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APPLICATION OF THE INTELLANAV STABLEPOINT™ ABLATION CATHETER FEATURING CONTACT FORCE AND LOCAL IMPEDANCE INFORMATION TO TREAT VENTRICULAR ISCHEMIC SUBSTRATE

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Introduction

Many scientific publications have discussed the utility of using contact force (CF) information and lesion indices in the context of atrial fibrillation ablation, but few have addressed the same topic in the context of ventricular tachycardia (VT) ablation. For the first time, the novel INTELLANAV STABLEPOINT™ Ablation Catheter (Boston Scientific) allows clinicians to study the interaction of CF and local impedance in lesion creation. This knowledge could potentially open new scenarios in treating diseased tissue. Thus, we present a case illustrating a strategy to create optimal ablation lesions in the context of VT ablation by leveraging the unique information provided by the INTELLANAV STABLEPOINT™ Ablation Catheter featuring DIRECTSENSE™ Technology.

Patient history

A 63-year-old male with a history of hypertension and inferior myocardial infarction with a left ventricular ejection fraction (LVEF) of 27%, received several shocks from his dual-chamber defibrillator despite optimized medical therapy. We decided to ablate the ischemic substrate using both CF and local impedance information derived from the INTELLANAV STABLEPOINT™ Ablation Catheter.

Procedure

The procedure was performed under conscious sedation. A Dynamic XT™ decapolar catheter (Boston Scientific) was used to cannulate the coronary sinus (CS). Both aortic retrograde and transseptal approaches were performed and were used interchangeably to obtain the best contact in different regions. The INTELLAMAP ORION™ Mapping Catheter was used with the RHYTHMIA HDx™ Mapping System to create a LV map during atrial pacing rhythm. A total of 10,805 points was obtained in 22 minutes, while pacing from the CS at a cycle length of 500 to 600 ms. A steerable sheath was used with both the INTELLAMAP ORION™ and INTELLANAV STABLEPOINT™ catheters. LUMIPOINT™ software (Boston Scientific) was used to highlight all late potentials recorded by the INTELLAMAP ORION™ catheter. The illuminated area was localized in the infero-posterior wall.

AutoTag pre-set feature

For this procedure, we benefited from features available in the latest update to the RHYTHMIA HDx™ software. The AutoTag feature available in SW4.0 allowed us to drop ablation tags automatically according to user-defined criteria. In our experience, we usually selected the following settings:

- Stability: 3 mm for 3 seconds
- Local impedance: DIRECTSENSE™ Technology drop of 10 ohms
- CF: 5 grams for 50% of the stability time

Regarding the stability setting, we used just 3 seconds because radiofrequency (RF) can create a good lesion very quickly, especially if a higher power is used. Thus, provided that contact is good and the local impedance drop is adequate, there is no need to maintain stability for a longer period of time.

In our opinion, the local impedance drop is the main indicator of lesion formation so we required a minimum drop of at least 10 ohms.

Finally, the CF criteria was required to ensure that the local impedance drop we achieved during RF application was due to tissue damage and not due to the catheter shifting into the blood pool.

The criteria we used for tag coloring was based entirely on the local impedance drop: thresholds of 15 ohms and 25 ohms (Figure 1).

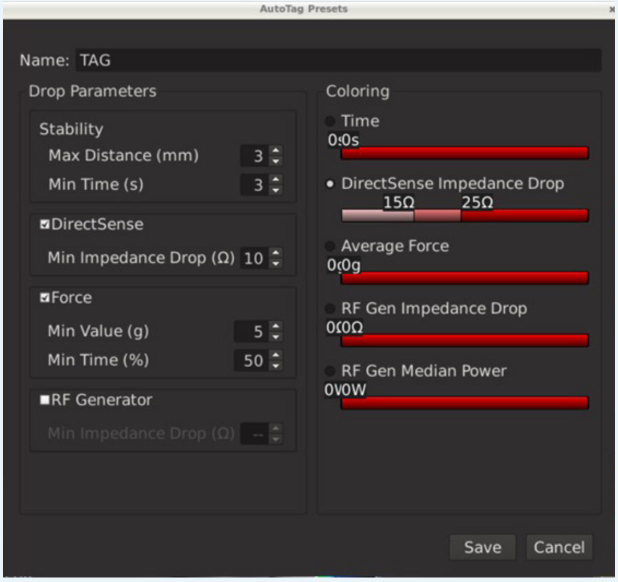

Figure 1. Tag coloring was based on the local impedance drop using the following boundaries: Light red tags indicated a local impedance drop of less than 15 ohms, pink indicated a drop between 15 and 25 ohms, while dark red tags greater than 25 ohms.

Baseline impedance and zero for CF

After creating the substrate map and highlighting the targeted electrograms with the LUMIPOINT™ Module, the baseline local impedance value (blood pool) and the zero value for the CF must be set. We set zero for CF in the left atrium via the transseptal access, since it could be quite difficult to avoid intermittent contact in the LV. In this patient, the baseline local impedance in the blood pool was approximately 130 ohms.

Use of CF for catheter positioning prior to ablation

CF information is very useful in ventricular substrate ablation as it helps ensure that the physician does not press the catheter too hard against the tissue. It also provides certainty about catheter contact in the scar region. With the INTELLANAV STABLEPOINT™ Catheter, we never deliver radiofrequency if contact force is less than 5 grams (Figure 2).

Provided that force was above a minimum of 5 grams, we did not find much value in increasing the CF in order to achieve greater local impedance drops for the patient in this case (Figure 3).

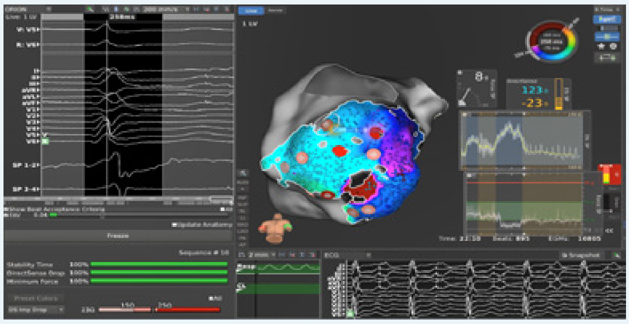

Figure 2. CF information is used to position INTELLANAV STABLEPOINT™ catheter against the tissue. In this case, a CF of 8 grams was sufficient to achieve a local impedance drop of 23 ohms which we considered a very good result in diseased tissue.

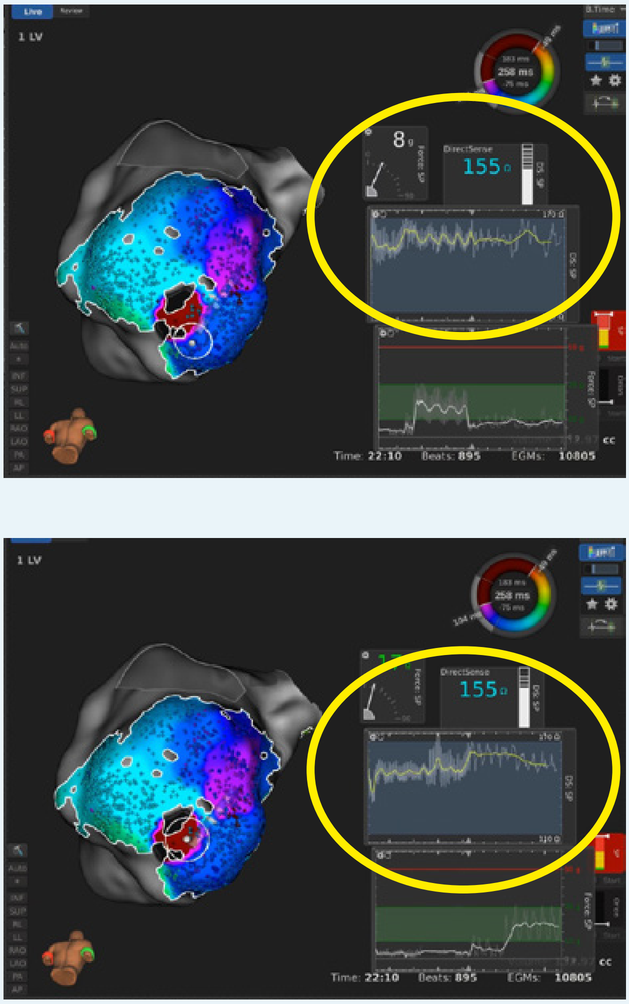

Figure 3. Despite increasing the CF from 8 grams (top panel) to 15 grams (bottom panel), the baseline local impedance remains at approximately 155 ohms.

Use of the local impedance to predict and assess lesion formation

As with the INTELLANAV MiFi™ OI Ablation Catheter (Boston Scientific), we found that with the INTELLANAV STABLEPOINT™ Ablation Catheter, electrical coupling with tissue prior to RF application was predictive of the subsequent local impedance drop: the higher the baseline local impedance of the tissue, the higher the drop. After a minimum force greater than 5 grams was obtained, we tried to optimize catheter positioning to achieve a higher baseline local impedance. If we were able to get a local impedance value of at least 10–15 ohms greater than blood pool local impedance in diseased tissue, we started RF delivery regardless of the force value provided as we were above 5 grams (Figure 4).

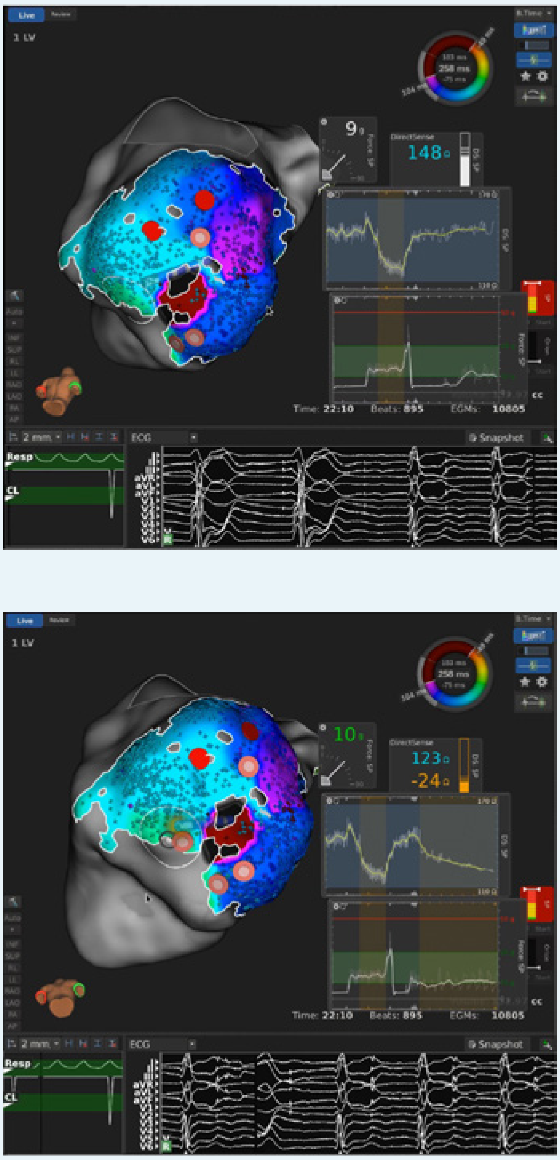

Figure 4. Local impedance value prior to RF delivery was 148 ohms, 18 ohms greater than blood pool (top panel). During RF ablation, we obtained a very good local impedance drop in scar tissue, 24 ohms (bottom panel).

Combining information from the local impedance and contact force graphs to explain unexpected findings

In addition to the force and local impedance information displayed as numerical values in the widgets, we found that we could sort out counterintuitive findings by examining the graphs. For example, consider the situation in which the average force was very high (30 grams) implying very good contact, but with a local impedance value very similar to the blood pool (133 ohms). This could be explained by looking at the force graph. We found that the CF was extremely variable and that the catheter probably was not in contact with the tissue most of the time. This explains the low baseline local impedance value. The interpretation was also confirmed by the very low local impedance drop obtained after RF delivery (Figure 5, top panel).

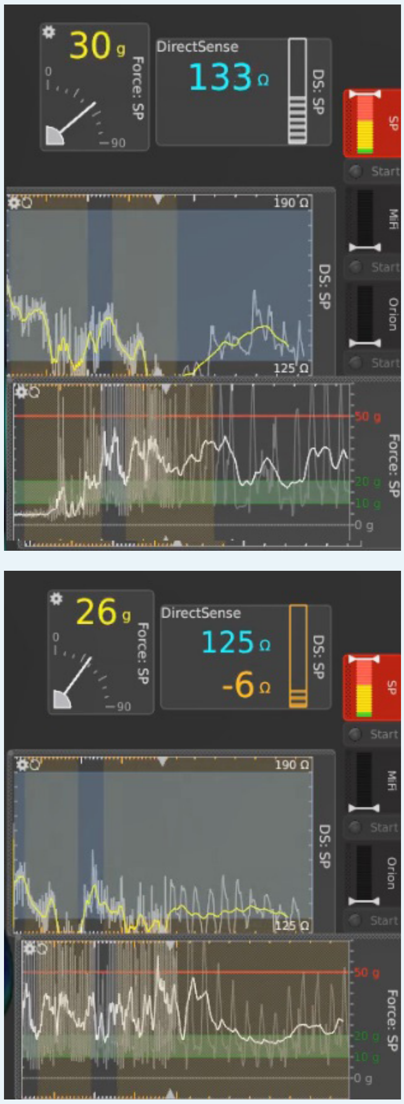

Figure 5. A high average CF (30 grams) masked very unstable catheter contact with the tissue that was clearly deducible in the oscillating force seen in the graph and by a low local impedance graph (top panel). A very low local impedance drop confirmed the unstable tissue contact (bottom panel).

In a second example, consider a similar finding but with a different interpretation (Figure 6). In this case, the CF graph displayed fast oscillation but the local impedance graph was stable and achieved a higher value than the blood pool impedance (142 ohms) (top panel). This finding indicated that the catheter was in good contact with the diseased tissue during most of the excursion time, explaining the higher and stable local impedance value. This was also confirmed by the very good local impedance drop obtained after RF delivery (bottom panel).

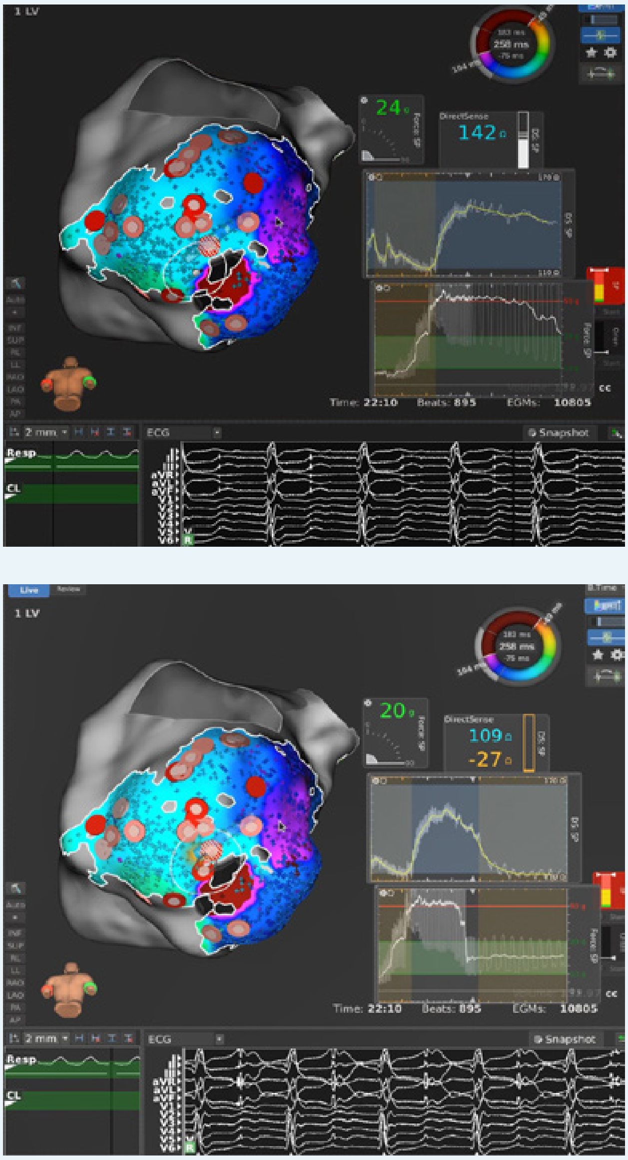

Figure 6. A very fast oscillating CF graph in combination with a stable local impedance graph displayed an average impedance value greater than blood pool impedance value, implying that the catheter maintained good electrical coupling with the diseased tissue during the mechanical oscillations (top panel). As expected, during RF delivery a very good local impedance drop was obtained (bottom panel).

These examples clearly explain why electrical coupling can be more predictive of local impedance drops compared to force alone, and why it is extremely important to look at the interplay between these two variables.

Discussion

In this case, we performed ischemic substrate ablation using the INTELLANAV STABLEPOINT™ Ablation Catheter in combination with the INTELLAMAP ORION™ Mapping Catheter and the RHYTHMIA HDx™ Mapping System. The unique combination of CF and local impedance information available with the INTELLANAV STABLEPOINT™ catheter proved very useful and enabled the precise assessment of catheter electrical coupling with the scar, mechanical contact and tip stability.

The main findings of this case highlight the complementary information provided by CF and local impedance. While information about CF is crucial to ensuring catheter contact with diseased tissue, stable and good quality electrical coupling seems to better predict optimal lesion creation in this type of tissue. Provided a minimal CF of approximately 5 grams was obtained, the proportional relationship between an increase in CF force and a drop in local impedance typically seen in healthy tissue, was not observed in this case. This confirms the complex biophysics involved in lesion creation in low voltage tissue and underscores the utility of the combined information about CF and local impedance when ablating this kind of tissue.

Conclusion

This case demonstrates the use of the INTELLANAV STABLEPOINT™ Ablation Catheter technology for VT substrate ablation and confirms that the combination of contact force and local impedance information available with this technology is extremely useful for assessing safety, catheter contact and lesion formation in diseased tissues.

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