

Transarterial Percutaneous Pacemaker Lead Extraction

Inadvertent placement of pacemaker (PMK) leads in the left ventricle (LV) through a subclavian artery is a rare complication during device implantation.

We report the case of a 63-year-old female patient with a history of single-chamber pacemaker implantation due to complete AV block. Routine echocardiography 3 months after the implantation showed the pacing lead crossing the aortic valve and positioned in the LV. The patient was asymptomatic, and was referred to our center. On admission, anticoagulant therapy was started and different diagnostic studies were performed. Transesophageal echocardiography (TEE) confirmed the presence of the lead in the LV crossing the aortic valve, and ruled out the presence of thrombi. A selective venography of the right subclavian vein verified the presence of the lead outside the vein, via the subclavian artery (Figure 1 A). Lead extraction with cardiovascular surgery was suggested once the diagnosis was confirmed in order to avoid lifetime anticoagulation, since the patient had a history of gastrointestinal bleeding. This option was rejected by the patient, so percutaneous extraction was the treatment of choice.

Two days before the procedure, a dual-chamber PMK was implanted in the left hemithorax. Removal was performed in a hybrid operating room under general anesthesia, guided by TEE. First, the PMK pocket was exposed and the lead was disconnected from the battery. Next, the lead was freed from the surrounding tissue up to the subclavian artery. Via a pigtail catheter, the lead point of entry into the artery was located and the necessary steps for covered-stent implantation were followed (Figure 1 B). The lead was then carefully removed manually until the tip was close to its entry site in the subclavian artery. A 7 x 50 mm self-expandable covered stent (Viabahn™ Gore) was inserted through right brachial access and positioned at the lead entry site. The lead was then completely removed with immediate stent deployment, covering the opening left by the lead in the artery (Figure 1 C). Control angiography confirmed adequate stent deployment, without contrast leak (Figure 1 D). The patient recovered uneventfully, and was discharged after a 48-hour observation period. No complications have been reported one year after the procedure.

Malposition of a pacemaker leads in the LV is a rare complication. What makes our case special is that the lead accessed the LV through the subclavian artery. In this rare complication, the lead usually accesses the LV through a foramen ovale of atrial or ventricular septal defects. (1)

These patients can be asymptomatic –suspected of right bundle branch block in ECG during ventricular stimulation– or can present embolic events and structural heart lesions. (2) Their risk of thromboembolism

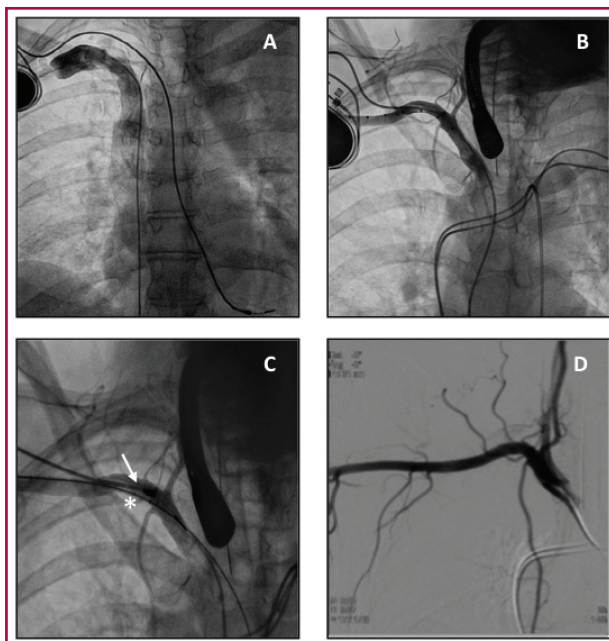


Fig. 1. **A.** Venography of the right subclavian vein showing the pacemaker lead passing outside the vein through the subclavian artery. **B.** Angiography of the right subclavian artery showing the lead inside the artery, the pigtail catheter, the leads of the new pacemaker and the transesophageal echo probe. **C.** Covered stent (asterisk) and pacemaker lead (arrow) placed at the entry site to the artery, just before the extraction. **D.** Digital subtraction angiography showing correct stent deployment without blood extravasation.

is high due to lead contact with the systemic circulation; therefore, anticoagulation should be started immediately once the diagnosis is confirmed.

With the passage of time, the lead can be surrounded not only by thrombi but also by cell proliferation tissue. Thus, any manipulation of the lead entails risk of embolism. Decision to extract the lead is based on several factors, including time between the implantation and diagnosis, thrombi attached to the lead, and the presence of symptoms, comorbidities, etc. Therefore, a conservative treatment with anticoagulation therapy is recommended in asymptomatic patients. On the other hand, lead extraction is recommended in symptomatic patients, in those with contraindication for anticoagulation therapy, in patients with embolic events despite being correctly anticoagulated or requiring cardiac surgery for other reasons; in these cases, cardiovascular surgery is the method of choice. (3)

In the present case, cardiovascular surgery was strongly rejected by our patient, so percutaneous extraction was the option, which implies two potential risks: thromboembolic complications during lead manipulation, and bleeding at lead entry site into the artery. The use of extraction tools with sheaths or laser is strongly not recommended to avoid embolism dur-

ing lead manipulation. In this patient, the absence of thrombus in the TEE, the short time between implantation and extraction, and the non-use of extraction tools reduced the risk of thrombus detachment.

Isolated cases of complex surgical techniques have been reported to close the arterial puncture site and prevent bleeding through the subclavian artery after lead extraction. (4) Using a vascular management, Kosmidou et al. described two cases of percutaneous lead removal via the left subclavian artery with a novel method employing a covered-stent as hemostatic barrier at the site of lead extraction in the subclavian artery, associated with embolic protection filter in the carotid artery. (5) A similar approach was followed in our patient, but we omitted the use of carotid embolic protection systems due to the short time between the implantation and the extraction, the absence of thrombus in the TEE and the lack of relevant evidence on the usefulness and safety of these devices during carotid angioplasty. (6)

In conclusion, we report the successful percutaneous extraction of a lead inadvertently placed in the left ventricle via the subclavian artery, using a covered stent at the entry site into the subclavian artery. In selected cases, this approach is a safer and less invasive option to cardiovascular surgery.

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Transapical Closure of Left Ventricular to Right Atrial Shunt Following Endocarditis

The communication between the left ventricle (LV) and the right atrium (RA) (Gerbode defect) is a very rare congenital or acquired defect of the septum dividing the right heart from the left heart. In recent years, percutaneous closure with a device has become a therapeutic option to traditional surgical repair. It can be performed using the transfemoral approach and a second option is the transapical approach.

We report the case of a 37 year-old female patient, with a history of two cardiac surgeries: closure of an ostium primum atrial septal defect at 4 years of age, and prosthetic mitral valve replacement (disc valve) for heart failure due to cleft, at the age of 6 years. She presented with late prosthetic valve endocarditis due to *S. viridans* during her first pregnancy, which was medically treated. At the age of 32 years, the patient was diagnosed with asymptomatic acquired Gerbode defect. She presented dyspnea on moderate exertion at the age of 37. Physical examination revealed a grade 3/6 systolic murmur at the left parasternal edge that radiated to the right of the sternum. It also revealed c-v wave in the jugular venous pulse and pulsating liver as seen in tricuspid regurgitation. The ECG revealed biventricular hypertrophy and right atrial enlargement, whereas the chest x-ray showed cardiomegaly and mechanical prosthesis in mitral position.

The echocardiography showed marked biatrial enlargement, and the color Doppler revealed systolic flow from the LV to the RA, with improved visualization in the transesophageal echocardiography (TEE) showing the defect at the level of the anterior membranous septum below the mitral prosthesis, with flow towards the RA. Three-dimensional (3D) echocardiography images showed that defect directly, and allowed to estimate its borders (Figure 1).

Percutaneous closure of the LV to RA shunt from the femoral artery was decided. In the catheterization laboratory, under general anesthesia, with TEE guidance and accessing via both femoral arteries, a guidewire could be introduced with difficulty through the defect but the catheter with the device could not be positioned. The system had to advance from the femoral artery through the aorta, follow the aortic arch, and from the LV apex make a countercurve to get through the orifice between the ventricular septal defect (VSD) patch and the atrial septum. Since it was more rigid than the guidewire, it could not be positioned properly. The procedure was ended without complications.

In that situation, the transapical approach was chosen. A submammary left anterior thoracotomy through the sixth intercostal space was performed under general anesthesia, and a purse string suture was performed for LV puncture. A 7 Fr introducer sheath

was guided by transepical echocardiography to define the puncture site and with 3D TEE for guidance during the procedure. Right femoral vein puncture to access the Gerbode defect was also performed, forming a loop with the transapical access. A pigtail catheter was advanced through the left femoral artery into the LV for contrast injections. An angled Glide guidewire was used in the transapical approach. Once the 0.035 Glide guidewire was passed through the LV to the RA defect, the guidewire was tunneled in the RA, and extracted forming a loop.

The Glide guidewire was advanced into the LV through the shunt for the implantation of the 12-mm Amplatzer Vascular Plug II device from the RA, deploying the retention disc in the LV without interfering with the aortic and mitral valves or the course of the shunt. Follow-up angiography revealed absence of flow through the device (Figure 2).

The outcome was asymptomatic and the patient leads a normal life.

The septum dividing the right heart from the left heart has an interatrial portion, an interventricular portion, and a small segment between the RA and the LV due to the more apical insertion of the tricuspid valve compared to the mitral valve.

The defect in question was described by Gerbode in 1958. (1) Two types of defect have been identified: congenital (usually associated with mitral valve defects) and acquired (secondary to valve surgery or post-endocarditis). (1) Acquired causes secondary to trauma, myocardial infarction and repair of VSD have also been described. In the case of the patient we report here, it was interpreted as sequelae of prosthetic valve endocarditis.

One of the most interesting topics for discussion on this condition is its difficult diagnosis. Clinically, it is similar to a VSD with tricuspid regurgitation. Several authors refer to the Gerbode defect as an echocardiographic pitfall. It is difficult to visualize the shunt in only one echocardiographic axis, since it courses in two different planes. (3) This septal defect should be suspected when an eccentric, high-velocity systolic jet is present in the RA, simulating tricuspid regurgitation, but originating in the septum. It is usually diagnosed by TEE. In dubious cases, some authors recommend magnetic resonance imaging to determine the location and size of the shunt. (4)

Since its discovery in 1958 to the present, surgical closure has always been the solution. A bovine or autologous patch is used, requiring extracorporeal circulation. Since our patient was a young woman with two previous cardiac surgeries, the first option was the percutaneous closure with Amplatzer device via femoral artery and aortic approach. However, excessive catheter angulation prevented us from implanting the occluder device percutaneously, so another option had to be chosen. (5)

The increasing use of a transapical approach both for percutaneous valve implantation as for closure of

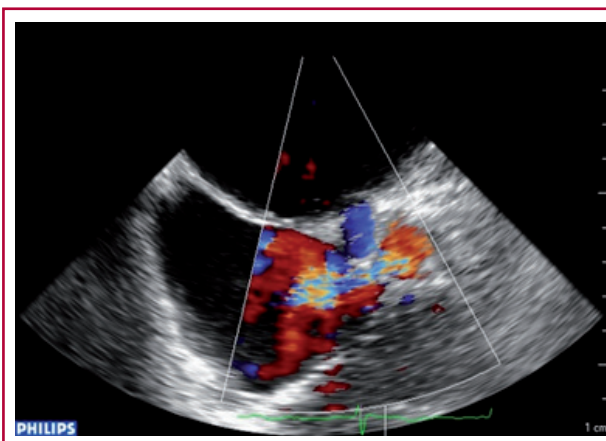


Fig. 1. 2D transesophageal echocardiography. Mid esophageal view at 65° with slight anteflexion showing high velocity flow from the left ventricle to the right atrium using color Doppler.

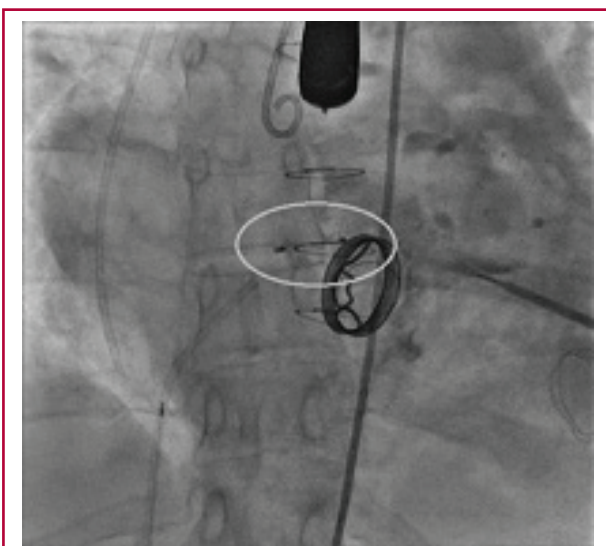


Fig. 2. Angiographic image of the end result of the procedure. It shows the deployed Vascular Plug device behind the mechanical prosthesis and the angiographic control without leakage.

paravalvular defects led us to consider this method. Surprisingly, the transapical approach supported by TEE (6) was very simple, as opposed to the difficulties encountered with the percutaneous approach.

The Gerbode defect is an extremely rare LV to RA shunt. It usually courses asymptotically. We consider that transapical closure of acquired Gerbode defect is an option when percutaneous closure is not possible. (5) To our knowledge, this is the first description of a patient with closure of acquired Gerbode defect using transapical approach. Our experience may be useful for the management of similar patients.

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Various Tachyarrhythmias via a Mahaim Accessory Pathway. All in One

We report the case of a 53-year-old female patient with a 10-year history of hypertension and trepidation, recurrent admissions due to wide QRS tachycardia requiring pharmacological cardioversion with amiodarone on several occasions, who was diagnosed with ventricular tachycardia. Holter monitoring showed multiple episodes of symptomatic tachyarrhythmia suggestive of nonsustained ventricular tachycardia (Figure 1 A) and the ECG revealed atrial fibrillation with wide QRS and left bundle branch block (LBBB) morphology, even under treatment with atenolol, amiodarone or flecainide. Baseline ECG exhibited sinus rhythm without preexcitation. Echocardiography and myocardial perfusion were normal.

The electrophysiological study exposed irregular episodes of wide QRS tachycardia and LBBB morphology, with nodal retrograde conduction decreasing at the bundle of His level (Figure 1 B). With incremental atrial overstimulation, progressive ventricular pre-excitation with LBBB morphology was evidenced, associated with smaller increase in the A-delta interval than in the AH interval. Atrial extrastimuli at a fixed pacing train resulted in higher level of pre-excitation with inversion of the right bundle of His branch activation sequence, consistent with a Mahaim accessory pathway (Figure 2 A). Spontaneous antidromic tachycardia was observed, induced by ectopic beats mimicking tachyarrhythmia (Figure 2 B) or by programmed stimulation, which could not be entrained due to the interruption of the arrhythmia. In some cases, antidromic tachycardia degenerated into atrial fibrillation (Figure 2 C). There was 12/12 lead electrocardiographic correlation between the ectopic beats and antidromic tachycardia. Only nodal conduction was evidenced with right ventricular stimulation.



Fig. 1. A. Holter monitoring recording with wide QRS ectopic beats. **B.** Spontaneous ectopic beat tracing of the accessory pathway with decremental retrograde conduction due to prolongation of the HV interval (markers). RA: Right atrium. HL: High lateral. ML: Mid lateral. LL: Low lateral. RB: Right branch.

Following diagnosis of Mahaim accessory pathway, a mapping of the accessory pathway potential was performed during atrial stimulation with a 4-mm ablation catheter in the tricuspid annulus. The catheter was placed at hour 7 of the annulus; 50 W and 60 °C radiofrequency was performed with pre-excitation disappearance. The pathway was ectopic during radiofrequency application. Stimulation maneuvers were then carried out with no connection through the accessory pathway.

The patient made good progress with no recurrence during one-year follow-up.

This case shows all the arrhythmic episodes caused by a Mahaim accessory pathway in the same patient, including repetitive, isolated extrasystoles originated in the anomalous pathway, antidromic supraventricular tachycardia, atrial fibrillation and abnormal automatism caused by radiofrequency. All these arrhythmias disappeared after successful ablation of the accessory pathway.

Mahaim fibers are unusual atrioventricular connections that exhibit decremental antegrade conduction properties, located at the tricuspid annulus and distally inserting into the right ventricle at the fascicular level in the right branch or in the myocardium near it. These pathways cause antidromic tachycardia with wide QRS and image of left bundle branch block,

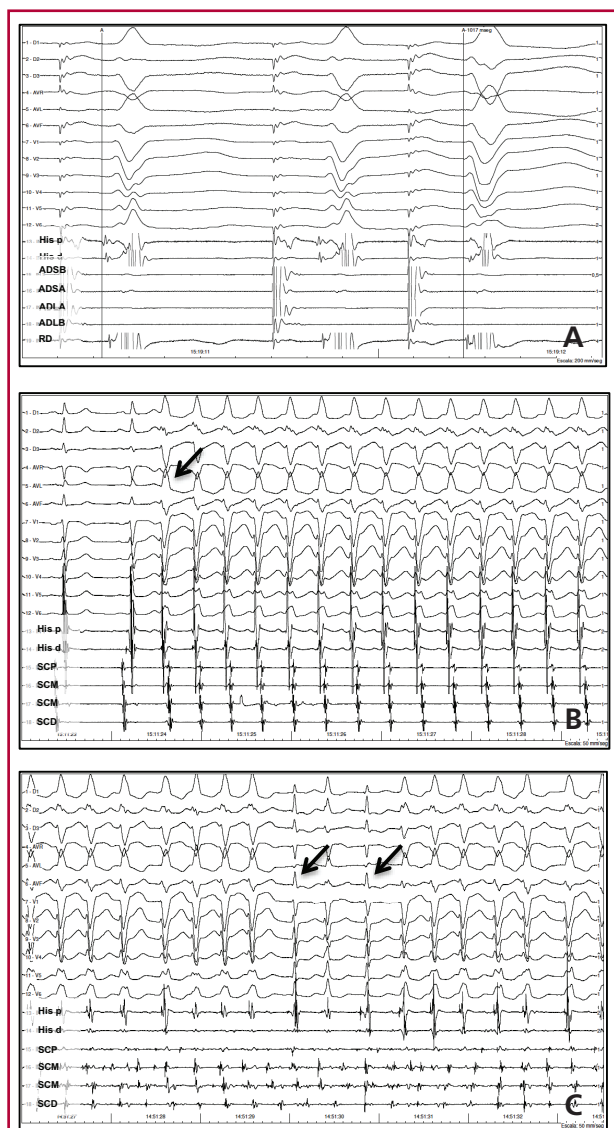


Fig. 2. A. Basal atrial stimulation with minimum pre-excitation and preferential conduction through the atrioventricular node (early His EGM activation with regard to the right branch). With the introduction of atrial extrastimuli (third beat), greater pre-excitation is evidenced, with inversion of ventricular septum activation sequence (EGM activation of the early right branch with respect to His). B. Antidromic tachycardia initiated with ectopic beats of the accessory pathway (arrow). C. Atrial fibrillation with different degrees of pre-excitation, and without pre-excitation in two beats (arrows). SCP: Proximal coronary sinus. SCM: Mid coronary sinus. SCD: Distal coronary sinus.

posing a difficult differential diagnosis with ventricular tachycardia.

Automaticity is an interesting aspect of this pathway, causing many symptoms in patients suffering from it. This aspect was first described by Kanter et al. in a patient with multiple episodes of nonsustained tachycardia during Holter monitoring. (1) Furthermore, Sternick et al. reported a series of 40 cases of Mahaim fibers, 12.5% of which had accessory pathway automaticity. (2) This property of the fibers

resides in that part of the tissue presents functional and histological characteristics similar to those of the atrioventricular node. Proof of this is that pacemaker cells have been found in pathology studies. (3) It is also worth mentioning that ectopic beats with identical morphology to automaticity and/or pre-excitation were observed during radiofrequency, which involves close contact of the catheter with the accessory pathway, predicting a successful ablation, as was the case in our patient. (4)

Patients with accessory pathways are known to have a higher incidence of atrial fibrillation, initiating with episodes of supraventricular tachycardia. Mahaim pathways are related with this association, as seen in the present case.

In summary, we report the case of a female patient with different types of arrhythmias and pre-excitation syndrome due to Mahaim accessory pathway. A thorough diagnostic methodology allowed us to determine a causal relationship between all the arrhythmias and the accessory pathway, all in one, enabling the correct therapeutic approach.

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EDITOR'S NOTE: The following two scientific letters correspond to the evolution of the same clinical case, consecutively treated in two different institutions.

Multi-Imaging in Adult-Type ALCAPA anomaly

Anomalous origin of the left coronary artery from the pulmonary artery (ALCAPA) is a rare entity representing between 0.24% and 0.46% of congenital heart defects, with a prevalence of 1 in 300,000 live births. (1) Left to its natural evolution, its mortality rate exceeds 90% in the first year of life. Those who reach adulthood (10-15%) develop a large-caliber right

coronary artery with extensive collateral circulation, which provides reverse flow in the left coronary circulation draining in the main pulmonary artery. (2)

In general, evolution is asymptomatic, with a 2:1 female predominance. Dyspnea, trepidation, angina and fatigue are the most common forms of presentation in 66% of adult cases. Twenty-seven percent of the patients usually present with ventricular arrhythmia and sudden death in the subgroup of adult patients with mean age of 33 ± 14 years.

All these findings correlate with the ischemic process, even in the absence of symptoms, and explain surgical repair as soon as the diagnosis is made, regardless of age. (2, 3)

Anomalous implantation of the left coronary artery was first reported in 1865 by Krause (4) and in 1885 by Brooks. (5) The first report in adults was discovered at autopsy of a 60-year-old woman following accidental death (5) in 1908. In 1933, a publication reported the case of a 3-month-old infant with autopsy-confirmed ALCAPA by Bland, White, and Garland. (6)

We report the case of a 39-year-old female patient, with history of syncope in her adolescence during physical activity, and two uneventful natural childbirths at the ages of 24 and 28 years.

The patient reported dyspnea on exertion over the previous year. A gamma camera study detected fixed basal anterior defect, which was informed as fibrosis. Coronary angiography showed large-caliber right coronary artery, significant development of collateral circulation, and fistulae communicating with the anterior descending artery and the pulmonary artery tree, filling with contrast agent when injected from the right coronary artery.

On the first visit to our institution, the patient referred occasional functional class II dyspnea and trepidation over the past 12 months.

Physical examination revealed a protomesosystolic murmur in the pulmonary area, electrocardiogram in sinus rhythm, and right axis deviation, without ST-segment disorders.

Based on her symptoms, the patient received beta blockers, improving her clinical condition. Echocardiography, computed tomography scan and cardiac magnetic resonance imaging (MRI) were performed.

Although echocardiography is not the ideal study to make this diagnosis, it showed a large right main coronary artery (9 mm) (Figure 1 A); color Doppler demonstrated a continuous diastolic flow consistent with collateral branches in several myocardial segments (Figures 1 B and C). The ostium of the left coronary artery (LCA) emerging from the left coronary sinus of Valsalva was not visualized, but a 10-mm round image in the main pulmonary artery was detected in the lateral-posterior region of the main pulmonary artery (Figure 1 D) with predominantly diastolic flow, consistent with the origin of the LCA. Such image was close (6 mm) to the natural origin of the artery, an important point to consider when choosing the surgical

procedure.

For better evaluation of the anatomy, a 256-slice CT scan and 3D image reconstruction was performed, showing a large-caliber (12.9 x 9.8 mm diameter) LCA originating from the lateral wall of the pulmonary artery (Figure 2 A and B), 11 mm from the valve plane, and 7.7 mm from the left sinus of Valsalva. The right coronary artery originated in the right Valsalva sinus with 9.6 x 13.5 mm diameter in its origin (Figure 2 C and D). A delayed enhancement cardiac MRI with gadolinium was performed, ruling out fibrosis. Biventricular systolic function was preserved.

Given this situation, with the confirmed diagnosis and the multiple images of the anomaly, and based on the publications of this rare entity, surgical correction of the defect was the treatment of choice due to the high risk of sudden death in these patients, regardless of the presence of ischemia or fibrosis.

There are three surgical techniques for adult patients with this rare condition. In the first place, physiologic restoration of the coronary flow is attempted with reimplantation of the LCA into the aorta. If that is

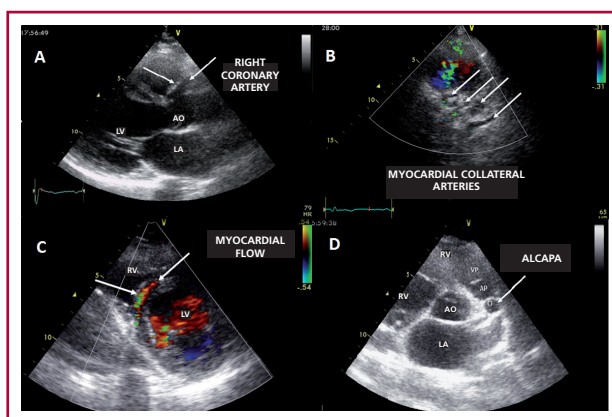


Fig. 1. See text for description.

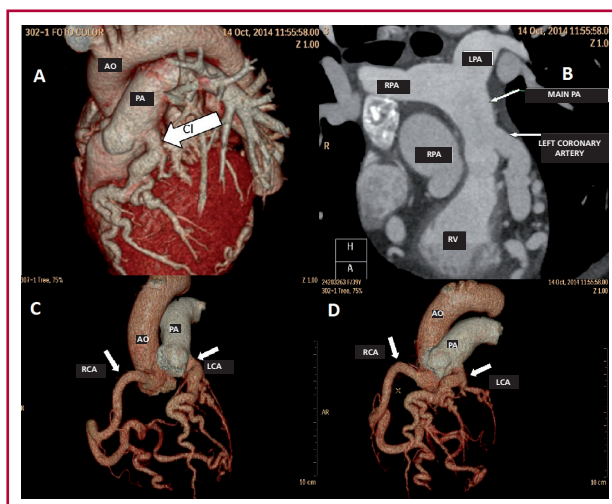


Fig. 2. See text for description.

not possible, mainly due to the LCA friable and fragile wall in adults, a venous or arterial bypass and closure of the LCA ostium in the pulmonary artery with a pericardial patch is performed. The least desirable surgical technique for these patients would be LCA ligation.

The patient was operated and LCA reimplantation into the aorta was performed. A Dacron tube graft was used for the anastomosis of the pulmonary arteriotomy; extracorporeal circulation and aortic cross-clamping times were 85 and 70 minutes, respectively. During the postoperative period, the patient presented with low cardiac output syndrome requiring high doses of inotropic agents and levosimendan infusion, probably due to myocardial stunning. The patient was finally referred to a center for circulatory support and possible heart transplant.

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Cardiogenic Shock Post-Correction of Anomalous Origin of the Left Coronary Artery from the Pulmonary Artery

We report the case of a 40-year-old female patient with ALCAPA syndrome who underwent corrective surgery with complete dissection of the pulmonary artery, dissection of left main coronary artery (LMCA), reimplantation into the aorta, and extension of the pulmonary artery with 26-mm prosthesis (extracorporeal circulation time 85 min, cross-clamping time 70 min). The patient progressed with refractory cardiogenic

shock during the first three postoperative days, so she was referred to our center for further evaluation, ventricular assistance and possible heart transplant.

On admission, the patient was hemodynamically unstable, requiring high doses of vasopressors and inotropics, and presented with multiorgan failure. Transesophageal echocardiography revealed severe left ventricular systolic function impairment, anterior and anteroseptal hypokinesis, without valvular or right ventricular involvement. Coronary angiography was performed to rule out coronary flow obstruction,

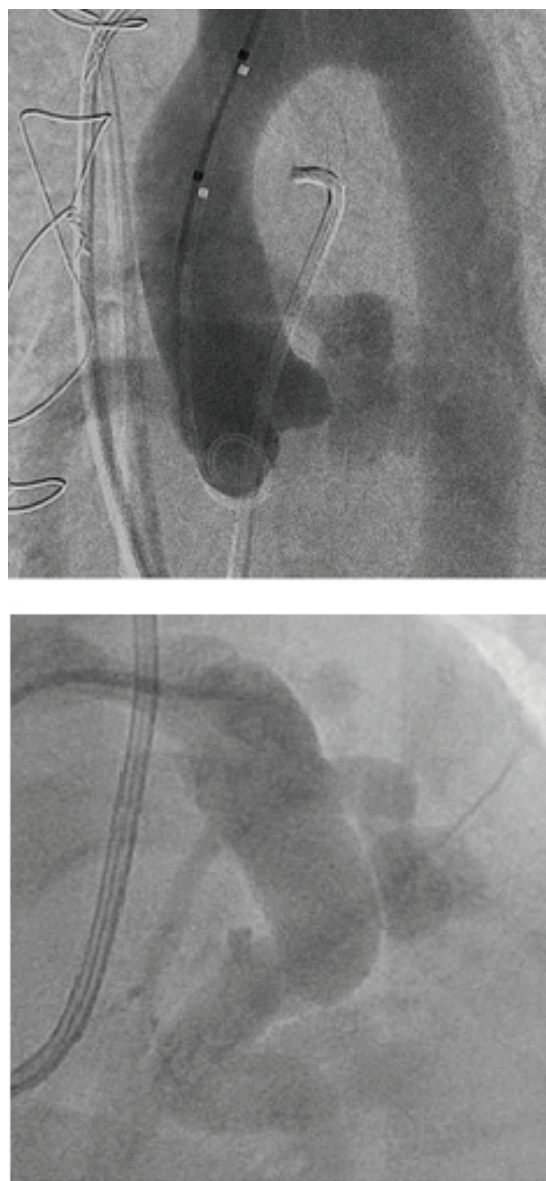


Fig. 1. A. Aortography. The image shows reimplanted left main coronary artery and right coronary artery (both tortuous and with large caliber), originating from the aorta. **B.** Right anterior oblique incidence showing the origin of the left main coronary artery.

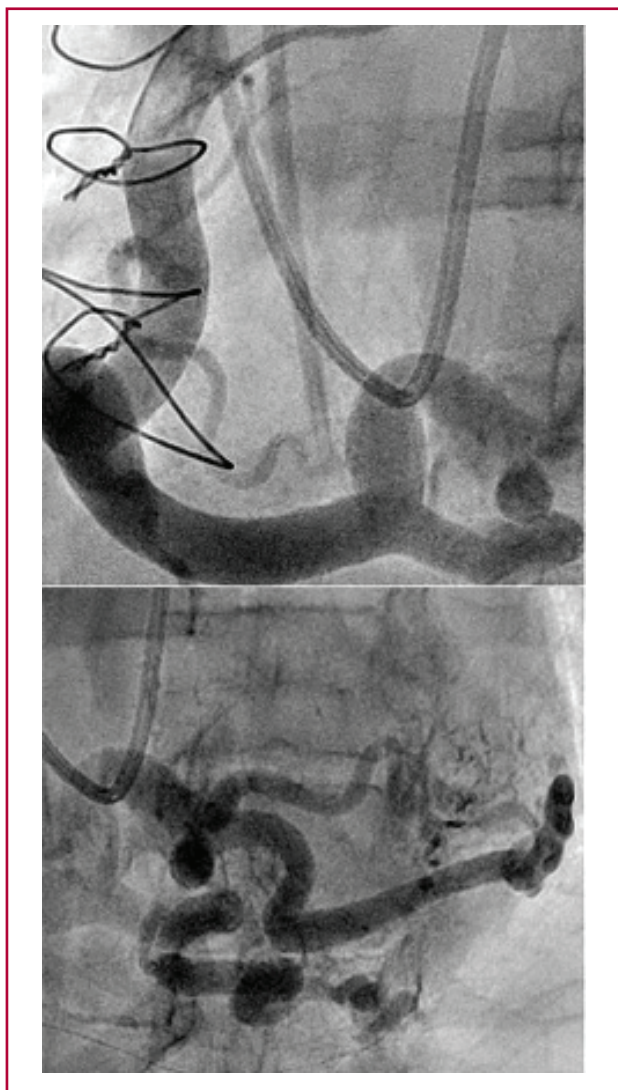


Fig. 2. The course of the right coronary artery is seen in its whole trajectory, including the prominent collateral circulation with the anterior descending artery at the distal level.

showing correct perfusion of the LMCA (Figures 1 and 2). The patient was placed on the waiting list for heart transplant.

Under hemodynamic support with inotropic agents (noradrenalin, dobutamine in moderate doses) and continuous furosemide infusion, the patient made good progress, with hemodynamic stability, progressive clinical improvement and normalization of kidney, liver failure and coagulation parameters.

On the seventh postoperative day, a follow-up echocardiography was performed, showing mild left ventricular systolic function impairment and anterior hypokinesia with no other significant findings. Mechanical ventilation was withdrawn without complications. A magnetic resonance imaging was performed as part of the follow-up, showing mild left ventricular systolic function impairment, basal anterior and basal

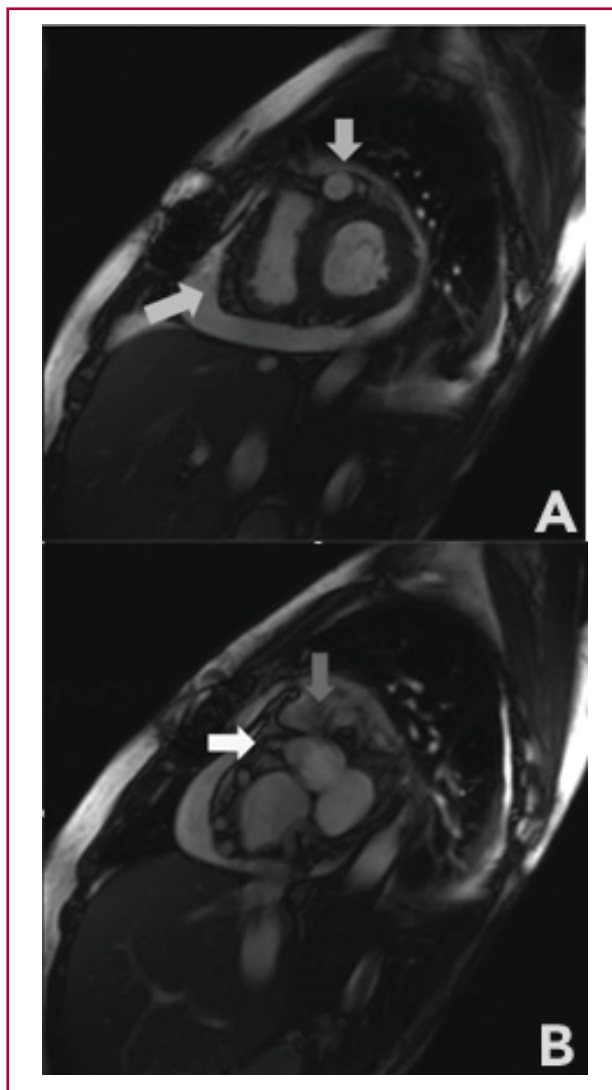


Fig. 3. A. Cardiac magnetic resonance imaging short axis view at the mid segment level, showing dilated left main coronary artery (upper arrow), multiple epicardial tortuous fistulae (lower arrow), and mild pericardial effusion. **B.** Cardiac magnetic resonance imaging short axis view at the basal segment level, showing the emergence of the reimplanted left main coronary artery (upper arrow) and right coronary artery (lower arrow) at the aortic level.

medial and anteroseptal hypokinesia, interventricular septum hypertrophy, mild left atrial enlargement, and mild pericardial effusion (Figure 3).

Considering the risk of sudden death associated with this syndrome and the history of syncope of unknown origin, placement of an implantable cardioverter defibrillator (ICD) was decided. The patient was discharged without further complications.

As mentioned above, the ALCAPA syndrome is associated with a high mortality rate; only 10% of these patients reach adulthood. This is due to the formation of collateral circulation between the right and left coronary artery, avoiding myocardial ischemia,

the pathophysiological substrate of the different syndromes (heart failure, myocardial infarction, mitral regurgitation, ventricular arrhythmia with sudden death) associated with this condition.

Our patient underwent LMCA reimplantation, the most commonly described therapeutic approach. Immediate postoperative course was torpid, with posterior favorable clinical outcome. Echocardiography and MRI showed mild deterioration of the left ventricular contractile function, with no other significant pathological finding.

The probable mechanisms of this evolution could be the inherent myocardial injury of cardiovascular surgery, inadequate myocardial protection determined by the cardiac anatomy of the patient, and the flow competence between the LMCA and the right coronary artery (RCA) –evident in the coronary angiography– on dilated and tortuous arteries, favoring coronary artery ectasia, resulting in myocardial injury.

There are no long-term studies on large adult populations with ALCAPA repair. Long-term outcome after revascularization mainly depends on the extension of nonviable myocardial tissue. (1) Due to the high risk of sudden death, placement of an implantable cardioverter defibrillator was determined.

This clinical case is presented because of the low prevalence of the condition. Occurrence in adults is even less prevalent. In this particular case, the postoperative course was atypical, with cardiogenic shock followed by recovery of left ventricular function.

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Nurses' Perceptions and Attitudes towards Automated Records in a Coronary Care Unit

Most published articles on the impact of information technologies on health care (eHealth) tend to show its benefits and positive outcomes but not its drawbacks. Publication bias against the problems these technologies could bring increases four times the likelihood of publishing studies that include beneficial rather than detrimental outcomes. (1) A recent systematic review

concluded that there is still a large gap between the advantages postulated by information technology enthusiasts and the empirically demonstrated benefits. (2) In any case, the advantages of automated processes related to health care –such as electronic records– are greater in outpatient care or in non-critical care settings. However, automation of nursing processes in critical care may have opposing effects to the alleged efficacy and cost reduction. Perhaps a more informal qualitative analysis could demonstrate the less manifest negative impact of implementing a system of electronic records on nursing care in critical settings.

In February 2015, we took part in an experience of automated daily nursing records in the Coronary Care Unit of a private institution in the City of Buenos Aires. Two weeks after implementing the system and training the nursing staff, we performed a series of 15 open qualitative interviews to learn the nurses' opinions and attitudes towards automated recording of daily progress and treatment of critical patients. The computerized system allowed nurses to manage medical indications, daily nursing records, pharmacy orders, and request complementary tests ordered by doctors. Regarding the positive aspects of electronic records, nurses pointed out that the system immediately warned them of new indications and prescriptions doctors made in their work station. Nurses also reported that the system allowed for more accessible and clear records and that, in principle, this would provide legal advantages and, certainly, easy invoicing. Automatic water balance calculation in patients was also highlighted by the respondents.

While the “auto-insertion” of text in daily records was reported as an advantage of the system, the main negative results pointed out that respondents who usually used pre-written or recycled texts (a model similar to the “copy-paste” function in word processors) repeated the evolution of patients in prior days, resulting in stereotyped and uniform reports. When asked, respondents acknowledged that they were more careful and original in handwritten reports. Somehow, homogeneous texts in electronic records reduce the richness of personalized texts. The method of “cloning a text” is appealing, because it is faster and efficient, as recognized by respondents. However, reusing an old text in new reports reduces the clinical value of observations. Handwriting on paper is often faster, more natural and ubiquitous; on the contrary, accessing a computer terminal to take down notes on patients' progress is slower and requires a different attention span, even though the access can be done in the patient's room. That was the respondents' general opinion in those used to take down handwritten notes to later add them in the electronic record. A major advantage mentioned by respondents was that uniformity in electronic records eliminated the difficulty of deciphering their colleagues' handwriting.

As other authors pointed out, computers can compete with patients for professional attention, affect-

ing their capacity for communication and relationship with the patient. (3) A study by Rouf et al. (4) analyzed the impression of patients that were attended by doctors using computers for medical records. Those patients referred that computers had adversely affected the amount of time doctors dedicated to talk and examination. In another study, primary care physicians spent 25-55% of consultation time looking at the computer screen. (5) When nurses from our study were asked whether the new electronic record system affected time and quality of care dedicated to patients, most of them answered positively. As referred by these nurses, electronic medical records took more time for those inexperienced with automation, and “put them away” from their patients despite working with a portable terminal. In short, automation can lead to less focused and personalized attention to patients. Paying attention to the computer and the patient at the same time requires multitasking, which is opposed to attentive presence. (3) In general, nurses are resistant to automation, seeing computerized health information systems as dehumanizing. Only nurses with more computer experience, together with younger and less experienced nurses, tend to have more positive attitudes to automation. (6)

Computerized information systems typically offer a relatively inflexible interface to browse the records. While searching through a paper record to get an idea of the previous evolution of the patient is faster and more convenient; searching in an electronic record can be more cumbersome. Respondents referred that the electronic record “was not useful to get a glance at the record sheet” because all the information does not appear on the same screen. Furthermore, there are too many data fields that are often left empty or filled in under special and uncommon clinical situations. These redundant fields make reading slower. Another respondent opinion refers that too much time is spent inputting data into the system when working with critical patients, who require interruption of the task to the point of sacrificing documentation on many occasions. Thus, nurses reported that many of the changes patients undergo during an emergency are not uploaded in the system, but could easily be taken down in paper records.

Finally, the disadvantages arising from “system crash” or speed issues could be technically corrected. However, a particular situation arises in the critical area when there is a delay since the medical prescription is uploaded until it appears in the pharmacy system, and the pharmacy does not supply the medication until the request becomes effective on their screen. This was reported as a common problem in

emergency situations requiring immediate treatment management.

In summary, expected benefits of automation are obvious and do not require formal testing. However, regarding safety and effectiveness evaluation, clinical computerization should be subject to the same requirements as the pharmaceutical industry, with promotion as a large-scale priority. In particular, marketed computerized systems seem to assume some conditions on medical practice that are not always exact or applicable in different working contexts. In some surveys for the nursing staff, more than half of respondents considered that electronic medical record systems were not fully integrated to their daily work flow. (7) Ultimately, the human factor again plays a key role in determining the usefulness and final adoption of automated medical records. The paradox is that while the use of those new eHealth technologies are imposed, there is still little –or modest– empirical clinical evidence on their benefits. (2) Modern enthusiasm for information technologies should not affect the unbiased analysis of the possible negative effects of automation on medical health care.

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