Arrhythmias, Vagus Nerve, Visceral Manipulation and Neural Manipulation

The stomach and the heart share a converging neural connection via the vagus nerve. In addition to the common physical neural connection, ghrelin, which is a peptide hormone produced mainly by cells in the fundus of the stomach, suppresses cardiac sympathetic nerve activity. In a phenomenon referred to as “cross-organ sensitization” the neural stimulation of one organ is capable of exciting or inhibiting the other organ through convergent neurons in the Central Nervous System. Cross-organ sensitization is accumulating a growing body of research. For example, the distention of the stomach has been shown to activate spinothalamic tract neurons. In an animal study on rats researchers discovered that introducing a “noxious” substance into the pericardium and/or distending the stomach activated 85% of the “gastrocardiac convergent neurons”. A bilateral vagotomy did not have any effect on the activation of these neurons.

In 2012 A.J. de Koning, DO, an instructor for the Barral Institute and osteopathic practitioner in Italy, was approached by a renowned Italian cardiologist for treatment due to not being able to stand during long surgeries. The treatment was successful. He invited De Koning to do research with 40 Atrial Fibrillation(AF) patients at his hospital and they observed significant positive changes in patient outcomes.

The general listening (GL) on each of the 40 AF patients was to the left epigastric area and the local listening (LL) was to the stomach (see discussion on GL and LL below). De Koning used techniques developed and taught by Jean-Pierre Barral to mobilize the parietal peritoneum relative to the anterior visceral peritoneum of the stomach. Each patient was seen two to three times, however, many were asymptomatic after only one session and many were able to discontinue use of pharmaceutical drugs that had been necessary for the management of their AF.

De Koning was able to teach the cardiologist how to perform these simple maneuvers and on one occasion, prior to a cardiac surgery, the surgeons could not lower a patient’s heart rate below 200bpm through his standard medical protocol. This cardiologist did the stomach mobilization technique and it brought the heart rate down to 100bpm.

As a result of the success of this study De Koning and the cardiologist launched a new clinic in Rome, which is the first of its kind. They are providing both conventional cardiac treatment along side of osteopathic treatment to patients suffering with AF.

In mobilizing the stomach De Koning et al., 2012, hypothesize they were having an effect on the terminal rami of the vagus nerve stimulating the afferent gastric vagal innervation creating a viscera-visceral reflex. This reflex, it is hypothesized, is then delivered to the solitary nucleus (NTS) and/or nucleus ambiguus (NA) creating a central convergence. The NA provides neural input that affects the respiratory sinus arrhythmia. In an animal study on rats it was demonstrated that the NA is able to inhibit gastric motility via the vagus nerve. In addition to the NA providing a possibly mechanism the neurons in the NTS might also be contributing due to their role in the “… gastric vago-vagal reflex control circuitry”.

In light of the studies by Qin et al., 1992-2012, it is possible this affect is due to other, lesser known gastrocardiac converging neurons.

A relationship between the stomach and heart is not an unknown phenomenon as postprandial angina pectoris is recognized for which convergent neurons provide a possible mechanism.

A.J. de Koning is finalizing his research and preparing it for publication.

Here is an article that shows the relationship of the stomach to the heart.

Inducibility of ventricular arrhythmias after gastric distension: The catecholamine equivalent in Brugada syndrome ablation?

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Brugada syndrome (BrS) is an arrhythmogenic disease associated with increased risk of sudden cardiac death (SCD) due to ventricular tachyarrhythmias. To date, the only proven effective therapy for symptomatic patients is implantable cardioverter-defibrillator (ICD) implantation. However, some patients with BrS who receive ICD therapy experience frequent appropriate shocks, and antiarrhythmic drugs are often poorly tolerated. In the last decade, radiofrequency ablation (RFA) has been proposed as an alternative to prevent these arrhythmias.[1,2] Regardless of the chosen target, RFA in BrS is challenging because the substrate (areas of delayed depolarization) usually is epicardial and the trigger (ventricular premature beats [VPBs]) is not always present at the time of the procedure. In this report, we describe a simple method for inducing VPBs and ventricular tachycardia (VT) in order to provide a reliable endpoint during RFA.

Case report

A 42-year-old southeast Asian male received an ICD in May 2000 for aborted SCD. The diagnosis of BrS was established after documentation on 12-lead ECG of a spontaneous coved Brugada pattern in the inferior leads and a flecainide-induced coved Brugada pattern in the right-sided precordial leads. As previously reported for this patient,[3] genetic testing was positive for a nonsense SCN5A mutation (R179X), which has been found to be associated with a Brugada ECG pattern in the inferior/right precordial leads and produces a nonfunctional cardiac sodium channel, carrying a more severe arrhythmic phenotype.[4] Accordingly, despite antiarrhythmic therapy with quinidine, our patient experienced recurrent appropriate ICD interventions (until February 2013, 11 isolated ICD shocks and 1 arrhythmic storm). Episodes are often preceded by a large meal, and the patient describes the subjective feeling of repetitive palpitations right before the shock. In 2011, when the patient was admitted to our coronary care unit for the arrhythmic storm, we were able to document with telemetry recordings that ICD shocks were triggered by polymorphic ventricular tachycardia (PVT) preceded by VPBs, with a uniform QRS morphology. These VPBs resembled isolated ectopics documented by 12-lead ECG that showed a left bundle branch block morphology and a superior axis of the QRS (Figure 1).

In February 2013, after another appropriate ICD intervention, we decided to perform an electrophysiologic study aimed at mapping and ablating the PVT-triggering VPBs. Following an adequate washout period for quinidine and after obtaining informed consent, with the patient under profound sedation with midazolam and fentanyl we proceeded with 3-dimensional electroanatomic mapping of the right ventricle and a locatable catheter with contact force capability. A detailed substrate map of the right ventricular endocardium performed during sinus rhythm showed no areas of low voltage, neither in the right ventricular outflow tract nor elsewhere. Due to absence of clinical VPBs during the study, both at baseline and with programmed stimulation or burst pacing, and given the objective difficulty in performing an accurate 12/12 pace mapping using the clinical 12-lead ECG (exact position of patient and precordial electrodes were unknown), we attempted to induce VPBs by reproducing the clinical trigger (large meals) with stomach distension obtained by insufflating room air (1000–1500 cc) through a nasogastric tube. This maneuver promptly and repeatedly elicited frequent monomorphic repetitive VPBs and runs of nonsustained VT, whose morphology was similar to the clinical VPBs (Figure 2). Combined activation and pace mapping allowed us to localize the origin of those ectopics in the midapical anteroseptal right ventricle, a region corresponding to the distal right ventricular Purkinje system. This was confirmed by observing typical Purkinje potentials preceding QRS during sinus rhythm (Figure 3). Emptying the stomach

KEYWORDS Brugada syndrome; Ventricular tachycardia; Ventricular premature beat; Vagal stimulation; Radiofrequency ablation

ABBREVIATIONS **BrS** = Brugada syndrome; **ICD** = implantable cardioverter-defibrillator; **PVT** = polymorphic ventricular tachycardia; **RFA** = radiofrequency ablation; **SCD** = sudden cardiac death; **VPB** = ventricular premature beat; **VT** = ventricular tachycardia (Heart Rhythm 2013;10:1549–1552)

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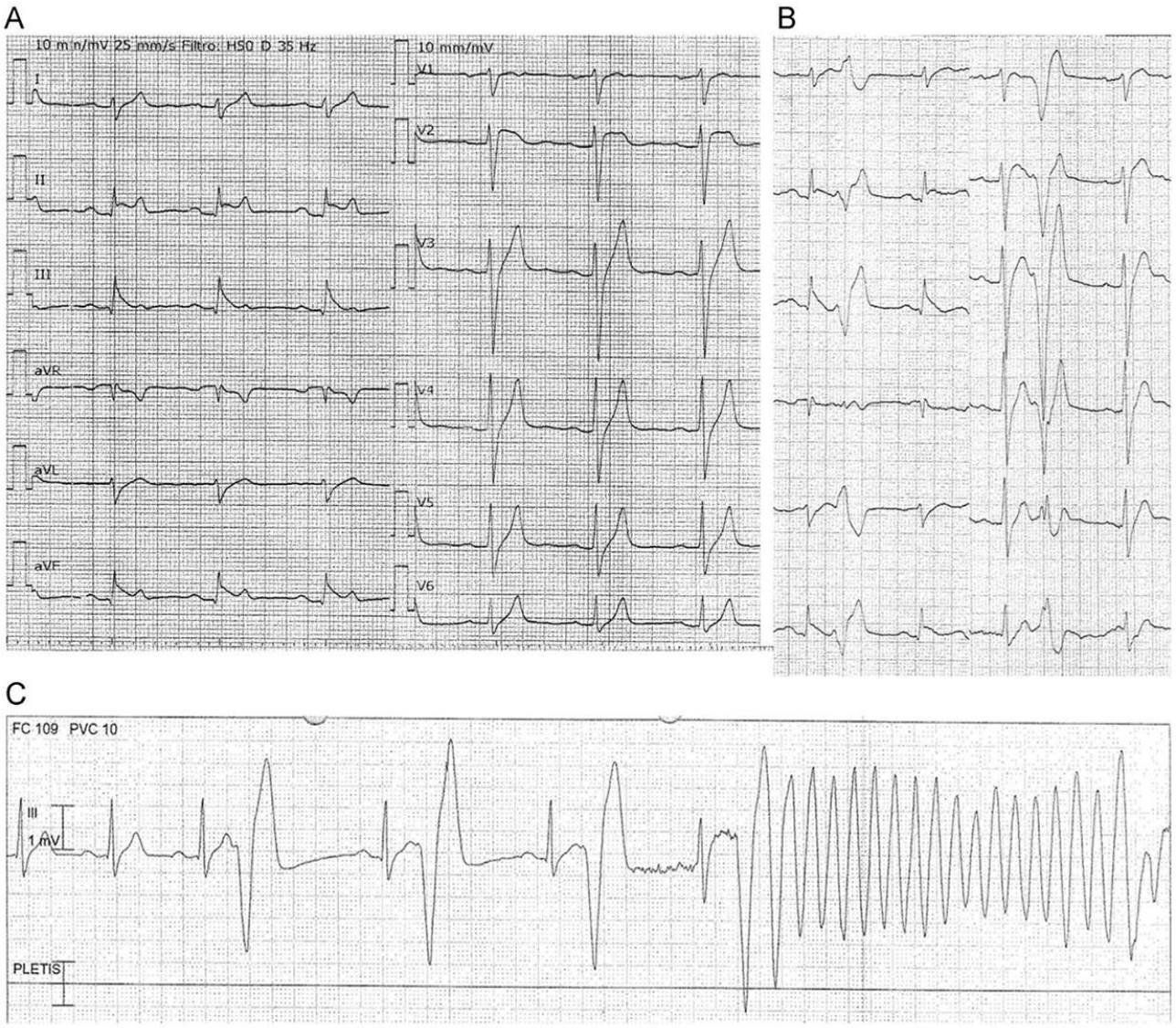

Figure 1 **A:** Baseline 12-lead ECG of the patient showing a Brugada pattern in the inferior leads. **B:** Clinical ventricular premature beat with left bundle branch morphology and superior axis. **C:** Telemetry recording showing polymorphic ventricular tachycardia preceded and triggered by a ventricular premature beat.

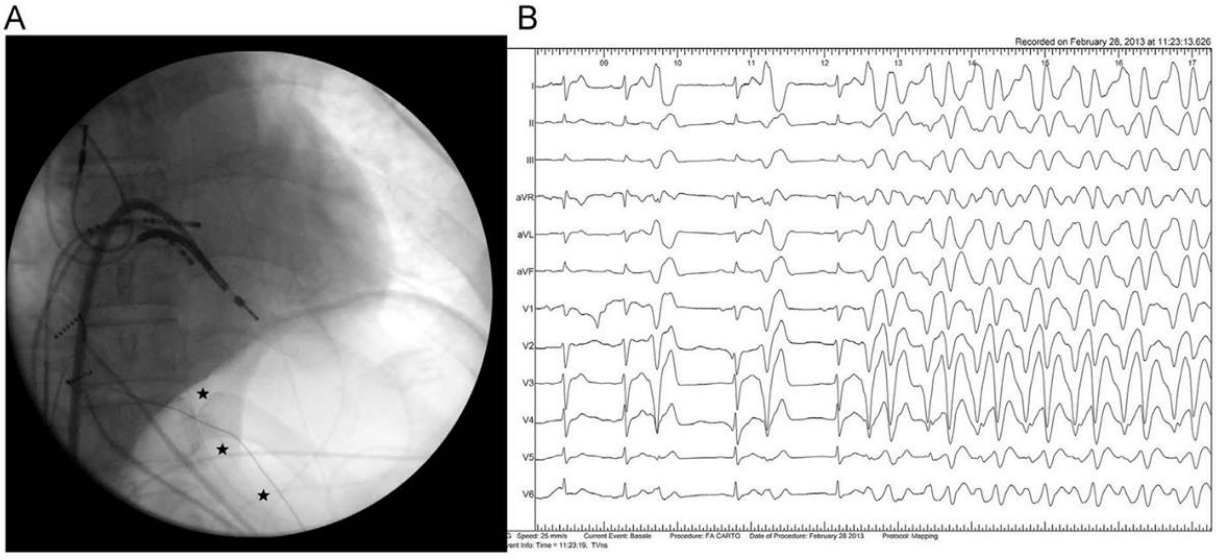

Figure 2 **A:** Fluoroscopic image (anteroposterior view) of the heart with concomitant gastric distension obtained with air insufflation (1500 cc) through a nasogastric tube (*stars*). **B:** Twelve-lead ECG during gastric distension showing monomorphic ventricular premature beats and a run of nonsustained ventricular tachycardia (with bigeminal fusion complexes).

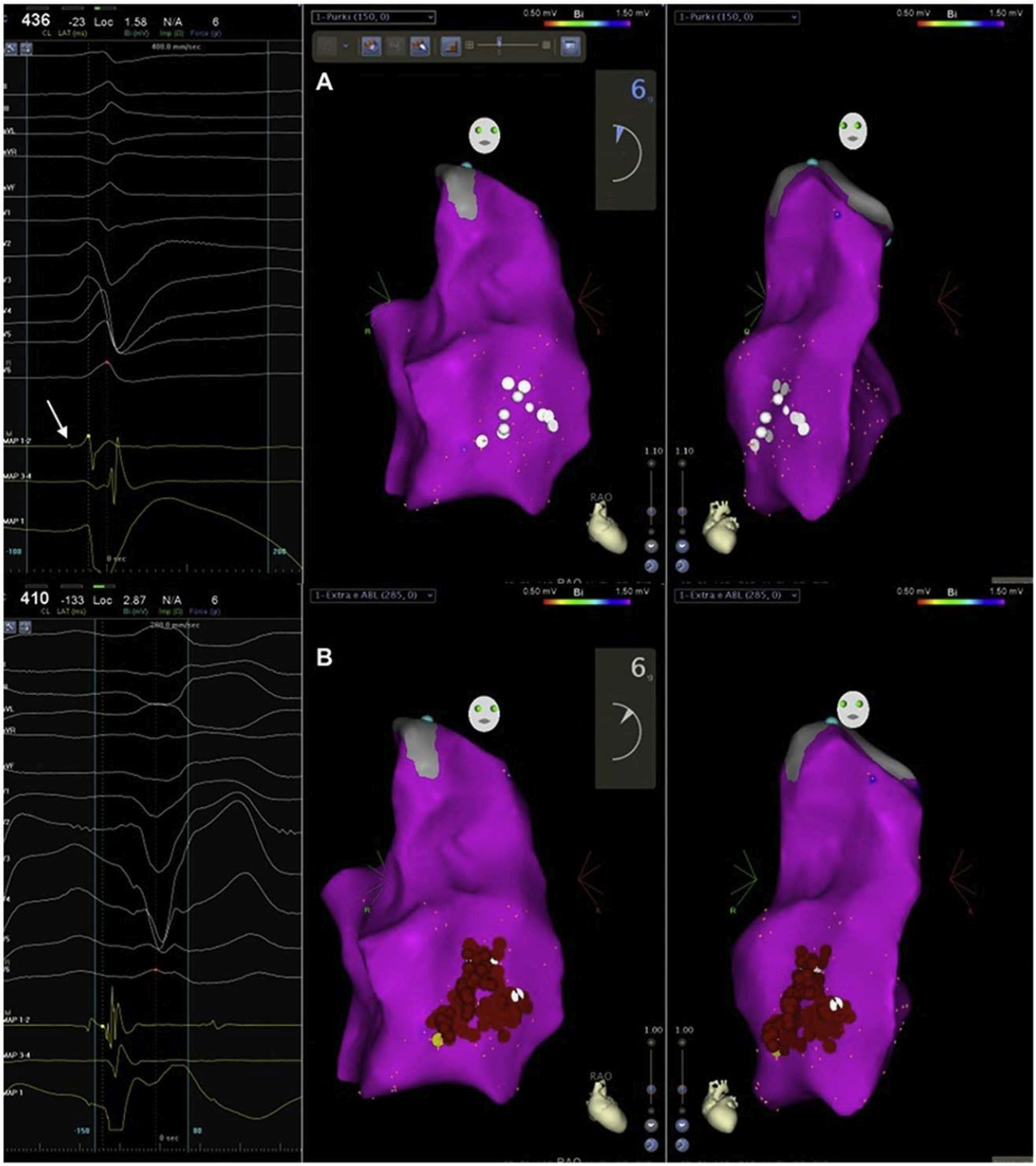

Figure 3 **A:** Detailed bipolar voltage map (150 points) of the right ventricle (right and left anterior oblique views) showing normal voltage (>1.5 mV) and multiple points (*white dots*) where a Purkinje potential (*arrow*) was recorded before the onset of the QRS. **B:** Same map showing multiple ablation points (*red dots*) in the area corresponding to the Purkinje potentials. *Yellow dot* indicates a site where activation mapping of ventricular premature beats revealed a presystolic potential preceding the QRS by 70 ms. Three-dimensional maps were obtained with a ThermoCool SmartTouch catheter (contact force threshold >5 g) and CARTO 3 system (Biosense Webster, Diamond Bar, CA).

stopped the occurrence of ventricular arrhythmias. We then proceeded with RFA, which was performed with an externally irrigated catheter (total ablation time 798 seconds, average temperature 39°C, average power 25 W) until all Purkinje potentials were abolished. During the subsequent 30 minutes of observation, both aggressive programmed ventricular stimulation/burst pacing and gastric distension rechallenge failed to induce any ventricular arrhythmias. The procedure was well tolerated without intraoperative or early postoperative complications. The patient was discharged

without antiarrhythmic therapy. In the subsequent 4 months, ICD interrogation showed no recurrence of shocks or VT episodes. It is relevant to note that by aiming at the VPB and not the substrate, the ECG Brugada pattern did not steadily normalize in our patient.

Discussion

Ventricular fibrillation/PVT RFA requires identification of a mappable trigger responsible for its initiation. In BrS, VPB ablation is highly successful and durable.[1] Unfortunately, VPBs are not always present when the electrophysiologic study is performed, which limits the applicability of RFA. BrS is a complex channelopathy characterized by susceptibility to ventricular arrhythmias and SCD and a dynamic ST elevation that varies over time. Autonomic influences seem to have an important role in BrS. It has been postulated that an epicardially localized imbalance between inward (I_{Na}, I_{CaL}) and outward (I_{Kto}) currents at the end of phase 1 of the action potential creates a transmural voltage gradient that generates the characteristic ST-segment elevation and facilitates phase 2 reentry, thus triggering VPBs and polymorphic ventricular arrhythmias. Acetylcholine blocks inward calcium currents[5] and enhances the epicardial ion imbalance, which can explain why the typical ECG pattern is more pronounced at night or at rest[6] and why ventricular arrhythmias are preceded by increased vagal activity.[7] One of the most common modulators of vagal activity is gastric distension, and it has been shown that ingesting a large meal in a very short period can augment the ECG changes diagnostic of BrS.[8] Given the peculiar history of our patient, whose ICD shocks frequently occurred after large meals that elicited palpitations, we attempted to reproduce this clinical occurrence by gastric distension created by insufflating room air into the stomach. This maneuver proved effective, simple to perform, inexpensive, and safe. Significant ventricular arrhythmias were easily and reproducibly induced, and gastric distension was obtained with just room air, a 50-cc syringe, and a nasogastric tube. Furthermore, gastric distension, compared to a large meal, carries a lower risk of aspiration (the patient is in the fasting state) and, compared to flecainide infusion, is easily and promptly reversible (by aspirating air through the same nasogastric tube). To our knowledge, this is the first clinical report of using gastric distension as a challenge to induce ventricular arrhythmias in order to guide and confirm VPB ablation. We hypothesize that, in BrS, this maneuver could represent the equivalent of catecholamine infusion commonly used during right/left ventricular outflow tract arrhythmias ablation procedures to induce VPBs and/or VT, absent or too rare in basal conditions.

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