Successful transvenous lead extraction using the Evolution System in a 17-kg child

On yedi kilogram ağırlığında bir çocukta "Evolution Sistemi" kullanılarak transvenöz lead'in başarıyla çıkarılması

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Summary– Despite technological advancements in the field of pacemaker lead extraction, available data on pediatric patients is limited, and risk of failure and severe complications remains high. In this report, we present the case of a male patient who, at five months old, had been transvenously implanted with a single-chamber ventricular pacemaker due to complete atrioventricular block. At 7-year of age, the patient was referred to us with growth-related lead tension, severe tricuspid insufficiency, and weak battery. We extracted the lead using the Evolution System and replaced the unit with a dual-chamber pacemaker with a SelectSecure lead. This new system can be used for lead extraction even in low-weight pediatric patients with congenital heart disease. Using a thin, lumenless SelectSecure lead appears to reduce the risk of venous obstruction.

Özet– Lead çıkarma işlemleri ile ilgili yeni teknikler gelişmesine rağmen, çocuk hastalarla ilgili bilgiler sınırlı olup işlem başarısızlığı ve ciddi komplikasyon riski hala çok yüksektir. Bu yazıda, beş aylıkken ameliyat sonrası AV tam blok nedeniyle başka bir merkezde transvenöz tek odacıklı ventriküler pacemaker yerleştirilmiş olan yedi yaşındaki çocukta büyümeyle ilişkili lead gerilmesi, mekanik basıyla ilişkili önemli triküspit yetersizliği gelişmesi ve aynı zamanda bataryanın bitmesi nedeniyle pacemaker ve lead çıkarılıp eş zamanlı "SelectSecure lead" içeren çift odacıklı pacemaker yerleştirilen hasta sunuldu. Doğumsal kalp hastalığı olan çocuk hastalarda lead çıkarma işlemi düşük kiloda bile Evolution Sistemi kullanılarak yapılabilir. Led çıkarıldıktan sonra yeni lead olarak SelectSecure lümensiz ince lead kullanımı ile venöz obstrüksiyon riski azaltılabilir gibi görünmektedir.

In the past decade, there has been a marked increase in pacemaker implantations in pediatric and congenital heart disease (CHD) patients. This practice has led to an increased number of patients requiring endocardial lead extraction, a complicated, high-risk procedure for which there is little data available. Lead extraction is recommended in cases of breakage, infection, mechanical or electrical deficiency, and low battery.[1] Several studies have documented the high incidence of lead failure in pediatric and CHD patients, as well as complications associated with abandoned leads.[1,2] Lead revision and replacement may be necessary several times over the extended lifespan of a patient implanted at a young age. The procedure can be performed percutaneously or surgically. Percutaneous techniques include simple traction, snares, telescopic sheaths, locking stylets, and ablation (laser or radiofrequency).[3]

Abbreviations:

AV	*Atrioventricular*
CHD	*Congenital heart disease*

In this report, we present the case of a patient who was transvenously implanted with a single-chamber ventricular pacemaker at 5 months old due to complete atrioventricular (AV) block. The patient was referred to us at age 7 years due to growth-related lead tension, severe tricuspid insufficiency, and low battery. We performed a lead extracted using the Evolution System and replaced his pacemaker with a dual-chamber pacemaker with a SelectSecure™ lead.

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CASE REPORT

A 7-year-old boy who at 5 months old had undergone surgery for a ventricular septal defect at a different center was referred to our center for pacemaker replacement. He later developed total AV block and was transvenously implanted with a single-chamber ventricular pacemaker. Six months prior to presenting at our unit, the aorta-right ventricular tunnel was closed with an ADO II device. The patient was referred to us due to a low battery and substantial lead tension seen on a teleradiogram (Figure 1a). Echocardiography showed lead-related severe tricuspid valve insufficiency (Figure 1b), insufficient valve closure, enlarged left heart cavities (left ventricular end-systolic diameter of 49 mm, end-diastolic diameter of 35 mm, and shortening fraction of 28%). At the catheter laboratory, the old incision site below the left subclavian artery was opened and the pacemaker was extracted. There were no prominent signs of infection. During the lead extraction procedure, the active fixation mechanism was detached and passive traction was attempted, with no result. A locking stylet was then advanced through the lead and attached to its distal end, and traction was applied again, with no success. As a next step, an Evolution 9 French mechanical dilator sheath (Cook Medical, Bloomington, IN) and locking stylet (Liberator Universal Locking Stylet; Cook Medical) were passed down the length of the lead. After the tricuspid valve was evaluated and no abnormalities found, the sheath was advanced, under transesophageal echocardiographic guidance, further toward the distal end of the lead. When the distal section and tip of the lead were loose and inside the dilator, the entire system was withdrawn (Figure 1c, d). A dual-chamber pacemaker with a 4.1 French SelectSecure™ lead was then implanted in the same area (Figure 1e). Because a sufficient R wave could not be obtained in the septal area, the lead was moved to the right ventricular apical septum. There were no com-

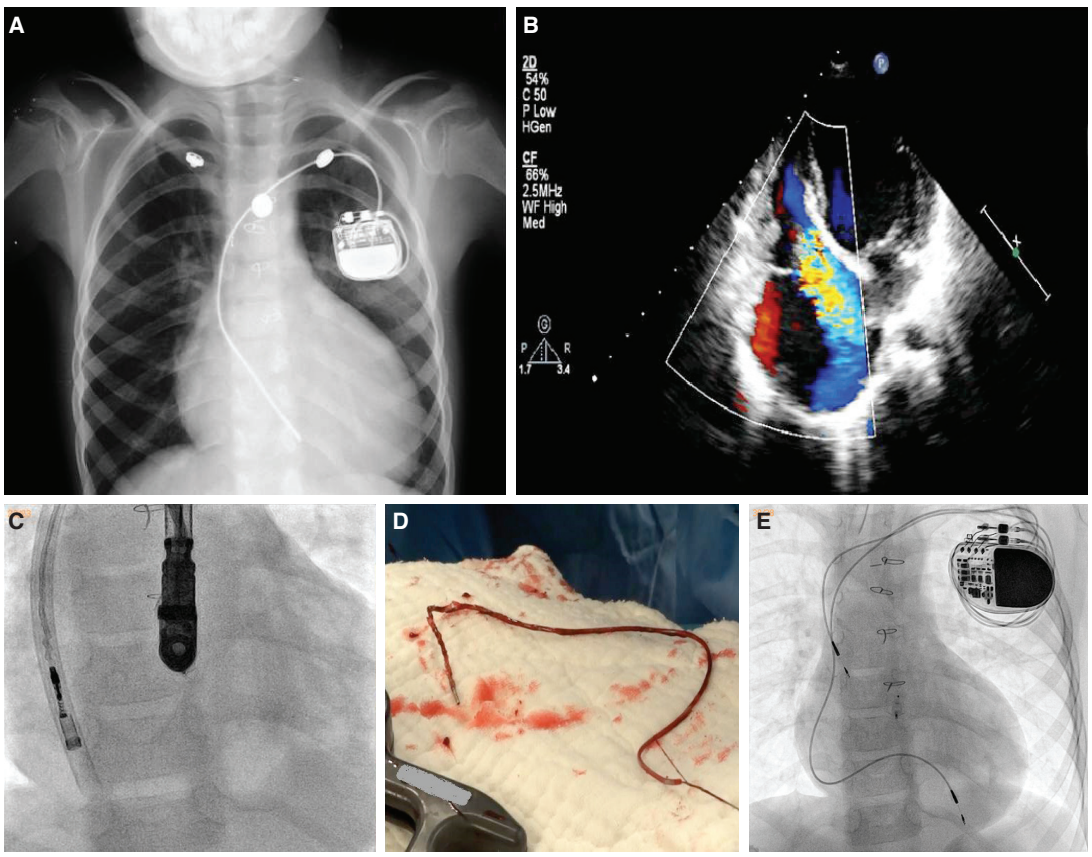

Figure 1. **(A)** Ventricular lead tension on teleradiogram; **(B)** lead pressure-related significant tricuspid insufficiency on color Doppler echocardiogram. **(C)** Extraction of the lead using the Evolution system; **(D)** extracted lead with fibrous tissue. **(E)** Dual-chamber pacemaker with SelectSecureTM lead, shown on teleradiogram.

plications. Echocardiography performed one month later showed that the tricuspid valve leaflet had started moving and that the insufficiency had regressed to moderate (left ventricular end; systolic diameter of 46 mm, end-diastolic diameter of 31 mm, and shortening fraction of 32%).

DISCUSSION

Despite continued progress in the field of lead extraction, the procedure remains highly risky and is likely to lead to severe complications, mainly due to the fibrous tissue that forms between the leads and vessel walls over time. Various techniques have proven effective in breaking leads free from these attachments. When traction and locking stylets fail and damage the lead, retrieving the fragments left behind is very difficult. One of the newest retrieval techniques is the Evolution System (Cook Medical Inc.), which consists of a sheath with a rotating stainless steel tip on its distal end that is activated using a handle similar to a gun trigger. The rotation of the tip is used to disrupt the fibrotic tissue that builds up around leads. There are mentions of this relatively new system in the literature.[4,5]

The transvenous method of pacemaker implantation and lead management has helped reduce the difficulties and risks inherent in surgical implantation.[3] In a study by Przybylski et al., six of 76 leads were extracted successfully using the Evolution System after all other methods had failed.[4] In a study by Hussein et al. of 29 patients undergoing a total of 41 extraction attempts in 2008-2009, the success rate in the group using the Evolution System (12 patients,16 leads) was 100%. After other techniques proved unsuccessful in the rest of the patients (17 patients, 25 leads), the Evolution System was used, with a lower success rate (77%). The remaining four patients required alternative methods (wire loop via femoral vein in two cases and laser sheaths in two cases).[5] In a study by Kuśmierski et al., three of 23 leads were successfully extracted using the Evolution System after all other methods had failed.[6]

The success of lead extraction procedures depends on factors such as patient age, duration of implantation, diameter and location of the lead, surrounding tissues, and insulation type.[1] In high-risk cases, the Evolution System enables a safe extraction, carried out effectively and without damaging the structure of the lead.[4] Taking into account risk factors such as our patient's low weight and long duration of implantation, we chose to use the Evolution sheath set. Notably, our patient has the lowest body weight among patients who have undergone lead extraction using the Evolution System and implantation of a dual-chamber pacemaker with a SelectSecure™ lead.

The SelectSecure™ lead (Medtronic) is an easily applicable and manageable system mainly used in young patients, as its small diameter (4.1 Fr) and lack of lumen prevent arrhythmia, venous obstruction, crushing, and friction resistance.[7,8] An important advantage in our case was that due to the patient's young age, low weight, and severe tricuspid valve insufficiency, we elected to use a thin, lumenless lead. One month after the lead was implanted, we observed that the tricuspid septal leaflet had begun to move and that insufficiency had regressed to a moderate degree.

While lead extraction carries a risk of severe complications in pediatric and CHD patients, it can be performed in low-weight patients with the help of the Evolution System. It appears that using the Select Secure™ lumenless thin lead is an option that could reduce the probability of tricuspid valve insufficiency and central venous obstruction.

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Key words: Cardiac pacing, artificial/methods; child; device removal; electrodes, implanted; heart defects, congenital/therapy; pacemaker; SelectSecure lead.

Anahtar sözcükler: Kardiyak pacing, yapay/yöntem; çocuk; cihaz çıkarma; elektrot yerleştirme; kalp defekti, doğumsal/tedavi; kalp pili; SelectSecure lead.