

EDITORIAL COMMENT

Transvenous Extraction of Pacemaker and Defibrillator Leads and the Risk of Tricuspid Valve Regurgitation

Making a Case for Thoughtful Lead Management*

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The implantation of cardiac implantable electronic devices (CIEDs) has increased in the last 2 decades. There has been also a parallel increase in the rate of transvenous lead extraction (TLE) procedures. The most common indications for TLE are systemic and local pocket infections, system upgrade, lead failure, lead recall or advisory, and venous occlusion (1-3). Leads implanted on a long-term basis develop adhesions to adjacent tissue, adjacent leads, and tricuspid valve (TV) leaflets, thus rendering TLE often complex and challenging. Several studies have described traumatic injury of the TV during lead extraction procedures, with incidence rates of 3.5% to 12% (4,5). Published data on extraction-related tricuspid regurgitation (TR) are limited and conflicting, however (6-8).

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In this issue of *JACC: Clinical Electrophysiology*, Park et al. (9) report a single-center experience of the incidence of acute increase in TR severity following TLE, and the associated risk factors with TR. The study included 208 patients who had a total of 266 ventricular leads (mean lead age, 11.8 ± 7.3 years)

extracted. Significant acute tricuspid regurgitation insufficiency (TRI) was observed in 24 (11.5%) patients. Acute TRI was associated with longer lead implant duration, extraction of pacemaker rather than defibrillator leads, anatomic injury to the TV, and longer post-extraction hospital stays. The implantation duration of the ventricular lead with the longest dwell time and the combined duration of all right ventricular leads were greater in the group with acute TRI than the group without TRI. There was a trend toward a greater number of extracted ventricular leads and extraction tools used per patient in the acute TRI group. Multivariate analysis demonstrated only lead implantation duration as an independent predictor of TLE-related acute TRI (odds ratio: 1.05; 95% confidence interval: 1.01 to 1.11; $p = 0.046$).

The study by Park et al. (9) is not the only paper on lead extraction-related TR, nor is it the first, but it does bring up several important points. First and foremost, it highlights the need for thoughtful lead management from implantation time through follow-up management. This study did not directly examine implantation technique as it relates to potential TV injury, but it is likely that inappropriate lead placement further increases the risk of TV injury. Physicians should critically examine their choice of implantation technique to improve future care. Despite the increased number of CIED systems implanted, there is still wide variation in implantation techniques, and the trend in some centers is to maintain outdated approaches. For example, a study by Bongiorni et al. (10) found that dual-coil implantable cardioverter-defibrillator (ICD) leads are preferred by more than one-half of the centers surveyed in the study despite evidence that these leads may not be more effective than single-coil leads and

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may be more difficult to extract and may lead to procedure-related TR.

The study brings up the issue of patient selection in terms of system upgrades with addition of new leads while removing previous leads or choosing to abandon leads. In the study, a multivariate analysis demonstrated lead implantation duration as the only independent predictor of TLE-related acute TRI. This finding underscores the need to consider an early extraction opportunity, as opposed to abandoning leads in favor of a presumably easier lead addition procedure.

Thoughtful lead management should include a discussion not only about when to perform lead extraction but also about how and where to do the procedure. In this study the extractions were performed by experienced operators in a high-volume referral center. Powered and mechanical sheaths were used as extraction tools in most study patients, compared with manual traction in previous studies, thus reflecting a more up-to-date approach. Transesophageal echocardiogram (TEE) was incorporated in all extraction cases to identify changes in TR from baseline and to assess TV leaflet integrity. Tricuspid valve insufficiency was seen in 11.5% patients and should thus be representative of true tricuspid valve insufficiency occurrence, as observed in an experienced extraction center when this issue was specifically studied. This percentage is likely to be even higher in a more generalized clinical practice and should serve as a reminder for all of us as we manage our patients.

The use of modern imaging modalities such as TEE may help prevent TV damage during complex extraction involving leads with prolonged dwell time. TEE can, for example, demonstrate the precise course of the lead and depict potential risks of tricuspid

leaflet injury, thus alerting the operator to act with enormous caution in those cases and prevent valve injury. The 2017 HRS expert consensus statement (11) recommended TEE in patients with suspected CIED infection or pocket infection, but the recommendation perhaps need to be expanded to patients with extraction of leads with longer implantation time, to identify TV injury during extraction that can change the post-operative course and prolong the hospital stay, as demonstrated in this study.

Long-term follow-up would be necessary to understand the clinical consequences of extraction-related TR further. In addition, the relatively small number of patients could lead to a lack of statistical power in identifying other TR predictors and inability to do further subgroup analysis by device type (ICD vs. pacemaker) and type of extraction tool used.

In conclusion, Park et al. (9) shed further light on important questions regarding the incidence of extraction-related TR in patients with pacemakers and ICDs and predictors of such complications while highlighting many important points such as proper implantation techniques, use of modern imaging during extraction, and the potential consequences of abandoning leads. The future of CIED-related TR from implantation or extraction in the era of implantation of devices in which endocardial leads are absent (leadless pacing) or nontransvalvular (as in His bundle pacing) is yet to be known, but these newer devices will likely change the future of TLE-related TR.

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