

50th Anniversary

36th International Congress on Electrocardiology

50th International Symposium on Vectorcardiography

Final Program & Abstracts

24 - 27 June, 2009
Wrocław, Poland



Under the honorary patronage of:
Rector of Wrocław Medical University
Polish Society of Internists
Noninvasive Electrocardiology and Telemedicine
Section of Polish Cardiac Society
Polish Family Medicine Society

PROGRAM AT GLANCE

WEDNESDAY, JUNE 24, 2009

16:00–18:00	Registration (Congress Venue: Mercure-Panorama Hotel)
18:00–19:00	Opening Ceremony (Aula Leopoldinum: Wrocław University)
19:00–21:00	Welcome Reception (Aula Leopoldinum: Wrocław University)

THURSDAY, JUNE 25, 2009

	HALL A	HALL B	HALL C
8:45–9:00	Welcome Address <i>P. Macfarlane, ISE President</i>		
9:00–10:30	Historical Session <i>P. Macfarlane</i>	Standaryzacja opisów EKG – dyskusja na wybranych problemach (sesja SENiT) <i>R. Baranowski, R. Piotrowicz, K. Wranicz</i> (in Polish)	
10:30–11:00		Coffee Break	
11:00–11:30	A. Bayes de Luna <i>Rijlant Lecture</i> The contribution of vectorcardiography for understanding electrocardiography: clinical point of view		
11:30–12:00	G. Schmidt <i>Keynote Lecture</i> Risk stratification in post-infarction patients with preserved left ventricular function		
12:00–12:30	Y. Birnbaum <i>Keynote Lecture</i> Differentiating between non-ischemic ST elevation and ST elevation in acute myocardial infarction		
12:30–13:30		Lunch Break	POSTERS 1
13:30–15:00	Young Investigators' Award <i>M. Hiraoka</i>	Telemedycyna w kardiologii (sesja SENiT) <i>R. Piotrowicz, W. Zareba</i> (in Polish)	
15:00–15:30		Coffee Break	
15:30–17:00	Heart Repolarization <i>G. Wagner, Y. Birnbaum, R. Piotrowicz</i>	Miscellaneous <i>L. Bacharova, B. Gorenek, C. Pastore</i>	
17:00–18:30	Myocardial necrosis – from ECG to magnetic resonance (ISHNE Session) <i>A. Bayes de Luna, R. Baranowski, Ł. Malek</i>		
21:00–23:0		„Wrocław by night” tour	

FRIDAY, JUNE 26, 2009

	HALL A	HALL B	HALL C
9:00–10:30	ISHNE Session Novel Concepts and Applications in Electrocardiology <i>W. Zareba, G. Schmidt</i>	Warsztaty interpretacji EKG <i>D. Kozłowski</i> (in Polish)	
10:30–11:00		Coffee Break	
11:00–12:30	Holter Monitoring/HRV <i>P. Macfarlane, P. Ponikowski</i>	Heart Modeling <i>A. van Oosterom, G. Wagner</i>	
12:30–13:30	Lunch Break	ICE Council Meeting	
13:30–15:00	Czy jest jeszcze miejsce dla leków antyarytmicznych w leczeniu migotania przedsionków? <i>W. Banasiak, P. Ponikowski, A. Fuglewicz</i> (in Polish)		POSTERS 2
15:00–15:30		Coffee Break	
15:30–17:00	Clinical Electrophysiology: Arrhythmias & Devices <i>A. Baranchuk, K. Łoboz-Grudzień, W. Banasiak</i>	Aktualny stan prewencji choroby sercowo-naczyniowej w Polsce <i>D. Czarnicka, J. Adamus</i> (in Polish)	
19:00–24:00		Farewell Dinner & Disco	

SATURDAY, JUNE 27, 2009

	HALL A	HALL B	HALL C
9:00–10:30	Atrial fibrillation – theory and clinical aspects <i>A. van Oosterom, A. Baranchuk</i>		
10:30–11:00		Coffee Break	
11:00–12:30	BSPM/Conduction disturbances <i>L. De Ambroggi, J. Liebman, M. Tysler</i>		
12:30 - 13:30	ISE Annual General Meeting YIA Outcomes CLOSING CEREMONY		

The Organizing Committee of the 36th International Congress on Electrocardiology would like to express a gratitude to the industry partners for supporting the meeting.

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The Young Investigators' Award Competition is sponsored by Draeger Medical

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Welcome Address

Dear Colleagues,

We feel greatly honoured to welcome you to the 36th International Congress on Electrocardiology joint with the 50th International Symposium on Vectorcardiography which this year takes place in Wrocław. The city of Wrocław deserves a name of the cradle of international meetings gathering scientists dealing with various aspects of electrocardiology. During the Congress, we are celebrating the 50th anniversary of the First Symposium on Vectorcardiography, which was organized in Wrocław in 1959 year by Professors Hugon and Zofia Kowarzyk.

The First Symposium had initiated the successive meetings held then annually as Colloquia Vectorcardiographica, of which three took place in Poland again (1960, 1962, 1969), alternatively with the meetings organized in Czechoslovakia by Professor Ivan Ruttkay-Nedecky. Later, according to the resolution signed in Yerevan (Armenia), the meetings were transformed into international congresses on electrocardiology.

The 36th International Congress on Electrocardiology, held under the auspices of the International Society of Electrocardiology, covers a broad spectrum of electrocardiology issues, from basic cell processes to clinical, modern applications. The participants can take an excellent opportunity to learn the state-of-art lectures, present the own latest research results as well to exchange experiences during both the plenary debates and more private talks.

I do hope the anniversary Congress will be a very special event because of the exciting scientific program, a presence of spirit of history and a charming summer atmosphere of the city of Wrocław that is an unique multicultural metropolis situated at the interface of ethnically diverse areas offering a great number of touristic attractions.

We cordially wish all the participants the fruitful discussions, joyful social life and unforgettable memories of the sojourn in Wrocław.

Józef Jagielski
Honorary President of the Congress

Powitanie

Szanowni Państwo,

Z wielką radością witamy wszystkich uczestników i gości 36. Międzynarodowego Kongresu Elektrokardiologii połączonego z 50. Międzynarodowym Sympozjum Wektokardiografii.

Będzie to wydarzenie szczególne z powodu obchodów półwiecza, jakie mija od Pierwszego Sympozjum Wektokardiografii zorganizowanego w 1959 roku na Akademii Medycznej we Wrocławiu przez Profesorów Hugona Kowarzyka i Zofię Kowarzykową. Pierwsze Sympozjum zainicjowało tradycję corocznych interdyscyplinarnych spotkań badaczy pasjonujących się elektrokardiologią - lekarzy, fizyków, biofizyków i matematyków. Spotkania te nosiły najpierw nazwę Colloquia Vectorcardiographica, a w 1974 roku zostały przekształcone w Międzynarodowe Kongresy Elektrokardiologii.

Jesteśmy przekonani, że 36. Międzynarodowy Kongres Elektrokardiologii, zorganizowany pod auspicjami Międzynarodowego Towarzystwa Elektrokardiologii, stanie się forum debaty nad różnorodnymi aspektami elektrokardiologii, od podstawowych procesów komórkowych po nowoczesne zastosowania kliniczne. Uczestnicy Kongresu mają doskonałą okazję do zapoznania się z wykładami wybitnych naukowców, zaprezentowania własnych osiągnięć oraz wymiany doświadczeń naukowych zarówno podczas dyskusji plenarnych, jak i kameralnych rozmów w trakcie spotkań towarzyskich.

Mamy szczerą nadzieję, że interesujący program naukowy jubileuszowego Kongresu, jak również wyjątkowa letnia atmosfera i atrakcje Wrocławia zapewnią Państwu miły pobyt i niezapomniane wrażenia.

Małgorzata Sobieszczkańska
President of the Congress



Akademia Medyczna im. Piastów Śląskich
R-BOR/5/17/R/2009 Rektor Wrocław, 20 maja 2009 r.

**Szanowna Pani
prof. dr hab. Małgorzata Sobieszcańska
Kierownik Zakładu Elektrokardiologii
i Prewencji Chorób Sercowo-Naczyniowych**

Szanowna Pani Profesor,

Uprzejmie dziękuję za zaproszenie do wzięcia udziału w 36 Międzynarodowym Kongresie Elektrokardiologii.

Cieszę się, że miasto Wrocław zostało wybrane jako miejsce organizacji tego prestiżowego Kongresu, choć nie jest to wybór będący dziełem przypadku.

Tegoroczny Kongres organizowany pod auspicjami Międzynarodowego Towarzystwa Elektrokardiologii odbywa się w 50-tą rocznicę Pierwszego Międzynarodowego Sympozjum Wektokardiografii, którego obrady toczyły się w naszej Uczelni z inicjatywy prof. Hagona Kowarzyka i prof. Pier'a Rijanta z Belgii w 1959 roku.

Od tego czasu przeszliśmy długą drogę. Wówczas przed półwieczem nasz kraj był za „żelazną kurtyną”, a w tym roku świętował 5-cio lecie swojego członkostwa w Unii Europejskiej.

Należy docenić inicjatorów tego Pierwszego Sympozjum, którzy w tak trudnym politycznie okresie udowodniali, że nauka nie ma granic, a jej osiągnięcia powinny służyć z pożytkiem wszystkim mieszkańcom naszej planety.

Wydział Lekarski Postępu 1, 50-367 WROCLAW, tel. 071 794 9100, fax 071 794 01 06, e-mail: sekretariat@am.wroc.pl

Rektor Akademii Medycznej im. Piastów Śląskich we Wrocławiu

W Kongresie biorą udział m.in. naukowcy z USA, Turcji, Chorwacji, Libanu, Szwecji.

Jestem przekonany, że Kongres okaże się ważnym wydarzeniem naukowym dobrze promującym Wrocław, naszą Uczelnię i dokonania jej akademickiej kadry naukowo-dydaktycznej.

Wszystkim uczestnikom Kongresu życzę owocnych obrad, ciekawych referatów, pogłębienia zasobu posiadanej wiedzy, także dzięki możliwości bezpośredniej wymiany doświadczeń, jaką stwarza to Sympozjum, a także wielu miłych wrażeń z pobytu w pięknym nadodrzańskim grodzie Wrocławia.

Łączę wyrazy powatania i serdecznie pozdrawiam

LETTER FROM:

Ryszard Andrzejak - Rector of Wrocław Medical University

Departament Prezydenta

Urząd
miasta
wrocławia



Wrocław, 4 maja 2009 r.
BPR.ZOA.0730-100/09

**Pani
dr hab. med. Małgorzata Sobieszcańska
Prezydent 36. Międzynarodowego
Kongresu Elektrokardiologii**

W imieniu Prezydenta Wrocławia, Pana Rafała Dutkiewicza, serdecznie dziękuję za informację na temat 36. Międzynarodowego Kongresu Elektrokardiologii. Ze względu na wyjątkowo prestiżową rangę spotkania oraz udział wielu naukowców i lekarzy z kraju i zagranicy Pan Prezydent przyjmuje zaproszenie do objęcia Patronatem Honorowym tego sympozjum. Wierzy również, że wrocławskie osiągnięcia w dziedzinie elektrokardiologii zostaną dostrzeżone, a miasto zyska na promocji.

Pan Prezydent przesyła wszystkim uczestnikom obrad życzenia owocnej dyskusji.

Łączę wyrazy szacunku,

Marcin Szlachetko
Zastępca Dyrektora Biura Prezydenta

LETTER FROM:

Rafał Dutkiewicz - Mayor of Wrocław

COUNCIL OF THE INTERNATIONAL SOCIETY OF ELECTROCARDIOLOGY

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P. Macfarlane	United Kingdom
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M. Tysler	Slovakia

LOCAL ORGANIZING COMMITTEE

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President of the Congress

Małgorzata Sobieszczkańska

Honorary President of the Congress

Józef Jagielski



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Wojciech Zareba, Rochester, USA

Congress Scientific Secretariat:

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Nowowiejska 38, 50-315 Wrocław, Poland
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E-mail: biuro@inspirecongress.pl



Congress Venue

Mercure Panorama Hotel
Plac Dominikański 1
50-159 Wrocław
Poland



Registration Desk

Registration Desk will be operating, as follows:

24 June, Wednesday: 16:00-18:00

25 June, Thursday: 8:00-17:00

26 June, Friday: 8:00-17:00

27 June, Saturday: 8:00-13:00

The all Congress Halls (A, B, C) are situated on Level 2.

Oral Presentations

All speakers giving a presentation in the plenary sessions are requested to upload and review their presentations 2 hours before the session in the Speakers' Room located on Level 2.

Multimedia System (LCD - projector and PC) will be available in the lecture halls. Presentations should be prepared in PPT format and presented on CD or Flash card.

Poster Presentations

Posters will be presented in the two sessions:

Poster Session 1 – Hall C

June 25, Thursday

The all posters should be on display between 09:00 and 17:00 and removed till 17:30

Poster Session 2 – Hall C

June 26, Friday

The all posters should be on display between 09:00 and 17:00 and removed till 17:30

The posters' presenters must be available throughout the all coffee breaks (10:30-11:00 and 15:00-15:30) in order to discuss the poster.

A reference number of each poster will be use to mark the presentation board.

Material for mounting a poster to the poster board will be supplied by the organizers. Please, ask the congress staff in the poster area for any assistance.

Congress Papers

The Congress papers are to be published in the book "Electrocardiology'2009", which will have been shipped to the participants of the Congress before the end 2009 year.

Only active participants of the 36. International Congress of Electrocardiology, i.e., the lecturers, speakers of the plenary sessions and the presenters of the posters, are allowed to submit the manuscripts to the Organizers.

Length of the manuscripts: up to 6 pages, including 2-3 figures and 1 table.

Language of the papers: English.

Submission manner: by e-mail malsobie@poczta.onet.pl or biuro@inspirecongress.pl

Submission term: from 1 June to 30 August, 2009.

Membership of the International Society of Electrocardiology

Membership Forms will be available at the Registration Desk.

Please, fill in the form and then return it to:

Prof. P.W. Macfarlane, Electrocardiology, Cardiovascular and Medical Sciences, Level 4, QEB Royal Infirmary, Glasgow G31 2ER, Scotland

Note: A membership fee is 25 USD – paid only one time!

More about the International Society of Electrocardiology on:

www.electrocardiology.org



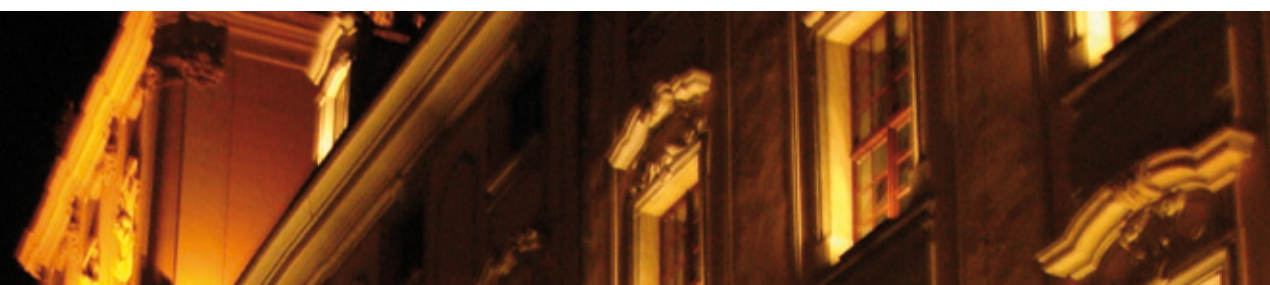
SOCIAL EVENTS

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Wednesday, 24 June

Opening Ceremony and Welcome Reception in "Aula Leopoldinum" at Wroclaw University,
18:00–21:00



Thursday, 25 June

"Wroclaw by night" tour
21:00–23:00



Friday, 26 June

Farewell Dinner and Disco
19:00–24:00

Program for Accompanying Persons

Wednesday, 24 June

18:00–21:00 Opening Ceremony and Welcome Reception
in "Aula Leopoldinum" at Wroclaw University

Thursday, 25 June

9:00–12:00 Visit to the exhibition "Europe - it's our history" in the Cen-
tenial Hall and a walk to Japanese Garden

12:30–13:30 Lunch (Mercure Panorama Hotel)

21:00–23:00 „Wroclaw by night” – tour on foot

Friday, 26 June

10:00–12:00 Boat cruise on the Odra River and a walk to Botanic Garden

12:30–13:30 Lunch (Mercure Panorama Hotel)

15:00–17:00 Visit to "Panorama Raclawicka" and National Museum

19:00–24:00 Farewell Dinner and Disco

(Restaurant "Pivnica Świdnicka", Town Hall, Market Square)

Lunch will be served on Thursday and Friday from **12:30** to **13:30** in the
hotel restaurant on Level 1.

Hall A

8:45–9:00 Welcome Address

P.W. Macfarlane, ISE President (*United Kingdom*)

9:00–10:30 The International Society of Electrocardiology: 1959 - 2009. Historical ISE Session

Chairperson: P.W. Macfarlane (*United Kingdom*)

Speakers:

B. Görenek (*Turkey*), M. Sobieszczanska (*Poland*),
L. Bacharova (*Slovakia*), P. Macfarlane (*United Kingdom*), L. De Ambroggi
(*Italy*), M. Hiraoka (*Japan*), C.A. Pastore (*Brazil*), J. Liebman (*United States*)

10:30–11:00 Coffee Break

11:00–11:30 Rijlant Lecture

Chairperson: P.W. Macfarlane (*United Kingdom*)

The contribution of vectorcardiography for understanding electrocardiography: clinical point of view.

A. Bayes de Luna (*Spain*)

11:30–12:00 Keynote Lecture

Chairperson: W. Zareba (*United States*)

Risk stratification in post-infarction patients with preserved left ventricular function.

G. Schmidt (*Germany*)

12:00–12:30 Keynote Lecture

Chairperson: G. Wagner (*United States*)

Differentiating between non-ischemic ST elevation and ST elevation in acute myocardial infarction.

Y. Birnbaum (*United States*)

12:30–13:30 Lunch Break

13:30–15:00 Young Investigators' Award Competition

Chairperson: M. Hiraoka (*Japan*)

13:30–13:45 Physiotherapy and cardiac rhythm devices: a review of the current status. G. Digby (*Canada*)

(Ab. YIA-1)

13:45–14:00 Effect of passive smoking on heart rate and heart rate variability in healthy subjects. M. Poręba (*Poland*)

(Ab. YIA-2)

14:00–14:15 Electro-anatomical relationship in the hearts with primum atrial septal defect. N. Hakacova (*Slovakia*)

(Ab. YIA-3)

14:15–14:30 User-friendly software package for quantitative evaluation of HRV, TWA and HRT in ECGs. K. Kudryński

(*Poland*)

(Ab. YIA-4)

14:30–14:45 Improved assessment of arrhythmia vulnerability.

Z. Tarjanyi (*Hungary*)

(Ab. YIA-5)

14:45–15:00 Features of heart rate turbulence observed after double ventricular premature complex and ventricular tachycardia. A. Tsvetnikova (*Russia*) Cancelled

(Ab. YIA-6)

15:00–15:30 Coffee Break

15:30–17:00 Heart Repolarization

Chairpersons: G. Wagner (*United States*), Y. Birnbaum (*United States*), R. Piotrowicz (*Poland*)

15:30–15:45 Ventricular repolarization behavior of high performance athletes analyzed by body surface potential mapping in two different training regimens. C.A. Pastore (*Brazil*)

(Ab. O-01)

15:45–16:00 Repolarization duration as a prognostic marker of cardiac death in patients with anterior myocardial infarction treated with primary PCI results of prospective 36 months follow-up. K. Szydio (*Poland*)

(Ab. O-02)

16:00–16:15 Correlation between T-wave alternans and stress test and scintigraphic examination in patients with coronary artery disease. D. Janusek (*Poland*)

(Ab. O-03)

16:15–16:30 T wave amplitude after tilt testing is lower in vasovagal patients than in healthy controls. D. Zysko (*Poland*)

(Ab. O-04)

16:30–16:45 Increased QT intervals in diabetic subjects?

S. Perz (*Germany*)

(Ab. O-05)

16:45–17:00 Effects of right and left ventricular apical pacing on repolarization and hemodynamics of the canine heart.

A. S. Tsvetkova (*Russia*)

(Ab. O-06)

17:00–18:30 Myocardial necrosis – from ECG to magnetic resonance. ISHNE Session. A. Bayes de Luna (*Spain*), R. Baranowski (*Poland*), Ł. Małek (*Poland*)

Hall B

09:00–10:30 Standaryzacja opisów EKG – dyskusja na wybranych problemach. Sesja SENIT. R. Baranowski, R. Piotrowicz, K. Wranciz

09:00–09:30 Propozycja Amerykańskich Towarzystw Kardiologicznych w zakresie standaryzacji opisów EKG.

R. Baranowski

09:30–10:00 Jak opisywać zaburzenia przewodnictwa śródkomorowego – czy jest szansa na consensus? R. Piotrowicz

10:00–10:30 Ocena rozrusznika w zapisach EKG – czy uda się zunifikować nazewnictwo i zasady opisu? K. Wranciz

SCIENTIFIC PROGRAM

THURSDAY, 25 JUNE, 2009

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10:30–11:00 Coffee Break

12:30–13:30 Lunch Break

13:30–15:00 Telemedycyna w kardiologii. Sesja SENiT.

Chairpersons: R. Piotrowicz (*Poland*), W. Zareba (*United States*)

13:30–13:50 Tele-konsultacje elektrokardiograficzne – czy potrzebne, czy opłacalne? R. Baranowski

13:50–14:10 Inteligentne systemy tele-monitorowania ambulatoryjnego w diagnostyce i leczeniu zaburzeń rytmu.

R. Piotrowicz

14:10–14:25 Tele-monitoring pacjenta ze stymulatorem.

J.K. Wranicz

14:25–14:40 Tele-elektrokardiologa w rehabilitacji pacjentów z niewydolnością serca – doświadczenia własne. E. Piotrowicz

14:40–14:50 Praktyczna demonstracja zastosowania rozwiązań telemedycznych w Instytucie Kardiologii w Warszawie w ramach programu TeleInterMed. R. Piotrowicz, R. Baranowski

14:50–15:00 Dyskusja.

15:00–15:30 Coffee Break

15:30–17:00 Miscellaneous

Chairpersons: L. Bacharova (*Slovakia*), B. Görennek (*Turkey*), C.A. Pastore (*Brazil*)

15:30 - 15:45 Long term home continuous ECG telemonitoring (MedicAlgorithmics) in cardiological practice – preliminary results. R. Baranowski (*Poland*)

(Ab. O-07)

15:45–16:00 Atrial overdrive pacing in sleep apnea: a meta-analysis. G. Digby (*Canada*)

(Ab. O-08)

16:00–16:15 Assessment of deceleration and acceleration capacity in children with mitral valve prolapse.

P. Jankowska (*Poland*)

(Ab. O-09)

16:15–16:30 The content of elements in rainwater and its relation to the frequency of hospitalization for atrial fibrillation in Opole Voivodship, Poland, during 2000-2002. S. Tubek (*Poland*)

(Ab. O-10)

16:30–16:45 Which electrocardiographic criteria should be used in professional athletes to identify left ventricular hypertrophy?

N. Samesima (*Brazil*)

(Ab. O-11)

16:45–17:00 The QT interval and left ventricular hypertrophy in essential hypertension.

I. Mozos (*Romania*)

(Ab. O-12)

Hall C

9:00–17:00 Poster Session 1

The posters marked with the numbers from 1 to 28 will be presented in this session (see Abstracts P-01 – P-28).

Session Topics

ECG Monitoring: P-01 – P-07, Arrhythmias: P-08 – P-10, Heart Repolarization: P-11 – P-12, Cardioelectric field: P-13 – P-16, BSPM: P-17 – P-26, Varia: P-27 – P-28

SCIENTIFIC PROGRAM

FRIDAY, 26 JUNE, 2009

Hall A

9:00–10:30 Novel concepts and applications in electrocardiology. ISHNE Session. Chairpersons: W. Zareba (*United States*), G. Schmidt (*Germany*)

9:00–09:30 Repolarization morphology and dynamics: mechanisms and clinical applications W. Zareba (*United States*)

9:30–10:00 Evaluation of heart rate and its dynamicity in patients with chronic heart failure: overview of methods and their clinical applications. I. Cygankiewicz (*Poland*)

10:00–10:30 Heart rate asymmetry P. Guzik, J. Piskorski (*Poland*)

10:30–11:00 Coffee Break

11:00–12:30 Holter Monitoring/HRV

Chairpersons: P.W. Macfarlane (*United Kingdom*), P. Ponikowski (*Poland*)

11:00–11:15 Reduced number of heart rate deceleration runs predicts all-cause mortality in post-infarction patients.

P. Guzik (*Poland*), (Ab. O-13)

11:15–11:30 Assessment of the autonomic modulation of the cardiovascular system in children with mitral valve prolapse.

P. Jankowska (*Poland*), (Ab. O-14)

11:30–11:45 Assessment of sleep apnea risk factors frequency and Holter evaluated apnea/hipopnea index value in group of stable patients with systolic heart failure in NYHA class II and III comparing to control group. M. Dobosiewicz (Poland)
(Ab. O-15)

11:45–12:00 Software support for patient button in event- and interpretive Holter recorders. P. Augustyniak (Poland)
(Ab. O-16)

12:00–12:15 Diagnostic aspects of HRV. T. Niederl (Austria)
(Ab. O-17)

12:15–12:30 Plenary discussion

12:30–13:30 Lunch Break

12:30–13:30 ISE Council Meeting

13:30–15:00 Czy jest jeszcze miejsce dla leków antyarytmicznych w leczeniu migotania przedsionków?
Chairpersons: W. Banasiak, P. Ponikowski

13:30–14:00 Dlaczego warto rozmawiać o migotaniu przedsionków? W. Banasiak

13:00–14:30 Praktyczne aspekty postępowania diagnostyczno-terapeutycznego na różnych etapach historii naturalnej migotania przedsionków. A. Fuglewicz

14:30–15:00 Dronedaron – nadzieja w leczeniu migotania przedsionków. P. Ponikowski

15:00–15:30 Coffee Break

15:30–17:00 Clinical Electrophysiology: Arrhythmias & Devices
Chairpersons: A. Baranchuk (Canada), K. Łoboz-Grudzień (Poland), W. Banasiak (Poland)

15:30–16:00 The link between electrocardiology and clinical electrophysiology. A. Baranchuk (Canada)

16:00–16:10 Real-time MRI guided atrial ablation.
R. S. MacLeod (United States)
(Ab. O-21)

16:10–16:20 Interatrial block in patients with sleep apnea.
G. Digby (Canada)
(Ab. O-22)

16:20–16:40 Ventricular arrhythmias assessment in patients with heart failure before and after effective cardiac rehabilitation. E. Piotrowicz (Poland)
(Ab. O-23)

16:40–16:50 Arrhythmic disorders in anorexia nervosa.
M. Yahalom (Israel)
(Ab. O-24)

16:50–17:00 Electrophysiological mechanisms contributing to proarrhythmic effects of hypokalemia in the guinea-pig heart.
O. E. Osadchii (Denmark)
(Ab. O-25)

Hall B

09:00–10:30 Warsztaty interpretacji EKG
D. Kozłowski

10:30–11:00 Coffee Break

11:00–12:30 Heart Modeling
Chairpersons: A. van Oosterom (Switzerland/The Netherlands), G. Wagner (United States)

11:00–11:30 Effect of myocardial anisotropy on noninvasive activation time imaging. P. M. van Dam (The Netherlands)
(Ab. O-18)

11:30–12:00 Subendocardial ischemia must be global or severe to cause significant primary ST depression in the ECG
M. Potse (Canada)
(Ab. O-19)

12:00–12:30 Non-invasive imaging of the timing of cardiac activation and recovery. P.M. van Dam (The Netherlands)
(Ab. O-20)

12:30–13:30 Lunch Break

12:30–13:30 ISE Council Meeting

15:00–15:30 Coffee Break

15:30–17:00 Aktualny stan prewencji choroby sercowo-naczyniowej w Polsce. D. Czarnecka, J. Adamus

15:30–16:15 Prewencja choroby niedokrwiennej serca.
D. Czarnecka

16:15–17:00 Nowe spojrzenie na najważniejsze czynniki zagrożenia incydem sercowo-naczyniowym – obecne standardy i aktualne badania kliniczne. J. Adamus

Hall C

9:00–17:00 Poster Session 2

The posters marked with the numbers from 29 to 54 will be presented in this session (see Abstracts P-29 – P-54).

Session Topics

BSPM: P-29 – P-33, Cardioelectric field: P-34 – P-42, CVD Prevention : P-43 – P-49, Varia: P-50 – P-54

SCIENTIFIC PROGRAM

SATURDAY, 27 JUNE, 2009

12

Hall A

09:00–10:30 Atrial fibrillation – theory and clinical aspects

Chairpersons: A. van Oosterom (*Switzerland/The Netherlands*), A. Baranchuk (*Canada*)

09:00–09:30 Vectorcardiographic based analysis of atrial fibrillation

A. van Oosterom (*Switzerland/The Netherlands*)

09:30–09:45 Interatrial fibrillatory frequency gradient in the precordial surface ECG leads in patients with atrial fibrillation.

P.G. Platonov (*Sweden*)
(Ab. O-26)

09:45–10:00 Right atrial organization and wavefront analysis in atrial fibrillation.

U. Richter (*Sweden*)

(Ab. O-27)

10:00–10:15 Influence of amiodarone therapy on P-wave signal-averaged electrocardiogram in patients with atrial fibrillation in early period after isolated coronary surgery.

P. Ptaszynski (*Poland*)
(Ab. O-28)

10:15–10:30 The changes in duration of repolarization in patient with transient disappearance of atrial fibrillation after cardiac surgery.

M. Obremaska (*Poland*)

(Ab. O-29)

10:30 - 11:00 Coffee Break

11:00–12:30 BSPM/Conduction disturbances

Chairpersons: L. De Ambroggi (*Italy*), J. Liebman (*United States*), M. Tysler (*Slovakia*)

11:00–11:30 BSPM: advantages and limitations

L. de Ambroggi (*Italy*)

11:30–11:45 Identification of local ischemic changes in the heart from BSPM during exercise using a two-dipole model

J. Švehlíková (*Slovakia*)
(Ab. O-30)

11:45–12:00 Usefulness of BSPM in long-term monitoring of heart condition in women after mastectomy and radiotherapy

L. Rusiecki (*Poland*)
(Ab. O-31)

12:00–12:15 The nonspecific intraventricular conduction delay may produce significant dispersion of regional isovolumic contraction times in patients after acute coronary syndrome with moderately depressed global left ventricular systolic function.

R. Skalik (*Poland*)
(Ab. O-32)

12:15–12:30 QT prolongation is a myocardial infarction indicator in patients with left bundle branch block and chest pain.

C. Girouard (*Canada*)
(Ab. O-32)

12:30–13:30

ISE Annual General Meeting
YIA Competition Outcomes
CLOSING CEREMONY

24-27 June, 2009,
Wroclaw, Poland

36th International Congress on Electrocardiology

ABSTRACTS

Ventricular repolarization behavior of high performance athletes analyzed by body surface potential mapping in two different training regimens

Carlos Alberto Pastore¹, Nelson Samesima¹, Luciene F. Azevedo², Luciana D. N. J. de Matos², Euler V. Garcia¹, Patrícia S. Perlingeiro², Igor L. Santos², Carlos Eduardo Negrão²

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Purpose: The sympathetic/parasympathetic tonus plays an important role on the modulation of ventricular repolarisation. High performance athletes undergo many different, intense training regimens, sometimes with the predominance of sympathetic, other times of parasympathetic activity. We aimed to evaluate the ventricular repolarisation behaviour of high-performance athletes in two distinct moments of training, during baseline and competitive regimens, using the body surface potential mapping (BSPM) method.

Material and methods: Twenty high performance athletes (9 cyclists and 11 marathon runners, all male, mean 29+/-4 years) from the cardiovascular rehabilitation outpatient clinic of the Heart Institute underwent BSPM examination with semi-automatic measurement of its 87-lead QT intervals and Tpeak-end intervals. Corrected QT interval and Tp-e interval minimum, maximum and mean values, QT interval dispersion (QTmax -

QTmin), and heterogeneity of Tp-e dispersion (Tp-e min - Tp-e max) were analysed. Routine examination (clinical, laboratorial, ergoespirometry, echocardiography, 12-lead ECG) was also performed. Paired and non-paired t-tests compared mean values; significance level was $p \leq 0.05$. Results: We found a significant increase in QTcmax (423+/-47 vs 387+/-24 ms, $p=0.031$) and QTcmean (409+/-46 vs 385+/-23 ms, $p=0.031$) intervals during baseline training when compared with values from the competitive training, although both intervals were within the normal range. However, training regimen did not influence Tp-e repolarisation dispersion. Furthermore, no influence of the sport modality was detected on QT and repolarisation dispersion.

Conclusions: Significant alteration was observed in QTcmax and QTcmean intervals, in high-performance athletes during baseline training.

Repolarization duration as a prognostic marker of cardiac death in patients with anterior myocardial infarction treated with primary PCI results of prospective 36 months follow-up

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Purpose: Prolonged, diurnal analysis of QT interval, as well early and late phase of it, often fails in patients with acute myocardial infarction (AMI) because of dynamic ST-T segment changes. The purpose of this study was to analyze prospectively if repolarization measured in one hour period, may be a predictor of cardiac death in patients with anterior AMI treated with primary PCI.

Material and methods: The study population consisted of 115 patients with first anterior MI (87 males, age: 58±11 years, LVEF: 41+/-7%) treated with primary PCI of left anterior descending coronary artery. All subjects were observed prospectively during 36 months follow-up. Holter recordings were performed in the 5th day of AMI. Repolarization parameters: QT, QTpeak and TpeakTend were assessed from 1 hour (between 1-4 a.m.) in which ST-T segment facilitated automatic beat-to-beat analysis of more than 95% of the recording. Bazget'z formula was used for heart rate correction.

Results: During 36-months follow-up 10 cardiac deaths (CD) occurred,

105 subjects were alive: age- 63+/-13 vs. 58+/-11 years, $p=0.22$ and LVEF: 35+/-7% vs. 41+/-7%, $p=0.01$; respectively. Both QTc and TpeakTendc were longer in CD group: 457+/-30 ms vs. 436+/-26 ms, $p=0.03$ and 111+/-18 ms vs. 94+/-17 ms, $p=0.034$; respectively. QTpeakc did not differentiate both groups: 346+/-31 ms vs. 342+/-29 ms, $p=0.76$. Predictive values of QTc and TpeakTendc were calculated with Receiver Operating Characteristics analysis. Cut-off value for QTc= 470 ms with sensitivity- 30%, specificity- 91.5%, positive predictive value- 25%, negative predictive value- 93%. Cut-off value for TpeakTendc= 111 ms with sensitivity- 60%, specificity- 86%, positive predictive value- 28.5% and negative predictive value- 95.7%.

Conclusions: Greater heterogeneity of the spatial and temporal repolarization processes are prognostic markers of cardiac death in patients with acute anterior infarction with high specificity and negative predictive values. One hour of analysis seems to be sufficient for risk stratification of these patients.

Correlation between T-wave alternans and stress test and scintigraphic examination in patients with coronary artery disease

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Purpose: T-wave alternans (TWA) allows identification of patients at an increased risk for ventricular arrhythmia. Myocardial ischemia could lead to life threatening ventricular arrhythmia in patients with coronary artery disease. For assessment of ischemic heart disease the stress test and scintigraphic test (SPECT) are used. The results of TWA analysis, stress testing and scintigraphic testing were not compared yet.

Material and methods: 16 patients with ischemic heart disease were studied. Body surface potential maps were recorded with use of 64 leads ECG system. Two minutes recordings were made. ECG stress test was used to increase heart rhythm to 100 bpm. TWA ratio was calculated with use of spectral method. Patients were divided in to two groups according to the value of TWA ratio: TWA positive (TWA+) 10 patients and TWA negative (TWA-) 6 patients. For every patient, maximum of TWA ratio was calculated from 64 ECG leads. For all studied patients scintigraphic examination was carried out.

Results: Patients were classified as TWA+ when alternans ratio exceeds value of 2.5 at least in one electrocardiographic lead. In TWA+ group mean maximum of alternans ratio (calculated from 64 leads) was equal to 6.18 (SD 5) and in group TWA- to 1.38 (SD 0.6). In the TWA+ group the significant value of TWA ratio was detected in minimum one lead and maximum 23 leads of all 64 leads. The correlation between TWA and ECG stress test was 10%, however the correlation between the results of TWA and SPECT test was 58%.

Conclusions: The analysis of distribution of the TWA ratio on the body surface showed strong diversity, depending on the electrode location. No correlation was observed between results of TWA and ECG stress testing, however significant correlation was detected between results of TWA and SPECT test. It can also indicate that TWA and SPECT have sufficient sensitivity for detection of ischemic heart disease in patients at risk of ventricular arrhythmia.

T wave amplitude after tilt testing is lower in vasovagal patients than in healthy controls

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Background: The amplitude of T-wave changes over tilt testing (TT) what may reflect autonomic tone alterations. T wave amplitude increase is assumed to reflect parasympathetic system activation and T wave decrease sympathetic predominance. The analysis of these changes may be helpful in the understanding of the pathophysiology of vasovagal syncope.

Purpose: The aim of the study was to assess the changes of T wave amplitude during TT.

The study group consisted of 68 pts with vasovagal history with syncope provoked by TT after NTG provocation and 58 healthy controls with negative TT with NTG provocation. ECG Holter recording was performed in every patient. T wave amplitude was assessed at the baseline, just before TT ending, just after tilt table lowering and 5 minutes later.

Results: In vasovagal patients T wave amplitude was lowest just before the end of TT (2.4+/-2.0mV and 5 min after TT was significantly higher than just before TT ending (immediately after 2.4+/-2.7mV and 5 min after 2.8+/-3.0mV) but even 5 min after TT remained significantly lower than at the baseline. In healthy controls T wave amplitude significantly decreased

just before TT ending (2.6+/-2.3mV) comparing to the baseline values (3.5+/-2.4mV) and during recovery returned gradually to the baseline values (immediately after 3.3+/-2.7mV and 5 min after 3.8+/-2.7mV). T wave amplitude 5 min after the end of TT was significantly higher in healthy controls than in vasovagal patients.

Conclusions: The observed decrease in T wave amplitude during TT is an expected finding which reflects sympathetic activation. The behaviour of T wave amplitude during recovery period indicates on the sympathetic overactivity in vasovagal pts during that period whereas in healthy controls sympathetic autonomic tone rapidly returns to the baseline values.

Increased QT intervals in diabetic subjects?

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Background: It is well-known that both, a prolonged QT interval and diabetes, are associated with increased cardiac risk.

Purpose and methods: To investigate whether the QT interval derived from the 12 lead resting ECG (10sec duration) is associated with diabetes we compared the QT interval distributions of diabetic persons (n=123) and non-diabetic persons (n=1696) examined within the population-based KORA-S4 study (age-group 50 to 74 years). The computerized QT interval measurements using the HES system were corrected for heart rate using the formulas of Bazett, Fridericia and the Framingham heart study.

Results: Comparison of the QT interval measurements - originally shorter in the diabetic group (405.1±26.1 ms vs. 409.6±29.0 ms, for diabetic and non-diabetic subjects, respectively) - resulted in an inverse relation after correction according to Bazett (434.8±21.8 ms vs. 428.2±21.8 ms; p<0.01) showing statistically significant differences between the diabetic

and the non-diabetic group. QT correction according to Fridericia (424.4±17.3 ms vs. 421.6±18.7 ms; ns.) and according to the Framingham heart study (423.9±16.7 ms vs. 421.2±18.3 ms; ns.) resulted in an almost equalizing of the QTc interval distributions of the diabetic and the non-diabetic group. However, heart rate was significantly increased in the diabetic group (69.6±11.4 bpm vs. 66.1±10.9 bpm; p<0.01).

Conclusions: On a population-based scale, there are obviously no major differences between the QTc distributions of diabetic and non-diabetic subjects after appropriate correction for heart rate. However, application of the Bazett formula simulates a significant increase of QTc intervals in the diabetic group, because it overcorrects QT intervals at higher heart rates, which were predominantly present in the diabetic group. These results also emphasize the need to implement a more reliable than Bazett's QT correction in routine clinical practice.

Effects of right and left ventricular apical pacing on repolarization and hemodynamics of the canine heart

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Purpose: The different sites of ventricular pacing produce marked changes in the myocardial repolarization and cardiac hemodynamics. However, the detailed quantitative comparisons of repolarization changes and pump function patterns have not been made under the apical electrical pacing of the right (RV) and left (LV) ventricles in the in situ heart.

Materials and methods: Epicardial monofocal RV and LV apex pacings were done (3.5V, 2ms, 150bpm). The unipolar ventricular electrograms were recorded in 15 mongrel anesthetized dogs with the aid of multiple plunge electrodes (total 64 leads). Hemodynamic patterns were registered using Prucka Mac-Lab 2000 (GE Medical System, GmbH) simultaneously.

Results: Under the LV apex pacing, the activation (68,5±13,6 msec) and ARI (104,2±47,9 msec) dispersions increased (p<0,05) as compared to supraventricular rhythm. A coincidence of activation and repolarization sequences was found as judged by the significant correlation between repolarization and depolarization times (r=0,81). The ARI durations tended to be shorter in the early-activated myocardial area. The reduction (p<0,05) of maximal systolic pressure, dP/dtmax and dP/dtmin in the RV were

observed. There were no significant alterations of the correspondent LV hemodynamic variables. Under RV apex pacing, the activation (70,0±14,5 msec) and repolarization (65,5±17,7 msec) dispersions increased (p<0,05) as compared to supraventricular rhythm. A coincidence of activation and repolarization sequences was found as well (r=0,73). The ARI durations tended to be longer in the early-activated myocardial area. The reduction (p<0,05) of maximal systolic pressure, dP/dtmax and dP/dtmin in the LV and RV, mean arterial pressure and total peripheral resistance were observed. The higher degree of hemodynamic suppression was observed under the RV, than LV apex pacing.

Conclusions: Thus, the apical pacing of the RV and LV leads to the modification of the ventricular repolarization patterns (more expressed under the LV, than RV pacing) associated with the pump function suppression (more expressed under the RV, than LV pacing).

O-07 Long term home continuous ECG telemonitoring (MedicAlgorithmics) in cardiological practice – preliminary results

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Background: Cardiac arrhythmias can be symptomatic as well as asymptomatic. Traditional Event Holter can diagnose symptomatic arrhythmias only. It is however important if asymptomatic forms are present in pts after ablation or with suspected paroxysmal atrial fibrillation.

Purpose: The aim of the work is to verify usefulness of intelligent telemonitoring in detection of the asymptomatic cardiac arrhythmias.

Material and methods: To enable continuous ECG monitoring during normal daily life we use automated, intelligent single channel ECG recorder (MedicAlgorithmics) with on-line monitoring of the recording quality to avoid nondiagnostic sessions. The system automatically analyses the ECG tracings on a PDA device located at the patient site. The algorithm detects arrhythmia events and sends them as ECG strips to the server. Simultaneously whole compressed ECG tracing it transmitted. ECG is daily reviewed by experienced technician and consulted by cardiologist. Here we present the preliminary results of 62 pts that were monitored for 1-21 days.

The average recording duration was 149 ± 108 hours; the longest lasted for 506 hours (21 days) of continuous recording. In summary it was 384 days.

Results: Total percentage of non-diagnostic time periods within all recordings was only 1,8% of the total recorded time. Important bradycardia (<50/min) was recorded in 22 pts cases with the mean brady heart rate of 35/min. Pauses above 2 s. were observed in 7 pts (max pause 3,6s s). Non sustained ventricular tachycardia was observed in 4 pts (4-24 bts, 100-240/min) from 1 to 71 nsVT episodes per patient. Supraventricular arrhythmias were noted in 22 patients (max SVT VR 115-160/min). In one patient a total AF burden of 0,3% of recording time (60min) was detected.

Conclusions: The intelligent monitoring system is a useful and promising tool for arrhythmia diagnosis and detection.

O-08 Atrial Overdrive Pacing in Sleep Apnea: A Meta-Analysis

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Purpose: Sleep Apnea (SA) is a common breathing disorder that affects 5% of the North American adult population. It has been suggested that suppressing periods of bradycardia associated with apnea, may reduce the autonomic imbalance associated with SA, improving the respiratory condition. The goals of this study was to conduct a systematic review to identify all randomized clinical trial data evaluating atrial overdrive pacing (AOP) for the treatment of SA and to perform a meta-analysis to estimate the true effect of AOP on SA.

Methods: A systematic review of the literature was performed to identify all reports of the effect of AOP for the treatment of SA. Eligible studies had to: be randomized and controlled, and use the apnea-hypopnea index (AHI) to determine the severity of SA.

Results: A total of 10 studies were identified, which included 175 patients with intermediate to severe SA. Overall, AOP reduced the AHI by -4.65 episodes per hour (95% confidence interval [CI], -8.27 to -1.03, $p = 0.01$).

The studies were similar as indicated by the statistical test for heterogeneity ($p = 0.20$). The studies that have included a CPAP arm in comparison to no pacing and AOP, showed the most significant results (49 to 2.7, 95% CI -56.2 to -36.5, $p < 0.001$).

Conclusions: Although it appears that AOP is associated with a statistically significant reduction in AHI, the magnitude of this benefit is small and likely not of clinical significance. AOP should not be universally indicated in patients with SA, unless they have a conventional indication for cardiac pacing.

Assessment of deceleration and acceleration capacity in children with mitral valve prolapse

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Background: Mitral valve prolapse (MVP) is a common cardiovascular abnormality in children. It is suggested that MVP can be accompanied by some autonomic abnormalities. Deceleration capacity and acceleration capacity are two, newly recognized ECG-derived descriptors of autonomic modulation of cardiovascular system. Both deceleration and acceleration capacity have been shown to predict mortality in survivors after myocardial infarction. Deceleration and acceleration capacity has not been evaluated in children with MVP so far.

Purpose: Comparison of deceleration and acceleration capacity in children with MVP and in healthy children.

Material and methods: 43 children with MVP (29 girls; age \pm SD: 13.3 \pm 3.5 years) and 52 healthy children (28 girls; age \pm SD: 13.8 \pm 2.7 years) were examined. The chest ECG (Porti 5, TMSI, The Netherlands) was recorded at rest in a recumbent position for 30 minutes in children breathing spontaneously. Deceleration capacity and acceleration capacity were calculated by means of phase rectified signal averaging. Comparisons were made using the Mann-Whitney U test. A probability value of <0.05

was considered statistically significant.

Results: There was not significant reduction in deceleration capacity (19.8 \pm 1.8 vs 25.1 \pm 2.0 ms; p=0.090) and acceleration capacity (-18.3 \pm 1.5 vs -22.7 \pm 1.6 ms; p=0.092) in children with MVP as compared with the control group.

Conclusions: Both deceleration capacity and acceleration capacity are similar in children with MVP and in healthy children.

The content of elements in rainwater and its relation to the frequency of hospitalization for atrial fibrillation in Opole Voivodship, Poland, during 2000-2002

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Purpose: The environmental cardiology is a new branch of medical sciences. The content of chemical elements in rainwater is a suitable indirect indicator of its presence in airborne dust, sometimes referred to as rain fallout. Rainwater is considered a suitable monitor for environmental or natural pollution. The yearly content of chemical elements in rainwater may be considered as a good indicator for determining the influence of these environmental factors on human body.

Material and methods: We decided to investigate the relationship between chemical elements in rainwater and the frequency of hospitalizations for atrial fibrillation (I48, ICD10) on the population of the region of Opole Voivodship, Poland in 2000-2002 years. The voivodship has a population of one million and is divided into 12 counties that have between forty-four thousand and 151 thousand inhabitants. We calculated the yearly average number of hospitalizations by reasons of atrial fibrillation per 10 thousand inhabitants in particular counties. The average content of the chosen chemical elements in kilograms per hectare per year (kg/

ha/yr) was calculated for each county individually. Spearman's correlation coefficient was evaluated.

Results: There is a high positive correlation between Cr in rainwater and hospitalized cases of atrial fibrillation (r = 0,62) and mild positive correlation with Cd (r = 0,57), Pb (r = 0,57), Zn (r = 0,50) and chloride (r = 0,48).

Conclusions: The observed positive correlation between Cr in rainwater and the number of hospitalizations by reason of the atrial fibrillation may be due to the biological activity of chromium compounds, e.g. the cytotoxic activity of hexavalent Cr.

There are reports in the literature suggesting possible relations between Cd, Pb and Zn and increased adrenergic stimulation, for example. Chloride ions play role in regulation of endothelium function, but its main role may be as oxidizer, too.

Which electrocardiographic criteria should be used in professional athletes to identify left ventricular hypertrophy?

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Purpose: The widely known ECG criteria use QRS complex voltages to define whether there is left ventricular hypertrophy (LVH). Mild myocardial hypertrophy is detected in many professional athletes, as a consequence of the intensity of training. Thus, it is not unusual to find large QRS voltages in an athlete's ECG, although with a normal heart. We investigated which ECG criterion applied best for identifying LVH in this population - Sokolow-Lyon, Romhilt-Estes, Cornell or Gubner.

Materials and methods: ECGs of 107 professional athletes (71% soccer players, 29% marathon runners, all male, age 25+/-10 years, with 9+/-8 years training) were analyzed with the four ECG LVH criteria, by the same observer unaware of ECHO results. ECG indicated LVH if: Sokolow-Lyon ≥ 35 mm (V1 or 2 S + V5 or 6 R waves); Romhilt-Estes score ≥ 5 points (frontal plane:

R/S waves ≥ 20 mm, horizontal plane: R/S waves ≥ 30 mm, Morris indices, V5 or 6 strain pattern, left axis deviation $\geq -30^\circ$, intrinsicoid deflection ≥ 0.04 s, QRS duration ≥ 0.10 s); Cornell ≥ 28 mm (aVL R + V3 S waves); Gubner ≥ 22 mm (DI R + DIII S waves). Hypertrophy was considered whenever: LVDD ≥ 60 mm and/or septum ≥ 13 mm and/or LV posterior wall ≥ 13 mm. Kruskal-Wallis tested quantitative variables, corrected chi-square for categorical variables. Significance level: $p \leq 0.05$.

Results: Romhilt-Estes showed the best results [75% sensitivity (Se), 84% specificity (Sp), 16 false-positives (Fp), 1 false-negative (Fn)], and was the only statistically significant criterion ($p=0.047$). Sokolow-Lyon showed 100% Se, 15% Sp, $p=0.545$, 88% Fp, 0% Fn. Cornell and Gubner showed 25% and 0% Se, 95% and 99% Sp, $p=0.205$ and $p=0.449$, respectively.

Conclusions: In this population of male professional athletes, Romhilt-Estes proved to be the best ECG LVH criterion, while Sokolow-Lyon did not discriminate normal from abnormal hearts. Cornell and Gubner should not be used in this population because of low sensitivity.

The QT interval and left ventricular hypertrophy in essential hypertension

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Background: QT interval prolongation has been associated with an increased risk of ventricular arrhythmia and sudden cardiac death. Left ventricular hypertrophy is an important indicator of target organ damage in arterial hypertension. It was the aim of this study to find out if essential hypertension and left ventricular hypertrophy influence QT interval duration and ventricular arrhythmia risk.

Material and methods: 35 patients with stage 2 essential hypertension underwent 12-lead ECG and Holter monitoring. 22 (63%) of the patients had left ventricular hypertrophy considering 5 ECG criteria: the Romhilt-Estes scoring system, the Sokolow-Lyon voltage, Cornell voltage, the diagnostic criteria based on the Framingham Heart Study data and the Perugia score.

Results: The QT interval was significant higher in hypertensive patients compared to healthy controls (403 ± 103 ms vs. 358 ± 38 ms in healthy controls), and in left ventricular hypertrophy patients (403 ± 103 ms vs.

391 ± 82 ms in patients without left ventricular hypertrophy). A QT interval duration > 400 ms was significant associated with left ventricular hypertrophy (RR=9.23). The QT interval duration correlated with the R wave amplitude in V5 and V6 ($R=12 \pm 9$ mm, $r=-0.637$). 2 (9%) of the patients with LVH had premature ventricular contractions.

Conclusions: The QT interval can be used in combination with the voltage criteria as a marker of left ventricular hypertrophy. Left ventricular hypertrophy increases ventricular arrhythmia risk in hypertensive patients.

Reduced number of heart rate deceleration runs predicts all-cause mortality in post-infarction patients

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Background: A number of parameters related to heart rate variability (HRV) has been shown to predict mortality in post-infarction patients. Most of known HRV parameters are derived from methods analyzing changes in duration of RR intervals, irrespective of their origin, i.e. whether they come from heart rate decelerations or accelerations.

Purpose: In this study we characterized unidirectional changes of RR intervals by means of counting episodes of uninterrupted beat-to-beat heart rate decelerations (deceleration runs) and looked at the predictive value of this method in post-infarction patients.

Material and methods: The method was developed using 24-h ECG Holter recordings of 1455 post-infarction patients (training sample) and blindly evaluated in 946 other post-infarction patients (validation sample). During a median follow-up of 24 months, 70 and 39 patients died in the

training and validation sample, respectively. In the Holter recordings, episodes of consecutive beat-to-beat heart rate decelerations (the so-called deceleration runs) were identified and characterized by their length. Results: Deceleration runs of 2 to 10 cardiac cycles were significantly less frequent in non-survivors. Multivariate model based on decreased counts of deceleration runs of 2, 4 and 8 cycles identified low, intermediate, and high-risk groups. The 2-year total mortalities in these groups were 1.8%, 6.1%, and 24% in the training sample and 1.8%, 4.1%, and 21.9% in the validation sample, respectively.

Conclusions: Infrequent deceleration runs during 24-hour Holter monitoring indicate high risk of subsequent mortality in survivors of acute myocardial infarction. HRV analysis referring the direction of RR intervals change has a significant prognostic value in post-infarction patients.

Assessment of the autonomic modulation of the cardiovascular system in children with mitral valve prolapse

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Background: Mitral valve prolapse (MVP) is one of the most common form of cardiac disease in children and may be accompanied by some autonomic abnormalities. Analysis of heart rate variability (HRV), resting heart rate (HR) or baroreflex sensitivity (BRS) allow studying autonomic modulation of cardiovascular system.

Purpose: The aim of this study was to investigate frequency domain HRV, BRS and resting HR to assess the changes in sympathovagal balance in children with MVP.

Material and methods: 43 children with MVP (29 girls; 5-18 years) and 52 healthy children (28 girls; 7-18 years) were included. 30-minute resting ECG (Porti 5, TMSI, Netherlands) and blood pressure (Portapres 2, FMS, Netherlands) signals were recorded non-invasively in supine. The HRV was evaluated by spectral analysis: total power (TP), power of very low (VLF), low (LF) and high frequency (HF) and LF/HF ratio. The BRS was measured using a cross-correlation method.

Results: Patients with MVP had significantly reduced TP (5207 ± 704 vs 9083 ± 1036 ms²; $p=0.003$), VLF (1841 ± 141 vs 3776 ± 582 ms²; $p=0.009$),

LF (1420 ± 221 vs 2126 ± 261 ms²; $p=0.022$), HF (1772 ± 376 vs 2876 ± 435 ms²; $p=0.035$) and reduced mean duration of cardiac cycles (764 ± 20 vs 832 ± 20 ms; $p=0.028$) as compared with healthy children. There was no significant reduction in prolongation of delay of baroreflex (2.01 ± 0.06 vs 1.87 ± 0.06 s; $p=0.069$) and no significant differences in BRS and LF/HF ratio between both groups.

Conclusions: Children with MVP have a changed autonomic control of the cardiovascular system. Our study demonstrates that children with MVP characterized by sympathetic hyperactivity and/or reduced vagal tone.

Assessment of sleep apnea risk factors frequency and Holter evaluated apnea/hipopnea index value in group of stable patients with systolic heart failure in NYHA class II and III comparing to control group

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Background: Sleep apnea syndrome (SAS) has a deteriorative influence for morbidity and mortality among patients with systolic heart failure (SHF). SAS occurs in 40-80% of this population. Obesity particularly conduces to SAS occurrence. Some studies indicated that Holter is useful in diagnostics of SAS. Holter - estimated apnea/hipopnea index (AHI) is dedicated for obstructive/mixed apnea diagnostics. The aim of the study was assessment of sleep apnea risk factors frequency and holter evaluated apnea/hipopnea index (AHI) value in group of stable patients with systolic heart failure in NYHA

class II and III comparing to control group.

Material and methods: Study group (SG) comprised 70 patients (F-8, M-62; age 54.8), NYHA class II and III, EF<40%. Control group (CG) comprised 50 subjects sex and age matched. Assessment of SAS risk factors included: presence of obesity (BMI, waist measurement), excessive neck circuit, smoking, alcohol consumption, soporific drug admitting and past stroke. Sleep apnea Holter diagnostics was performed using Lifescreen Apnea program. Presence of sleep disturbances were evaluated by estimated AHI.

Results: Average BMI was 26.3 kg/m² in SG and 28.7 kg/m² in CG (p<0.01). Obesity (BMI > 30 kg/m²) occurred in 15.7% of SG and 22% of CG (p<0.05). Central obesity occurred in 58.5% of SG and 80% of CG. Excessive neck circuit occurred in 15.7% of SG and 42% of CG. Smoking was present in 17.1% SG and in 4% CG (p<0.05). Frequency of other risk factors did not differ between groups. AHI value was 16.4 in SG and 10.2 in CG.

Conclusions: 1. Central obesity and excessive neck circuit are rarely observed among heart failure patients comparing to control group. 2. Obesity - main risk factor of obstructive sleep apnea is rarely observed in heart failure subjects. 3. Despite of rarely observed sleep apnea risk factors among heart failure patients, probability of occurring obturative/mixed apnea is significantly higher comparing to control group.

Software Support for Patient Button in Event- and Interpretive Holter Recorders

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Background: The usual role of patient button is to provide the temporal reference for events experienced by the patient during the out-hospital monitoring. Looping event recorders use this button for triggering the ECG recording. In both cases, the patient button signal is subjective and thus not reliable enough to capture rare cardiac events in particular when not accompanied with pain.

Purpose: Our research was aimed at development of a low-complex software procedure signaling the possible emergency as result of real-time scanning of the incoming ECG signal.

Material and methods: We focused first on the choice of the emergency detector procedure covering wide range of diseases but not requiring much computational power in the patient-side wearable system. After the investigation of numerical complexity of the initial stages of ECG processing and correlation of twelve most common diseases with basic cardiac parameters, we proposed a compound emergency indicator combining heart rate and QRS contour variations. Its effectiveness lies in high degree of their mutual independence. The computation is simple enough to be

implemented in the development kit of the PXA-270 CPU, currently used in a series of handheld computers.

Results: Tests of the emergency detector software supporting the patient button, performed with use of MIT-BIH long term database showed the sensitivity of 0.956 and the specificity of 0.988 while the power consumption raised due to the signal interpretation by only 0.24mW. These results were confirmed in further tests using custom 24-hours annotated Holter recordings. The reliability of event marks accompanying the Holter record may be significantly improved thanks to the software support of patient button without limiting the recorder autonomy time. The emergency alert may remotely change current medical procedure or trigger a rescue action. Similar technique is also useful in auto-adaptive ECG interpretation or distant on-demand recording for changes of the software architecture and functionality.

Diagnostic aspects of HRV

Thomas Niederl

The heart is one of the most important target organs for the autonomic nervous system. Hence, the heart rate is a very important parameter of many higher order regulating systems of the human body. These higher order parameters can be mapped into a single, easy to interpret image, which we obviously call "Fire of Life".

As a side effect of the high resolution acquisition of the ECG, respiration patterns can be derived using the EDR method to further support findings.

Effect of myocardial anisotropy on noninvasive activation time imaging

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Purpose: Anisotropic myocardial conductivity affects the electrocardiogram (ECG) in two ways: 1) it influences the activation sequence and 2) it modulates the relation between the distribution of cardiac current sources and the ECG. This second effect is ignored by many inverse models that attempt to estimate activation times (AT) from ECG data. Our purpose was to assess the effect of anisotropy on estimated AT.

Methods: Propagating action potentials were simulated with an anisotropic reaction-diffusion model of the human heart. From the results, 64-channel ECGs were computed with a finite-difference model of a human torso ("forward model"), in which the anisotropy ratio can be chosen at will. The simulated ECGs were used as input to an inverse model based on an equivalent dipole layer (EDL) and fastest-route algorithm. This inverse

model assumes an isotropic heart, where the relation between cardiac and surface potentials is concerned, although it allows anisotropy in the activation sequence. The inversely estimated AT were compared to the reference AT from the forward model.

Results: When the forward model was isotropic, inversely computed AT differed from the reference AT by only a few milliseconds. With the estimated AT, the inverse model accurately reproduced the input ECG. When the forward model was anisotropic, the inverse model still found an activation sequence that reproduced the ECG accurately. The AT with which this was achieved differed importantly from the reference timings (rms and absolute maximum difference for isotropic 12/40ms versus 15/67 ms anisotropic). However, the estimated earliest activation sites differed by less than 14 ms for both cases.

Conclusions: The assumption of isotropy on which many inverse models rely affects the estimated activation sequence, but not the estimated earliest activation sites.

O-19 Subendocardial ischemia must be global or severe to cause significant primary ST depression in the ECG

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Purpose: Primary ST depression in the ECG is thought to be caused by subendocardial ischemia. The classical explanation is that a partially blocked coronary artery causes only the inner part of the ventricular wall to become ischemic. This idea was supported by mathematical studies which, however, ignored the anisotropic electrical conductivity of the myocardium. Recent numerical studies that did account for this anisotropy have shown that regional subendocardial ischemia may well lead to ST elevation in overlying leads, instead of ST depression. The meaning of primary ST depression has therefore become uncertain. The purpose of this study was to find scenarios that could lead to primary ST depression.

Methods: Ischemia was simulated in a detailed bidomain reaction-diffusion model of the human heart and torso. Myocardial anisotropy and the major inhomogeneities in torso conductivity were accounted for. Subendocardial ischemia with 30%, 50%, 70%, and 90% transmural extent was simulated, as well as transmural ischemia. For each transmural extent, 4 different ischemic zones with 75mm diameter were simulated, as well

as one ischemic zone affecting the whole left ventricle. The severity of ischemia was also varied. Significant ST depression was defined as $>1\text{mm}$ (0.01mV).

Results: Regional subendocardial ischemia of any transmural extent only caused significant ST depression when it was severe enough to cause activation block in the ischemic zone. In contrast, a zone that affected the whole left ventricle caused several mm ST depression even for moderate ischemia without changes in activation.

Conclusions: Two explanations for primary ST depression remain: severe regional subendocardial ischemia, and global subendocardial ischemia (i.e. affecting the whole left ventricle). The latter hypothesis is attractive because it explains the clinical observation that the pattern of primary ST depression cannot predict the location of a coronary stenosis.

O-20 Non-invasive imaging of the timing of cardiac activation and recovery

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Purpose: Non-invasive imaging of the timing of ventricular activation and recovery is of clinical relevance. We are currently developing an inverse procedure based on the equivalent double layer source model of the cardiac electric generator. The implied inverse problem is non-linear and can only be solved through a regularized iterative optimization procedure, requiring a high quality initial estimate. In this paper we present the results obtained by using such estimates, both for activation and recovery timing, based on electrophysiological knowledge of the heart.

Methods: The initial estimate of the activation sequence was computed by using a dedicated fastest route algorithm that we developed, which takes anisotropic propagation into account. A Bayesian approach was used to select locations from which activation is initiated. The initial estimate of the recovery sequence was based on the initial activation wave, by taking into account the effect of electrotonic current flow on the recovery process in the 3D tissue. Subsequently, activation and recovery times were alternately optimized until convergence was reached between measured and simulated ECGs.

Material: Three cases were used to test the method: a normal healthy

subject, a WPW patient, and a Brugada patient during an Ajmaline provocation test.

Result: The presented inverse procedure identified activation and recovery sequences that completely agreed with known electrophysiology, both on the epicardium and the endocardium. The resulting simulated ECGs closely matched the measured ECGs (relative RMS based difference ≤ 0.18 , correlation ≥ 0.98).

Conclusions: The basis of the success of the presented inverse procedure stems from the fact that the initial estimates of activation and recovery are based on electro-physiological knowledge of the general nature of propagation in anisotropic media. The quality of the results holds a clear promise for any future application of this inverse procedure in a clinical

Real-Time MRI Guided Atrial Ablation

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Background: Ablation of the atrium offers the only true cure for atrial fibrillation (AF). If successful, MRI guided therapy could improve safety and success rates for this therapy and thus make it available to more patients. Challenges in developing MRI guided interventions include the incompatibility of standard catheters, RF generators, and electrophysiological measurement systems with the magnetic fields in the MRI scanner.

Purpose: The goal of this study was to evaluate the feasibility of real time magnetic resonance imaging (MRI) to guide radio frequency (RF) ablation in the atrium.

Material and methods: We report on results from animal studies on 12 canines carried out with 3-Tesla MRI (Siemens) using customized catheters (Surgivision Inc.) and standard clinical RF Generator (Biosence Webster). The animal preparation was a fully anesthetized canine and all access to the atrium was by means of a venous catheter capable of applying RF

energy to the endocardium. Imaging included pre-intervention magnetic resonance angiography with a bolus injection of Gadolinium, followed by delayed enhancement MRI; non-contrast T1 weighted imaging; and continuous, real time scanning. Customized software allowed real time display of both individual slices and a merging of slices with pre-acquired and segmented volume scans of the heart. After euthanasia, visual, MRI and/or CT imaging, and histological evaluation provided independent evidence of the location and extent of lesion formation.

Results: We achieved successful application of RF lesions under MRI guidance to the posterior wall of the right atrium, right atrial appendage, and right atrial septum. Lesions were visible in delayed enhancement MRI but also in contrast free images acquired 20-30 s after the ablation. Lesion location and extent were validated through visual inspection and photography and post mortem MRI, both with and without delayed enhancement.

Conclusions: These results firmly prove the feasibility of real time MRI guidance of catheter ablation in the atria.

Interatrial Block in Patients with Sleep Apnea

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Purpose: Sleep Apnea (SA) is a common disorder that affects more than 5% of the adult North American population. It is associated with atrial arrhythmias and stroke. The mechanisms of this association remain unclear. We attempt to determine the prevalence and identify the factors associated with interatrial block (IAB) in a population with SA.

Methods: Consecutive patients referred for a polysomnography study at the Sleep Disorder Clinic of the Kingston General Hospital. Apnea-hypopnea index (AHI) scores were collected. 12-lead ECG data was scanned and amplified (x 8 times); P-wave duration and P-wave dispersion were measured using a semiautomatic caliper. IAB was defined as a P-wave duration ≥ 120 ms. Bivariate and multivariate analyses were performed.

Data from 172 consecutive patients was examined. Severe SA (mean AHI=56.1 \pm 28.1) was present in 144 (SA group). The remaining 28 had mild or no SA (mean AHI=6.5 \pm 3.6) and were used as controls. Age and gender distribution between the two groups did not differ (56.7 \pm 12.6 years for SA, 58.0 \pm 13.7 years for controls, p=0.64, and 69.4% male, 53.6% male

respectively, p=0.103). Obesity was more prevalent in the SA group (78.5% versus 32.1% in controls, p<0.001). No significant differences were found for hypertension, CAD and congestive heart failure. IAB was more prevalent in patients with severe SA (34.7% SA vs 0% controls, p <0.001). Age and AHI > 30 were independent predictors of IAB (p=0.003 and p=0.001 respectively). In linear regression the P-wave was prolonged by 1.7 ms for each decade of age (p=0.003) and by 6.4 ms for the SA group, this was significant when compared to the control group (p=0.001). P-wave dispersion was significantly higher in the severe SA group (14.6 \pm 7.5 for SA, 8.9 \pm 3.1 controls, p<0.001.).

Conclusions: IAB is very frequent among patients with severe SA. Older age and severe SA are predictors of IAB. P-wave dispersion is increased in patients with severe SA.

This may explain in part, the high prevalence of atrial arrhythmias in patients with SA.

Ventricular arrhythmias assessment in patients with heart failure before and after effective cardiac rehabilitation

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Background: Ventricular arrhythmias (VA) in heart failure patients (HF-pts) are associated with poor quality of life (QoL) and prognosis. Effective cardiac rehabilitation (CR) improved QoL and prognosis. Peak oxygen consumption (pVO₂) and QoL are accepted parameters of effectiveness of CR.

Purpose: To evaluate the influence of two models of CR on VA, pVO₂ and QoL in HF-pts.

Material and methods: 132 HF-pts (mean 58.7±9.8 years) randomized into two groups underwent an 8-week CR. Group 1 (60 pts) - training on ergometer. Group 2 (72 pts) - walking training. Patients with sustain-VT were excluded. VA were analyzed before and after CR: (1) total ventricular premature beats (TVPBs), (2) ventricular couplets (VC), (3) non sustained ventricular tachycardia (nsVT), in 24-hour Holter recording.

CR effectiveness assessment included: pVO₂ (ml/kg/min in cardiopulmonary exercise test), QoL (SF-36 points) before and after CR.

Results:

Arrhythmias

Group 1: ΔTVPBs = 461 (±2219) p=NS; ΔVC = 42 (±251) p=NS; ΔnsVT = 6 (±38) p=NS.

Group 2: ΔTVPBs = -13 (±1962) p=NS; ΔVC = -11 (±212) p=NS; ΔnsVT = -2 (±24) p=NS.

CR-effectiveness

Group 1 ΔpVO₂ = 1.06 (±2.5), p = 0.0021, ΔSF-36 = -12.23 (±31.53), p = 0.0012.

Group 2 ΔpVO₂ = 1.83 (±2.6), p = 0.0001, ΔSF-36 = -8.33 (±25.60), p = 0.0006.

Conclusions:

- Both models of cardiac rehabilitation significantly improved pVO₂ and QoL in heart failure patients but did not influence on ventricular arrhythmias (premature beats, couplets and nsVT)
- Effective cardiac rehabilitation in heart failure patients seems not to reduce ventricular arrhythmias (premature beats, couplets and nsVT)

Arrhythmic Disorders in Anorexia Nervosa

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Background: Anorexia Nervosa (AN) is a life-threatening condition, with a significant risk for death, due to cardiac complications. It is characterized by abnormal eating behavior with the prevalence of 0.5% to 1.0%. It affects predominantly adolescent girls, has the highest mortality rate of all psychiatric disorders, and has been associated with bradycardia, hypotension, mitral valve prolapse and heart failure. The diagnosis of AN can be elusive and more than one half of all cases are undetected.

Purpose: to evaluate cardiac findings in AN.

Material and Methods: 23 patients (20 females) with AN were examined in the last 3 years, including ECG, echocardiogram and Holter monitoring. The mean age was 16 years (range 11.5-20), weight loss 13.5 kg (range 6-26), and BMI 15.4 (range 10.9-20). MVP was found in 3, mitral regurgitation (MR) in 4, and mild Aortic stenosis in one. 10 young adults (8 females and 2 males, mean age 15 years), without AN served as a control group.

Results: All patients had bradycardia (mean 44/min, range 26-68/min)

documented by ECG and Holter monitoring. Findings were sinus and nodal bradycardia, with no evidence of arrhythmias, or QT interval prolongation. No patient needed pacemaker therapy. In the control group the mean slow heart rate was 74/min (range 66-99/min).

Conclusions: Bradycardia, in young adults, especially females with weight loss, should raise the possible diagnosis of AN, so it can be treated early and promptly in time.

Electrophysiological mechanisms contributing to proarrhythmic effects of hypokalemia in the guinea-pig heart

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Purpose: Diuretic-induced hypokalemia was shown to increase arrhythmogenicity in cardiac patients. The aim of the present study was to determine if proarrhythmic effects of hypokalemia are attributed to steep ventricular action potential (APD90) restitution slopes, shortened refractoriness, amplified repolarization gradients, or slowed ventricular conduction.

Material and methods: The volume-conducted ECG and monophasic action potentials from six ventricular epicardial sites were recorded simultaneously in isolated, perfused guinea-pig heart preparations. APD90 restitution, effective refractory periods and inducibility of tachyarrhythmias were assessed from left ventricular (LV) epicardial and endocardial stimulation sites.

Results: Hypokalemic (2.5 mM K⁺) perfusion promoted spontaneous ectopic activity, reduced the ventricular fibrillation threshold, and increased the inducibility of tachyarrhythmias by programmed stimulation and

rapid pacing. Hypokalemia prolonged ventricular repolarization and shortened the effective refractory periods thereby increasing the critical interval for ventricular re-excitation. Nevertheless, hypokalemia-induced arrhythmogenicity was associated with flattened rather than steepened APD90 restitution slopes, slowed APD90 restitution kinetics, and no effect on spatial distribution of restitution slopes. The flattening of APD90 restitution curve was found to be greater at the right ventricular (RV) as compared to the LV recording sites, thus contributing to increased RV-to-LV transepicardial dispersion of APD90. As determined by local activation time recordings at distinct ventricular sites, hypokalemia significantly prolonged the LV-to-RV transepicardial conduction.

Conclusions: Taken together, these findings suggest that hypokalemia-induced arrhythmogenicity is attributed to shortened LV refractoriness, increased critical intervals for LV re-excitation, amplified repolarization gradients, and slowed ventricular conduction rather than steepened APD90 restitution slopes.

Interatrial fibrillatory frequency gradient in the precordial surface ECG leads in patients with atrial fibrillation

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Introduction: Interatrial frequency gradient is used to guide catheter ablation of atrial fibrillation (AF) but reliable tools for its non-invasive estimation are lacking. Atrial fibrillatory cycle length (AFCL) in lead V1 has shown agreement with RAA AFCL in earlier studies, while ECG signals from left precordial leads did not correlate with atrial fibrillatory activity. We hypothesized that leads V1 and V2 may be used for estimation of the interatrial frequency gradient in patients with verified RAA-LAA gradient.

Methods: 12-lead ECG was recorded simultaneously with electrograms from RAA and LAA in 12 pts (17 recordings) who had interatrial AFCL gradient during AF ablation (AFCL difference between RAA and LAA > 10 ms). Right-to-left gradient was observed in 8 cases (negative gradient) and left-to-right gradient in 9 cases (positive gradient). AFCL from V1 and V2 was determined using spatiotemporal QRST cancellation and time-frequency analysis and V1-V2 AFCL gradient was calculated. Invasive vs

non-invasive AFCL gradient difference was calculated to study mean error between two methods of measurement (ME).

Results: In 6 cases, the V1-V2 matched the RAA-LAA gradient direction ($\Delta\text{Endo-AFCL} = -12 \pm 26\text{ms}$, $\Delta\text{ECG-AFCL} = -18 \pm 23\text{ms}$, $\text{ME} = -5 \pm 10\text{ms}$). In the remaining 11 cases no V1-V2 gradient was observed (7 cases, $\Delta\text{Endo-AFCL} = -19 \pm 35\text{ms}$, $\Delta\text{ECG-AFCL} = 0 \pm 3\text{ms}$, $\text{ME} = -18 \pm 35\text{ms}$) or it was reverse to RAA-LAA gradient (4 cases, $\Delta\text{Endo-AFCL} = 19 \pm 27\text{ms}$, $\Delta\text{ECG-AFCL} = -16 \pm 36\text{ms}$, $\text{ME} = -36 \pm 51\text{ms}$). Agreement between RAA-LAA and V1-V2 gradients was more common in cases with right-to-left gradient (5 of 8) than in cases with left-to-right gradient (1 of 9), $p < 0,05$.

Conclusions: Interatrial AFCL gradient may be retrieved from leads V1 and V2, especially when AFCL in RAA is shorter than in LAA during ablation procedure. However, further refinements of signal-processing technology and/or the use of alternative leads are needed in order to achieve reliable estimation of left atrial AFCL and interatrial gradient.

Right atrial organization and wavefront analysis in atrial fibrillation

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Purpose: The purpose of this study is to develop techniques for quantifying the propagation pattern during atrial fibrillation (AF) along a one-dimensional catheter as well as to investigate potential relationships between extracted parameters and body surface parameters.

Materials and methods: The database consisted of 26 10-s recordings from patients during drug-refractory AF, in which 5 adjacent bipolar electrograms from a catheter in the right atrium were recorded. The 12-lead ECG was recorded simultaneously. The proposed method for wavefront analysis is based on the detected activations. Close activations in different electrograms are combined into wavefronts, analyzed with respect to their consistency over time, and resulting in a parameter denoted 'wavefront consistency'. Furthermore, a propagation profile, reflecting the predominant activation order along the catheter, is calculated from the wavefronts. Measures of intra-atrial signal organization which are based on time-frequency analysis are employed to assure the reliability of the analysis.

Results: The database was divided into one group with too low and one group with sufficient degree of intra-atrial signal organization for wavefront analysis ($N = 9/N = 17$, respectively). For the latter group, wavefront detection was performed. The consistency of the wavefronts yielded 15.1 ± 5.6 ms and was not reflected by the body surface parameters. AF frequency was able to distinguish between the recordings with different degrees of intra-atrial signal organization ($f = 6.6 \pm 1.0$ Hz/ 5.8 ± 0.5 Hz, $p = 0.008$).

Conclusions: The degree of wavefront consistency provided insights into the temporal variability of the activation order, an aspect which was not reflected by the body surface parameters. However, AF frequency could distinguish between recordings with different degrees of intra-atrial signal organization, thus supporting its role as an AF organization measure.

Influence of amiodarone therapy on P-wave signal-averaged electrocardiogram in patients with atrial fibrillation in early period after isolated coronary surgery

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Background: Atrial fibrillation (AF) occurs commonly after artery bypass surgery. Prolonged P-wave duration (PWD) on atrial signal averaged ECG (A-SAECG) recorded before cardiac surgery is a predictor of atrial fibrillation (AF) following operation. The purpose of this study was to evaluate the influence of amiodarone therapy on PWD in patients with AF early after coronary surgery.

Material and methods: Study population consisted of 250 patients with 2-3 vessel coronary disease who had no prior history of AF. There were 160 male and 90 female aged 33-78 years; mean 59 ± 6 . All patients 2 days before and 14 days after CABG underwent A-SAECG recordings. Filtered P wave signals averaging at noise level of $< 0.3 \mu V$ was analyzed.

Results: Twenty-eight (11%) of the patients developed AF 2-7 days after surgery. In 13 patients amiodarone therapy was continued in postoperative

period after successful cardioversion. The P wave duration recorded before surgery was significantly longer in patients with postoperative AF (135 ± 19 ms vs. 117 ± 11 ms; $p = 0.001$).

Conclusions: Prolonged P wave duration is good predictor of atrial fibrillation after coronary surgery. The shortening of P-wave duration after operation is significant only in patients with atrial fibrillation and postoperative amiodarone therapy.

Table P-wave duration before and after CABG

	PWD 1	PWD 2	
AF(-) 222 pts (89%)	117+11 ms	118+14 ms	NS
AF(+) on amiodarone, 13 pts	135+14 ms	123+19 ms	$p < 0.001$
AF(+) off amiodarone, 15 pts	134+31 ms	129+15 ms	NS

PWD1 - before operation; PWD2 - 14 days after surgery

The changes in duration of repolarization in patient with transient disappearance of atrial fibrillation after cardiac surgery

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Background: Restoration of sinus rhythm in patients (pts) with atrial fibrillation (AF) is related with increased risk of polymorphic ventricular tachycardia. During the early recovery phase after cardiac surgery in pts with AF transient sinus rhythm restoration may be observed and that period is related with increased risk of severe ventricular tachyarrhythmias.

Purpose: The aim of the study was to assess the changes in duration of

repolarization in pts with preoperative chronic AF in regard to restoration of sinus rhythm or maintenance of AF.

The study group consisted of 33 pts aged 67.1+/-9.3 (15F, 18M) referred for cardiac surgery with chronic AF. The QTc interval and mean R-R interval were measured before cardiac surgery, and on the first day after cardiac surgery. The pts were divided into Group I with sinus rhythm restoration and Group II with AF on postoperative first day. Six pts with ventricular pacing were excluded from further analysis.

Results: Transient restoration of sinus rhythm was observed in 59% of pts. We observed one event of ventricular fibrillation and one event of polymorphic ventricular tachycardia in patients with restoration of sinus rhythm. The concomitant diseases, kind of cardiac surgery and obtained results of QTc and R-R intervals were presented in Table 1.

Conclusions: The patients with sinus rhythm restoration after cardiac surgery on postoperative first day had longer QTc than those with maintained AF. The ventricular tachycardia and fibrillation occurred only in pts with restoration of sinus rhythm. Low incidence of ventricular tachyarrhythmias requires enlargement the study group to achieve or exclude statistical significance.

Table

	Group I (16)	Group II (11)	p
Diabetes mellitus (%)	31	18	
Arterial hypertension (%)	63	36	NS
Valvular surgery (%)	88	82	NS
CABG (%)	31	36	NS
R-R interval before (ms)	858+/-152.1	799+/-208.0	NS
QTc interval before(ms)	434+/-34.8	421+/-53.3	NS
R-R interval after (ms)	725+/-150.2#	811+/-212.5	NS
QTc interval after(ms)	493+/-63.0*	429+/-65.9	<0.01

*p<0.01 vs QTc before in group I and II

p<0.05 vs before

O-30 Identification of local ischemic changes in the heart from BSPM during exercise using a two-dipole model

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Purpose: A method for identification of local ischemic lesions by an inverse solution with two dipoles was tested on patients with coronary artery disease. The results were compared with perfusion images obtained by single photon emission computer tomography (SPECT) and with findings from coronarography.

Material and methods: Body surface potential maps (BSPMs) from 64 leads were recorded in 10 patients at rest and during exercise test on supine ergometer with a stepwise increasing load from 25 to 250 W. Difference QRST integral map (DIM) computed by subtracting integral map at rest from the map during exercise at load of 75W was considered as representation of possible local repolarization changes induced by the stress. Inverse solutions with 1 and 2 dipoles located in 164 predefined positions within the ventricular

muscle volume were computed to find the best equivalent generator (EG) producing the DIM. Common torso model with main inhomogeneities (lungs, heart cavities) was used in the solution. For the two-dipole model, 2 clusters of dipoles were defined using several pairs of dipoles best representing the DIM. Properties of the clusters were then used to assess the number, type and location of possible ischemic lesions.

Results: In 8 of 10 analyzed cases, the ischemic lesions were identified in agreement with SPECT. For 3 patients the inverse solution identified 2 distinct clusters. They represented either 2 local lesions or borders of 1 large transmural lesion. For another 3 patients one lesion was identified and no local lesions were found in 2 cases. DIM for one patient was not evaluated, because it could not be satisfactorily represented by modeled EGs and in 1 case the SPECT image was not in agreement with our result.

Conclusions: Presented method provides the possibility to identify the presence of local ischemic lesions during exercise and to distinguish between 1 and 2 lesions in most cases. The use of individual torso geometry could further improve the results.

O-31 Usefulness of BSPM in long-term monitoring of heart condition in women after mastectomy and radiotherapy

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Purpose: The goal of the study was to find possible abnormalities in BSPM patterns after few years from finishing the oncological treatment.

Material and methods: The group of 33 women after mastectomy was analyzed. The first BSPM registrations were performed directly after surgical intervention (as soon as skin was healed). Then patients were treated by radiotherapy or radiochemotherapy according to the modern oncological treatment regimen. As soon as the therapy was completed, the second and the next BSPM maps were recorded. The interval between the first and the last BSPM examinations was 2-4 years. For each patient, departure maps were created comparing the initial and final registrations. Then analysis of departure maps was performed.

Results: In the analyzed patients, three types of evolving patterns were observed: decreasing, increasing and stable. The first type of changes was caused by early radiation reaction, and they disappeared after several

months. The second type of changes detected in the isointegral maps were demonstrated at least one year after finishing therapy, they reflected serious heart disturbances. Finally, the stable type means an absence of evident changes in the BSPM maps.

Conclusions: The BSPM analysis seems to be a comfortable tool for long-term monitoring of the heart's condition in women after oncological treatment. Electric heart abnormalities caused by ionizing irradiation can be demonstrated in isointegral maps. Departure maps are suitable for monitoring an individual patients. The observed changes depend on the treatment duration, total radiation dose and time of the BSPM examination after radiotherapy.

The nonspecific intraventricular conduction delay may produce significant dispersion of regional isovolumic contraction times in patients after acute coronary syndrome with moderately depressed global left ventricular systolic function

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Background: Contribution of left bundle branch block to regional contractile dyssynchrony in patients with severe myocardial damage is well-documented. However, the significance of nonspecific intraventricular conduction disturbances (NIVCD) to regional contractile synchrony in patients after acute myocardial infarction with moderately depressed systolic LV function has not been thoroughly investigated as yet.

Purpose: Aim of the study was to evaluate the effect of presence of NIVCD in electrocardiographic record on the intraventricular dispersion of regional isovolumic contraction times (IVCTm).

Material and methods: 30 patients after acute myocardial infarction (15 pts with NIVCD; widened QRS complexes: QRS width equal or above 120 ms without fulfillment of RBBB or LBBB criteria - group A, vs 15 pts without NIVCD in electrocardiographic record - group B) with moderately

depressed left ventricular systolic function in echocardiography (EF biplane approximately 40%) entered the study. The pulsed wave tissue doppler echocardiography (PW-TDE) interrogation of IVCTm within the basal and medial segments of lateral wall and interventricular septum was performed in all the examined subjects. Afterwards, the IVCTm dispersion index (the difference between the shortest and longest IVCTm within the interrogated walls) was measured in both groups.

Results: The difference between the shortest and longest IVCTm was statistically significant in the group A (25 ± 2 ms vs 42 ± 4 ms, p value < 0.05). The differences between the obtained values of IVCTm in the group B were not significant. The IVCTm dispersion index was significantly bigger in the group A as compared with the group B (17 ± 2 ms vs 4 ± 4 ms, p value < 0.05).

Conclusions: The slight intraventricular conduction delay in electrocardiographic record may produce dyssynchronous contraction of left ventricle in patients after acute coronary syndrome with moderate depression of global LV systolic function.

QT prolongation is a myocardial infarction indicator in patients with left bundle branch block and chest pain

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Background: The diagnosis of acute ischemia in patients (pts) with chest pain relies mostly on symptoms and the electrocardiogram (EKG); left bundle branch block (LBBB) mask ischemic changes, precluding the diagnosis. The QT interval is known to be affected by the transmural ischemia. We hypothesized that the variation in QT values could be a reliable indicator of ongoing ischemia in LBBB pts.

Material and methods: Patients were chosen during a 5 years period from the primary PTCA cath lab database, having at least an occluded artery on the angiogram, enzyme elevation, either LBBB or pacemaker rhythm and another EKG off the ischemic event to compare QT values. Corrected QT measurement (QTc) was taken from the automated values given by the EKG machine; two EKGs off ischemia were used to ascertain any normal variation during time.

Results: From 5177 pts with a PTCA in the chosen period, 278 pts had a primary PTCA with at least the 3 EKGs needed, and from them, 64 had LBBB and 29 had a pacemaker rhythm. Mean age was 75.7 years (± 11.8 years) and there was 63% of men in the LBBB group. Mean QTc value

during ischemia was 484.14 msec, and 468.03 msec and 462.85 msec in EKGs off ischemia (p value for the variation of 0.013). Culprit arteries were: left main/LAD in 42.18%; RCA and Left circumflex in 48.43%; and three vessels disease in 9.37%. The left main/LAD was the only variable associated with the highest variation in QTc: 472.69 msec and 459.6 off ischemia vs ischemic QTc of 491.59 msec ($p=0.01$). A TIMI score higher than three was also a predictor of QTc prolongation ($p=0.049$). If off ischemia EKGs are compared between, and then the variation to ischemic QTc is plotted against, we obtained this positive (PPV) and negative (NPV) predictive values: for a 15 msec prolongation PPV 0.86, NPV 0.63 (sensitivity 0.44 and specificity 0.93); and for 20msec prolongation PPV 1, NPV 0.6 (sensitivity 0.33 and specificity 1).

Conclusions: When evaluating a chest pain patient with LBBB for the presence of ischemia, and if there is a previous EKG to compare, the QTc prolongation is a useful marker of ongoing transmural infarction. A QTc increase in at least 15 msec is a good cut-off value for the diagnosis of myocardial infarction.

Asymmetrical properties of short-, long-term and total heart rate variability in healthy people

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Background: Heart rate asymmetry (HRA) is a physiological phenomenon manifested by the fact that the contribution of heart rate decelerations to short-term HRV is greater than that of accelerations.

Purpose: To assess the presence of HRA in long-term and total heart rate variability (HRV).

Material and methods: The study was performed in 241 healthy volunteers (median age 23 years; 105 female participants). Resting supine ECG was recorded for 30 minutes. The analysis of Poincaré plot of RR intervals was applied for HRA quantification. A set of variables measuring contributions of decelerations to short-term (C1d), long-term (C2d) and total HRV (CTd) along with the relative number of decelerations to all sinus RR intervals with changing duration (Nd) were calculated. In statistical analysis, binomial test was applied. Results are shown as median with interquartile range (IQR) for C1d, C2d, CTd and Nd. The frequency of C1d > 50%, C2d < 50%, CTd < 50% and Nd < 50% in the studied group is accompanied by 95% confidence interval (CI).

Results: Median contribution of heart rate decelerations to the short-term HRV (C1d) was 54.2% (IQR: 51.1-58.1%), to the long-term HRV (C2d) it was 47.3% (IQR: 44.1-49.7%), to the total HRV (CTd) it was 48.3% (IQR: 46.3-49.9%) and to the number of all RR intervals with changing dura-

tion (Nd) it was 49.2% (IQR: 47.5-51.1%). The C1d > 50% was present in 82.6% (95%CI: 77.2-87.1%; p<0.0001 - binomial test), C2d < 50% in 76.4% (95%CI: 70.5-81.6%; p<0.0001), CTd < 50% in 76.4% (95%CI: 70.4-81.6%; p<0.0001) and Nd < 50% in 60.2% (95%CI: 53.7-66.4%; p=0.0019) of studied subjects.

Conclusions: Heart rate asymmetry is present in short- and long-term as well as total HRV in 30-minute resting ECG recordings from healthy people no older than 40 years old. In such recordings, the contribution of heart rate decelerations is larger than that of accelerations only for short-term HRV but not long-term and total HRV.

Heart rate and heart rate variability obtained from Holter recordings in patients with patent foramen ovale and stroke

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Background: Heart rate variability (HRV) is strongly influenced by central autonomic nervous activity. Recently, it was found that patients with stroke had diminished HRV. Purpose of the study was to analyze heart rate (HR) and HRV obtained from 24-hour ECG recording in patients with patent foramen ovale (PFO) and history of ischemic stroke, with regard to location in central nervous system (CNS) according to Oxfordshire Classification.

Methods: Cohort of 90 patients with PFO and non-severe brain event (stroke or documented transient ischaemic attack- TIA), without any other structural heart disease was analyzed. Nine of them were excluded due to the non-sinus rhythm or frequent arrhythmias. The study population consisted of 48 patients with Posterior Circulation Stroke (POCS; 38 females, age: 38+/-12 years) and 33 patients with other, anterior ischemic locations (Partial or Total Anterior Circulation Stroke- ACS: 19 females, age: 37+/-11 years). Data of 30 healthy subjects (H) were also used for comparison with PFO cohort. Maximum, average and minimum HR (HR max, HR avg and HR min) and time domain HRV parameters (SDRR and rMSSD) were collected from the entire 24-hour ECG recording.

Results: Mean HR was lower in patients with PFO than in control subjects: 71+/-9 vs. 78+/-8 bpm, p=0.005; no difference was observed for HR min- 55+/-7 vs. 53+/-5 bpm, p=0.98. POCS patients had the lowest values of both SDRR and rMSSD when compared with ACS and healthy: SDRR- 131+/-28 vs. 147+/-33 vs. 157+/-26 bpm, MANOVA p= 0.001 and rMSSD- 31+/-12 vs. 40+/-20 vs. 42+/-17 bpm, MANOVA p= 0.03; respectively. Type of ischemic event did not differentiate subjects from both groups.

Conclusions: Significantly lower heart rate variability in patients with vertebral-basilar location of ischemic episode may suggest the presence of higher sympatho-vagal disturbances in this group. Further prospective analyzes are needed to assess the clinical significance of this finding.

Correlation between serum BNP levels and indices of heart rate variability and heart rate variability indices in patients with diastolic heart failure

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Background: The aim of the study was to define the relationship between brain natriuretic peptide (BNP) serum levels and heart rate variability (HRV) as the indicators of autonomic balance in patients with diastolic heart failure.

Material and method: The study comprised 100 subjects. The study group (SG) consisted of 50 hypertensive patients with heart failure (NYHA class II-IV), preserved left ventricular systolic function and echocardiographic indicators of diastolic dysfunction. Control group (CG) consisted of 50 hypertensive patients without heart failure. Entering BNP serum level and 24-hours ECG Holter were performed. SDNN, SDNNI, SDANN, rMSSD, pNN50 and HRV TI in time-domain HRV analysis were assessed.

Results: In the SG BNP serum levels median was value 63.41 pg/ml. Median BNP level correlated positively with NYHA class and were as follows: 47.08 pg/ml for NYHA class II; 135.72 pg/ml for NYHA class III and 227.83

pg/ml for NYHA IV. ($r = 0.645$; $p < 0.001$). In HRV analysis mean SDNN value was 132.46 ± 31.33 ms, mean SDNNI was 37.57 ± 10.80 ms, SDANN 122.04 ± 30.61 ms, rMSSD 37.27 ± 17.81 ms, pNN50 0.076 ± 0.084 ms and HRV TI 18.38 ± 5.28 ms. Significant positive correlations was defined in NYHA class II patients for BNP and rMSSD value ($p < 0.012$), for BNP and SDNNI ($p < 0.057$) and for BNP and pNN50 ($p < 0.007$). In NYHA III patients correlations between BNP and SDNNI ($p < 0.03$) was found. In the CG BNP median value was 26,19 pg/ml. HRV values were as follow: SDNN 144.84 ± 44.04 ms, SDNNI 42.38 ± 16.47 ms, SDANN 134.72 ± 43.15 ms, rMSSD 41.36 ± 30.20 ms, pNN50 0.086 ± 0.088 ms a HRV TI 19.54 ± 5.52 ms. There was no correlation between the HRV parameters and BNP levels in the CG.

Conclusions: 1. In patients with diastolic heart failure BNP serum level correlates positively with the clinical state assessed by NYHA class. 2. BNP serum level demonstrates significant positive correlation with some of the HRV indices in NYHA class II and III diastolic heart failure patients.

The assessment of QTc and QTd in opioid-dependent patients on long-term methadone therapy

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Background: Methadone used in the treatment opioid-dependent subjects can cause QTc prolongation and polymorphic ventricular tachycardia (torsade de pointes).

Purpose: Assessment of the frequency of the QTc prolongation in ECG recording in a population of opioid-dependent subjects on a long-term methadone treatment.

Material and Methods: ECG recordings were carried out on 68 subjects (20 female and 48 male) on long-term methadone therapy (digital recording, Medea system). RR and QT intervals were measured in all leads with assessing of QT min, QT max and QTd by using caliper function in enlarged evolutions. Precision of measurement was 2 ms. QT-corrected intervals were calculated using Bazett's formula (QT max was used for correction). As the upper limit of normal QTc the following values were accepted: 450ms for women and 440ms for men.

Results: The average RR interval was 869 ± 165 ms. Among all subjects tested: average QTmin was 384 ± 36 (304-480) ms; QTmax 412 ± 38 (334-

558) ms; QTc 445 ± 29 (402-606) ms; QTd 28 ± 11 (6-78) ms. The average QTc in women was 452 ± 43 ms, comparing to men 442 ± 21 ms (NS). Dispersion of QT interval in women was 27 ± 14 ms, and in men 29 ± 10 ms (NS). In 10 (50%) women QTc exceeded 450 ms, in 3 of them it was >470 ms, in one >500 ms. For 20 (42%) men QTc exceeded 440 ms, in 6 of them it was >470 ms and one >500 ms. The increased dispersion of QT (QTd > 50 ms) revealed for 1 woman QTd 78 ms with QTc 605 ms and 1 man QTd 60 ms with QTc 477 ms.

Conclusions: Prolongation of repolarisation period (QTc) exceeding upper limits of normal QTc was recorded for almost half of opioid-dependent patients on long-term methadone maintenance therapy. However, QTc exceeded risky limit 500ms only sporadically. The increased occurrence of QTc prolongation among these subjects indicates that carefulness in usage of drugs prolong QT interval is necessary.

Heart rate variability in pregnant women with cardiovascular complications

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Purpose: The purpose of researches was evaluating of the peripheral autonomic dysregulation of the pacemaker activity in sinus node (SN) in pregnant women, as a pathogenic link of cardiovascular complications (CVC).

Material and method: High-resolution rhythmocardiography (RCG) investigation with a computer analysis of HRV in Time Domain (AT) and Frequency Domain (AF) and apparatus-program complex CAP-RC-01-Micor were used. 35 women with normal pregnancy (NP), and 31 women with complications (PC) underwent were investigated some times during their pregnancy by RCG. Quadratic dispersion of HRV waves σ_l , σ_m , σ_s , connected with humoral-metabolic, sympathetic and parasympathetic influences in SN, and their spectral analogous HF%, LF%, VLF% were obtained in rest and stimulant tests. Then HRV indices were compared between groups.

Results: Pregnancy in NP was accompanied by an authentic increase of VLF% and by adequate reactions to stimuli, by reduction of σ_s in AT without change the spectral density power of HF% in AF, because this band included the "special waves" with the spectral peak in 0.21 ± 0.01 Hz. In the pregnant women with CVC high frequency "special waves" were absent, the amplitudes of all HRV fluctuations SDNN, σ_l , σ_m , σ_s in AT were

reduced, with the high authenticity ($t=3.49-11.2$, $p<0.001$). Moreover, HRV stabilization was defined at the beginning of pregnancy. It was interpreted, as a predictors of CVC until their clinical manifestation. The spectral correlation between HRV regulative factors consists in the biggest share of VLF% and the smallest share of HF% (VLF%= 53.3 ± 19.1 in PC vs $24.73 \pm 13.3\%$ in NP; and HF%= 22.3 ± 12.8 vs $61.69 \pm 19.9\%$, correspondingly). The reactions to stimuli in tests were significantly decreased in PC. In this group the dynamics of the RCG indices was absent during pregnancy, too. The CVC of pregnancy were accompanied by the significant HRV stabilization from the early period of pregnancy to its end. Here is a reduction of amplitudes of all types of HRV-waves in AT and AF, as RCG symptoms of significant oppression of the autonomic influences in the SN. Heart rate reactions to stimuli are nearly absent.

Conclusions: In most cases, these HRV authentic changes are observed at the first 3 month of pregnancy, when the clinical symptoms of complications are absent practically. Thus, HRV data in AT and AF are valid for singling out certain early markers of complications in pregnant women.

Coronary artery disease and heart rate variability

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Purpose: Purpose of presented assessment was the definition of heart rate variability (HRV) symptoms in 3383 patients (pts) with a coronary artery disease (CAD).

Material and method: Control group consists of 48 age-matched healthy men. HRV was registered by high-resolution CAP-RC-01-Micor complex in rest and 4 stimulant tests some times during 5-9 years observation and analyzed with evaluation of spectral and statistic HRV indices - HF%, LF%, VLF% - (0.15-0.4, 0.04-0.15 and 0.0033- 0.04 Hz), and their statistic quadratic dispersions - σ_s , σ_m , σ_l , demonstrating parasympathetic, sympathetic and humoral-metabolic influences in the sinus node of the heart (SN). Received data were confirmed by results of other investigations (ECG, EchoCG, HM), clinical symptoms and comparison with control data ($p<0.01-0.001$).

Results: The following RCG symptoms of the ischemic process in the heart, consistently appeared in the order: at first, the share of humoral VLF% increased at the expense of HF%, then, the amplitudes of all HRV waves decreased, according to the meanings of σ_l , σ_m , σ_s , with the simultaneous reduction of the reactions to stimuli in tests. In case of stenocardia, there were segments of the significant HRV stabilization, synchronous to ST-depression and corresponding to functional classes. At last, there

was the stabilization of the whole HRV on the background of tachycardia and absence of reactions to any stimuli in tests. This was a syndrome of autonomic cardiomyopathy, as a predictor of CAD complications and lethal outcome. HRV data testified, that the CAD accompanied by obligatory dysregulation in the SN. SN dysregulation had peculiarities for every CAD clinical forms. Also it was possible for the add opportunities of a differential diagnostics between the prevalent defeat of the myocardium or coronary vessels. In pts with the prevalence of a muscle variant of CAD the rehabilitative period after an exercise was significantly extended, the load dose was not reached, showing the myocardial rigidity. In a number cases it was proved by EchoCG data. The prevalence defeat of coronary vessels, clinically accompanied by the stenocardia. In the majority cases, this stabilization coincided with retrosternal pains during HRV investigation. Acute coronary syndrome had the appointed HRV predictors. There were extension of the HRV stabilizations, their increase in frequency, decrease and fluctuation of the ischemic threshold. Probably, the degree of HRV stabilization matches functional and cellular remodeling in the SN.

Conclusions: HRV analysis gives a certain possibilities for nonspecific differential diagnostics of the SN dysregulation in patients with CAD.

Heart rate variability in patients with hypertension disease

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Purpose: Purpose of this assessment was evaluation HRV of high-resolution in patients (pts) with hypertension disease (HD).

Material and methods: The pts with HD of the 1-st and 2-nd stages (HD1, n=54, HD2, n=61) and 48 healthy age-matched men (control) were selected from 1281 subjects with arterial hypertension on the background clinical, ECG, EchoCG data. All subjects were investigated by the rhythmocardiography (RCG) with HRV spectral and statistic analyses in rest and 4 stimulant tests. HRV indices were defined - HF%, LF%, VLF% - (0.15-0.4, 0.04-0.15 and 0.0033- 0.04 Hz), and their quadratic dispersions - $\sigma_s, \sigma_m, \sigma_l$, respectively.

Results: HRV data of HD1 were presented by the reduced values of the vagal indices - $\sigma_s = 0.011 \pm 0.006 \text{ sec.}$; HF% = $13.44 \pm 6.6\%$ vs normal $\sigma_s = 0.046 \pm 0.017 \text{ sec.}$; HF% = $56.9 \pm 17.4\%$ in all tests ($t = 13.71 - 16.81$, $p < 0.001$). The sympathetic spectral share was increased - $\sigma_m = 50.72 \pm 16.4\%$ vs normal $19.5 \pm 10.1\%$ without any change values of the m-waves, ($\sigma_m = 0.023 \pm 0.01 \text{ sec.}$ vs control $0.025 \pm 0.01 \text{ sec.}$). This difference was in all tests, even in Vm with the vagal excitation. Differences between statistic (σ_m) and spectral indices (LF%) implied, that the epinephrine concentration, exited from the sympathetic terminals, was normal, but it was frequent due to a decrease of the parasympathetic inhibitory influence in the sinus node (SN). It is possible that HD1 pathogenesis is

associated with primary cholinolytic effects and the AH is not the result of the sympathetic excitement, but rather a consequence of the vagal reduction. It may be supposed, that the well known sympathetic increase is the secondary effect. The specific value of the above mentioned HRV signs amounts to 84.2%, in sensibility - 77.6%, the positive prognostic value was 84.7% and the negative prognostic value being 77.07%. HD2 was presented by reduced amplitude and spectral density power of the sympathetic m-waves ($\sigma_m = 0.011 \pm 0.005 \text{ sec.}$; LF% = $27.27 \pm 6.4\%$) and vagal s-waves ($\sigma_s = 0.008 \pm 0.003 \text{ sec.}$; HF% = $16.92 \pm 8.5\%$), the prevalence of long humoral waves ($\sigma_l = 0.015 \pm 0.006 \text{ sec.}$; VLF% = $60.4 \pm 8.2\%$), and a low reactions in tests and the protraction of the restorative time after exercise. The prevalence of humoral influence and significant decrease autonomic regulation in the SN kept in all stimulant tests, as the common HRV reduction. The specific value of these RCG signs for diagnostics of the stage 2 HD amounts to 34.15 %, sensibility - 72.9 %, the positive and negative prognostic value being - 60.9 and 40.3 %.

Conclusions: The received RCG data on HD allow to suppose the functional and dystrophic defeats in the SN, an exchange of the ionic transfer through the cellular membranes, a damage of energy and cellular metabolism. During the formation of the HD stages, one can observe a qualitative heterogeneity of HD pathogenesis, which expresses itself in the changes of interaction of the autonomic terminals and the vessel wall without any morphological breaches, and the same changes, but in conditions of these structures being remodeling and autonomic denervation. The first variant is, perhaps, found in stage 1HD, while the second variant is connected with a succeeding transformation of stage 1 into stage 2 HD. The difference in the pathogenic patterns requires a differential treatment.

Effect of nebivolol and perindopril/losartan on atrial fibrillation recurrence and P-wave dispersion in patients with recurrent atrial fibrillation

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Purpose: P-wave dispersion (PWD) has been shown to be a non-invasive electrocardiographic predictor for development of atrial fibrillation (AF). The aim of the study was to compare the effects of nebivolol and perindopril/losartan on AF recurrence, on PWD, and on left atrium (LA) size.

Material and methods: A total of 75 patients in sinus rhythm but at least one episode of AF in the previous month were enrolled in the study. The patients had received treatment with either perindopril/losartan (n= 35) or nebivolol (n= 40) for one year. PWD, and echocardiographic measurements were performed at baseline and after 3, 6 and 12 months of treatment.

Results: Mean age was 65 years and 56% were males. The prevalence of various demographic, and etiologic factors were similar between the groups except that subjects treated with perindopril/losartan were significantly more likely to have coronary artery disease ($p = 0.001$). During follow-up, a total of 33 (94.3%) patients treated with perindopril/losartan had a recurrence of AF as did 22 (48.9%) patients treated with nebivolol ($p < 0.0001$). While PWD values were significantly reduced by nebivolol ($41 \pm 11 \text{ ms}$ to $22 \pm 5 \text{ ms}$, $p < 0.001$), no significant change was observed with ramipril/losartan ($42 \pm 6 \text{ ms}$ to $35 \pm 2 \text{ ms}$, $p > 0.05$). Nebivolol significantly decreased PWD at 3rd

month, but no significant reduction on PWD was determined at 6th and 12th months ($41 \pm 11 \text{ ms}$ to $25 \pm 8 \text{ ms}$, $p < 0.001$ at 3rd month). Baseline and follow-up LA diameters were not significantly different between the groups.

Conclusions: Nebivolol was more effective than perindopril/losartan in preventing new episodes of AF. This could be related to the greater PWD reduction observed with nebivolol.

Short-term ECG recordings for heart rate assessment in patients with chronic atrial fibrillation

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Background: Ambulatory Holter monitoring covering at least 24 hours seems to be the gold standard in clinical assessment of the mean ventricular rates and its irregularity, both at rest and during exercise. Unfortunately, 24 hours monitoring may be not long enough for optimal management of the heart rate in AF patients. Up to date there is no consensus on how to define the proper rate control and what is the length sample of ECG tracing that should be recorded.

Purpose: The purpose of the study was to examine whether the heart rate samples based on short term ECG recorded at different period of day may represent mean heart rate and rate irregularity obtained from standard 24 hours Holter monitoring.

Material and methods: A total of 55 patients (25 males and 30 females, with mean age of 72 ± 77.6 years) with chronic AF were enrolled in the study.

Ambulatory 24-hour ECG Holter recordings were performed and the mean heart rate (mHR) and coefficient of irregularity (CI) were assessed. These parameters mHR and CI were assessed during 24 hours recording as well

as during 5 minute sample recorded in supine position at the beginning of Holter recording and during 5 and 60 minutes recordings in the following periods of the day: 6.00-6.05AM; 6.00-7.00AM; 12.00-12.05PM; 12.00-1.00PM; 6.00-6.05PM; 6.00-7.00PM; 12-12.05AM; 12.00-01.00AM. These intervals were arbitrarily chosen by the authors.

Results: The mean value of HR during 5 minutes sample after 15 minutes of resting as well as 60 minutes mHR recorded between 6.00-7.00 AM, was similar to 24 hours mHR. The mean values of CI only during 60 minutes recording at 6.00 am was insignificant different to the 24 hours. Mean heart rate and irregularity parameters during the all others period of the day, in 5 and 60 minutes were significant different to the 24 hours.

Conclusions: 1. Short-term (5 minutes) ECG recording taken at rest after moderate exercise during a follow up visit might accurately predict mean heart rate over 24 hours. 2. In patients with atrial fibrillation, in whom long term Holter recording was performed, daily mean heart rate and rate regularity might be predicted from 60 minutes ECG interval, but only during early morning period of the day.

Arrhythmias in the course of thrombolytic therapy: which of them can be considered reperfusion arrhythmias?

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Material and methods: 43 STEMI patients (age 37-77 (55 ± 10)) were involved in the study. In 42% of cases the inferior MI was diagnosed. 12-lead continuous ECG-monitoring was started since the patient was admitted to the coronary care unit. All the patients received thrombolytic therapy (TT) with prourokinasae. The time "Pain to treatment" was 232 ± 76 min. TT was considered to be effective in 62% of patients. In 52% "reperfusion peak" was found in course of TT. ST-segment elevation exacerbation during the reperfusion therapy was as high as 140% and higher; ST increased within 10 min and dropped thereafter reaching the initial level within the next 15 min.

Results: In 33% of patients (in 54% of patients with effective TT), arrhythmias directly related to blood flow restoration were registered. These arrhythmias were located close to the "reperfusion peak" – within $3,7 \pm 3,9$ min. The structure of reperfusion arrhythmias was the following: in 73% - accelerated idioventricular rhythm was found, in 35% - bradyarrhythmia (only in patients with inferior MI), in 33% - the number of ventricular ectopic beats increased, 33% of patients showed the combination of different rhythm disorders. Not only was the directly reperfusion arrhythmias, but also the ventricular arrhythmias distribution character analyzed in the first

24-hours of MI. In the course of the TT and 3,5 hours later the accelerated idioventricular rhythms were mainly observed. Most of potentially life threatening arrhythmias were found 5-7,5 hours later. Thus, within 3,5 hours after starting TT 31% of accelerated idioventricular rhythm was observed, vs. only 7% of the number of nonsustained ventricular tachycardia ($p < 0,0001$). The control group of patients within the same period of STEMI did not receive the TT; the pattern in this group was quite different.

Conclusions: The differences between patterns of ventricular arrhythmias distribution between the two above mentioned groups of patients allows to conclude that retarded arrhythmias are indirectly related to the reperfusion, which requires further evidence to support.

Repolarization of the chicken left ventricle under ectopic pacing

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Purpose: The purpose of the present study was to evaluate the effects of ectopic pacing of the left ventricle on repolarization heterogeneity across and along the left ventricular free wall in birds.

Material and methods: Unipolar electrograms were acquired by means of a 128-channel data acquisition system from as many as 98 sites of the left ventricular free wall with 14 plunge needles, each consisting of seven electrodes, under sinus rhythm and endocardial/epicardial pacing of the base/apex of the left ventricle in six anaesthetized adult female chickens. Activation-recovery intervals (ARIs), corrected to cycle length, were used for estimating repolarization.

Results: At sinus rhythm, the shortest ARIs and the longest ones were found to be in the basal subepicardium and the apical and mid-wall sub-endocardium of the left ventricle, respectively; the apicobasal difference in ARIs was greater than the transmural one. The pooled ARI was increased

statistically significant by ventricular pacing. Nonuniform prolongation of ARIs resulted in decreasing the transmural difference and increasing the apex-to-base difference in ARIs. The total left ventricular transmural gradient was found to be contributed by the basal rather than apical transmural difference in ARIs. The total left ventricular apicobasal gradient was found to be contributed by the apicobasal difference in mid-myocardial and sub-endocardial ARIs more than in subepicardial ARIs.

Conclusions: Repolarization heterogeneity exists within the left ventricle of the chicken heart at sinus rhythm, with the apicobasal difference in ARIs being greater than the transmural one. Compared with transmural heterogeneity, apicobasal heterogeneity of local repolarization properties more contributes to the total left ventricular repolarization gradient. This study was supported by the Russian Science Support Foundation and the Program of support for basic research performed in the Ural Branch of the Russian Academy Sciences.

Genesis of the T wave in frogs and pikes

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Background: The heart of poikilothermic animals presents a convenient model to study the T wave genesis as it has the only ventricle and hence the interventricular gradient is omitted.

Purpose: The aim of our investigation was to determine the contribution of apex-to-base and transmural repolarization gradients on the genesis of the T wave of electrocardiogram in the amphibian and the fish heart.

Material and methods: Potential mapping was done on the hearts of eight pikes and nine frogs using 32 body surface, 24 epicardial and 40-72 intramural unipolar leads at temperatures for pikes +12°C and for frogs +18 and +10°C. Activation times, repolarization times and activation-recovery intervals (ARI) were measured.

Results: The ventricular epicardial repolarization sequence in frogs and pikes had a preferential direction from apex to base according to the distribution of ARIs being shorter at the apex and longer at the base ($p < 0.05$). The significant transmural ARI gradient was found at the base of the ventricle. However, the directions of the transmural ARI and repolarization time gradients were opposite in the two species: the repolarization sequence proceeded from endocardium to epicardium ($p < 0.05$) in pikes and from epicardium to endocardium in frogs ($p < 0.05$). The body surface potential

distributions during the T wave in both animal species studied were quite close to each other in spite of the opposite transmural repolarization gradients. Lowering the temperature of the frog heart from 18 to 10°C produced the inversion of the ventricular epicardial repolarization sequence due to preferential prolongation of ARIs in the apical area ($p < 0.05$). This alteration of the repolarization pattern resulted in the inversion of the body surface potential distribution during the T wave.

Conclusions: Thus, the data of the present study provide evidence in support of the major role of the apex-to-base repolarization pattern in the generation of the electrocardiographic T wave in pikes and frogs.

Changes in QRS complex in rats with streptozotocin-induced diabetes mellitus

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Purpose: In rats with streptozotocin-induced diabetes mellitus (DM), an increase in left ventricular mass to body weight ratio (LVM/BW) is observed, associated with the increased QRS voltage and prolonged QRS duration. These QRS changes are interpreted as ECG signs of left ventricular hypertrophy. However, this experimental model of DM is associated with considerable alteration of myocardial tissue including impairment of connexin43 (Cx43) expression (the principal connexin of mammalian gap junctions). In this study we analyzed the QRS changes in rats with streptozotocin-induced diabetes mellitus in relation to changes in Cx43.

Material and Methods: The standard 12-lead ECG was recorded in Wistar rats with DM induced by streptozotocin (DM, n=8), as well as in age- (CONa, n=7) and weight-matched (CONw, n=7) control groups. The QRS duration (QRSdur), the estimated maximum QRS vector magnitude (QRSmax) and the electrical axis were evaluated. The left ventricular mass (LVM) was weighed after rats were sacrificed. Left ventricular protein levels of Cx43 were analysed using SDS-PAGE and Western blotting.

Results: In DM rats, the values of LVM/BW were significantly higher than in control animals, but the absolute values of LVM were significantly lower. The QRSdur and QRSmax increased significantly in DM rats, and the electrical axis shifted to the left. The Cx43 expression increased in average by 83%.

Conclusions: We showed that the significantly higher values of QRSmax and QRSdur, and the shift of the electrical axis to the left were not associated with the increase in LVM in DM rats, therefore the observed changes in QRS cannot be attributed to LVH. We interpret these changes as manifestations of diffuse impairment of myocardium affecting the sequence of depolarization.

Electric activity of heart ventricles of a pig

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Purpose: The purpose of this work was to investigate the sequence of depolarization and repolarization of heart ventricles of a pig.

Material and methods: The sequence of depolarization and repolarization was studied on 10 pigs of Landras and Big White by the method of multichannel synchronous cardioelectrotopography. Cardiopotentials were registered in walls of pig's heart ventricles.

Results: On initial phases of pig's heart ventricles depolarization, the sub-endocardial layer of interventricular septum from the side of left ventricle excited practically simultaneously with the base area of papillary muscles of left ventricle. After that the area of papillary muscles of a free right ventricle wall and the subendocardial region of interventricular septum from the side of right ventricle depolarized. Multiple foci of initial depolarization located on the whole myocardium from which the excitation wave extends radially appeared. The area of dorsal region of the base of left ventricle depolarized the last. The research of the period of repolarization of pig's heart ventricles showed that subendocardial layers repolarized earlier than subepicardial ones.

Conclusion: Particularities of pigs heart ventricles depolarization are connected with the character of distribution of the conduction system fibers in it which penetrate all the thickness of myocardium wall of both ventricles. Due to the depolarization of ventricles occurs during the short period of time, and multiple areas of early, middle and late electric activity appear. The arrangement of subendocardial zones of early repolarization corresponds to the location of electronegativity foci in the period of ventricles depolarization. However the order of repolarization does not repeat the sequence of depolarization and depends basically on local properties of excitability.

The work is supported by the grant of the scientific school of the academician M.P.Roshchevsky (SS-2452.2008.4); the grant of young scientific UrO RAS.

The effects of ectopic excitation on ventricular repolarization in the common toad

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Purpose: The present study was aimed at investigating of repolarization under ventricular pacing in the common toad *Bufo bufo* (n=9).

Material and methods: The activation and repolarization times, as well as activation-recovery intervals (ARIs) were determined from unipolar myocardial electrograms obtained by a custom-designed 128-channel synchronous recording system. Electrical bipolar pacing (cycle length, 1200 ms; duration, 1 ms; twice diastolic threshold) was done at the right atrium (supraventricular rhythm) and the ventricular apex and base (ectopic excitation) on the anterior aspect of the heart.

Results: Under supraventricular rhythm, the earliest repolarization was observed to be in the subepicardial layers of the anterior ventricular base, whereas the latest repolarization was shown to be in the subendocardial layers of the posterior ventricular base. The longest ARIs were recorded in the subendocardial layers, but the shortest in the subepicardial layers of the ventricle (p<0.001). Under ventricular pacing, the earliest re-

polarization was observed to be in the areas of a stimulus. Under pacing of the base, the latest repolarization was shown to be in the apex, but in the base under apical pacing. The dispersion of repolarization (p<0.05) and ARIs (p<0.03) decreased under pacing of the base compared with supraventricular rhythm. The repolarization sequence depended on the ARIs distribution (r=0.97) and was correlated not statistically significant with the activation sequence under basal and apical pacing, although the values for the correlation coefficient were moderate (r=-0.63 and r=0.32, respectively).

Conclusions: Thus, under ectopic excitation of the heart ventricle of the toad, heterogenous changes in duration of ARIs in the different layers of the ventricle take place due to changing the repolarization sequence of the myocardium.

Effect of Waveform Abnormality, Noise, Gender and Age on QTcB Measurements by Three Automated Electrocardiographic Algorithms

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Background: QT interval measurement is subject to significant variability and the use of automated ECG measurement algorithms has been proposed to reduce it. The objective of this study was to compare Bazett-corrected QTc intervals (QTcB) obtained by an older generation automated algorithm (Old12SL, GE Healthcare) and by two newer generation automated algorithms (New12SL GE Healthcare and V3.19 Cardionics) with semi-automated measurements (SAM) by experienced cardiologists from superimposed representative complexes as the gold standard.

Methods: ECG recordings from 403 healthy subjects (age 34±10.6) and 1388 patients (age 38±10.6) were randomly selected from various studies performed at MDS ECG Central Lab and classified by the cardiologists as normal (4227), borderline (1254), abnormal (575), or not analyzable (49), for a total of 6056 analyzable ECGs out of 6105 selected. Errors of automated measurement were defined by >30 ms absolute difference between QTcB intervals obtained by the SAM and automated algorithms. The effects of ECG classification, gender, age, and noise (global, high [HF] and low

[LF] frequency) on QTcB measurement error were analyzed for each algorithm by a logit model. Global, HF, and LF were assessed by an automated tool (AMPS, LLC).

Results: Overall, Old 12 SL had approximately twice as many errors (5.25%) as New12SL (2.33%) and V3.19 (2.30%). ECG abnormality classification had the greatest effect upon measurement error; gender, LF and global noise were also significant (p<0.05) while age and HF were not.

Conclusion: ECG abnormality classification, gender and low frequency noise are related to error in automated QTcB measurement, more so with older than with newer ECG algorithms.

ECG Classification	Old 12SL	New 12SL	V 3.19
Abnormal	16.52%	7.30%	10.61%
Borderline	6.14%	2.79%	2.15%
Normal	3.45%	1.51%	1.21%
Overall	5.25%	2.33%	2.30%

Table: Prevalence of QTcB measurement error with the 3 algorithms

Body surface potential mapping during the calve's heart depolarization

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Introduction: The "flash" type of myocardial activation is characteristic of ungulate animals. The study of the formation of the cardioelectric field (CEF) in calves is very useful for comparative investigations and it allows to solve some questions in the problem of the CEF genesis. The purpose of our work was to study the dynamic of CEF distribution at the calf's heart ventricular depolarization.

Material and methods: The electric heart activity was investigated on the body surface and intramural layers by system of multichannel simultaneous electrotopography in 8 bull calves at the age of 6 - 26 days (weighing $47,4 \pm 3$ kg). The BSPM was analyzed respectively the second sagittal lead according to Roshchevsky (Roshchevsky, 1978).

Results: On ESGSII records during the period preceding the formation of QRS – complex the distribution of electric potentials was formed, in which positive potentials were recorded mostly on the 2/3 of ventral and the 1/3 of caudal half of the dorsal body surface, whereas negative ones were mostly

on the dorsal surface, respectively. The positive maximum was located on the ventral body side in the field of the heart ventricles projection, while the negative maximum was situated on the dorsal surface of the cranial half of the body. The beginning of the RSII-peak was characterized by the distribution of positive potentials with the extremum on the ventral body side and distribution of negative potentials on the dorsal body side. The change of mutual positions of the areas of negative and positive potentials occurred on the body surface during SSII descending phase. The final stage of the depolarization of the calf's ventricles was characterized by the zone of positive potentials on the 2/3 of the craniodorsal body surface and negative ones were on the caudoventral body surface. At the final period of the ventricles depolarization the areas of negative and positive potentials didn't change their localization. Numerous initial foci of the ventricle depolarization were revealed.

Conclusions: The comparison of the sequence of the ventricle depolarization and the spread of cardioelectrical potentials on the body surface showed that the "flash" type of myocardial activation was characteristic of calves that was typical of ungulate animals.

The work is supported by the Scientific school of Academician M.P. Roshchevsky SS– 2452.2008.4; by the program of the Presidium of RAS «Basic Sciences for Medicine».

Body surface potential mapping in isiah rats during early postnatal ontogenesis

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Purpose: Rats with inherent stress-induced arterial hypertension (ISIAH) were being bred in the Institute of Cytology and Genetics of SD, RAS. These rats are genetically predisposed to a development of arterial hypertension that results in myocardial hypertrophy and produced changes in electrical heart activity. The purpose of this work was to investigate an electrical heart activity of ISIAH rats during the early postnatal ontogenesis.

Materials and methods: Investigations were done in ISIAH rats at the age of 1 (n=12), 7 (n=10), 14 (n=12), 17 (n=10) and 28 (n=9) days during ventricular depolarization by the body surface potential mapping.

Results: It was revealed that body surface cardioelectric field formed in ISIAH rats aged from 1 to 28 days on 7-10 ms before the RII-peak. The zones of positive and negative cardiopotentials changed their locations twice during the depolarization in all rats that is the evidence of the successive type of myocardial activation in ISIAH rats. It was shown that durations of depolarization phases changed with age in different ways: the initial and terminal phases decreased with age from 1 to 17 days of postnatal ontogenesis and then they increased to the age of 28 days, duration of the middle phase didn't change with age significantly. The decreasing of the

initial and terminal phases of depolarization with age from 1 to 17 days may be the evidence of a gradual disappearance of the relative heart hypertrophy that caused after the birth till 10-17 days of postnatal ontogenesis. The increasing of these parameters to the age of 28 days may be the evidence of the development of the left ventricular hypertrophy that is typical for ISIAH rats. In normotensive Wistar rats changes in durations of depolarization phases differed from those in ISIAH rats.

Conclusions: Ascertained age-specific alterations of cardioelectric field in ISIAH rats may be of great importance when establishing the beginning of hypertrophy development.

The work is supported by the scientific school of the academician M. Roshchevsky, by RFBR 08-04-01804, Fundamental Sciences for Medicine.

Departure maps of body surface potential mapping in the spherical system

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Purpose: A goal of the investigations was to separate the patients with intraventricular conduction pathology from the pattern isopotential maps established in the normal subjects on the base of body surface potential mapping obtained in the spherical system.

Material and methods: The study population comprised 32 normal subjects, without any clinically evident cardiovascular disorders, and 56 patients with bundle branch blocks (BBB), who were preliminary diagnosed using standard 12-lead ECG examination. A subject of analysis was cardioelectric field activity within the QRS complex on the isopotential maps. Heart potentials were recorded by body surface potential mapping method with 87-lead Fukuda Denshi HPM-7100 system in cylindrical array, and then transformed to the 30-lead spherical system. In order to compare the map obtained from the individual patients with BBB, the corresponding variables were referred to the group-mean map established previously in the control group. For visualizing the areas of significant differences in the potential distribution and values, a technique of departure maps, created using the statistical principle of variables standardization, was applied.

Results: In our earlier investigations, to specify the maps from patients

with BBB, we used both the method of differentiating and separating the patient groups by comparing a location of local potential extrema on the isopotential maps taken from the patients and from the normal subjects. The results obtained with the departure maps technique showed that the letter method is more sensitive and possesses a higher discriminative values with regard to stratification of the cases with intraventricular conduction disturbances.

Conclusions: The method of departure maps used in the BSPM spherical system could be of clinical usefulness in detecting patients with various types of bundle branch blocks.

Qualitative comparison of isointegral maps in patients with bundle branch blocks using objective correlation function

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Purpose: The aim of the investigations was to qualify how useful correlation function can be for comparing the mean maps in case of different type of bundle branch blocks.

Material and methods: A study population comprised 6 groups of 66 patients with different bundle branch blocks, including 17 patients with complete RBBB, 8 with partial RBBB, 16 with complete LBBB, 6 with partial LBBB and 14 patients demonstrating LAFB (left anterior fascicle block). The 6th group was constituted by 5 cases recognized as RBBB accompanied by LAFB. For each patient a procedure of body surface potential mapping (BSPM) using a 87-lead Fukuda Denshi system was performed and then isointegral maps were created. Then isointegral maps in 6 groups were averaged and 6 representative "mean" patients were obtained. Comparison of the two "mean" patients was undertaken using correlation coefficient definition. Significant differences were estimated by the t-test.

Results: For one type of isointegral map, 15 correlation coefficients were calculated. For complete and partial blocks (both right

and left), the highest values of these coefficients were observed. As the most discriminative interval, the QRS area was demonstrated.

Conclusions: Correlation coefficient can be an useful tool for comparing two averaged map patterns of bundle branch blocks. Additionally, it can be analyzed to find significant differences between the particular patient groups.

Body surface potential mapping patterns in diabetic patients – isointegral map analysis

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Purpose: The study was undertaken to obtain and describe isointegral maps in patients with diabetes. The aim was to find some sensitive changes in BSPM recordings reflecting the first symptoms of eventually heart failure.

Material and methods: The examined group consisted of 25 patients, aged 38-76 years (mean age: 62.4 ± 10.0 years). The study population consisted of 13 females and 12 males. In 23 cases, diabetes mellitus type 1 was diagnosed, and in 2 cases – diabetes mellitus type 2. The studied group underwent a procedure of body surface potential mapping using a 87-lead Fukuda Denshi system, from which the isointegral maps were created. The obtained maps were compared to the mean maps of 30 healthy people (the control group). Differences were displayed as departure maps.

Results: In the isointegral maps, some differences, in comparison with the corresponding data obtained from the control group, were observed. It concerned about 1/3-1/2 of the examined cases depending on analyzed intervals. The changes during ventricular repolarization time as well as in

QRST segment were demonstrated. Some departure maps indicated beginning of heart complications.

Conclusions: Using a BSPM technique for exploring the cardiac electric field properties in diabetic patients is a noninvasive and sensitive method for finding some heart abnormalities. Changes observed in the BSPM maps can indicate increased risk of heart disease.

Specific patterns of isochrones distribution in the patients with complete and incomplete left bundle branch block

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Background: Ventricular activation time (VAT) is a significant criterion for diagnosing bundle branch blocks.

Purpose: The aim was to investigate a distribution of the isochrones on the VAT maps registered with BSPM method in the normal subjects and in the patients with left bundle branch block (LBBB) in order to determine the possible specific features that could be useful in clinical diagnostics.

Material and methods: The study population consisted of 38 patients with complete or incomplete LBBB diagnosed using the standard 12-lead ECG. As the reference group served 33 subjects with no cardiovascular involvement. For body surface potential mapping (BSPM) registrations, from which the VAT maps were subsequently created, the 87-lead Fukuda Denshi system was applied.

Results: Analyses of the VAT maps obtained from the LBBB group revealed that activation starts in the middle portion of the intraventricular septum and then spreads freely through the right ventricle. Simultaneously, the wavefront coming from the right branch activates the septum from the right to left side, so the right ventricle is depolarized earlier than the left one.

In the last phase, the activation reaches the left ventricle, and the most delayed activation comprises finally the upper part of this ventricle. In the patients with incomplete LBBB, the ventricular activation trajectory looks very similar but delay time is shorter.

Conclusions: 1. The specific pattern of VAT values were observed in the both group with LBBB as compared with the controls. 2. There were also the significant differences in VAT maps between the complete and incomplete LBBB. 3. The obtained VAT patterns could be helpful in diagnosis of LBBB.

Activation changes in the left bundle branch in children with chronic kidney disease treated conservatively

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Background: Various cardiac involvements are observed in children with chronic renal failure, and disturbances in heart conduction system are the most common ones.

Purpose: Determining the areas of changes ongoing during ventricular activation in the young patients with chronic kidneys disease (CKD) treated conservatively.

Material and methods: Patients were 36 children with CKD, and 30 normal children served as the control group. For assessing a depolarization propagation within the ventricles, the non-invasive method of body surface potential mapping (BSPM) was used.

Results: In the examined group of children with CKD, the early changes in ventricular depolarization propagation were observed. These abnormalities corresponded to a pattern of LAFB (left anterior fascicle block). These changes became more severe as time went by, along with a progress of the disease, which was confirmed in the repeated BSPM registrations. In the patients with CKD, the most early activated ventricular region is the sub-

endocardial layer of the lower left surface of the intraventricular septum. In the next step, the depolarization goes from left to right side of the septum. Because of the obstacle in the left anterior fascicle, the free wall of the left ventricle is reached by the wave with a delay through the posterior fascicle. Then, the activation wanders to the anterior and later walls of the heart, and finally reaches the free left ventricular wall.

Conclusions: 1. BSPM makes possible to detect some distortions of the ventricular depolarization trajectory in the early stage of chronic kidney disease. 2. Progression of the renal failure implies a development of the changes within the anterior left fascicle. 3. The observed with BSPM disturbances in the ventricular depolarization can be triggered by multifactor metabolic disturbances occurring in course of chronic renal failure.

P-wave isointegral maps in hypertension and in myocardial infarction

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Purpose: We studied the influence of changes in electrical activity of the left ventricle on the atrial electrical activity. We analyzed isointegral maps of P waves (IIM P) in patients with cardiovascular diseases based on different etiology and cell properties to find out whether and how they differ mutually as well as from IIM P of controls.

Material and methods: We studied 84 subjects: 16 patients with myocardial infarction (group MI; age 40-71 years (y); 1 woman (w); 3 months after acute MI), 16 patients with hypertension (HT; 25-75 y; 6 w), 26 patients with left ventricular hypertrophy and HT (LVH; 32-72 y; 11 w), and 26 controls without cardiovascular diseases (C; 21-56 y; 10 w). We analyzed values and positions of the IIM P extrema.

Results: Similar individual IIM P distributions occurred in all groups. IIM P maxima were significantly higher in the MI group (MI: 5.0 ± 1.8 mV.ms; C: 4.0 ± 1.1 mV.ms; HT: 3.6 ± 0.8 mV.ms; LVH: 3.8 ± 0.8 mV.ms; $p < 0.05$), in men only against HT group (HT: 3.6 ± 1.0 mV.ms; $p < 0.05$). The same trend was in peak-to-peak values, but significant difference occurred only

between the MI and the LVH groups (MI: 9.6 ± 2.8 mV.ms; LVH: 8.0 ± 1.9 mV.ms; $p < 0.05$). Although being the deepest, there were no differences in minima between the MI group and the others (MI: -4.6 ± 1.4 mV.ms). There were no differences between any of groups C, HT, and LVH in any extreme value. Maxima were shifted significantly to the left in HT and LVH groups compared to C, and LVH compared to MI, always located in the precordial area. Minima were significantly shifted downwards in male patients against controls. They were located mainly in the right clavicular area and around the right shoulder. There were no differences between men and women within each group in a ny studied parameter.

Conclusions: Higher extreme values in MI group were unexpected as all MI patients had hypertension. Reasons for this finding have to be studied in specialized studies.

Supported by grant VEGA 1/4271/07 offered by Ministry of Education SR.

Beat-to-beat variability of isointegral maps of P waves in normal adults

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Purpose: We studied the physiological variability in the atrial electrical activity based on beat-to-beat comparison. We analysed isointegral maps of P waves (IIM P) in healthy adults without proved cardiovascular diseases.

Material and methods: We recorded body surface maps in 49 subjects (age 21-55 years; 39 men) during normal expiration. We analyzed values and positions of extrema in individual IIM P, 3.6 ± 0.8 beats (2-5) for each subject. We studied changes in observed parameters among individual beats separated by 0-3 beats.

Results: Similar individual IIM P distributions occurred in all subjects. Mean IIM P maxima were 5.0 ± 1.8 mV.ms; minima were -4.7 ± 1.8 mV.ms; peak-to-peak values were 9.7 ± 3.1 mV.ms. Maxima were located in the precordial area, minima in the right clavicular area and around the right shoulder. The most sensitive parameter to beat-to-beat changes was the maximum value. Significant difference was found between the first and the fourth beat. The maximum increased in men, while in women it decreased ($p < 0.05$). Similar change was found also between the first and the second

beat. Position changes of extrema as well as of the minimum values were not significant.

Conclusions: Differences between the first and the fourth beat could be ascribed to respiration movements. We counted the first beat in the moment of expiration beginning. The time difference between the first and fourth beat is approximately equal to the duration of expiration, thus they reflect the maximal difference in chest geometry caused by respiration movements. This has to be considered when comparing patients' maps with controls.

Supported by grant VEGA 1/4271/07 offered by Ministry of Education, SR.

Isointegral body surface maps in rats with left ventricular hypertrophy

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Purpose: The aim of the present study was to analyze the body surface isointegral distribution in rats with hypertensive left ventricular hypertrophy (LVH).

Material and methods: Body surface mapping was performed in rats ($n=14$; age 6-8 months; body weight, 174-295 g) from sixty-four unipolar electrodes regularly distributed over the thorax. After that, the left renal artery was clipped to produce two-kidney one-clip hypertension. Four weeks after surgery, body surface mapping was performed again and blood pressure was measured. QRS, ST-T, and QRST isointegral maps were processed for each rat in both situations. The distribution of the positive and negative areas, extrema, and peak-to-peak values were analyzed for each isointegral map. Normotensive rats were controls.

Results: Systolic blood pressure in hypertensive rats was $\sim 40\%$ higher than in control rats (163 ± 11 mmHg vs 115 ± 6 mmHg). LVH ($\sim 27\%$ increase in the ratio left ventricular weight/ body weight, $p < 0.05$) was observed in hypertensive rats compared with controls. When assessing isointegral maps,

the differences between the baseline and hypertensive states in the distribution of the positive and negative areas were not discovered. The extrema and peak-to-peak values were higher in the hypertensive state compared with the baseline one. The most significant changes were observed in QRS isointegral maps, whereas ST-T and QRST isointegral maps did not show statistically significant changes.

Conclusions: the spatial characteristics of the body surface potential distribution do not alter during the development of hypertensive LVH in rats that may be explained by the unaltered cardiac excitation sequence. The increase of the extrema and peak-to-peak values during the development of hypertension is due to LVH. Isointegral mapping can be used for diagnostics of hypertensive LVH.

This study was supported by the Russian Science Support Foundation and the Program of support for basic research performed in the Ural Branch of the Russian Academy of Sciences.

Electrocardiographic QRS voltage and duration criteria and different patterns of left ventricular hypertrophy and geometry in essential hypertension

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Purpose: The aim of the study was to examine the relationship between electrocardiographic QRS voltage and duration criteria for diagnosis of left ventricular hypertrophy (LVH) and echocardiographic LV geometry pattern in pts with essential hypertension (EH). Method Used.

Material and methods: Standard 12-lead ECG, echocardiography and ABPM were performed in consecutive 101 pts with EH, without signs of CAD, mean age 62 +/- 4,5 yrs, 61 men and 40 women. Subjects were divided into 4 groups of echocardiographic LVH and geometry pattern based on LVMI (left ventricular mass index) and RWT (relative wall thickness): normal geometry (N, n=42), concentric remodeling (CR, n=17), concentric hypertrophy (CH, n=15) and eccentric hypertrophy (EH, n=23). The following electrocardiographic QRS voltage and duration criteria for LVH were evaluated: QRS voltage criteria-Cornell voltage (CV), sum of 12-lead QRS voltage (S) and QRS duration criteria-QRS duration (D), QRS duration x sum of 12-lead QRS voltage (S x D), Cornell Product (CP). Then the relations between LVH ECG parameters

and echocardiographic parameters like LVM and LVMI, RWT were analyzed in linear regression analysis. Multiple logistic regression analysis was performed to check if above relationship is independent on age, sex, BMI and ABPM parameters.

Results: Median values of QRS time dependent parameter- D did not differ between pts with 4 patterns of LVH and geometry. Median values of QRS voltage criteria: S (1,7mV), CV (2,2mV), and QRS duration and voltage product criteria: S x D (147,2 m Vms) and CP 200,0 m Vms) were the highest in pts with CH and differ significantly between pts with N and CR but not with EH. Regression analysis revealed significant correlations between LVM, LVMI and S ($r=0,4$; $r=0,45$ respectively, $p=0,0000$ for all) and S x D ($r=0,4$; $r=0,44$) and CV ($r=0,39$; $r=0,39$) and CP ($r=0,39$; $r=0,39$). These relations remained independent after adjustment to age, sex, BMI and ABPM parameters in multiple logistic regression analysis. No correlations of RWT and any of above ecg LVH parameters were found.

Conclusions: Both QRS voltage and duration LVH ECG criteria were correlated with LVM and its index but not with RWT. However the highest median values of QRS voltage and duration product criteria were observed in patients with CH, none of them can differentiate pattern of LVH and geometry.

Right ventricular end-diastolic diameter is associated with the presence of sinus rhythm among patients with hemodynamic significant mitral stenosis

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Background: Despite the significant decrease in occurrence of rheumatic disease in Europe, mitral stenosis (MS) is still responsible for the increase of morbidity and mortality. The most common arrhythmia in patients with MS is atrial fibrillation, which is not strictly related to progression of the disease. Atrial fibrillation increases the risk of embolisms.

Purpose: The aim of this study was to find the factors related to sinus rhythm among patients with hemodynamic significant MS (mitral valve area, MVA < 2.5 cm²).

Material and methods: Retrospective analysis was performed in 102 patients (mean age 61 years, 22% male) with SM hospitalized in 2005-2008 in Department of Cardiology. Patients were divided into two groups depending on heart rhythm in standard 12-lead ECG/Holter ECG monitoring: SR group (sinus rhythm without paroxysmal atrial arrhythmias) n=34 (21% male) vs. non-SR group n=68 (22% male). In both groups the analysis of the following parameters was performed: age, BMI, operative risk-Euroscore, NYHA class, data from history considering the presence of HA, DM, cigarette smoking as well as results of laboratory tests (serum lipid level, platelets and fibrynogen, markers of inflammatory process as CRP,

WBC), echocardiography (MVA, EF, RVD, LA/RA index, PASP, acceleration time-AT), coronary angiography and ECG analysis (mitral P, RBBB, right axis). In order to define the factors related to the presence of SR, uni- and multivariate regression analysis was performed. The Spearman correlation coefficient was calculated to investigate associations between possible confounders and SR.

Results: Multivariate analysis showed that only RVD was significantly associated with SR (OR 0.03; 95% CI 0.002-0.46; $P=0.01$). We found correlation between the SR presence and RVD ($R=-0.36$; $P=0.004$) or AT ($R=+0.42$; $P=0.006$).

Conclusions: In patients with hemodynamic significant mitral stenosis clinically useful in prognosis of sinus rhythm seems to be the RVD. The higher value of the diastolic dimension of right ventricle and the lower acceleration time in the pulmonary artery, the less chance of sinus rhythm.

P-29 Late ventricular activity in postinfarction heart failure

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Background: Ventricular arrhythmias account for sudden cardiac death (SCD) in patients with congestive heart failure. Ventricular arrhythmias and SCD can be predicted by late ventricular potentials (LVP). Considering the high incidence of SCD due to cardiac arrhythmias in heart failure patients, it is the aim of this study to assess LVP in postinfarction heart failure patients.

Material and methods: 16 postinfarction heart failure patients underwent: 12-lead ECG (assessing the mean QT interval duration in the 12 ECG leads: QTm), signal averaged ECG (SAECG to detect LVP) and 64-leads body surface mapping (BSM: isointegral QRS maps of the last third of the QRS complex and QRST maps). 75% (12) of the patients had LVP, especially patients with an old inferior myocardial infarction and 75% (12) had left ventricular hypertrophy, considering at least one of 5 ECG criteria.

Results: RMS40 (the square root of the last 40 ms of the SAECG signal was: $20 \pm 13 \mu\text{V}$) correlated with: isointegral QRS maxima ($20 \pm 13 \text{ mV}\cdot\text{ms}$; $r = -0.68$), isointegral QRS minima ($18 \pm 10 \text{ mV}\cdot\text{ms}$; $r = 0.72$), Sokolow-Lyon

index ($27 \pm 18 \text{ mm}$; $r = 0.61$), Cornell index ($19 \pm 13 \text{ mm}$; $r = 0.62$). A relative risk for ventricular arrhythmias of 1.33 was found for LVP. 33.33% (4) of the patients with LVP had also a QTm > 450 ms, 66.67% (8) had also multipolar isointegral QRST maps and 83.33% (10) left ventricular hypertrophy according to the ECG criteria. Age > 65 years (RR=1.66), hypertension as comorbidity (RR=1.2), inferior myocardial infarction (RR=3) and left ventricular hypertrophy (RR=1.38) were significant associated with the presence of LVP.

Conclusions: Late ventricular potentials are better predictors of ventricular arrhythmias compared to multipolar isointegral maps and the QT interval. LVP will appear more often and SCD risk will be increased in elderly postinfarction heart failure patients and patients with inferior myocardial infarction, hypertension and left ventricular hypertrophy.

P-30 Body surface potential mapping of sportsmen and nontrained people during ventricular repolarization at rest and after physical exercise

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Background: The investigation of body surface potential mapping of sportsmen and nontrained people during ventricular repolarization at rest and physical exercise allows to estimate features of recovery process in the heart of trained men.

Material and methods: BSPM from 64 unipolar leads during ventricular repolarization has been registered on the thorax of 26 sportsmen-skiers with the highest sports qualification at the age of 18-28 years and of 22 nontrained people at the age of 18-30 years. While using an exercise ergometer physical loads were induced. The loads were chosen individually and were submaximal for each subject. After BSPM measurement in the state of rest the exercise started and lasted 5 min. Then parameters were registered during 3 min of recovery.

Results: At rest the mean heart rate (HR) was $59 \pm 10 \text{ bpm}$ and $66 \pm 13 \text{ bpm}$ ($p < 0.05$) in sportsmen and nontrained people, respectively. The maximal positive amplitude at rest in sportsmen thoracic surface was $0.83 \pm 0.25 \text{ mV}$ at $261.71 \pm 38.98 \text{ ms}$ after peak RII, in nontrained people it was $0.89 \pm 0.31 \text{ mV}$ at $232.54 \pm 30.46 \text{ ms}$. A negative extremum on thorax of skiers was $-0.30 \pm 0.11 \text{ mV}$, in nontrained people it was $-0.39 \pm 0.17 \text{ mV}$. The maximal thoracic negative value in sportsmen and nonsportsmen was registered at $259.22 \pm 40.90 \text{ ms}$ and $235.86 \pm 29.59 \text{ ms}$, respectively. Immediately after

the exercise, the HR average mean value in sportsmen was $156 \pm 8 \text{ bpm}$, in nontrained people it was 173 ± 12 ($p < 0.001$). At the first minute of recovery period after the exercise in comparison with the state of rest significant enlargement in the amplitudes of maximum and minimum was noted in all the participants. Beside the state of rest the positive and negative extrema were registered significantly earlier in all people. In sportsmen in comparison with nontrained people the maximum was noted later ($p < 0.05$). At the second minute of recovery period after the exercise the values of the extrema significantly decreased in comparison with the same characteristics at rest in all the subjects ($p < 0.05$). Maximal values of positive and negative potentials were registered later in sportsmen in comparison with nontrained people. At the third minute of recovery period after the exercise in sportsmen in comparison with nontrained people the amplitude of the maximum was significantly less; in sportsmen the extrema were registered later ($p < 0.05$).

Conclusions: Significant changes were revealed in amplitude-temporal characteristic of cardioelectric field during repolarization on thoracic surface of sportsmen-skiers in comparison with nontrained people. During recovery period after the exercise significant changes in the ventricular repolarization process of sportsmen were determined in comparison with nontrained people. Those changes of cardioelectric field on body surface of sportsmen and nontrained people at rest and after physical exercise are revealed, and they are probably caused by particularities of recovery in the "athlete's" heart.

The work is supported by the grant RFBR 09-04-98814-p; by the program of the Presidium of RAS «Fundamental Sciences for Medicine»; by the grant of scientific schools SS – 2452.2008.4.

Characteristics of the cardiac electric field in young subjects related to blood pressure

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Purpose: The aim of the study was to analyze ventricular parameters of the cardiac electric field in boys and young men - using vectorcardiography (VCG) and isointegral body surface potential mapping (BSIM), to look for changes characteristic for increased ventricular sympathetic drive and for the effect of obesity in prehypertensive and hypertensive subjects.

Material and methods: The study group consisted of 100 boys and men, aged 15-24 years with normal ECG. There were 33 subjects with elevated blood pressure (BP) >120/80 <140/90 mmHg, non obese - with body fat percentage < 25% (NEBP, averaged age 17.8 y.) and 17 obese (OEBP, age 17.5 y.), 18 hypertensive non obese subjects with BP ≥140/90 mmHg, (NHBP, age 19.1 y.) and 15 obese subjects (OHBP, age 17.5 y.), 17 controls had optimal BP and normal body weight (C, age 18.4 y.). ECG in the orthogonal Frank leads and 80 electrodes body surface potential maps were recorded using the PC based ECG computer system Cardiac 128.1 in seated subjects and midrespiratory position. VCG and BSIM parameters, relevant for depolarization and repolarization were quantitatively evaluated

and statistically compared by one way ANOVA. Regression analysis was used to indicate the relationship between BP and/or fat percentage on one hand and VCG and BSIM parameters on the other.

Results: Magnitude of the maximal spatial T vector as well as maxima and peak to trough amplitudes of the STT BSIMs were significantly lower in all subgroups as compared to controls and lowest in obese subjects. There were no differences between NEBP and NHBP, or between OEBP and OHBP subjects. Combination of obesity and BP elevation significantly decreased not only positive but also negative values of STT BSIMs potentials. The area of positivity diminished and the summary magnitude of electric potential from all lead was significantly ($p < 0.01$) lower by 26-54%. In addition, the negative values on the upper and dorsal part of the chest tended to be less negative as compared to the values in the C. No significant changes of the depolarization QRS BSIMs were found.

Conclusions: The ventricular recovery pattern may reflect an increased sympathetic drive of the ventricular myocardium accompanying moderately elevated BP (>120/80 <140/90 mmHg). This effect is augmented by obesity.

Supported by the grant of Slovak Society of Cardiology

Amplitude-temporal characteristics cardioelectric field of sportsmen-skiers on different training cycle stages

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Background: During sportsmen annual training cycle the increasing of physical load intensity, physical activity frequency, execute work power occur, that reduces to the intensification of cardiovascular system work.

Purpose: For the revealing of sportsmen heart electrical activity changes, due to the increasing of physical load the analyze of cardioelectric field on body surface of sportsmen-skiers of the highest sports qualification at rest on preparatory and competition stages of training cycle has been realized.

Results: In sportsmen-skiers at the initial stage of ventricular depolarization on a competition stage in comparison with preparatory one the significant ($p < 0,05$) increase of maximal amplitude of negative extreme was noticed: $3,00 \pm 0,99$ mV and $2,27 \pm 0,78$ mV, appropriately. At ventricular repolarization significant ($p < 0,05$) increase of amplitude of negative extreme was observed: $0,48 \pm 0,13$ mV and $0,37 \pm 0,14$ mV appropriately on a competition stage in comparison with a preparatory stage. It was revealed that, at the period of ventricular depolarization of the heart the time of achievement of the largest positive cardiopotential quantity in sportsmen-

skiers on a competition stage in comparison with a preparatory stage was significant ($p < 0,05$) earlier (on 10,16 +6,88 ms) in about 62% of subjects, later (on 8,15 +4,78 ms) in about 38% of the people. The negative extreme achieved the maximum in the sportsmen-skiers on a competition stage in comparison with a preparatory stage significant ($p < 0,05$) earlier (on 5,79 +3,28 ms) in about 54% of investigated people, later (on 4,29 +5,44 ms) in about 46% of the sportsmen.

In the period of maximal physical exercises, which are typical of a competition stage of an annual training cycle of sportsmen-skiers of the highest sports qualification, the significant change of amplitude-temporal characteristics of cardioelectric field on body surface.

The work is supported by the scientific school of Academician M.P. Roshchevsky SS 2452.2008.4; by program of Presidium of RAS "Fundamental Sciences for Medicine"; RFBR 09-0498814-r.

System for real-time mapping of body surface potential changes

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Purpose: A compact system for multichannel ECG recording is presented that enables evaluation of dynamic changes in surface integral maps and their use for noninvasive location of possible local ischemic sources in the heart during mental or physical load.

Material and methods: BSPM from 10 patients with coronary heart disease were recorded to test the method for noninvasive location of ischemic lesions during stress. It evaluates changes in QRST integral maps and computes an inverse solution with one or two dipoles. A portable BSP mapping system that can record up to 128 body surface potentials simultaneously was developed to facilitate the use of the method. Active electrodes, intelligent battery powered data acquisition unit and optical connection to an USB port of the hosting notebook computer were used to guarantee high signal quality and patient safety. Menu-driven modular software was developed for recording and processing of ECG potentials including evaluation of integral surface maps that can be applicable for cardiac diagnostics.

Results: Experimental verification of the proposed method showed that despite a common torso geometry model was used, location of ischemia

was in agreement with SPECT in 8 cases and in one case the ECG data were not appropriate for the method. These results are reported in detail in separate paper. Testing of the system on larger group of persons showed that proper processing of ECG signals, namely careful cycle identification, baseline adjustment and compensation for changed heart rate during the measurement may be crucial for correct evaluation of computed integral maps. For this reason off-line map processing and detailed evaluation is also recommended.

Conclusions: First experience with the system suggest that it may be a useful tool for non-invasive identification of local ischemia based on simple inverse solution using dynamic changes in surface integral maps during stress.

Increased transient outward current in the subepicardial region can explain the slurring of the QRS. A simulation study

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Background: QRS slurring was statistically associated with a history of malignant arrhythmias. Clarification of the possible mechanisms of this easily detectable feature is needed to increase its predictive value.

Methods: We built a finite element model of the ventricles with 27000 elements organised in six myocardial strata for each ventricle. The shape of the action potential was computed in each stratum using a modified Luo Rudy dynamic model with parameters extracted from the literature for the human myocardium. Activation times were assigned with a cellular automaton model and tuned to reproduce the well known recordings by D. Durrer et al. Electrograms were computed for 370 electrodes positioned on a surface with the shape of a human thorax in a uniform volume conductor around the ventricle (electrode positions were kindly provided by R. Macleod from Utah University). Two simulations were compared, one without an Ito current and one with a maximum transient outward conductance (gIto) assigned randomly in the 0.076-0.19 nS/pF interval in the subepi-

cardial layer. QRS slurring was measured by the decrease of the second derivative of the potential in time on each lead between the Ito and the non-Ito cases, at the end of ventricular activation. 1000 such pairs of simulations were run, with maximal conductances for the rapid and slow K (gKr, gKs), the ATP-dependent K (gKATP), plateau K (gKp), T and L-type Ca (gCaT, gCaL), Na/Ca exchanger (gNaCa) currents in a 40-160% range from the reference value.

Results: Adding the Ito current produced a QRS slurring aspect in 322 +/- 2.4 of the 370 leads. The magnitude of the slurring was strongly associated with gIto (r=0.75). Of the other maximum current conductances studied only gCaT (r=0.47) and gKp (r=-0.38) had a limited influence.

Conclusions: The QRS slurring aspect on the electrocardiogram was reliably produced by the increase of the gIto in the subepicardial layer.

Single fibre based heart activity model (SFHAM) based QRS-waves synthesis.

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Purpose: This communication presents a newly developed single fibre based heart activity model (SFHAM) based on the current flow through the single fibres of the cardiac muscle (CM). The analytical functions describing ionic flows along the fibres that spread from endo- to pericardial regions of CM are derived. Five effective fibres are identified and assigned to the appropriate segments of CM. On the basis of standard 12-lead ECG measurement, after performing numerical fitting procedures, the parameters determining the shapes and amplitudes of the functions proposed are obtained in such a way that the sum of five potentials considered gives the values of electrical potential measured. As a consequence, five independent courses of partial, transient potentials are obtained representing: anterior, inferior, lateral, posterior walls, and interventricular septum activities, respectively.

Results: The model permits determination of electric properties of selected fragments of CM. The model was verified on the basis of the confronta-

Implementation of SFHAM in coronary heart disease diagnosis

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Background: Computer analysis (referred as to SATRO method) of distribution of transient electric potentials produced by the heart activity permits evaluation of depolarisation taking place in individual fragments of the muscle of the left chamber, which is promising for the use of this method in diagnosis of the cardiac muscle ischemia. The study reported was undertaken to compare the effectiveness of the SATRO method and ECG recording on exercise for prediction of disturbances in the cardiac muscle perfusion diagnosed by the exercise perfusion scintigraphy of the cardiac muscle or single photon emission computed tomography (SPECT) and for prediction of infarcts diagnosed by the surface mapping of the cardiac muscle activity.

Methods: At a few clinical centres the patients with ischemia were diagnosed with SPECT, the patients with suspected infarcts were diagnosed with the surface mapping of the cardiac muscle activity and a reference group of healthy subjects were subjected to SPECT and mapping examination. For each subject the ECG recording was made at rest and on exercise. On the basis of the ECG

tion of the maps of the total electric potentials on the patient's body with those obtained from mapping measurements (for recollection – the total potential is defined as a sum of five partial potentials mentioned above). A strong correlation between our theoretical results and the measured counterparts was obtained, proving that our model can be applied in further investigation. What is the most interesting, our model allows generation of the maps describing electrical activity of given region of CM, contrary to the commonly used maps providing information on the activity of the whole heart.

Conclusions: It is expected that SFHAM will permit detection of pathological changes in particular fragments of CM.

at rest results for the healthy subjects the standard parameters of the transient potentials were determined. These parameters were compared with those of the ECG results of the subjects suffering from ischemia or infarct and relations were derived between the electric activity of individual fragments of the cardiac muscle and their diagnosed health status.

Results: The relations were used for comparison of the parameters with the experimental data and a good agreement was obtained between the theoretical predictions and actual measurements.

Sensitivity: standard ECG / SPECT = 0%, stress ECG / SPECT - 18%,

Sensitivity SATRO / SPECT = 93%, specificity - 81%;

Sensitivity SATRO / mapping = 98%, specificity - 86%.

Conclusions: The model presented permits investigation of the potentials produced by the electric activity of individual fragments of the cardiac muscle on the basis of the standard ECG examination only. The results indicate the possibility of using SATRO as a screening test in diagnosis of ischemia or infarct, which has hitherto been possible only with advanced diagnostic tools.

Diagnostic value of high-frequency signal-averaged orthogonal electrocardiography and vectorcardiography in patients with acute coronary syndrome with ST-elevation

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Purpose: Assessment of the diagnostic value of high-frequency signal-averaged orthogonal electrocardiography in patients with STEMI.

Material and methods: 72 patients with STEMI and a group of 20 healthy controls. All patients and healthy controls were examined telemetrically by high-frequency ECG (HF-ECG), 1000 Hz sampling rate. Additional investigations: creatine kinase, troponin T, Echocardiography (2D-Echo), coronary angiography, myocardial perfusion scintigraphy. High-frequency ECG records were transformed into X, Y, Z Frank orthogonal leads, that underwent signal averaging and then transformed into vector loops. Two approaches were used synthesizing orthogonal leads and loops: with and without inversion of aVR. Analyzed vector variables: area of the QRS- and T-loops, amplitude of the maximal vector, angle α of the maximal vector, proportion of the loops from the different planes. We determined vector variables with high classifying function regarding location of STEMI and optimized combination of variables with high predictive function regarding 2D-Echo ejection fraction (EF).

Results: QRS- and T-loop variables – amplitude of the maximal vector, area of the loop and angle α of the maximal vector are highly sensitive and specific localizing the exact region of myocardial necrosis. The algorithm including vector variables without inversion of aVR has higher classifying function: correctly classified by this algorithm are 80.4% of all examined people, 80.6% of the patients with STEMI and 80.% of the healthy controls. High degree of correlation was found between the changes of the analyzed vector variables and the severity of systolic myocardial dysfunction, evaluated by 2D-Echo EF.

Conclusions: Signal-averaged orthogonal leads and vector loops, synthesized on the basis of 12-channel HF-ECG possess high informative value in the diagnosis of STEMI, making possible precise qualitative and quantitative assessment of these patients.

Dispersion of repolarization and arrhythmias at acute overload

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Background: It is known that a mechanical load alters electrophysiological properties and could result in arrhythmias. Factors that favor arrhythmias at heart overload remain partly unclear. The objective of the present study was to determine the dispersion of repolarization and an incidence of ventricular arrhythmias at different loading conditions.

Material and methods: The ventricular overload was produced by a 1-min aortic stenosis in rabbits (n=10) and by a rapid saline infusion in dogs (n=9). Unipolar electrograms were recorded from ventricular epicardial electrodes in rabbits and plunge electrodes in dogs. Durations of repolarization were determined as activation-recovery intervals (ARIs).

Results: Under acute increase in the left ventricular (LV) afterload the ARIs shortened ($p<0.05$) on the lateral surface of right ventricle (RV) and prolonged ($p<0.05$) on the LV apex. This opposite direction of changes in repolarization durations on the right and left ventricles resulted in increasing the interventricular dispersion of repolarization ($p<0.05$), which accompanied by ventricular extrasystoles or paroxysms of ventricular tachycardia.

At volume loading in dogs, there was a prolongation ($p<0.05$) of ARIs in the all layers of the middle and basal parts of the LV, intramural layers of the RV apex and subendocardium of the RV base. At further increase of LV end diastolic pressure, ARIs shortened ($p<0.05$) in the subendocardium of the RV base, LV base, and LV middle free wall. Due to the inhomogeneous changes of repolarization durations across the ventricular wall, the transmural dispersion of repolarization increased in the middle LV free wall and LV base and correlated with the incidence of rhythm disturbances at volume overload.

Conclusions: Ventricular arrhythmias under acute heart overload might be caused by the increase both of the interventricular and transmural dispersions of repolarization.

Late phase of repolarization (TpeakTend) as a prognostic marker of left ventricle remodeling in patients with anterior myocardial infarction treated with primary PCI

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Background: Left ventricle remodeling (LVR) is regarded as a marker of unfavorable prognosis in patients after acute myocardial infarction (AMI). Repolarization (QT), especially, its late part (TpeakTend) is strongly related to local myocardial attributes. The purpose of this study was to assess prospectively if repolarization duration measured from one hour of nighttime period, may be a predictor of LVR occurrence in patients with anterior AMI treated with primary PCI.

Material and methods: The study population consisted of 111 patients with first anterior AMI (87 males, age: 58+/-11 years, LVEF: 41+/-7%) treated with primary PCI of left anterior descending coronary artery. LVR, defined as left ventricle end-diastolic volume increase >20% during 6 months follow-up, occurred in 35 patients (31 males, age: 56+/-10 years, LVEF: 37+/-7%, LVR+), 76 subjects were free of LVR (49 males, age: 58+/-10 years, LVEF: 43+/-7%, LVR-). Holter recordings were performed in the 5th day of AMI. Repolarization parameters: QT, QTpeak and TpeakTend were assessed from 1 hour (between 1-4 a.m.) in which ST-T segment facilitated automatic beat-to-beat analysis of more than 95% of recording. Bazzet's formula was used for heart rate correction.

Results: Study groups did not differ in age, LVEF, treatment and QTc: 441+/-29 ms vs. 434+/-25 ms, p=0.37 for LVR+ vs. LVR-. Patients with LVR had shorter QTpeakc (333+/-34 ms vs. 345+/-25 ms, p=0.03) and remarkable longer TpeakTendc (108+/-15 ms vs. 89+/-17 ms, p=0.0001). Receiver Operating Characteristics analysis revealed that the best cut-off value was 103 ms with sensitivity- 65.7%, specificity- 81.6%, positive predictive value- 62% and negative predictive value- 83.8%.

Conclusions: Greater transmural heterogeneity of the repolarization processes is powerful prognostic markers of left ventricle remodeling occurrence in patients with acute anterior infarction. One hour of analysis seems to be sufficient for risk stratification of these patients.

Influence of over-sampling of ambulatory ECG recordings on QT intervals measurements

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Purpose: Oversampling has been proposed to enhance the fidelity of low sampling rate of ambulatory ECG, but could create distortion on the signal. The objective of the study was to assess the impact on QT/QTcF measurement of the use of an algorithm to over sample a tracing recorded at 200 samples per seconds (sps) to 500sps.

Material and Methods: Five 12 leads Holters were recorded in five healthy volunteers using a 1000Hz ELA device and triplicate ECGs were extracted with Antares (Amps llc) software at 30 predefined time points. Only stable and good quality tracings were automatically extracted. The 10 sec strips were then converted in 200sps and 500sps ECGs, subtracting respectively four every five dots and one every two dots. Then the 20sps were over sampled from 200sps to 500sps using a specific algorithm (Cardionics). Finally, the intervals of all ECGs were measured by an experienced cardiologist (same reader per subject) with the help of Trace (Cardionics) software using a semi-automated method. The QT and QTcF of each corresponding pairs of ECGs (200 and 500Hz) were then compared using Bland and Altman method and the mean±SD of each individual subject was calculated for each sampling rate.

Results: 434 pairs of ECGs were extracted of which 387 were considered

as measurable by the readers and so were analyzed. The mean QT, QTcF and their corresponding standard deviation (SD) measured on each pair of ECGs (200Hz and 500Hz) are displayed in table 1.

The mean difference between each ECG pair was small (0.84 ms for QT and 1.02 ms for QTcF). The standard deviation of the QT and QTcF were smaller when the measurements were performed on 500Hz tracing than on 200Hz tracings, however, the difference was limited.

Conclusions: No significant difference was noted when comparing QT/QTcF measured on 200Hz and 500Hz ECGs. However, higher sampling rate is associated with a limited decrease in variability of these measurements.

Table 1. Mean QT and QTcF with SD measured on each pair of ECG (ms)

	200Hz		500Hz	
	Mean	SD	Mean	SD
QT	371,79	26,48	370,95	25,02
QTcF	398,28	11,85	397,27	10,69

Magnetocardiographic parameter for Jt-point determination in subjects with early repolarization syndrome

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Purpose: We proposed a novel magnetocardiographic (MCG) parameter that would allow to objectively and precisely identify the location of the so called "transition point J (Jt-point)" marking a transition from the depolarization phase (DP) to the repolarization phase (RP) of the ventricles in healthy subjects as well as asymptomatic individuals with early repolarization syndrome (ERS).

Materials and methods: MCG examinations were performed in an unshielded space at rest in 10 males with ERS (aged 17-30 years) and 10 healthy individuals with normal PQRST morphology. The registered PQRST magnetocardiograms were averaged and synchronized. ECG lead I was used for the magnetocardiograms synchronization. For determination of the Jt-point location we assessed an integral energy (IE) parameter of an instantaneous summary magnetic field (SMF) generated by an instantaneous transmural

summary current density gradient of the ventricles during the $R_{peak}-T_{peak}$ interval. We identified the Jt-point location at the instant of time of the $R_{peak}-T_{peak}$ interval corresponding to the minimal IE value. We also assessed the SMF distribution pattern registered at the Jt-point.

Results: In all normal as well as all subjects with ERS the Jt-point located at the end of the DP and the beginning of the RP of the ventricles. In the healthy subjects the Jt-point corresponded to the normal, "abrupt transition" pattern of the SMF distribution, whereas in the ERS subjects the SMF distribution at the Jt-point represented the "delayed transition" pattern from the DP to the RP. The Jt-point in all healthy subjects concurred with the "conventional" J-point of the ECG lead I. We determined the Jt-point in the subjects with ERS at the end of the late delta waves and/or small secondary R waves (R') following the QRS magnetocardiocomplexes.

Conclusions: The IE parameter allows to precisely determine the Jt-point location in individuals with elevated J waves. The Jt-point with the minimal IE value is useful for objective identification of the accurate "boundary" between the end of the DP and the beginning of the RP of the ventricles including cases of "overlapping" of these phases. We hypothesized that the Jt-point corresponded to the transitional point of time between the isovolumic contraction period and the ejection period of the ventricles in both groups.

Magnetocardiographic assessment of J-wave morphology in subjects with early repolarization syndrome

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Purpose: The aim of the study was to determine a distribution pattern of an instantaneous summary magnetic field (SMF) generated by a summary current density (SCD) during a J-wave interval in subjects with early repolarization syndrome (ERS).

Material and methods: Magnetocardiographic (MCG) examinations were performed in an unshielded space at rest in 10 asymptomatic males with ERS (aged 17-30 years) and in 10 healthy individuals with normal QRS morphology. We assessed during the descending part of the R wave in healthy and during the J-wave (late delta wave and/or a small secondary R' wave) in ERS subjects: 1) linearity and position of the null isoline (NI) on the SMF maps; 2) a

direction and a number of instantaneous current density vectors or current components (CC) of the SCD.

Results: In all normal subjects we revealed close to a linear distribution of the NI and corresponding to it singular CC directed downward and leftward along the longitudinal axis of the SMF map. In all ERS subjects the curvilinear NI subdivided into two parts during the J-wave interval:

1) the first one was parallel to the transversal axis of the heart and located in the 1st and the 4th triangular sectors on the SMF maps (the area of the basal loop of Torrent-Guasp myocardial band (TGMB) projection). The corresponding CC was directed leftward and upward in the SCD maps; 2) the second one was approximately parallel to the base of the 3rd triangular sector and located in the 3rd triangular sector (the area of the descending segment of the TGMB projection). The corresponding CC was directed downward in the SCD maps. We revealed the more earlier onset of the depolarizing current in the ventricular base (VB) of ERS subjects than in the normal subjects during the QRS interval. **Conclusions:** In subjects with ERS the J-wave pattern corresponded to the curvilinear distribution of the depolarizing SCD. According to this pattern the CC of the VB formed by the current density gradient between the right segment and the left segment of the basal loop predominated over the CC of the descending segment of TGMB. We hypothesized that the more earlier than normal onset of the depolarizing current in the VB was due to overdistention (volume overload) of the right segment of TGMB and "premature" activation of the mechano-electrical feedback and Frank-Starling mechanisms in the base of the ventricles.

Ischemic heart disease progression in patients with diabetes mellitus type 2

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Background: In patients with diabetes mellitus (DM), a risk of ischemic heart (IHD) disease is significantly increased.

Purpose: The aim of investigations was to determine a causative relationship between diabetes mellitus type 2, as a risk factor of atherosclerosis, and progression of ischemic heart disease, as a consequence of lipids disturbances.

Material and methods: A study group consisted of 80 patients with DM type 2 (the mean age: 63.8 years), and with the mean disease's history of 4.4 years. Among many other biochemical parameters, lipidogram abnormalities (total cholesterol, HDL-cholesterol, LDL-cholesterol, triglycerides) and glycosylated hemoglobin level were analyzed in the all examined patients.

Results: The data collected showed the statistically significant inverted correlation between glycosylated hemoglobin level and HDL-cholesterol fraction and the direct correlation between glycosylated hemoglobin level and blood triglycerides, i.e. the higher glycosylated hemoglobin, the lower HDL, and conversely: the higher glycosylated hemoglobin, the higher trig-

lycerides. Moreover, in the bad controlled diabetics, a tendency to higher LDL-cholesterol and total cholesterol levels was also observed. The mentioned-above abnormalities in the blood lipid metabolism were enhanced proportionally both to the age of the patients and the disease's duration.

Conclusions: In the observed patients with diabetes mellitus type 2, the considerable atherogenic hyperlipidemia as well dyslipidemia were found, which were aggravated proportionally to the blood glycosylated hemoglobin level applied for long-term control of hyperglycemia. A risk of atherosclerosis progression increased significantly in the patients with a level of glycosylated hemoglobin > 6.5% and in the cases with a long-term duration of diabetes mellitus.

Polymorphisms of the chosen genes in relation to a risk of ischemic heart disease

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Background: In addition to conventional factors, genetic determinants can also play a role in the appearance of ischemic heart disease and myocardial infarction. The complicated etiology of diseases prompts to simultaneous research on different genes the protein products of which can be related to disease pathophysiology. The occurrence of phenotype manifestations often appears when polymorphisms overlap various genes. Research on single genes cannot explain correlation between their polymorphism and disease risk. It seems that investigations of different alleles arrangement will permit to detect their contribution to ischemic heart disease and myocardial infarction.

Material and methods: We tested G20210A factor II (prothrombin), G1691A factor V (factor V Leiden), C677T methylenetetrahydrofolate reductase (MTHFR) polymorphisms and insertion/deletion polymorphism of angiotensin-converting enzyme (ACE) gene. Study comprised 13 subjects: 5 cases of ischemic heart disease, 4 cases of myocardial infarction and 3 cases with family history of myocardial infarction. Polymorphism variants

of factor II, V, and MTHFR genes were determined using PRONTO ThromboRisk test (PRONTO Diagnostics Israel). Insertion/deletion polymorphism of ACE gene was determined by polymerase chain reaction (PCR) and standard gel electrophoresis.

Results: Although the study group was not large, it is worth noting that we did not find cases with favourable genotype, which in the earlier publications was indicated as associated with a low risk of ischemic heart disease. Developing the above- presented preliminary research on and study the other genes polymorphism can be useful in drawing conclusions about genotypes contributing to ischemic heart diseases.

Some demographic factors and recreational physical activity assessed retrospectively in patients with IHD referred to cardiac rehabilitation

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Purpose: Purpose of the study was to analyze a relation between the selected demographic factors and the intensity of recreational physical activity in the patients with IHD.

Material and methods: A study group consisted of 250 patients with IHD (184 men and 66 women) at the mean age of 6.4 ± 8.9 years. A profile of physical activity was assessed for a 20-year period before the IHD onset with the modified Framingham questionnaire. An average intensity of recreational physical activity was measured per one week using metabolic equivalents (METs) for describing the particular forms of exercises. As the minimal one-week intensity of preventive physical efforts was assumed a caloric uptake of 1000 kcal, which equaled, after adjusting to body mass, 13.1 ± 2.4 METs.

Results: The examined women presented the average retrospective activity of 3.8 ± 2.0 METs, whereas the men of 4.6 ± 2.4 METs. Educational level appeared to affect physical activity, ranging from 3.8 ± 2.4 METs to 5.3 ± 2.3 METs, as from elementary to university education. Blue collars achieved rec-

reational activity of 4.3 ± 2.4 METs, whereas white collars of 5.4 ± 2.0 METs. The average physical activity was higher for younger patients (<55 years) than for elder ones (>70 years): 5.0 ± 2.5 vs. 4.6 ± 2.0 METs, respectively. Also, the patients living in the rural areas were more active as compared with those from urban areas: 5.5 ± 2.0 vs. 4.3 ± 2.3 METs, respectively.

Conclusions: the examined population in the life period preceding the IHD diagnosing did not reach even 50% of the required as minimal caloric expenditure recommended for cardiovascular prevention.

Age and risk of sudden cardiac death in IHD patients subjected to long-term cardiac rehabilitation

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Background: Sudden cardiac death (SCD) has a multifactorial background. There are many known parameters useful in stratification of the patients with IHD being at high risk of SCD. Exercise ECG testing enables to evaluate a physical capacity level considered the most significant risk factor of death. Besides, it yields a possibility of analyzing heart rate recovery (HRR), which can be treated as the next simple and useful parameter in assessing a SCD risk.

Purpose: Aim of the study was to observe an influence of age on HRR in the IHD patients.

Material and methods: Group of 140 patients with IHD subjected to invasive treatment (PTCA, CABG) were divided to the two age subgroups: A: 59 patients (55.47 ± 3.17 years) and B: 81 patients (70.31 ± 4.71 years). The all patients underwent a 6-month cardiac rehabilitation including physical training performed 5 times a week. The program included a 45-min cycloergometer training (ERGOLINE system) with the 4-min interval loads (50% of those established during the ECG exercise testing) increasing with time and broken by the 2-min rest with 10 Watt load (3x/week), and gen-

erally improving exercises (2x/week). HRR was measured as a difference between the heart rate at peak effort during the exercise test and the heart rate after 1st minute of the recovery phase. The HRR value equal or less than 12 beats per minute is assumed as the important prognostic marker of cardiac mortality.

Results: HRR equal or ≤ 12 was observed in 10/59 (16,95%) of the younger patients, and in 31/82 (38,27%) of the elderly patients. After completion of cardiac rehabilitation, this unfavorable HRR was noted in only 2 of A group patients (80% improvement) and in 15 of B group patients (52% improvement).

Conclusions: Insufficient HRR, related to the higher risk of SCD, was clearly more pronounced in the elderly patients of the examined IHD population.

Tachycardia as an independent risk factor in chronic lead poisoning

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Background: It is suggested that lead exposure may be connected with cardiovascular diseases such as arterial hypertension, coronary heart disease, stroke, and peripheral arterial disease. It is known that tachycardia is an independent cardiovascular risk factor in patients with heart diseases and also in healthy individuals. Heart rate variability (HRV) is a noninvasive measurement reflecting autonomic cardiac function predicting death and arrhythmic complications in healthy middle-age and elderly subjects.

Purpose: The aim of the study was to compare heart rate measured during 24-hour ECG recording in people occupationally exposed to lead with the non-exposed objects.

Material and methods: The study group included 43 copper-smelters and 43 healthy subjects matched individually. A 24-hour ECG Holter monitoring was performed in all men. In all participants any heart disease including arterial hypertension and other serious diseases were formerly

excluded by special questionnaires, physical examination and echocardiography. None of the men was on any medications.

Results: The 24-hour ECG Holter monitoring, both for daily (6:00-22:00) and night hours (22:00-6:00) showed that maximum, minimum, and mean heart rate were significantly higher in copper-smelters than in healthy subjects ($p < 0.05$). The maximum heart rate ≥ 120 bpm was observed in 35 copper-smelters, and in 14 controls ($p < 0.01$). There was also a positive correlation between maximum heart rate and blood lead level in workers exposed to lead.

Conclusions: The negative influence of lead on the cardiovascular system may be connected with the higher heart rate.

Decreased heart rate variability in healthy volunteers with tachycardia

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Background: Increased heart rate may predict higher cardio-vascular and non-cardiovascular mortality even in healthy people.

Purpose: A purpose of the study was to evaluate the association of tachycardia measured at rest and heart rate variability in healthy volunteers.

Material and methods: We included 50 participants to the study group, aged 24-75 years (mean age: 50.35 ± 13.07). With criterion of tachycardia (HR, heart rhythm > 100 bpm) at rest, we divided a study group into: group I included subjects with tachycardia and group II – subjects with a normal resting heart rate. 24-hour Holter ECG with time domain analysis (SDNN, SDNNi, SDANN, RMSSD and pNN50 parameters) was performed in all participants with subanalysis for day (6:00–22:00) and night hours (22:00–6:00).

Results: In the participants with increased heart rate measured at rest, maximal, minimal and mean heart rate were statistically significantly higher in comparison with group II (HR max - I: 154.00 ± 36.57 bpm; II: 119.73 ± 23.84 bpm;

$p < 0.05$; HR min - I: 69.50 ± 23.33 bpm; II: 52.62 ± 8.54 bpm; $p < 0.05$; HR mean - I: 88.00 ± 12.56 bpm; II: 71.42 ± 12.16 bpm; $p < 0.05$). SDNN and SDANN were significantly lower in a group I than in group II (SDNN - I: 97.50 ± 26.87 ms; II: 139.31 ± 54.58 ms; $p < 0.05$; SDANN - I: 78.55 ± 36.13 ms; II: 124.58 ± 46.35 ms; $p < 0.05$). Moreover, as compared to a group with normal heart rate at rest, SDANN was significantly lower in subjects with tachycardia during both periods - day and night hours (SDANN day hours - I group: 75.20 ± 14.85 ms vs. II: 100.92 ± 41.34 ms; $p < 0.05$ and SDANN night hours - I: 44.55 ± 51.97 ms vs. II: 83.33 ± 34.13 ms; $p < 0.05$). SDNN was lower in a group with tachycardia only during night hours (SDNN night hours - group I: 71.80 ± 56.14 ms; group II: 109.63 ± 45.47 ms; $p < 0.05$). There was a positive correlation between the measured heart rate at rest and mean heart rate ($r = 0.65$; $p < 0.05$); and also between heart rate and maximal ($r = 0.63$; $p < 0.05$), and minimal heart rate ($r = 0.57$; $p < 0.05$) from 24-hour Holter monitoring.

Conclusions: In the normal subjects with tachycardia at rest measured casually, the decreased values of heart rate variability were detected. A single casual measurement of heart rate correlates with values detected during 24-hour recording, which indicates the usefulness of this simple measurement as the initial evaluation of cardio-vascular risk.

Knowledge of normal values of heart rate in inhabitants of Wrocław city

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Background: A high resting heart rate is associated with an increased risk of ischemic heart disease and hypertension even in normotensives, and it is suggested to be a risk factor for sudden cardiac death.

Purpose: The purpose of the study was to determine the knowledge of normal values of heart rate in randomly selected inhabitants of the city of Wrocław.

Material and methods: The study was performed in randomly selected group of 39 inhabitants of Wrocław city (about 635.000 inhabitants), in Lower Silesia region of Poland, aged 24 to 88 years (mean age: 52.33±14.43 years). A special questionnaire on cardio-vascular risk factors and knowledge of heart rates was fulfilled anonymously by the participants. In all participants, the pulse was measured as well as blood pressure, height, body mass and waist circumference.

Results: The following values of pulse were declared by participants as normal: 70 bpm by 46.2 %, the value of 120 bpm by 43.6 %, heart rate of 40 bpm by 25.6 % and 60 bpm – by 48.7 %. In the multiple choice questions, the most frequently chosen option referred to normal heart rates was 70 bpm and 120 bpm, which was declared by 25.65 % of respondents. The entirely correct answer was given only by 12.8 of participants. The ability to measure heart rate was declared by 82.1% of participants. Subjects with higher education more frequently chose the correct answers in comparison with those with lower educational status (23.1 % vs. 9.1 %, $p<0.05$). Simultaneously they had a better knowledge on method of measuring the pulse (92.9% vs. 73.9%; $p<0.05$) and on their own heart rate at rest (91.3% vs. 64.3%; $p<0.05$). Mean heart rate determined during physical evaluation was 69.94±10.24 bpm, and mean value of blood pressure – 129.09/80.03 ± 18.28/7.09 mmHg. In 5.1% of participants, there was tachycardia (>100/bpm), and no one had bradycardia. Values of RR≥140/90 mmHg were detected in 10.53% of individuals.

Conclusions: The knowledge of normal values of heart rate in inhabitants of one of the biggest Polish cities, even though it is a relatively simple measure, seems to be insufficient. This observation correlates with the insufficient knowledge of the general population on major cardio-vascular risk factors, however education status influences the knowledge of health problems, including heart rhythm.

The relationship between paced QRS width, natriuretic peptide level and physical capacity in patients after pacing upgrade due to chronic heart failure in the course of permanent atrial fibrillation and right ventricular apical pacing

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Background: Cardiac resynchronization therapy (CRT) is a proven treatment for chronic systolic heart failure. It also affects QRS width in patients after right ventricular apical pacing.

Purpose: We analyzed the relationship between changes in QRS width and clinical and hemodynamic response in patients followed up for 12 months.

Material and methods: We enrolled 34 patients (9 F, 25 M), aged 49 to 84, mean age 69.7 years, with chronic heart failure (NYHA class III 28 pts, NYHA class IV 6 pts) and permanent atrial fibrillation who had undergone right ventricular apical pacing 35.4 to 184.2 months (mean 89.4) before. The patients had been paced for over 95% of the time in the ventricular mode, which was achieved via atrioventricular junction ablation (9 pts) or pharmacotherapy. The patients were subdivided into two groups: those who switched to dual site right ventricular pacing (BiP) - 10 patients, and those who received CRT (BiV) - 24 patients. We analyzed changes in BNP levels, 6 minute

walk distance (6MW) and left ventricular ejection fraction (in the BiP and BiV group) as compared with paced QRS width.

Results:The BiP group was characterized by: 1. a weak negative correlation between paced QRS width and changes in left ventricular ejection fraction (LVEF); 2. a moderate negative correlation between changes in paced QRS width and changes in BNP levels.

The BiV group demonstrated: 1. a weak negative correlation between paced QRS width and changes in the 6MW test; 2. a weak positive correlation between paced QRS width and changes in BNP levels; 3. a moderate negative correlation between changes in paced QRS width and changes in LVEF.

Conclusions:

1. The shortening of QRS duration is related, albeit weakly to clinical and hemodynamic improvement in patients with permanent atrial fibrillation and high rate pacing after upgrade to CRT.

2. Dual site right ventricular pacing showed a weak relationship with hemodynamic improvement expressed as LVEF and it correlated with an increase of BNP level.

The vector graphics in analysis of standard coronary angiograms as a contribution to coronary blood flow assessment

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Background: In the paper, a Java Applet drawing the plot of the surface, defined by explicit two-variable mathematical function, was used in intention to assess the coronary blood flow on the basis of standard angiograms.

Material and methods: The standard (2D) single-plane coronary angiograms were obtained from patients undergoing diagnostic angiography (age 48-56 years, 35% female, 65% male). A single-plane digital angiographic system (INNOVA 2000 General Electric) was used for image acquisition that were acquired at 15 frames/sec speed, with the gantry angles selected by the individual operators and recorded on the computer workstation in DICOM system.

The image analysis includes: vessels segmentation based on previously defined junction points, stacks assembling of vessels images belonging to the same cycle of the contrast flow, registration of intravascular optic density changes with time, working out of the correlation of obtained results with the geometrical characteristic of the respective surface plotter of

examined vessels.

Results: Analysing obtained results, we can find the statistically significant correlations between noted intravascular optic density fluctuations and spatial and linear characteristic of vessels surface plotter. The power of mentioned relationship was measured by Fisher's test.

Conclusion: The working up method of coronary vessels blood flow analysis permits fast qualitative assessment in "real-time" of performing angiography. However, on this stage of conducting research it is not enough sensitive for evaluation of quantitative characteristic of the coronary blood flow.

Influence of normal menstrual cycle on circadian rhythm of autonomic nervous activity

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Background: Decreased estrogen level appearing in postmenopausal women is known as one of risk factors of ischemic heart disease and sudden cardiac death. The balance of autonomic nervous activity (ANA) in early morning has been postulated as a sign of precipitating factor reflecting increased incidences of sudden death in patients with cardiovascular diseases. It is not known how postmenopausal state influences the balance of ANA.

Purpose: To understand the relation between menstrual states and ANA, we studied the changes in circadian rhythm of ANA that occurred during the normal menstrual cycle of 9 healthy young women (mean age 20.6 years). Holter ECG was monitored during the follicular phase (F-phase) and luteal phase (L-phase). ANA was evaluated by heart rate variability (HRV).

Results: Mean heart beats/24hrs increased significantly during L-phase (70.4→76; $p<0.01$), and both SDNN (msec)/24hrs and CVRR (%)/24hrs reduced during L-phase (184.5→150.1; $p<0.01$ and 23.4→21.3; $p<0.01$, respectively). While HR (bpm) every hour, high frequency spectra (HF) and low frequency spectra (LF)/HF demonstrated typical circadian rhythm,

early morning HR and LF/HF during L-phase were higher than those during F-phase (57.3→65.3; $p<0.01$ and 1.3→2.1; $p<0.05$, respectively). Early morning HF during L-phase, however, was lower than that during F-phase (1510.9→1079.7; $p<0.01$). In the morning during F-phase, HF decreased slowly and LF/HF slowly increased. Therefore, sympathetic nervous activity is higher and parasympathetic nervous activity is lower in L-phase, which may be comparable to postmenopausal state, than those of F-phase.

Conclusions: The results suggest possible basis contributing to increased incidence of sudden cardiac death and cardiovascular disease in postmenopausal women, and also to high incidences of cardiac events occurring in early morning.

Gender differences in heart rate variability, oxygen saturation and ventilation during normobaric hypoxia

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Background: The differences between genders in the respiratory system and in the red blood cells are well documented. Also oxygen saturation in normoxia and ventilatory response to hypoxia have been found different in men and women. Studies of cardiac autonomic nervous system (ANS) activity during acute exposure to hypobaric hypoxia have suggested a depression of autonomic functions and a shift in the sympatho-vagal balance towards relatively more sympathetic and less parasympathetic activity at higher hypoxic levels.

Purpose: The aim of the present study was to assess the effects of hypoxia on cardiac ANS function, hemoglobin oxygen saturation (SaO₂) and ventilation in young healthy males and females.

Material and methods: Eight women and six men, matched for age and BMI, were exposed to normoxia (40-min) followed by 30-min acute normobaric hypoxia (FiO₂ = 12.86%).

Results: The power spectral analysis and the Poincaré plot analysis of the

heart rate variability, used as assessment of cardiac ANS activity, showed a significant reduction of vagal activity ($p < 0.03$) in women but not in men, comparing normoxia to hypoxic conditions. Also the fractal dimension, as expression of the complexity of the system, was significantly lower ($p < 0.01$) only in females during the exposure to hypoxia. On the other hand, the increase of the heart rate during hypoxia was significant in females ($p < 0.007$) as well as in males ($p < 0.026$). In normoxia the SaO₂ values was slightly higher in females than in males ($99.38 \pm 0.92\%$ vs $99.0 \pm 0.89\%$; ns). Compared hypoxia to normoxia, the SaO₂ decrease was significant in females ($p < 0.0001$) as well as in males ($p < 0.015$). Neither in men nor in women was observed any significant difference in ventilation during the experimental protocol.

Conclusions: These results indicate a different sex response of the cardiac ANS, linked to the acute exposure to hypoxia, suggesting in females a relevant reduction of the vagal activity concomitant with the higher SaO₂ decrease.

RF ablation of incessant atrioventricular tachycardia after Cartier operation with Kalangos Ring due to Ebstein Anomaly

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Purpose: We present a case of 15-year old girl with Ebstein anomaly, significant tricuspid valve (TV) regurgitation, ASD II and initially asymptomatic WPW syndrome. Biodegradable Kalangos Ring was used for TV plasty with very good hemodynamic effect. Several weeks after the operation she presented persistent atrio-ventricular tachycardia (AVRT) with RBBB morphology (130-160/min). Tachycardia did not respond to antiarrhythmic therapy.

Methods: Before ablation echocardiography showing good function of the TV with thick folding of the myocardium over the ring at the posterolateral wall. EPS confirmed the presence of atrioventricular pathway (AP) with slow bi-directional conduction. Single stimulus induced AVRT with long RP' interval. The mapping of the posterior-to-lateral wall of the TV showed the broad zone of low amplitude potentials. The 4 mm tip RF ablation electrode was used and after 2 applications the tachycardia was terminated, but antegrade conduction over the AP was preserved. Several additional

applications were only transiently successful thus the decision was made to use irrigated catheter. Linear application was performed with repeated cessation of conduction over the pathway, however the slow tachycardia was inducible.

Results: After several minutes the pathway become silent. During 6 months follow-up she did not experience tachycardia despite no antiarrhythmic therapy. This case revealed that implantation of biodegradable Kalangos Ring may change the electrical properties of the preexisting AP leading to incessant AVRT. In this situation the ablation of the pathway can be difficult due to a myocardial folding covering the pathway.

Conclusions: Integrating echocardiography, angiography with irrigated electrode can be successful in abolition of the pathway.

Physiotherapy and Cardiac Rhythm Devices: A Review of the Current Status

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Purpose: We review current standards that exist locally, provincially and internationally regarding the use of physiotherapy modalities in patients with pacemakers and/or implantable cardioverter-defibrillators (ICD). These cardiac rhythm devices (CRD) prolong survival and their use is increasing, so more elderly patients will be presenting to physiotherapy centers with CRD. Many may not receive optimal care because of the preconception that physiotherapy modalities are potentially harmful to these patients.

Materials and Methods: Retrospective analysis of patient encounters within a 2-year period at a local physiotherapy facility was performed. An electronic questionnaire was administered to members of the Ontario Physiotherapy Association to investigate provincial policies. Finally, seven international physiotherapy societies and four CRD manufacturers were contacted to inquire about recommendations.

Results: The local physiotherapy facility treated 25 patients with CRD (22 pacemakers, 3 ICD) at 230 visits (9.2 visits/patient). Five patients received TENS and all 25 were administered alternative treatments with low-risk of device-interference in the form of ultrasound (15), acupuncture

(19), LASER (7), traction/manual therapy (12), exercise (8), education (18), taping (5) and/or moist heat (5). No serious complications occurred. In only one case was the arrhythmia service contacted. Provincially, 11% of physiotherapists did not treat CRD patients. 51% did not implement a CRD safety policy. International societies and device manufacturers offered few specific or consistent recommendations.

Conclusions: There are no specific policies regarding the administration of physiotherapy modalities in CRD patients. TENS, diathermy, and Interferential Electrical Current Therapy are best avoided. Further safety research may allow for these modalities to be used.

Effect of passive smoking on heart rate and heart rate variability in healthy subjects

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Background: Cigarette smoking has been proved to increase the risk of cardiovascular diseases and death. It was shown that smoking increases sympathetic activity probably due to oxidative stress and inflammatory response. Such relations are also suggested in case of passive exposition to tobacco smoke (TS).

Purpose: Cardiac autonomic function in subjects claiming to have chronic exposition to tobacco smoke was investigated by analysis of heart rate variability (HRV). Heart rate variability (HRV) is a noninvasive measurement reflecting autonomic cardiac function predicting death and arrhythmic complications.

Material and methods: Analysis included 45 adult healthy non-smokers aged 24-77 years (mean: 51.82 ± 14.41), 16 men and 29 women. Participants fulfilled a special questionnaire on life style and habits including passive exposure to TS. Volunteers were divided into two groups: 22 exposed to TS

(group I) and 23 not exposed (group II). All the subjects participated in 24-hour ECG Holter recordings. Other examinations included blood pressure, heart rate, height and body weight, waist circumference and general physical examination. Time-domain parameters: SDNN, SDNNi, SDANN, RMSSD and pNN50 were analyzed from the entire recording and from the night (22:00–6:00) and the day (6:00–22:00) periods.

Results: In the subjects exposed to passive smoking at work and/or at home, there were no differences in maximal, mean and minimal heart rate between the two study groups. On 24-hour ECG analysis, SDANN and rMSSD were significantly lower in group I (exposed to TS) as compared with group II (SDANN - I: 121.16 ± 27.95 ms; II: 133.88 ± 30.29 ms; p < 0.05; rMSSD - I: 34.36 ± 16.57 ms; II: 47.87 ± 33.72 ms; p < 0.05). It was shown that during the day and the night hours rMSSD was significantly lower in exposed subjects than in the non-exposed ones: rMSSD day - I: 30.10 ± 15.48 ms; II: 45.23 ± 39.87 ms; p < 0.05; rMSSD night - I: 41.95 ± 19.37 ms; II: 52.22 ± 20.87 ms; p < 0.05). Moreover, SDANN was statistically significant lower in group I in comparison with group II only during the day hours (SDANN day - I: 94.75 ± 32.56 ms; II: 112.58 ± 38.62 ms; p < 0.05).

Conclusions: Passive exposure to smoking is associated with lower HRV, which may increase cardiac risk via disturbances in the autonomic nervous system.

YIA-3 Electro-anatomical relationship in the hearts with primum atrial septal defect

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Purpose: Leftward deviation of the QRS axis and abnormalities of the mitral valve are frequently present in patients with a primum defect of the atrial septum (primum ASD). The pathophysiology of these associated findings is, however, not understood. The aim of the study was to test the hypothesis that patients with primum ASD have imbalance in the positions of papillary muscles compared to healthy subjects and this anatomical imbalance correlates with leftward deviation of the QRS axis.

Material and methods: Thirty-five patients with primum ASD and 35 healthy subjects were included in the study. ECHO images were used for determination of the papillary muscle positions. Twelve lead ECG was used for determination of the QRS axis in the frontal plane in both patients and healthy subjects. The balance in the positions of the mitral papillary muscles, measured as the ratio between the free wall angle of the anterior and posterior papillary muscles, was assessed as the main outcome measure. The correlation between the position of the papillary muscles and the QRS axis was calculated.

Results: The median ratio between the free wall angle of the anterior and posterior papillary muscle was 1.23 (CI = 0.99 to 1.35) in primum ASD patients compared to 1.4 (CI = 1.29 to 1.55) in healthy subjects ($p=0.0016$). This ratio correlated with deviation of the QRS axis ($r=0.5$, $p=0.003$, CI = 0.20 to 0.71).

Conclusions: The relationship between the positions of the mitral papillary muscles and QRS axis deviation is present in primum ASD patients. This relationship can explain left QRS deviation in primum ASD patients.

YIA-4 User-friendly software package for quantitative evaluation of HRV, TWA and HRT in ECGs

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Purpose: Quantitative evaluation of cardiac risk prediction parameters requires implementation of complex computer algorithms. Various commercial applications provide cardiologists with tools that deliver diagnostic parameters. However, these tools often lack the possibility either to compare the results with other parameters or to verify methods applied. Doctors are left with a final result and are neither able to examine nor alter the employed algorithms. This precludes further research. In this paper a software package for quantitative evaluation of HRV, TWA and HRT in ECGs is presented. It is written for the purpose of scientific research rather than clinical diagnosis.

Materials and methods: The software is written in Matlab. Recorded signal can be loaded from binary, text or system specific (Medea, Finometer) format files. It enables plotting ECG records, visualizing QRS detections, computing and plotting HRV series. ECG can be denoised by cascaded 50Hz notch filtering, highpass filtering or synchronized averaging. TWA analysis is performed both in spectral and in time domain by applying

Poincare maps. Analysis of both sinoatrial and stimulated rhythm registrations is possible. HRT onset and slope parameters are computed using Schmidt algorithm. HRV analysis is provided by the associated standalone component written in Java. It determines statistical (mNN, SDNN, RMSSD) and spectral (LF and HF power, LF/HR ratio) parameters. Frequency characteristic is determined using parametric (autoregression, ARMA) and non-parametric (periodogram) methods.

Results and conclusions:

The developed software package is a flexible and comprehensive tool for TWA, HRT, TWA quantitative analysis in ECGs. It offers the possibility to choose from various modeling methods and to modify the applied algorithms. The interface is user-friendly and enables interactive selection of ECG signal fragments for analysis. Currently, the tool is added for segmenting ECG by wavelet analysis.

Improved assessment of arrhythmia vulnerability

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Background: Basic studies emphasize the correspondance of spatio-temporal repolarisation disparity (RD) and arrhythmia vulnerability. The clue of noninvasive RD assessment is in the simultaneous evaluation of QRS and QRST integral maps. From the point of view noninvasive measurement technology this needs the detailed knowledge of body surface potential distribution over the complete QT interval. It was verified earlier in our group that the morphology of QRST integral maps is determined by the cardiac depolarization sequence (represented by QRS integral maps), and by a superimposed component, randomly changing beat-to-beat. The random component reflects the dynamical changes of action potential area gradients (approximately AP duration changes). Essentially the random RD component is responsible for the functional repolarization heterogeneities yielding isolated myocardial regions still refractory while the surrounding myocardium is already excitable.

Material and methods: In this study 10 healthy subjects and 10 post-MI

ICD patients were enrolled. Records were taken with a length of 5 minutes in steady state supine position. The computation of random RD was based on the beat-to-beat analysis of QRS and QRST integral maps using our linear model introduced earlier.

Results: Results revealed that BSPM based risk assessment definitely surpass the performance of conventional QT variability assessing lead-systems, because the largest variability quite often is out of the thoracic area explored by the 12-lead system (a). QRS and QRST integral computations were not sensitive on ± 10 or ± 20 msec errors in wave-limit determinations (in QRS and QRST, respectively) and on the superimposed ECG noise, i.e. the spatio-temporal beat-to-beat changes of RD are represented with a high-fidelity, i.e. $S/N \geq 10$ (b).

Features of heart rate turbulence observed after double ventricular premature complex and ventricular tachycardia

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Purpose: To analyze parameters of heart rate turbulence (HRT) and its relationship with normalized coupling interval (nCI), postectopic interval (PI), mean intraectopic interval (R'R') and heart rate (HR) in surviving patients and in died suddenly patients with double ventricular premature complexes (PVCs) and ventricular tachycardias (VTs).

Material and methods: 37 patients with prior myocardial infarction (MI) were included in the 1-st group and 16 died suddenly patients (MI) – in the 2-d group. HRT (TO and TS) was measured in 24-hour Holter recordings (KTResult2, «INCART», St.-Petersburg, Russia) for 126 double PVCs and 38 VTs in the 1-st and for 75 double PVCs and 46 VTs – in the 2-d group.

Results: It was revealed reduced HRT after double PVC in 2-d group (TO = $0,99 \pm 5,12\%$ vs $-2,86 \pm 3,86\%$ ($p=0,0001$), and TS = $9,56 \pm 8,36$ ms/RR vs $14,56 \pm 12,49$ ms/RR ($p=0,005$)). HRT after VT was decreased in the 2-d group too (TO = $1,59 \pm 8,10\%$ vs $-2,42 \pm 6,23\%$ ($p=0,004$), and TS = $11,13 \pm 10,06$ ms/RR vs $16,57 \pm 10,93$ ms/RR ($p=0,024$)).

In case of double PVC the slope of the linear regression of TS on the PI was positive both in the 1-st group ($r=0,489$) and in the 2-d ($r=0,246$). In case of VT in the 1-st group slope of linear regression of TS on the nCI was

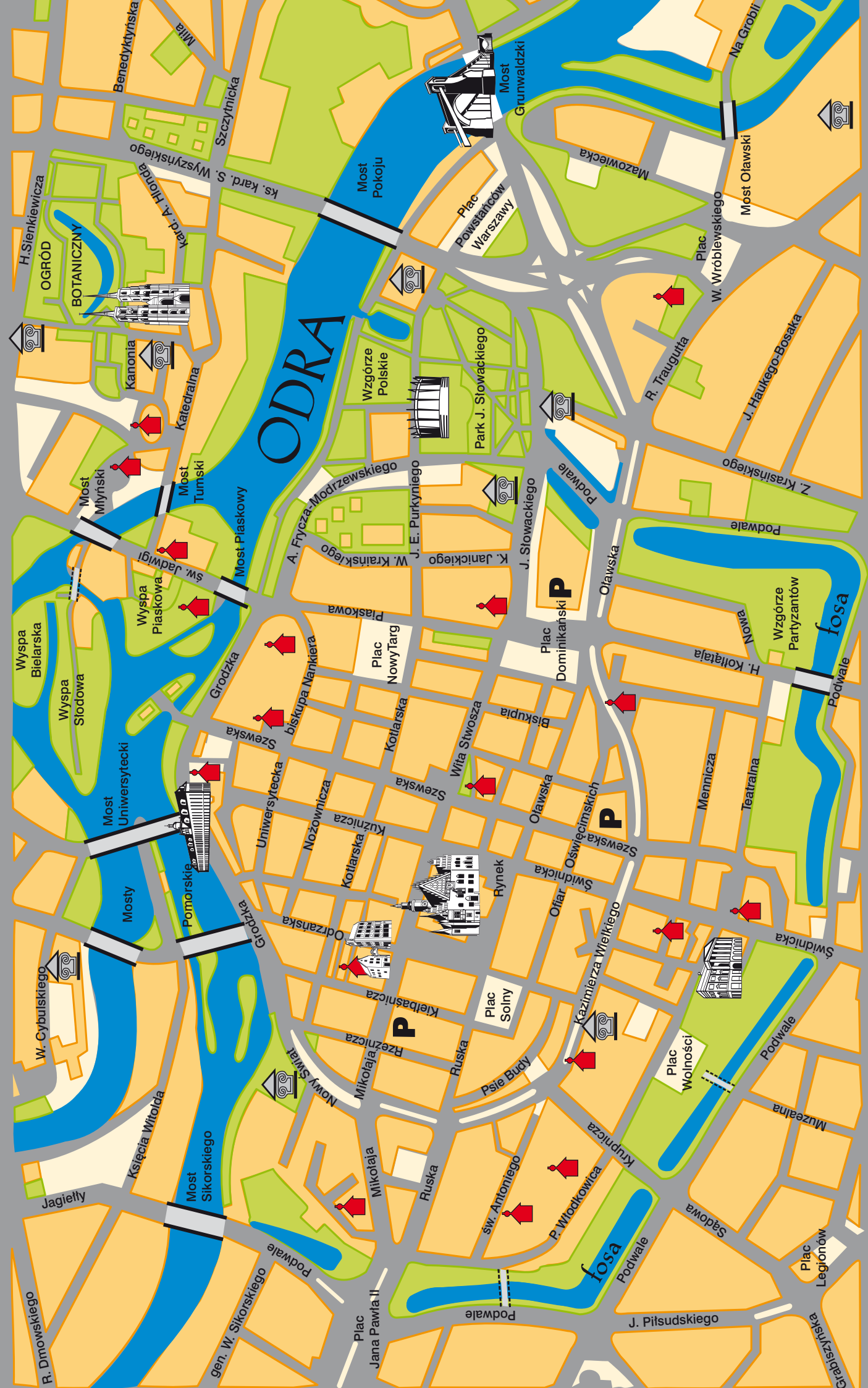
negative ($r=-0,425$), slope of linear regression of TO on the mean R'-R' – positive ($r=0,561$). In the 2-d group slope of linear regression of TS on the nCI was positive. Besides correlation between TS and HR was observed in both groups ($r=0,586$).

Conclusions: HRT after double PVC and VT was reduced in died suddenly patients. At double PVC TS increases with longer PI and shorter nCI. At VT TS increases with shorter nCI, but there was inverse relationship in died suddenly patients. It is necessary to carry out further studies of HRT after these ventricular arrhythmias to determine the threshold between its normal and abnormal values, taking into account described relationships, for subsequent using as predictors of sudden death.

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MAP OF WROCLAW

Torvalipin

Atorwastatyna

Teraz odpłatność
30%
dla pacjenta *



Niebezpieczny poziom

Cel terapii



7,85 zł*

Opuść niebezpieczny poziom

15,65 zł*

Atorwastatyna
potwierdzona klinicznie
regresja blaszki miażdżycowej¹

Torvalipin (atorwastatinum) – 10 mg, 20 mg, 40 mg; tabletki powlekane.

Skład: 1 tabletkę powlekaną Torvalipin zawiera 10 mg, 20 lub 40 mg atorwastatyny. **Wskazania do stosowania:** Jednoczesne stosowanie z zalecaną dietą, w celu obniżenia podwyższonego stężenia cholesterolu całkowitego, cholesterolu LDL, apolipoproteiny B lub triglicerydów u pacjentów z pierwotną hipercholesterolemią, heterozygotyczną hipercholesterolemią rodzinną lub hiperlipidemią mieszaną (odpowiadającą typowi II a lub typowi II b wg Fredericsona), jeżeli dieta oraz inne środki nefarmakologiczne były niewystarczająco skuteczne. Również homozygotyczną hipercholesterolemią rodzinną jako leczenie wspomagające z innymi lekami obniżającymi poziom cholesterolu (LDL) lub w przypadkach, gdy inne metody terapeutyczne nie są wystarczająco skuteczne. **Dawkowanie i sposób podawania:** Po., niezależnie od posiłków, o dowolnej porze dnia 10-80 mg raz na dobę w zależności od stężenia LDL-cholesterolu i jego wartości docelowej. Początkowo zwykle stosuje się 10 mg raz na dobę. Zmiany dawkowania można dokonywać w odstępach co najmniej 4 tyg. Nie ma potrzeby modyfikacji dawki u osób z niewydolnością nerek ani chorych w podeszłym wieku. U dzieci 4-17. rz. z homozygotyczną hipercholesterolemią rodzinną początkowo 10 mg/d, dawka może być w razie potrzeby zwiększona. Przed leczeniem i w jego trakcie powinien być oznaczony profil lipidowy (przeciętnie co 3 mies.), a jako wskaźnik skuteczności leczenia powinno przede wszystkim służyć stężenie cholesterolu LDL. **Przeciwwskazania:** Nadwrażliwość na atorwastatinę lub którąkolwiek substancję pomocniczą tego leku w wywiadzie. Czynna choroba wątroby lub utrzymująca się zwiększona aktywność aminotransferaz w surowicy krwi, przekraczającą 3-krotnie górną granicę wartości uznanej za prawidłową. Miopatia. W okresie ciąży lub karmienia piersią. Kobiety w wieku rozrodczym, które nie stosują odpowiednich środków antykoncepcyjnych. **Specjalne ostrzeżenia i środki ostrożności dotyczące:** W trakcie leczenia preparatem Torvalipin może dojść do wzrostu aktywności aminotransferaz. Lek należy odstawić przy wartościach trzykrotnie przekraczających wartości prawidłowe. W czasie leczenia atorwastatiną może dojść do miopatii, która może doprowadzić do rhabdomyolizy i do niewydolności nerek. Ryzyko wzrasta przy jednoczesnym stosowaniu: fibratów; niacyny; cyklosporyny; nefazodonu, niektórych antybiotyków, p-grzybiczych pochodnych azolowych oraz inhibitorów proteazy HIV (rytonawir). Jeżeli u pacjenta wystąpią objawy miopatii, zaleca się zbadanie aktywności kinazy kreatynowej (CK). W przypadku poważnego jej wzrostu leczenie należy przerwać. **Interakcje:** Jednoczesne podawanie leku Torvalipin i cyklosporyny, antybiotyków (erytromycyny, klarytromycyny, kwinuaprystyny, dalfoprystyny), inhibitorów proteazy, nefazodonu może doprowadzić do wzrostu stężenia atorwastatyny, co może doprowadzić do miopatii z rhabdomyolizą i niewydolnością nerek. Reakcja podobna może wystąpić po jednoczesnym stosowaniu pochodnych kwasu fibrynowego. Jednoczesne stosowanie fenytoiny może obniżać skuteczność leku Torvalipin. Przy stosowaniu leków alkalinizujących może dojść do obniżenia stężenia atorwastatyny w osoczu bez znacznego wpływu na efekt jej działania. Warfaryna w skojarzeniu z atorwastatiną może wpływać na parametry koagulacji. Przy jednoczesnym stosowaniu atorwastatyny i kolestypolu, stężenie statyny może ulec obniżeniu a efekt kliniczny takiej kombinacji jest większy. Spożywanie soku grejpfrutowego może doprowadzić do zwiększenia stężenia leku w osoczu. **Działania niepożądane:** Działania niepożądane są łagodne i przemijające. Najczęstsze działania niepożądane to: zaburzenia ze strony przewodu pokarmowego, bóle głowy, bóle mięśni i zaburzenia snu. Rzadko występujące: wzrost aktywności aminotransferaz. Objawy miopatii z towarzyszącymi bólami mięśni i ich osłabieniem oraz wzrostem aktywności kinazy kreatynowej (CK) zaobserwowane jedynie u 0,1% pacjentów. U żadnego nie doszło do rhabdomyolizy. **Podmiot odpowiedzialny:** Actavis Group hf., Reykjavikurvegur 76-78 IS-220 Hafnarjörður Islandia. **Numery pozwolenia MZ na dopuszczenie do obrotu:** 12938, 12939, 12940. Lek wydawany wyłącznie z przepisu lekarza (Rp).

* Cena urzędowa detaliczna: wynosi odpowiednio: 16,51 PLN dla Torvalipin 10 mg, 26,04 PLN dla Torvalipin 20 mg, 52,02 PLN dla Torvalipin 40 mg. **Odpłatność dla pacjenta:** wynosi 7,42 PLN dla Torvalipin 10 mg, 7,85 PLN dla Torvalipin 20 mg oraz 15,65 PLN dla Torvalipin 40 mg.)

4. 2005, tom 12, nr 7, 471-480 Copyright 2005 Via Medica ISSN 1507-4145

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