CASE REPORT

The mechanism of endocardial lead-induced tricuspid regurgitation

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SUMMARY

Using this case report we attempt to define the mechanism of endocardial lead-induced tricuspid regurgitation (TR) in particular the direct effect of endocardial pacing leads on the competence of the tricuspid valve. We recommend a high index of suspicion and an early diagnostic strategy in order to reduce long-term morbidity which is associated with this condition and the need for a potentially avoidable surgery.

BACKGROUND

Endocardial lead-induced tricuspid regurgitation (TR) may lead to right ventricular failure and may require tricuspid valve repair. An understanding of the mechanism of this iatrogenic complication is essential for the success of a repair as well as the development of a preventive strategy.

CASE PRESENTATION

A 66-year-old man with a background history of hypertension, chronic slow atrial fibrillation, permanent pacemaker and previous abdominal aortic aneurysm repair presented with exertional dyspnoea and peripheral oedema. Clinical examination confirmed evidence of right heart failure with raised jugular venous pressure hepatomegaly, ascites and gross peripheral oedema. Echocardiography revealed mildly dilated left ventricle with severe mitral regurgitation and mildly reduced function. However the most notable finding was a markedly hypertrophic and dilated right ventricle with torrential TR and a dilated right atrium. The likely preoperative explanation for the TR was a combination of annular dilation and the presence of the transvenous pacing wires. A preoperative transoesophageal echo confirmed these findings. The patient underwent mitral and tricuspid valve repairs through a transseptal approach. The access to the heart was achieved via a standard median sternotomy the patient was placed on cardiopulmonary bypass using a bicaval cannulation technique. The tricuspid valve was inspected through a right atriotomy. The transvenous pacing wire has not only pierced through the septal leaflet of the tricuspid valve but it had wedged it open (figure 1). The ventricular lead of the transvenous pacing wire had formed calcified adhesions to the postero-lateral aspect of the superior vena cava as it joined the right atrium. This had fixed the area between the septal and posterior leaflets of the tricuspid valve in an open position resulting in torrential tricuspid regurgitation. The Tricuspid valve was repaired after excision of the culprit pacing wire from the

valve. The valve was made competent by closing the hole primarily using a prolene stitch and stabilising the tricuspid annulus with a standard ring. An epicardial pacing wire was inserted to replace the transvenous system.

OUTCOME AND FOLLOW-UP

Postoperative transoesophageal echo confirmed no regurgitation. The patient made an excellent postoperative recovery.

DISCUSSION

There have been a number of case reports and series on this subject over the past three decades.^{1–5} However this case illustrated a cardiac surgical prospective of the mechanisms that led to tricuspid regurgitation; following endocardial lead insertion. We discuss the surgical strategy for a successful repair in cases where the lead has impinged on the valve leaflet, preventing it from competent closure. As illustrated in this case report, failure to diagnose this condition early may lead to progressive right heart failure which necessitates surgical intervention. We recommend a high index of suspicion as a preventive strategy.

Although there is some evidence that describes an indirect phenomenon by which right ventricular (RV) dys-synchrony as a result of RV pacing⁶ leads to TR, for most cases the mechanism of endocardial lead-induced TR is caused by a mechanical interference of the pacing lead with the tricuspid valve. This interference may be characterised as (a) impingement (described in the majority of cases), (b) perforation, (c) entanglement or (d) adhesion. However in practice subjective assessment is limited due to the similarities in their presentation. For example, in this case the endocardial lead had not only appeared to perforate the septal leaflet, but also appeared adherent to the chords and difficult to exclude entanglement of the lead with the chords. We concluded that identification of the lesion as one of the above alone was impossible. Lin *et al*³ reported their experience in 41 patients. In their publication they retrospectively reported cases of ‘impingement’ of the tricuspid valve, ‘perforation’ of the leaflets, lead ‘entanglement’ with the chords and lead ‘adherence’ to the valve. Hence in our opinion it is difficult to characterise the patho-physiology of this condition retrospectively with any degree of certainty through examining patient’s records or by imaging even in three dimensions.

The unique finding in this case was that the ventricular lead had formed calcified adhesions with

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Figure 1 Sketch diagram of the mechanism of endocardial lead-induced tricuspid regurgitation. This diagram shows the transvenous pacing wire wedging the valve open as well as piercing through the septal leaflet of the tricuspid valve. Note the area close to the superior vena cava where the wire is adherent to the right atrium by calcific lesion.

the postero-lateral wall of the superior vena cava at its junction with the right atrium. This had resulted in the adjacent valve leaflets (septal and posterior) being wedged wide open by the pierced/tangled lead, and resulted in torrential tricuspid regurgitation. Our surgical strategy prior to the operation was to free the leaflet from the epicardial lead and to reposition the lead between the leaflets in a way as to avoid impinging the septal leaflet. It became quite clear after right atriotomy that this strategy was not a viable option. The calcific attachments of the lead to the right atrium had a leverage effect on the valve making it difficult to sustain optimal positioning. Hence the ventricular lead was excised and replaced by an epicardial lead. These calcific adhesions may be responsible for the long-term mechanism

which is known as impingement of the septal leaflet. Surgical repair of the tricuspid valve associated with impingement of the leaflet by a pacing lead should therefore include freeing of the lead from the right atrium and possibly replacement of the endocardial lead with an epicardial one. The awareness of their presence may also guide preoperative imaging and planning. These attachments were not picked up by either of the two- or three-dimensional echocardiograms. Use of CT may be of help in this situation.

In this case, the presence of TR was overlooked for a number of years. The patient symptoms were thought to be secondary to pulmonary hypertension as a result of mitral regurgitation. Early detection of a mechanical cause could have been simply treated with repositioning of the pacing leads. Patients with progressive TR after transvenous lead insertion should be investigated for this possibility.^{7 8} Early cardiological or surgical intervention is essential.

Learning points

- ▶ The mechanism underlying impingement of the tricuspid valve may be explained by calcified adhesions which fix the endocardial leads to the right atrial wall.
- ▶ A high index of suspicion for diagnosis of endocardial lead-induced tricuspid regurgitation is essential.
- ▶ We recommend an early diagnostic strategy in order to reduce long-term consequences of this condition.

Competing interests None.

Patient consent Obtained.

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REFERENCES

- 1 Huang TY, Baba N. Cardiac pathology of transvenous pacemakers. *Am Heart J* 1972;83:469–74.
- 2 Petterson SR, Singh JB, Reeves G, *et al*. Tricuspid valve perforation by endocardial pacing electrode. *Chest* 1973;63:125–6.
- 3 Lin G, Nishimura RA, Connolly HM, *et al*. Severe symptomatic tricuspid valve regurgitation due to permanent pacemaker or implantable cardioverter-defibrillator leads. *J Am Coll Cardiol* 2005;45:1672–5.
- 4 Kucukarslan N, Kirilmaz A, Ulusoy E, *et al*. Tricuspid insufficiency does not increase early after permanent implantation of pacemaker leads. *J Card Surg* 2006;21:391–4.
- 5 Gould L, Reddy CV, Yacob U, *et al*. Perforation of the tricuspid valve by a transvenous pacemaker. *JAMA* 1974;230:86–7.
- 6 Vaturi M, Kusniec J, Shapira Y, *et al*. Right ventricular pacing increases tricuspid regurgitation grade regardless of the mechanical interference to the valve by the electrode. *Eur J Echocardiogr* 2010;11:550–3.
- 7 Champagne J, Poirier P, Dumesnil JG, *et al*. Permanent pacemaker lead entrapment: role of the transesophageal echocardiography. *Pacing Clin Electrophysiol* 2002;25:1131–4.
- 8 Seo Y, Ishizu T, Nakajima H, *et al*. Clinical utility of 3-dimensional echocardiography in the evaluation of tricuspid regurgitation caused by pacemaker leads. *Circ J* 2008;72:1465–70.

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