Category

Best Startup

Product/Solution Name

Volta AF-Xplorer

Date of Approval

2023-01-21

Indications

Our first product's name is VX1 which has been improved and the new version has been called at the beginning VX1+ and now Volta AF-Xplorer. VX1 + and Volta AF-Xplorer refers to the same product.

Date of Approval (If FDA/EMA approved) : FDA clearance (Volta AF-Xplorer): January 2023/ FDA clearance (VX1) : 16 September 2020 / CE-marking (VX1) : 14 January 2020

Therapeutic Categories

MedTech

Attached Files:

- 001_Volta Medical_Traditional Premarket Notification_VX1_11222022.pdf

Background information and need for solution/product

Worldwide, Atrial Fibrillation (AF) is the most common sustained cardiac arrhythmia in adults with more than 37 million patients. The currently estimated prevalence of AF in adults is between 2% and 4%, and a 2.3-fold rise is expected. (2020 ESC)

AF is caused by abnormal electrical impulses forming anywhere in the atria. The pathophysiology of AF is complex, involving interaction among multiple factors, including triggers, which are responsible for AF initiation; substrate, which is necessary for AF maintenance; and perpetuators, which underlie the progression of the arrhythmia from paroxysmal to the persistent forms. (2017 HRS)

Catheter ablation has become an established therapy for the treatment of atrial fibrillation and remains the prevailing cardiac ablation procedure performed globally. The conventional anatomical ablation approach, which consists of the complete isolation of pulmonary veins by linear lesions around their antrum, is mostly effective for paroxysmal AF (30% of patients). However, for complex cases of persistent AF (70% of patients), the current ablation strategy is suboptimal.

The absence of a consistent standard of care for persistent AF has led to a diverse range of approaches over the last decades. Multiple groups and technologies have offered approaches to localize regions of abnormal electrical activity in the heart based upon electrogram analysis. Some have focused on the frequency of activation of electrograms emanating from AF / AT drivers (Atienza, Almendral et al. 2009, Atienza, Almendral et al. 2014). Others have targeted driving regions localized after advanced signal

processing, allowing for reentrant electrical source visualization (Narayan, Krummen et al. 2012, Miller, Kowal et al. 2014, Miller, Kalra et al. 2017). Also, some have simply ablated in areas where low voltage electrograms were suggestive of discontinuous impulse propagation (Narayan, Wright et al. 2011, Jadidi, Cochet et al. 2013, Jadidi, Lehrmann et al. 2016). Finally, some have chosen to target abnormal mono- or multipolar electrograms, named complex fractionated atrial electrograms (CFAEs) (Nademanee, McKenzie et al. 2004, Oral, Chugh et al. 2009).
However, these approaches resulted in varied and frequently unsatisfactory outcomes accompanied by elevated rates of recurrence. Moreover, most of these ablation strategies rely heavily on operator's experience and skills and lack reproducibility.

Inspired by the work of Dr. Nademanee on CFAEs, Dr. Julien Seitz, Dr. Clément Bars, and Dr. Jérôme Kalifa (co-founders of Volta Medical) worked on a more precise definition of intracardiac signals associated with driver regions during atrial fibrillation (regions perpetuating the arrhythmia). This resulted in the definition of what is known as spatiotemporal dispersion. With the help of Théophile Mohr Durdez (co-founder and CEO of Volta), a data scientist from the French engineering school Polytechnique, they developed an AI software capable of mimicking their expert analysis to reproducibly identify these specific abnormal intracardiac signals, known as dispersed EGMs.

Attached Files:
- VX1_Brochure.pdf

History of the development of the solution/product

The « Substrate HD » study is a « proof-of-concept » published in the Journal of the American College of Cardiology in 2017.
This study defined the concept of "dispersion" and "dispersed electrograms" which can be used to identify driver regions (regions perpetuating the arrhythmia) during AF ablation. Dispersion areas were defined as clusters of electrograms, either fractionated or non-fractionated, that displayed interelectrode time and space dispersion at a minimum of 3 adjacent bipoles such that activation spread over all the AF cycle length. This work also presented preliminary findings supporting that the targeted ablation of dispersed electrograms may represent an effective approach to treat AF patients.

Volta's first product, VX1, leverages machine learning including deep learning algorithms to faithfully reproduce the multi-parametric analysis performed by the human brain. VX1 allows a reliable and reproducible approach between centers, as demonstrated by the « Ev-AIFib » study.
Ev-AIFib is a prospective, multicentric, non-randomized trial. This study aimed to evaluate the performance and safety of Volta Medical software VX1 on 85 de novo persistent AF patients, 8 sites and 17 operators. It was concluded that VX1 allowed for robust center-to-center standardization of acute and long-term ablation outcomes after electrogram-based ablation (Seitz, Mohr Durdez et al. 2022, Deisenhofer 2022). Furthermore, after a one-year follow-up, patients demonstrated a high freedom from atrial fibrillation and from any atrial arrhythmia, 89% and 73% after an average of 1.3 procedures per patient, respectively. Ablation at dispersion areas led to acute termination of AF in 88% of patients.

The TAILORED-AF clinical trial is an international, multicenter, randomized controlled study involving 26 sites and 374 patients. Patient enrollment was completed at the beginning of 2023 and the study results are expected in 2024.
TAILORED-AF was designed to confirm the clinical significance of VX1 and lay the groundwork for establishing VX1 as a new standard of care for persistent AF ablation. It aims to demonstrate that a

tailored VX1-guided ablation strategy targeting areas exhibiting spatiotemporal dispersion in association with PVI, is superior to conventional anatomical ablation approaches (PVI alone) for the treatment of persistent AF.
The primary endpoint is freedom from documented AF episodes lasting longer than 30 seconds, with or without antiarrhythmic drugs (AADs), 12 months after a single index ablation procedure. Secondary endpoints include absence of AF and/or atrial tachycardia (AT) episodes after a 12-month period, following one or more procedures, as well as safety.

Attached Files:
- JACC Seitz 2017.pdf

Why this solution/product is innovative, the broad implications for future research, and/or how it will improve the human condition

Why this solution/product is innovative, the broad implications for future research, and/or how it will improve the human condition
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Founded by three physicians and a data scientist in 2016 in Marseille, Volta's overarching goal is to improve cardiac arrhythmia management by developing state-of-the-art, data-driven medical devices trained on large databases of procedural data with the highest standards of data protection.

The development of Volta Medical algorithms, relying on artificial intelligence (AI), represents an attempt at satisfying a medical need for an automatic and reliable detection of dispersed electrograms. The conventional atrial fibrillation treatment strategy, which consists of an anatomical approach with the isolation of the pulmonary veins, results in poor results for patients with persistent AF, and about half of the patients require repeat treatments. The approach proposed by Volta allows the standardization of a so-called "tailored" ablation procedure.

Volta Medical's first product, VX1, is the first commercially available AI decision-support software to help guide physicians during complex ablation procedures with identification and real-time annotation of unique abnormalities ("dispersed electrograms"). Volta AF-Xplorer, an upgraded version of the software VX1, was cleared by the U.S. Food and Drug Administration (FDA) in January 2023 and is pending CE-mark.

During the procedure, as the electrophysiologist moves the diagnostic multipolar catheter inside the patient's heart, the system continuously collects intracardiac electrograms. The electrical signals are analyzed in real-time by Volta's algorithm to detect abnormal electrograms of interest called "dispersed" electrograms, which are potentially involved in the arrhythmia mechanism. The regions of interest are displayed on a dedicated user-friendly interface and can then be tagged on a 3D map of the heart.

Volta's dispersion algorithm uses a dual approach of machine learning and deep learning classifiers to analyze intra-cardiac signals recorded with a multipolar catheter. Both classifiers have been trained on a large database of EGMs, annotated by expert electrophysiologists.
To further enrich its database, Volta has developed ai.dea: a 'first of its kind' data collection ecosystem. This ecosystem seamlessly captures rich EP-lab data, to train AI-based algorithms for future solutions in the fight against complex heart rhythm diseases. Through partnerships with European and

American centers, Volta is also increasing the representativeness and diversifying its database..

Volta AI software is compatible with most 3D navigation systems, mapping catheters and EP recording systems. The second-generation software, Volta AF-Xplorer, also features an enhanced integration with Abbott EnSite X mapping system providing improved workflow due to automated Volta 'regions of interest' tagging capabilities. In addition, the software provides compatibility with Biosense Webster's popular Octaray multipolar mapping catheter. This extended compatibility supports a tailored and intuitive workflow which allows a fast-learning curve.

Over 1000 procedures have so far been supported in the EU and US by Volta AI software. Based on clinician's feedback and clinical results, this technology ultimately may contribute to make catheter-ablation outcomes significantly more reliable for complex arrhythmias, including persistent AF.

Attached Files:

- AFXplorer brochure v15_240423.pdf

Please provide appropriate references (ie Pubmed links)

Seitz, J., Bars, C., Théodore, G., Beurtheret, S., Lellouche, N., Bremondy, M., ... & Kalifa, J. (2017). AF ablation guided by spatiotemporal electrogram dispersion without pulmonary vein isolation: a wholly patient-tailored approach. Journal of the American College of Cardiology, 69(3), 303-321. https://pubmed.ncbi.nlm.nih.gov/28104073/

Seitz, J., Durdez, T. M., Albenque, J. P., Pisapia, A., Gitenay, E., Durand, C., ... & Kalifa, J. (2022). Artificial intelligence software standardizes electrogram-based ablation outcome for persistent atrial fibrillation. Journal of Cardiovascular Electrophysiology, 33(11), 2250-2260. https://pubmed.ncbi.nlm.nih.gov/35989543/

Deisenhofer, I. (2022). Electrogram-based AF ablation--finally, reproducibility!. Authorea Preprints. https://pubmed.ncbi.nlm.nih.gov/35989539/

Attached Files:

- EGM based AF ablation finally reproducibility Deisenhofer editorial to EVAIfib 822 1.pdf