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A Solution Trick: Implantation of Coronary Sinus Lead Without Delivery System, A Case Series Study

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SOUHRN

Kontext: Zahájení srdeční resynchronizační terapie (cardiac resynchronization therapy, CRT) představuje jeden z nejnáročnějších výkonů v invazivní kardiologii. Rozdílná anatomie koronárního sinu a složitost výkonu může vést k neúspěšné implantaci elektrody, případně si může vyžádat chirurgickou implantaci elektrody do koronárního sinu.
Metody: Naše studie byla retrospektivní, observační, s malou skupinou pacientů a kontrol. Pacienti byli vybíráni z kandidátů CRT, jimž byla na kardiologickém oddělení v období mezi červencem 2020 a březnem 2021 do levé komory implantována elektroda bez zaváděcího sheathu. Informace o pacientech byly získávány retrospektivním prohlížením zdravotnické dokumentace. Popis samotného jednoduchého triku: víceúčelový (multipurpose, MP) nebo jakýkoli jiný diagnostický katétr se přes bezpečný „tear-away" zavaděč zavede do pravé síně a tímto katétrem se kanyluje ústí koronárního sinu (KS); následně se provede angiografické vyšetření KS. Do cílové cévy se přímo zavede tuhý drát (ASAHI Grand Slam 0,014"; 180 cm) nebo se použije měkký drát pro selektivní kanylaci cílových přívodních cév katétrem a měkký drát se poté nahradí tuhým drátem. Následně se katétr vytáhne přes tuhý vodicí drát. Přes tuhý vodicí drát se do KS zavede elektroda pro levou komoru. Tato elektroda se zavede do cílové srdeční žíly a tuhý drát se vytáhne.
Výsledky: Ve všech případech (až na jednoho, 80letého) se jednalo o muže, ostatní byli ve věku 50–70 let. U čtyř pacientů byla stanovena diagnóza ischemické kardiomyopatie, u jednoho kardiomyopatie neischemické etiologie. Čtyři pacienti byli hospitalizováni, jeden byl ambulantní. U tří pacientů byl výkon proveden z oblasti pravého prsního svalu. U tří z pěti pacientů bylo plánováno použití konzervativní techniky, nemohli jsme však provést kanylaci KS ani proniknout zavaděčem dostatečně hluboko k zadním srdečním žilám. Pro kanylaci KS nebo cílové žíly jsme jako řešení problému použili výše popsaný trik. Při kontrolním vyšetření pacientů po jednom týdnu a jednom měsíci nebyla zjištěna žádná komplikace.
Závěry: Drát Grand Slam poskytuje oporu elektrodě v KS bez zaváděcího systému a pomáhá při implantaci elektrody do levé komory. Abychom získali spolehlivé informace o bezpečnosti a účinnosti popsaného „triku", je třeba provádět takové výkony u malých počtů pacientů a následně provést i randomizované studie.

Keywords:
Congestive heart failure
CRT
Defibrillation
ICD

ABSTRACT

Background: Cardiac resynchronization therapy (CRT) is one of the most challenging procedure of invasive cardiology. Variations of coronary sinus anatomy and complexity of the procedure may result in unsuccessful implantation or may need surgical implantation of coronary sinus lead.
Methods: This is a retrospective observational case study. The patients were enrolled from the CRT patients who were implanted LV lead without delivery sheath of cardiology department between July 2020 and March 2021. Patient information was obtained by retrospective file scanning. Description of tips of the trick: Multipurpose (MP) or any diagnostic catheter is pushed forward to the right atrium via a tearable safe sheath. Coronary sinus (CS) ostium is cannulated by the catheter. CS angiography is performed. Stiff wire (ASAHI Grand Slam, 0.014 inch, 180 cm) is directly advanced into the target vessel or a soft wire is used for selective cannulation of targeted tributaries by the catheter and soft wire is exchanged with the stiff one. The catheter is extracted over stiff guidewire. LV lead is advanced over stiff guidewire to CS. LV lead is advanced into the target cardiac vein and stiff wire is extracted.
Results: All patients were male, one of them is 80 years old and the others 50–70 ages old. Four patients were suffering from ischemic cardiomyopathy and one from non-ischemic cardiomyopathy. Four patients were inpatients, one patient was outpatient. Procedure was performed from right pectoral area in three patients. In three of the five patients, conservative technique was planned, and we were unable to cannulate CS or to go to a very low posterior cardiac vein with delivery sheath. We used descripted trick to cannulate CS or targeted vein as a problem solver. One week and 1-month follow-ups of the patients werer uneventful.
Conclusions: Grand Slam wire provides back up to CS lead without delivery system and it can help to implant LV lead. We need more case series and randomized studies to understand safety and efficacy of the new trick.

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Introduction

Cardiac resynchronization therapy (CRT) is a non-pharmacological treatment option that improves morbidity and mortality in selected patients with heart failure.[1-2] Despite well-defined technique of CRT-defibrillator (CRT-D) implantation, these cases are still challenging due to details of the procedure.[2] CRT-D implantation is impossible in 5–10% of patients because of several reasons even in high volume centers with experienced operators.[3–5] Also, numerous patients who cannot benefit from CRT because of CS anatomic variations force us to find new tips and tricks. "Pipe shaped" ostium with narrow ostium, too tight upward angulation next to a very low posterior venous tributary or systolic compression of the posterolateral-posterior coronary sinus segment are the some of the reasons of the cannulation problems of CS ostium.[6] Inability to access CS ostium is one of the most common causes of implant failure up to 4%.[7–9] A 0.035-mm diameter teflon J wire, inner catheter, and contrast dye may be helpful in assisting this process and steerable ablation catheter may be used to rail delivery sheath to CS in challenging cases.[6] Nevertheless, unsuccessful cannulation of CS is the major cause of failing CRT-D implantation.

In these case series of CRT implantation, we present a problem solution trick to implant coronary sinus lead without a delivery system.

Methods

This is a retrospective observational case study. The patients were enrolled from the CRT patients who was implanted LV lead without delivery sheath of cardiology department between July 2020 and March 2021. CRT indications were decided according to ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure (2016).[10] Patient files were scanned retrospectively.

Description of tips of the trick

Pocket of battery is opened to left/right pectoral area. Delivery sheath is not used in this LV implantation trick. Tearable safe sheath is advanced into left/right subclavian vein via Seldinger technique and multipurpose (MP) or any diagnostic catheter is pushed forward to the right atrium. MP or diagnostic catheters are thinner and they can be manipulated easier than delivery sheath by operators. Coronary sinus (CS) ostium is cannulated by the catheter. CS angiography is performed by the catheter. Stiff wire (ASAHI Grand Slam, 0.014 inch, 180 cm) is directly advanced into the target vessel or a soft wire is used for selective cannulation of targeted tributaries by the catheter and the soft wire is exchanged with the stiff one. The catheter is extracted over stiff guidewire. LV lead is advanced over stiff guidewire to CS. LV lead is advanced into the target cardiac vein and stiff wire is extracted.

Results

All patients were male. Four patients were suffering from ischemic cardiomyopathy and one from non-ischemic cardiomyopathy. Four patients were inpatients, one patient was outpatient. Procedure was performed from right pectoral area in three patients. In three of the five patients, a conservative technique was planned, and we were unable to cannulate the CS. The problem was solved with descripted trick. In two patients who signed informed consent, LV lead was implanted via directly the descripted new trick. Because our experience shows us the procedure is easier and it takes shorter time. One-week and 1-month follow-ups of the patients were uneventful.

The first patient was 68 years old male, single lead implantable cardioverter defibrillator was implanted 10 years ago. It was infected. Reimplantation was planned from the right pectoral area 6 months later after the first implantation as a CRT-D. CRT-D procedure failed due to an unknown reason. Patient rejected surgical implant. The procedure was started from right pectoral area, delivery system advanced into the right atrium but it did not come close to CS ostium because of hypertrophic crista terminalis and angulated CS ostium (Fig. 1A). Delivery sys-

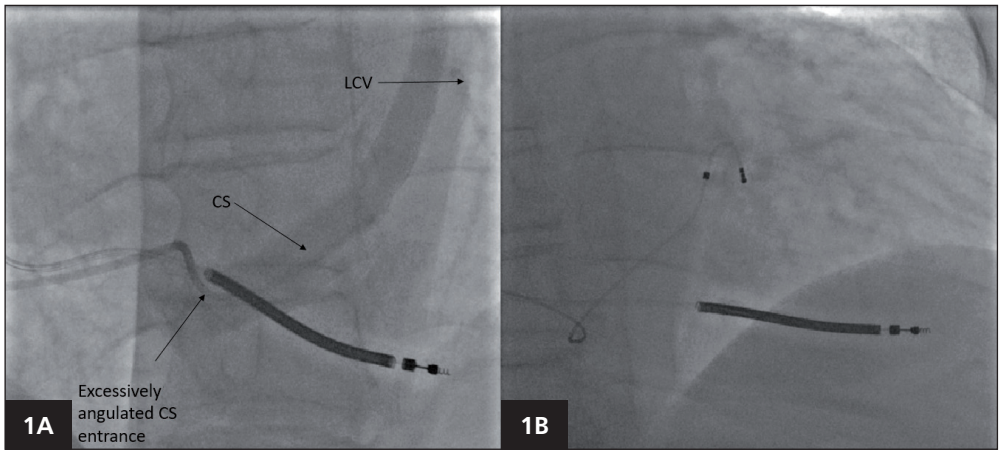

Fig. 1 – (A) CS angiography was administrated by MP catheter. Coronary sinus (CS), excessively angulated CS entrance, and lateral cardiac vein (LCV) were visualized. (B) Final cine angiography of left ventricular (LV) lead and right ventricular (RV) lead.

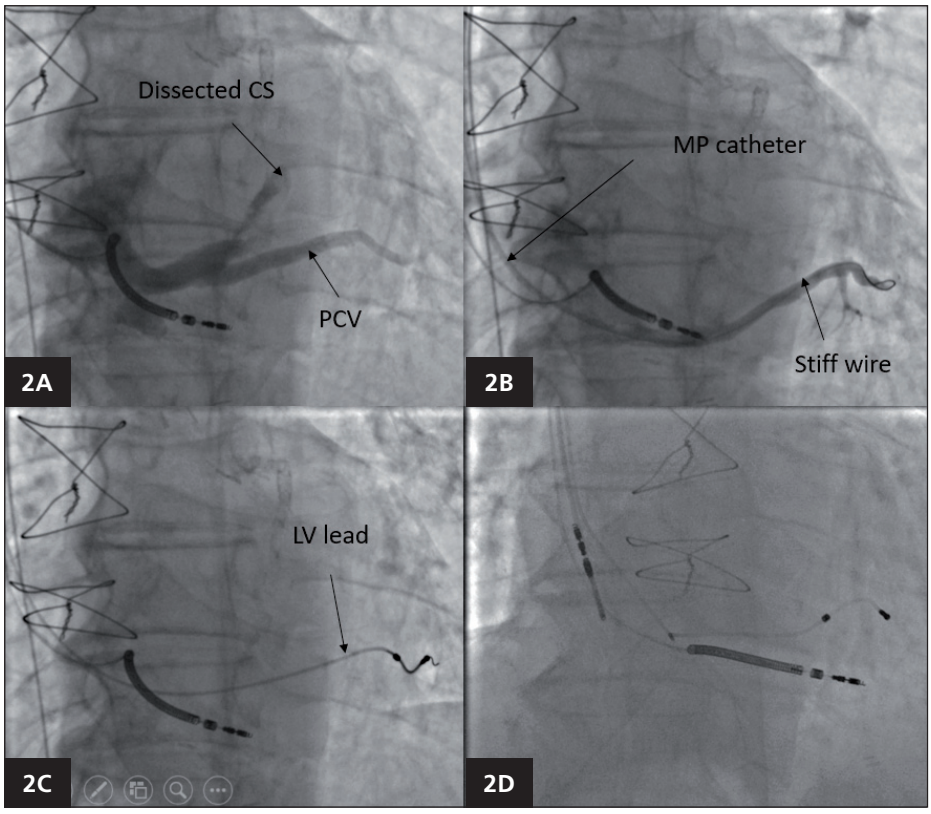

Fig. 2 – (A) Angiography of CS by multipurpose (MP) catheter. Dissected CS and posterior cardiac vein (PCV) were visualized. (B) Selective angiography of PCV by MP catheter, MP catheter used like a microcatheter and grand slam stiff wire advanced into vessel instead of extracted standard soft wire. (C) LV lead slides over the grand slam wire. (D) Final cine angiography of right atrium (RA) lead, RV lead and LV lead.

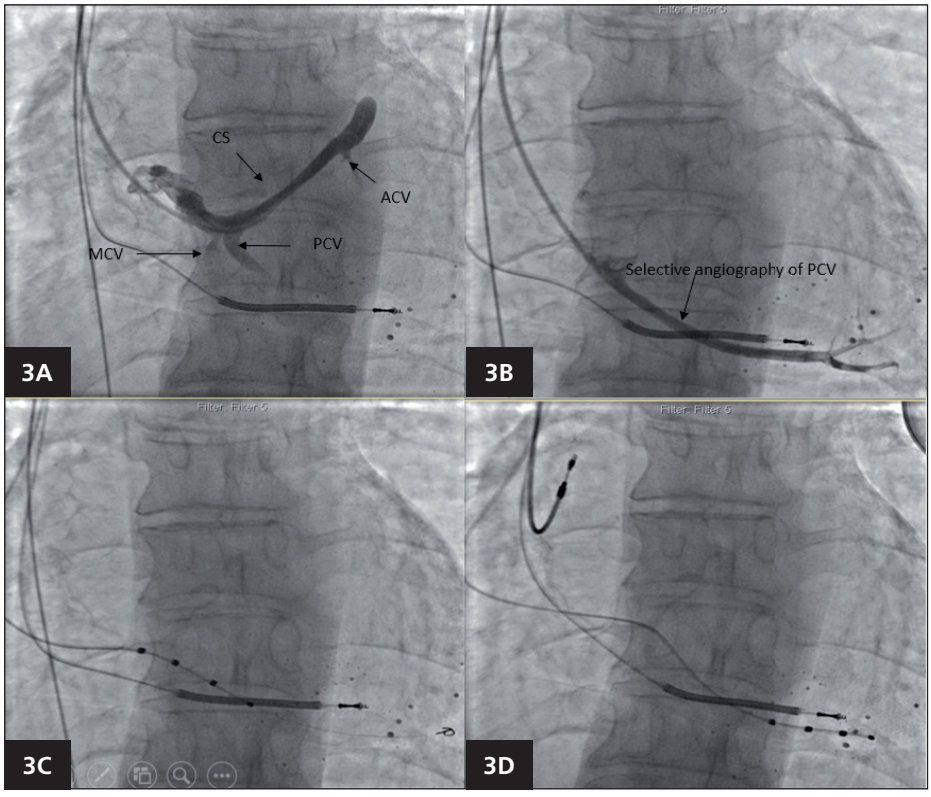

Fig. 3 – (A) CS angiography was administered by MP catheter. Anterior cardiac vein (ACV) was not suitable to implant LV lead. (B) Selective angiography of PCV by MP catheter. (C) LV lead slides over the grand slam wire. (D) Final cine angiography of right atrium (RA) lead, RV lead, and LV lead.

tem was extracted and procedure was completed with the trick which is descripted. LV lead was implanted to lateral cardiac vein (LCV) (Fig. 1B).

In 80-year-old male, CRT-D implantation was planned from left pectoral area. CS was cannulated by delivery system. CS had a valve after posterior cardiac vein. Valve was tried to be passed by 0.014 inch soft guidewire, hydrophilic coated 0.035 inch guide wire and 0,038 inch J type teflon wire and it was unsuccessful. A dissection occurred in CS (Fig. 2A). We targeted to posterior cardiac vein (PCV)

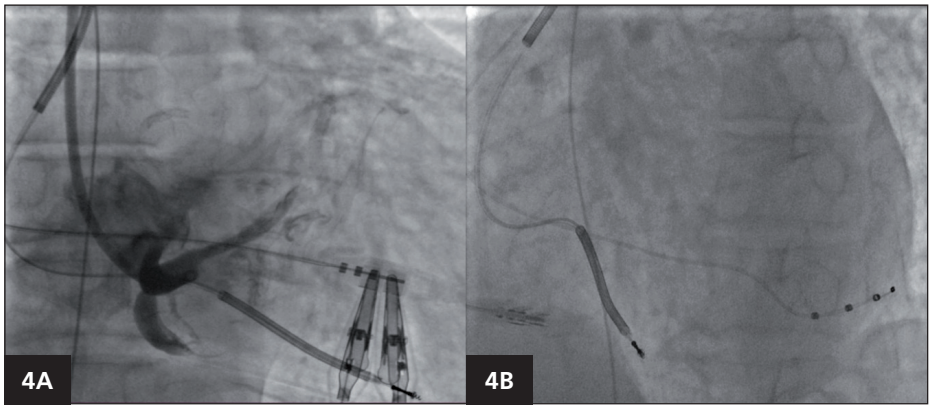

Fig. 4 – (A) CS angiography was administrated by delivery catheter. (B) Final cine angiography of right ventricular (RV) lead and left ventricular (LV) lead that was implanted by novel technique.

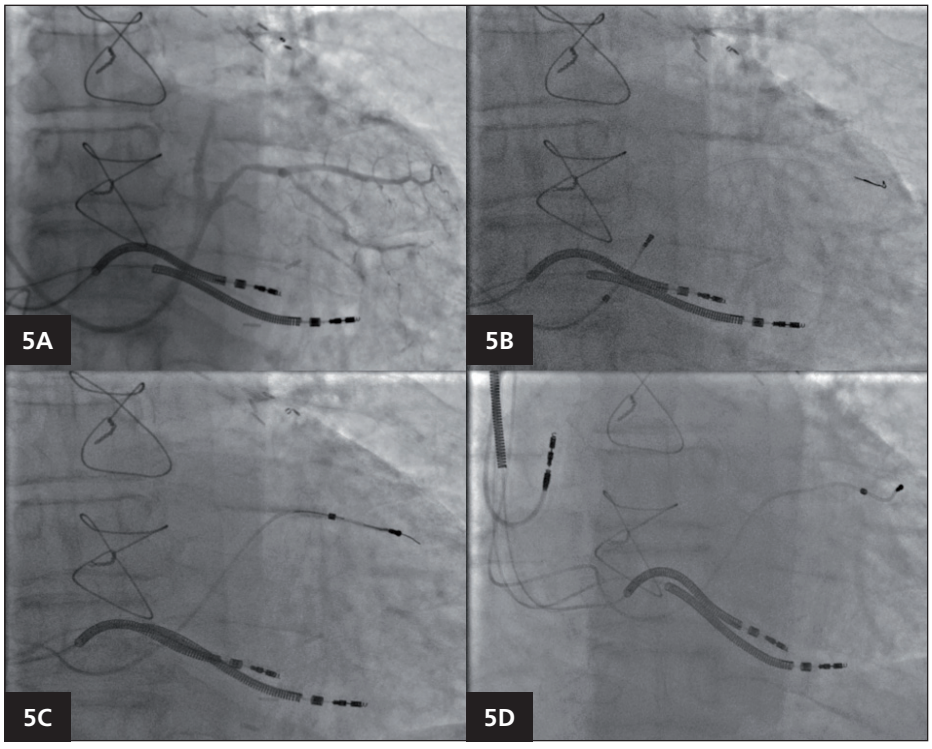

Fig. 5 – (A) CS and ACV angiography was administered by MP catheter. (B) LV lead was on the ostium of CS while it was sliding over the grand slam wire. (C) LV lead was advanced into ACV accompanied by grand slam stiff wire. (D) Final cine angiography of right atrium (RA) lead, RV lead, and LV lead.

with 0.014-inch soft wire. It was unsuccessful because CS had too tight upward angulation next to a very low posterior venous tributary. Delivery sheath was extracted and we tried descripted trick. MP catheter was used for easy manipulation and PCV was cannulated. Soft wire (0,014 inch) advanced into PCV and MP catheter advanced into PCV over soft wire. Selective PCV angiography was administered (Fig. 2B). LV lead was advanced into PCV over the stiff wire (Fig. 2C) like in descripted technique and procedure was completed successfully (Fig. 2D).

In a 51-year-old male, CRT-D implantation was planned from left pectoral area. LV lead implantation was decided to be carried out with the descripted technique. CS was cannulated by MP catheter and CS angiography was administrated (Fig. 3A). It was not possible to implant the CS lead to anterior cardiac vein because of the tinny vessel. LV lead was targeted to implant to PCV, soft wire advanced into PCV and MP catheter advanced into PCV over soft wire. Selective PCV angiography was administered (Fig. 3B). LV lead was advanced into PCV over the stiff wire (Fig. 3C) like in the descripted technique and the procedure was completed successfully.

Another patient, 54-year-old male, was on hemodialysis via fistula on his left arm. CRT-D implantation was planned from right pectoral area. CS was cannulated with delivery sheath. Blunt CS with early leaving LCV was visualized (Fig. 4A). LV lead was tried to be implanted to LCV but it was unsuccessful because of the shortness of

LCV. PCV could not be cannulated with delivery sheath. Delivery sheath was extracted and MP catheter was used for easy manipulation. LV lead was implanted to target vessel with the descripted technique. (Fig. 4B).

In 62-year-old male, CRT-D upgrade was planned from right pectoral area. He had two RV lead in his right ventricle because of broken lead revision. LV lead implantation was decided to be implanted with the descripted technique. CS was cannulated by MP catheter and CS angiography was administrated (Fig. 5A). Stiff wire was advanced into ACV. LV lead was slowly passed from CS ostium (Fig. 5B, Video 1). Anterior cardiac vein was targeted to implant LV lead (Fig.5C, Video 1). LV lead was successfully implanted to anterior cardiac vein (Fig. 5D).

Discussion

Technological developments in the field of interventional cardiology have increased the life expectancy of cardiology patients. Due to the needs of surviving patients, the number of patients who have been implanted with a cardiac implantable device is increasing day by day.[11] CRT-D implantation procedure is a complex procedure and a variation of coronary sinus anatomy can make a successful implantation of CRT-D harder or impossible.[12] LV lead implantation is the most important and one of the most challenging part of the procedure.[3] Cannulation of CS, implantation of LV lead, and tearing the CS delivery sheath without dislocation of the lead are the parts that make the procedure challenging. Real life data show that primary implantation of the LV lead into the venous tributary of CS is unsuccessful in up to 10% of patients.[3,4,13] Causes of unsuccessful CRT-D implantation are due to stenotic or occluded thoracic venous system, difficult coronary sinus access, tortuous and stenotic venous tributaries, tiny venous tributaries, right-sided implants and persistent left superior vena cava syndrom.[14] Many cases of CRT fail in CS cannulation, the first step of LV lead implantation.[7–9]

In this trick, CS ostium is cannulated with the MP catheter easier than with delivery sheath and "Pipe shaped" ostium with narrow ostium, too tight upward angulation next to a very low posterior venous tributary are not on road of CS cannulation. Delivery sheaths are made 9 French (F) in the market. This diameter of the catheter inhibits it to go to coronary sinus. But in this trick we used a 5F or 6F diagnostic catheter to cannulate CS and they can be manipulated easily. After the stiff wire advanced into targeted vein, LV lead easily goes from CS ostium angulations. We are sure that newly developed stiffer wires with proximal tips will support LV lead better. After angiography of CS, soft wire guidance may be used for selective cannulation of targeted tributary. And stiff wire can be helpful to make straighten the tortoise tributaries. Compared with the conservative method, one of the advantages of the technique is no possibility of dislocation of the LV lead while tearing the delivery sheath. This technique provides practitioners an easy access to CS and probably less dissection of CS because of not using delivery sheath.

Also, this trick is a good alternative in CRT-D cases applied via right subclavian vein. This is because, in cases applied via right subclavian vein are more challenging to cannulate CS ostium, compared via left subclavian vein. Right subclavian vein and CS ostium are in the same plane in cardiac anatomy, that's why stiff wire is more supportive to implant LV lead. Generally, practitioners hesitate to use stiff wires. But grand slam wire is used also in conservative technique for angulated tributaries. Soft tip of the wire makes it safer. As it was shown in our experiences, using this wire does not cause complications and it is safe. It is helpful to implant LV lead in tortuous, stenotic, and tiny tributaries of CS.[14] Descripted trick is an alternative solution for difficult coronary sinus access, tortuous and stenotic venous tributaries, tiny venous tributaries, right-sided implants.

Disadvantages of the technique

Despite stiff wires, especially Grand Slam (ASAHI; 0,014 inch) are good supporters for LV lead, they are still unsuccessful to support LV lead in severely angulated side branches of CS.

Conclusion

Grand Slam wire provides back up to LV lead without delivery system. We need more case series and randomized studies to compare the safety and efficacy of the trick. It can be used in selected cases. To invent new stiff wires with longer hydrophilic and soft distal tips and stiffer proximal tips can provide extra back up.

Conflict of interest

The author has no conflict of interest to disclose.

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