

Use of Barbed Suture in Robot-Assisted Mitral Valvuloplasty

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Robot-assisted annuloplasty using a mitral band has a major issue: suturing is time consuming because knot tying is performed mechanically under endoscopic view. We suture the mitral band to the native valve by running sutures using the V-Loc barbed suture nonabsorbable wound closure device (Covidien, Mansfield, MA) with 3-0 monofilament. This technique allows rapid suturing of the band to the valve. Although conventional

interrupted sutures leave multiple knots protruding on the band, using the V-Loc eliminates the need to tie surgical knots and leaves a clean surface, which may potentially reduce the risk of thrombogenesis. This method is highly useful for robotic mitral annuloplasty.

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Robot-assisted mitral annuloplasty is gaining popularity. However, a problem with the robotic procedure is that suture of the annuloplasty band to the valve is time consuming. Previous studies have attempted to shorten the suture time by using the U-clip (Medtronic, Minneapolis, MN) [1, 2], but the U-clip is no longer commercially available. Therefore, surgeons generally have to return to the conventional interrupted suture, tying single knots using a knot pusher through a minithoracotomy by an assistant or by the console surgeon. Although continuous running suture using monofilament is possible, this method is not widely used due to various disadvantages, including slackness of the sutures.

In an attempt to improve the suture technique in robotic mitral valve annuloplasty, we suture the band to the mitral valve by running suture using the V-Loc polybutester (PBT) nonabsorbable wound closure device (Covidien, Mansfield, MA), a recently launched monofilament suture with unidirectional barbs (Figure 1). We report the favorable results obtained using this device.

Technique

We use the da Vinci surgical system (Intuitive Surgical Inc, Sunnyvale, CA) to perform total endoscopic mitral annuloplasty through 5 ports. Leaflet resection is conducted for prolapse of the posterior leaflet, whereas a loop technique [3] that uses premeasured expanded polytetrafluoroethylene (ePTFE) loops to replace diseased chordae is performed for anterior leaflet lesion. Then, an

annuloplasty band (ATS Medical Inc, Minneapolis, MN) is sutured to the valve annulus. Suturing is done using the V-Loc polybutester nonabsorbable wound closure device with a 3-0 needle. The suture is cut to a length of 10 cm, a double knot is tied at the end, and stitch is started from the side of the anterior commissure. The needle is inserted into the ATS band, then into the fibrous trigone, and back into the band. Continuous suturing proceeds as shown in Figure 2.

At the middle of the mitral annulus on the P2 side, suturing is temporarily ceased. Next, stitching is restarted from the trigone on the posterior commissure side, using a second V-Loc suture, and proceeds in the same manner. At the center of the band, the 2 sutures are back-stitched and passed through the ATS mitral band to finish suturing.

After testing for regurgitation, the left atrium is closed and air is evacuated. Terminal warm blood cardioplegia is administered, and the aorta is declamped. The operation is completed.

The technique was used in 10 consecutive patients (7 men, 3 women; mean age 58.0 ± 13.9 years) with severe regurgitation and compared with 24 patients in whom the conventional interrupted suture using monofilament 2-0 Pronova (Ethicon, Irvine, CA) was performed by the console surgeon. The aortic cross-clamp time and the suturing time were, respectively, 101.0 ± 19.5 minutes and 28.8 ± 4.5 minutes for the conventional method and 88.5 ± 37.5 minutes and 13.3 ± 1.9 minutes for the V-Loc method. Both times were significantly shortened ($p < 0.05$) using the V-Loc device. The mean difference was 12.5 minutes for the aortic cross-clamp time and 15.5 minutes for the time required for suturing.

Comment

In a total endoscopic robot-assisted mitral valve repair, suturing the native annulus to the artificial ring by

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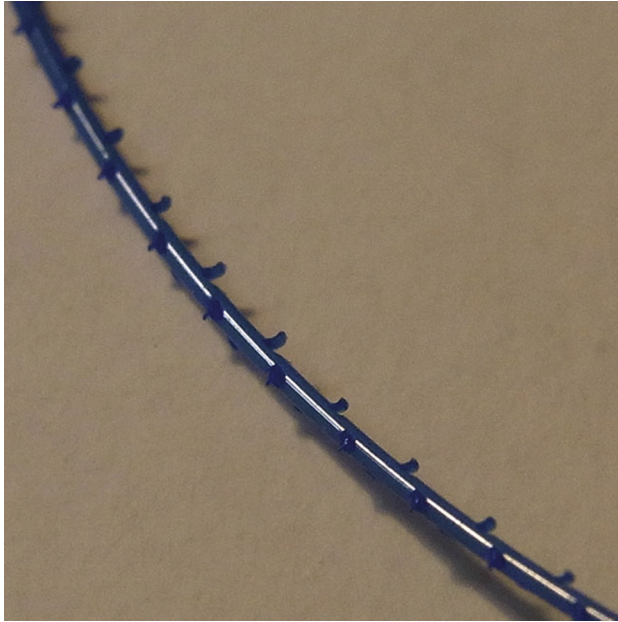


Fig 1. The barbed suture of the V-Loc (Covidien, Mansfield, MA) nonabsorbable wound closure device.

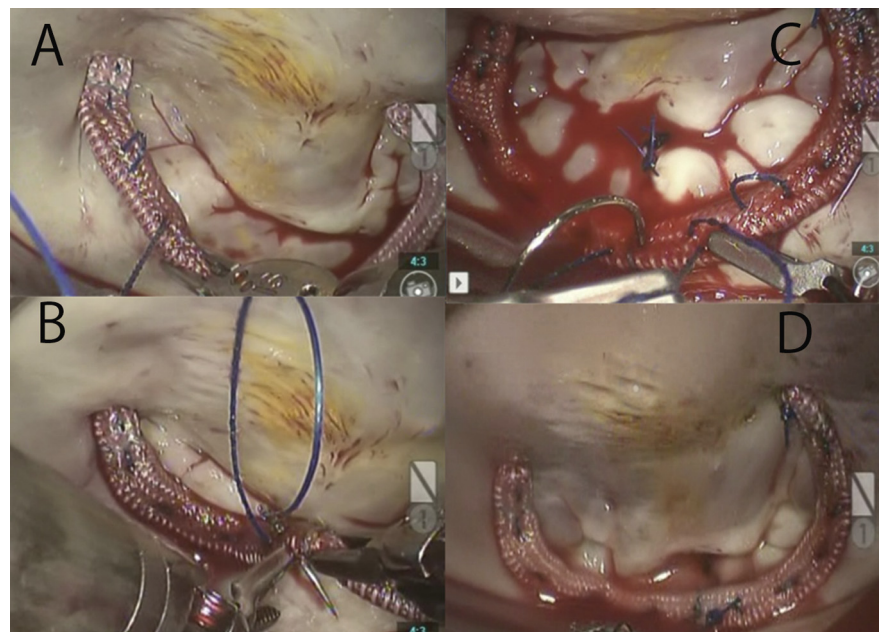
performing single interrupted sutures using 2 robotic arms requires considerable time. As an alternative to this technique, 100S U-clips were used [1, 2]. Although this method shortened the aortic cross-clamp time, U-clips are no longer commercially available, and the prospect of future availability is uncertain. We therefore attempted to suture the valve annulus using monofilament running suture. However, when we used the conventional

monofilament, the suture became slackened during the process of suturing, resulting in separation of the annuloplasty ring from the tissue and other complications. This method was therefore abandoned.

With launching of the V-Loc nonabsorbable wound closure device to the market, we considered applying this device to suture the annuloplasty ring using running suture. The V-Loc device consists of a monofilament with barbs along the entire length of the thread, which allows the thread to advance in one direction only. The monofilament has the characteristic that once stitched into tissue, the barbs stop the thread from retreating and therefore prevent slackening. Moreover, the artificial ring is covered with fibers. Once the V-Loc thread passes through the ring, the stitch cannot be pulled out in the opposite direction; thus, knot tying is not required. These features reduce the time taken to suture the artificial ring. The results of this suture method were highly satisfactory, achieving adequate closure of the ring without ring loosening. Moreover, although interrupted suturing leaves knots of the thread protruding on the left atrial side, use of the V-Loc device yields a smooth, extremely clean surface after the operation, which may potentially reduce the risk of postoperative thrombus formation in the atrium.

Importantly, the suturing time is shortened. Using the V-Loc continuous suture technique, the aortic cross-clamp time was reduced by an average of 12.5 minutes compared with the interrupted suture technique. In robotic surgery, shortening of cardiac arrest time is highly significant. This method has the advantage that it allows the complicated valvuloplasty procedure to be done with a greater margin of safety. Surgical evaluation indicates that this technique is very

Fig 2. Procedures of performing running suture using the V-Loc nonabsorbable wound closure device (Covidien, Mansfield, MA). (A) After repair of the posterior leaflet, suturing is started from the left trigone. (B) The annulus of the posterior leaflet is sutured. (C) Suturing is restarted from the right trigone. (D) The sutures are tightened. The procedure is completed.



safe and efficacious, although long-term follow-up of the patients is essential.

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