

External Plication of the Atrialized Right Ventricle in the Repair of Ebstein's Anomaly



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We describe a change in our technique for plication of the atrialized right ventricle during a Cone repair. The plication was performed from the “Outside”—on a beating heart. Advantages expected from this change are—all major coronaries are better seen when full of blood and can be avoided, if a major vessel is compromised—electrocardiography changes should point it out immediately, there is a small but significant saving in terms of arrest time and if the plication needs to be taken down because of an adverse coronary event—this can be done without the need of another cardioplegia.

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INTRODUCTION

In Ebstein's anomaly, a delamination error of the tricuspid leaflets leads to a downward displacement of the posterior and septal leaflets below the true tricuspid annulus. The right ventricle (RV) that remains above the new functional annulus is thinned, dyskinetic, and dilated—atrialized RV. During right atrial contraction, this atrialized RV acts as a capacitance chamber, which decreases the blood volume available for RV ejection. Therefore, most techniques for the repair of this anomaly (Danielson, Carpentier, or Cone Repair) involve some form of plication of the atrialized RV and this plication is performed from within the heart working through an atriotomy. RV plication, in this way, may interrupt some coronary arteries and may lead to a kink in the right coronary artery (RCA) that can lead to arrhythmias, decrease in ventricular function, and adverse outcomes.^{1,2}

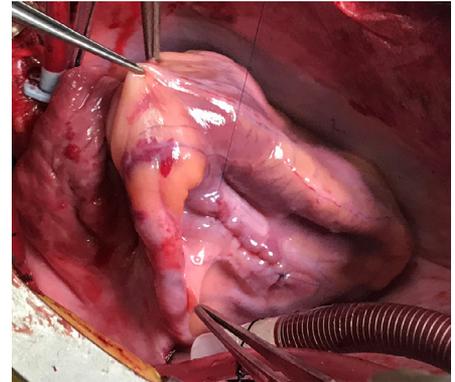
Our technique of plicating the atrialized RV, from the outside, on a beating heart evolved from our experience when we noticed that in most patients, the extent of the atrialized ventricle was easily visible externally on a beating heart and extended from true to the functional tricuspid valve (TV) annulus. Additionally, all major coronaries were easily visible when and distortion or compromise of any major branches could be avoided if the plication was performed on a beating heart.

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Repair of Ebstein's anomaly—plication of atrialized RV from “Outside”—on beating heart.

Central Message

Plication of the atrialized right ventricle from the “Outside”—on a beating heart, in repair of Ebstein's anomaly, helps avoid all major coronaries and decreases cardioplegic arrest time.

TECHNIQUE

Intraoperatively, the thinned out, triangle-shaped dyskinetic RV segment and nearby coronary arteries were identified before cardiopulmonary bypass. This is usually an inverted triangle (Fig. 1). The apex of triangle marked the distal extent of atrialized ventricle (functional TV annulus), the base is formed by the atrioventricular groove (AV groove) and the RCA (the true annulus). The lateral edge can be felt by palpation—a sharp well defined muscular edge marks the functional annulus and RV. The medial margin of this triangle is limited by the interventricular septum and the posterior descending artery.

The apex was marked with a 5-0 polypropylene suture on a polytetrafluoroethylene pledget.

Cardiopulmonary bypass was initiated with an aortic and bicaval cannulation. And with the heart beating and empty, RV plication was performed starting with the preplaced 5-0 polypropylene stitch. Plication was performed using running 5-0 polypropylene in 2 layers, avoiding all visible coronary branches (Fig. 2).

Since the point of detachment of the displaced leaflets at the time of valvuloplasty will be at the false annulus, it is important

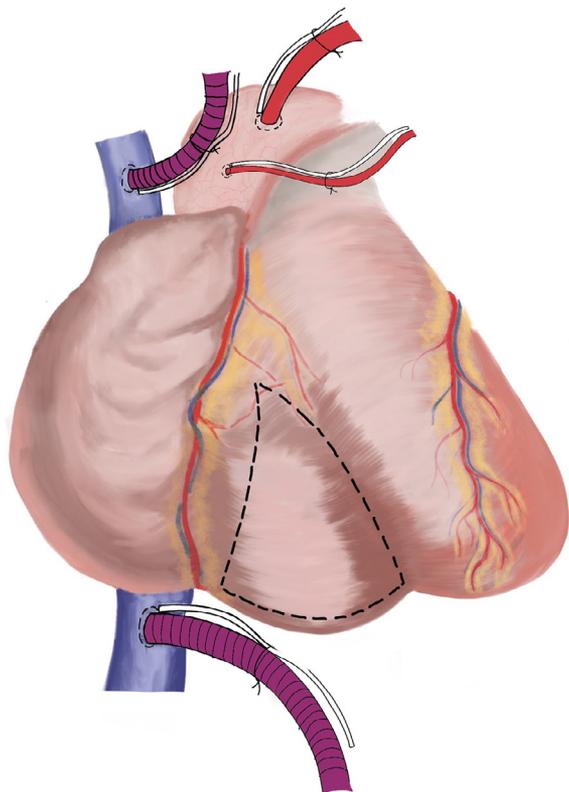


Figure 1. External appearance and the proposed triangle for plication.

for this plication to stay 1–2 mm within this triangle. This should avoid the entrapment of any usable TV tissue in the suture line.

Contrary to what we do in a conventional internal plication, here, because all major coronaries were easily visible, all sutures passed full thickness into the RV wall. Plication stopped just short of the AV groove and during this time the

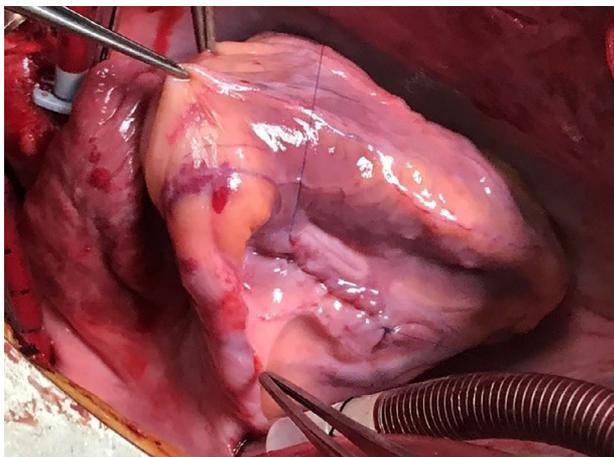


Figure 2. External plication of the atrialized right ventricle.

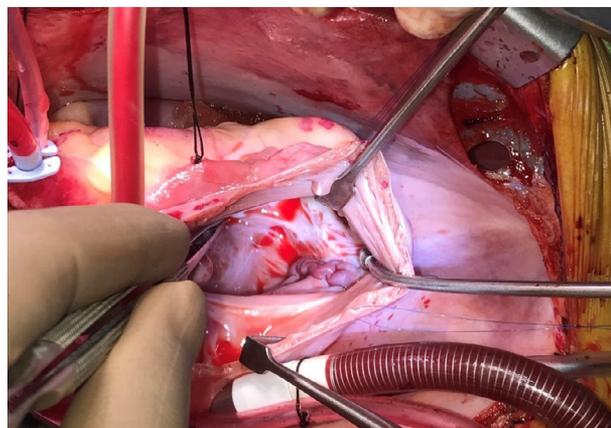


Figure 3. Plication as viewed through the right atrial incision.

EKG was closely monitored to identify any changes that may suggest coronary malperfusion.

Following cardioplegia, a right atriotomy was performed and the plicated region was inspected (Figs. 3 and 4). As compared to a conventional plication, external plication had created a similar reduction in the RV, extending from the functional to the true annulus. There was a similar reduction at the level of the true annulus and the blind pouch created at the proximal extent of the plication was closed with 1 or 2 superficial, interrupted 5-0 polypropylene sutures.³

The rest of the procedure (Cone repair) proceeded as usual. Postoperative transesophageal echocardiography confirmed a good repair and with only mild tricuspid regurgitation in both patients.

Both patients were extubated on the day after surgery and both had an unremarkable postoperative hospital stay.

DISCUSSION

Surgical repair of Ebstein's anomaly has evolved considerably; however, basic principles remain constant—valvuloplasty and RV plication.⁴

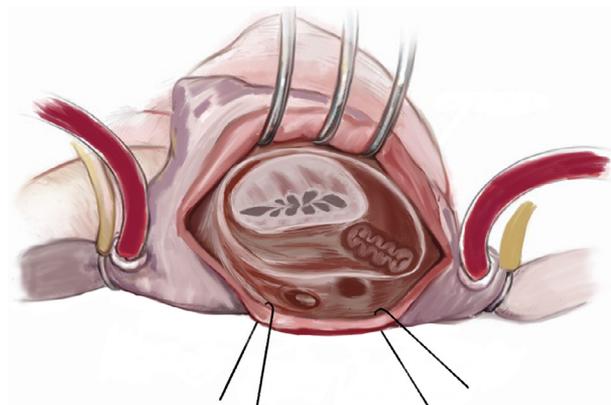


Figure 4. Graphic representation—relationship of the tricuspid valve with the plication suture line.

The most recent Cone repair also involves RV plication and this is done on cardioplegia, working through a right atrial incision (internal plication). Risks involved during this plication arise when a branch or RCA itself is compromised. We believed that watching the outside of the RV while plicating will protect from such a mishap. This did not hold true on 1 instance when the complication was realized when we attempted to come off bypass. Rectification involved another cardioplegic arrest; repair was taken down and the plication was redone.

External plication that we describe helps to avoid a compromise of any major coronaries as these are clearly visible. Rarely, if a coronary is occluded or kinked, we expect that EKG changes will identify this immediately. Additionally, as the plication is performed externally, if needed, the culprit sutures can be easily removed without having to rearrest and taking down the repair. And since this plication is performed on a beating heart, a small but significant decrease in the cardioplegic arrest time is an additional advantage.

We believe that this technique for RV plication is useful for many patients with Ebstein's anomaly; however, there will be patients who will not be suitable for this technique—especially those with massively atrialized RV where a conventional

plication should be planned. In addition, this technique poses a small risk of incorporating usable tricuspid valve leaflets in the plication. This risk is minimized if the suturing stays few millimeters within the triangle described earlier. And since nothing has been divided or resected, in case it seems that the plication has involved usable valve tissue, there will be a chance to correct it and convert to a conventional plication, once the right atrium is opened.

Conventional method of plication may not electrically isolate the atrialized RV and so the re-entrant circuits that remain can cause arrhythmias.² Unproven yet, but with our technique of transmural plication, we expect a transmural scar that may obviate this complication.

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