Permanent Cardiac Pacing in Children - Choosing the Optimal Pacing Site: A Multi-Center Study

J. Janousek, I. E. van Geldorp, S. Krupickova, E. Rosenthal, M. Tomaske, A. Früh, J. Elders, A. Hiippala, R. A. Gebauer, P. Kubuš, F. Gabbarini, S-A. Clur, B. Nagel, J. Ganame, J. Papagiannis, J. Marek, J-H. Nürnberg, C. Wren, M. Friedberg, M. de Guillebon, S. Tisma-Dupanovic, F. Prinzen, and T. Delhaas

for the WG on Arrhythmias of the AEPC

Kardiocentrum and Cardiovascular Research Center, Prague, Czech Republic, Pediatric Cardiology, Cardiovascular Research Institute, Maastricht University Medical Center, Maastricht, Netherlands, Evelina Children's Hospital, London, United Kingdom, University Children's Hospital, Zurich, Switzerland, Oslo University Hospital (OUS), Oslo, Norway, Dept of Cardiology 670, UMC St. Radboud, Nijmegen, Netherlands, Hospital for Children and Adolescents, Helsinki, Finland, Department of Pediatric Cardiology, Heart Centre Leipzig, Leipzig, Germany, Pediatric Cardiology Division Infant Hospital Regina Margherita, Turin, Italy, Emma Kinderziekenhuis - AMC, Amsterdam, Netherlands, Paediatric Cardiology, Children's Hospital, Graz, Austria, Pediatric Cardiology. University Hospital Leuven, Leuven, Belgium, Division of Pediatric Cardiology. Mitera Children's Hospital, Maroussi, Greece, Paediatric Cardiology, Great Ormond Street Hospital, London, United Kingdom, Klinikum Links der Weser Abt.Kinderkardiologie, Bremen, Germany, Pediatric Cardiology, The Newcastle upon Tyne Hospitals NHS Foundation Trust, Newcastle upon Tyne, United Kingdom, Division of Cardiology, The Hospital for Sick Children, Toronto, ON, Canada, Department of Cardiology, Hopital Haut Lévêque, Bordeaux-Pessac, France, Cardiology Section, Children's Mercy Hospitals and Clinics, Kansas City, MO, Department of Physiology, Cardiovascular Research Institute, Maastricht University Medical Center, Maastricht, Netherlands, Department of Biomedical Engineering, Cardiovascular Research Institute, Maastricht University Medical Center, Maastricht, Netherlands

Kardiocentrum

Maastricht University

AEPC

No relationships to disclose

Rationale

- Pediatric pacing presents an optimal model for assessment of pacing-associated LV dysfunction
  - » Different pacing sites including LV pacing used

Aim

- To evaluate long-term influence of different pacing sites on LV synchrony and function in a large cohort of pediatric patients with CAVB and structurally normal heart

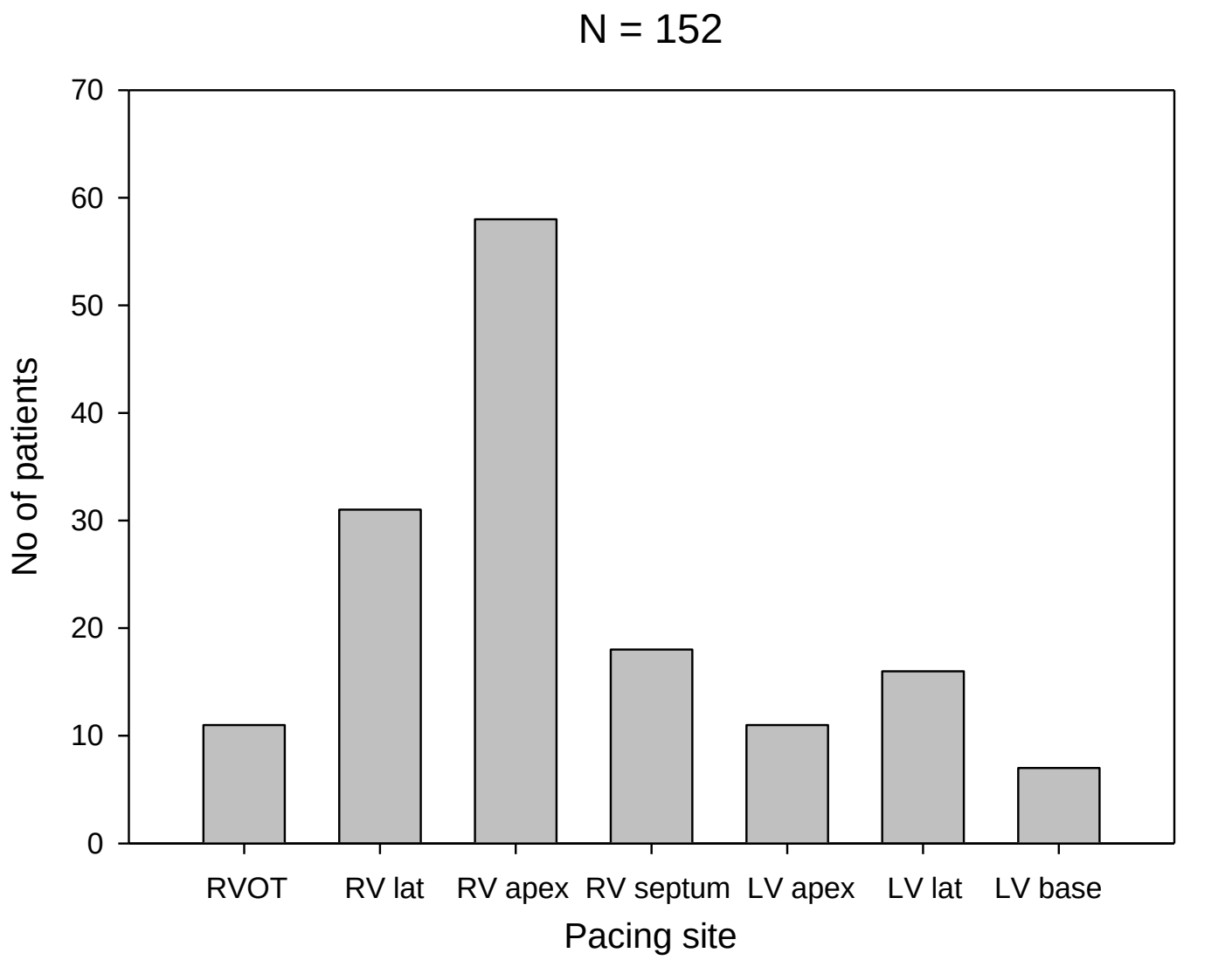
Patients

- N = 152 children (17 centers)
- Structurally normal heart
- Initially normal LV function
  - » SF mean 40 ± 9 % and EF 62 ± 12 %
- Paced for complete AV block (>70 % Vp)
  - » Etiology
    - – Congenital 78.3 %, acquired non-surgical 21.7 %
- Cross-sectional analysis
  - » Age: median 11.2 (IQR 6.6 - 15.3) yrs
  - » Pacing duration: median 5.3 (IQR 3.0 – 8.6) yrs

Methods

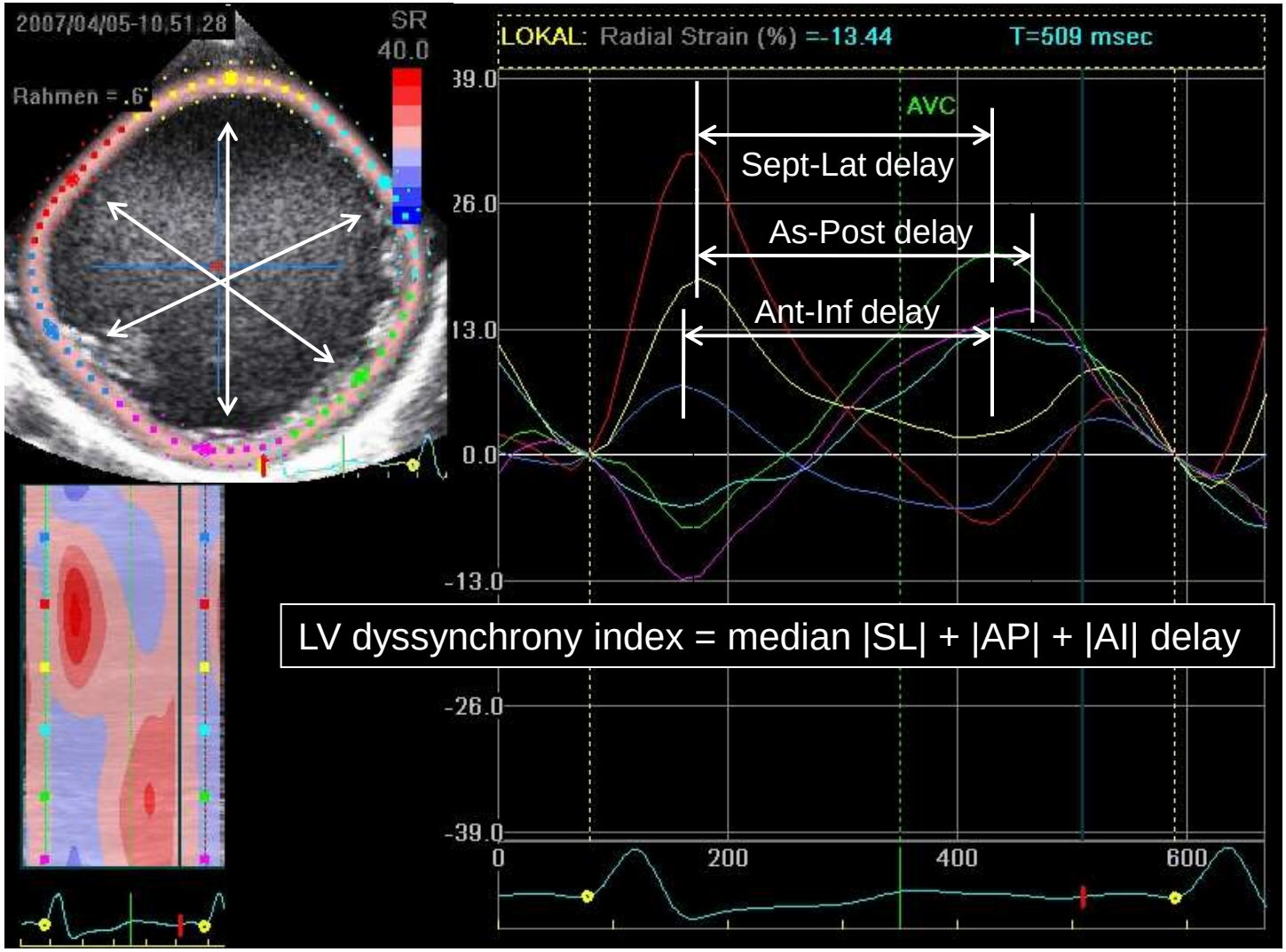
- Data evaluation in a core lab
- Pacing site assignment
  - (12-lead ECG, biplane x-ray)
- Echocardiographic data
  - Biplane LV volumes and EF
  - LV dyssynchrony
    - Conventional ECHO
      - Inter-ventricular mechanical delay (= LV PEP – RV PEP)
      - LV septal to posterior wall motion delay
    - Speckle tracking:
      - LV dyssynchrony index

Pacing sites



Speckle tracking measurements

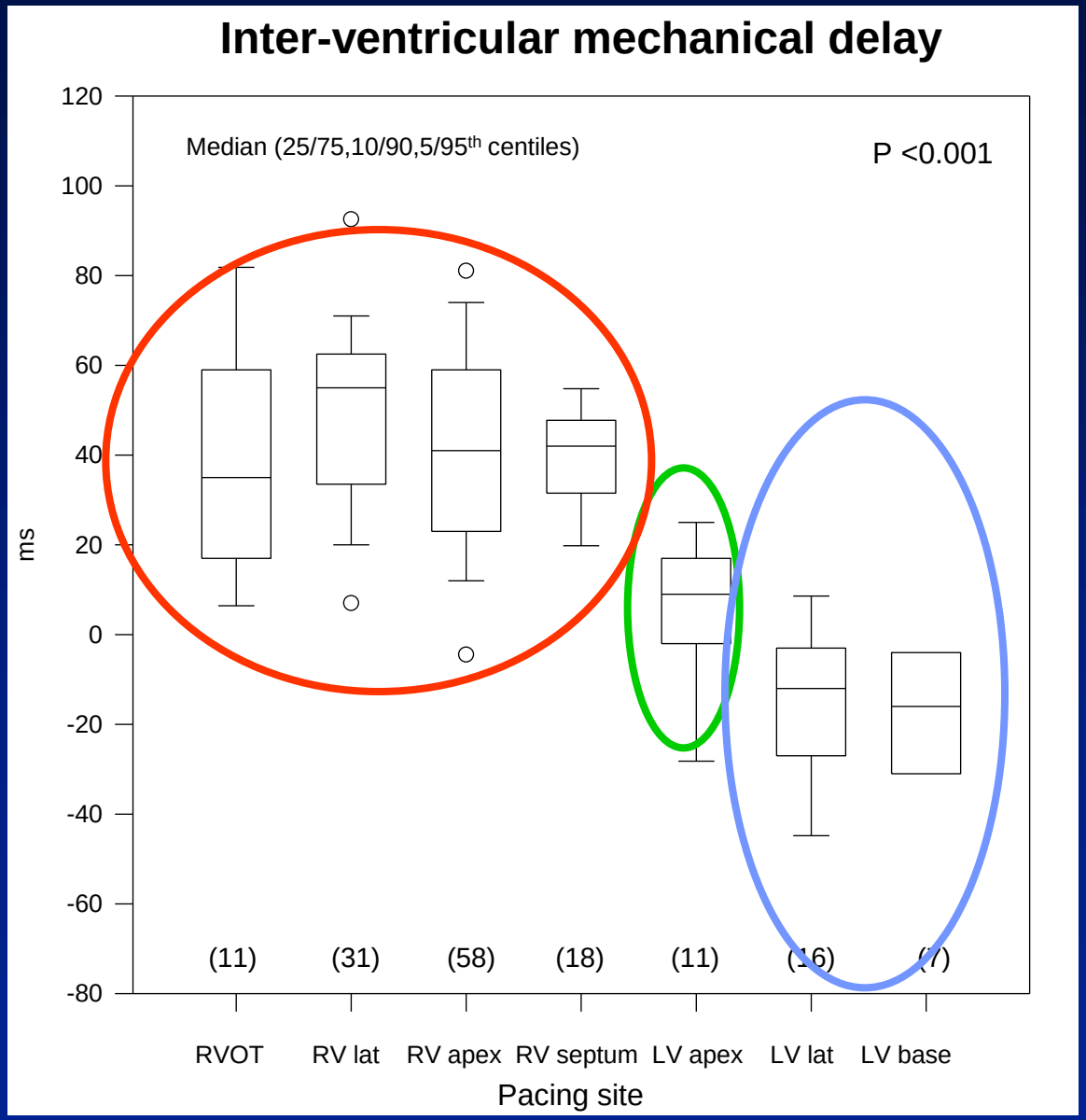
Radial LV strain



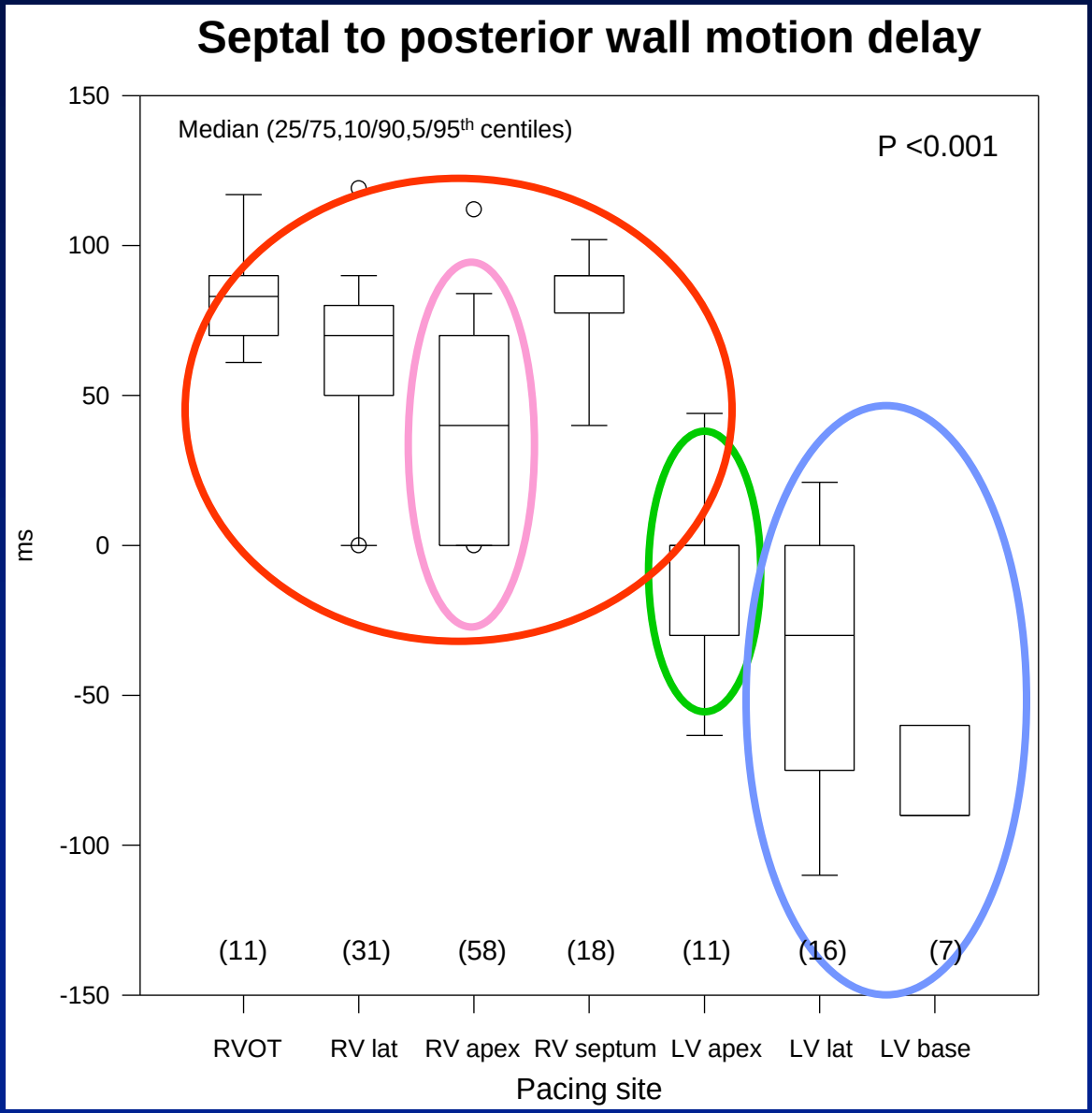
Results: Inter-observer agreement (N=28)

- Pacing site assignment equal = 27/28 pts.
- Coefficient of variation
  - Biplane LV EF = 9.7 %
  - Interventricular mechanical delay = 5.7 %
  - Septal to posterior wall motion delay = 11.2 %
  - Inter-segmental mechanical delay (radial strain) = 0.9 %

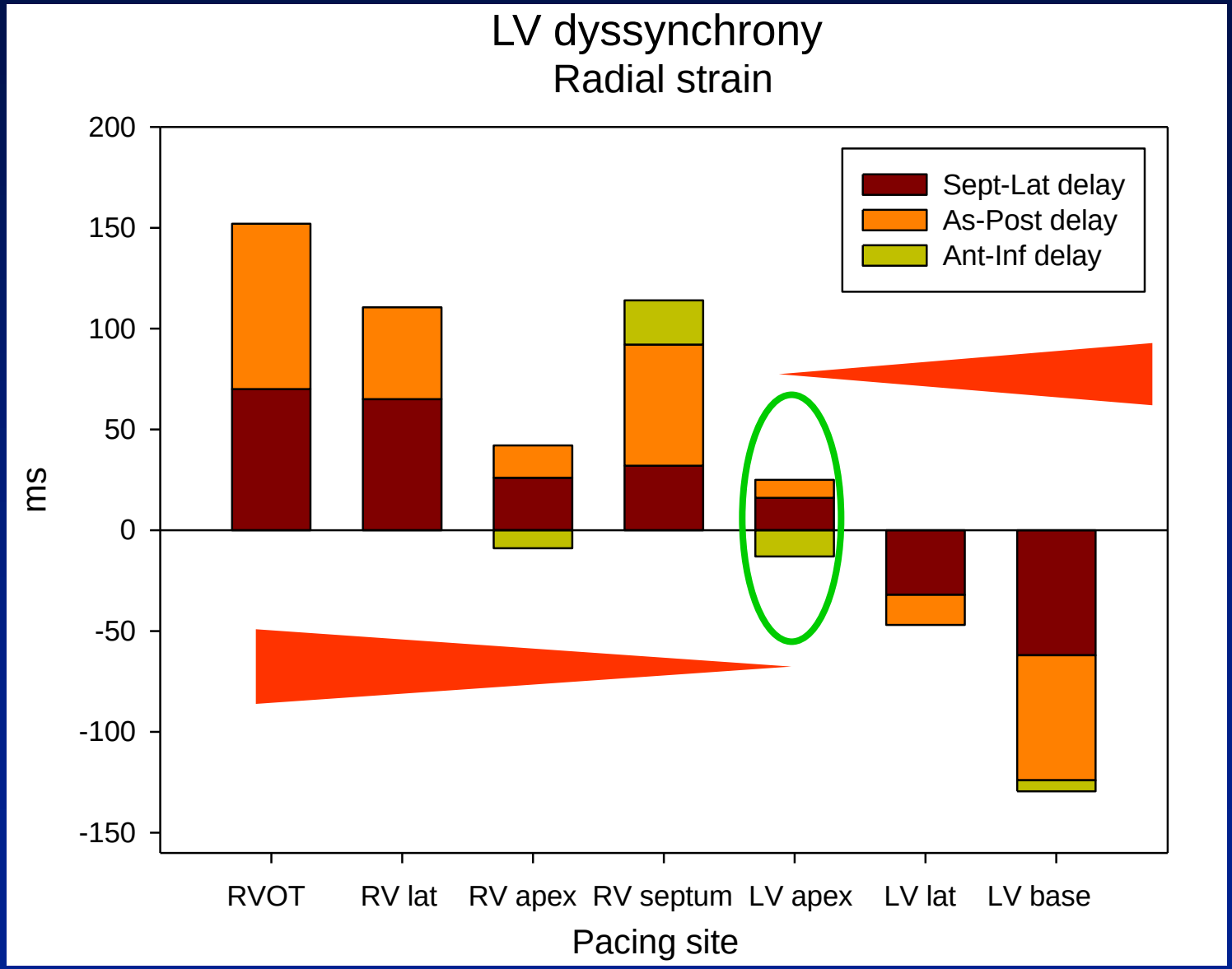
Results: Inter-ventricular dyssynchrony



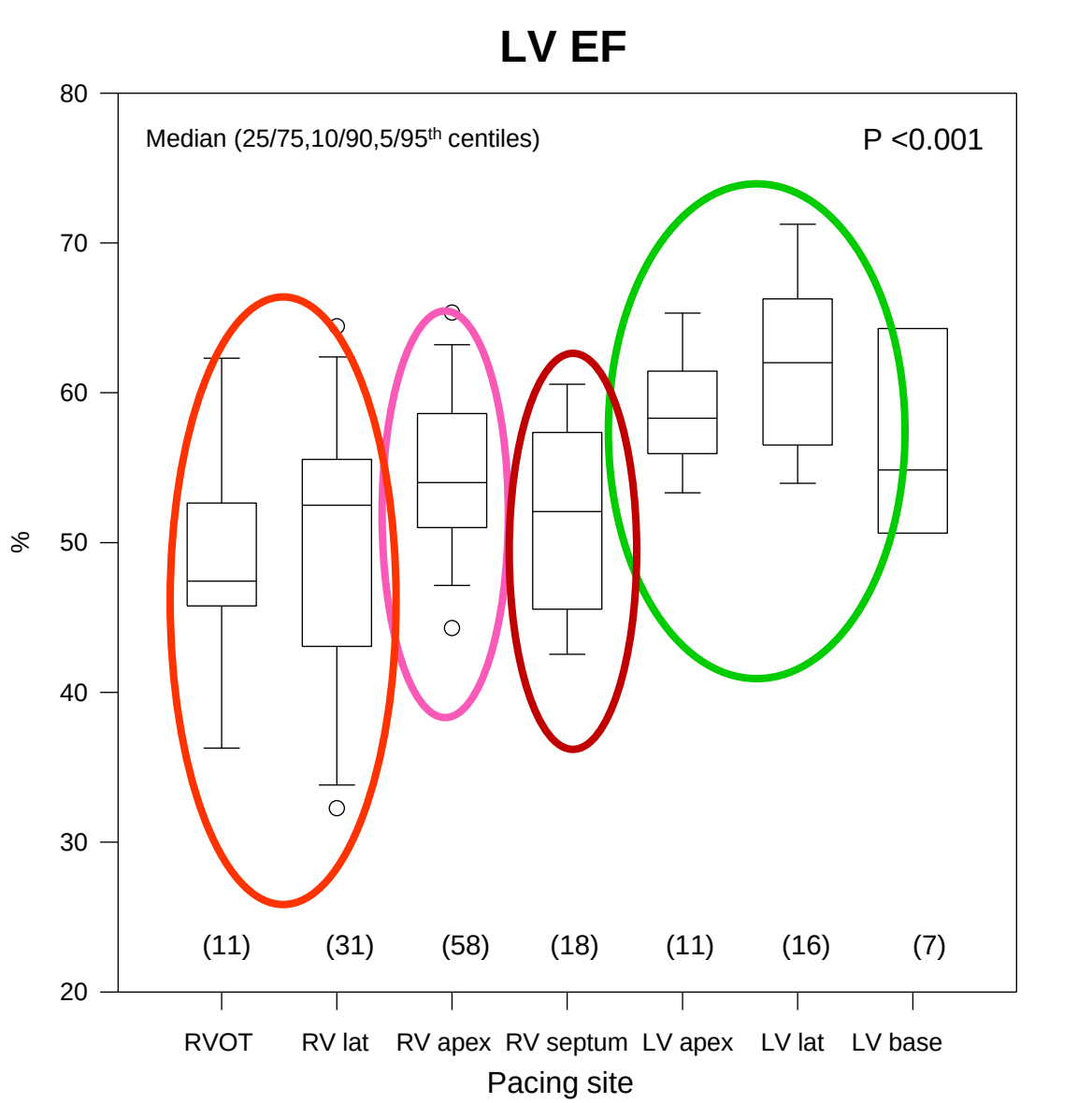
Results: Intra-ventricular dyssynchrony



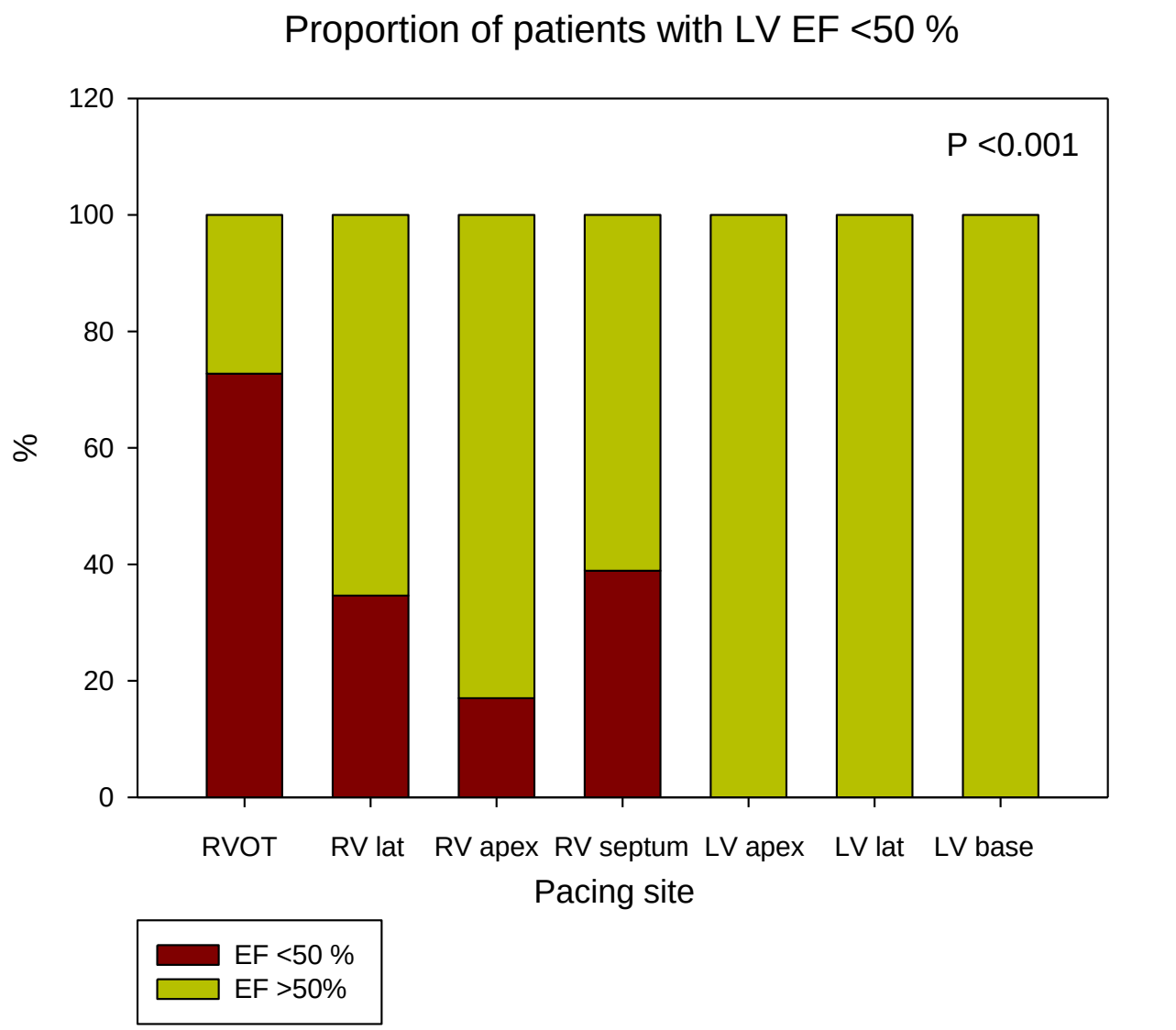
Results: Intra-ventricular dyssynchrony



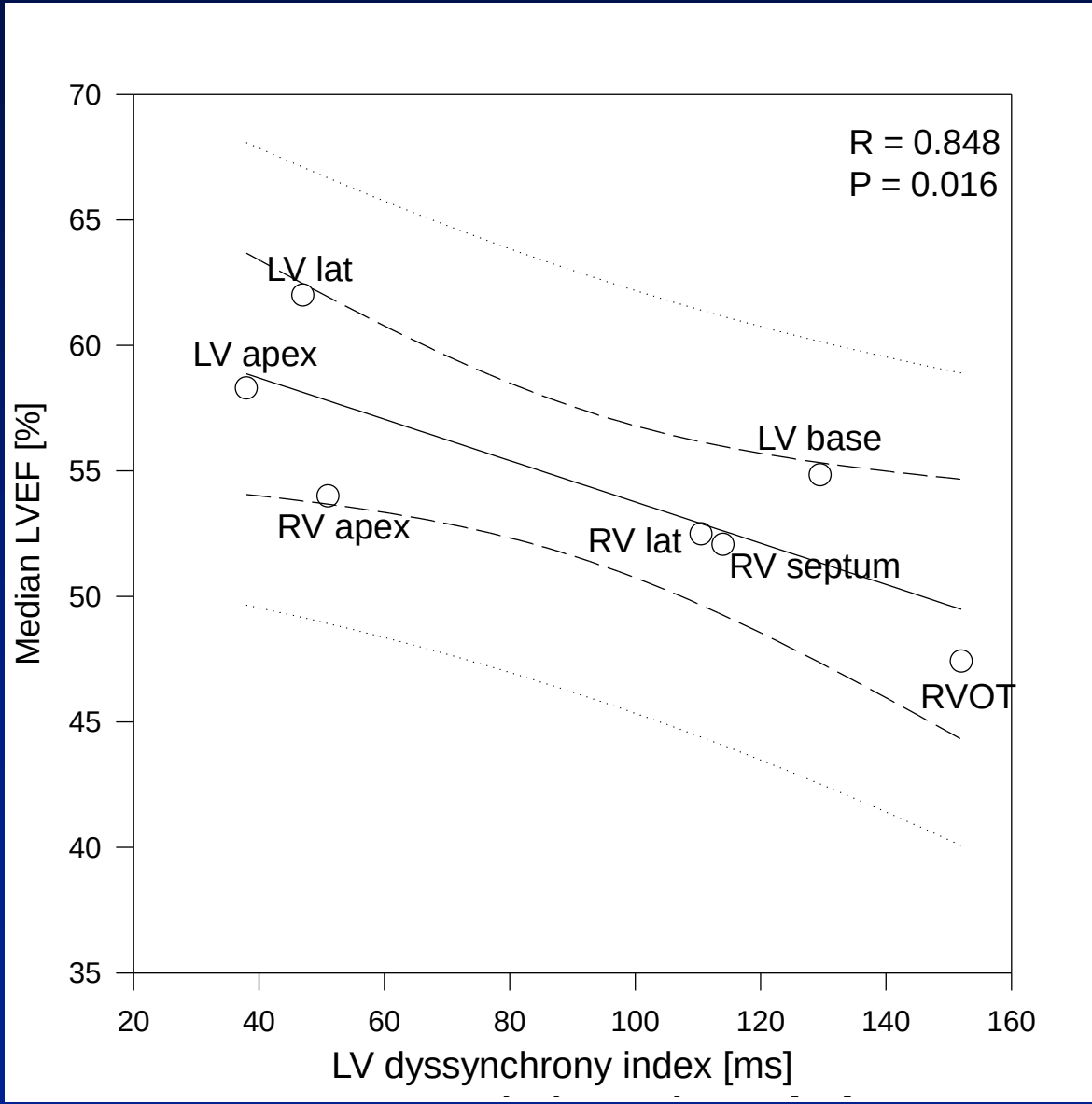
Results: LV function



Results: LV function



Results: LV EF vs dyssynchrony



Results: Predictors of LV EF

Independent variable	OR	5 % CI	95 % CI	*P*
Predictor of LVEF < 45 %				
RV lat/RVOT pacing	**7.9**	**2.1**	**29.6**	**=0.002**
Predictor of LVEF ≥ 55 %				
LV apex/LV lat pacing	**8.7**	**2.5**	**30.5**	**<0.001**

- Not significant
  - Presence of maternal Ro/La antibodies
  - Age at implantation
  - Pre-implantation LV size and function
  - Duration of pacing
  - DDD mode
  - QRS duration

Multiple logistic regression

Conclusions

- LV mechanical synchrony and function
  - » May significantly deteriorate with RVOT/RV lat pacing
  - » Is best preserved by LV apical/LV lat pacing
- RV apical pacing
  - » Well tolerated in the majority
- RV septal pacing
  - » No advantage over RV apical pacing

Clinical implications

- Epicardial pacing
  - » Prefer LV apical or free wall lead placement
  - » Avoid RV free wall and outflow tract
- Endocardial pacing
  - » Non-targeted RV septal pacing of no advantage

Thanks to all contributers!