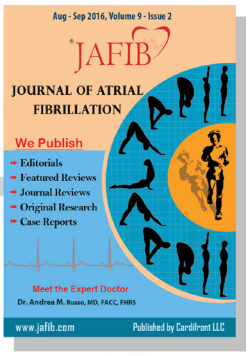
JAFIB®
Original Research
Journal of Atrial Fibrillation



www. jafib.com

Achieving Bidirectional Long Delays In Pulmonary Vein Antral Lines Prior To Bidirectional Block In Patients With Paroxysmal Atrial Fibrillation (The Bi-Bi Technique For Atrial Fibrillation Ablation)

Adel F Mina MD FACC, FHRS, Nicholas L Warnecke, PA-C

Unity Point Health Methodist, Peoria, IL.

Abstract

Background: Pulmonary Vein Antral isolation (PVAI) is currently the standard of care for both paroxysmal and persistent atrial fibrillation ablation. Reconnection to the pulmonary vein is the most common cause of recurrence of atrial fibrillation. Achieving the endpoint of bidirectional block (BDB) for cavotricuspid isthmus dependant flutter has improved our outcomes for atrial flutter ablation. With this we tried to achieve long delays in the pulmonary veins antral lines prior to complete isolation comparable to those delays found in patient with bidirectional block of atrial flutter lines.

Study Objective: The objective of this paper was to evaluate feasibility and efficacy of achieving Bidirectional long delays in pulmonary vein antral lines prior to Bidirectional Block in patient with paroxysmal atrial fibrillation.

Method: A retrospective analysis was performed on patients who had paroxysmal atrial fibrillation procedures at Unity Point Methodist from January 2015 to January 2016. 20 consecutive patients with paroxysmal atrial fibrillation who had AF ablation using the Bi-Bi technique were evaluated.

Result: Mean age was 63, number of antiarrhythmic used prior to ablation was 1.4, mean left atrial size was 38 mm. Mean chads score was 1.3. Mean EF was 53%.

Long delays in the left antral circumferential lines were achieved with mean delay of 142 milliseconds +/-100. Also long delays in the right antral circumferential lines were achieved with mean delay of 150 milliseconds +/-80.

95 % (19/20) of patients were free of any atrial arrhythmias and were off antiarrhythmic medications for AF post procedure. There was only one transient complication in one patient who developed a moderate pericardial effusion that was successfully drained with no hemodynamic changes. The only patient who had recurrence was found to have asymptomatic AF with burden on his device <1%, this patient was also found to have non PV triggers for his AF. In patients with only PV triggered AF success rate was 100%.

Conclusion: Achievement of Bidirectional long delays in pulmonary vein antral lines prior to Bidirectional Block in patient with paroxysmal atrial fibrillation is feasible and highly effective technique in this small cohort of patients studied. We also outlined the procedure in details.

Introduction

Pulmonary Vein Antral isolation (PVAI) is currently the standard of care for both paroxysmal and persistent atrial fibrillation ablation.[1] The success rate for PVAI is still modest about 70-75% with first procedure and improves to 80-85% with multiple procedures in patients with paroxysmal Atrial Fibrillation.[2,4]

Reconnection to the pulmonary vein is the most common cause of recurrence of atrial fibrillation. The ability to achieve a durable PVAI with transmural lesions can be difficult. Various modalities have been done to improve outcome including injection of adenosine to look for latent conduction, pacing on the antral line and further ablation for areas of capture. Contact mapping has improved our understanding of lesion formation with care to apply enough power, time and contact.[3,8] Despite all of these efforts we still are at modest outcome for recurrence.

Achieving a bidirectional block (BDB) is currently the standard of care for typical atrial flutter ablation. Achieving the endpoint of BDB for cavo-tricuspid has revolutionized our understanding and improved our outcomes for atrial flutter ablation. Currently, success rates for atrial flutter ablation are close to 95% when BDB is achieved.[4]

Verma et al has studied patients who have had atrial fibrillation ablation with a repeated electrophysiological procedure.[2] He found

Key Words:
Ablation, PVI, Bidirectional Delay, Bidirectional Block.

Disclosures:
None.

Corresponding Author:
Adel F Mina,
112 N.E. Crescent,
Avenue Peoria,
IL 61606.

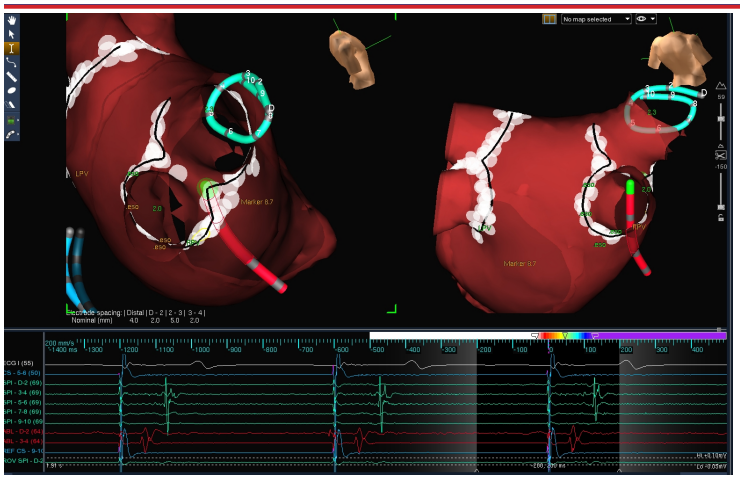


Figure 1: ABL (ablation catheter), SPI (Spiral catheter in RUPV), REF CS (coronary sinus catheter) During pacing form CS proximal we noticed a significant delay in spiral catheter located in RUPV

EAM (electro anatomical map) using Ensite. illustrating the intentional gap left at the superior aspect of RUPV to help evaluate for BD delay prior to closing the GAP. The Black line is the line drawn prior to ablation and the white dots are the ablation lesions done

that patients who maintained sinus rhythm with no recurrence had significant delay from pulmonary vein to the atrium or no conduction i.e. exit block from the veins. He also noted that patients who had a longer delay are more likely to maintain sinus rhythm with or without anti-arrhythmic. Therefore, we hypothesized that if we are able to achieve this delay in the first procedure in both antral lines prior to complete isolation of the veins then this may lead to more favorable effects on outcome. With this we tried to achieve long delays in the PV antral lines prior to complete isolation comparable to the delays found in patient with bidirectional block seen in Atrial flutter cases Fig 1,2.

Pulmonary vein antral lines are circular lines and therefore it is possible to pace both sides of each line and look for conduction delay. We proposed that pacing from distal coronary sinus while watching for delay in the left upper pulmonary vein (LUPV) with the aim of achieving long bidirectional delay before complete isolation of the left antral line. This is done by leaving a small gap in the superior

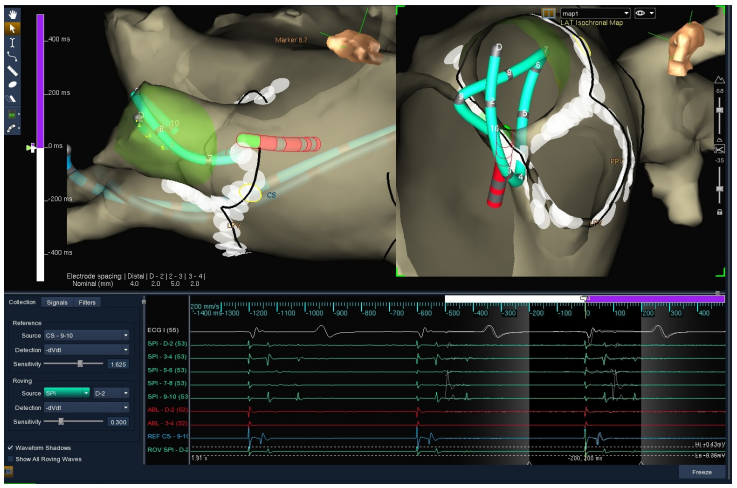


Figure 2: ABL (ablation catheter), SPI (Spiral catheter in LUPV), REF CS (coronary sinus catheter) During pacing form CS Distal we noticed a significant delay in spiral catheter located in LUPV with a double potential , significant delay between potentials is noted

EAM (electro anatomical map) using Ensite illustrating the intentional gap left at the superior aspect of LUPV to help evaluate for BD delay prior to closing the GAP. The Black line is the line drawn prior to ablation and the white dots are the ablation lesions done

aspect of the line(by the roof)and only close this gap after achieving enough delay, preferably >135, in the line.

Likewise for the right sided antral line we paced from the proximal coronary sinus while watching for signal delay in the spiral catheter inserted in the right upper pulmonary vein (RUPV) Fig 1,2.

Procedure Protocol

Patients with paroxysmal atrial fibrillation who have failed antiarrhythmic medications were asked to stop their antiarrhythmic medications 5 days prior to the procedure or longer for amiodarone cases. After detailed information was given to patients about the procedure, and informed consent was obtained the patients were then brought into the EP lab. Venous access was attained with ultrasound guidance using three 8 French sheaths inserted into the right common femoral vein. Next, 9 French sheaths were inserted into the left common femoral vein and 7 French sheaths were inserted into the right internal jugular vein.

Transesophageal echocardiogram and a 64-slice CAT scan was obtained on all patients prior to the procedure. The anatomy obtained from both transesophageal echocardiogram and 64-slice CAT scan was integrated with electro-anatomical mapping anatomy obtained from the EnSite Velocity System (St. Jude Medical) Figure 1.

All patients were anticoagulated with Coumadin or new oral anticoagulants with target INR between 2 and 3 both before the procedure as well as after the procedure, for at least three months. Periodic INRs were done before and after the procedure.

All patients underwent general anesthesia with hemodynamic monitoring by the anesthesia teams. Arterial lines were inserted through the femoral arteries to confirm hemodynamic stability.

An 8 French ACUSON AcuNav intracardiac echo catheter (Siemens Medical USA, Malvern, PA) were inserted into the left common femoral veins and placed into the right atrium. They were then used to monitor transseptal punctures, confirm catheter stability and position, and lastly, used to evaluate catheter contact during ablation and provide safety guards for early detection of complications.

Duodecapolar catheters were inserted through the right internal jugular vein into the coronary sinus with the proximal poles in the high right atrium.

Two transseptal punctures were performed with intracardiac echo as well as fluouroscopic guidance using the ACross™ Transseptal

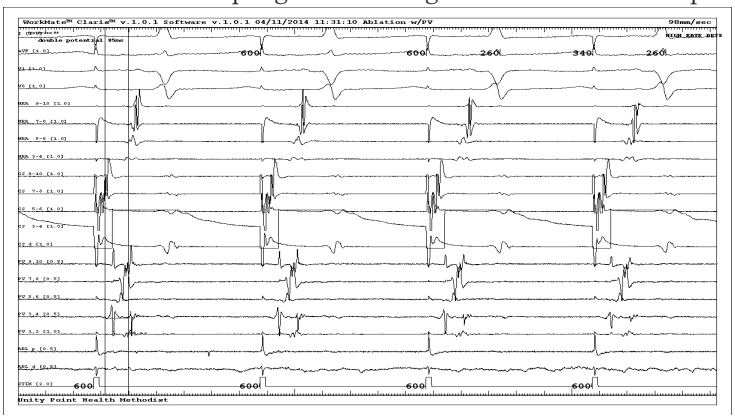


Figure 3: ABL (ablation catheter), PV (Spiral catheter in LUPV), CS (coronary sinus catheter), HRA (high right atrial catheter). STIM (stimulation channel)

During pacing form CS Distal we noticed a significant delay in spiral catheter located in LUPV with a double potential , delay between potentials are 85 ms

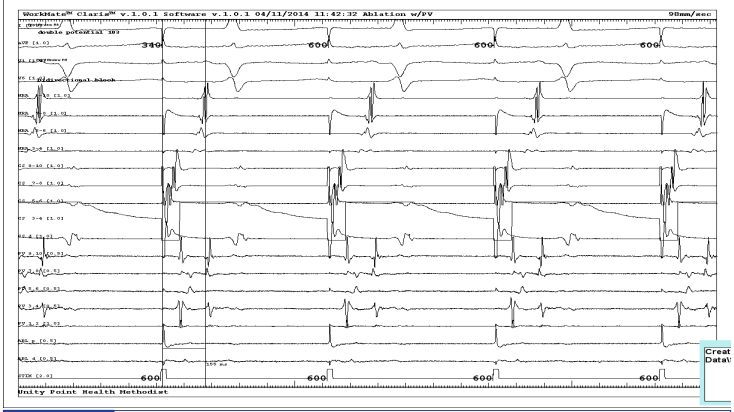


Figure 4: ABL (ablation catheter), PV (Spiral catheter in LUPV), CS (coronary sinus catheter), HRA (high right atrial catheter). STIM (stimulation channel)

During pacing form CS Distal we noticed a significant delay in Spiral (PV) catheter located in LUPV with a delay of 155 ms in the left antral line.

Access System (St. Jude Medical). The SafeSept™ Transseptal Guidewire (Pressure Products, Inc., San Pedro, CA) was used to avoid through and through punctures.

Next, a spiral catheters were used to obtain electroanatomical mapping of the left atrium, which was later merged with CT imaging anatomy.

An esophageal temperature probe was advanced into the esophagus and intermittently repositioned in close proximity to the ablating catheter for each patient. Considering the importance esophageal temperature change during ablation; any significant rise of more than 0.5° was enough to consider lowering the wattage output or moving to another area. Power was titrated at 20 watts with an irrigation catheter in areas close to the esophagus.

Peri-procedural anticoagulation was obtained with heparin bolus, as well as heparin drip to maintain ACT more than 350 and less than 400. ACTs were checked every 15 minutes, and heparin was readjusted until ACTs remained stable.

Left atrial pressure, as well as patient input and output, were continuously monitored throughout the procedure. Ablation was performed using saline irrigation catheters with power of 30-35 watts. In areas close to the esophagus or inside the veins the power was titrated down to 20 watts. Care was taken to avoid ablation inside veins and do large antral lines.

Steps Done for Achieving Long Bidirectional Delays for Pulmonary Veins Antral Lines (Fig 1-7)

1.Electroanatomical map of the left atrium was obtained for each patient.

2.Two wide antral lines with were drawn with a small gaps left at the superior aspect of the line on each side, leaving also the carina open.

3.Ablation was done on top of the drawn lines while pacing from distal CS for left antral line and proximal CS for right antral line,

4.Evaluation of the delay to pulmonary vein potential was intermittently measured till we achieve a delay of at least 135 ms or more on each antral line while pacing from the coronary sinus catheter.

5.If the ablation was completed without achieving antral delay then we try look for gap in the line and do further ablation in area of gaps or persistent signal.

6.If delay was still not achieved then we pace at line for area of capture and ablate at area of capture or viable myocardium.

7.If delay was still not achieved then we look for signal inside the line and target areas with narrowest delay as a sign of a gap.

8.Once we achieved the delay we paced from inside the veins to ensure that the delay is bidirectional, and then we closed the gap at the superior aspect of each line.

9.We then paced from the spiral catheter inside each of the four veins to ensure exit block

10.We insured entrance block by evaluation of absence of signal inside the veins or this was done with pacing in the left atrial appendage or right atrium to make sure that the remaining signals left were only far field.

11.We then put some lesions at the carina on each side for completion purposes.

Isuprel was then started with decremented atrial pacing down to a cycle length of 200 for 6 seconds to insure the veins are disconnected with no further induction of AF.

Protamine 40 mg was given, and catheters were removed at the end of the procedure. Hemostasis was achieved by manual pressure at venous access sites. The patient then was transferred to the floor where they stayed overnight and was sent home the next day.

The patient was followed up with holter monitor done for 24 hours every 3 months till 1 year, and an event monitor for any symptoms of recurrence during the first year and thereafter. Patients were also

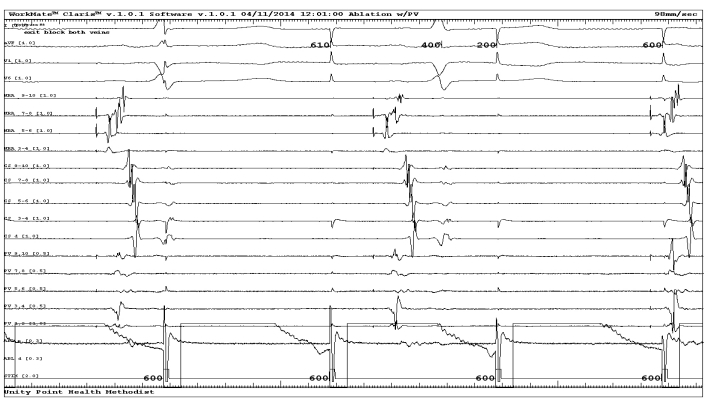


Figure 5: ABL (ablation catheter), PV (Spiral catheter in LUPV), CS (coronary sinus catheter), HRA (high right atrial catheter). STIM (stimulation channel)

During pacing form ablation catheter inside LUPV we noticed evidence of Exit block from the vein.

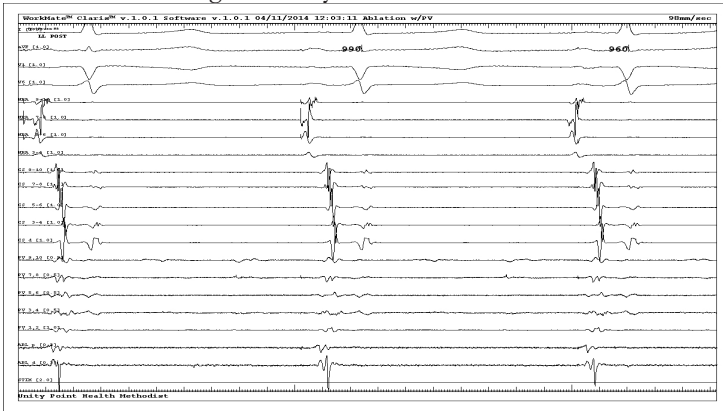


Figure 6: ABL (ablation catheter), PV (Spiral catheter in LLPV), CS (coronary sinus catheter), HRA (high right atrial catheter). STIM (stimulation channel)

PV potentials are gone as evidence of entrance block into the vein.

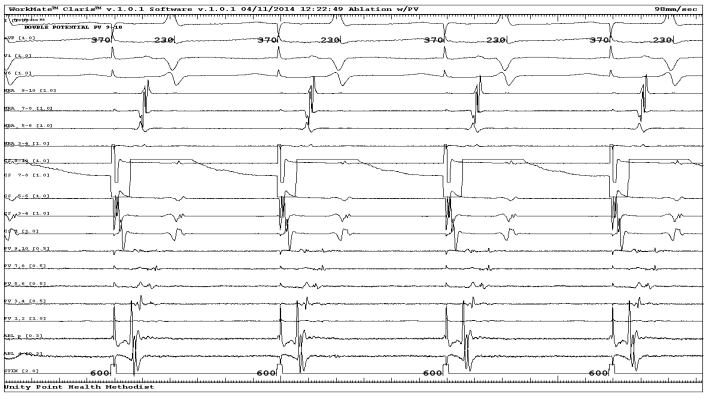


Figure 7: ABL (ablation catheter), PV (Reflexion catheter in RUPV), CS (coronary sinus catheter), HRA (high right atrial catheter). STIM (stimulation channel)

During pacing form CS proximal we noticed a significant delay in Spiral (PV) catheter located in RUPV also douple potentials and significant delay between potential in right antral line

followed closely with a visit every 3-6 months since procedure with frequent EKGs. 4 patients had dual chamber devices which were used to evaluate for recurrence of AF every 3 months post procedure.

Any atrial arrhythmias >30 seconds after the 90 days waiting period were considered as failure or recurrence.

Results

20 consecutive patients were analyzed. Mean age was 63, number of antiarrhythmic used prior to ablation were 1.4, mean left atrial size was 38 mm. Mean chads score was 1.3. Mean EF was 53%.

Delays Achieved

Of the 20 patient that underwent atrial fibrillation ablation with the new technique we were able to obtain an average delay of 142 +/- 100 milliseconds. Also long delays in the right antral circumferential lines were achieved with mean delay of 150 +/-80 milliseconds.

Outcome

95 % (19/20) of patients were free of any atrial arrhythmias and were off antiarrhythmic medications for AF post procedure. There was only one transient complication in this group related to moderate pericardial effusion that was successfully drained with no hemodynamic changes. The only patient who had recurrence was found to have AF burden on his device <1%, this patient was also found to have non PV triggers for his AF triggers as demonstrated with the presence of frequent non Pulmonary Veins PACs during Isupril infusion.

In patients with only PV triggered AF success rate was 100%.

Mean total ablation time was only 71 min. Mean fluoroscopy was only 2.8 min. 20 patients stopped their antiarrhythmic medications for AF.

Mean follow up for all patients' were12 months (6 to 18).

Discussion

In this study we demonstrated the feasibility of achieving long delays into the pulmonary veins antral lines prior to complete isolation. These delays are somewhat comparable to the delays we usually see in the typical flutter lines. We also found no recurrence of AF in all patients who achieved long delays and had pulmonary veins triggers for AF suggesting the durability of isolation.

All patients were free of symptoms post ablation and there was no need for repeat ablation in any patient.

To our best of our knowledge this is the first report of ablation to achieve such a high success 95% with clinical success of 100 %. Other meta-analysis showed that the single-procedure freedom from atrial arrhythmia of 53.1 % in patients with paroxysmal AF with the average number of procedures per patient of 1.51.[6]

We believe that Bi-Bi technique for AF ablation may improve our term treatment of paroxysmal AF and it may be a step closer towards the cure.

We noticed our total ablation time is short and comparable to other studies using the standard technique.[9]

The new technique does not seems to add significant complication as there is no added ablations or no deviation from the standard technique except for paying more attention to the signal delay during the same procedure. We had only one complication which compares favorably with the updated worldwide survey of AF ablation rate of major complications of 4.54%.[7]

Also note our fluoroscopy time is very low compared with other studies we are getting closer to achieve near zero fluoroscopy, this is done with the help of 3 D mapping and intra-cardiac echo.

Limitations

This is a single center, single operator experience with limited number of patients and limited follow up. Further studies will be needed to substantiate the findings.

Conclusions

Achievement of bidirectional long delays in pulmonary vein antral lines prior to bidirectional block in patient with paroxysmal atrial fibrillation is feasible and highly effective technique in this small cohort of patient studied. We hope that the Bi-Bi technique for AF ablation may translate to a true Bye -Bye for AF in patients with paroxysmal AF.

References

1. Shah Dipen. Electrophysiological evaluation of pulmonary vein isolation. Europace. 2009;11 (11):1423–33.
2. Verma Atul, KilicaslanFethi, PisanoEnnio, MarroucheNassir F, FanelliRaffaele, BrachmannJohannes, GeuntherJens, PotenzaDomenico, MartinDavid O, CummingsJennifer, BurkhardtJ David, SalibaWalid, SchweikertRobert A, NataleAndrea. Response of atrial fibrillation to pulmonary vein antrum isolation is directly related to resumption and delay of pulmonary vein conduction. Circulation. 2005;112 (5):627–35.
3. Kumar Saurabh, MichaudGregory F. Unipolar electrogram morphology to assess lesion formation during catheter ablation of atrial fibrillation: successful translation into clinical practice. Circ Arrhythm Electrophysiol. 2013;6 (6):1050–2.
4. Essebag Vidal, WylieJohn V, ReynoldsMatthew R, BaldessinFerdinando, McClennenSeth, ShvilkinAlexei, GermanoJoseph, RichardsonAllison, ZimetbaumPeter J, JosephsonMark E. Bi-directional electrical pulmonary vein isolation as an endpoint for ablation of paroxysmal atrial fibrillation. J Interv Card Electrophysiol. 2006;17 (2):111–7.
5. Oral H, StickerlingC, TadaH, ChoughS P, BakerR L, WasmerK, PelosiF, KnightB P, MoradyF, StrickbergerS A. Role of transisthmus conduction intervals in predicting bidirectional block after ablation of typical atrial flutter. J. Cardiovasc. Electrophysiol. 2001;12 (2):169–74.
6. Ganesan Anand N, ShippNicholas J, BrooksAnthony G, KuklikPawel, LauDennis H, LimHan S, SullivanThomas, Roberts-ThomsonKurt C, SandersPrashanthan. Long-term outcomes of catheter ablation of atrial fibrillation: a systematic review and meta-analysis. J Am Heart Assoc. 2013;2 (2).
7. Cappato Riccardo, CalkinsHugh, ChenShih-Ann, DaviesWyn, IesakaYoshito, KalmanJonathan, KimYou-Ho, KleinGeorge, NataleAndrea, PackerDouglas,

SkanesAllan, AmbrogiFederico, BiganzoliElia. Updated worldwide survey on the methods, efficacy, and safety of catheter ablation for human atrial fibrillation. Circ Arrhythm Electrophysiol. 2010;3 (1):32–8.

8. Afzal Muhammad R, ChattaJawaria, SamantaAnweshan, WaheedSalman, MahmoudiMorteza, VukasRachel, GundaSampath, ReddyMadhu, DawnBuddhadeb, LakkireddyDhanunjaya. Use of contact force sensing technology during radiofrequency ablation reduces recurrence of atrial fibrillation: A systematic review and meta-analysis. Heart Rhythm. 2015;12 (9):1990–6.
9. Liu Xiao-Hua, ChenChao-Feng, GaoXiao-Fei, XuYi-Zhou. Safety and Efficacy of Different Catheter Ablations for Atrial Fibrillation: A Systematic Review and Meta-Analysis. Pacing Clin Electrophysiol. 2016;39 (8):883–99.