilator. The suture should distribute equally within the 3 sinuses (Fig 3). Finally, concomitant common surgical procedures to correct the eventual aortic valve prolapse or other procedures (supracorony ascending aorta replacement, coronary artery bypass grafting, mitral valve repair, etc) were performed as necessary.


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16 patients and demonstrated constant results in all but 2 patients whose AI increased by 1 grade. There have been no reoperations for aortic valve insufficiency and no deaths.

Comment

Different concepts of an annuloplasty approach have been proposed. Prosthetic material close to leaflets may potentially lead to inflammatory process and aortic leaflets restriction. The implantation of external devices carries the risk of injury to the coronary arteries, or restriction. These limitations of prosthetic annuloplasty devices result in their infrequent use, and they may provide an argument for a cardiac surgeon to replace a diseased but potentially reparable valve.

In 1958, Taylor and colleagues [3] were the first to describe the concept of externally (without opening the aorta) tightening the aortic valve to reduce AI. The use of a circular suture annuloplasty was also described by Aicher and colleagues [5]. We propose to perform the annuloplasty not in the annulus, which is below the nadir of the sinuses of Valsalva and does not refer to any anatomic or histologic distinct structure [6], but in the level of the semilunar leaflet attachment line. This area consists of dense fibrosis tissue, which mechanical stability is underlined by the fact that it is the anatomic structure where the sutures, in case of aortic valve replacement, are placed once the diseased leaflets are excised. Just a low grade of downsizing of the aortic valve in this level allows gaining the same effect as with the suture placed in the aortic annulus, which being dipper than the valve leaflets must be tied more significantly to effectively increase the cusps’ coaptation surface.

Since the suture passes at the level of the commissures through the interleaflet triangles and at the level of the sinus nadir is placed above the leaflet attachment, the suture’s main force is vectored on the horizontal and not
the vertical level. Thus, this technique does not alter the aortic root geometry in terms of raising the cusps or closing the commissures only. It results by increasing the cusps’ coaptation surfaces and stabilizing the aortic valve fibrous skeleton. Stitching the area of the leaflet attachment consisting of dense fibrosis tissue prevents suture tearing out of the aortic wall. The Hegar dilator enabled us to achieve precisely the required diameter and to prevent aortic valve stenosis. Our technique is not time-consuming and it has been free of coronary artery complications. It requires no foreign material come into contact with the blood stream. Moreover, it is an inexpensive, speedy, and easily learned technique applicable during elective and emergency surgical interventions. Limitations of our results are the small cohort size and lack of long-term follow-up results.

We believe that this is a useful supplement to our surgical armamentarium in this era of technically sophisticated surgical procedures for aortic annuloplasty. Nevertheless, in patients with additional leaflet disease (in addition to annulus dilatation) leaflet reconstruction techniques have to be added as necessary.

References