Noninvasive detection of atrial fibrillation in cryptogenic stroke: Contribution of a new e-cardiology device

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Introduction

Missing atrial fibrillation (AF) may lead to an ischemic stroke. This complication may be avoided with oral anticoagulant treatment. Early detection of asymptomatic AF is challenging.

Case report

We describe the case of a 42-year-old engineer, physically fit with no significant personal or family medical history, who arrived at our emergency department few hours after the sudden onset of diplopia and balance disturbance. Computed tomography angiography did not detect any intracranial bleeding, parenchymal hypodensity, arterial occlusion, or dissection. An ischemic stroke was suspected. Intravenous administration of thrombolytic therapy was withheld because he arrived outside the therapeutic window for its administration. The patient received intravenous administration of 250 mg of acetylsalicylic acid and was admitted to the stroke unit and was managed according to standardized international protocols for acute stroke care. A complete workup for stroke etiology was performed including cerebral magnetic resonance imaging study, which confirmed the presence of recent infarcts in the vertebrobasilar territory (Figure 1). Detailed cardiac investigations revealed the presence of sinus rhythm throughout 72 hours of electrocardiographic ambulatory monitoring and unremarkable transthoracic and transesophageal echocardiograms: atria of normal shapes and sizes, normal left ventricular ejection fraction, absence of valvular abnormalities, and no evidence of patent foramen ovale or aneurysm of the interatrial septum. Echocolor Doppler of the extracranial vessels showed no atheroma or dissection.

Autoimmune, infectious, and coagulation studies were normal, as were the thyroid function, blood lipids, and blood glucose. During 7-day hospitalization, the patient's systolic blood pressure and diastolic blood pressure consistently remained ≤130 and ≤80 mm Hg, respectively, and he remained free from angina, dyspnea, and palpitation. His clinical status evolved favorably, with complete resolution of diplopia and balance disturbance. He did not present any additional signs or symptoms suggestive of recurrent stroke while in the hospital. He was discharged with a diagnosis of embolic stroke of undetermined source[1] and with a treatment for secondary stroke prevention based on acetylsalicylic acid DL-lysine (Kardégic, 160 mg/d) and a statin, with a therapeutic target of low-density lipoprotein cholesterol maintenance level of less than 1.0 g/L. At the 3-month follow-up clinical examination, the patient was asymptomatic except for fatigue. In order to search for cardiac arrhythmia, the implantation of a subcutaneous electrocardiographic loop recorder monitor was proposed, but the patient declined. Instead, he accepted to wear a CardioNexion T-shirt (@-Health, Les Milles, France), which continuously monitors the electrocardiogram, via a portable telephone connected to a surveillance station. This garment

KEY TEACHING POINTS

- By wearing a garment connected to a dedicated noninvasive telemedicine system it was possible to early detect asymptomatic paroxysmal atrial fibrillation.
- The connected garment allowed noninvasive, real-time rhythm follow-up.
- This observation justifies larger observational studies to confirm the reliability and durability of the connected garment.

KEYWORDS Atrial fibrillation; Connected garment; Cryptogenic stroke; Noninvasive monitoring; Real time
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Dr Tarlet and Mr Coulon own shares of @-Health. Other authors report no conflicts of interest. **Address reprint requests and correspondence:** Dr Jean-Michel Tarlet, Institution Centre de Cardiologie, 32 Blvd du Roy René, 13100 Aix-en-Provence, France. E-mail address: jmtarlet@healthcardionexion.com.

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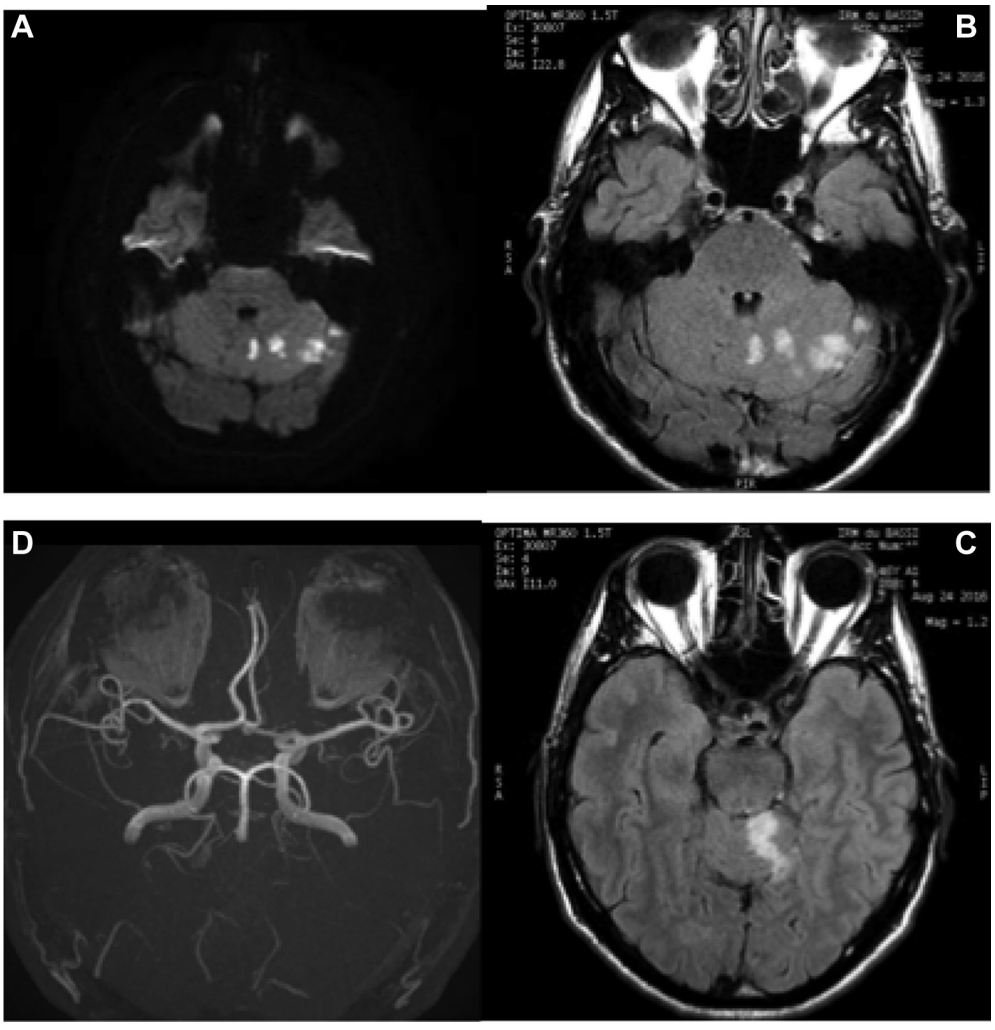

Figure 1 Cerebral magnetic resonance imaging performed on the fourth day after stroke onset. In the diffusion-weighted imaging sequence, hypersignals are visible in the left cerebellar hemisphere, the territory of the posteroinferior cerebellar artery and the vermis, the territory of the superior cerebellar artery, and branches of the left vertebral and basilar arteries (**A**). The embolism-like ischemic lesions are apparent in the fluid-attenuated inversion recovery sequence (**B, C**). The left posteroinferior cerebellar artery is not visible on time-of-flight angiography (**D**).

is comfortable and washable. The initial weeks of telemonitoring revealed stable sinus rhythm with rare ventricular extrasystoles and a single, nondiagnostic, nocturnal pause due to atrioventricular block. The quality of the electrocardiographic signal transmitted via the Internet cloud was high, with a consistently visible P wave (Figure 2).

Approximately 2 weeks later, 3 hours after participating in an unspecified sport, the patient developed an asymptomatic episode of AF (Figure 3) between 3:35 PM and past midnight (Supplemental Figure 1). The recording was immediately transmitted to the patient's cardiologist for an emergency consultation. In view of the CHA_2DS_2-$VASc_2$ score of 2 points, based on the history of stroke, the patient was placed on a direct oral anticoagulant treatment.[1] He continued to wear the T-shirt in order to monitor his tolerance to physical efforts and for diagnostic confirmation for 3 months.

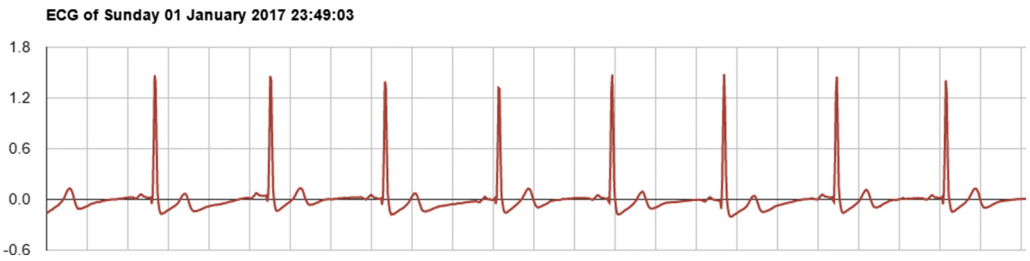

Figure 2 Example of a tracing recorded by the @-Health telesurveillance system, showing normal sinus rhythm at 62 beats/min with rare ventricular extrasystoles. The quality of the signal transmitted via the Internet cloud is high, with a clearly visible P wave.

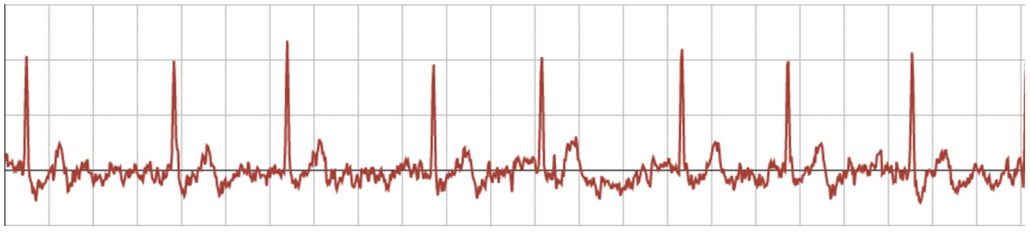

Figure 3 Electrocardiographic recording of an asymptomatic paroxysmal atrial fibrillation episode.

Discussion

Stroke etiology remains of undetermined source (ie, cryptogenic) in approximately 20%–40% of patients. AF accounts for up to 20% of cryptogenic stroke, of which more than 20% are fatal.[2] The term *embolic stroke of undetermined source*[3] is a clinical entity that refers to a subgroup of patients with cryptogenic strokes presenting with an embolic pattern (single cortical, multiple territorial involvement, not lacunar subcortical infarcts), and who are deemed to be at a higher risk of stroke recurrence owing to possible underlying AF, as compared with the more heterogeneous group of cryptogenic stroke. The Cryptogenic Stroke and underlying Atrial Fibrillation study recorded a 30.5% rate of asymptomatic AF 3 years after suffering a stroke of unknown origin in patients wearing a Reveal XT subcutaneous implantable cardiac monitor (Medtronic, Inc., Minneapolis, MN).[4] The ECOST trial[5] demonstrated the long-term safety and effectiveness of remote home monitoring of implantable cardioverter-defibrillators in detecting adverse events as compared to standard ambulatory follow-ups.

Connected garments (Supplemental Figure 2) have the advantage of being not invasive. Transmission of the signal through the smartphone allows rhythm monitoring anywhere. No connecting terminals are necessary.

In this case, arrhythmia occurs within 2 weeks but it could appear later. The CardioNexion T-shirt can be worn without any time limit. P-wave detection using this device is achieved through a dipole.

Telecardiology confers medical and economic advantages to recipients of implantable cardioverter-defibrillators,[6,7] such that the Heart Rhythm Society has assigned a level IA recommendation to this type of patient monitoring.[8] With the connected garment, CardioNexion technology monitors the electrocardiogram in permanence, along with other variables, including body temperature, respiratory rate, and patient geolocation.

Conclusion

This case report demonstrates that it is possible to detect asymptomatic atrial fibrillation with a noninvasive connected garment.

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Appendix

Supplementary data

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.hrcr.2018.06.006.

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