ESC European Society of Cardiology

European Heart Journal - Case Reports (2022) **6**, 1–5
https://doi.org/10.1093/ehjcr/ytac209

CASE REPORT
Arrhythmias/electrophysiology

Syncope in a pregnant woman with repaired Tetralogy of Fallot: a case report

Nare Ghazaryan *, Miqayel Adamyan, Lianna Khachatryan, and Tatevik Hovakimyan

Nork-Marash Medical Center, Armenak Armenakyan St. 13, 0047 Yerevan, Armenia

Received 14 December 2021; first decision 5 January 2022; accepted 17 May 2022; online publish-ahead-of-print 24 May 2022

Background Tetralogy of Fallot (TOF) is one of the most widespread cyanotic congenital heart disease (CHD), which can be successfully repaired in the neonatal period. However, residual problems and the surgical technique itself can create a favourable basis for arrhythmias and conduction abnormalities in these patients. Sometimes, these arrhythmias may worsen during pregnancy and require urgent intervention.

Case summary This is a case of a 25-year-old woman, who underwent a surgical repair of TOF at the age of 2 years. She suffered an ischaemic stroke postoperatively, which was complicated with secondary seizures and syncope. These episodes were evaluated as epilepsy. The patient was admitted to our hospital with the above-mentioned complaints in the 10th week of pregnancy. A comprehensive cardiac examination was performed. Her presyncopal event was captured during Holter monitoring, which documented a severe dysfunction of the sinus node. She was diagnosed with postoperative sick sinus syndrome and implanted with a permanent dual-chamber pacemaker (PM). After the operation, the patient did not have any episodes of syncope or seizures and the PM check-up showed almost 30% of atrial pacing.

Conclusion No matter how obvious the neurological or other nature of syncope may seem, it is advised to exclude the cardiac origin of syncope, especially in patients with repaired CHD. One of the most common complications after surgery of CHD is rhythm and conduction disturbances. In some of these cases, permanent PM implantation can be unavoidable, even during pregnancy. The implantation of the PM device during pregnancy can be performed safely.

Keywords Syncope • Tetralogy of Fallot • Sick sinus syndrome • Pregnancy • Pacemaker implantation • Case report

ESC Curriculum 5.2 Transient loss of consciousness • 5.7 Bradycardia • 5.9 Pacemakers • 9.7 Adult congenital heart disease

Learning points

- No matter how obvious the neurological or other nature of syncope may seem, it is advised to exclude the cardiac origin of syncope, especially in patients with repaired congenital heart disease.
- If indicated, the implantation of the pacemaker device during pregnancy can be performed safely.

* Corresponding author. Email: nareh.ghazaryan777@gmail.com
Handling Editor: David Duncker
Peer-reviewers: Michael Spartalis, Carolina Schwab, Sarv Priya, and Carlos Minguito Carazo
Compliance Editor: Brett Sydney Bernstein
Supplementary Material Editor: Ayse Djahit
© The Author(s) 2022. Published by Oxford University Press on behalf of the European Society of Cardiology.
This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial License (https://creativecommons.org/licenses/by-nc/4.0/), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact journals.permissions@oup.com

Introduction

Patients with congenital heart disease (CHD) are at risk of developing post-surgery heart rhythm disorders. Tetralogy of Fallot (TOF) is one of the most common forms of CHD and one of the first that has been successfully restored by cardiac surgeons. By currently adopting treatment strategies, the perioperative mortality rate is <1% and post-surgery 30-year survival rate is nearly 90%.[1,2] Residual problems after surgery, the use of patch material, atriotomy, and ventriculotomy, however, can cause scarring, fibrosis, and fibrous fatty substitution. These may become favourable bases for arrhythmias and conduction abnormalities, which may worsen during pregnancy and cause symptoms such as syncope or presyncope.[3–8] That is why a regular cardiologist follow-up after surgery is crucial, especially before planning pregnancy. In the case of loss of consciousness, it is strongly advised to exclude cardiac origin, regardless of how obvious the neurological or other nature of syncope may seem.

Timeline

Case report

Patient presentation

A 25-year-old pregnant woman in the 10th week of pregnancy was admitted to our hospital because of syncope, presyncope, and seizures, which became more frequent and repetitive during pregnancy. Such episodes have been happening since 2005. Brain magnetic resonance imaging (MRI) was performed on our patient at the time. It showed lacunes as a result of previous strokes. Since electroencephalogram (EEG) showed epileptiform activity, she was diagnosed with secondary epilepsy. The patient was prescribed a daily 300 mg carbamazepine by her neurologist. She had a previous history of surgical repair of TOF in 1997 and irregular visits to a paediatric cardiologist. In 1997 and 1999, she suffered ischaemic strokes, which were complicated by the above-mentioned secondary epilepsy.

Work up

An initial cardiac examination including electrocardiogram and echocardiogram was performed. The electrocardiogram demonstrated

21 years prior to admission	Surgical repair of Tetralogy of Fallot
Soon after the surgical repair and 2 years later	Ischemic strokes
13 years before admission	Diagnosis of secondary epilepsy due to syncope, presyncope and seizures
The year of admission	Pregnancy and increased frequency of syncope
Day 3 of admission	Diagnosis of postoperative sinus node dysfunction
Day 5 of admission	Permanent dual-chamber pacemaker implantation
36 months of follow up	No episodes of syncope, presyncope or seizures. Pacemaker check-up showed 30 % of atrial pacing.

normal sinus rhythm with incomplete right bundle branch block (QRS duration 90 ms) and a corrected QT interval of 428 ms (*Figure 1*). The echocardiogram demonstrated a mild pulmonary stenosis and pulmonary insufficiency, a mild tricuspid insufficiency, preserved biventricular ejection fraction, no signs of elevated pulmonary pressure, and no major residual structural abnormalities. A 24 h Holter monitor was performed, which showed preserved sinus and an atrioventricular (AV) nodal function (daily mean frequency of HR—79 b.p.m.), a mild burden of ventricular ectopies (400–450 premature ventricular complexes (PVCs)/24 h), and no other significant rhythm and conduction anomalies. The patient did not experience her typical symptoms during Holter monitoring, therefore was advised a repeated Holter monitoring of 48–72 h duration. This time her presyncopal event was captured on the Holter monitor, which documented a severe dysfunction of the sinus node of 50 s duration, consisting of three episodes of significant sinus arrest (3.7, 19, and 23 s) (*Figure 2*). Sinus arrest episodes coincided with the patient feeling near-syncope and dizziness.

Diagnosis

The patient was diagnosed with postoperative sick sinus node syndrome and advised to have an implantation of a permanent dual-chamber pacemaker (PM). However, epilepsy was not ruled out in our clinic but was established that it was not the only cause for frequent loss of consciousness. That is why high doses of carbamazepine did not stop her symptoms. Differential diagnosis from reflex syncope, common during pregnancy, was the next main challenge. The maternal haemodynamic changes as well as the fetus itself can amplify the vasovagal response and lead to sinus arrest and syncope. The inferior vena cava can be pressed by the fetus, preventing venous return into the heart and causing neurally mediated syncope.[9,10] Most of these cases are benign, have no clinical relevance, and can be

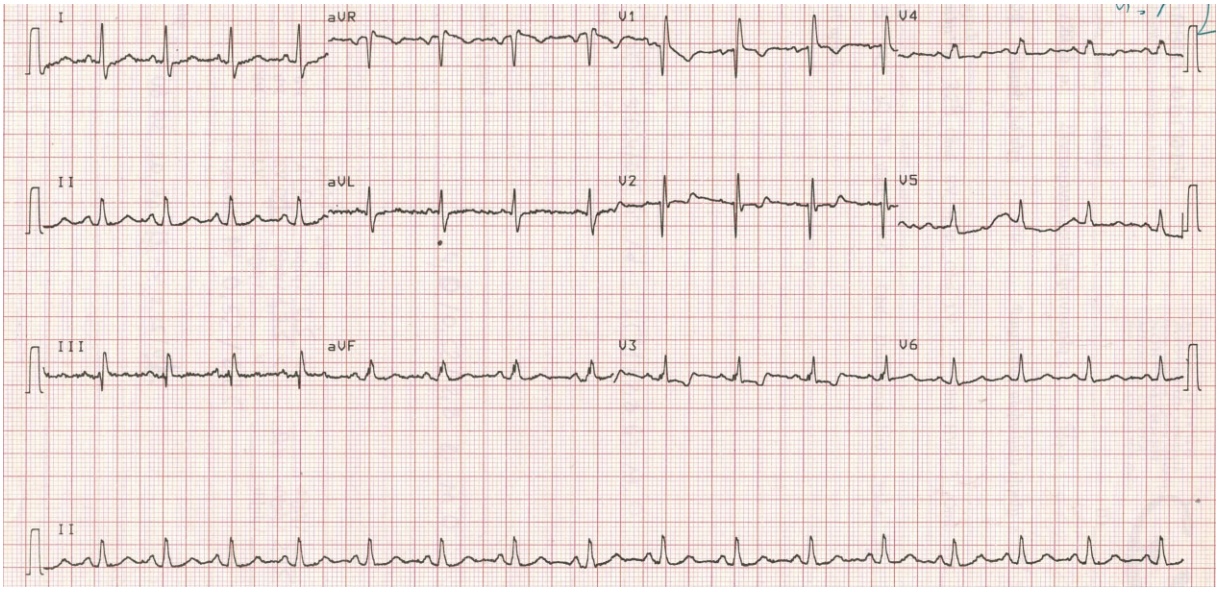

Figure 1 Twelve-lead electrocardiogram.

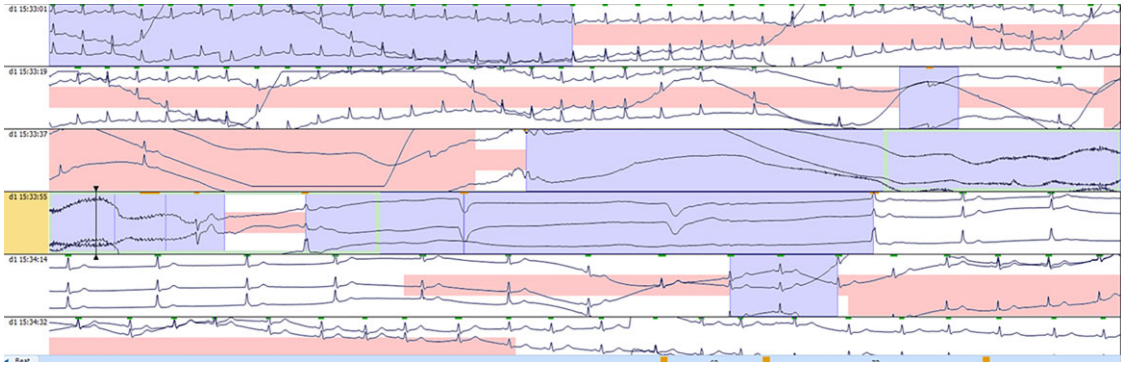

Figure 2 Sinus pause on Holter monitoring.

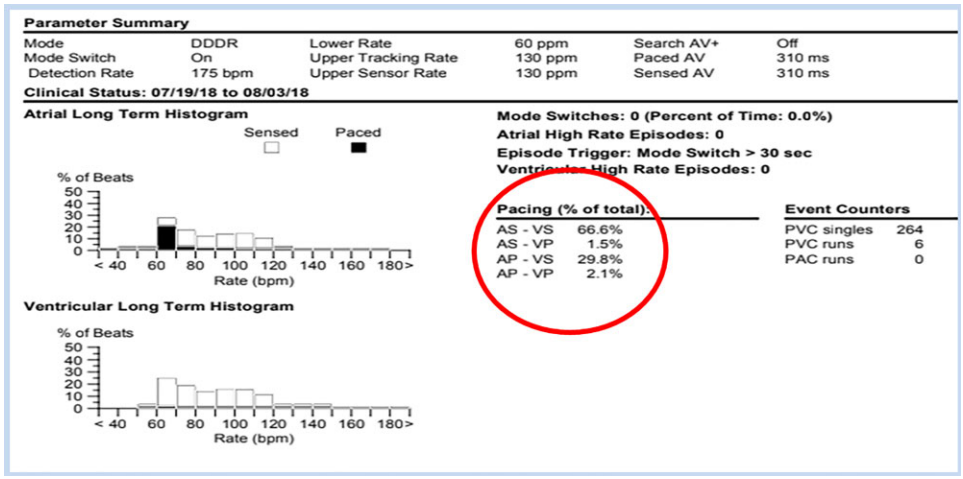

Figure 3 Pacemaker follow-up.

successfully prevented by a counter-pressure manoeuvre. Although in the case of pre-existing sinus node dysfunction, the above-mentioned mechanism may lead to a sharp increase in complaints, which happened to our patient. Sick sinus syndrome and a high-grade AV block during pregnancy in patients with repaired CHD can lead to a significant haemodynamic disturbance in both mother and fetus. Therefore, taking also into account that our patient was severely symptomatic even before pregnancy, it was decided to implant a dual-chamber PM. Implantation was urgently performed with minimized radiation time and potential harm to the fetus.

Follow-up

During 30 months of post-operation follow up, the patient did not have any episodes of syncope, presyncope, or seizures and the PM check-up showed almost 30% of atrial pacing (*Figure 3*). Given the previous MRI and EEG results, the neurologist found that the optimal solution was to continue carbamazepine in a lower dose of 50 mg after PM implantation. The pregnancy continued to be normal and a healthy baby was born on the 40th week.

Discussion

The strong point of this case is that we managed to capture the patient's presyncopal event with Holter monitoring, which revealed a significant sinus pause. According to European guidelines, the documented symptomatic sick sinus syndrome is an absolute indication for a permanent PM implantation.[11] On the other hand, the gradual slowing of the sinus rhythm before the sinus pause on Holter monitor speaks in favour of the reflex syncope, which is common during pregnancy. In physiological pregnancy, however, sinus tachycardia due to the overcirculation is more common and the absence of the latter in our patient indicates an affected sinus node. Given the history of the TOF and surgical repair in the childhood, our patient was diagnosed with postoperative sinus node dysfunction and a permanent PM implantation was performed. The presence of 30% of atrial pacing and the absence of any syncopal episodes after implantation justifies our approach for this case.

The most common complication in adult patients after surgery of TOF include rhythm and conduction disturbances, where more prevalent are ventricular tachyarrhythmias.[3] Right ventriculotomy and the use of patch material create a favourable basis for reentrant circuits and sustained ventricular tachycardia. Besides, right ventricular (RV) volume overload and RV enlargement as a result of pulmonary regurgitation, often seen after TOF repair can be other reasons for increased ventricular ectopic activity. So, in a patient with TOF repair and syncope, an Implantable cardioverter-defibrillator (ICD) implantation could be appropriate. However, our patient did not have any of the risk factors for ventricular tachycardia, such as prior palliative systemic to pulmonary shunt, frequent PVCs (only 400–450 PVCs/24 h), wide QRS complexes, decreased left ventricular ejection function or diastolic dysfunction, dilated or dysfunctional right ventricle, severe pulmonary regurgitation or stenosis, or elevated levels of Brain natriuretic peptide (BNP). Besides, her presyncopal event was captured on the Holter monitor and coincided with sinus pause, thus it was not more unexplained. So, our patient did not have classical indications for ICD therapy. On the other hand, the documented symptomatic sick sinus syndrome is an absolute indication for a permanent PM implantation, which was urgently performed on our patient.

The frequency of bradyarrhythmias following the TOF repair has dramatically decreased after the advancement of the surgical technique. According to the study conducted in Japan, the bradyarrhythmias are not quite widespread (~8%), in which sick sinus syndrome accounts for only 1% of cases of clinically significant bradyarrhythmias.[4] In some cases of severe conduction abnormalities after TOF repair, permanent PM implantation can be unavoidable, even during pregnancy. Conduction abnormalities during pregnancy can cause significant haemodynamic compromise for both mother and fetus.[12–15] If indicated, implantation of a PM device during pregnancy can be performed safely.[16,17]

Lead author biography

My name is Nare Ghazaryan. I am 31 years old. In 2014, I graduated with honours from Yerevan State Medical University and continued my studies in clinical residency in Cardiology. Within the DAAD scholarship, I spent 6 months of my residency in the Department of Cardiology at the University Clinic of Heidelberg. Immediately after completing my residency in 2017, I left for Germany and started to work in the Department of Internal Medicine at Gross-Umstadt Clinic. However, later I decided to return to Armenia to invest my knowledge and potential in my homeland. In 2019, I completed 1 year of Fellowship in Clinical Arrhythmology in Nork-Marash Medical Center and since then I am working as a young cardiologist in the same centre.

Supplementary material

Supplementary material is available at *European Heart Journal – Case Reports* online.

Acknowledgements

We would like to express our sincere gratitude to all doctors, who were involved in this case, in particular to invasive electrophysiologist Armen Khachatryan, to functional diagnostic specialist Tatevik Gabrielyan and to pediatric cardiologist Hovhannes Zohrabyan. We are also very thankful to all other medical stuff for their mindful work and dedication.

Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as Supplementary data.

Consent: The patient was informed and has signed the patient consent form in accordance with COPE guidelines.

Conflict of interest: None declared.

Funding: This report received no external funding.

References

1. Atik FA, Atik E, da Cunha CR, Caneo LF, Assad RS, Jatene MB, Riso A, Barbero-Marcial M. Long-term results of correction of tetralogy of Fallot in adulthood. *Eur J Cardio-Thoracic Surg* 2004;**25**:250–255.
2. Murphy JG, Gersh BJ, Mair DD, Fuster V, McGoon MD, Ilstrup DM, McGoon DC, Kirklin JW, Danielson GK. Long-term outcome in patients undergoing surgical repair of tetralogy of Fallot. *N Engl J Med* 1993;**329**:593–599.
3. Zubairi R. Arrhythmia susceptibility and management in adult patients with repaired tetralogy of Fallot. *J Clin Exp Cardiol* 2011;**01**:1–3.
4. Nakazawa M, Shinohara T, Sasaki A, Echigo S, Kado H, Niwa K, Oyama K, Yokota M, Iwamoto M. Arrhythmias late after repair of tetralogy of Fallot. *Circ J* 2004;**68**:126–130.
5. Kuzevska-Maneva K, Kacarska R, Gurkova B. Arrhythmias and conduction abnormalities in children after repair of tetralogy of Fallot. *Vojnosanit Pregl* 2005;**62**:97–102.
6. Nollert G, Fischlein T, Bouterwek S, Böhmer C, Klinner W, Reichart B. Long-term survival in patients with repair of tetralogy of Fallot: 36-year follow-up of 490 survivors of the first year after surgical repair. *J Am Coll Cardiol* 1997;**30**:1374–1383.
7. Hansen DE, Craig CS, Hondeghem LM. Stretch-induced arrhythmias in the isolated canine ventricle. Evidence for the importance of mechanoelectrical feedback. *Circulation* 1990;**81**:1094–1105.
8. Folino AF, Daliento L. Arrhythmias after tetralogy of Fallot repair. *Indian Pacing Electrophysiol J* 2005;**5**:312.
9. Schwarzwald S, Kersten D, Mitrache A, Cohen TJ. Syncope in pregnancy: case report and review of the literature. *EP Lab Digest* 2015;**15**. https://www.eplabdigest.com/articles/Syncope-Pregnancy-Case-Report-and-Review-Literature
10. Huang M-H, Roeske WR, Hu H, Indik JH, Marcus FI. Postural position and neurocardiogenic syncope in late pregnancy. *Am J Cardiol* 2003;**92**:1252–1253.
11. Glikson M, Nielsen JC, Kronborg MB, Michowitz Y, Auricchio A, Barbash IM, Barrabés JA, Boriani G, Braunschweig F, Brignole M, Burri H, Coats AJS, Deharo J-C, Delgado V, Diller G-P, Israel CW, Keren A, Knops RE, Kotecha D, Leclercq C, Merkely B, Starck C, Thylén I, Tolosana JM, Leyva F, Linde C, Abdelhamid M, Aboyans V, Arbelo E, Asteggiano R, Barón-Esquivias G, Bauersachs J, Biffi M, Birgersdotter-Green U, Bongiorni MG, Borger MA, Čelutkienė J, Cikes M, Daubert J-C, Drossart I, Ellenbogen K, Elliott PM, Fabritz L, Falk V, Fauchier L, Fernández-Avilés F, Foldager D, Gadler F, De Vinuesa PGG, Gorenek B, Guerra JM, Hermann Haugaa K, Hendriks J, Kahan T, Katus HA, Konradi A, Koskinas KC, Law H, Lewis BS, Linker NJ, Løchen M-L, Lumens J, Mascherbauer J, Mullens W, Nagy KV, Prescott E, Raatikainen P, Rakisheva A, Reichlin T, Ricci RP, Shlyakhto E, Sitges M, Sousa-Uva M, Sutton R, Suwalski P, Svendsen JH, Touyz RM, Van Gelder IC, Vernooy K, Waltenberger J, Whinnett Z, Witte KK, Kronborg MB, Michowitz Y, Auricchio A, Barbash IM, Barrabés JA, Boriani G, Braunschweig F, Brignole M, Burri H, Coats AJS, Deharo J-C, Delgado V, Diller G-P, Israel CW, Keren A, Knops RE, Kotecha D, Leclercq C, Merkely B, Starck C, Thylén I, Tolosana JM. 2021 ESC Guidelines on cardiac pacing and cardiac resynchronization therapy: developed by the Task Force on cardiac pacing and cardiac resynchronization therapy of the European Society of Cardiology (ESC) With the special contribution of the European Heart Rhythm Association. *Eur Heart J* 2021;**42**:3427–3520.
12. Tateno S, Niwa K, Nakazawa M, Akagi T, Shinohara T, Yasuda T. Arrhythmia and conduction disturbances in patients with congenital heart disease during pregnancy. *Circ J* 2003;**67**:992–997.
13. Hidaka Y, Akagi T, Himeno W, Ishii M, Matsuishi T. Left ventricular performance during pregnancy in patients with repaired tetralogy of Fallot. *Circ J* 2003;**67**:682–686.
14. Mendelson CL. Disorders of the heartbeat during pregnancy. *Am J Obstet Gynecol* 1956;**72**:1268–1301.
15. Joglar JA, Page RL. Antiarrhythmic drugs in pregnancy. *Curr Opin Cardiol* 2001;**16**:40–45.
16. Hartz J, Clark BC, Ito S, Sherwin ED, Berul CI. Transvenous nonfluoroscopic pacemaker implantation during pregnancy guided by 3-dimensional electroanatomic mapping. *Hear Case Rep* 2017;**3**:490–492.
17. Sharma JB, Malhotra M, Pundir P. Successful pregnancy outcome with cardiac pacemaker after complete heart block. *Int J Gynaecol Obstet* 2000;**68**:145–146.