BENIGN PERSISTENT T-WAVE INVERSION MIMICKING ISCHEMIA AFTER PACING

CONTRIBUTION OF VECTORCARDIOGRAM DISTINGUISHES BETWEEN NEW AND OLD LEFT BUNDLE BRANCH BLOCK

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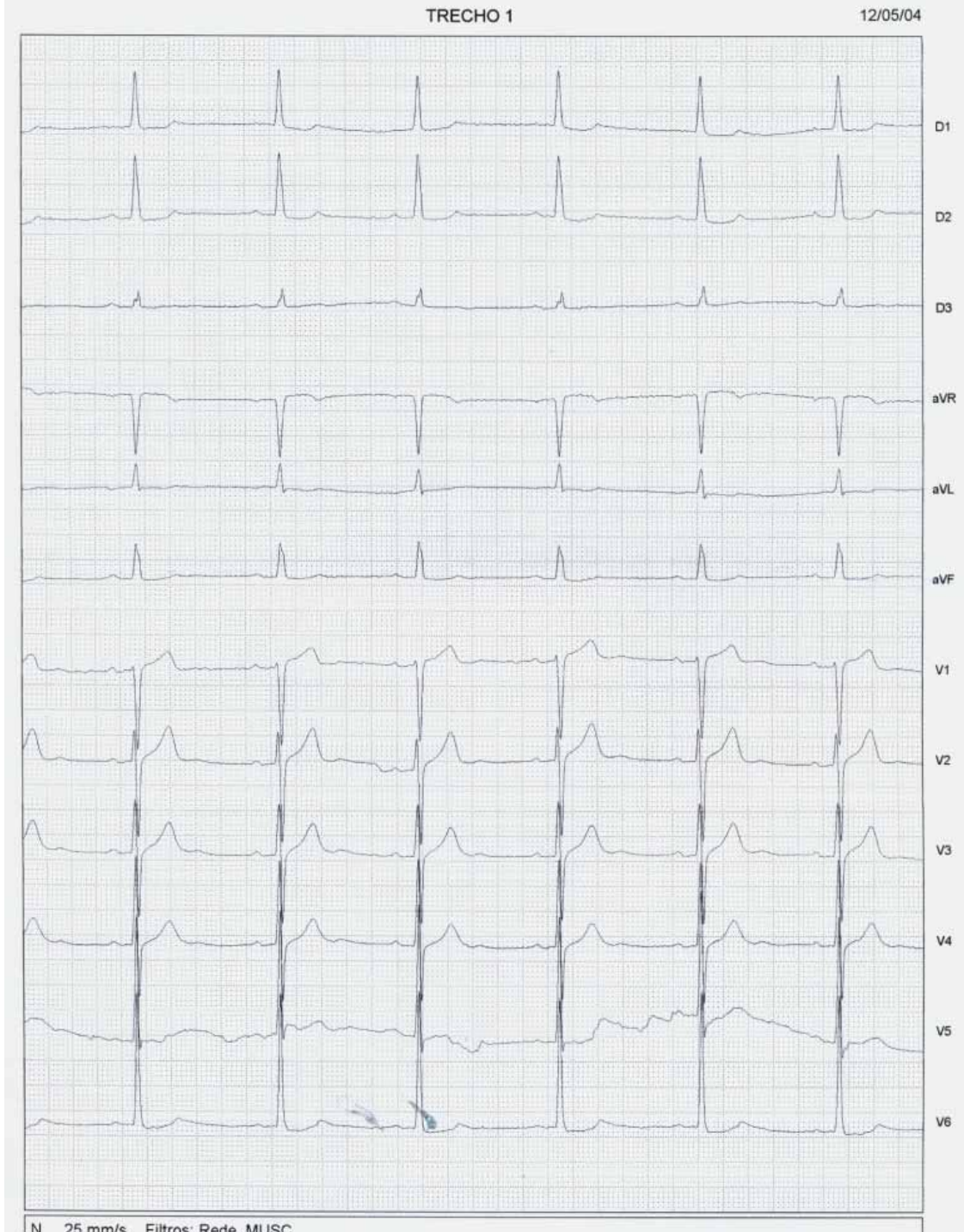
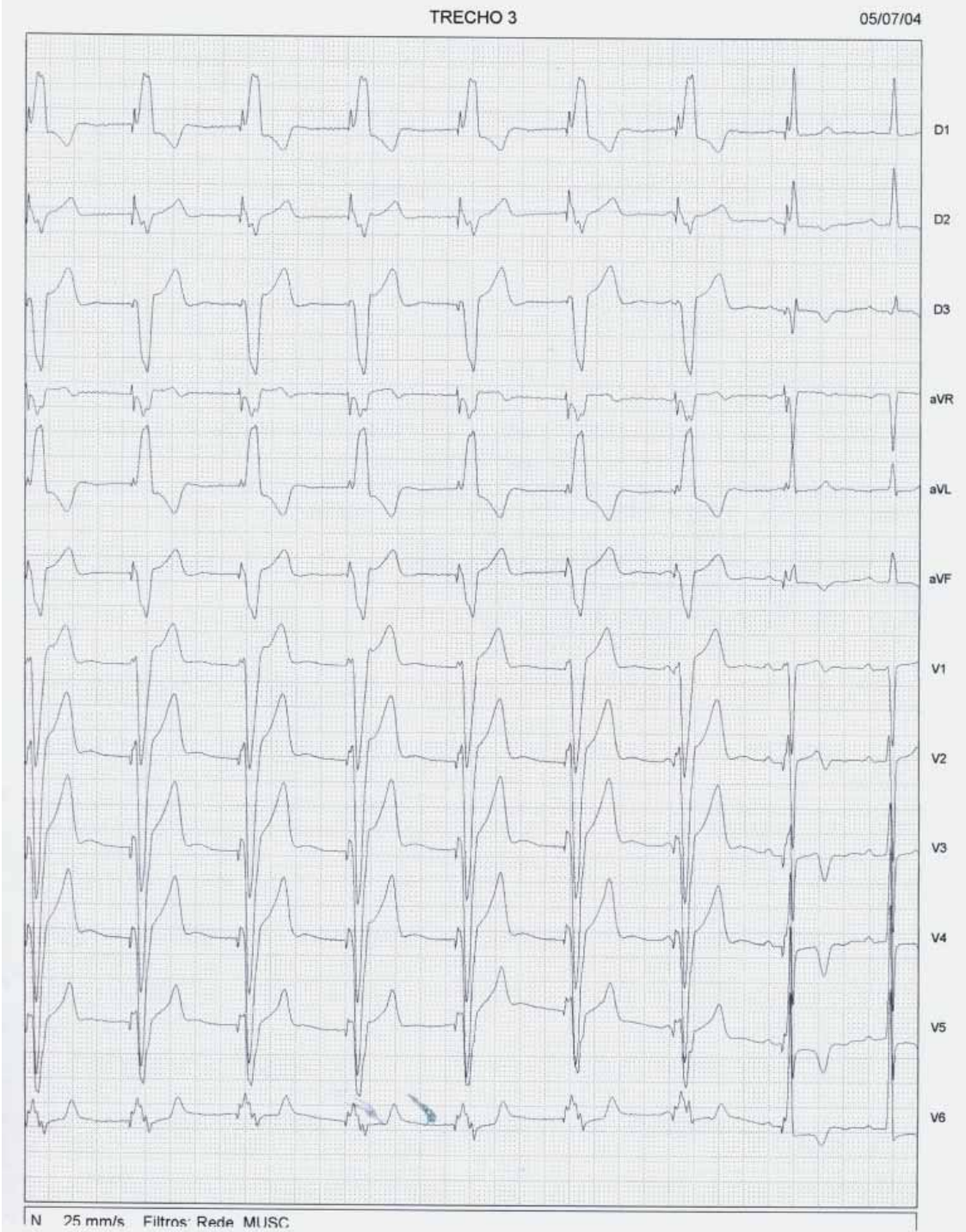
Paciente masculino, 90 anos, implantou marcapasso do tipo VVIM em 10/04/2000 por BAV total intermitente sintomático comprovado pelo Holter. Nesta ocasião apresentava fibrilação atrial com baixa taxa de resposta ventricular (alto grau de BAV) sintomática. Não há referência de sintomas de isquemia miocárdica. Mesmo assim um outro colega solicitou a cintilografia miocárdica a qual foi normal.
Exame físico da ocasião revelava hipertensão arterial sistólica 160/80mmHg.Ausculta cardíaca: Ritmo cardíaco irregular lento;SS+/4 no foco mitral;SD+/4 no foco Aórtico. Pulmões Limpos. Sem edema periférico.
ECO(24/04/2010)=FE=49%;DS=52mm=70mm;esclerose mitro-aórtica leve; disfunção sistólica leve.
Os 3 ECGs seguintes realizados de rotina (paciente sem sintomas)
Um abraço Raimundo

Male patient, 90 years old, implanted pacemaker-type "on demand" pacing mode VVM on 10/04/2000 by symptomatic intermittent third degree AV block registred on the Holter. On this occasion he presented symptomatic atrial fibrillation with heart rate too slow
Absence of symptoms of myocardial ischemia. Physical Exam showed a sytolic hypertension BP 160/80mmHg.
Cardiac asucultation: irregular rhythm slow, SS + / 4 in the mitral focus, DS + / 4 in aoritc focus.
Lungs: Clean.
No peripheral edema wealthy.
ECO (24/04/2010) = EF = 49%, SD = 52mm = 70mm; sclerosis arctic light; dysfunction lica light systems. Myocardial Scintigraphy was normal.
The three following ECGs performed with the patient without symptoms.
Raimundo

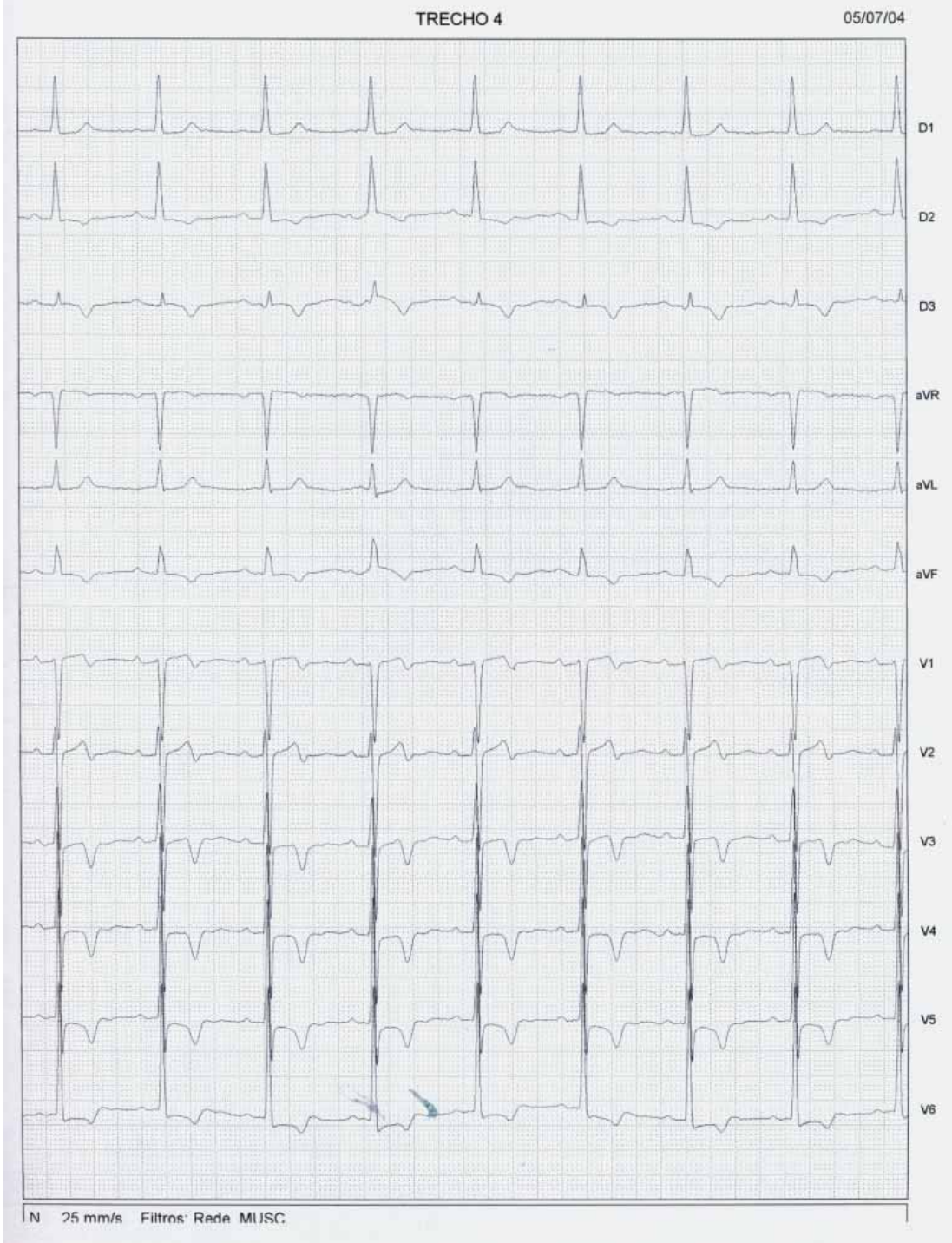
ECG1:12 05 2004



ECG2 :05 07 2004



ECG3: 05 07 2004



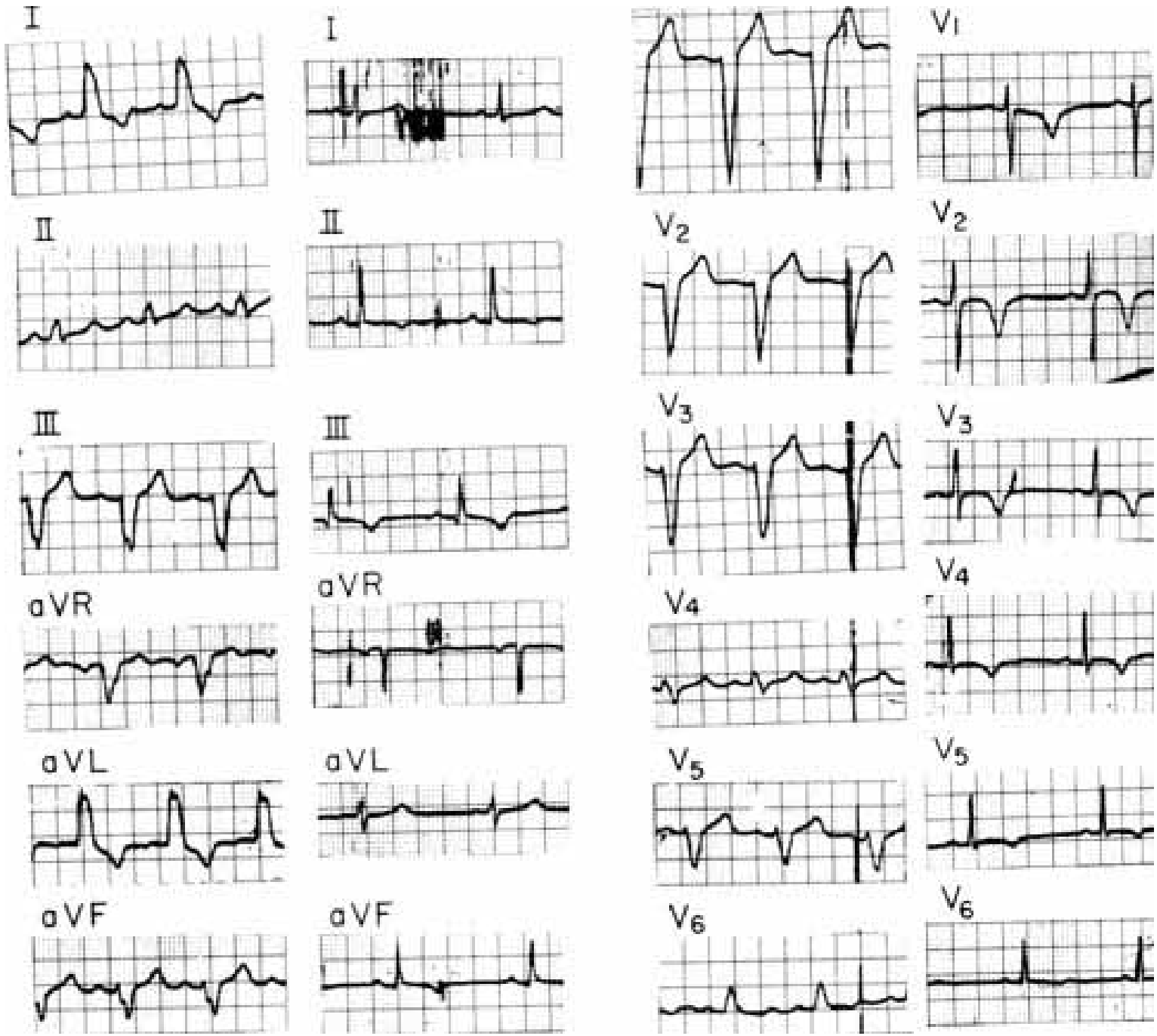
Cardiac memory distinguishes between new and old left bundle branch block

Alexei Shvilkin, MD, PhD.

Objective

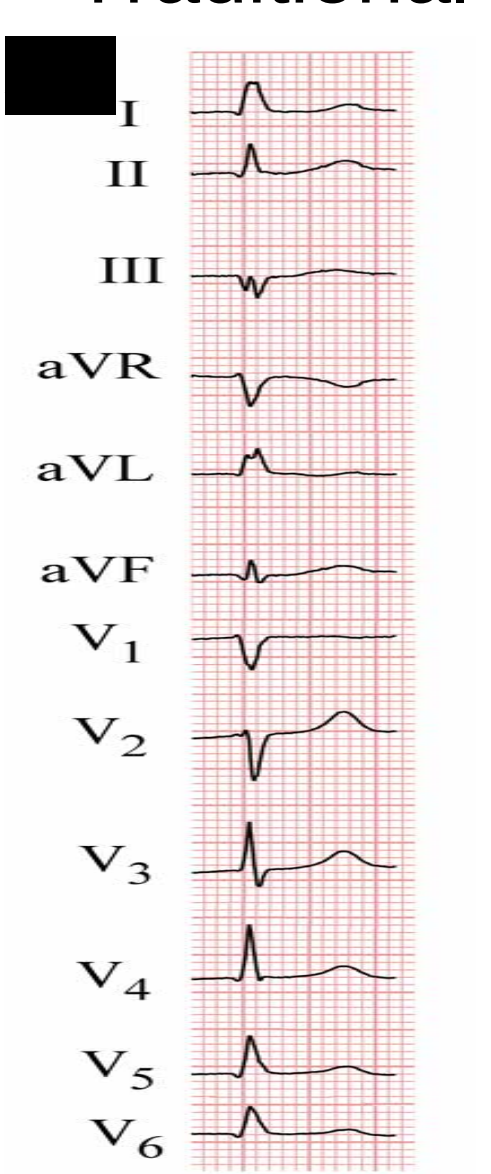
- Left Bundle Branch Block **(LBBB)** can complicate acute myocardial infarction as well as obscure diagnostic ECG abnormalities caused by myocardial ischemia
- Current ACC/AHA STEMI Guidelines consider new or presumed new LBBB associated with symptoms suggestive of ACS Class I indication for PCI/thrombolysis
- Patients with chest pain and LBBB of unknown duration often undergo unnecessary cardiac catheterization
- Therefore the ability to determine whether LBBB is acute or old without previous ECG can influence the decision to employ reperfusion

LBBB causes cardiac memory

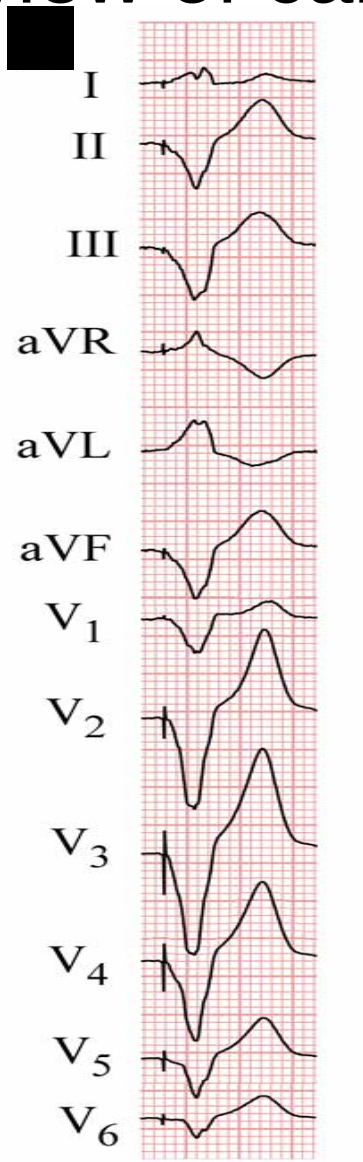


From: Denes P, Pick A, Miller RH, et al. Ann. Intern. Med, 1978;89:55-7.

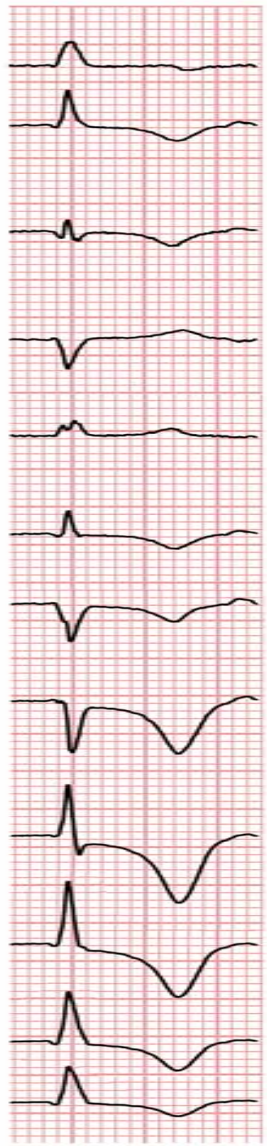
Traditional view of cardiac memory



Baseline sinus rhythm

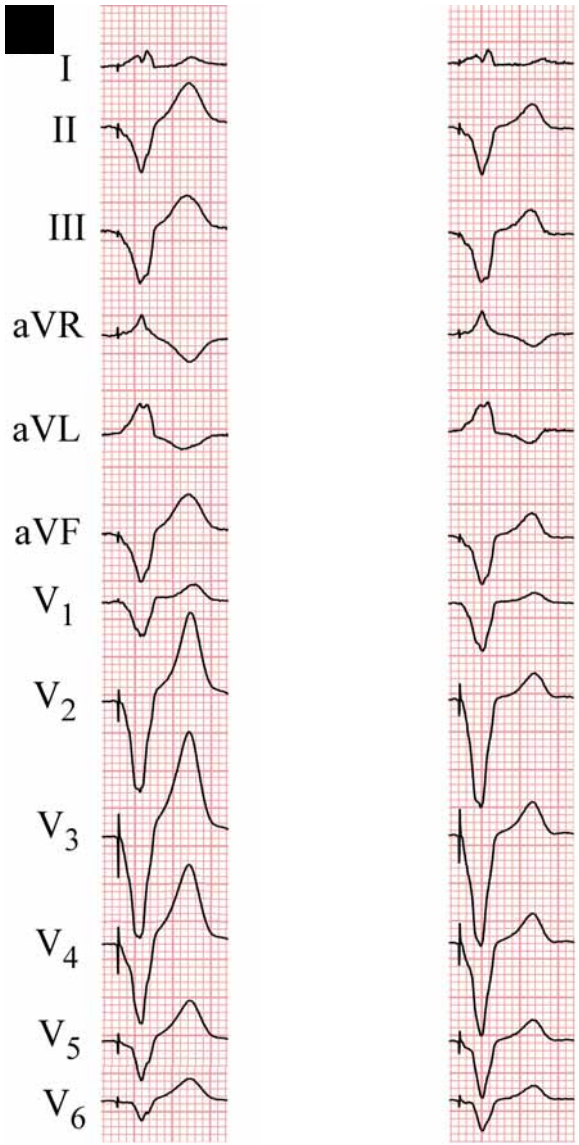


Ventricular pacing



Pacing off after 7 days

Evidence of cardiac memory during continuous pacing



Ventricular pacing Day 1

Ventricular pacing Day 7

T wave amplitude decreases with increased duration of pacing

Shvilkin A. Bojovic B, Vajdic B, et al, Vectorcardiographic determinants of cardiac memory during normal ventricular activation and continuous ventricular pacing. Heart Rhythm 2009 Jul;6: 943-948.

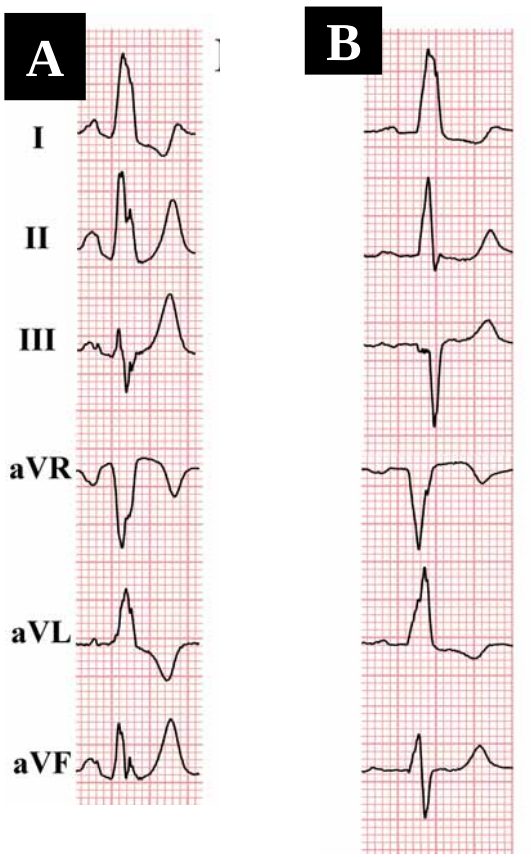
Hypothesis

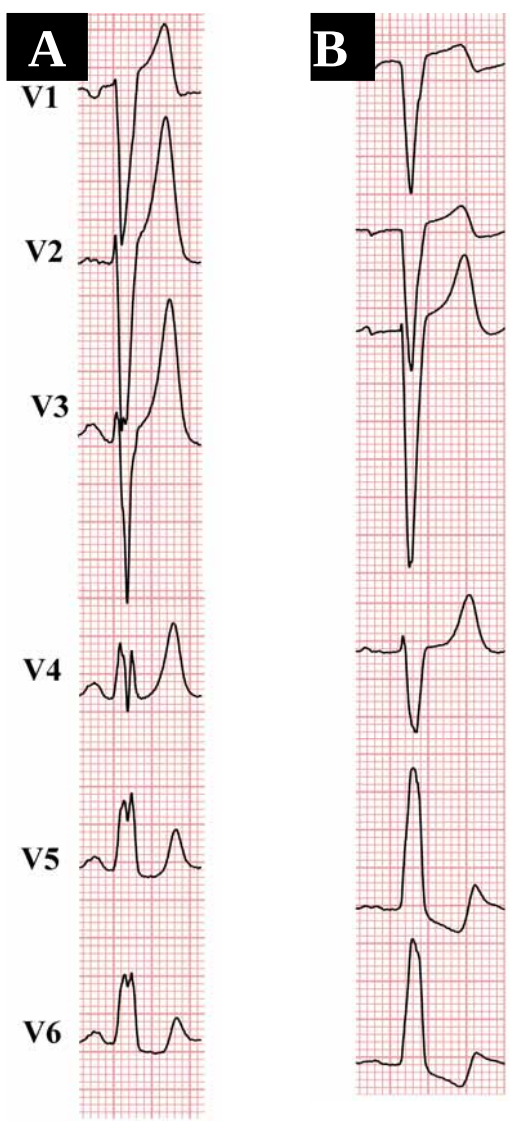
- LBBB as any aberrant pattern of ventricular activation over time results in development of **cardiac memory**
- T wave should decrease with increased duration of aberrant conduction in LBBB
- Therefore T wave magnitude in the old LBBB should be smaller than in the new LBBB
- This feature might distinguish “new” from “old” LBBB

Methods

- Retrospective search of a digital ECG database to identify cases of new and old LBBB
- Definitions:
  - New LBBB: prior ECG with narrow QRS (<110 ms) and normal T waves **within 24 hrs** of the index tracing;
  - Old LBBB: documented for **at least 3 months**
- Manual confirmation using accepted LBBB criteria
- ECG analysis: Dower transform-derived vectorcardiogram reconstructed and analyzed using ***Visual3Dx*** software (NewCardio, Inc. - Newcardio.com)

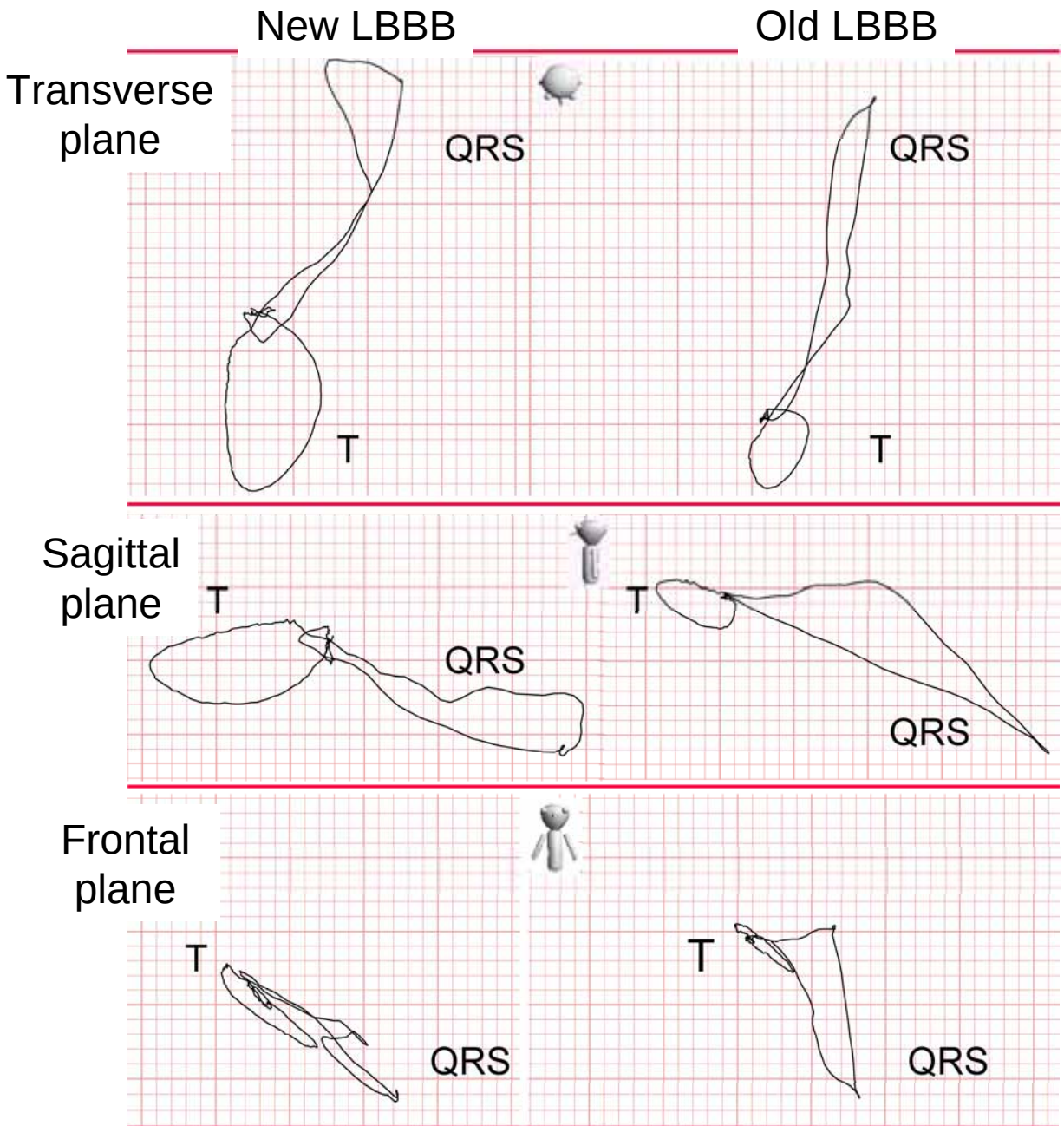
Examples of new (A) and chronic (B) LBBB



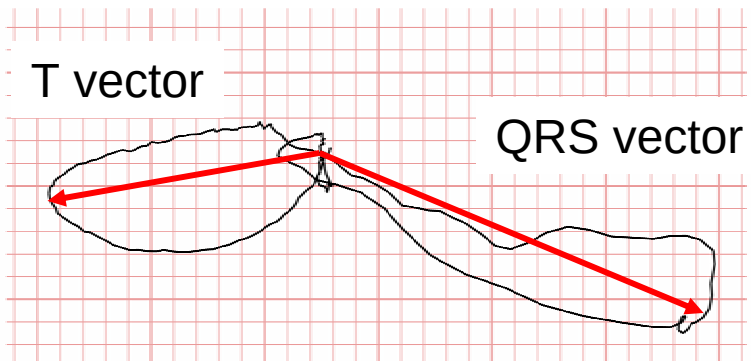


T wave amplitude is higher in the new LBBB

Vectorcardiogram



Vector magnitude measurement



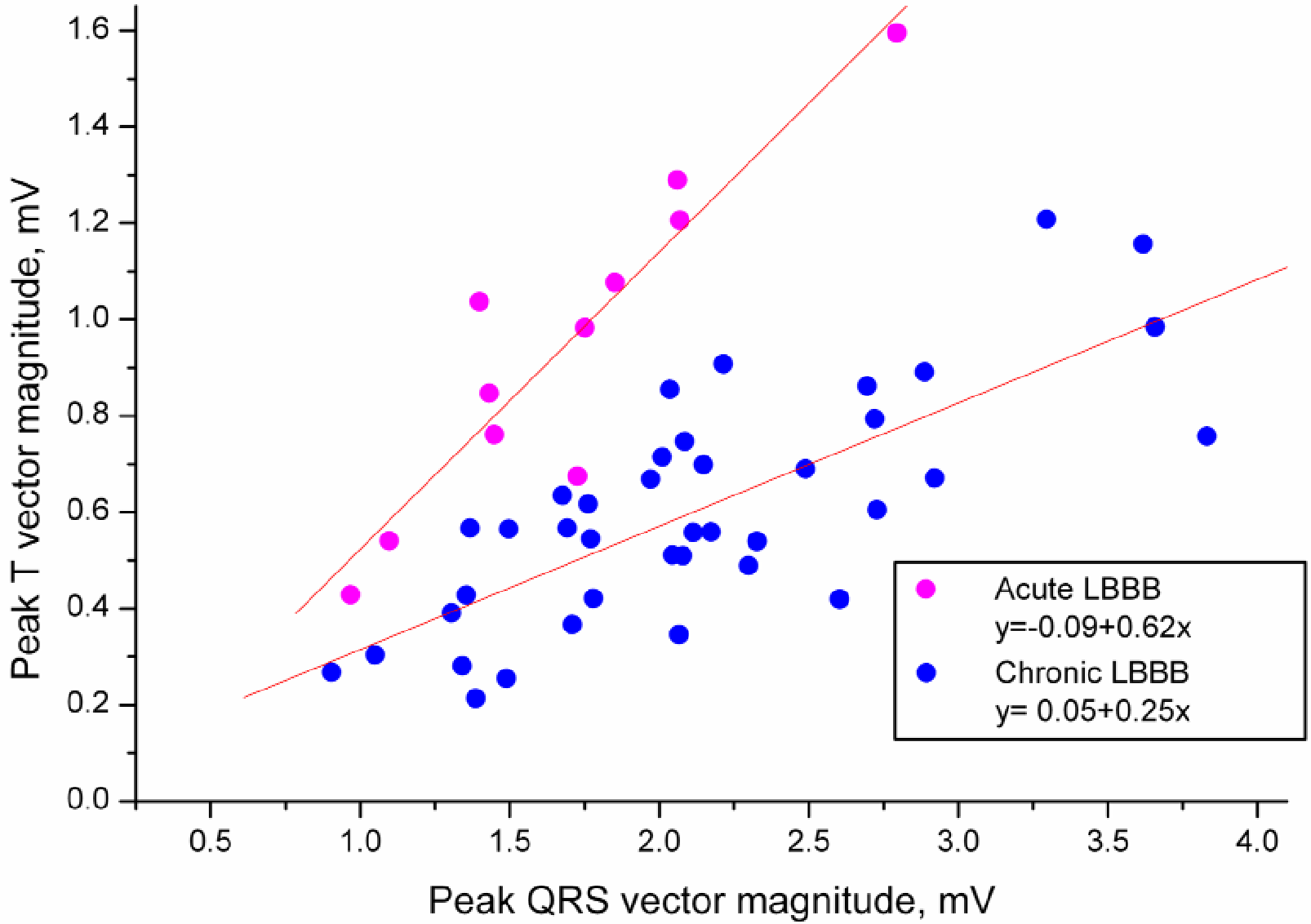
Clinical characteristics of patients

	Acute LBBB (n=11)	Chronic LBBB (n=39)
Age, years	**72 ± 6.6**	**76 ± 2.6**
Gender, M n (%)	**6 (55)**	**12 (31)**
LV EF, %	**60.0 ± 3.2 (n=7)**	**46.9 ± 3.4 * (n=27)**
Prior history of MI, n (%)	**1 (9)**	**11 (28)**
Hypertension, n (%)	**9 (81)**	**30 (77)**
Diabetes, n (%)	**2 (18)**	**12 (31)**
CHF, n (%)	**3 (27)**	**10 (26)**
Aortic stenosis, n (%)	**2 (18)**	**2 (5)**
Mean BP, mm Hg	**97.3 ± 6.1**	**93.0 ± 2.1**
Ischemia	**0**	**0**

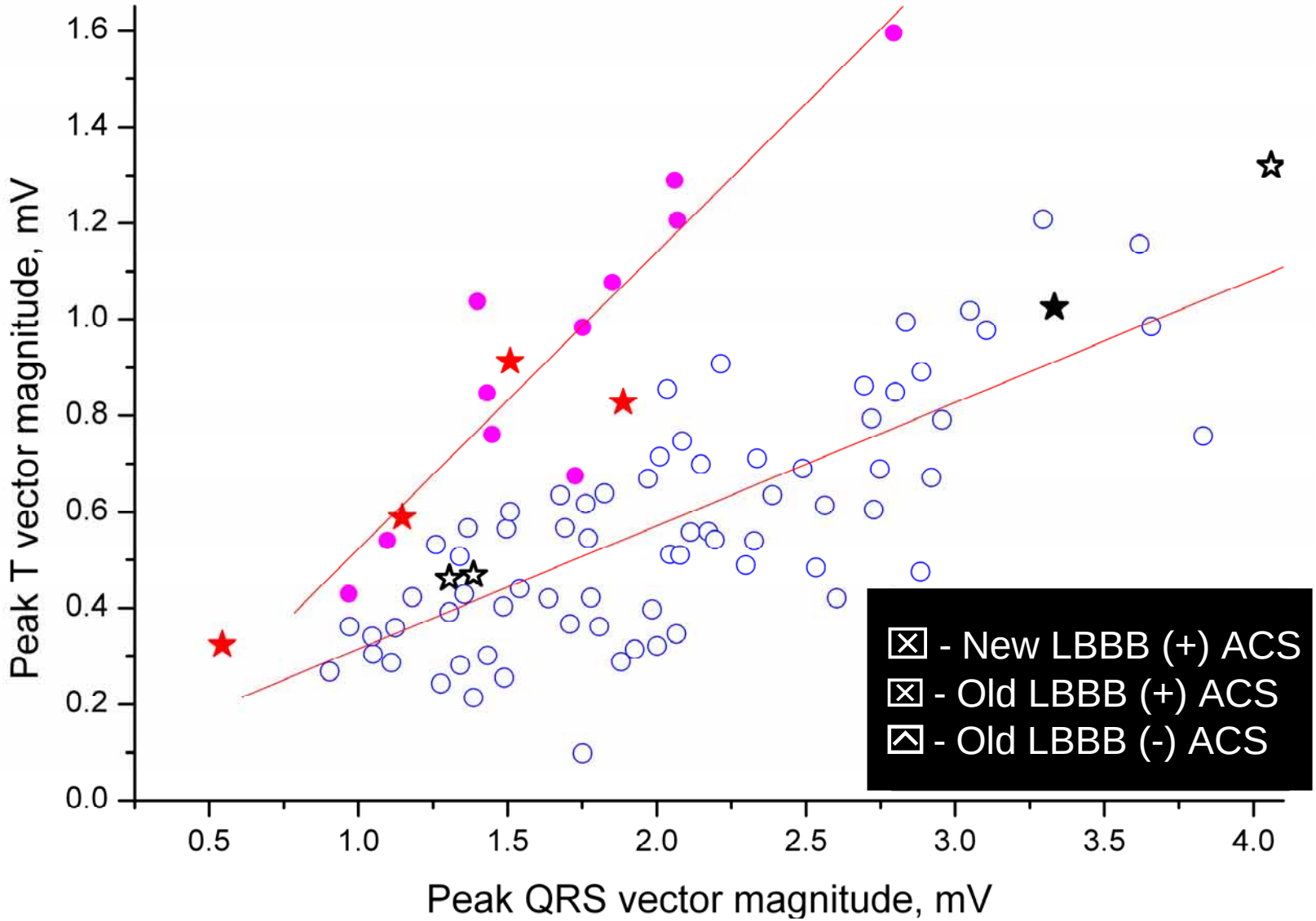
ECG/Vectorcardiographic data

	Acute LBBB (n=11)	Chronic LBBB (n=39)
LBBB duration, median (range)	2.16 hrs (3 min – 22 hrs)	420 days (98 – 1502 days)
HR, min $^{-1}$	96 ± 6	76 ± 3 *
QTc duration, Bazett	493 ± 12	469 ± 5
Peak QRS vector magnitude, mV	1.69 ± 0.15	2.13 ± 0.11 **
Peak T vector magnitude, mV	0.95 ± 0.10	0.60 ± 0.04 **
Peak QRS/T vector magnitude ratio	1.87 ± 0.10	3.73 ± 0.17 **
Peak QRS vector elevation (θ), degrees	82 ± 4	78 ± 2
Peak QRS vector azimuth (φ), degrees	-79 ± 6	-75 ± 2
Peak T vector elevation (θ), degrees	85 ± 4	88 ± 2
Peak T vector azimuth (φ), degrees	75 ± 7	92 ± 5
Peak QRS-T vector angle, degrees	152 ± 7	159 ± 5
* - $p < 0.05$ ** - $p < 0.001$		

QRS/T vector magnitude ratio in new and old LBBB



LBBB with suspected ACS



Conclusions

- Cardiac memory facilitates distinction between old and new LBBB by affecting QRS/T vector magnitude ratio
- Vector-based discriminant analysis formula successfully distinguished between old and new LBBB in 49/50 cases in the validation set
- In a small sample of patients presenting with suspected ACS (n=8) LBBB was correctly classified despite superimposed ischemic changes
- Visual3Dx™ algorithm uses digital data from standard 12-lead ECG recorders and can be easily incorporated in ECG equipment to improve diagnosis