

# The efficacy of electrocardiography in detecting acute rejection in pediatric heart transplant recipients

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# Background

- Acute allograft rejection is an important problem for heart transplant recipients.
- Endomyocardial biopsy is the most reliable but invasive method to detect acute rejection.
- We aimed to detect efficacy of ECG to help diagnosis of acute rejection.

# Methods

- 37 patients undergoing orthotopic heart transplantation between 2005-2016 are included.
- Data
  - Presence of rejection in the biopsies
  - Echocardiography results and
  - ECG recordings during admission for biopsy and on suspicion for rejection are evaluated.

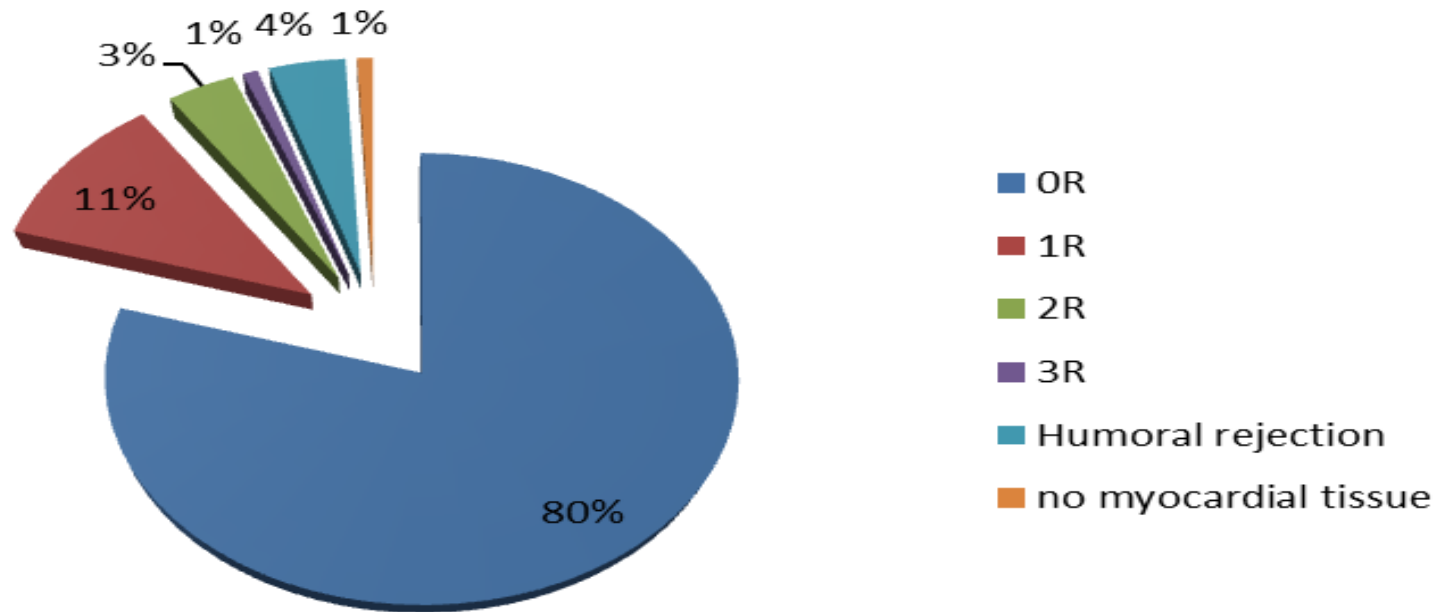
# Methods

- ECG data
  - PR, QRS, QTc period
  - QRS axis
  - Heart rate
  - ST segment and T wave abnormalities
  - Ventricular hypertrophy
  - Conduction block
  - Voltage suppression, and
  - Dysrhythmia were noted.

# Results

- Mean age at the time of transplantation was 11.9 y (11 months - 19 years).
- Cardiac diagnoses
  - dilated cardiomyopathy 15
  - restrictive cardiomyopathy 12
  - congenital heart disease 4
  - chemotherapy-related cardiomyopathy 2
  - hypertrophic cardiomyopathy 1
  - arrhythmogenic right ventricular dysplasia 1

# Results of Biopsies



- **Figure.** Distribution of 252 biopsies scored by the International Society for Heart and Lung Transplantation (ISHLT) guidelines [Stewart 2005]. Grade oR = no rejection; grade 1R = mild; grade 2R = moderate; grade 3R = severe rejection.

# ECG data – Rejection

|                          | No rejection | Grade 1R           | Grade 2R          | Acute humoral     | S u s p e c t e d humoral |
|--------------------------|--------------|--------------------|-------------------|-------------------|---------------------------|
| PR (msec)                | 142.7        | 130.7<br>(p:0.117) | 146.6<br>(p:0.60) | 130.8<br>(p:0.05) | 145.2<br>(p:0.68)         |
| QRS (msec)               | 73.2         | 64.1<br>(p:0.05)   | 51.6<br>(p:0.016) | 72.4<br>(p:0.90)  | 64.7<br>(p:0.24)          |
| QTc (msec)               | 420.6        | 426.3<br>(p:0.38)  | 417<br>(p:0.76)   | 423.8<br>(p:0.74) | 435.5<br>(p:0.14)         |
| Heart rate<br>(beat/min) | 99.5         | 108.1<br>(p:0.03)  | 110<br>(p:0.14)   | 113.8<br>(p:0.18) | 104.2<br>(p:0.42)         |

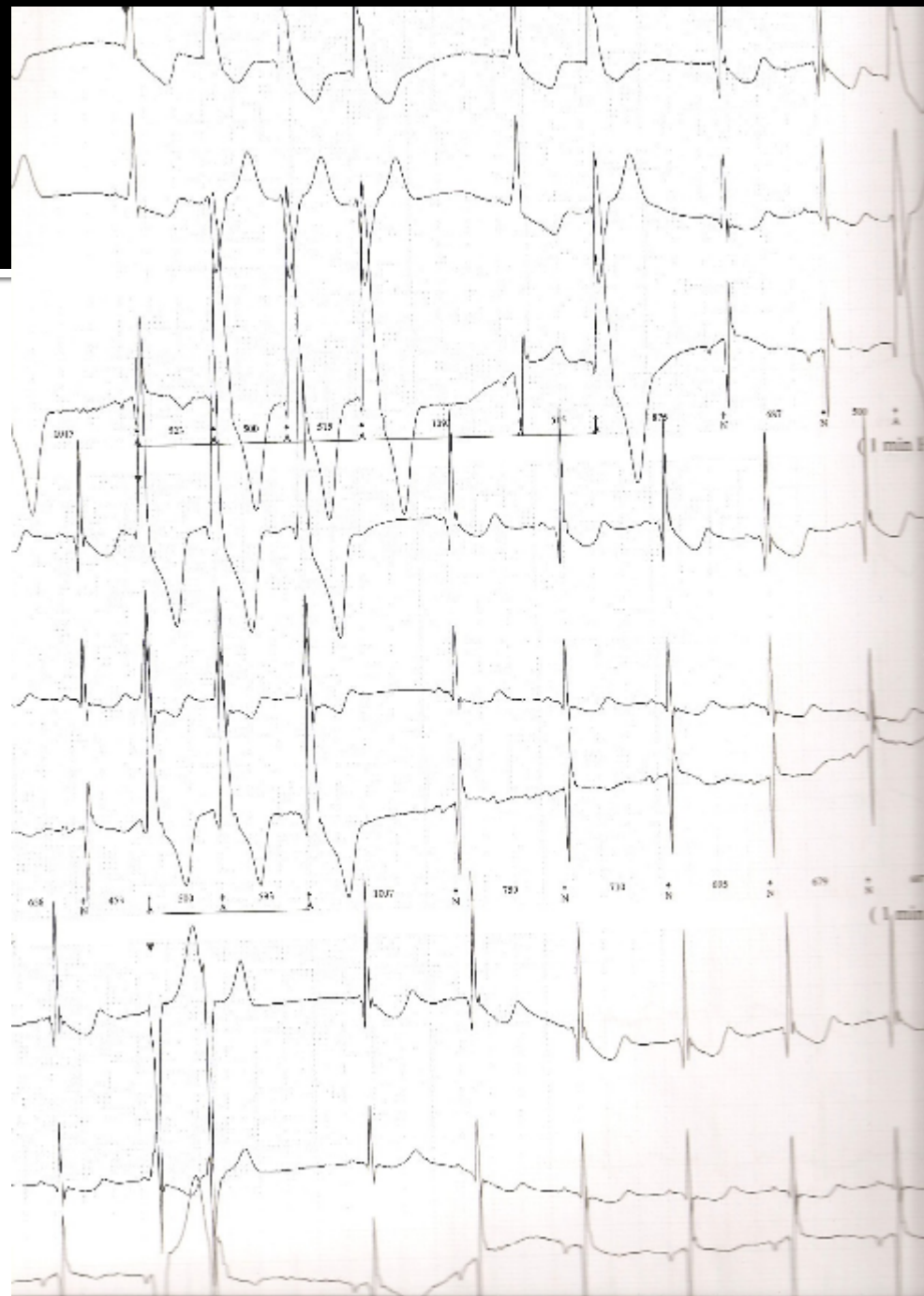
# ECG data – Rejection

|               | ST elevation  |               | ST depression |               | Negative T wave<br>N (%)<br>p:0.034 | V o l t a g e<br>suppression<br>N (%) | RBBB<br>N (%) | LBBB<br>N (%) | VHT<br>N (%) | Arrhythmia<br>N (%) |
|---------------|---------------|---------------|---------------|---------------|-------------------------------------|---------------------------------------|---------------|---------------|--------------|---------------------|
|               | 1 mm<br>N (%) | 2 mm<br>N (%) | 1 mm<br>N (%) | 2 mm<br>N (%) |                                     |                                       |               |               |              |                     |
| Rejection (-) | 9<br>(4.5)    | 2<br>( 1)     | 10<br>(5)     | 4<br>(2)      | 29<br>(14.4)                        | 2<br>(1)                              | 8 8<br>(43.6) | 5<br>(2.5)    | 1 3<br>(6.5) | 6<br>(3)            |
| Rejection (+) | 2<br>(4.2)    | 1<br>(2.1)    | 12<br>(25)    | 3<br>(6.3)    | 13<br>(27.1)*                       | 2<br>(4.2)                            | 1 8<br>(37.5) | 1<br>(2.1)    | 4<br>(8.4)   | 1<br>(2)            |



# 14 years old First month of transplantation

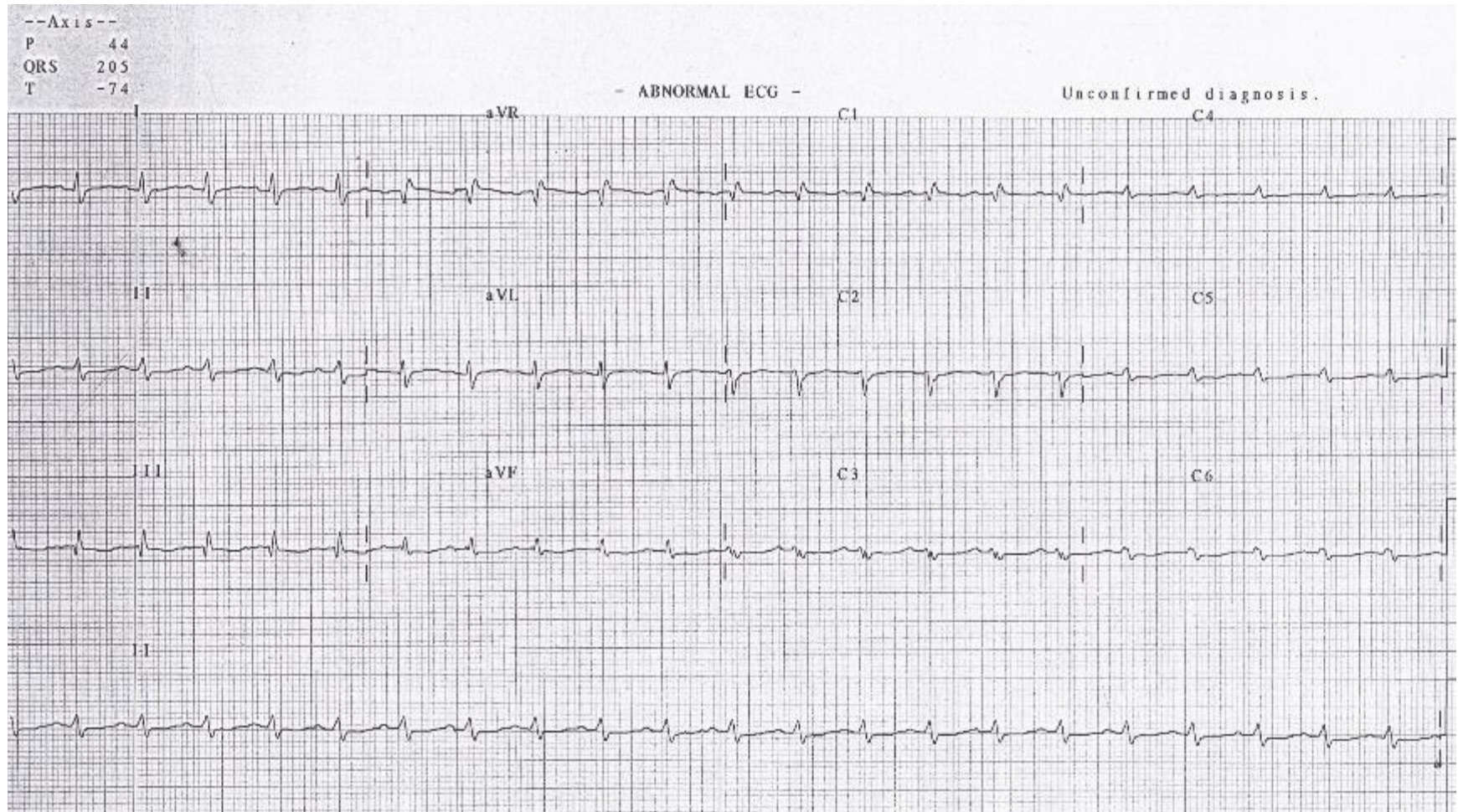
- Ventricular and supraventricular tachycardia



# 14 y-old boy, 3rd year of transplantation

- Routine follow-up visit
- No complaint
- Tachycardia and pretibial edema
- Echo: Ejection fraction 31%, shortening fraction 16%
- ECG : voltage suppression
- He admitted that he did not take medications last 2 weeks
- At 6th day of treatment, biopsy showed no rejection although echo and ECG were still abnormal

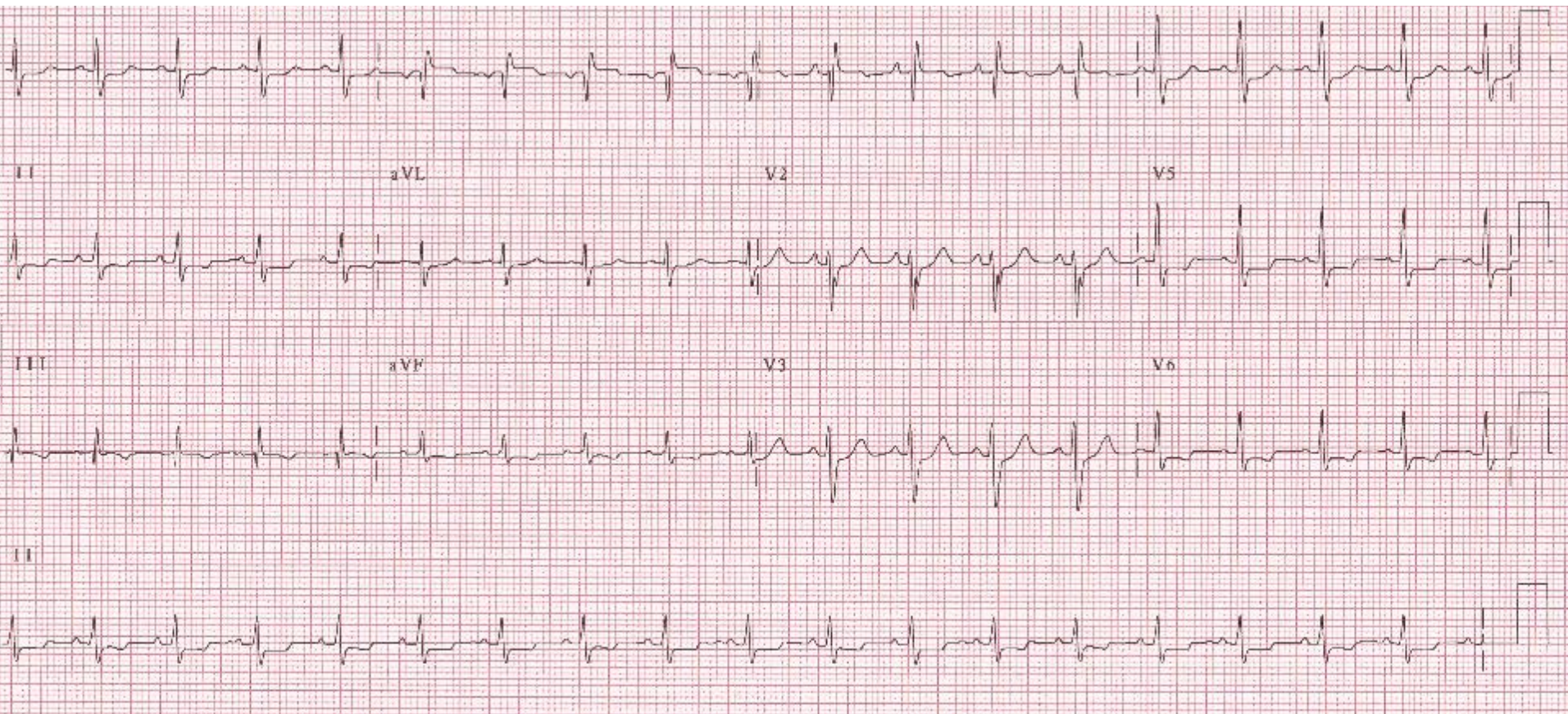
# 14 y-old, 3rd year of tx. Acute rejection- Voltage suppression



Ejection fraction 31%, shortening fraction 16%

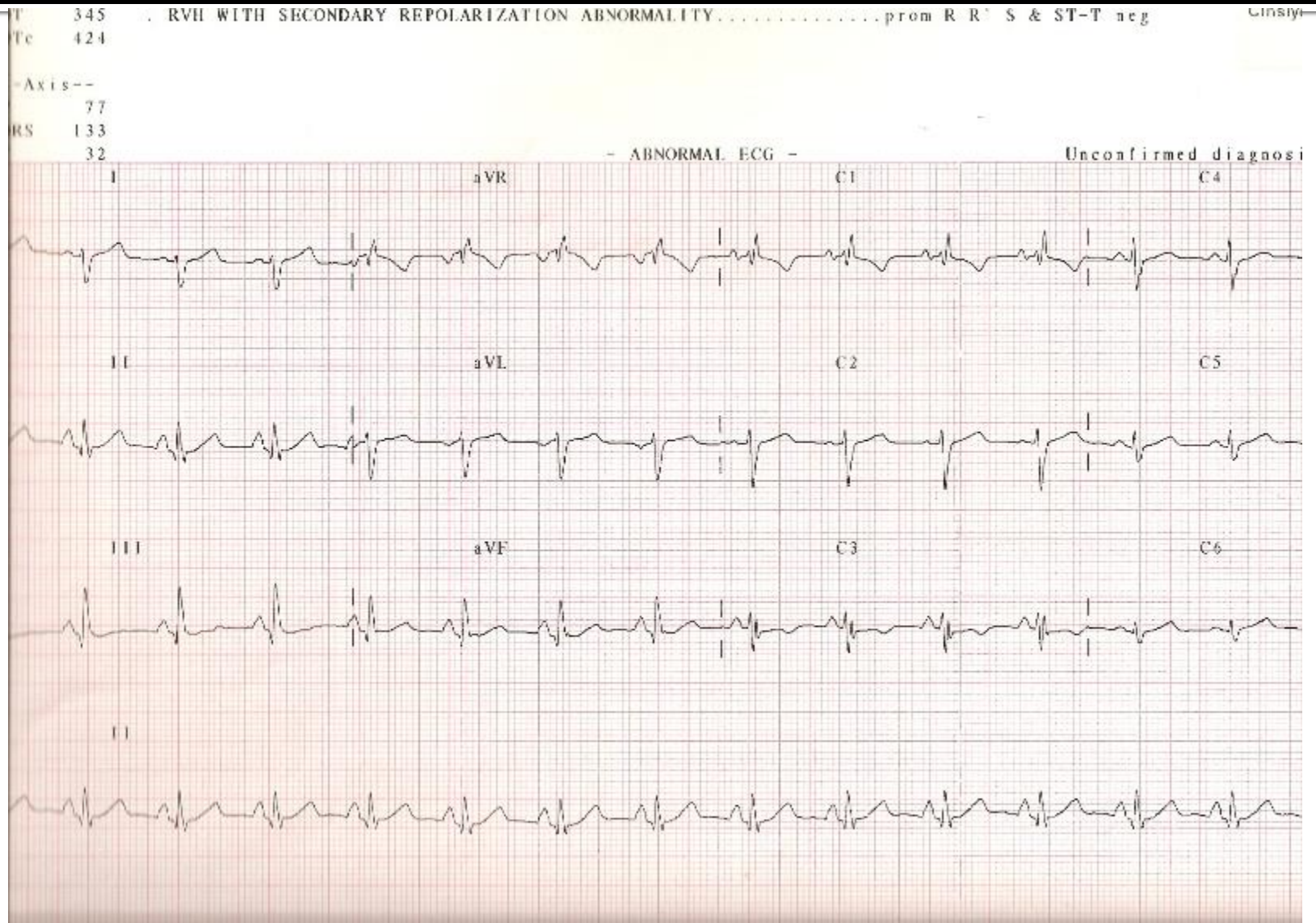


**At 17th day of treatment: Voltage suppression improved, negative T waves and ST depression**



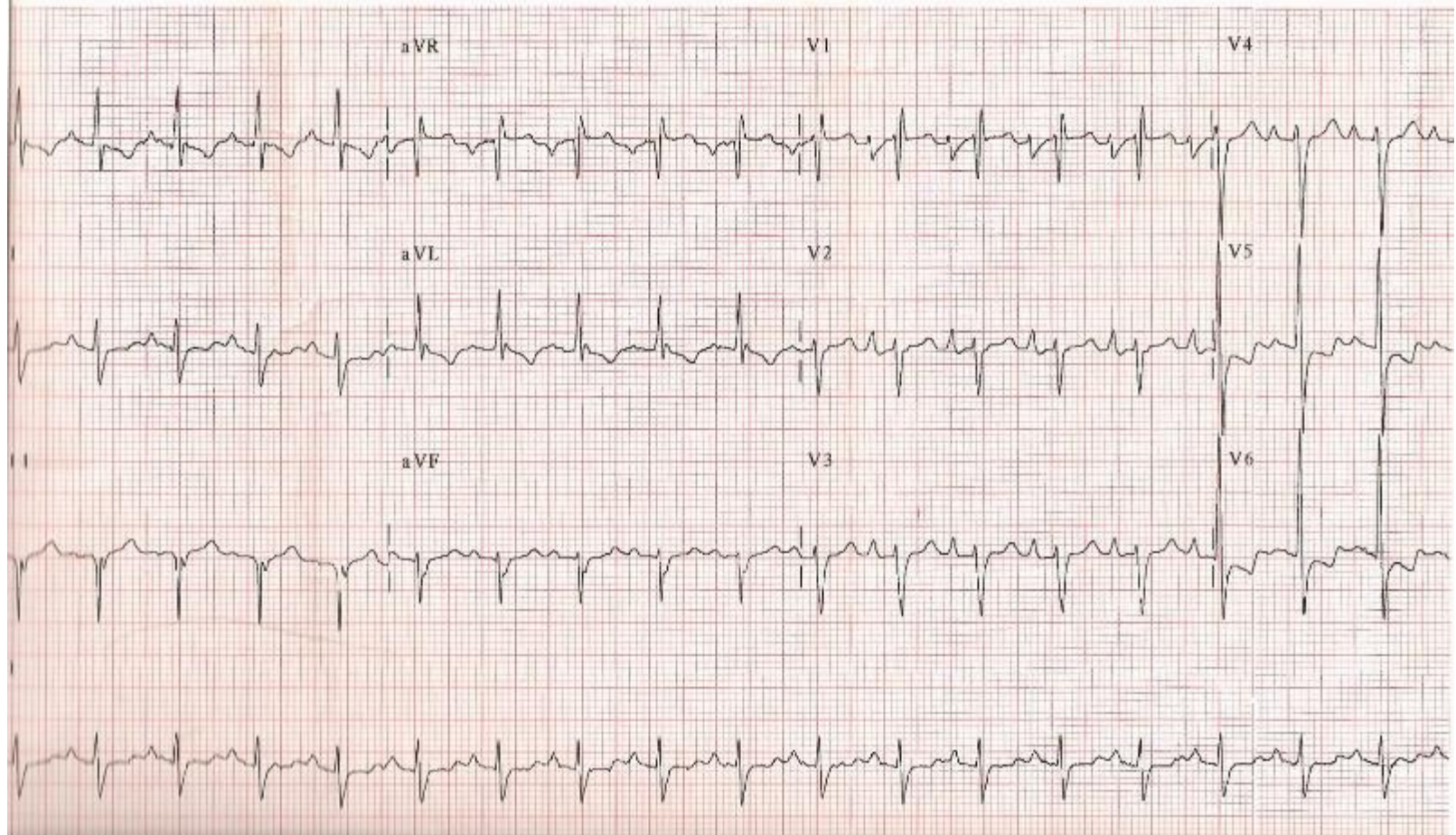


# Voltage suppression, R axis deviation



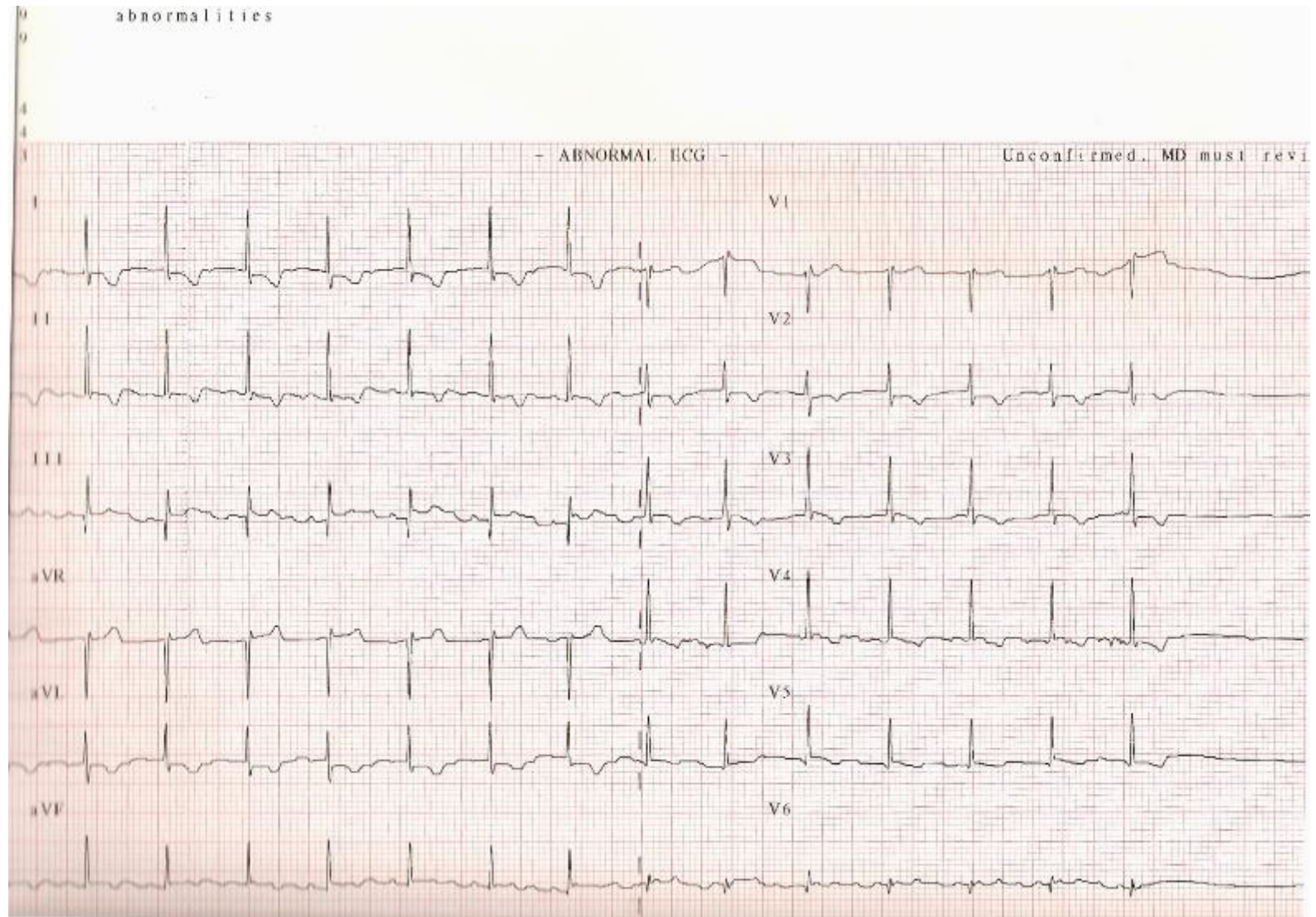
# Negative T waves and ST depression

ECG 390 . Lateral ST-T abnormalities,.....ST-T negative I,aVL,V5,V6 Requested  
.. Consider ischemia.....T > -.20 mV, ST > -.10 mV  
AXIS--  
35  
RS -50  
157  
- ABNORMAL ECG -  
PRELIMINARY-MD MUST





# Negative T waves and ST depression



# 16 years old. Atrial flutter



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# Incidence and Prognostic Value of Electrocardiographic Abnormalities after Heart Transplantation

G olshayan D, et al

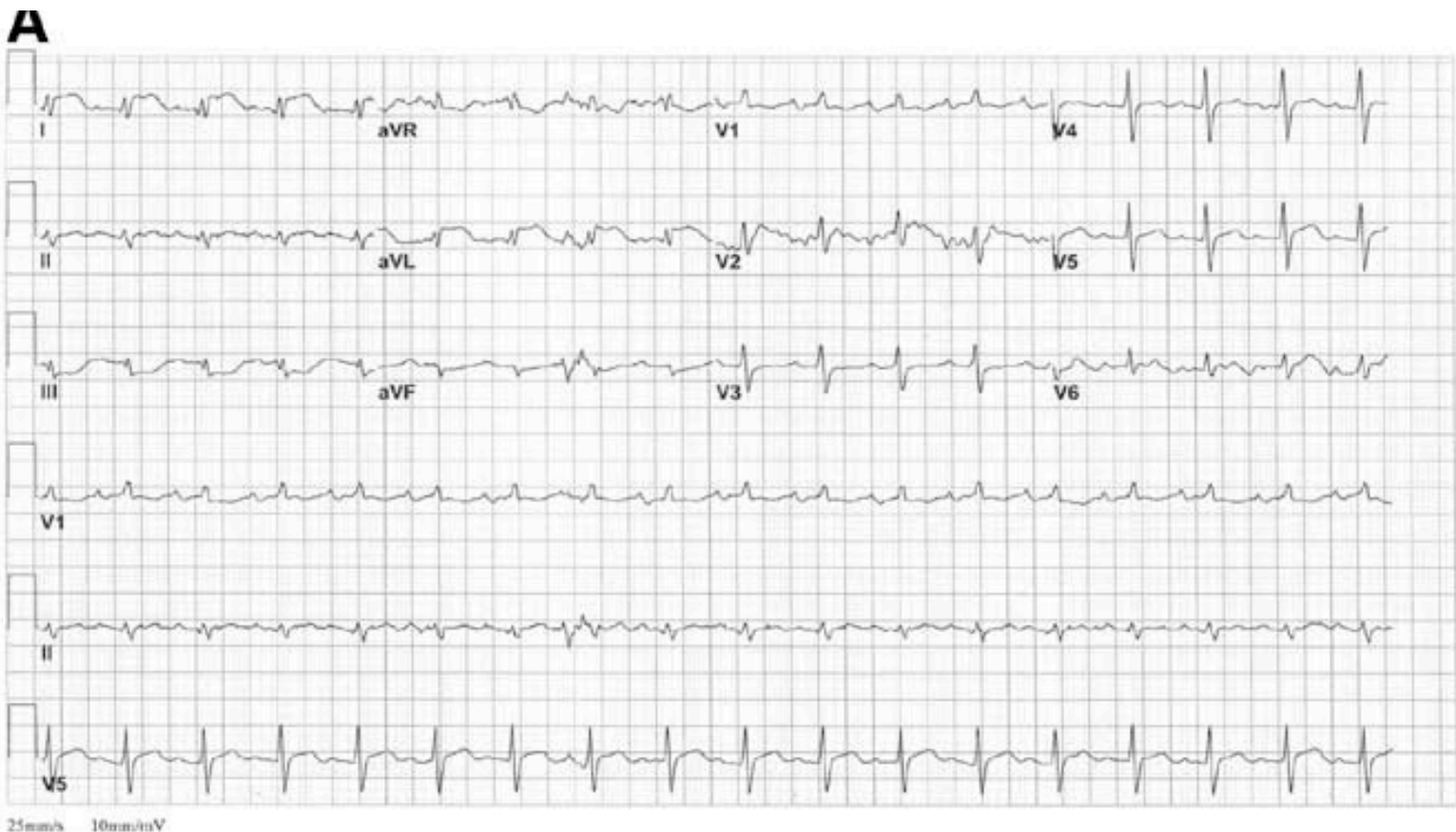
- The most prevalent abnormality : complete or incomplete RBBB. New RBBB appeared in 69% of the patients, mainly during the first month.
- 9 episodes of supraventricular arrhythmias: 1 atrial fibrillation, 6 atrial flutter, 1 junctional tachycardia
- 3 of the 6 episodes of atrial flutter occurred during an episode of acute rejection
- RBBB was not associated with acute rejection

*Clin. Cardiol. 21, 680-684 (1998)*

# Acute Orthotopic Heart Transplantation Rejection With ST-Segment Elevation in Leads I and aVL

Peter Vlismas, et al

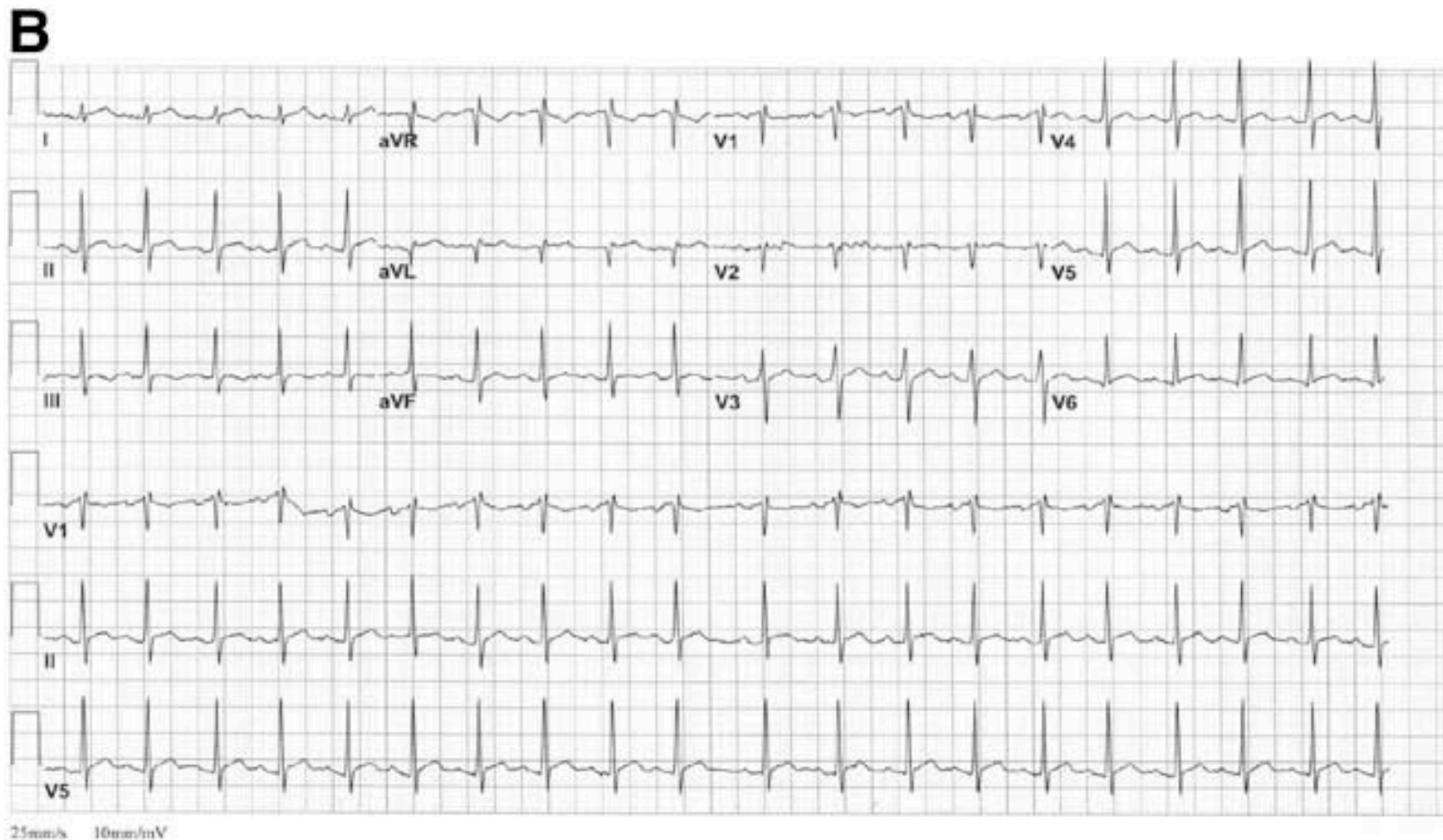
Presentation with sinus tachycardia and lateral ST-segment elevations with reciprocal depressions in inferior leads



# Acute Orthotopic Heart Transplantation Rejection With ST-Segment Elevation in Leads I and aVL

Peter Vlismas, et al

On hospital day #5 ECG demonstrating resolved ST-segment elevations



*Circ Heart Fail. 2015;8:836-838*

# Conclusion

- Routine ECG follow-up of patients with OHT was previously shown to help detect acute rejection.
- Our study supports the power of ECG to demonstrate abnormalities **even in asymptomatic patients and in those with normal biopsy but with clinical evidence of acute rejection.**
- **Serial ECGs are important to depict deteriorations**

# Conclusion

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- ST depression or elevation
- T wave inversion
- Voltage suppression
- New onset arrhythmia especially after the first 3 months should alert for acute rejection