L'INSTITUT DE RYTHMOLOGIE ET MODÉLISATION CARDIAQUE
BORDEAUX

39ème SEMINAIRE DE CARDIOLOGIE CONGENITALE ET PEDIATRIQUE
22 et 23 mars 2018

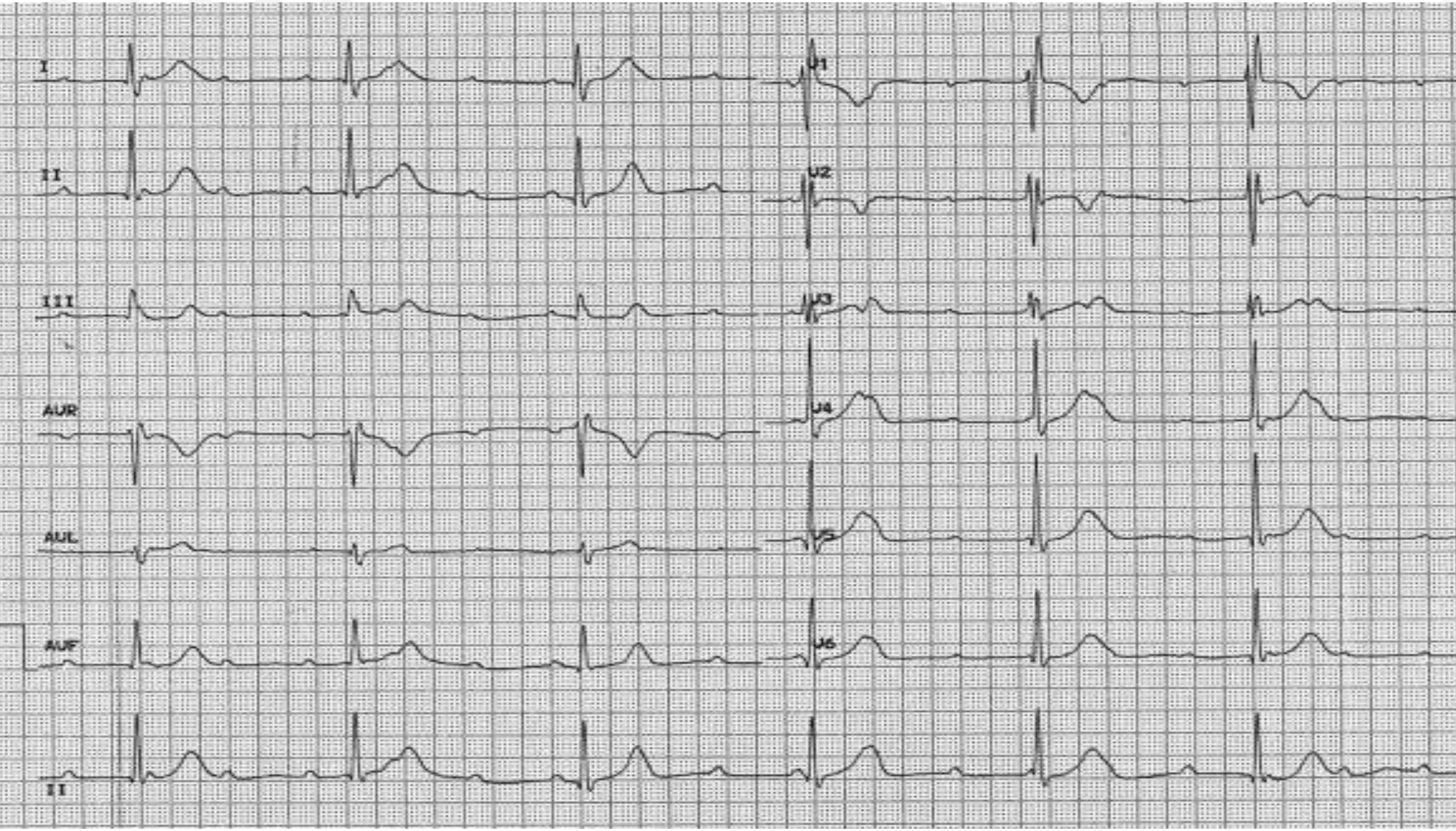
Comment Stimuler ?

Pr Jean-Benoît THAMBO
Unité Médico-Chirurgicale des Pathologies Cardiaques congénitales du Foetus de l'Enfant et de l'Adulte
Hôpital cardiologique Haut Lévêque
Bordeaux

www.RhythmoPedia.com

Pathologies Cardiaques Congénitales
Hôpitaux de Bordeaux

Enfant; 6 ans; 24 Kg = syncope

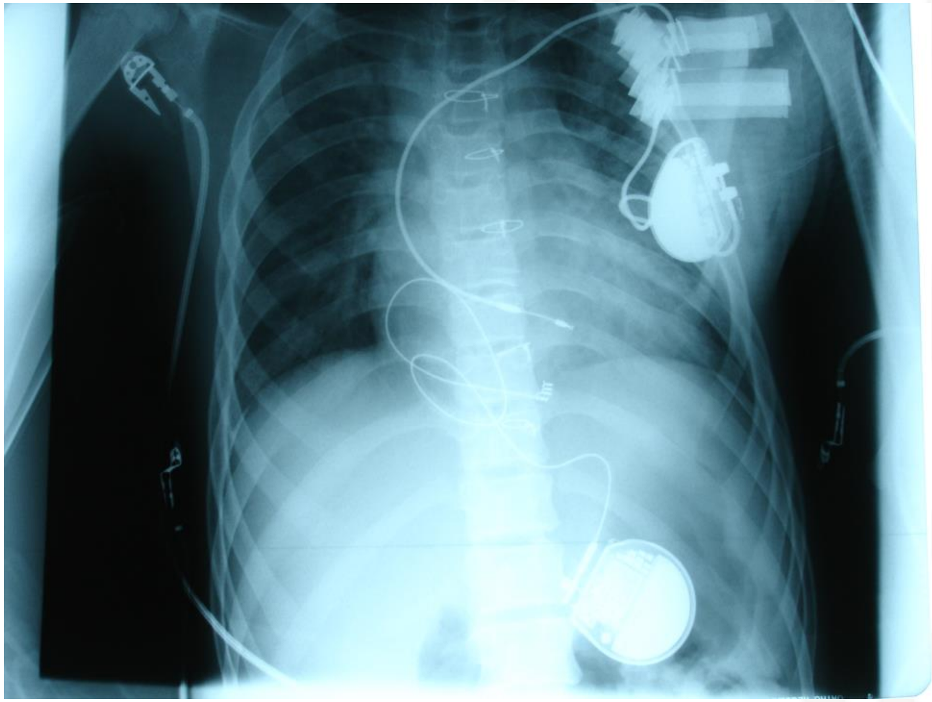


Quel diagnostic évoquez vous

1. BAV premier degré avec ESA
2. Bloc auriculo-ventriculaire 2/1 type mobitz 2
3. Bloc auriculoventriculaire complet
4. Arythmie respiratoire

EPI vs ENDO

- **Epicardial or endocardial ?**



Epi steroid lead pacing

Arch Mal Coeur Vaiss. 2004 Oct;97(10):994-9.

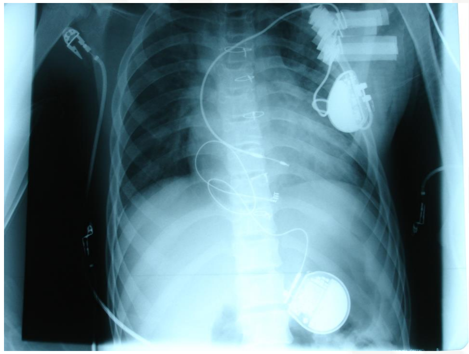
[Congenital complete atrio-ventricular block].

[Article in French]

Abstract

Congenital complete atrio-ventricular block is a rare condition, the result of an anatomical anomaly of the conduction pathways, or even the trans-placental passage of maternal antibodies causing fetal myocarditis with fibrosis of the conduction tissue. It is not clear whether AV block discovered later in childhood is really "congenital". Whatever the age of the child, the only treatment is pacemaker implantation. Cardiac failure and syncope are absolute indications for implantation. Children whose heart rate is below 50 beats per minute (bpm) represent a group at high risk of syncope or even sudden death and must be paced, even if asymptomatic. Moreover, certain patients with immunological complete AV block have cardiopathy and must also be paced. In our department, the route for pacing is epicardial in younger children, in practice weighing less than 10-15 kg, and endocavitary in older children. The choice is either double chamber pacing, which restores AV conduction initiated by the child's sinus, or ventricular pacing with activity-controlled heart rate. Although worrying complications have been described, such as venous thrombosis, infections related to repeated interventions, and delayed cardiomyopathy, the results of paediatric pacing are generally satisfactory and the great majority of children with congenital complete AV block lead a normal life.

< 15 KG	Epicardial	Dual lead
15-25 KG	Endocardial	VVIR
> 25 KG	Endocardial	DDD



Europace (2012) **14**, 509–514
doi:10.1093/europace/eur327

CLINICAL RESEARCH
Pacing and Resynchronization Therapy

Permanent epicardial pacing in children: long-term results and factors modifying outcome

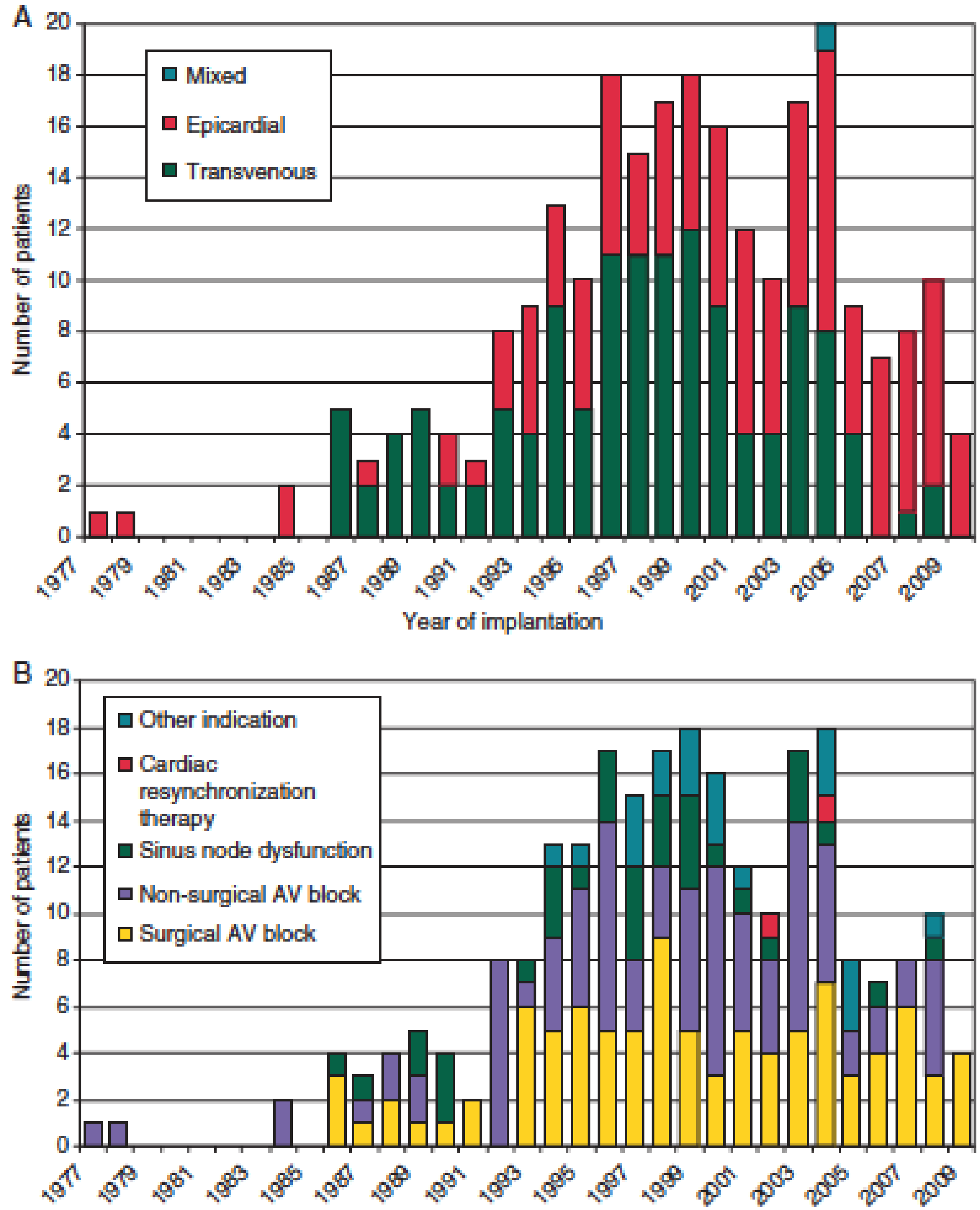
Petr Kubuš[1*], Ondřej Materna[1], Roman A. Gebauer[2], Tomáš Matějka[1], Roman Gebauer[1], Tomáš Tláskal[1], and Jan Janoušek[1]

[1]Kardiocentrum and Cardiovascular Research Centre, University Hospital Motol, V Úvalu 84, 150 06 Prague, Czech Republic; and [2]Department of Paediatric Cardiology, University of Leipzig, Heart Centre, Strümpellstrasse 39, 04289 Leipzig, Germany

Aims To evaluate the results of permanent epicardial pacing in children.

Methods and results All consecutive patients from one country ($n = 119$, period 1977–2009) undergoing permanent epicardial pacemaker implantation at <18 years of age (median 1.8 years, inter-quartile range 0.3–6.4 years) were studied retrospectively. Median patient follow up was 6.4 years (inter-quartile range 2.9–11.1 years); 207 generators, 89 atrial and 153 ventricular pacing leads were implanted. The probability of absence of any pacing system dysfunction was 70.1 and 47.2% at 5 and 10 years after implantation, respectively. Overall probability of continued epicardial pacing was 92.8 and 76.1% at 5 and 10 years, respectively, and increased in the recent implantation era (post-2000, $P = 0.04$). The use of steroid-eluting leads decreased the risk of exit block with a hazard ratio (HR) of 0.20 [95% confidence interval (CI) 0.09–0.44, $P < 0.001$)]. The use of bipolar Medtronic 4968 leads reduced the risk of surgical reintervention because of fracture, insulation break, outgrowth or exit block in comparison to the unipolar 4965 lead design (HR 0.12, 95% CI 0.04–0.40, $P < 0.001$). The AutoCapture™ feature (HR 0.08, 95% CI 0.02–0.36, $P < 0.001$) and steroid-eluting leads (HR 0.30, 95% CI 0.11–0.84, $P = 0.021$) decreased the risk of battery depletion.

Conclusion The probability of continued epicardial pacing in children was 76% at 10 years after implantation, increased for implantation in recent years, and allowed transvenous pacing to be deferred to a significantly greater age. The use of bipolar steroid-eluting leads and of a beat-to-beat capture tracking feature significantly increased pacing system longevity and decreased the need for surgical reinterventions.


A
Mixed
Epicardial
Transvenous
Number of patients
Year of implantation
B
Other indication
Cardiac resynchronization therapy
Sinus node dysfunction
Non-surgical AV block
Surgical AV block
Number of patients

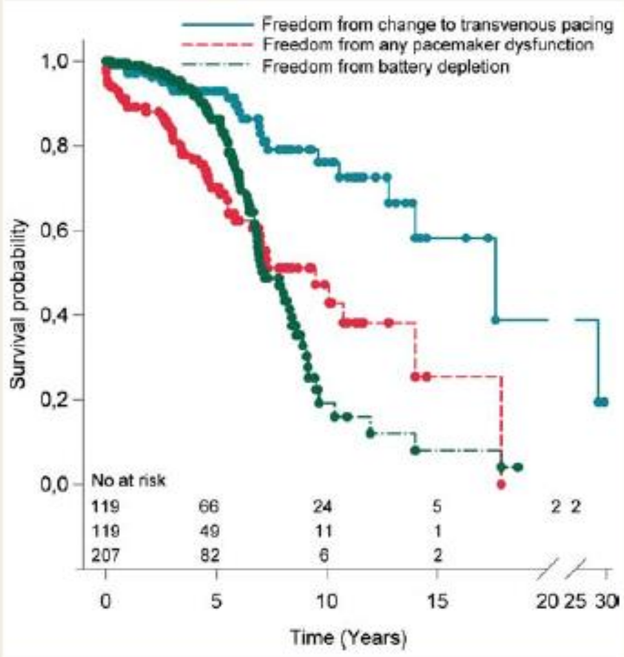


Figure 2 Epicardial pacemaker survival probability. Number of patients at risk at a particular follow-up time is displayed for the three survival curves.

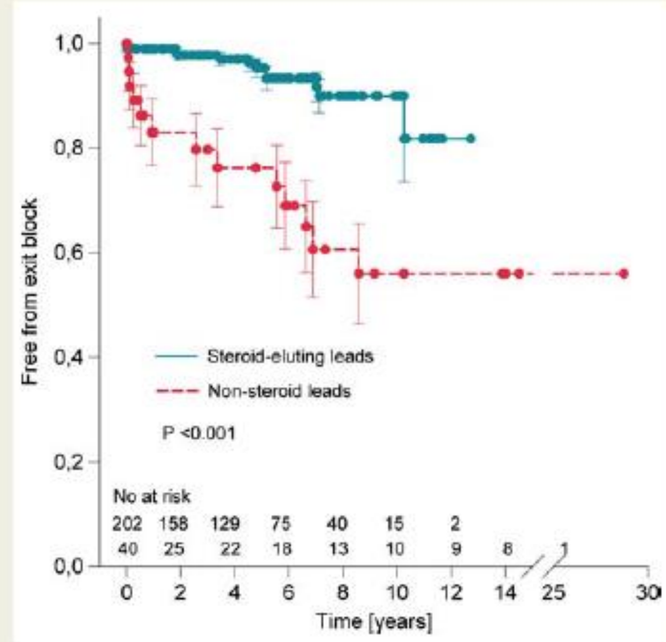


Figure 3 Probability of freedom from exit block. Number of patients at risk at a particular follow-up time is displayed for both survival curves.

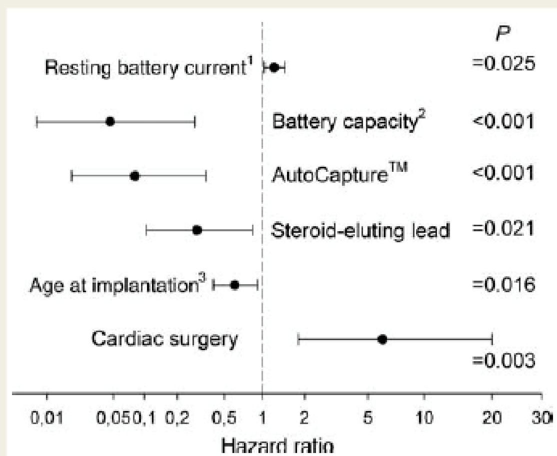


Figure 4 Factors affecting battery longevity. Explanations: [1]per microampere, [2]per ampere hour, [3]per each 5 years increment.

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Transvenous pacing in pediatric patients with bipolar lumenless lead: Ten-year clinical experience

Paolo De Filippo [a,*], Fabrizio Giofrè [a], Cristina Leidi [a], Michele Senni [b], Paola Ferrari [a]

[a] Cardiac Electrophysiology and Pacing Unit, Cardiovascular Department, Ospedale Papa Giovanni XXIII, Bergamo, Italy
[b] Cardiovascular Department, Ospedale Papa Giovanni XXIII, Bergamo, Italy

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ABSTRACT

Introduction: A number of challenges can affect long-term performance of endocardial implanted systems in pediatric patients. Select Secure™ lead offers potential advantages for this population. This analysis aims to evaluate long-term performance of this lead in children, with and without congenital heart disease.

Methods: A retrospective analysis of all patients younger than 16 years, implanted with at least one Select Secure™ lead at our institution, was performed. Clinical patient characteristics, electrical lead parameters, implant related complications, occurrence of surgical revisions and other complications were analyzed.

Results: From 2006 to 2016, 40 pediatric patients (26 males; age: 10.3 ± 4.6 years) underwent a cardiac device implantation with at least one Select Secure™ lead. Axillary vein access was chosen in 77.5% of the procedures. The intra-atrial loop of the leads was successfully created and the generator was placed in a sub-pectoral pocket in all patients. A total of 57 Select Secure™ leads were implanted: 23 in the right atrium and 34 in the right ventricle. PM/ICDs implantation was uneventful in all 40 patients. One lead, dislodged the day after implantation, was successfully extracted and replaced in the same day. Adequate pacing parameters were achieved during a follow-up of 6 ± 2.9 years (range 0.9–10.8 years).

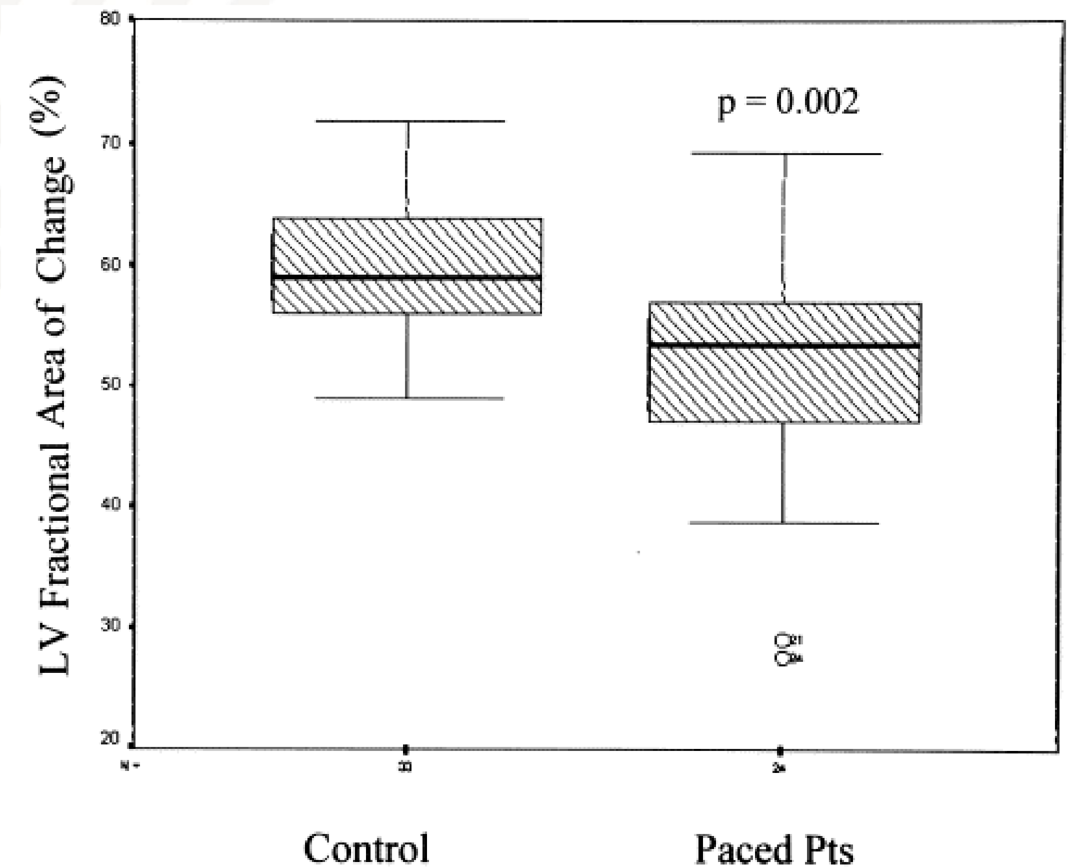
Conclusions: In a pediatric population, the Select Secure™ lead used in the axillary vein, the creation of an intra-atrial loop and the placement of the generator in a sub-pectoral pocket ensured a safe implantation of pacemaker or ICD and an effective stimulation at medium-term follow-up.

Quel est votre attitude ?

1. PM endocavitaire simple chambre
2. PM endocavitaire double chambre
3. PM épicardique avec sonde steroid eluding
4. PM épicardique double chambre A_V

Quel site de stimulation ?

Detrimental effect of long term apical right ventricular pacing



Long term RVP from the apex appears to be associated with LV systolic and diastolic dysfunction

Tatengco et al JACC 2001

European Heart Journal (2009) 30, 1097–1104
doi:10.1093/eurheartj/ehp060

CLINICAL RESEARCH
Heart failure/cardiomyopathy

Predictors of left ventricular remodelling and failure in right ventricular pacing in the young

Roman A. Gebauer[1], Viktor Tomek[1], Aida Salameh[2], Jan Marek[3], Václav Chaloupecký[1], Roman Gebauer[1], Tomáš Matějka[1], Pavel Vojtovič[1], and Jan Janoušek[2]*

[1]Kardiocentrum and Cardiovascular Research Center, University Hospital Motol, Prague, Czech Republic; [2]Department of Pediatric Cardiology, University of Leipzig, Heart Center, Strümpellstrasse 39, 04289 Leipzig, Germany; and [3] Department of Pediatric Cardiology, Great Ormond Street Hospital, London, UK

Received 11 May 2007; revised 11 December 2008; accepted 30 January 2009; online publish-ahead-of-print 12 March 2009

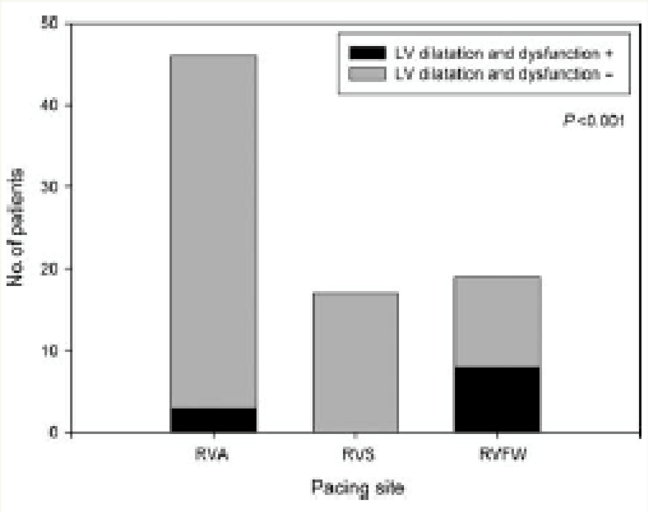


Figure 1 Proportion of patients developing LV dilatation and dysfunction (SF<26% and LVEDD >+2z-values) according to the pacing site. RVA, endocardial RV apical pacing; RVS, endocardial RV septal pacing; RVFW, epicardial RV free wall pacing.

Aims To identify risk factors for left ventricular (LV) dysfunction in right ventricular (RV) pacing in the young.

Methods and results Left ventricular function was evaluated in 82 paediatric patients with either non-surgical ($n = 41$) or surgical ($n = 41$) complete atrioventricular block who have been 100% RV paced for a mean period of 7.4 years. Left ventricular shortening fraction (SF) decreased from a median (range) of 39 (24–62)% prior to implantation to 32 (8–49)% at last follow-up ($P < 0.05$). Prevalence of a combination of LV dilatation (LV end-diastolic diameter >+2z-values) and dysfunction (SF < 0.26) was found to increase from 1.3% prior to pacemaker implantation to 13.4% (11/82 patients) at last follow-up ($P = 0.01$). Ten of these 11 patients had progressive LV remodelling and 8 of 11 were symptomatic. The only significant risk factor for the development of LV dilatation and dysfunction was the presence of epicardial RV free wall pacing (OR = 14.3, $P < 0.001$). Other pre-implantation demographic, diagnostic, and haemodynamic factors including block aetiology, pacing variables, and pacing duration did not show independent significance.

Conclusion Right ventricular pacing leads to pathologic LV remodelling in a significant proportion of paediatric patients. The major independent risk factor is the presence of epicardial RV free wall pacing, which should be avoided whenever possible.

REVIEW

The Deleterious Consequences of Right Ventricular Apical Pacing: Time to Seek Alternate Site Pacing

ANTONIS S. MANOLIS

Trial	No. of Patients	Mean Age (y)	Mean FU (y)	LA Diameter	LV Function	CHF	AF
Tantengco et al.[28]	24	19.5	9.5	NA	↓	2 pts	NA
Karpawich et al.[29]	14	15.5	5.5	NA	Altered Histology	NA	NA
Thambo et al.[30]	23	24	10	NA	↓/DS	NA	NA
Tse et al.[31]	12	72	1.5	NA	↓/MPD	NA	NA
Hamdan et al.[32]	13	66	NA*	NA	↓/↑SNA	NA	NA
DAVID[36]	506	64	1	NA	NA	↑	NA
MADIT II[37,38] Substudy	567	64	1.7	NA	NA	↑	NA
Wonisch et al.[39]	17	59	0.25	NA	NA	**	NA
Thackray et al.[40]	307	72	5.2	NA	NA	↑	↑
MOST[41]	1,339	74	6	NA	NA	↑	↑
Nielsen et al.[43]	177	74	2.9	↑	↓	NA	↑
O'Keefe et al.[44]	59	69	1.5	NA	↓	NA	NA

AF = atrial fibrillation; CHF = congestive heart failure; DS = dyssynchrony; FU = follow-up; LA = left atrium; LBBB = left bundle branch block; LV = left ventricular; MPD = myocardial perfusion defects; NA = not available/ not assessed; SNA = sympathetic nerve activity.

*Acute study.

**Permanent RV pacing significantly reduced exercise capacity and submaximal cardiorespiratory parameters.

European Heart Journal (2009) **30**, 1033–1034
doi:10.1093/eurheartj/ehp130

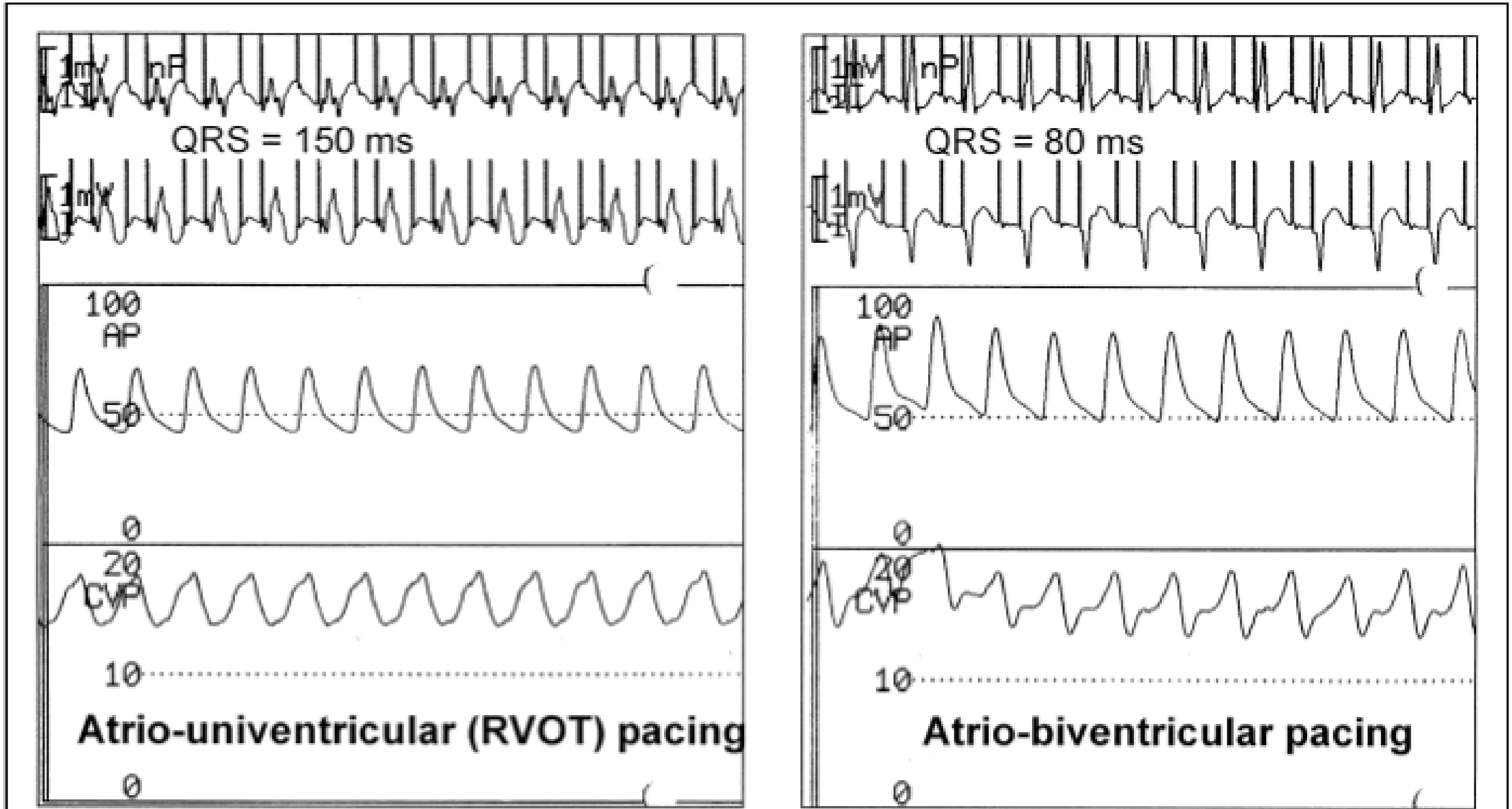
EDITORIAL

Selecting pacing sites in children with complete heart block: is it time to avoid the right ventricular free wall?

Luc Mertens* and Mark K. Friedberg

Resynchronization Pacing Is a Useful Adjunct to the Management of Acute Heart Failure After Surgery for Congenital Heart Defects

Jan Janoušek, MD, Pavel Vojtovič, MD, Bohumil Hučín, MD, Tomáš Tláskal, MD, Roman Antonín Gebauer, MD, Roman Gebauer, MD, Tomáš Matějka, MD, Jan Marek, MD, and Oleg Reich, MD



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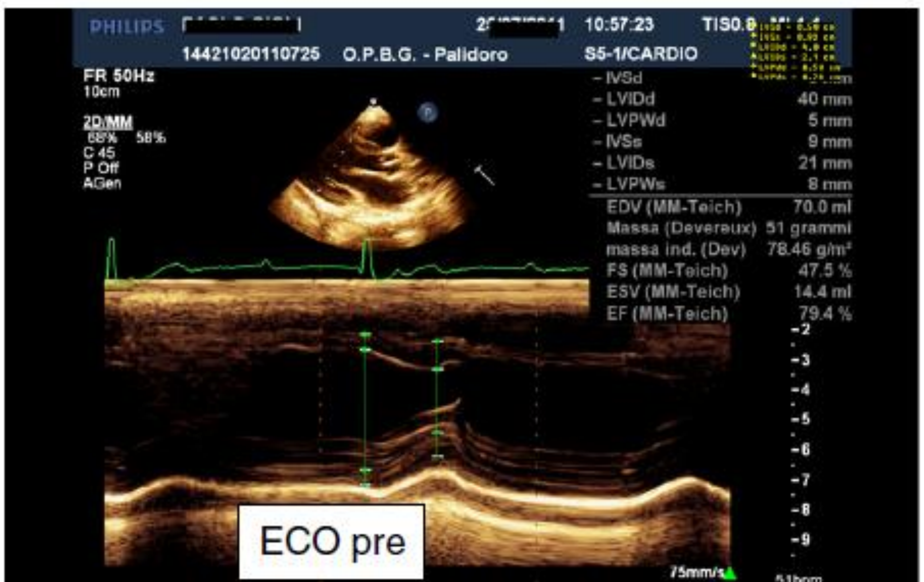
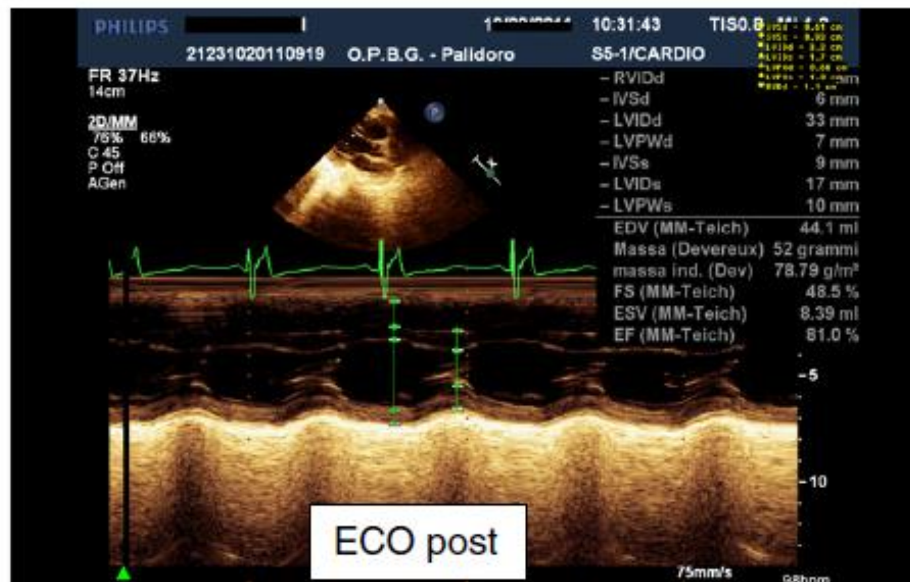
Letter to the Editor

"De novo" biventricular pacing in two children with complete atrio-ventricular block and severe ventricular dilatation: Early reverse remodeling ☆

Antonio Ammirati, Massimo Stefano Silvetti *, Duccio Di Carlo, Fabio Anselmo Saputo, Antonio Longoni, Fabrizio Drago





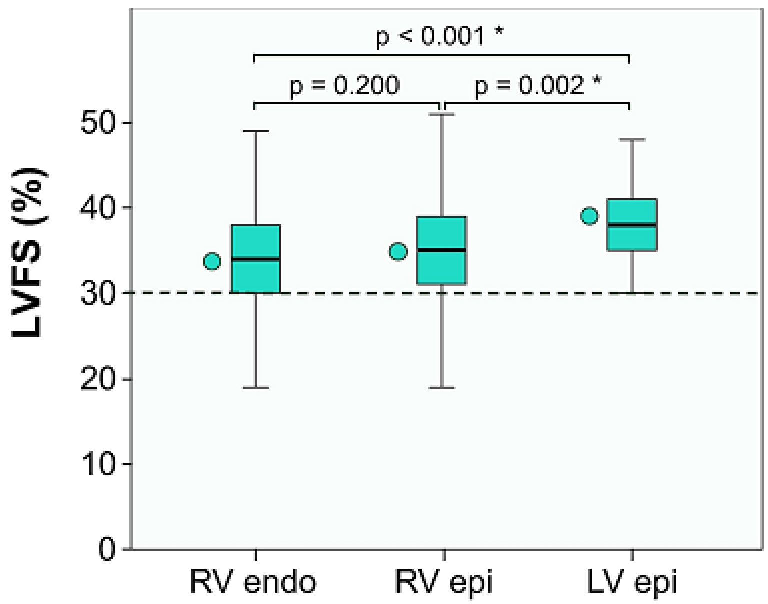
1 week later

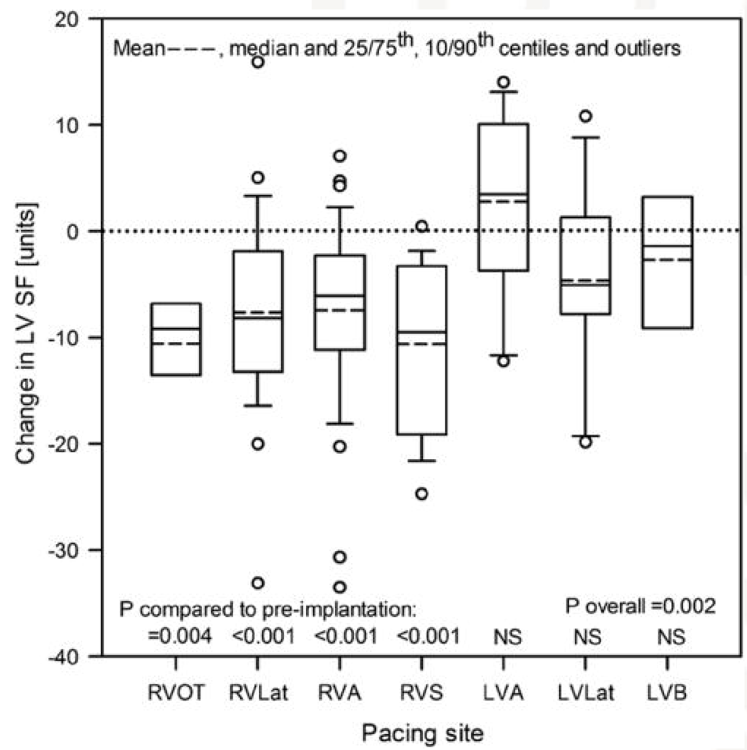
Best site to pace ?

La stimulation ventriculaire droite permanente expose à un remodelage ventriculaire délétère

Particularités de la population pédiatrique:

- Stimulés toute leur vie
- Stimulés pendant la croissance cardiaque





van Geldorp I, Heart 2011

Janousek J, Circulation 2013

CARDIOVASCULAR

Acute Hemodynamic Benefit of Left Ventricular Apex Pacing in Children

Ward Y. Vanagt, MD, Xander A. Verbeek, PhD, Tammo Delhaas, MD, PhD, Marc Gewillig, MD, PhD, Luc Mertens, MD, PhD, Patrick Wouters, MD, PhD, Bart Meyns, MD, PhD, Willem J. Daenen, MD, and Frits W. Prinzen, PhD

Departments of Physiology and Pediatrics, Cardiovascular Research Institute Maastricht, Maastricht, The Netherlands, and Departments of Pediatric Cardiology, Anesthesiology, and Cardiothoracic Surgery, University Hospital Gasthuisberg, Catholic University of Leuven, Leuven, Belgium

Background. Despite the fact that pacing at the right ventricular apex acutely and chronically decreases left ventricular contractile function, this pacing site is still conventionally used in adults and children. Because animal studies showed beneficial effects of left ventricular pacing, we compared the hemodynamic performance of left ventricular apex, left ventricular free wall, and right ventricular apex pacing in children.

Methods. Studies were performed in 10 children (median age, 2.5 years; range, 2 months to 17 years) undergoing surgery for congenital heart disease with normal systemic left ventricular anatomy and intraventricular conduction. High-fidelity left ventricular and arterial pressure measurements were performed during epicardial right ventricular apex and left ventricular apex and free wall pacing.

Results. Left ventricular apex pacing increased the maximum rate of rise of left ventricular pressure and pulse pressure significantly relative to right ventricular apex pacing (by 7.7% ± 7.2% and 7.7% ± 7.0%, respectively) without changes in end-diastolic left ventricular pressure. Left ventricular free wall pacing did not significantly improve hemodynamics as compared with right ventricular apex pacing. The QRS duration was not different among pacing at the three sites.

Conclusions. In this short-term study left ventricular apex pacing is hemodynamically superior to right ventricular apex and left ventricular free wall pacing in children. Therefore, the left ventricular apex appears a favorable pacing site after pediatric cardiac surgery.

(Ann Thorac Surg 2005;79:932–6)

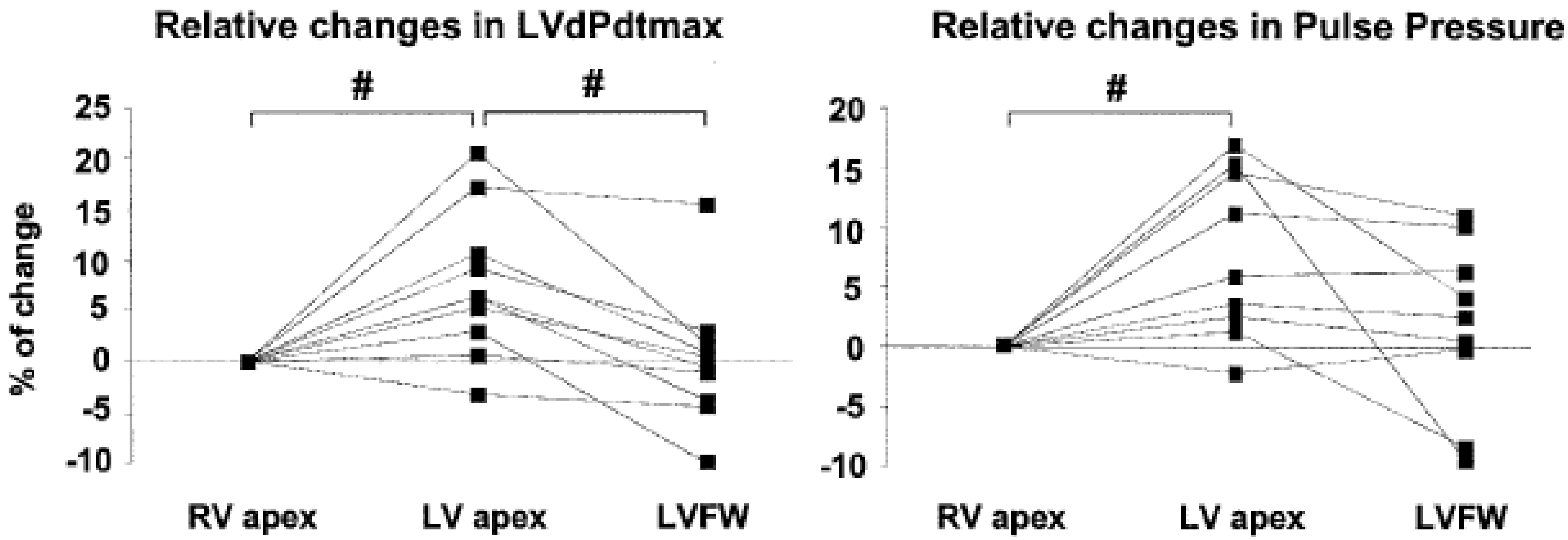


Fig 1. Percentage changes in maximal rate of rise of left ventricular pressure (LVdPdtmax; *left panel, n = 10) and in pulse pressure (right panel, n = 9) for individual patients with right ventricular* (RV) *apex pacing as reference value (*# = p < *0.05 versus left ventricular apex pacing).* (RV apex = *RV apex pacing;* LV apex = *left ventricular apex pacing;* LVFW = *left ventricular free wall pacing.)*

Table 1. Patient Characteristics

Patient Number	Age (y)	Diagnosis	Surgical Procedure	Percent Change in LVdPdtmax (LV apex vs RV apex pacing)	Percent Change in Pulse Pressure (LV apex vs RV apex pacing)
1	0.2	ASD/VSD	Patch	20.7	15.4
2	0.3	TOF	Patch + PA dilation	9.2	5.9
3	0.3	ASD/VSD	Patch	3.0	1.2
4	0.6	TOF	Patch + PA dilation	10.7	17.0
5	2.1	ASD	Patch	−3.2	−2.2
6	2.9	ASD/VSD	Patch	5.4	2.5
7	4.4	VSD	Patch[a]	6.4	
8	9.3	SubAS	Myotomy[a]	0.6	3.6
9	13.5	AS	Ross	17.2	14.7
10	17.7	MVP	Annuloplasty + ring	6.6	11.2

[a] Surgery complicated by AV block.

AS = aortic stenosis; ASD = atrial septal defect; LV = left ventricular; LVdPdtmax = maximal rate of rise of LV pressure; MVP = mitral valve prolapse; PA = pulmonary artery; RV = right ventricular; SubAS = subaortic stenosis; TOF = tetralogy of Fallot; VSD = ventricular septal defect.

Table 2. Hemodynamic Results[a]

Variable	RV Apex Pacing Absolute Values	LV Apex Pacing Relative to RV Apex (%)[a]	LVFW Pacing Relative to RV Apex (%)[a]	ANOVA p Value
LVPsys	79.5 ± 14.3 mm Hg	2.7 ± 4.1	0.3 ± 6.3	NS
LVdPdtmax	918 ± 251 mm Hg/s[c]	7.7 ± 7.2[b]	0.2 ± 6.6[c]	0.002
LVdPdtmin	724 ± 188 mm Hg/s	2.6 ± 7.6	−1.8 ± 8.1	NS
LVPed (mm Hg)	13.0 ± 3.8	−0.6 ± 6.2	0.0 ± 6.5	NS
Pulse pressure	40.2 ± 11.5 mm Hg[c]	7.7 ± 7.0[b]	1.8 ± 7.2	0.016
Heart rate	128 ± 30 bpm	−1.8 ± 20.6	0.4 ± 24.2	NS

[a] Baseline value during RV apex pacing, change ± standard deviation relative to RV apex pacing during LV apex and LVFW pacing and analysis of variance p value for overall group comparison. Changes relative to RV apex pacing expressed as percentage of change, except for LVPed, expressed in mm Hg. [b] $p < 0.05$ versus RV apex pacing; [c] $p < 0.05$ versus LV apex pacing.

ANOVA = analysis of variance; LV = left ventricular; LVdPdtmax = maximal rate of rise of LV pressure; LVdPdtmin = maximal rate of fall of LV pressure; LVFW = LV free wall; LVPed = end-diastolic LV pressure; LVPsys = maximal systolic LV pressure; NS = not significant; RV = right ventricular.

Un double chambre pour qui ?

Question

1. Dés 25 kg, il est classique de passer en endocavitaire double chambre
2. Je reste en VVIR le plus longtemps possible car il est préférable d'implanter le moins de sonde possible
3. Les capteur d'asservissement sont aujourd'hui très efficace et évitent les sous détections atriale avec chute brutale de fréquence de stimulation souvent mal tolérés
4. Un simple chambre est classiquement implanté lors de troubles conductifs A-V intermittents

Comment stimuler une Cardiopathie congénitale…

Adverse impact of chronic subpulmonary left ventricular pacing on systemic right ventricular function in patients with congenitally corrected transposition of the great arteries

Wee Tiong Yeo [a,b,1], Julian W.E. Jarman [a,1], Wei Li [a,1], Michael A. Gatzoulis [a,1], Tom Wong [a,*,1]

A B S T R A C T

Background: Patients with congenitally corrected transposition of the great arteries (ccTGA) are at high risk of heart block requiring subpulmonary left ventricular (LV) pacing. Long-term right ventricular (RV) pacing in congenitally normal hearts is associated with LV dysfunction. We examined the effects of univentricular subpulmonary LV pacing on the systemic RV in a ccTGA cohort.

Methods: ccTGA patients with two echocardiographic studies at least 6 months apart were included. Records of 52 patients, 22 with pacing, were retrospectively reviewed. Seven patients with biventricular pacing were included for comparison.

Results: The LV-Paced Group experienced deterioration in the RV fractional area change (RVFAC) (28.7 ± 10.0 vs. 21.9 ± 9.1%; $P = 0.003$), systemic atrioventricular valve regurgitation ($P = 0.019$) and RV dilatation (end-diastolic area 32.7 ± 8.7 vs. 37.2 ± 9.0 cm^2; $P = 0.004$). There was a corresponding deterioration in NYHA class ($P = 0.013$). Multivariate Cox regression analysis showed that pacing was an independent predictor of deteriorating RV function and RV dilation (hazard ratio 2.7(10–7.0) and 4.7(1.1–20.6) respectively). None of these parameters changed significantly in the Un-paced Group. The CRT Group showed improvement in RVFAC (22.0% to 30.7% ($P = 0.030$) and NYHA class ($P = 0.030$), despite having lower baseline RVFAC (22.0 ± 5.7 vs. 31 ± 9.7%; $P = 0.025$) and greater dyssynchrony (RV total isovolumic time 13.4 ± 2.1 vs. 9.3 ± 4.2 s/min; $P = 0.016$) when compared to the Un-Paced Group.

Conclusions: Univentricular subpulmonary LV pacing in patients with ccTGA predicted deterioration in RV function and RV dilatation over time associated with deteriorating NYHA class. Alternative primary pacing strategies such as biventricular pacing may need consideration in this vulnerable group already highly prone to mortality from systemic RV failure.

Effects of Nonsystemic Ventricular Pacing in Patients with Transposition of the Great Arteries and Atrial Redirection

ALICE HOROVITZ, M.D.,* MAXIME DE GUILLEBON, M.D.,* IRENE E. VAN GELDORP, M.D.,*†
PIERRE BORDACHAR, M.D., PH.D.,* FRANCOIS ROUBERTIE, M.D.,* XAVIER IRIART, M.D.,*
HERVÉ DOUARD, M.D.,* MICHEL HAISSAGUERRE, M.D.,* JEAN-BENOIT THAMBO, M.D.*

From the *University Hospital for Cardiology, University Victor Segalen Bordeaux II, Bordeaux, France; and †Cardiovascular Research Institute Maastricht, Maastricht University, Maastricht, The Netherlands

TABLE 2

Echocardiographic Results

	Nonpaced (n = 35)	Paced (n = 11)	P-Value
RV ejection fraction (%)	44 ± 10	39 ± 7	0.04
RV shortening fraction (%)	33 ± 10	27 ± 11	0.04
RV Tei-index	0.48 ± 0.2	0.58 ± 0.2	ns
RV dP/dt_{max} (mmHg/s)	1,024 ± 318	891 ± 470	0.04
S′ of the tricuspid annulus (cm/s)	8 ± 2	7 ± 2	ns
Tricuspid regurgitation (mm^2)	8 ± 9	14 ± 14	ns
Interventricular delay ((ΔTεRV-LV); ms)	31 ± 17	99 ± 100	<0.001
Right intraventricular delay ((ΔTεRV-IVS); ms)	23 ± 11	70 ± 29	<0.001

TABLE 3

Results of Exercise Stress Testing

	Nonpaced (n = 35)	Paced (n = 11)	P-value
Peak VO_2 (mLO_2 /kg/min)	26 ± 7	22 ± 6	0.04
VE/VCO_2 slope	32 ± 7	35 ± 5	Ns
Oxygen pulse (mLO_2/beat)	10.9 ± 3.2	8.9 ± 1.5	0.05
Maximal exercise (W)	120 ± 32	100 ± 30	0.05
Circulatory power (mmHg $mLO_2/min/kg^2$)	4,540 ± 1,665	3,213 ± 1,094	0.02

Values are presented as means ± SD.

Conclusions: **Long-term pacing of the nonsystemic ventricle in patients with atrial switch for TGA was associated with significantly impaired functional status, exercise capacity, and systemic ventricular function.** *(J Cardiovasc Electrophysiol, Vol. pp. 1-5)*

Impact of pacing on systemic ventricular function in L-transposition of the great arteries

Sophie C. Hofferberth, MBBS,[a] Mark E. Alexander, MD,[b] Douglas Y. Mah, MD,[b]
Victor Bautista-Hernandez, MD,[a] Pedro J. del Nido, MD,[a] and Francis Fynn-Thompson, MD[a]

Methods: We performed a retrospective review of all patients with a diagnosis of ccTGA who underwent pacemaker insertion. From 1993 to 2014, 53 patients were identified from the cardiology database and surgical records.

(J Thorac Cardiovasc Surg 2016;151:131-9)

Central Message

All patients with congenitally corrected transposition of the great arteries who develop heart block should undergo primary biventricular pacing, as this therapy appears to prevent development of late-onset systemic ventricular dysfunction.

Perspective

Congenitally corrected transposition of the great arteries (ccTGA) is associated with a high incidence of atrioventricular nodal block due to unique conduction pathway characteristics, associated defects, and surgical interventions. The impact of univentricular versus biventricular pacing (BiVP) on systemic ventricular function remains poorly understood. This study demonstrates univentricular pacing is associated with late-onset systemic ventricular dysfunction, whereas primary BiVP preserves systemic ventricular function in patients with ccTGA. Primary BiVP should be considered in all patients with ccTGA who develop heart block.

Indication stimulation BiV ou syst V sur VD systémique

Chez les patients appareillés et nécessitant une stimulation permanente

améliorer le statut fonctionnel

et éviter une altération progressive de la fonction du VD systémique

Primo implantation

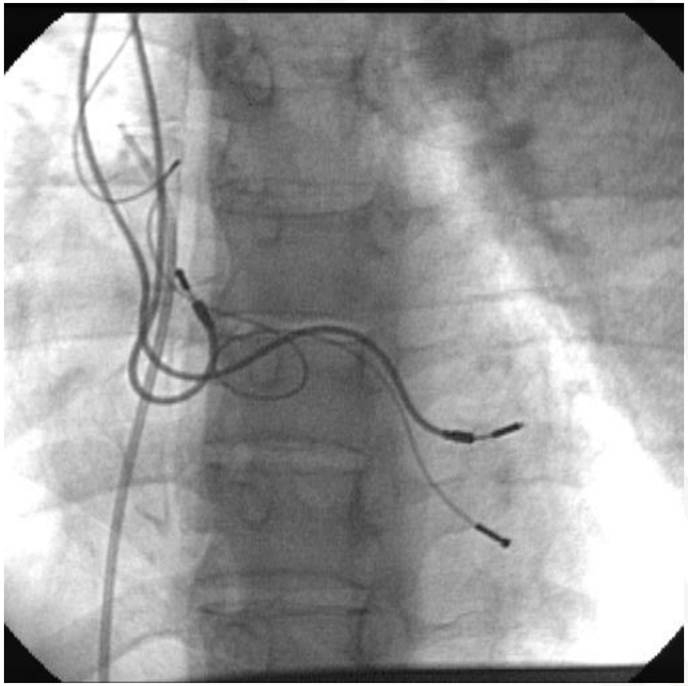
en vue de préserver leur statut fonctionnel et hémodynamique

Pas de données pour proposer la stimulation BiV comme traitement de la dysfonction du VD systémique symptomatique ou débutante

Nécessite études multicentriques

Comment implanter

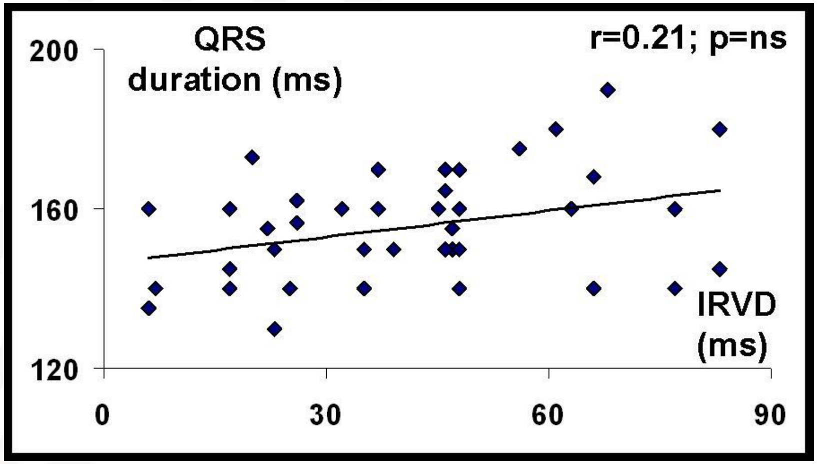
- Difficile ++
  - Stimuler le V systémique
  - Plusieurs approches :
    - Endocavitaire : mais sinus coronaire (souvent impossible accès)
    - Epicardique : chirurugie
  - Problème des sondes
    - Eviter sondes endocavitaires

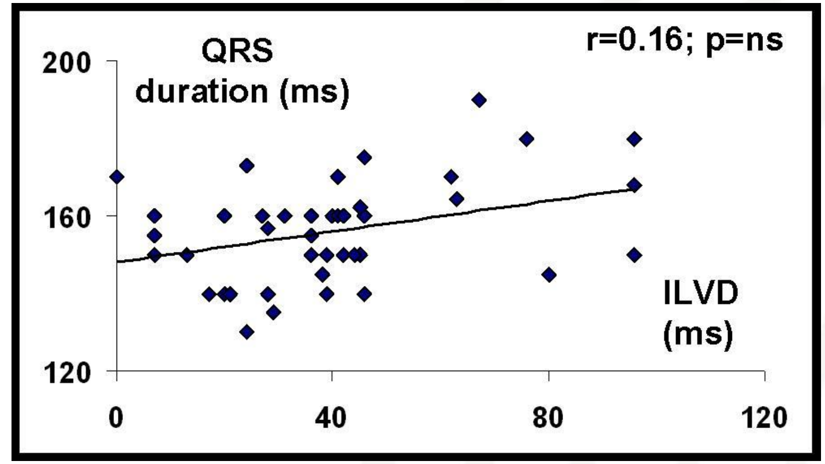


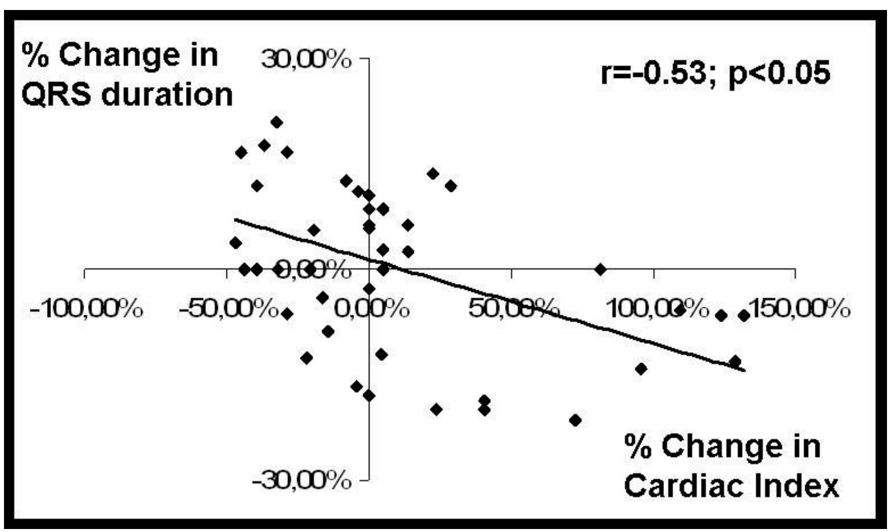
Tétralogie de Fallot : les questions

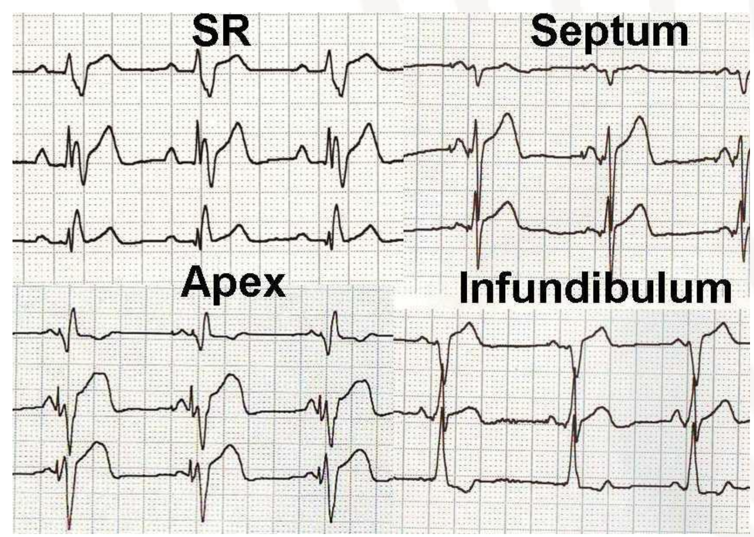
- BBDt +++ = asynchronisme
- La stimulation ne doit pas le majorer…
- Y a t'il un site ou un mode de stimulation qui puisse corriger cet asynchronisme ?
- Correction précoce de cet asynchronisme = remodelage (mécanique, électrique ?)

TOF RV pacing site



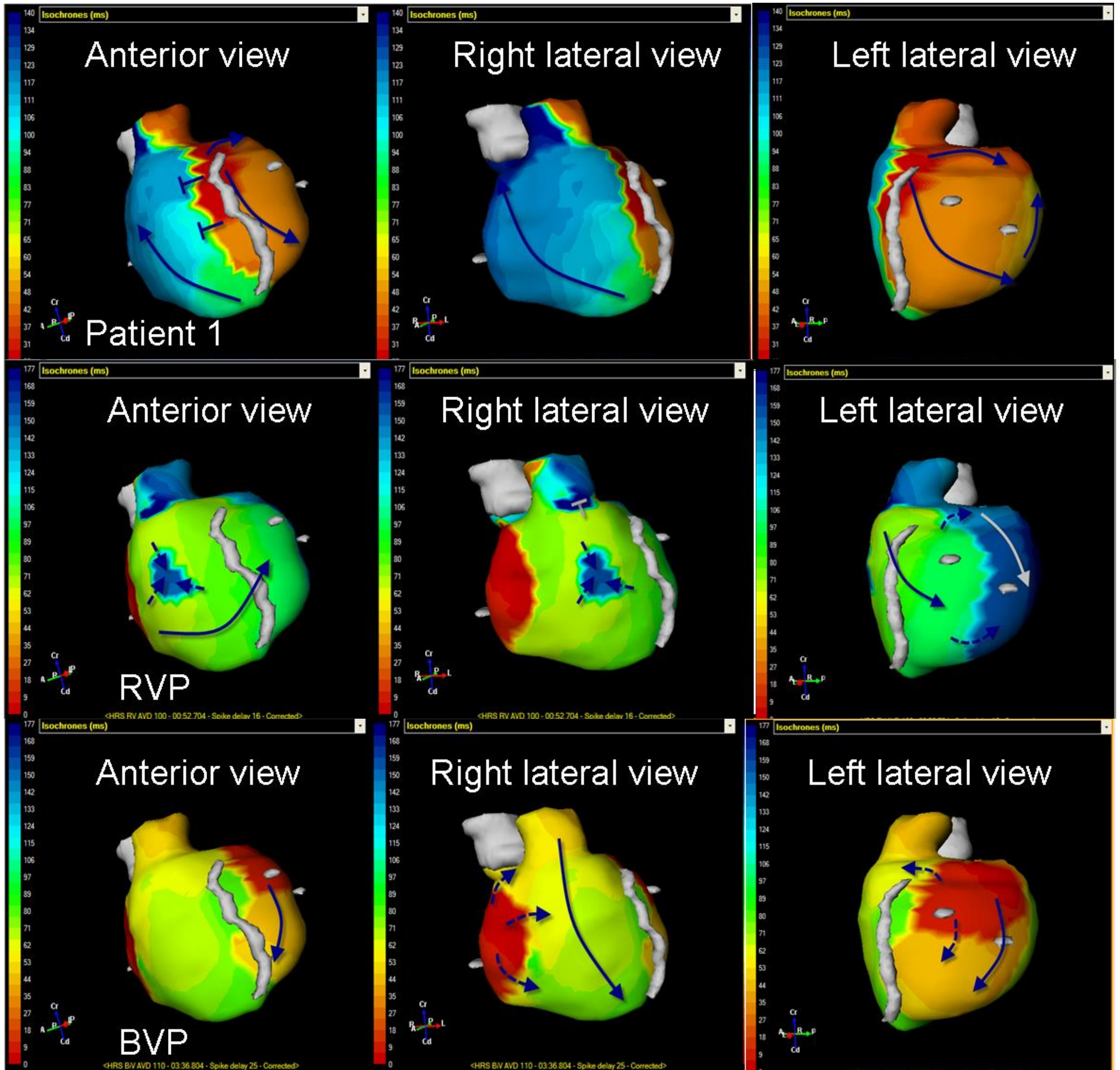






Bordachar P, Europace 2008.

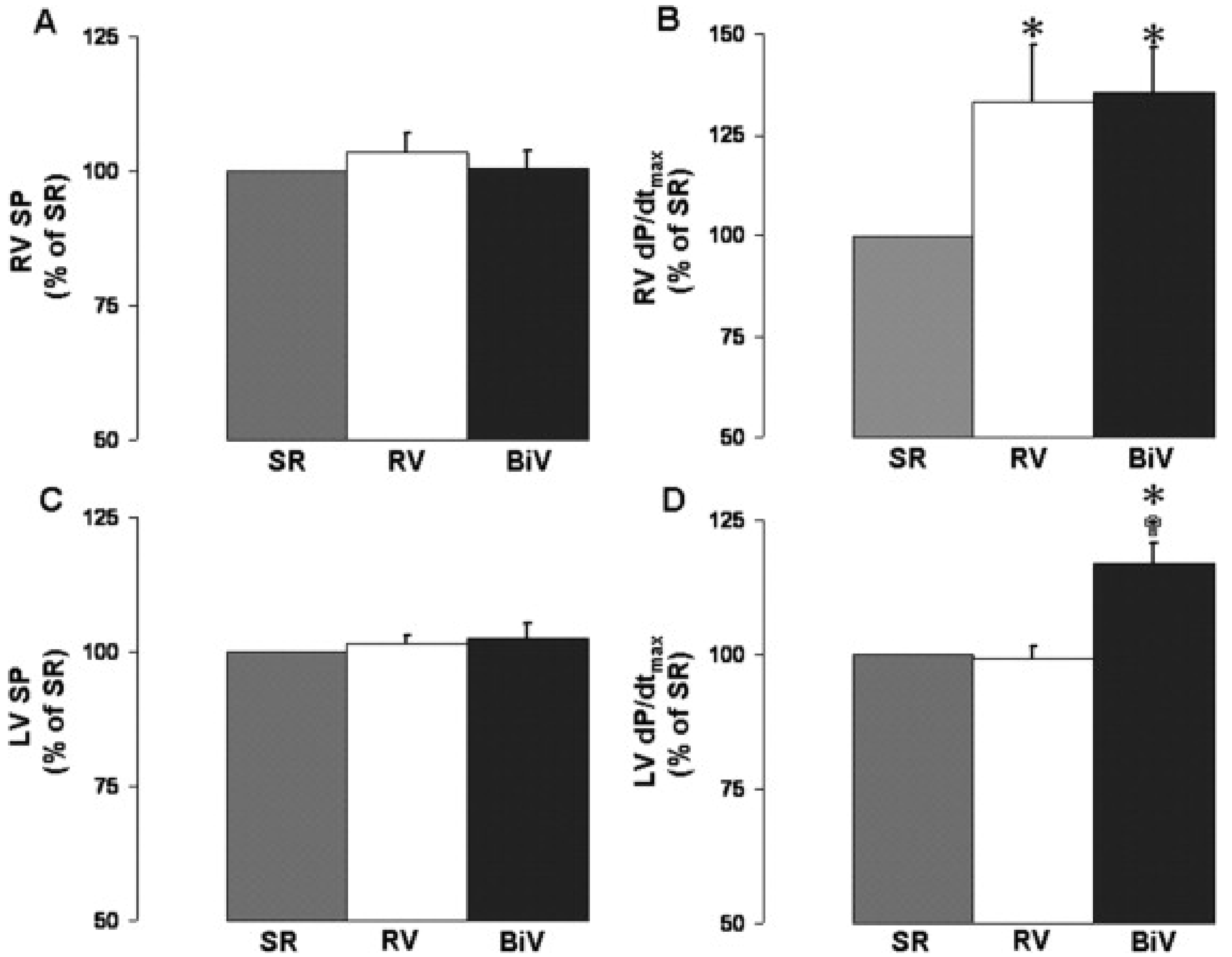
RS vs RV vs BIV Pacing in TOF / cardioinsight



cardioInsight

Thambo JB, Int J Cardiol, 2011

TOF SR vs RV vs BiV



Thambo JB et al. Heart Rhythm. 2010

Conclusions

- Implanter en pensant à demain
- A ce jour implantation 100 % chir : enfant et adulte jeune…
- Besoin de développer des alternatives de stimulation **moins invasives, durables** qui **préservent** la fonction contractile

Pacing site and configuration

< 15 KG	Epicardial	LV apex ? or lat
15-25 KG	**Epicardial**	RA/LV LV
> 25 KG	**Epicardial**	RA/LV LA/LV
30-40 ans	Epicardial	BIV or LV

100 % chirurgical

Besoin d’une technique alternative

Stimulation plus physiologique

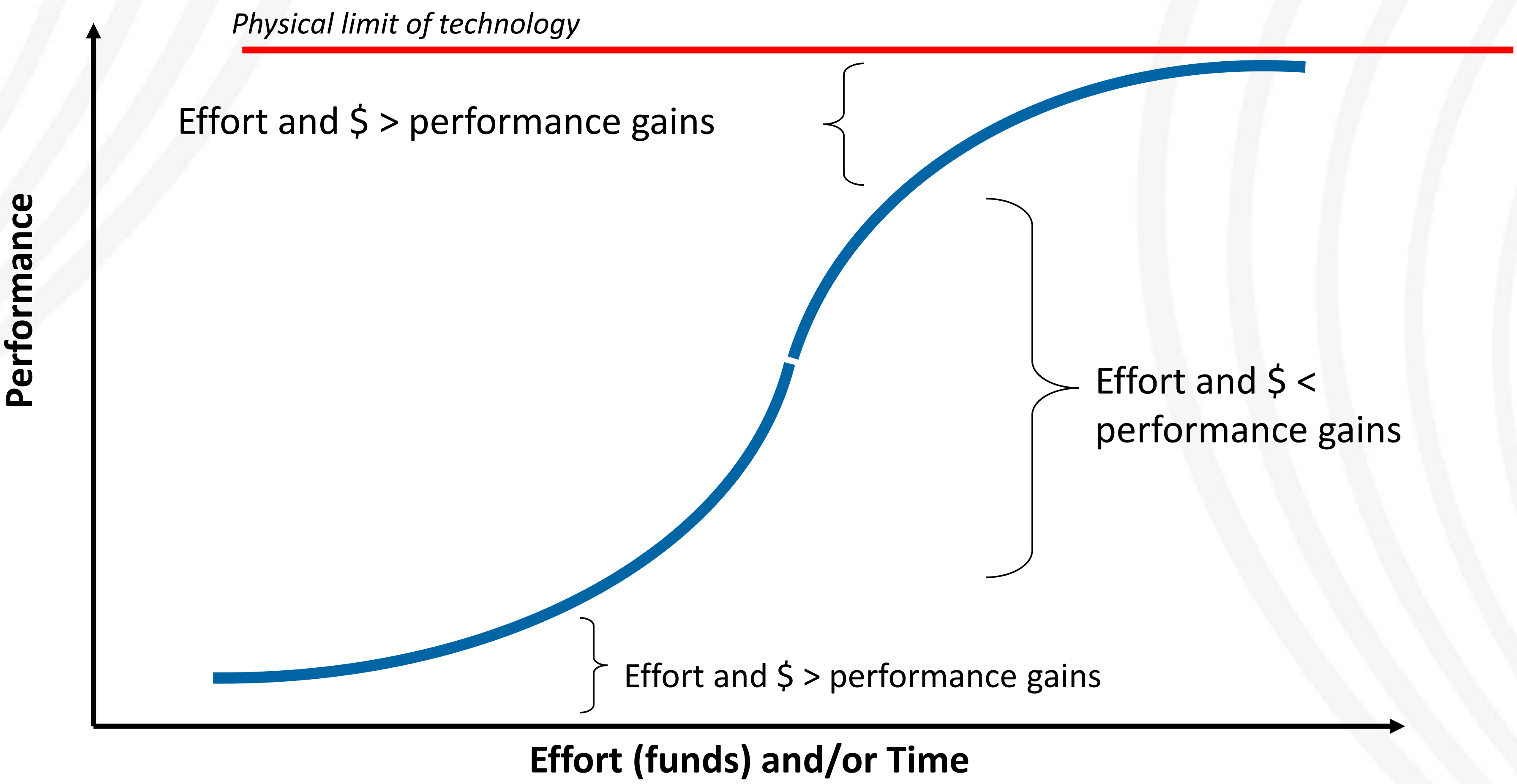
BiV ou VG

Pas de sonde endocavitaire

Le moins invasif possible

Durabilité longue

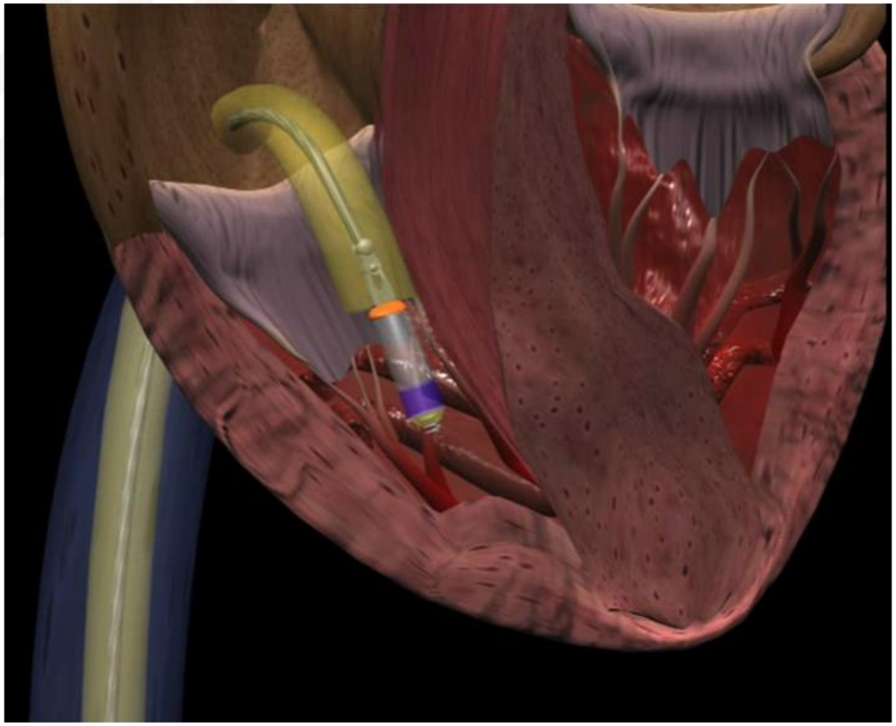
Courbe en S pour une technique innovante

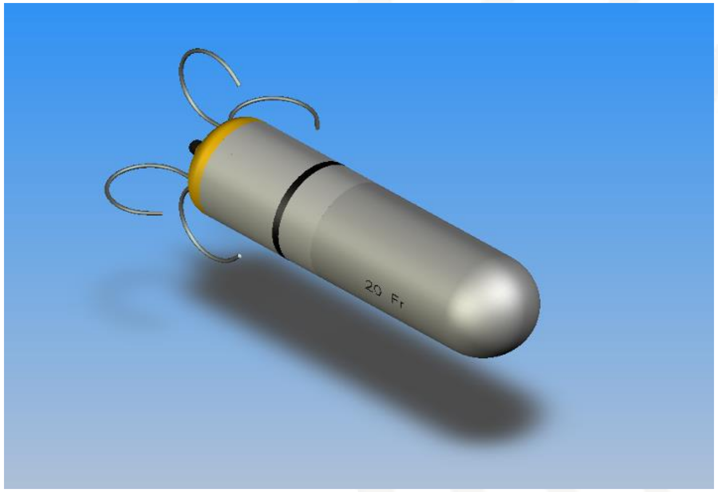


Progrès technologiques suivent le plus souvent une courbe en S

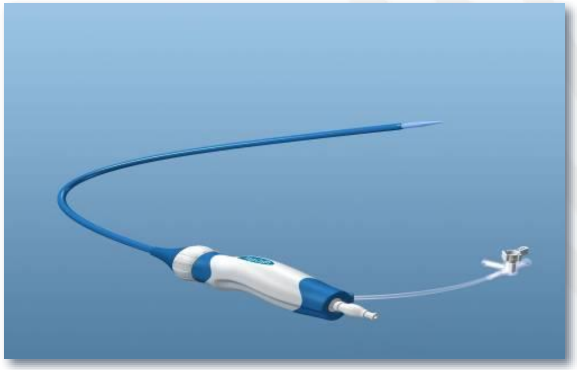
Foster, *Innovation: The Attackers Advantage,* Summit Books, 1986

Dispositif sans sonde

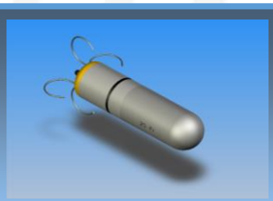




⓾7 mm x 24 mm



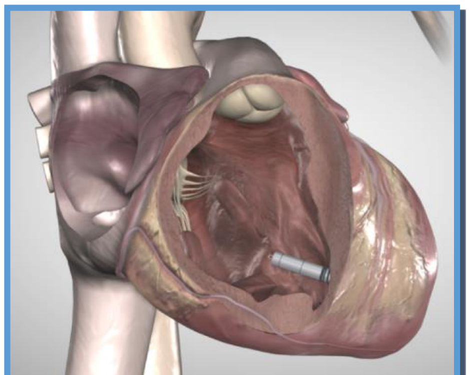
⑩Les avantages du stimulateur sans sonde



⑩*Miniaturized, Leadless VVIR Pacer*

⑩ +

⑩*Steerable Sheath/Catheter*



⑩Moins invasif

- *Pas de chirurgie*
- *Moins de complications*
- *Moins d'irradiation*
- *Intérêt cosmétique*

⑩Meilleure efficacité

- *Procédure plus simple*
- *Accès fémoral*
- *Pas de problèmes de connection*
- *MRI compatible*

⑩Meilleure cout/efficacité

- *Réduction temps d'hospitalisation*
- *Moins de complications*

Leadless PM in pediatrics: limitations

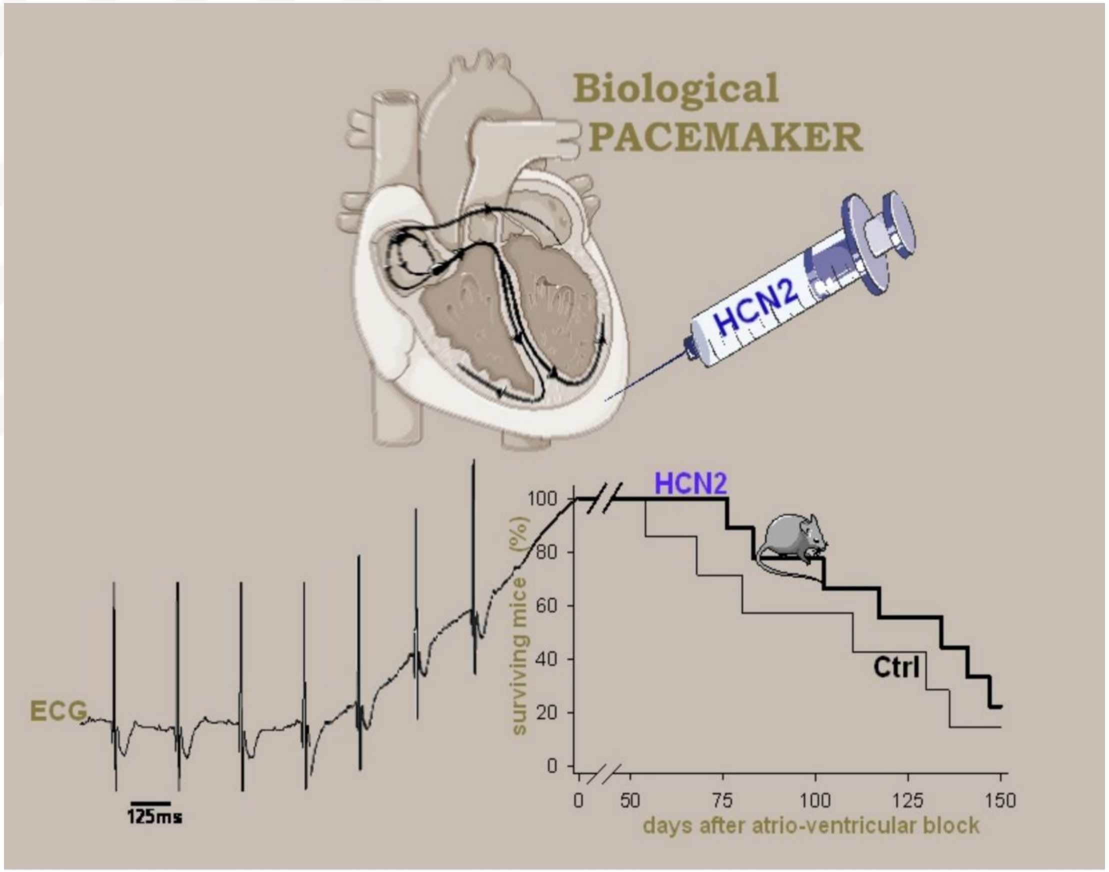
Leadless PM in pediatrics: limitations

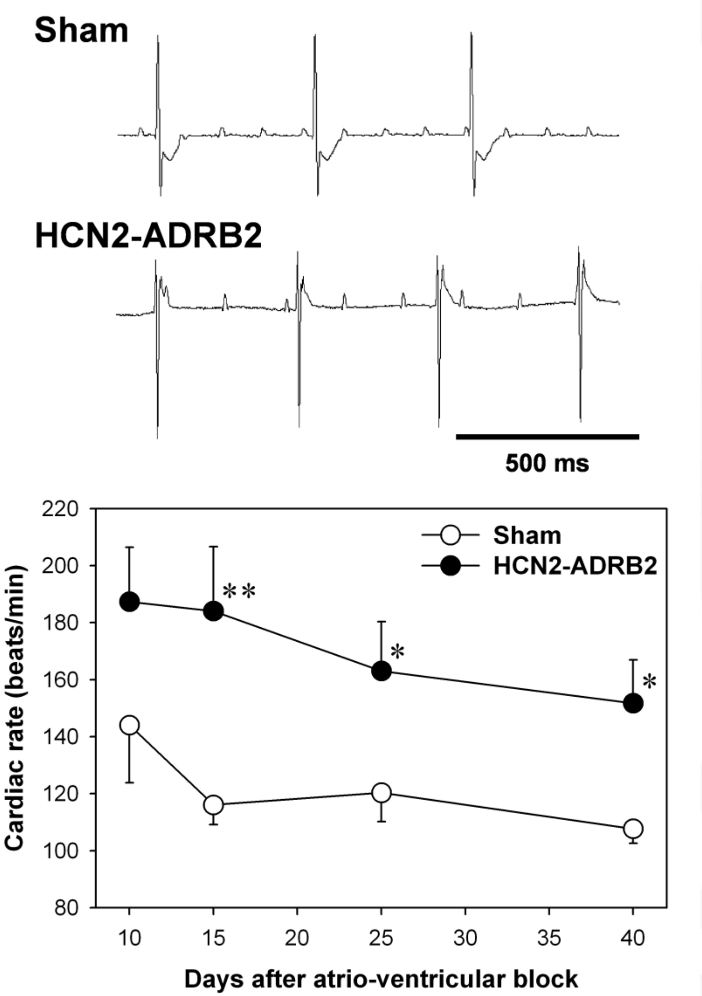
Leadless PM in pediatrics: limitations

Leadless PM in pediatrics: limitations

Leadless PM in pediatrics: limitations

Peut-être …





Charpentier F, et al.

CARDIOVASCULAR

Efficacy of Prophylactic Epicardial Pacing Leads in Children and Young Adults

Mitchell I. Cohen, MD, Larry A. Rhodes, MD, Thomas L. Spray, MD, and J. William Gaynor, MD

Divisions of Cardiology and Cardiothoracic Surgery and Departments of Pediatrics and Surgery, The Children's Hospital of Philadelphia and The University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania

Background. Epicardial pacemakers are often required in children and young adults who cannot undergo a transvenous system because of patient size, vascular barriers, or significant residual intracardiac shunts. Prophylactic epicardial pacing leads, placed at the time of concomitant congenital heart surgery, may reduce a late thoracotomy or sternotomy. The efficacy of prophylactic epicardial leads in the pediatric population is unknown.

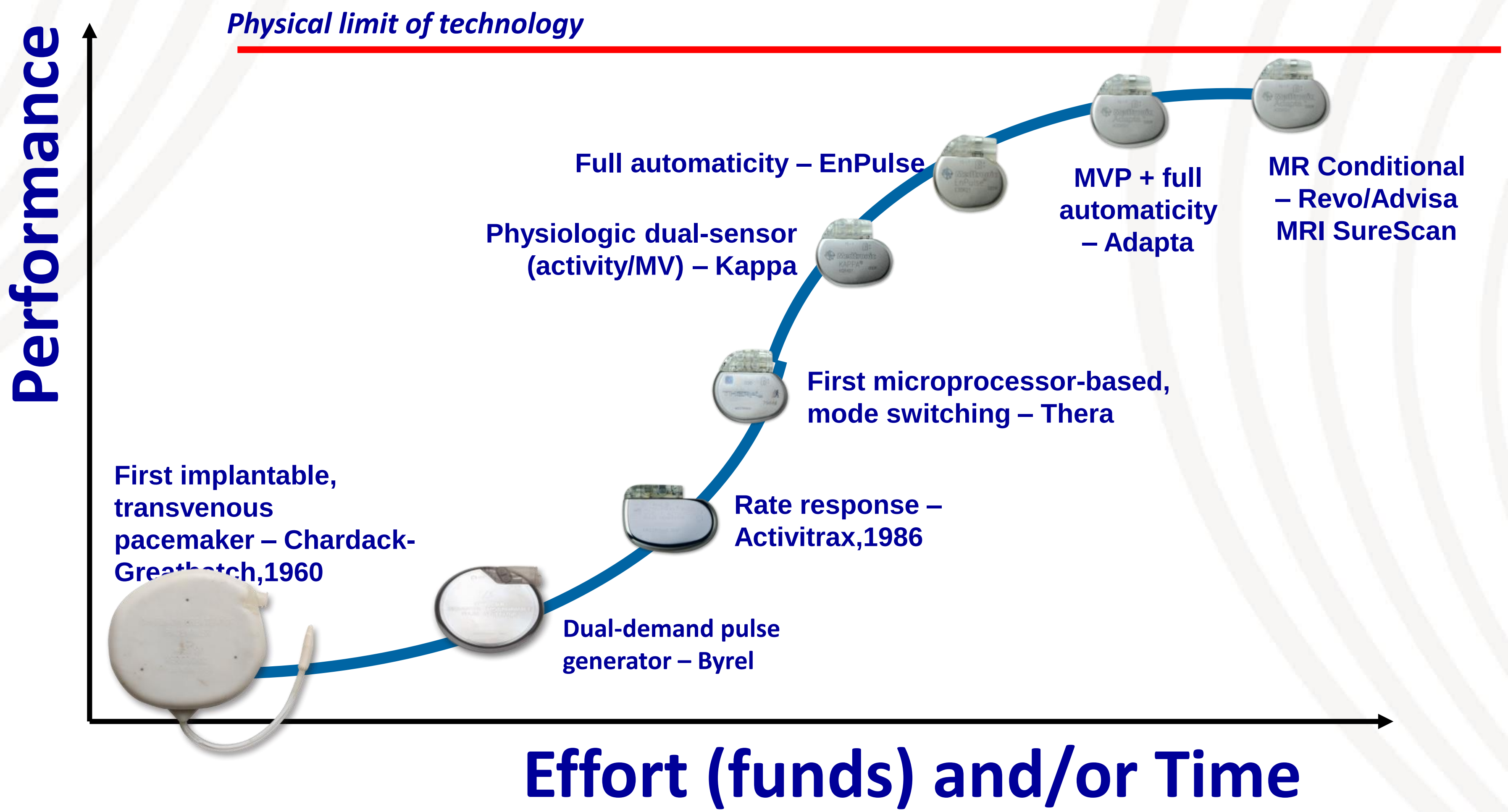
Methods. A retrospective review of the cardiovascular surgery and pacemaker databases at The Children's Hospital of Philadelphia identified all patients less than or equal to 21 years of age, who underwent placement of an epicardial pacing lead between January 1, 1990 and December 31, 2002. Prophylactic epicardial pacing leads placed at the time of a concomitant congenital heart procedure were compared to standard epicardial leads that were connected to a simultaneous programable generator. Pacing and sensing threshold data were obtained in prophylactic epicardial leads at the time of lead retrieval and 6 month follow-up and compared to standard epicardial pacing leads.

Results. Twenty-two (13 ventricular, 9 atrial) prophylactic epicardial pacing leads were retrieved in 13 patients at a median of 252 days (7 days to 3.98 years) from the time of initial implant and compared to 256 (164 ventricular, 92 atrial) standard epicardial leads placed in 142 patients. Nineteen (86%) prophylactic epicardial leads had acceptable pacing and sensing thresholds at lead retrieval. Only 1 patient with atrial and ventricular leads had poor pacing and sensing at retrieval and required a redo-sternotomy for placement of new atrial and ventricular epicardial pacing leads. For the remaining atrial (n = 7) and ventricular (n = 12) prophylactic epicardial leads, there was no significant difference in pacing (atrial, 1.59 ± 1.1 μJ; ventricular, 1.98 ± 1.9 μJ) or sensing (atrial, 3.6 ± 1.8 mV; ventricular, 13.8 ± 4.4 mV) compared to standard pacing (atrial, 2.1 ± 1.8 μJ; ventricular, 1.9 ± 3.4 μJ) and sensing (atrial, 3.3 ± 1.7 mV; ventricular, 11.3 ± 5.3 mV) epicardial leads. Six-month follow-up pacing and sensing thresholds were not significantly different between the prophylactic and standard epicardial pacing leads.

Conclusions. Prophylactic epicardial pacing leads can be successfully placed and retrieved in a subset of children and young adults who will likely require pacing at a later date. Prophylactic leads have comparable pacing and sensing qualities at lead retrieval and short-term follow-up compared to standard epicardial leads. Consideration for prophylactic epicardial pacing leads will likely reduce the need for a late thoracotomy or sternotomy.

(Ann Thorac Surg 2004;78:197–203)

Innovation S-curve in Implantable Bradycardia Therapy



Technological performance often follows an S-shaped curve

Foster, *Innovation: The Attackers Advantage*, Summit Books, 1986

History of leadless pacing: 1970

J. ELECTROCARDIOLOGY, 3 (3-4) 325-331, 1970

Special Article

Totally Self-Contained Intracardiac Pacemaker*

J. WILLIAM SPICKLER, PH.D., NED S. RASOR, PH.D.†, PAUL KEZDI, M.D.
S. N. MISRA, M.D., K. E. ROBINS, P.E., AND CHARLES LeBOEUF, P.E.

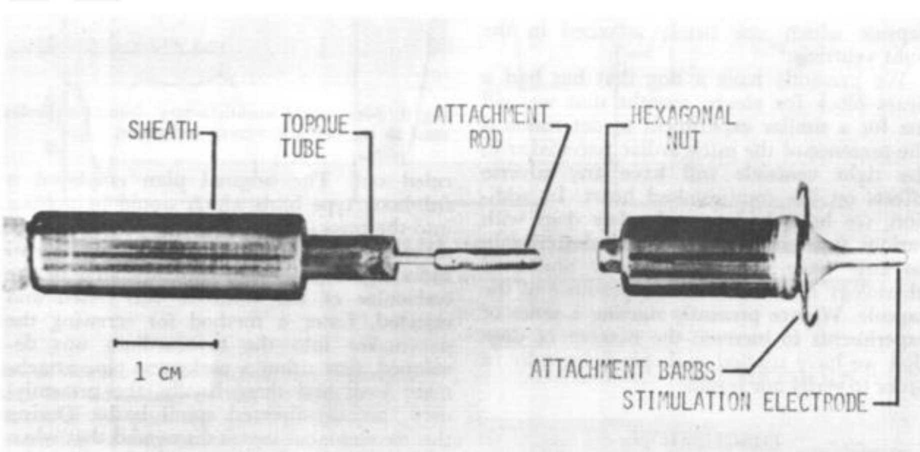


Fig. 4. Intracardiac pacemaker with catheter for transvenous insertion.

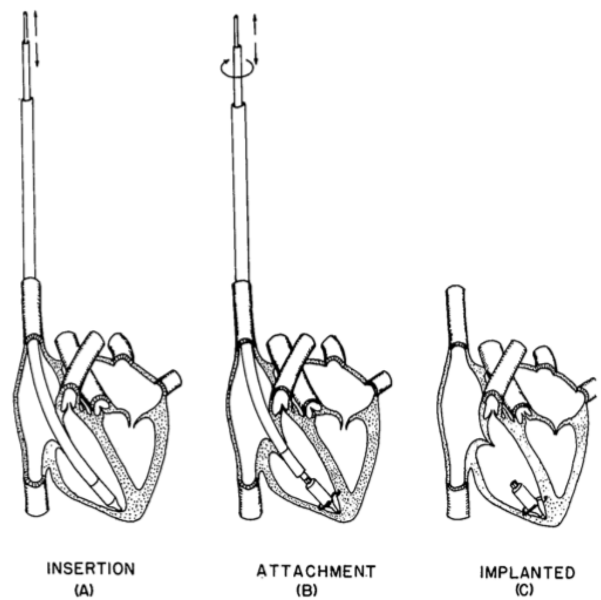


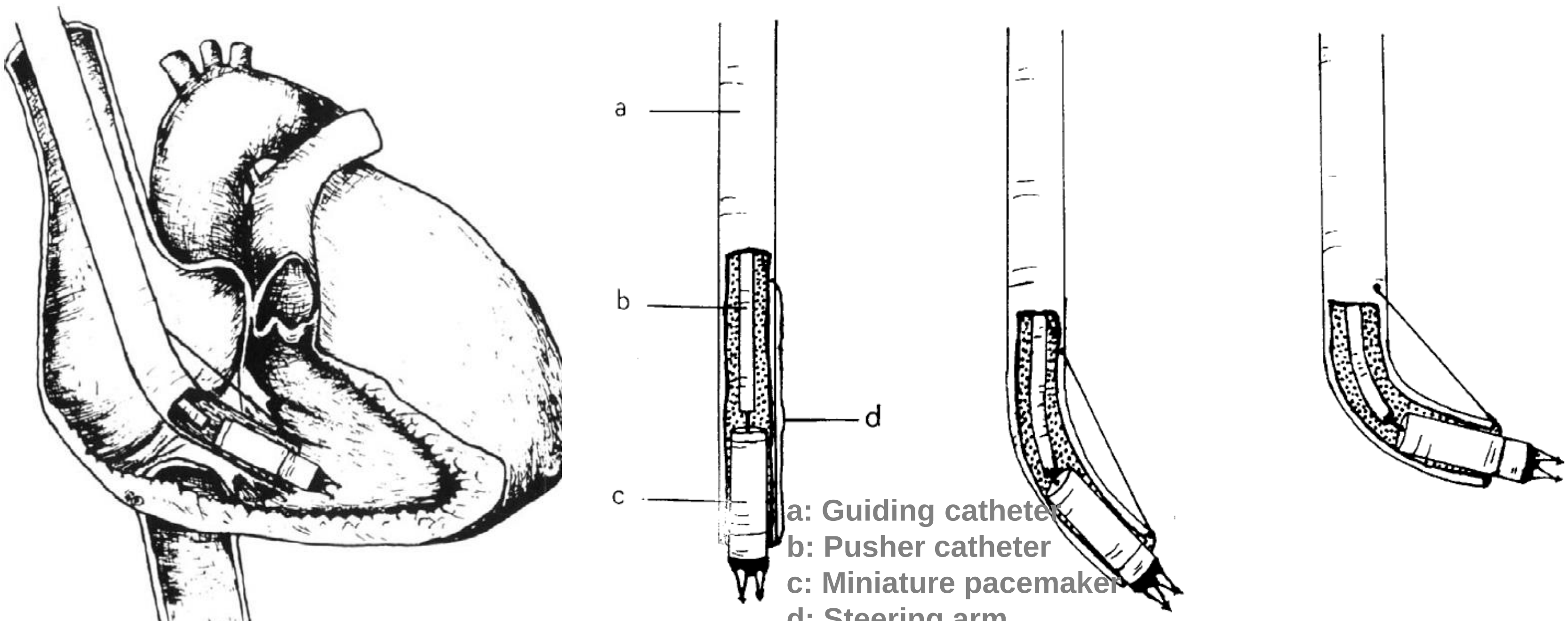
Fig. 5. Intracardiac pacemaker insertion procedure.

History of Leadless Pacing: Miniature Pacemaker Tested in 1991

EUR.J.CPE.1991.1:27–30

A Miniature Pacemaker Introduced Intravenously and Implanted Endocardially. Preliminary Findings from an Experimental Study

P.E. VARDAS, C. POLITOPOULOS, E. MANIOS, F. PARTHENAKIS, and C. TSAGARAKIS



a: Guiding catheter
b: Pusher catheter
c: Miniature pacemaker
d: Steering arm

The Micra™ Leadless Pacemaker

Leadless Pacemaker: Potential Benefits

- Reduced Invasiveness
  - No surgery
  - Fewer complications (no lead or subQ device)
  - Less radiation exposure for implanter
  - More cosmetic for patient ("invisible")
- Improved Efficiency
  - Simpler procedure; no surgery
  - Femoral venous access
  - No system connections
  - MRI conditional
- More Cost-Effective Therapy
  - Reduced length of hospital stay
  - Fewer acute and chronic complications

1) Impact du site de stimulation

Congenital Heart Disease

Detrimental Ventricular Remodeling in Patients With Congenital Complete Heart Block and Chronic Right Ventricular Apical Pacing

Jean-Benoît Thambo, MD*; Pierre Bordachar, MD*; Stephane Garrigue, MD, PhD; Stephane Lafitte, MD, PhD; Prashanthan Sanders, MBBS, PhD; Sylvain Reuter, MD; Romain Girardot, MD; David Crepin, MD; Patricia Reant, MD; Raymond Roudaut, MD; Pierre Jaïs, MD; Michel Haïssaguerre, MD; Jacques Clementy, MD; Maria Jimenez, MD, PhD

Background—Although dual-chamber pacing improves cardiac function in patients with complete congenital atrioventricular block (CCAVB) by restoring physiological heart rate and atrioventricular synchronization, the long-term detrimental effect of asynchronous electromechanical activation induced by apical right ventricular pacing (RVP) has not been well clarified.

Methods and Results—Twenty-three CCAVB adults (24±3 years) with a DDD transvenous pacemaker underwent conventional echocardiography before implantation and, after at least 5 years of RVP, an exercise test and echocardiography coupled with tissue Doppler imaging and tissue tracking. They were compared with 30 matched healthy control subjects. After 10±3 years of RVP, CCAVB adults had significantly higher values versus controls in terms of intra–left ventricular (LV) asynchrony (respectively, 59±18 versus 19±9 ms, $P<0.001$), extent of LV myocardium displaying delayed longitudinal contraction (39±15% versus 10±7%, $P<0.01$), and septal-to-posterior wall-motion delay (84±26 versus 18±9 ms, $P<0.01$). The ratio of late-activated posterior to early-activated septal wall thickness was higher after long-term RVP than before (1.3±0.2 vs 1±0.1, $P=0.05$) and was higher than in controls (1±0.1, $P<0.05$). The percentage of patients with increased LV end-diastolic diameter was higher after long-term RVP than before implantation and was higher than in controls (57% versus 13%, $P<0.05$, and 57% versus 0%, $P<0.01$, respectively). CCAVB patients with long-term RVP had a lower cardiac output than controls (3.8±0.6 versus 4.9±0.8 L/min, $P<0.05$) and lower exercise performance (123±24 versus 185±39 W, $P<0.001$).

Conclusions—Prolonged ventricular dyssynchrony induced by long-term endovenous RVP is associated with deleterious LV remodeling, LV dilatation, LV asymmetrical hypertrophy, and low exercise capacity. These new data highlight the importance of the ventricular activation sequence in all patients with chronic ventricular pacing. (***Circulation*. 2004;110: 3766-3772.**)

Circulation 2004

EUROPEAN SOCIETY OF CARDIOLOGY®
European Heart Journal (2009) **30**, 1033–1034
doi:10.1093/eurheartj/ehp130

EDITORIAL

Selecting pacing sites in children with complete heart block: is it time to avoid the right ventricular free wall?

Luc Mertens* and Mark K. Friedberg

News strategies…

Interactive CardioVascular and Thoracic Surgery 9 (2009) 743-745

www.icvts.org

Case report - Congenital

Intra-diaphragmatic pacemaker implantation in very low weight premature neonate

François Roubertie[a], Emmanuel Le Bret[b,*], Jean Benoit Thambo[a], Xavier Roques[a]