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Clinical case of intracardiac pacemaker lead fracture

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Abstract

Lead fracture is a serious complication of a pacemaker; its prevalence is 0.1–4.2%. The common site of lead fracture is at the space between the clavicle and the first rib. The causes are intense physical activity, which approximates the clavicle to the rib and compression of the lead, chest trauma, anatomical features, twiddler's syndrome. Diagnosis of lead fracture is can be made by electrocardiography — there is a transient or permanent stimulation/sensitivity disturbance. When the programmer interrogates the pacemaker, a significant sign is an abrupt rise in the lead impedance, although cases of fracture with normal impedance values have been reported. The article presents an extremely rare clinical case of an intracardiac lead fracture in a 28-year-old patient. At the initial implantation, leads were passed through the accessory left superior vena cava, resulting in a loop in the right ventricle. The patient himself was subjected to increased physical activity. The question of the need to remove such leads remains open. Some authors note that the distal end is firmly fixed to the heart wall, and therefore does not expose the patient to a vital risk. Others consider that the lead can become a source of thrombus formation, or fragmentation with embolism in the pulmonary circulation can occur. In our case, the causes of the fracture were probably an intense physical activity and bending of the lead inside the right ventricle. The clinical situation was discussed with cardiac surgeons of the federal centers of cardiovascular surgery. Given the high risks of open-heart surgery, it was decided to refrain from removing the broken lead, and the patient was provided with atrial pacing.

Keywords: cardiac implantable electronic devices, pacing, lead fracture, intracardiac pacemaker lead fracture.

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Introduction. Electric cardiac pacemaker (ECP) implantation has recently become common procedure. In the vast majority of cases, this surgery involves the placement of one or more leads in the right heart, through which cardiac stimulation will be provided. As with any surgical intervention, pacemaker implantation can result to various complications, including lead fracture. Our article presents an extremely rare clinical case of an ECP lead intra-cardiac fracture.

Case history. Patient A., 28 years old, received inpatient treatment in the surgical department for the management cardiac arrhythmias and an electrocardiac stimulation for planned ECP replacement due to depletion of the power source. The patient had no complaints, and the general clinical laboratory examination revealed no abnormalities.

A two-chamber ECP was implanted in the patient at the age of 16 years old (2008). The surgical indication was a sick sinus syndrome with episodes of severe sinus bradycardia and chronotropic incompetence. Moreover, according to the cardiac ultrasound examination (US) data, a congenital heart defect known as a persistent left superior vena cava draining into the coronary sinus was diagnosed. Implantation was performed on the left side through the persistent left superior vena cava. The postoperative period was uneventful, and no disturbances in the ECP functioning were revealed during subsequent checks.

When checking the ECP functioning during the current hospitalization, a dysfunction of the ventricular lead was detected. A sharp increase in the threshold and an impedance was noted in the period ranging from June to July 2019 (Fig. 1). An intracardiac fracture of the ventricular lead was diagnosed during an X-ray examination of the chest organs in the X-ray operating room (Fig. 2).

During a detailed survey, the patient noted that he was repeatedly subjected to severe physical

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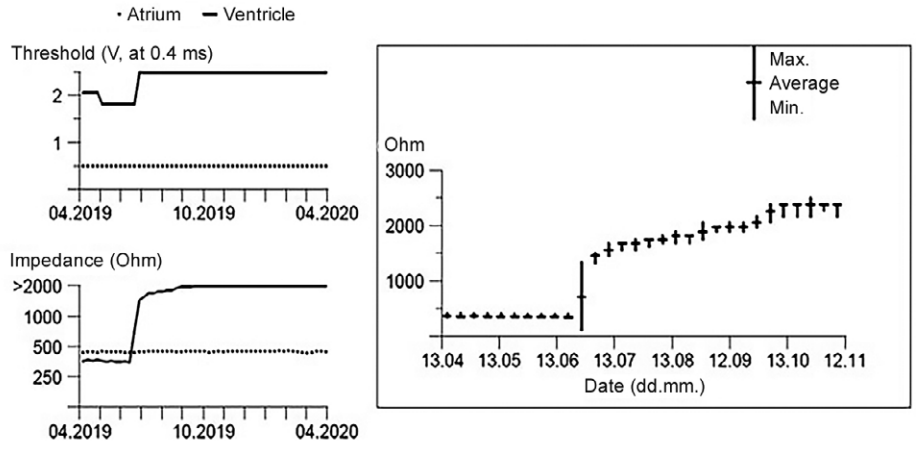

Fig. 1. Report of the primary evaluation of the patient's pacemaker. On the left are data on the threshold dynamics and the impedance of the ventricular and atrial leads during the year; on the right are data on the monthly dynamics of the ventricular lead impedance.

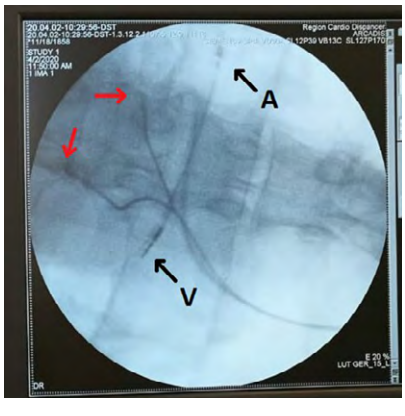

Fig. 2. X-ray examination data. The leads were passed through the accessory left superior vena cava; A, atrial lead; V, ventricular lead; red arrows indicate the ventricular lead fracture.

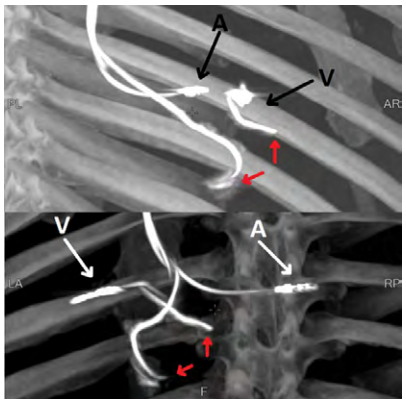

Fig. 3. X-ray computed tomography data; A, atrial lead; V, ventricular lead; red arrows indicate the ventricular lead fracture.

exertion over the past years and that he did pull-ups on the bar in the months of June and July 2019. The heart ultrasound examination revealed that the distal end of the ventricular lead was located in the apex of the right ventricle, while the other part of the lead formed a loop in the cavity of the right ventricle. The lead fracture was confirmed by an X-ray computed tomography (Fig. 3).

The patient's referral to one of the federal centers for cardiovascular surgery to consult a cardiac surgeon in order to decide on the removal of the ventricular lead was planned, but could not be undertaken because of the closure of the centers for quarantine due to the COVID-19 pandemic.

When testing the atrial lead, the indicators of the pacing threshold and Wenckebach points were found to be satisfactory. The ECP was switched to the AAI mode, with the remaining battery life of 16 months. The patient was discharged for outpatient management with recommendations to check the ECP after two months and to try to contact federal centers after the termination of the quarantine.

The patient was later on consulted by a cardiac surgeon at the Federal Center for Cardiovascular Surgery; and it was decided to refrain from removing the ventricular lead. During the next hospitalization, the two-chamber ECP was replaced with a single-chamber ECP in AAI mode, and the ventricular lead was isolated. The postoperative period was uneventful, and the patient was discharged for outpatient management.

Discussion. Lead fracture is a serious pacing complication, with a prevalence of 0.1–4.2% [1]. A typical lead fracture site is the gap between the clavicle and the rib 1. It can be caused by severe physical activity, which pushes the clavicle closer to the rib, and also leads to the compression of the lead, chest trauma, anatomical characteristics, and tweedler syndrome [2–4]. A fracture can be diagnosed during electrocardiography, when a transient

or constant impairment of stimulation/sensitivity occurs. When the ECP is checked by the programmer, a significant sign can be a sharp increase in the lead impedance, although cases of fracture with normal impedance values have also been described [3, 5]. Generally, a fracture, especially a complete one, is clearly visible on fluoroscopy or radiography. Clinically, the patient may notice the return of bradyarrhythmia symptoms, similar to the symptoms present before the ECP implantation, and also consciousness disorders [3, 6].

The lead fracture rarely occurs in the cavity of the heart or vessel and, according to E. Alt et al. (1987), it is detected in 7% of all fractures [7]. Since the publication of the work by E. Alt et al., leads have become technologically more advanced, and intracardiac fracture is currently more of a casuistic case. Fractures of the atrial, ventricular, and coronary sinus leads are presented in the world literature [3, 8, 9].

B. Godin et al. described a complete fracture of the ventricular lead within the right ventricle near the tricuspid valve. Transesophageal ultrasound revealed a mobile calcified mass fixed to the proximal end of the lead [8]. In the work by D.X. Augustine et al., an intracardiac fracture of the ventricular lead occurred in an 87-year-old patient; as a result, she was brought constantly by her relatives by her both hands [10]. F. Khattak et al. presented a case of breaking of the tip of the atrial lead. An interesting fact was that the fracture occurred while taking amusement rides in an amusement park [3]. Several papers describe technical problems with leads from some manufacturers that resulted in fragmentation and migration of the leads. For example, this earlier happened with the Accufix leads made by Telectronics Pacing Systems; therefore, it was even required to recall the batch [11]. H. Nägele et al. described a case of fracture and fragmentation of a coronary sinus lead [9].

The question regarding the need to remove broken leads remains open. The distal part creates the risk of embolism both by a fragment of the lead and (in some cases) by blood clots formed. In the work of B. Godin et al., described above, the calcified mass could also be an organized thrombus [8, 12]. E.Z. Golukhova et al. presented a patient with dislocation of a rather long cut off end of the lead into the system of the right pulmonary artery. Due to the high risk of complications, it was decided to remove the lead by an open method [13]. In a similar situation discussed by A.R. Udyavar et al., the dislocated end of the lead was not removed due to its high degree of fixation [14].

The latest HRS (Heart Rhythm Society, 2017) guidelines present the discussion on the removal of non-functioning leads. The decision should be made based the patient's age, physical and mental condition, as well as consent, and this should come after assessing the risk of the intervention. Removal of the lead may be accompanied by perforation of the heart or vessel wall on one hand, and on the other hand, it may reduce the probability of infectious and venous thromboembolic complications in the future [15, 16]. It is unlikely that the distal broken end of the lead can be removed by the endovascular route; therefore, open cardiac surgery is required [13].

In our case, the intracardiac fracture was probably caused by a combination of two factors; first, the patient underwent severe physical exertion, including pull-ups on the bar in June and July 2019, which is compared with the data from the ECP testing by the programmer. Secondly, the lead inserted through the persistent superior vena cava during initial implantation required the creation of a loop inside the right ventricle to provide stimulation, which could contribute to its additional bending. Due to the high risk associated with open heart surgeries, cardiac surgeons refrained from removing the ventricular lead. The preservation of the atrioventricular conduction and a satisfactory pacing threshold along the atrial circuit enabled the use of pacing in the AAI mode in the patient.

Conclusion. Lead fracture is a potentially dangerous complication of cardiovascular electronic device implantation. Despite the technological improvement of leads, this complication has not yet been eliminated from clinical practice. The medical practitioner should bear in mind that a lead fracture can occur not only near the collar bone, but also inside the heart and blood vessels. When managing patients with implanted devices, it is necessary to provide them with information about all possible complications of the procedure and further restrictions, including physical restrictions. This is particularly important in the management of young patients due to their high activity.

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REFERENCES

1. Kleemann T., Becker T., Doenges K. et al. Annual rate of transvenous defibrillation lead defects in implantable cardioverter-defibrillators over a period of >10 years.

Circulation. 2007; 115: 2474–2480. DOI: 10.1161/CIRCULATIONAHA.106.663807.

2. Bohm A., Duray G., Kiss R.G. Traumatic pacemaker lead fracture. *Emerg. Med. J.* 2013; 30 (8): 686. DOI: 10.1136/emermed-2012-202090.

3. Khattak F., Khalid M., Gaddam S. et al. A rare case of complete fragmentation of pacemaker lead after a high-velocity theme park ride. *Case Rep. Cardiol*. 2018; 2018: 4192964. DOI: 10.1155/2018/4192964.

4. Böhm A., Komáromy K., Pintér A., Préda I. Pacemaker lead fracture due to Twiddler's syndrome. *Pacing Clin. Electrophysiol*. 1998; 21 (5): 1162–1163. DOI: 10.1111/j.1540-8159.1998.tb00166.x.

5. De Maria E., Fontana P.L., Bonetti L., Cappelli S. An unusual presentation of complete pacing lead fracture with very low impedance values. *J. Cardiovasc. Electrophysiol.* 2013; 24 (12): 1225–1425. DOI: 10.1111/jce.12223.

6. Kalinin R.E., Suchkov I.A., Mzhavanadze N.D., Povarov V.O. Endothelial dysfunction in patients with cardiac implantable electronic devices (literature review). *Nauka molodykh — Eruditio Juvenium*. 2016; (3): 84–92. (In Russ.)

7. Alt E., Volker R., Blomer H. Lead fracture in pacemaker patients. *Thorac. Cardiovasc. Surg.* 1987; 35: 101–104. DOI: 10.1055/s-2007-1020206.

8. Godin B., Savoure A., Bauer F., Anselme F. Complete pacemaker lead fracture potentially due to intra-cardiac mass. *Europace*. 2011; 13 (4): 593–595. DOI: 10.1093/europace/euq406.

9. Nägele H., Hashagen S., Ergin M. et al. Coronary sinus lead fragmentation 2 years after implantation with a retained guidewire. *Pacing Clin. Electrophysiol*. 2007; 30 (3): 438–439. DOI: 10.1111/j.1540-8159.2007.00688.x.

10. Augustine D.X., Carson K., Garg A. Distal pacemaker lead fracture: a rare entity. *BMJ Case Rep.* 2010; 2010: bcr0520103019. DOI: 10.1136/bcr.05.2010.3019.

11. Mucha E., Catalano P., Myers T. Fracture and migration of a pacemaker atrial lead retention wire found by fluoroscopic screening in an asymptomatic patient. *South. Med. J.* 1996; 89 (8): 798–800. DOI: 10.1097/00007611-199608000-00008.

12. Kalinin R.E., Suchkov I.A., Shitov I.I. et al. Venous thromboembolic complications in patients with cardiovascular implantable electronic devices. *Angiologiya i sosudistaya khirurgiya*. 2017; 23 (4): 69–74. (In Russ.)

13. Golukhova E.Z., Revishvili A.Sh., Bazaev V.A. et al. Dislocation of ventricular electrode of pacemaker into the right pulmonary vein. *Vestnik aritmologii*. 2012; (67): 66–71. (In Russ.)

14. Udyavar A.R., Pandurangi U.M., Latchumanadhas K., Mullasari A.S. Repeated fracture of pacemaker leads with migration into the pulmonary circulation and temporary pacemaker wire insertion via the azygous vein. *J. Postgrad Med*. 2008; 54 (1): 28–31. DOI: 10.4103/0022-3859.39187.

15. Kalinin R.E., Suchkov I.A., Mzhavanadze N.D. et al. Congenital complete heart block in pregnant women: a multidisciplinary approach to diagnostics and treatment. *I.P. Pavlov Russian Medical Biological Herald*. 2016; 24 (3): 79–85. (In Russ.) DOI: 10.17816/PAVLOVJ2016379-85.

16. Kusumoto F.M., Schoenfeld M.H., Wilkoff B.L. et al. 2017 HRS expert consensus statement on cardiovascular implantable electronic device lead management and extraction. *Heart Rhythm*. 2017; 14 (12): e503–e551. DOI: 10.1016/j.hrthm.2017.09.001.