

The impact of Cardiac Resynchronization Therapy on outcome of infants with severe Congestive heart failure due to dilated cardiomyopathy  
 ----The importance of detecting "optimal pacing site" in OR



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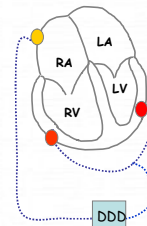
### Aim

- To investigate the outcome of DCM with onset in infancy after CRT using epicardial leads and DDD pacemaker, with special emphasis of detecting "the optimal pacing site" by intra-operative trans-thoracic / trans-esophageal echocardiography (TTE/TEE) monitoring.
- The optimal pacing site is guided as the latest contraction site by "radial strain" 2D speckle tracking imaging

### Demographic Data

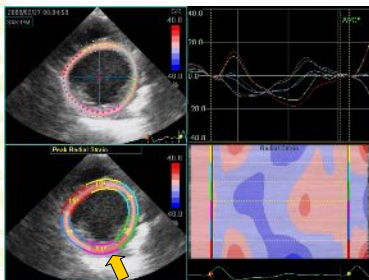
Dx	@ CRT							
	Age (mo)	Wt (Kg)	NYHA	CTR (%)	LVFS (%)	Max BNP (pg/ml)	Ts-SD (ms)	
1 H DCM, p-myocarditis	♂	9	6.5	4	70	1	1800	159
2 H DCM, p-myocarditis	♂	11	6.0	4	65	7	7680	164
3 G DCM,	♂	13	6.8	4	71	6	3550	151
4 O DCM,	♀	11	6.1	4	75	6	5210	65
5 H DCM	♀	9	7.0	4	66	7	1720	97

### How to do "CRT" by using epicardial lead in small infants with DCM



- Epicardial lead placement
- Y-shape lead for RV/LV pacing
- DDD pacemaker
- Dyssynchrony as enrolling criteria

### How to determine Optimal Pacing Site



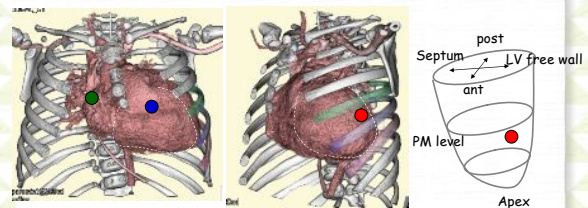
Latest contraction segment of the ventricle determined by time-to-peak radial strain of LV



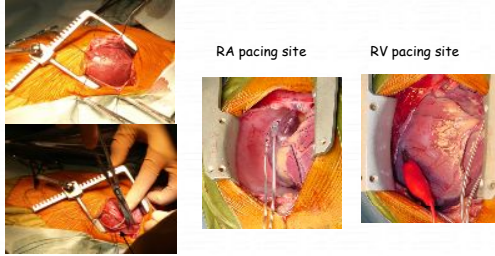
"Optimal pacing site"

Suffoletto MS et al. Circulation 2005;113:960-968

### Estimation of Lead position by MDCT



### OR setting of epicardial leads



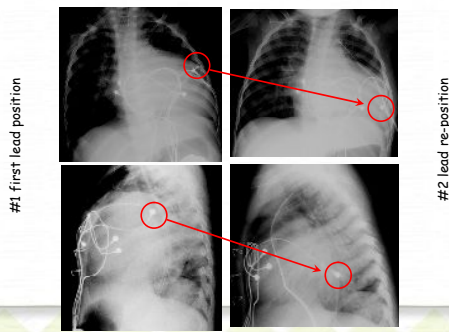
RA pacing site      RV pacing site

Place LV pacing lead at the estimated "optimal pacing site" through left thoracotomy, then place RA pacing lead through median sternotomy. Finally place RV pacing lead by intra-operative "CRT simulation".

### Outcome of CRT using epicardial leads

Dx	Follow/Up (m.o.)	NVHA	CTR (%)	LVFS (%)	Max BNP (pg/ml)	Ts-SD (ms)	outcome
1 H DCM	92	4	1 70 47	1 34	1800x 15	159 31	alive
2 H DCM	28	4	2 65 52	7 28	7680 35	164 40	alive
3 G DCM	27	3	2 71 57	6 32	3550 30	155 69	alive
4 O DCM	25	4	2 75 54	6 35	5210 31	65 10	alive
5 H DCM	8	4	4 66 68	7 9	1720 3040	97 63	Dead

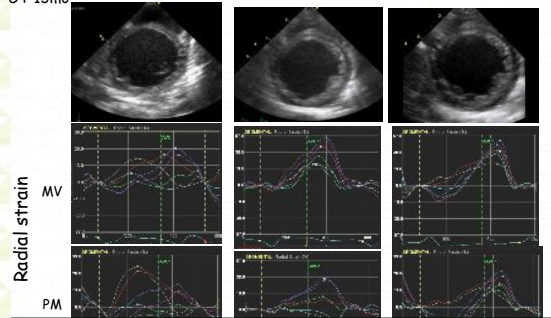
### The Crucial setting of Optimal Pacing Site



#1 first lead position

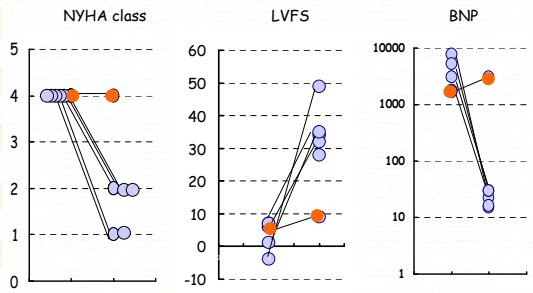
#2 lead re-position

### GT 13mo Before #1 CRT #2 CRT



Td-SR	112ms	55ms	17ms
Td-SR12	271ms	90ms	56ms

### Outcome of CRT



### Mid- & Long term prognosis of CRT in children

Study	Total (n)	CHD (n)	Systems RV (n)	Single Ventricles (n)	Conv. Pacing Prior to CRT (n)	NVHA Class (Median)	Age at CRT (Median)	FUP Median (range)	nonresponders (n)	Removed from Transplant List (n)	
Strieper et al. 2004	7	7	17	0	5	NA	7.3	16	2	5/7	
Jancousek et al. 2004	8	8	8	0	6	median 2	12.5	17.4	0	0/0	
Dubin et al. 2005	103	73	17	7	48	1-15	12.6	4	11	3/18	
Khairy et al. 2008	13	10	4	0	7	NA	6.5	15.6	0	NA	
Beek et al. 2008	3	0	0	0	3	NA	1.5	(2-12)	0	0/0	
Mook et al. 2006	6	2	0	0	6	NA	10.0	10	0	2/2	
Jancousek et al. 2006	74	NA	22	3	58	median 2	10.9	8.1	9	3/0	
Deochin et al. 2009	60	46	7	13	32	1-15	15	8.4	11	NA	
Jancousek et al. 2009	109	87	36	4	84	3/4-19	2.5	10.0	7.5	15/31	NA
<b>Total</b>	<b>383</b>	<b>233/309</b>	<b>94</b>	<b>27</b>	<b>247</b>				<b>48</b>	<b>15/35</b>	
	(79.4%)	(24.6%)	(7%)	(64.6%)					(13.3%)	(37.1%)	

## CRT responder vs non-responder

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- Patient Selection
- Procedural success
  - Optimal Pacing site
  - Optimal Pacing Interval ( AV, VV delay )
- Post-CRT managements

## Conclusion

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- > The major indication of CRT is ventricular dyssynchrony
- > The key to success of CRT for DCM with infant onset is "[Optimal pacing site](#)" and "[optimal AV/VV delay](#)".
- > LV pacing lead position for "[Optimal pacing site](#)" is agreed with the latest contraction site of LV detected by 2D radial strain
- > CRT in children  $\pm$  CHD often requires "epicardial leads", however its outcome is comparable to those using transvenous lead.
- > The meticulous intraoperative screening for optimal pacing site is mandatory for getting optimal outcome of CRT.