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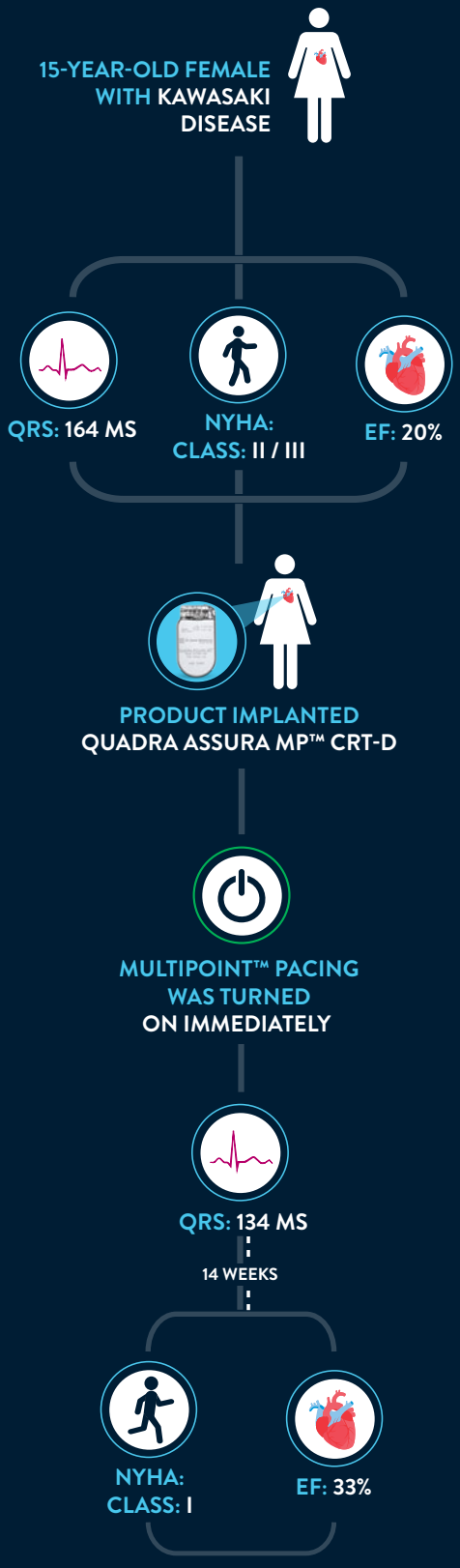
MULTIPOINT™ PACING CARDIAC RESYNCHRONIZATION THERAPY IMPROVES HEMODYNAMIC OUTCOMES

Seung-Jung Park, M.D.
Samsung Medical Center
Seoul, Republic of Korea



INTRODUCTION

Recent studies have shown that MultiPoint™ Pacing can improve the hemodynamic response to cardiac resynchronization therapy (CRT).[1] Data has also shown that the improvement was seen in both ischemic and nonischemic patients.[1-4] This new technology advancement has strengthened the confidence of a young ischemic cardiomyopathy patient, her family and her pediatric physician, who had been hesitant about device therapy but is now committed to CRT implant.

PATIENT HISTORY

- 15-year-old female
- NYHA Class II/III
- Kawasaki disease diagnosed in 2001 when patient was 1 year old
- Myocardial infarction due to LAD and RCA occlusion in 2011 that progressed to dilated cardiomyopathy
- CABG surgery in 2002 (LITA to mid LAD)
- Since 2010, the deterioration of LV function, QRS widening and dyspnea were more significant (Table 1)

Table 1

Time	QRS duration (ms)	LVEDD (mm)	LVESD (mm)	LVEF (%)	NYHA class
2010-Aug	106	55	40	52	I
2011-Jul	118	62	48	43	I
2012-Sep	138	68	51	47	I
2013-Jul	146	69	61	26	I-II
2014-Aug	158	72	60	33	II-III
2015-Jan	164	75	64	20	II-III

IMPLANTATION AND MULTIPOINT™ PACING PROGRAMMING

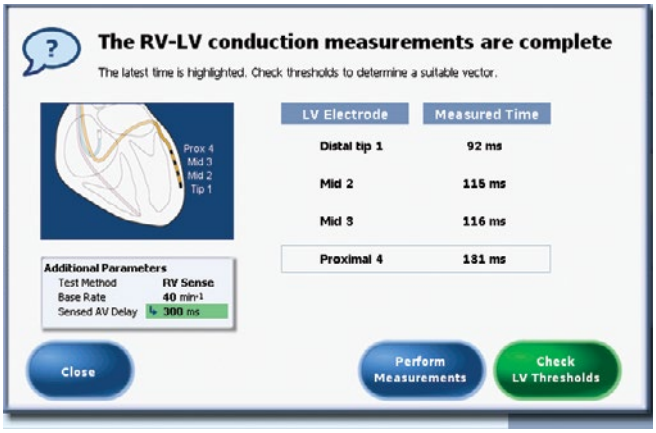
The patient was implanted with an Abbott Quadra Assura MP™ CRT-D and Quartet™ LV lead 1458Q. The Quartet lead facilitated a fast and smooth implantation of about 1.5 hours, which helped to lessen the nervousness of the pediatric patient.

ECG was evaluated for all 10 vectors under biventricular pacing. Then, RV-LV conduction test was performed to determine the earliest and latest conduction test.

RV-LV conduction test (RV sensed) (Figure 1)

- Earliest activation: D1 (92 ms)
- Latest activation: P4 (131 ms)

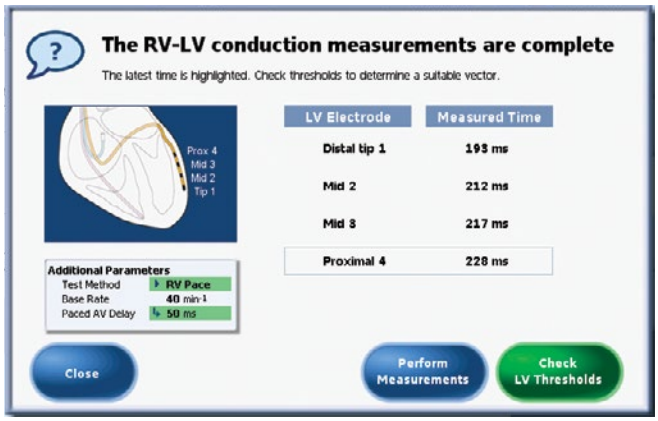
Figure 1



RV-LV conduction test (RV paced) (Figure 2)

- Earliest activation: D1 (193 ms)
- Latest activation: P4 (228 ms)

Figure 2



MultiPoint™ Pacing was programmed ON based on the RV-LV conduction test results in Figures 1 and 2 using P4 (latest activation site) as LV1 and D1 (earliest activation site) as LV2, and then to RV (Figure 3). The positions of the P4, D1 and RV pacing sites are as shown in the venograms (Figure 4).

Figure 3. Programed pulse configurations and delays for MultiPoint™ pacing

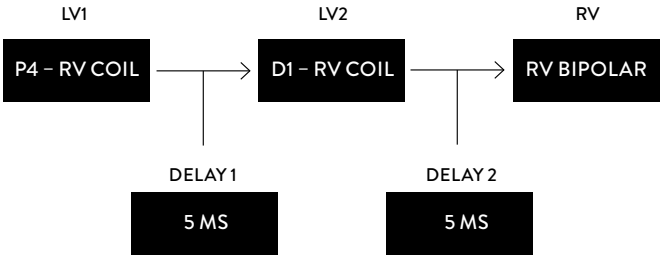
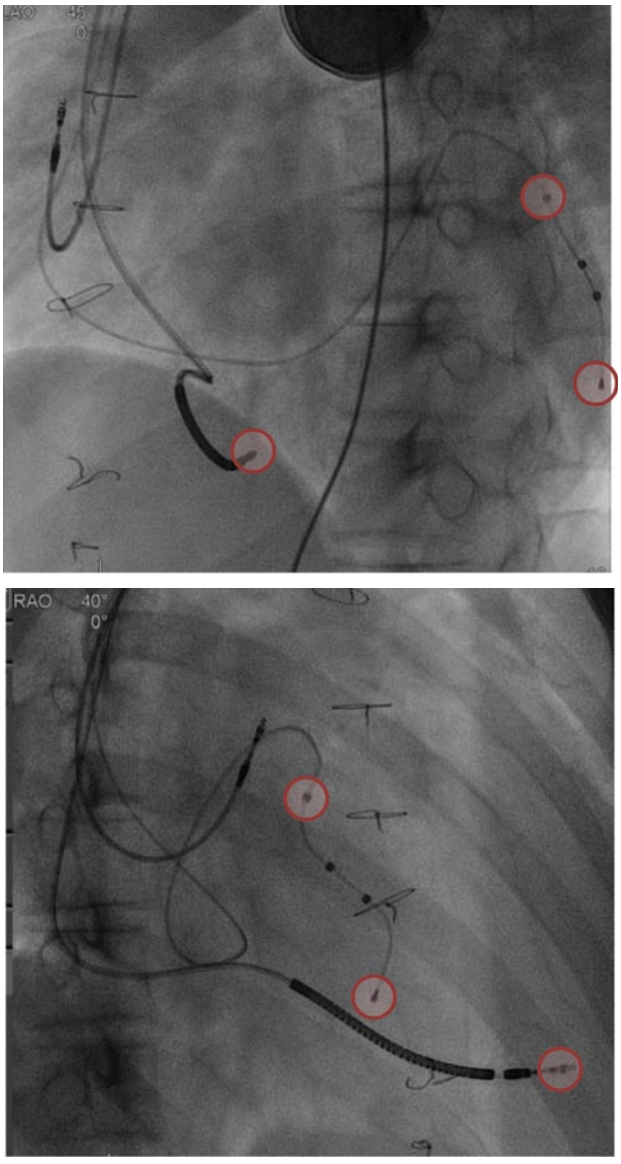


Figure 4. CRT-D: MultiPoint™ pacing with P4, D1 and RV



HEMODYNAMIC IMPROVEMENT WITH MULTIPOINT™ PACING

During the implant, the QRS duration under various pacing configurations was measured. A narrowing of the QRS complex was observed progressively from intrinsic baseline to conventional CRT (D1-M2), and then MultiPoint™ Pacing. The shortest QRS duration was achieved with MultiPoint Pacing at 134 ms (Figure 5).

Figure 5a. Change in QRS duration. 2010-Aug: QRSd 106 ms (top) and 2015-Jan: QRSd 164 ms (bottom)

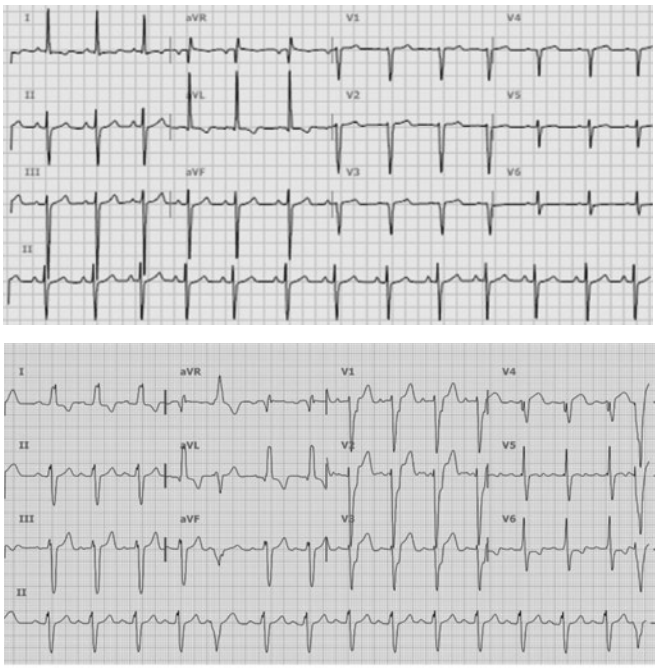
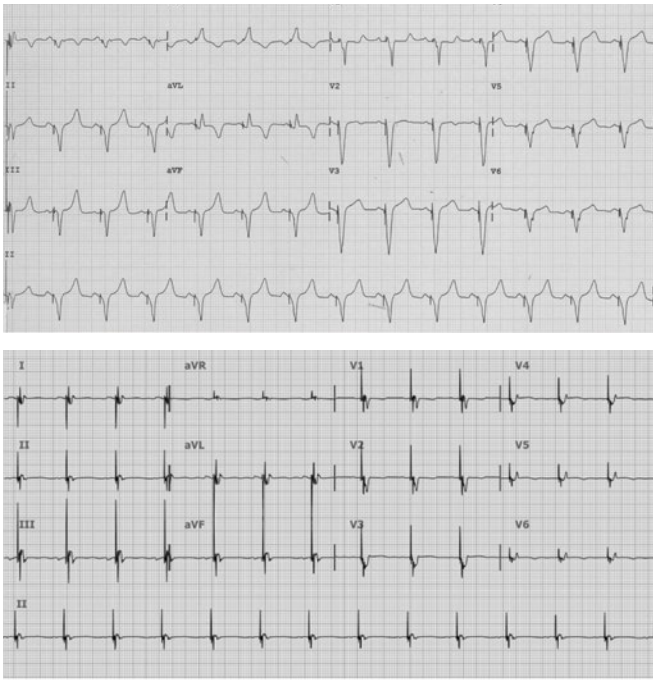


Figure 5b. Change in QRS duration. Conventional CRT: QRSd 145 ms (top) and MultiPoint Pacing CRT: QRSd 134 ms (bottom)

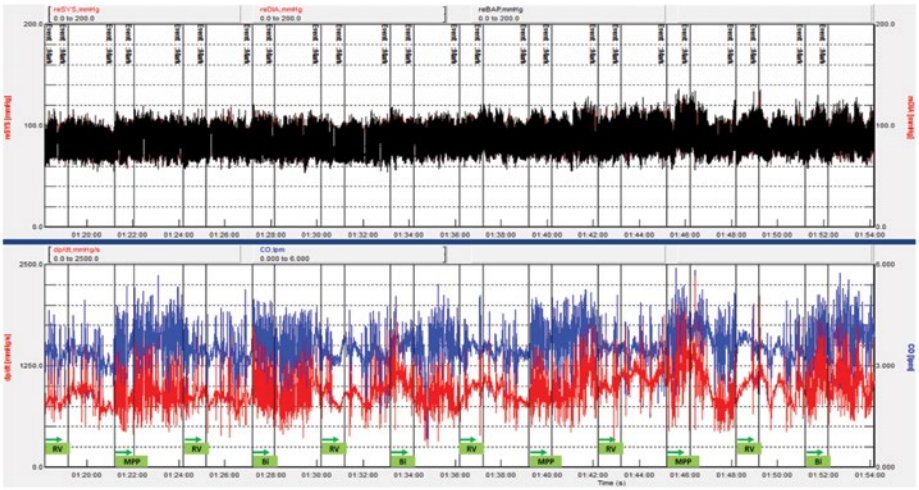


On the next day after implant, acute dP/dt_{max} measurement was performed. The best dP/dt_{max} was acquired under MultiPoint™ Pacing with a 39.4% increment from the baseline (Table 2 and Figure 6).

Table 2. Acute hemodynamic changes

	Pacing types	dp/dt (mmHg/s)	C.O. (l/m)
	Intrinsic	710	2.69
3 min.	Conventional BiV pacing	980	3.65
	MultiPoint™ pacing	990	3.81

Figure 6



Two weeks after implantation, the NT-proBNP test was done. There was a significant reduction of the NT-proBNP level from 4,299 before implantation to 2,168 after two weeks of MultiPoint Pacing. The reading was reduced to 1,854 after six weeks of MultiPoint Pacing, and further reduced to 1,231 after 14 weeks. The continued reduction in NT-proBNP levels following implant with MultiPoint Pacing programming indicated that the patient's heart failure condition was continuously improving (Figure 7).

Figure 7. Change in NT-proBNP

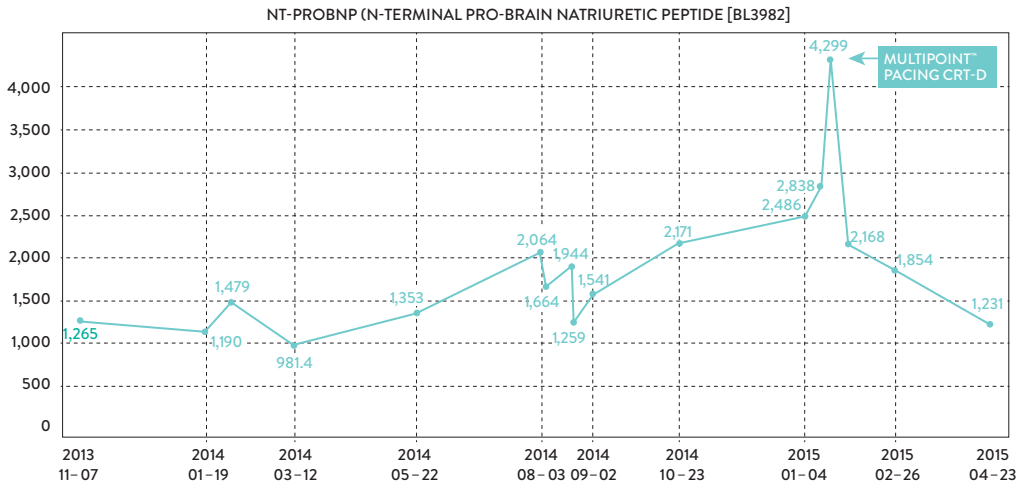


Table 3 and Table 4 summarize the acute and 3-month hemodynamic improvement of the patient.

Table 3. Acute hemodynamic change

Test	Time to Perform	Intrinsic Baseline	Conventional CRT	MultiPoint™ Pacing
QRS Duration (ms)	Implant day	164	145	134
dP/dt_{max} (mmHg/s)	2nd day	710	979	990
Cardiac Output (L/m)	2nd day	2.69	3.65	3.81

Table 4. Summary of the hemodynamic improvement of the patient

Test	Baseline	2 weeks	6 weeks	14 weeks
NT-proBNP	4,299	2,168	1.854	1.231
LV EF (%)	20%	25%	30%	33%
NYHA Class	II/III	II	I/II	I

CONCLUSION

MultiPoint™ Pacing demonstrated a better performance compared to conventional biventricular pacing regarding acute electrical reverse remodeling and hemodynamic changes for this patient with ischemic cardiomyopathy caused by Kawasaki disease. This patient's condition was improved with an early activation of MultiPoint Pacing therapy.

REFERENCES

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Brief Summary: Please review the Instructions for Use prior to using these devices for a complete listing of indications, contraindications, warnings, precautions, potential adverse events and directions for use.

Quartet™ LV lead
Indications and Usage: The Quartet lead has application as part of an Abbott Biventricular system.
Contraindications: The use of the Quartet lead is contraindicated in patients who:
• Are expected to be hypersensitive to a single dose of 1.0 mg of dexamethasone sodium phosphate.
• Are unable to undergo an emergency thoracotomy procedure.
• Have coronary venous vasculature that is inadequate for lead placement, as indicated by venogram.

MultiPoint™ Pacing and SyncAV™ CRT Technology
Indications: Abbott ICDs and CRT-Ds are intended to provide ventricular antitachycardia pacing and ventricular defibrillation for automated treatment of life-threatening ventricular arrhythmias. AF Suppression™ pacing is indicated for suppression of paroxysmal or persistent atrial fibrillation in patients with the above ICD indication and sinus node dysfunction. In patients indicated for an ICD, CRT-Ds are also intended: to provide a reduction of the symptoms of moderate to severe heart failure (NYHA Functional Class III or IV) in those patients who remain symptomatic despite stable, optimal medical therapy (as defined in the clinical trials section included in the Merlin™ PCS on-screen help)and have a left ventricular ejection fraction less than or equal to 35% and a prolonged QRS duration to maintain synchrony of the left and right ventricles in patients who have undergone an AV nodal ablation for chronic (permanent) atrial fibrillation and have NYHA Class II or III heart failure.
Contraindications: Contraindications for use of the pulse generator system include ventricular tachyarrhythmias resulting from transient or correctable factors such as drug toxicity, electrolyte imbalance, or acute myocardial infarction.
Adverse Events: Implantation of the pulse generator system, like that of any other device, involves risks, some possibly life-threatening. These include but are not limited to the following: acute hemorrhage/bleeding, air emboli, arrhythmia acceleration, cardiac or venous perforation, cardiogenic shock, cyst formation, erosion, exacerbation of heart failure, extrusion, fibrotic tissue growth, fluid accumulation, hematoma formation, histotoxic reactions, infection, keloid formation, myocardial irritability, nerve damage, pneumothorax, thromboemboli, venous occlusion. Other possible adverse effects include mortality due to: component failure, device programmer communication failure, lead abrasion, lead dislodgment or poor lead placement, lead fracture, inability to defibrillate, inhibited therapy for a ventricular tachycardia, interruption of function due to electrical or magnetic interference, shunting of energy from defibrillation paddles, system failure due to ionising radiation. Other possible adverse effects include mortality due to inappropriate delivery of therapy caused by: multiple counting of cardiac events including T waves, P waves, or supplemental pacemaker stimuli. Among the psychological effects of device implantation are imagined pulsing, dependency, fear of inappropriate pulsing, and fear of losing pulse capability.

Refer to the User's Manual for detailed indications, contraindications, warnings, precautions and potential adverse events.

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