



Severe Myocarditis:

A 2012 update...

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www.reamedpitie.com





Conflict of interest

- Principal Investigator: HEROICS trial
 - HVHF after complicated heart surgery
 - NCT01077349
 - Sponsored by GAMBRO
- Principal Investigator: EOLIA trial
 - VV ECMO in ARDS
 - NCT01470703
 - Sponsored by MAQUET, Getinge Group
- Received honoraria from MAQUET, Getinge Group



Definition - Etiologies

- «Myocarditis» is defined as inflammation of the heart muscle
- Histology: cellular infiltrate and myocyte necrosis
- Etiologies:
 - Infectious diseases
 - Viruses: *Coxsackie, Adenovirus, HIV, CMV, Hep B Parvovirus B19, HHV6, (H1N1)*
 - Bacteria
 - Parasites (Toxoplasma, Chagas)
 - Fungi
 - Hypersensitivity (Drugs)
 - Autoimmune and systemic diseases
 - Lupus, Wegener, Eosinophilic, Sarcoidosis, Giant cell
 - Myocardial toxins (Cocaine, chemotherapy)
 - Peripartum



Sudden Death in Young Adults: A 25-Year Review of Autopsies in Military Recruits

Robert E. Eckart, DO; Stephanie L. Scoville, DrPH; Charles L. Campbell, MD; Eric A. Shrv. MD; Karl C. Staiduhar. MD;
Robert N. Potter, DVM, MPH; Lisa A. Pearse, MD, MPH; and Renu Virmani, MD

Ann Intern Med. 2004;141:829-834.

- 6.3 millions military recruits over 25 yrs
 - 126 non-traumatic sudden deaths, autopsy performed
 - 10% of myocarditis-related deaths

Cardiac Abnormality	Sudden Deaths, <i>n</i> (%)*
Cardiomyopathy	23 (36)
Myocarditis	13 (20)
Hypertrophic cardiomyopathy	8 (13)
Idiopathic dilated cardiomyopathy	1 (2)
Right ventricular dysplasia	1 (2)
Coronary artery pathology	39 (61)
Anomalous coronary artery	21 (33)
Atherosclerotic coronary artery disease	10 (16)
Coronary artery hypoplasia	3 (5)
Coronary aneurysm	2 (3)
Intramycocardial coronary bridge	2 (3)
Coronary dissection	1 (2)
Miscellaneous cardiac findings	2 (3)
Bicuspid aortic valvular stenosis	1 (2)
Embolic myocardial infarction	1 (2)



Clinical manifestations

- From asymptomatic EKG abnormalities to overt cardiac failure...
- Clinical features:
 - Preceding viral illness, flu-like syndrome
 - Fever
 - Chest pain, mimicking acute coronary syndromes
 - Tachycardia
 - Arrhythmia
 - Sudden death:
 - 10% of cases (Eckart, AnnIntMed, 04)
 - Clinical signs of heart failure
 - Minimal, slow evolution
 - Fulminant, leading to refractory cardiogenic shock in a few days

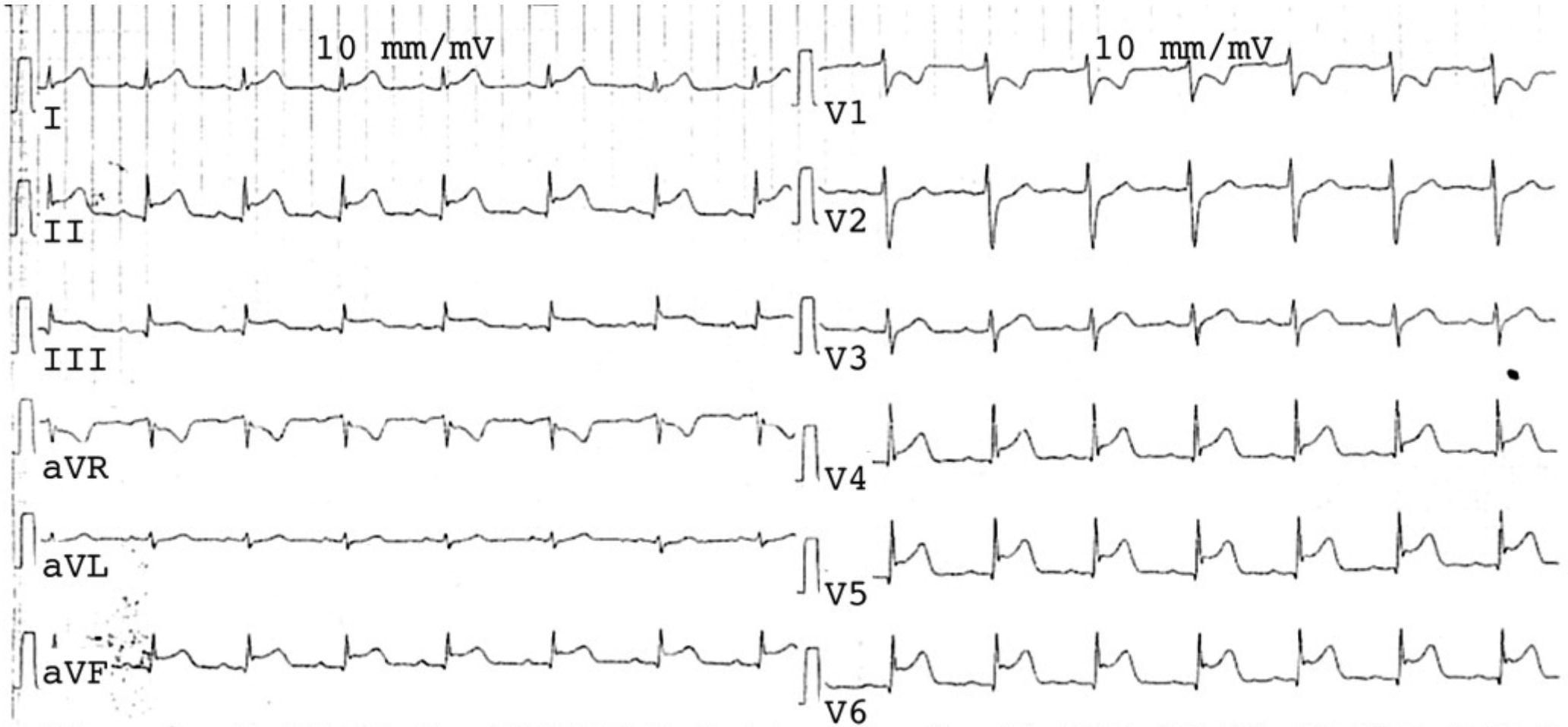


EKG

- EKG findings
 - Sinus tachycardia
 - Diffuse ST-T wave abnormalities
 - Prolonged QT interval
 - Bundle branch block (LBBB++)
 - **Myocardial infarction pattern**
 - Complete heart block
 - Supraventricular tachyarrhythmias
 - Ventricular tachyarrhythmias
- May be normal...

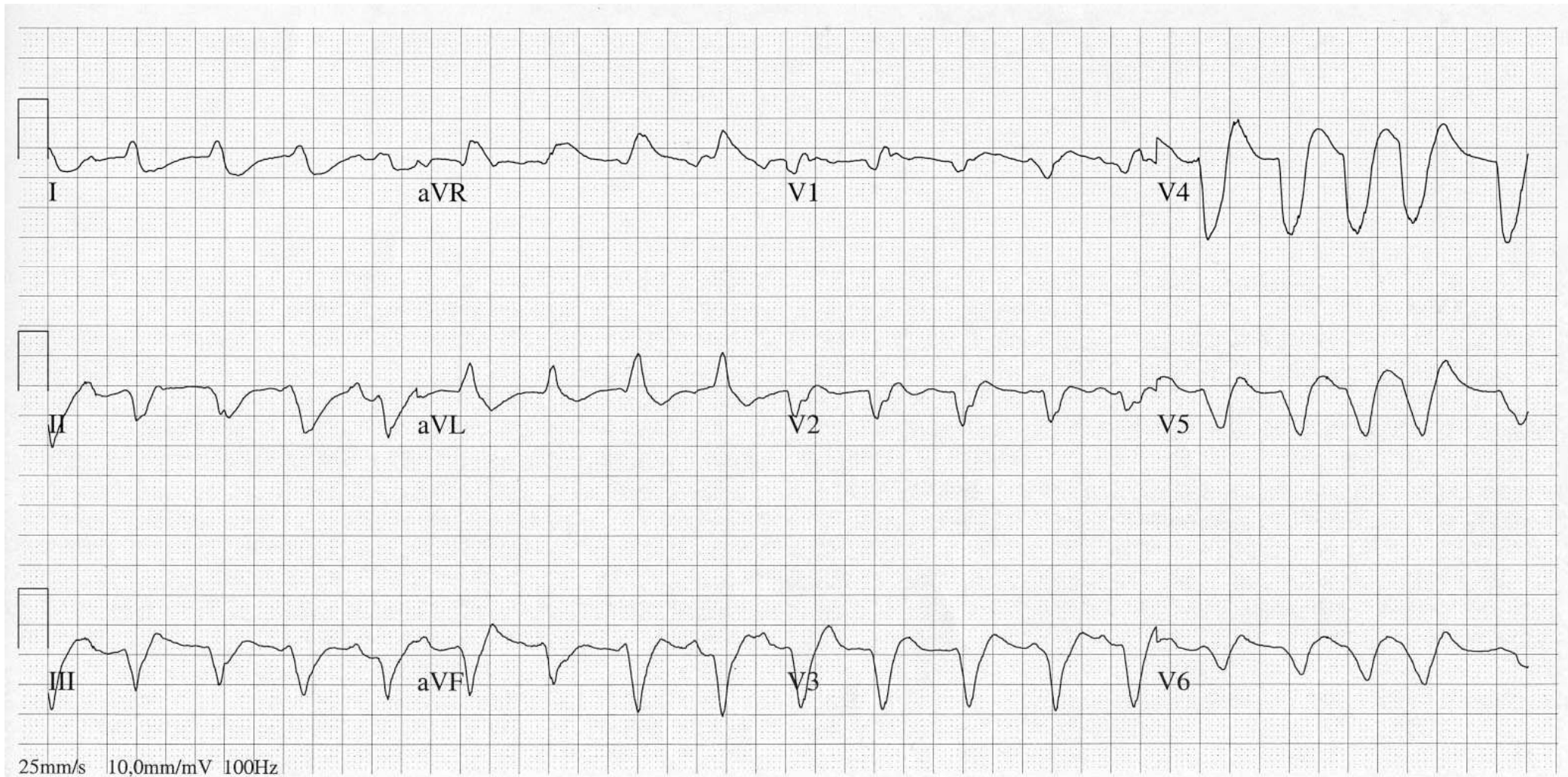


EKG mimicking AMI





EKG: LBBB

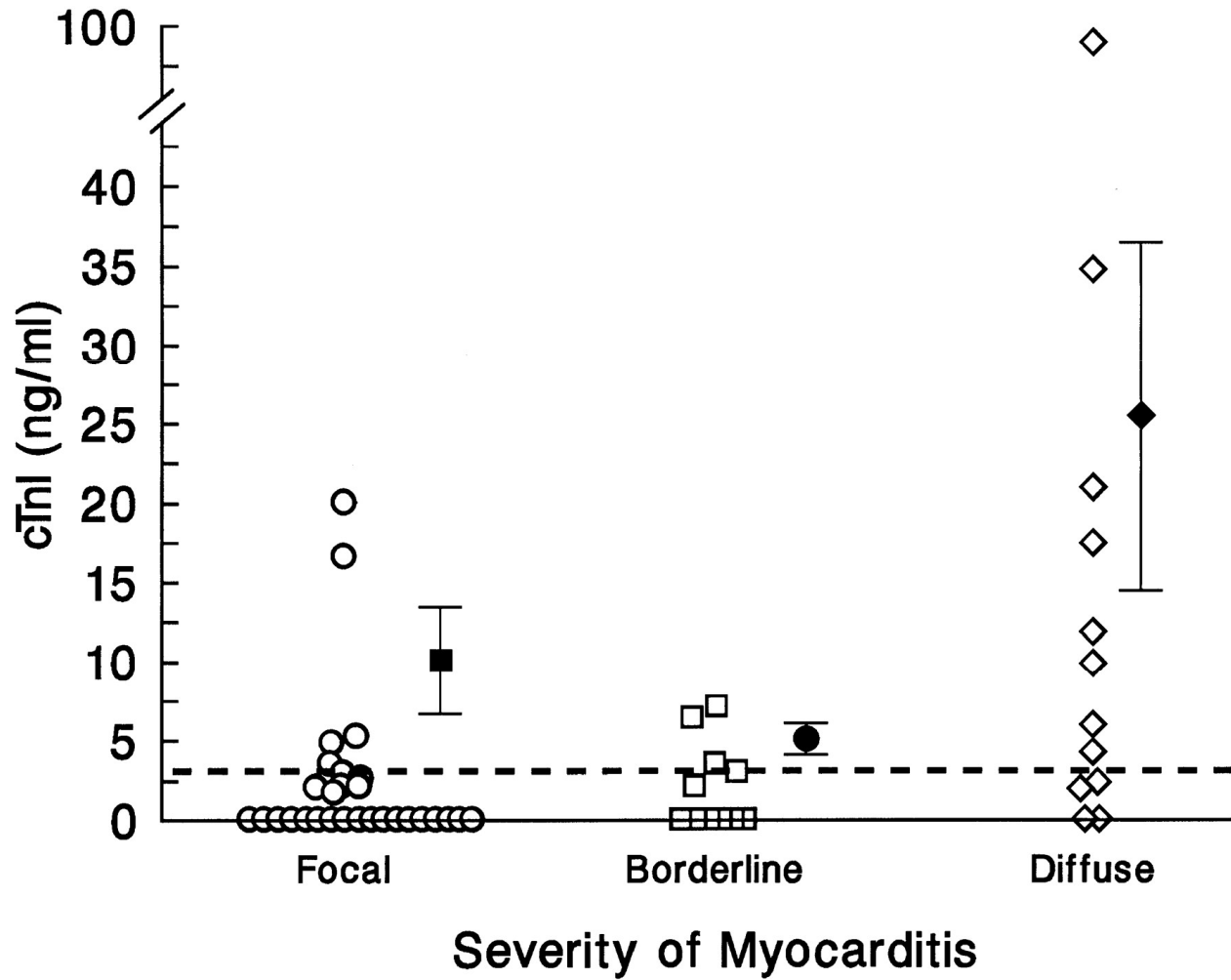




Laboratory Findings



Biology: Troponin (Smith, Circ, 97)





Many patients with
acute/fulminant myocarditis
will undergo
coronary artery angiography...



Other laboratory findings

- Non specific tests
 - Leucocytosis/leucopenia, Eosinophilia+++
 - Mononucleosic syndrome
 - Sedimentation rate, CRP, PCT...
- Specialized tests
 - Virological diagnosis
 - Serology (limited value)
 - Cultures: throat and stools
 - PCR (blood, CSF, tissues)
 - Inflammation:
 - Antinuclear Ab, ANCA, Angiotensin Conversion Enzyme
- Research tests
 - Autoantibodies (mitochondria, myosin, β -receptor)
 - Immunohistochemical myocardial studies (research)



Doppler Echocardiography



Echocardiographic Findings in Fulminant and Acute Myocarditis

G. Michael Felker, MD,* John P. Boehmer, MD, FACC,*‡ Ralph H. Hruban, MD,†

JACC Vol. 36, No. 1, 2000
July 2000:227-32

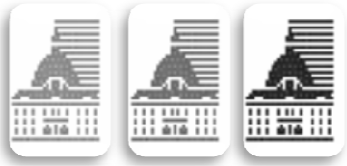
- Fulminant myocarditis
 - Markedly decreased LV EF
 - *Near normal LV dimension*
 - *Increased septal thickness*
- Acute myocarditis
 - Markedly decreased LV EF
 - *Dilated LV*
 - *Normal septal thickness*



Doppler Echocardiography

○ Other findings

- Regional wall motion abnormalities
- Diastolic dysfunction
- Change in echocardiographic image texture:
 - Increased brightness
 - Heterogeneity
- Thrombi
- Pericardial effusion



Cardiac MRI...

The new diagnostic gold standard?



Cardiac MRI

- Combination of
 - T1-weighted and T2-weighted
 - Gadolinium contrast-enhanced MRI +++
- Visualize localization, activity and extent of inflammation
 - One or several foci in the myocardium
 - Foci most frequently located in lateral free wall
 - Frequent subepicardial lesions
 - Can guide myocardial biopsies+++



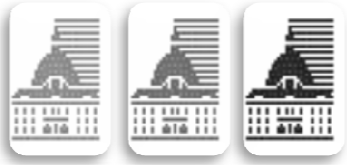
Cardiovascular Magnetic Resonance Assessment of Human Myocarditis

A Comparison to Histology and Molecular Pathology

Circulation

March 16, 2004





Still indication for
myocardial biopsies?

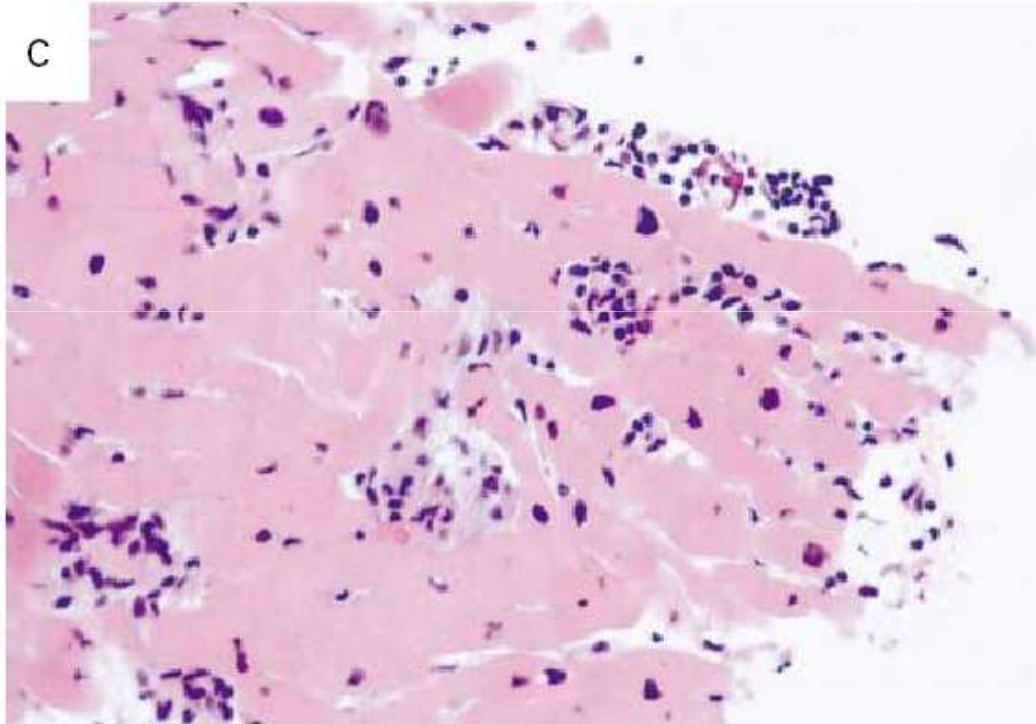


Histology: Dallas Criteria

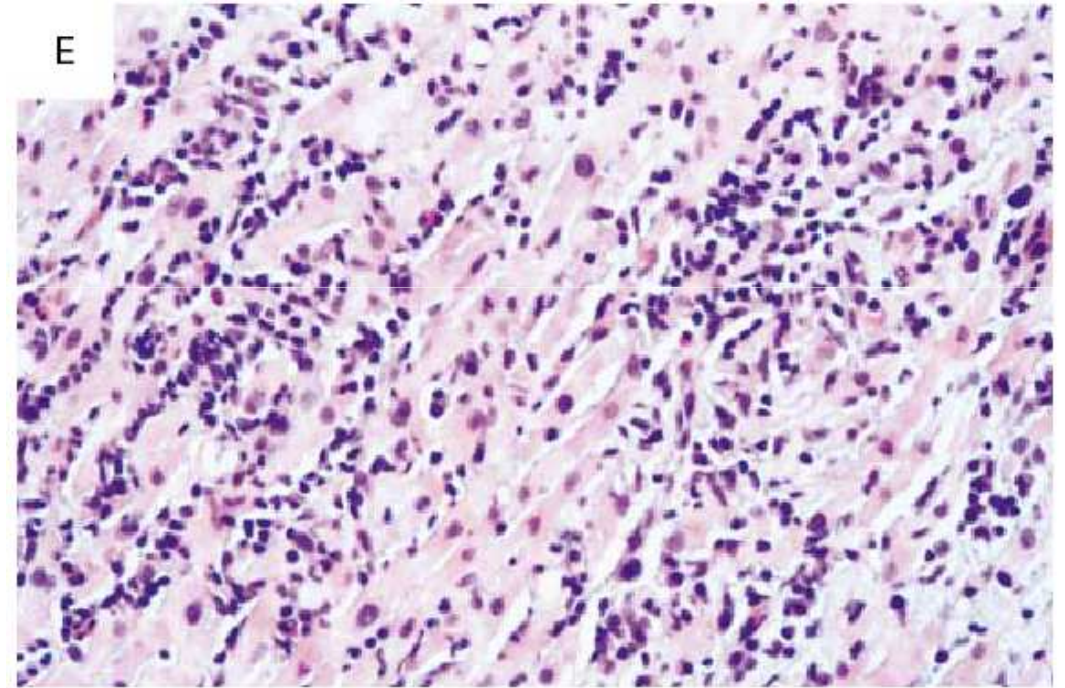
- 3 histological grades (*Aretz, Hum Pathol, 87*)
 - Active Myocarditis :
 - *Cellular infiltrate +, myocyte necrosis +*
 - Borderline Myocarditis :
 - *Cellular infiltrate +, myocyte necrosis -*
 - Negative Biopsy :
 - *Cellular infiltrate -, myocyte necrosis -*
- Distribution and diffusion of the cellular infiltrate
 - Focal, confluent or diffuse
 - Mild, moderate, severe
- However, low to moderate sensitivity/specificity



Histology: Dallas Criteria



Borderline



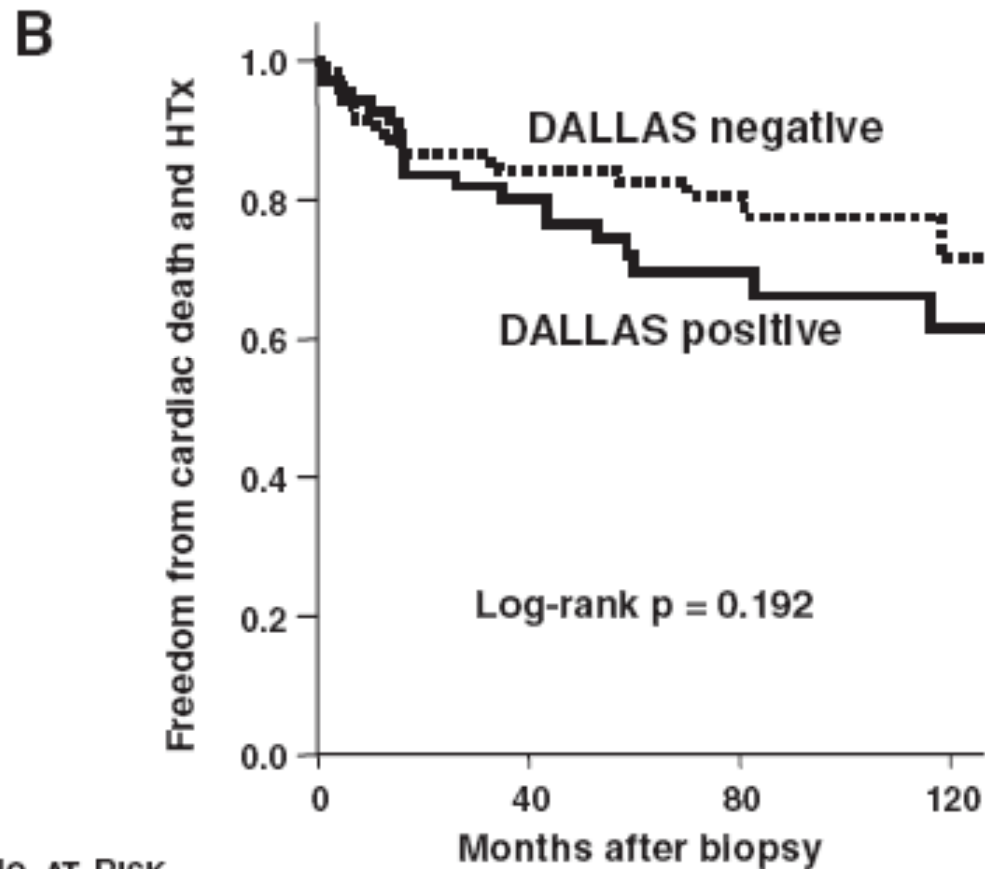
Active



Predictors of Outcome in Patients With Suspected Myocarditis

Ingrid Kindermann, MD; Michael Kindermann, MD; Reinhard Kandolf, MD; Karin Klingel, MD;
Burkhard Bültmann, MD; Thomas Müller; Angelika Lindinger, MD; Michael Böhm, MD

Circulation. 2008;118:639-648.



NO. AT RISK

DALLAS negative	112	71	27	12
DALLAS positive	69	44	20	13

AHA/ACCF/ESC Scientific Statement

The Role of Endomyocardial Biopsy in the Management of Cardiovascular Disease

A Scientific Statement From the American Heart Association, the American College of Cardiology, and the European Society of Cardiology

Circulation 2007;116:2216-2233

Table 2. The Role of Endomyocardial Biopsy in 14 Clinical Scenarios

Scenario Number	Clinical Scenario	Class of Recommendation (I, IIa, IIb, III)	Level of Evidence (A, B, C)
1	New-onset heart failure of <2 weeks' duration associated with a normal-sized or dilated left ventricle and hemodynamic compromise	I	B
2	New-onset heart failure of 2 weeks' to 3 months' duration associated with a dilated left ventricle and new ventricular arrhythmias, second- or third-degree heart block, or failure to respond to usual care within 1 to 2 weeks	I	B
3	Heart failure of >3 months' duration associated with a dilated left ventricle and new ventricular arrhythmias, second- or third-degree heart block, or failure to respond to usual care within 1 to 2 weeks	IIa	C
4	Heart failure associated with a DCM of any duration associated with suspected allergic reaction and/or eosinophilia	IIa	C
5	Heart failure associated with suspected anthracycline cardiomyopathy	IIa	C
6	Heart failure associated with unexplained restrictive cardiomyopathy	IIa	C
7	Suspected cardiac tumors	IIa	C
8	Unexplained cardiomyopathy in children	IIa	C
9	New-onset heart failure of 2 weeks' to 3 months' duration associated with a dilated left ventricle, without new ventricular arrhythmias or second- or third-degree heart block, that responds to usual care within 1 to 2 weeks	IIb	B
10	Heart failure of >3 months' duration associated with a dilated left ventricle, without new ventricular arrhythmias or second- or third-degree heart block, that responds to usual care within 1 to 2 weeks	IIb	C
11	Heart failure associated with unexplained HCM	IIb	C
12	Suspected AF/VT/C	IIb	C
13	Unexplained ventricular arrhythmias	IIb	C
14	Unexplained atrial fibrillation	III	C

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2	New-onset heart failure of 2 weeks' to 3 months' duration associated with a dilated left ventricle and new	I	B

Grade 1, Level B:

New-onset heart failure of <2 weeks' duration associated with a normal-sized or dilated left ventricle and hemodynamic compromise

New-onset heart failure of 2 weeks' to 3 months' duration associated with a dilated left ventricle and new ventricular arrhythmias, second- or third-degree heart block, or failure to respond to usual care within 1 to 2 weeks

11	Heart failure associated with unexplained HCM	IIb	C
12	Suspected AF/VT/C	IIb	C
13	Unexplained ventricular arrhythmias	IIb	C
14	Unexplained atrial fibrillation	III	C



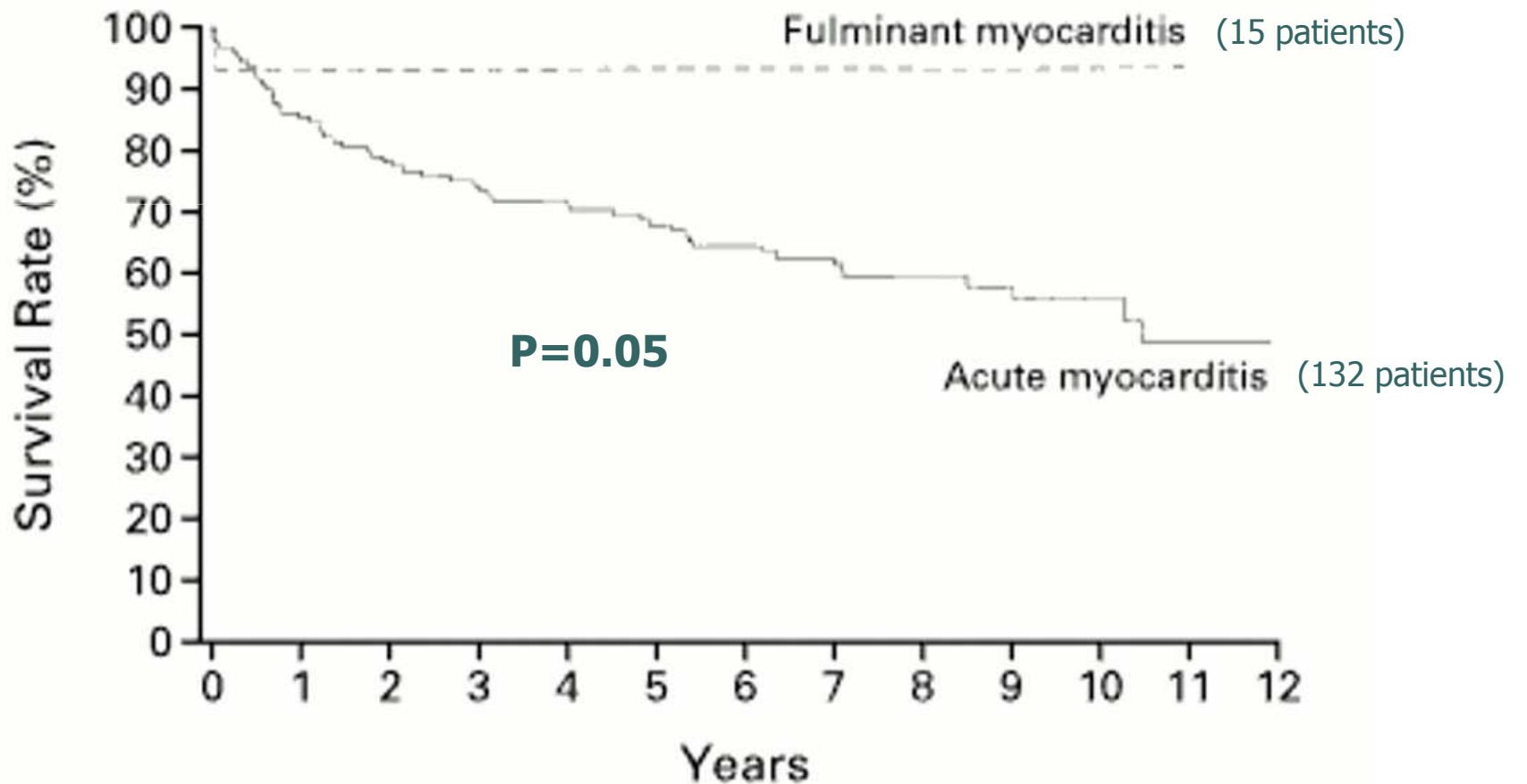
Prognosis



Prognosis

McCarthy, NEJM, 2000

Survival without transplantation

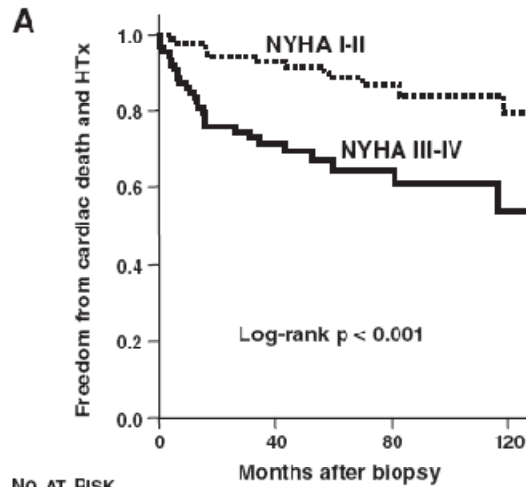




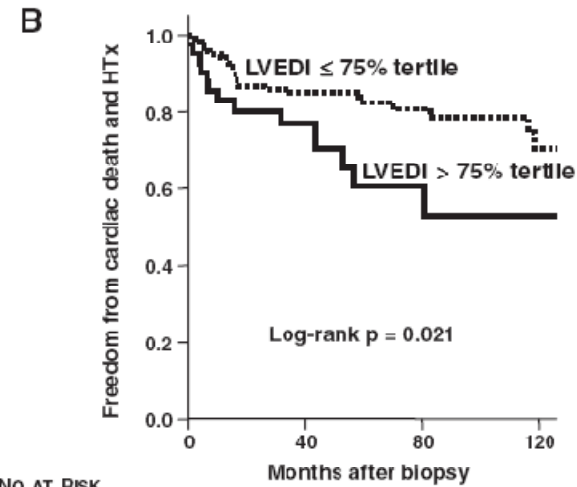
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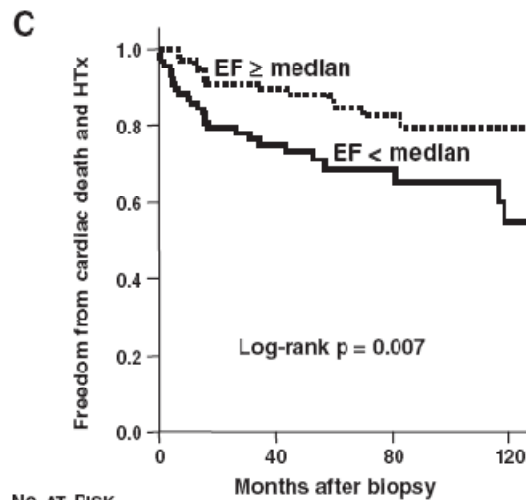
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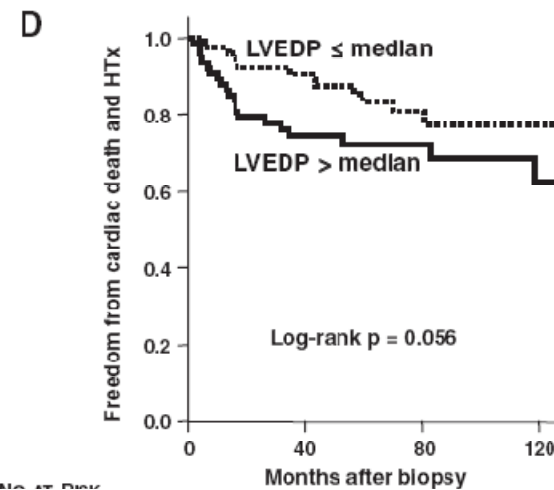
No. AT RISK				
NYHA III	91	72	30	18
NYHA III-IV	90	43	17	7



No. AT RISK				
LVEDI \leq 75% tertile	127	87	37	17
LVEDI $>$ 75% tertile	42	24	8	7



No. AT RISK



No. AT RISK



Outcomes, long-term quality of life, and psychologic assessment of fulminant myocarditis patients rescued by mechanical circulatory support

Mariana Mirabel, MD; Charles-Edouard Luyt, MD, PhD; Pascal Leprince, MD, PhD;
Jean-Louis Trouillet, MD; Philippe Léger, MD; Alain Pavie, MD; Jean Chastre, MD; Alain Combes, MD, PhD

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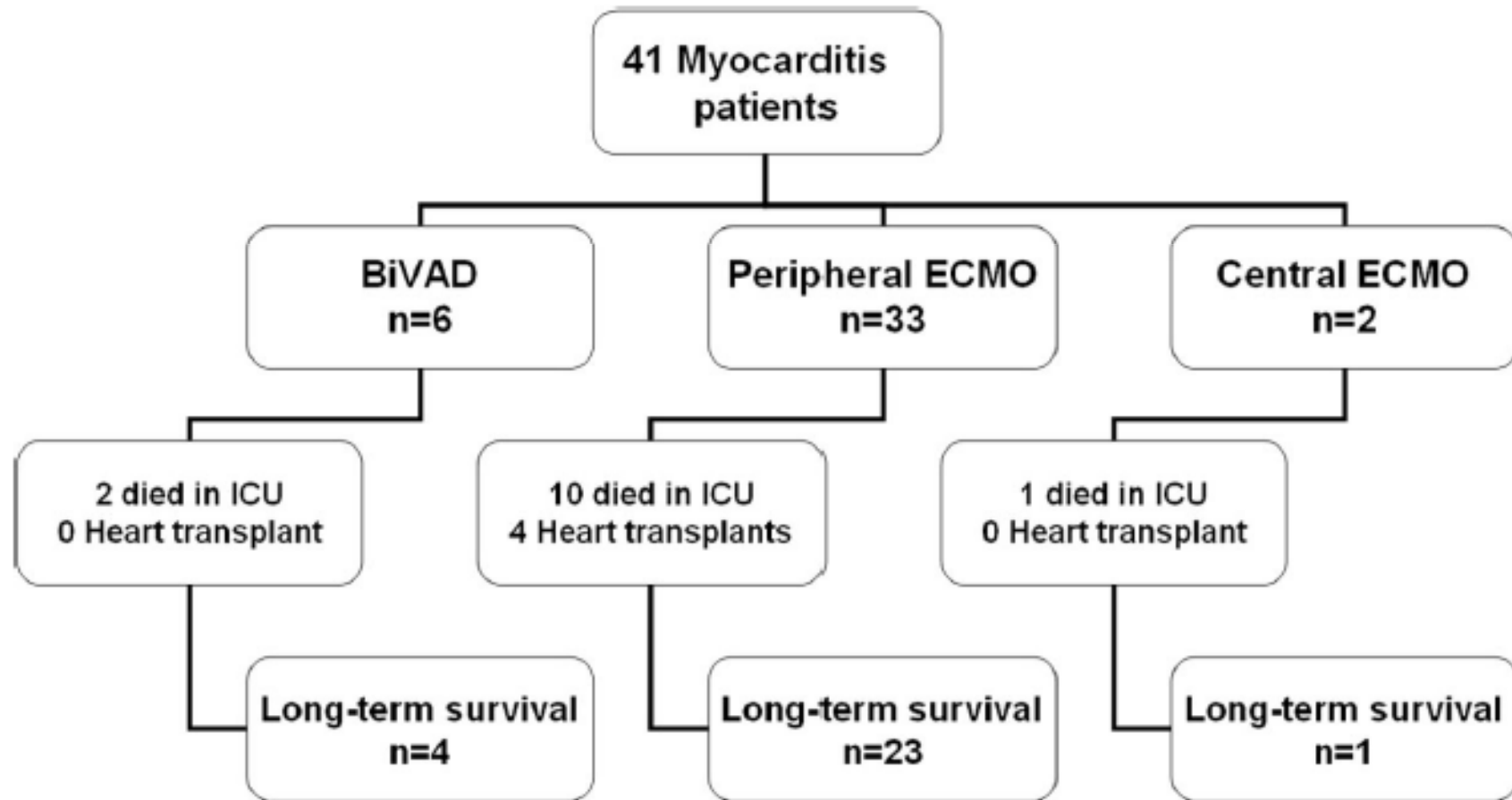
- 2003 - 2009
- 41 patients refractory cardiogenic shock due to fulminant myocarditis
 - Mean age 38 ± 12 years
 - 66%, women
- Mechanical assistance
 - Thoratec BiVAD (n=6) or
 - ECMO (n=35)



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41 Myocarditis patients

Long term survival: 68%

4 (10%) patients had heart transplantation

**Independent predictors of ICU death determined at admission:
SAPS II >56 (OR, 10.23) and troponin Ic >12 microg/L (OR, 7.49)**

Long-term survival
n=4

Long-term survival
n=23

Long-term survival
n=1



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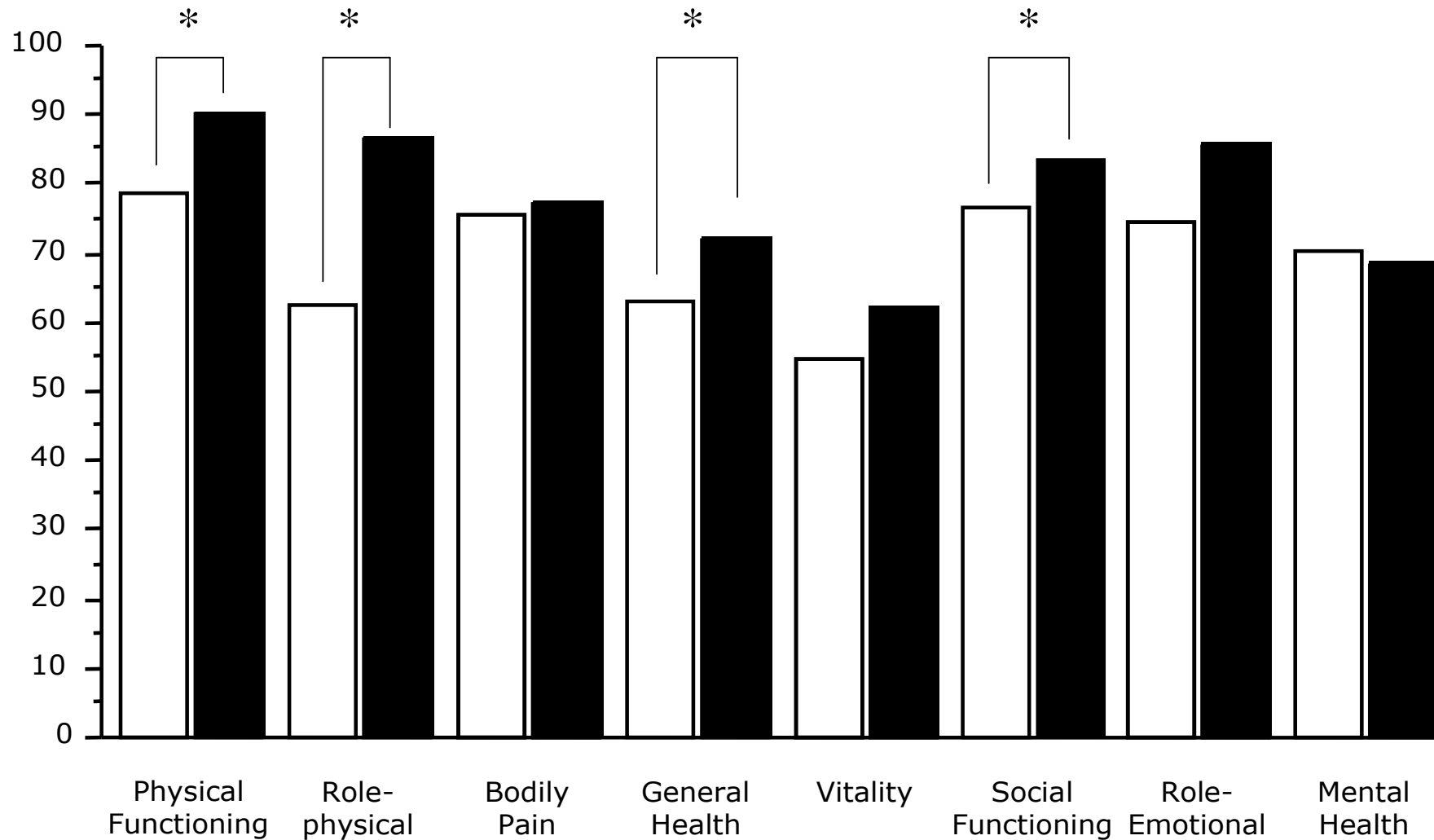
- Complete follow-up for 26 survivors
- Median follow-up was 525 [92–2400] days
- Mean LVEF was $57 \pm 9\%$
 - $\geq 60\%$ for 12 non-transplant and all 4 transplanted
 - 40–60% for 10 nontransplanted survivors
- 21 patients had percutaneous femoral ECMO
 - 10 still complained of paresthesia/peripheral neurological defect
 - 2 had persistent leg ischemia requiring surgical repair for 1 and amputation for the other



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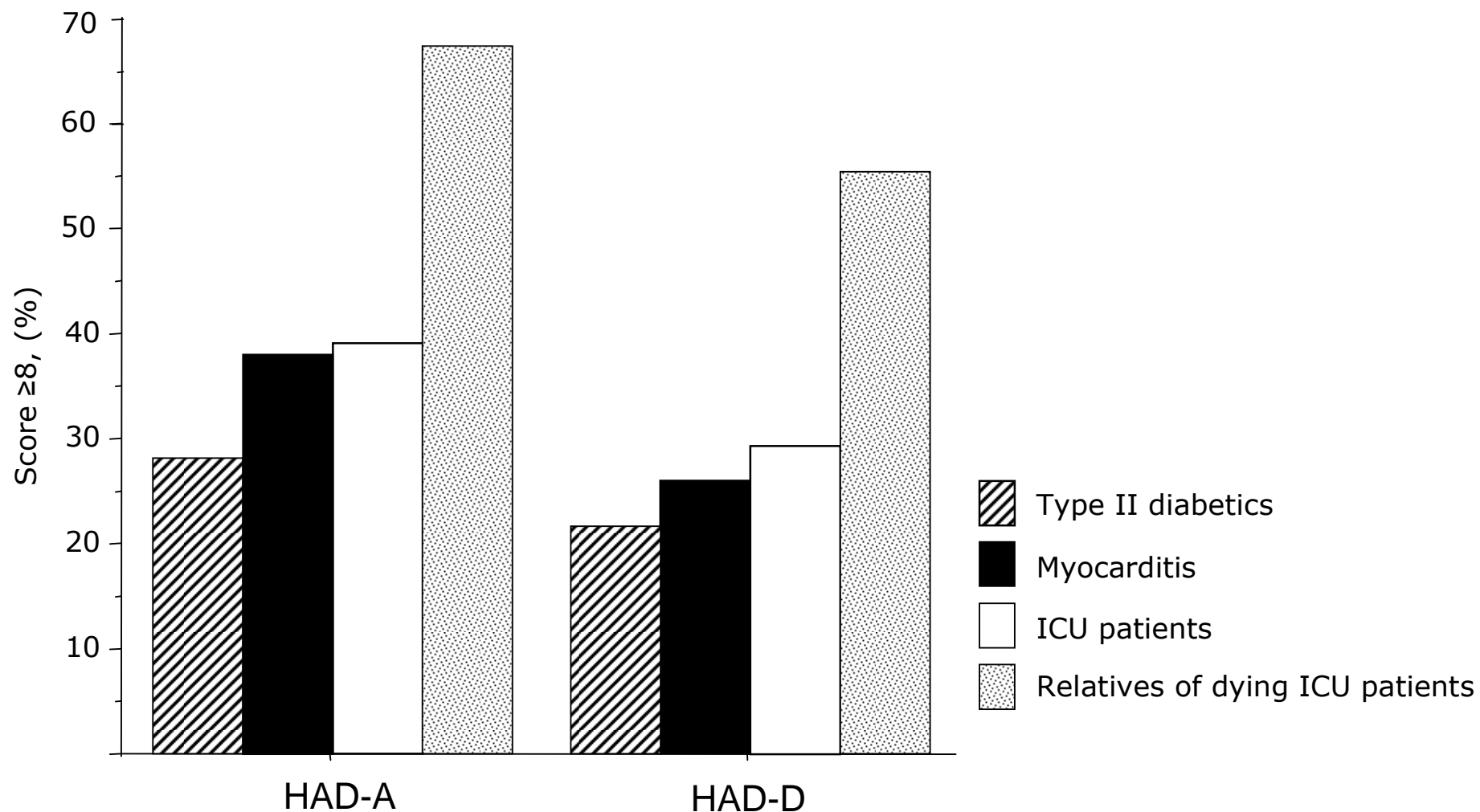




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EDITOR'S
CHOICE

Development of diastolic heart failure in a 6-year follow-up study in patients after acute myocarditis

Felicitas Escher,¹ Dirk Westermann,¹ Regina Gaub,¹ Johannes Pronk,¹ Thomas Bock,² Nidal Al-Saadi,³ Uwe Kühl,¹ Heinz-Peter Schultheiss,¹ Carsten Tschöpe^{1,4}

See Editorial, p 685

¹Department of Cardiology and Pneumology, Charité—University Medicine Berlin, Campus Benjamin Franklin, Berlin, Germany

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Heart 2011;97:709–714

ABSTRACT

Background The aim of this study was to analyse the long-term prognosis of patients with acute myocarditis (AMC) who had been discharged from hospital while having normal left ventricular (LV) function.

Methods and results 50 patients with acute myocarditis who underwent endomyocardial biopsies (EMBs) were prospectively studied. Their clinical condition was examined during a mean follow-up period of 72 (54–78) months, including tissue Doppler imaging (TDI). 4% (2/50) died, and 6% (3/50) developed dilated cardiomyopathy. 45/50 (90%) showed a normal or improvement in LV function over time. In the course of the follow-up, 49% (22/45) suffered from heart failure symptoms despite a normal ejection fraction (HFNEF). This was associated with an abnormal E/A ratio, an impaired deceleration time of early mitral flow velocity and isovolumic relaxation time, and a pathological increase in the LV filling index E/E' , in contrast to patients without heart failure symptoms (E/E'_{septal} 10.9 (9.3–13.8) vs 6.8 (6.4–9.1); $p=0.001$). Plasma N-terminal proB-type natriuretic peptide levels were increased threefold in patients with HFNEF (19.9 (10.6–24.1) vs 7.3 (4.2–11.9) pmol/l; $p=0.006$).

Conclusions It is assumed that the evidence for AMC is associated not only with the risk of developing LV dilatation but also with an increased risk of symptomatic diastolic dysfunction after several years.

recover fully over time or whether their morbidity is still compromised after years has not yet been clarified. Thus, definitive data of patients with AMC are lacking concerning the prediction of the long-term clinical prognosis and the identification of distinct aetiopathogenetic subsets based on endomyocardial biopsies (EMBs).

Therefore, we investigated the long-term follow-up and prognosis of patients after AMC.

METHODS

Patients

The study subjects consisted of 50 consecutive patients (37 males, 13 females) admitted to our institute from January 1995 to November 2004. In detail, the tentative, clinically suspected diagnosis of AMC was ascertained in patients who had presented with a very recent onset of congestive heart failure symptoms, with an abrupt onset of complaints such as angina or dyspnoea, and any infarct-like presentation such as elevated serum markers of myocardial injury (troponin T and creatine kinase/creatin kinase-MB) and/or newly developed ECG changes (ST-segment elevation or T wave inversion). No patient was included with previously known cardiomyopathy or a family history of cardiomyopathy. Exclusion criteria were antiviral, immunomodulatory or immunosuppressive therapy within the last 6 months, clinical or biochemical evidence



See Editorial, p 685

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Conclusions It is assumed that the evidence for AMC is associated not only with the risk of developing LV dilatation but also with an increased risk of symptomatic diastolic dysfunction after several years.

6-year myocarditis

C¹, Thomas Bock,² Tschöpe^{1,4}

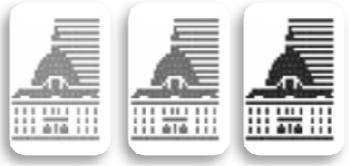
Whether their morbidity over years has not yet been established in a meta-analysis of patients with acute myocarditis and the prediction of the long-term outcome and the identification of prognostic subsets based on endomyocardial biopsies (EMBs).

the long-term follow-up after acute myocarditis (AMC).

Of 50 consecutive patients (ages 18–65) admitted to our institution from January to November 2004. In 2004, 10 patients suspected diagnosis of acute myocarditis who had presented with acute onset of congestive heart failure, chest pain, and any infarct-like ECG changes (elevated serum markers of troponin T and creatine kinase-myocardial band (CK-MB) newly developed ECG changes (ST-segment depression or T wave inversion)). In 10 patients with previously known acute myocarditis and history of cardiomyopathy, 10 patients were antineoplastic, immunosuppressive therapy within

diastolic dysfunction after several years.

modality of immunosuppressive therapy within the last 6 months, clinical or biochemical evidence



Treatment



Treatment

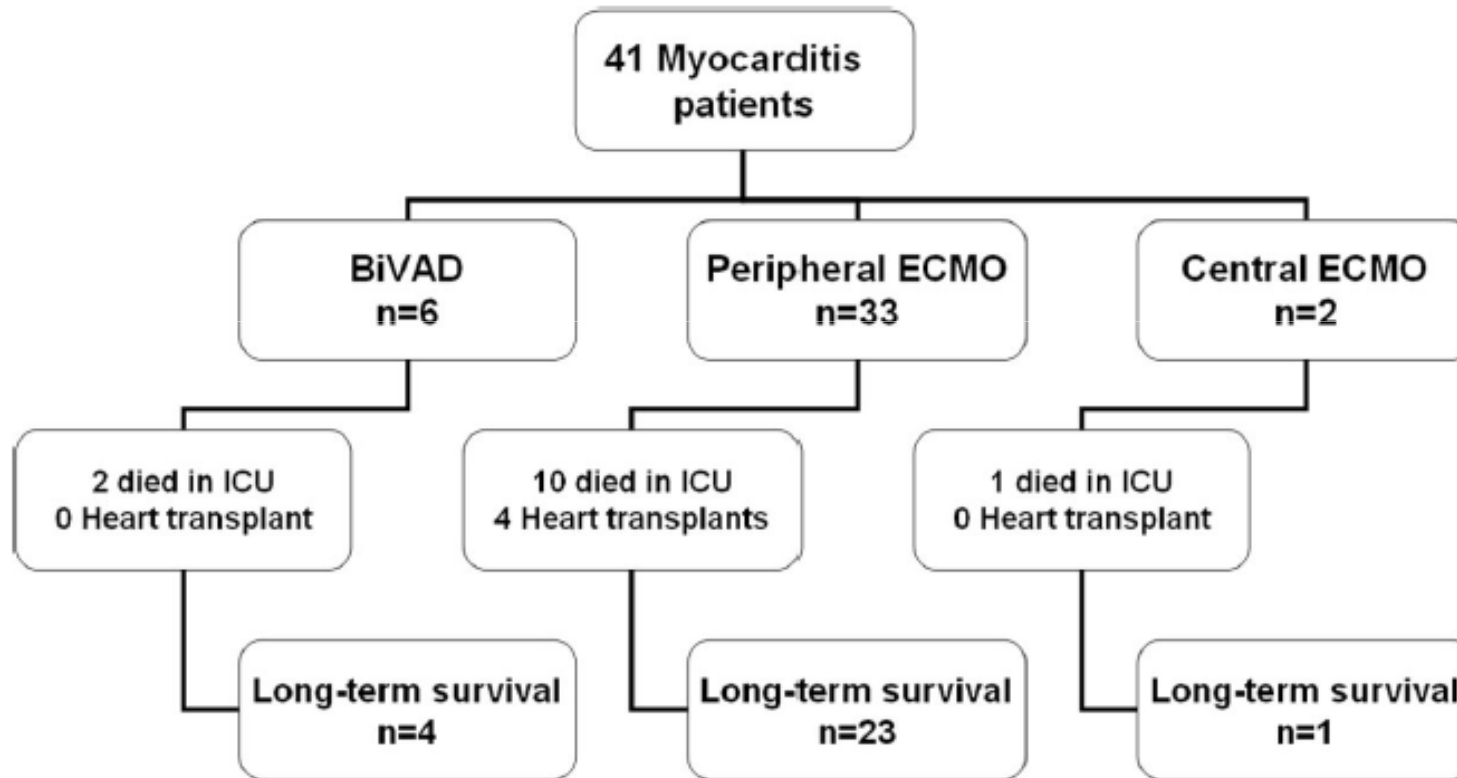
- Supportive care always indicated
 - Bed rest, Diuretics, vasodilators
 - ACE inhibitors, angiotensin-receptor blockers
 - Aldosterone antagonists
 - β -blockers, (with caution in the acute phase)
 - Immunosuppressors if specific disease
 - Vasopressors/inotropic agents in case of shock
- Mechanical assistance +++
 - May be urgently needed if fulminant form or rapid deterioration of hemodynamic status
 - Patients should rapidly be transferred to experienced centers
 - Bridge to recovery:
 - ECMO+++, First line assistance
 - (Heart transplantation)



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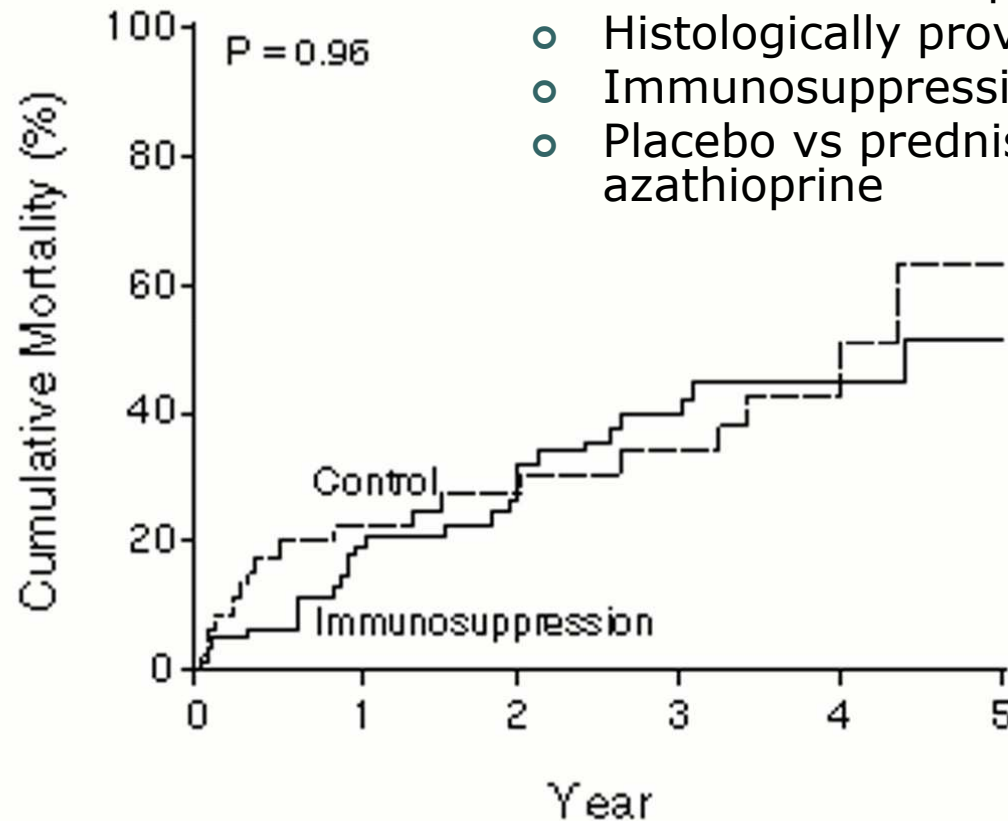


Long term survival: 68%, 4 (10%) patients had heart transplantation
Independent predictors of ICU death determined at admission:
SAPS II >56 (OR, 10.23) and troponin Ic >12 g/L (OR, 7.49)



Myocarditis Treatment Trial

- 111 randomized patients, LVEF < 45%
- Histologically proven myocarditis
- Immunosuppression protocol
- Placebo vs prednisone + Cyclosporine or azathioprine



Mason, NEJM, 1995

Immuno-suppression	64	49	37	23	12	0
Control	47	32	23	16	6	0

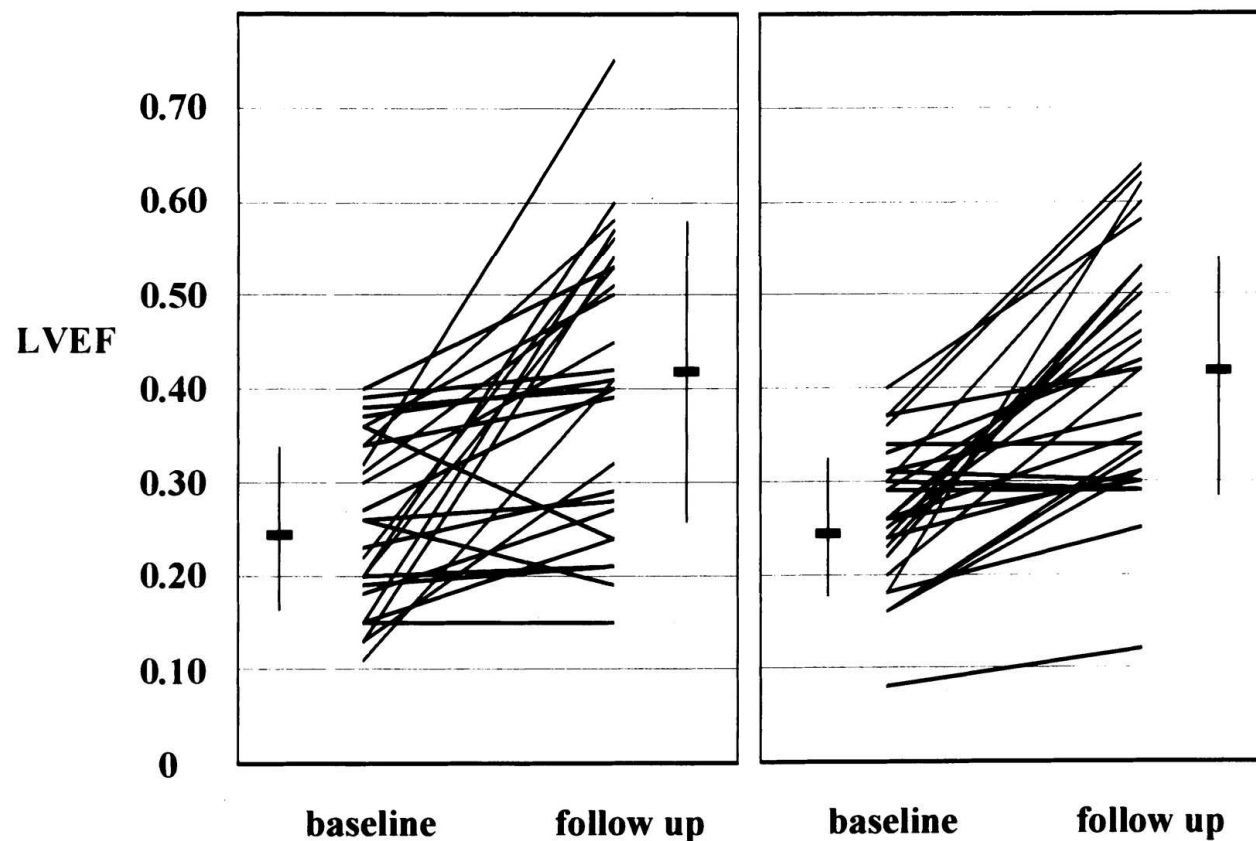


IV immune globulin

McNamara, Circ, 2001

*Conventional therapy plus
Placebo*

*Conventional therapy plus
Immune Globulin*



- 62 patients with DCM, randomized, LVEF < 40%
- Placebo vs IVIg
- P = NS



Specific/Novel treatments

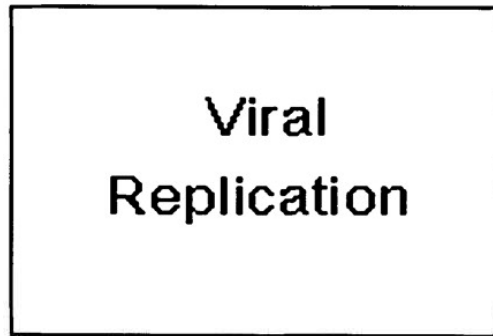
- Immunosuppression
 - First line therapy if
 - Giant cell
 - Systemic autoimmune diseases
 - Corticosteroids
 - Cyclosporine, Tacrolimus
 - Azathioprine
- Immunomodulation/Stimulation
 - IV Immune globulins
 - Interferon
- Antiviral agents, vaccination



Tailored immune-modulating strategies

Liu, Circ, 2001

Phase I

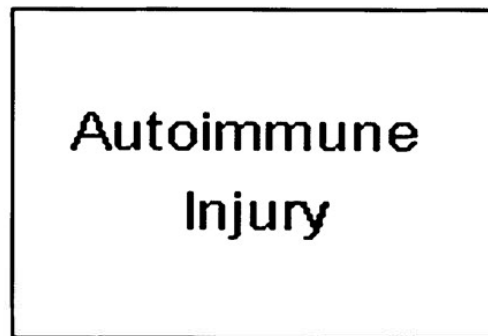


Diagnosis:
Virus detection

Treatment:
Antiviral
Immune support



Phase II

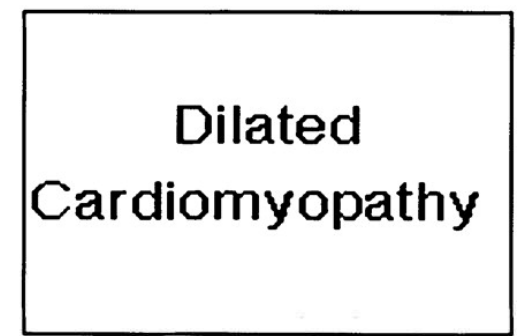


Diagnosis:
Biopsy
Immune markers

Treatment:
Immune suppression



Phase III



Diagnosis:
Imaging
Rule out

Treatment:
ACEI
 β -blocker



Immunomodulation vs Immunosuppression

- β -Interferon for patients with entero-adenovirus myocardial persistence
 - *Kuhl, Circ, 2003*
 - 22 patients, LV Dysfunction, viral genome +
 - Interferon: virus clearance, improved LVEF
- Immunosuppressants: prednisone+imurel
 - *Frustaci, Circ, 03*
 - 41 patients, active myocarditis, LV Dysfunction
 - 21 responders, 20 non responders
 - Responders: AutoAb +, viral genome -
 - *Wojnicz, Circ 01*
 - 84 patients DCM, HLA overexpressed on myocytes
 - Treatment 3 months
 - EF improvement in treated patients: 71% vs 31%



Evaluation of Bromocriptine in the Treatment of Acute Severe Peripartum Cardiomyopathy

A Proof-of-Concept Pilot Study

Karen Sliwa, MD, PhD; Lori Blauwet, MD; Kemi Tibazarwa, MD; Elena Libhaber, PhD; Jan-Peter Smedema, MD, MMed(Int); Anthony Becker, MD; John McMurray, MD, FESC; Hatice Yamac, MD; Saida Labidi, MSc; Ingrid Struhman, PhD; Denise Hilfiker-Kleiner, PhD

Background—Peripartum cardiomyopathy (PPCM) is a potentially life-threatening heart disease that occurs in previously healthy women. We identified prolactin, mainly its 16-kDa angiostatic and proapoptotic form, as a key factor in PPCM pathophysiology. Previous reports suggest that bromocriptine may have beneficial effects in women with acute onset of PPCM.

Methods and Results—A prospective, single-center, randomized, open-label, proof-of-concept pilot study of women with newly diagnosed PPCM receiving standard care (PPCM-Std; n=10) versus standard care plus bromocriptine for 8 weeks (PPCM-Br, n=10) was conducted. Because mothers receiving bromocriptine could not breast-feed, the 6-month outcome of their children (n=21) was studied as a secondary end point. Blinded clinical, hemodynamic, and echocardiographic assessments were performed at baseline and 6 months after diagnosis. Cardiac magnetic resonance imaging was performed 4 to 6 weeks after diagnosis in PPCM-Br patients. There were no significant differences in baseline characteristics, including serum 16-kDa prolactin levels and cathepsin D activity, between the 2 study groups. PPCM-Br patients displayed greater recovery of left ventricular ejection fraction (27% to 58%; $P=0.012$) compared with PPCM-Std patients (27% to 36%) at 6 months. One patient in the PPCM-Br group died compared with 4 patients in the PPCM-Std group. Significantly fewer PPCM-Br patients (n=1, 10%) experienced the composite end point of poor outcome defined as death, New York Heart Association functional class III/IV, or left ventricular ejection fraction <35% at 6 months compared with the PPCM-Std patients (n=8, 80%; $P=0.006$). Cardiac magnetic resonance imaging revealed no intracavitary thrombi. Infants of mothers in both groups showed normal growth and survival.

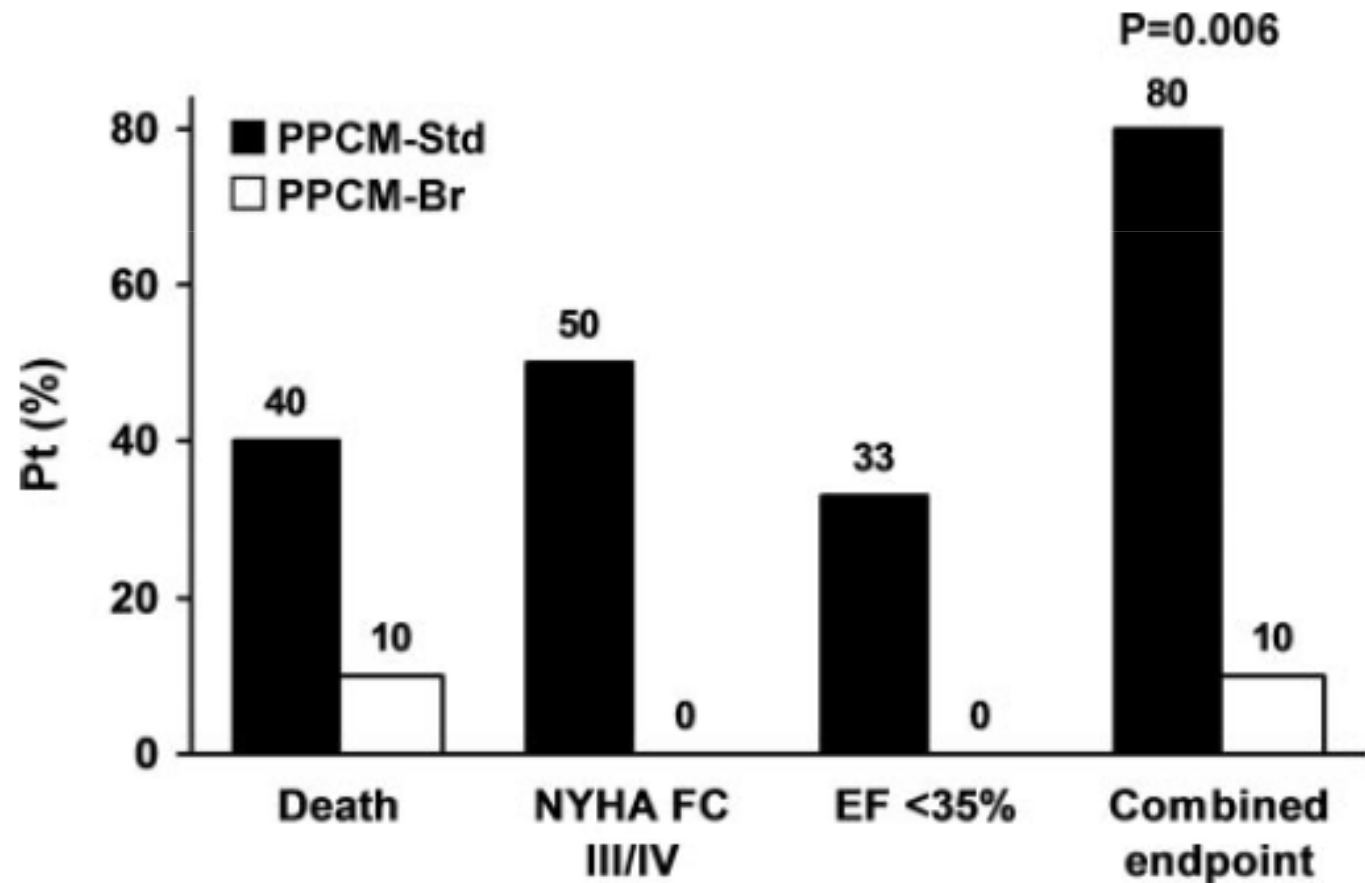
Conclusions—In this trial, the addition of bromocriptine to standard heart failure therapy appeared to improve left ventricular ejection fraction and a composite clinical outcome in women with acute severe PPCM, although the number of patients studied was small and the results cannot be considered definitive. Larger-scale multicenter and blinded studies are in progress to test this strategy more robustly. (*Circulation*. 2010;121:1465-1473.)



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EDITOR'S
CHOICE

Early treatment with clarithromycin attenuates rat autoimmune myocarditis via inhibition of matrix metalloproteinase activity

Keiichi Hishikari,¹ Ryo Watanabe,² Masahito Ogawa,² Jun-ichi Suzuki,² Mayumi Masumura,¹ Tomoko Shimizu,³ Kiyoshi Takayama,³ Yasunobu Hirata,² Ryozo Nagai,⁴ Mitsuaki Isobe¹

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See Editorial, p494

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ABSTRACT

Background Matrix metalloproteinase (MMP) activity is upregulated in the hearts with myocarditis, and its activation contributes to the changes in left ventricular function. A major macrolide antibiotic, clarithromycin (CAM), has many biological functions including MMP regulation. However, little is known about the effect of CAM in myocarditis via MMPs.

Objective To clarify the role of MMPs regulated by CAM in the progression of myocarditis.

Design CAM was given to experimental rats with autoimmune myocarditis (EAM) from day -7 to day 21 (early treated group, n=6) or from day 1 to day 21 (late treated group, n=6) twice a day.

Results Although the non-treated rats showed blood pressure decline and impaired cardiac function, early CAM treatment prevented this progression.

Pathologically, severe myocardial cell infiltration (30.5±4.2%) and fibrosis (32.2±1.1%) were detected in the non-treated group, while early CAM treatment significantly suppressed these changes (infiltration 6.5±0.2%, fibrosis 5.9±3.9%). Zymography showed that non-treated EAM resulted in enhanced ventricular activities of MMP-9, while early CAM treatment reduced the alteration. However, late CAM treatment was less effective than the early treatment.

Conclusions Early CAM treatment is effective to attenuate myocarditis by suppressing MMP-9.

is an important event in the process of inflammation and tissue remodelling. A member of the MMPs, MMP-9 (gelatinase B), has an important role in tissue remodelling and the migration of smooth muscle cells, macrophages and other cells.⁸

Clarithromycin (CAM) is a 14-member ring macrolide and a potent antibiotic for the treatment of various microbial infections. CAM has been reported to have multiple biological effects, such as alteration of inflammatory factors and MMPs.^{9,10} Although we have shown that CAM suppresses cardiac rejection using murine heart transplant models,¹¹ little is known about the effects of CAM in myocarditis.

This study, for the first time, demonstrates that CAM suppresses acute myocarditis through the inhibition of MMP-9 expression and activity.

MATERIALS AND METHODS

Reagents and animals

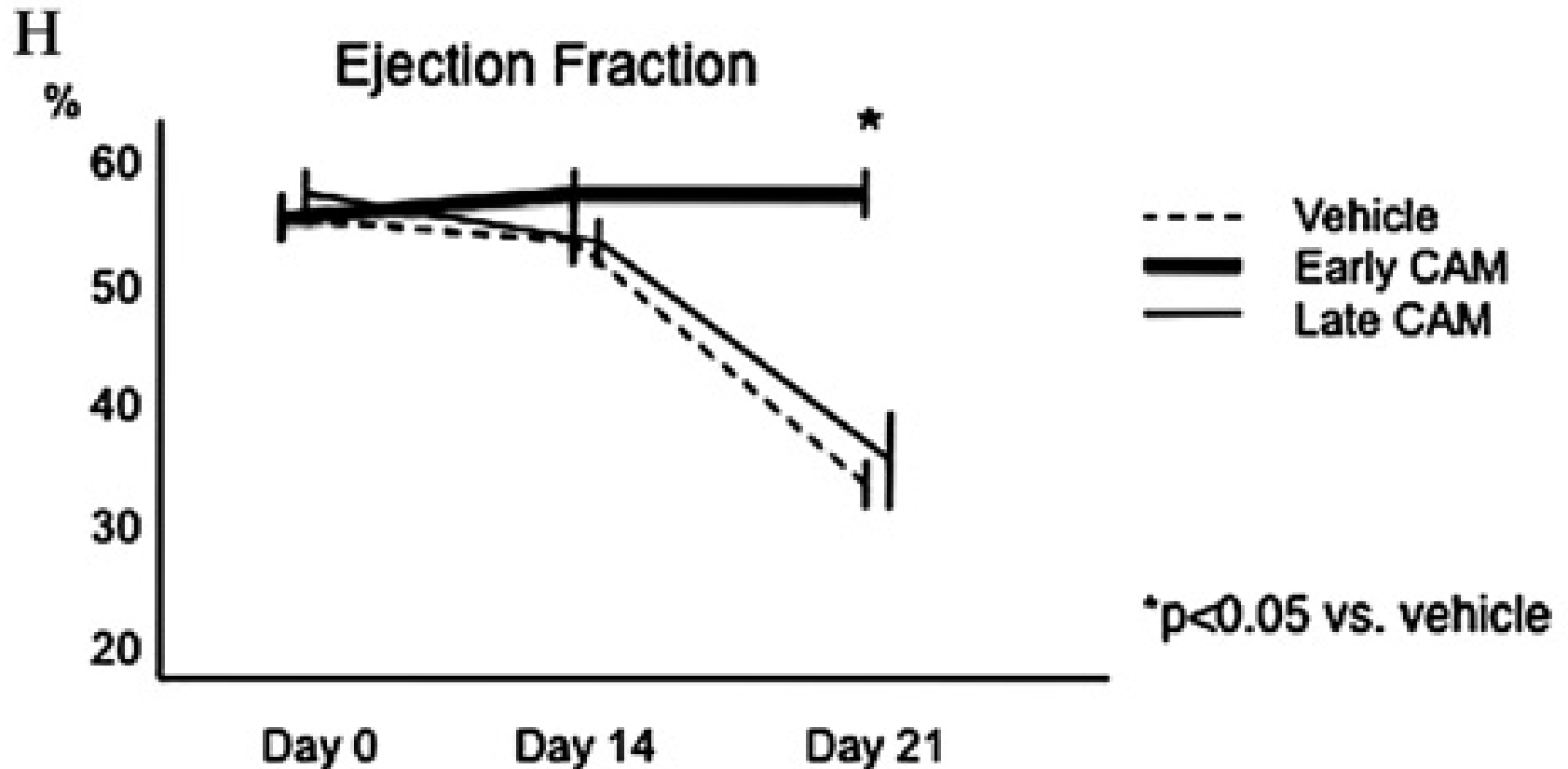
CAM was kindly provided by Taisho Toyama Pharmaceutical (Tokyo, Japan). Male Lewis rats (6 weeks old, 200–250 g) were purchased from Sankyo Laboratories (Tokyo, Japan). Rats were given CAM (100 mg/kg/day) orally twice a day. We selected the dose for rats based on our previous paper.¹¹ Rats with EAM were divided into three groups: (a) early treated group (from day -7 to day 21, n=6); (b) late treated group (from day 1 to day 21, n=6) or (c) vehicle (untreated group, n=6) for



Early treatment with clarithromycin attenuates rat autoimmune myocarditis via inhibition of matrix metalloproteinase activity

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Regulatory T Cells Protect Mice Against Coxsackievirus-Induced Myocarditis Through the Transforming Growth Factor β -Coxsackie-Adenovirus Receptor Pathway

Yu Shi, PhD; Masahiro Fukuoka, PhD; Guohua Li, PhD; Youan Liu, MD; Manyin Chen, MD;
Michael Konviser, MSc; Xin Chen, MD; Mary Anne Opavsky, MD, PhD; Peter P. Liu, MD

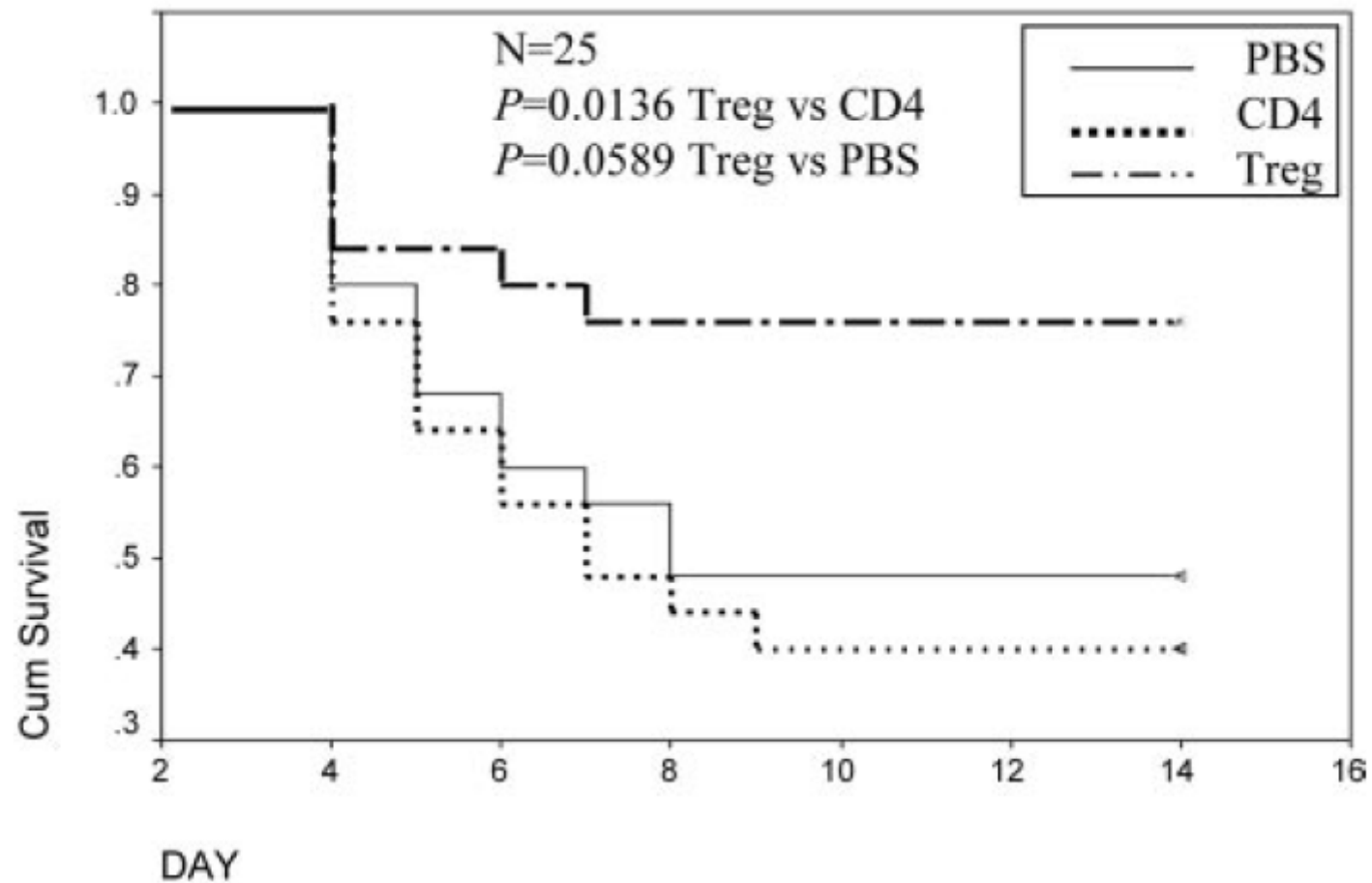
Background—Coxsackievirus B3 infection is an excellent model of human myocarditis and dilated cardiomyopathy. Cardiac injury is caused either by a direct cytopathic effect of the virus or through immune-mediated mechanisms. Regulatory T cells (Tregs) play an important role in the negative modulation of host immune responses and set the threshold of autoimmune activation. This study was designed to test the protective effects of Tregs and to determine the underlying mechanisms.

Methods and Results—Carboxyfluorescein diacetate succinimidyl ester-labeled Tregs or naïve CD4⁺ T cells were injected intravenously once every 2 weeks 3 times into mice. The mice were then challenged with intraperitoneal coxsackievirus B3 immediately after the last cell transfer. Transfer of Tregs showed higher survival rates than transfer of CD4⁺ T cells ($P=0.0136$) but not compared with the PBS injection group ($P=0.0589$). Interestingly, Tregs also significantly decreased virus titers and inflammatory scores in the heart. Transforming growth factor- β and phosphorylated AKT were upregulated in Tregs-transferred mice and coxsackie-adenovirus receptor expression was decreased in the heart compared with control groups. Transforming growth factor- β decreased coxsackie-adenovirus receptor expression and inhibited coxsackievirus B3 infection in HL-1 cells and neonatal cardiac myocytes. Splenocytes collected from Treg-, CD4⁺ T-cell-, and PBS-treated mice proliferated equally when stimulated with heat-inactivated virus, whereas in the Treg group, the proliferation rate was reduced significantly when stimulated with noninfected heart tissue homogenate.

Conclusions—Adoptive transfer of Tregs protected mice from coxsackievirus B3-induced myocarditis through the transforming growth factor β -coxsackie-adenovirus receptor pathway and thus suppresses the immune response to cardiac tissue, maintaining the antiviral immune response. (*Circulation*. 2010;121:2624-2634.)



Regulatory T Cells Protect Mice Against Coxsackievirus-Induced Myocarditis Through the Transforming Growth Factor β -Coxsackie-Adenovirus Receptor Pathway



Red Wine May be Used in the Therapy of Myocarditis

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ABSTRACT

Myocarditis is one of the most commonly cardiovascular diseases in clinical practice, but the treatment is always limited at present. Considering the multifactorial etiology of myocarditis, a novel therapeutic agent with multi-bioactivities should be presented. Red wine has been recognized as a favorable natural medicine against a large number of pathologic conditions. Recent results indicate that red wine could effectively decrease inflammatory factors secretion, reduce the migration of neutrophils, antagonize oxidation, and regulate immunity. By these bioactivities of anti-inflammation, anti-oxidation, and immunomodulation, red wine may be an effective therapeutic candidate to manage the symptoms and prevent the recurrence of myocarditis. *J. Cell. Biochem.* 111: 808–810, 2010. © 2010 Wiley-Liss, Inc.



Conclusion

- Myocarditis is a rare and severe condition
 - Especially the fulminant form
- Diagnosis based on clinical features, EKG, Echo, Troponin, MRI
 - Myocarditis can mimic acute coronary syndromes
- Mechanical circulatory assistance may be urgently needed if rapid hemodynamic deterioration
- Immunosuppression during the acute phase
 - Giant cell
 - Systemic autoimmune diseases
- Significant progresses in the understanding of the pathophysiology of the disease in recent years
 - Help design tailored immune-modulating strategies



La Pitié: 1612 to 2012...

