Connexin30.2 forms functional gap junction channels in the heart

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Connexins (Cxs), a family of membrane proteins in vertebrates, form gap junction (GJ) channels that provide a direct pathway for electrical and metabolic signaling between cells. Up to now, three members of connexin family are defined as major heart connexins: Cx40, Cx43 and Cx45. In collaboration with Dr. Willecke's laboratory (Bonn University), we identified connexin30.2 as a new member of heart connexins. Cx30.2 was detected in the myocytes of the AV-node and its expression coincides with expression of Cx40. To characterize gating properties and single channel conductance of Cx30.2 gap junction channels, HeLa cells were transfected with wild type Cx30.2 or Cx30.2 fused with green fluorescent protein (Cx30.2–GFP). Dye transfers studies demonstrate that Cx30.2 and Cx30.2–GFP channels are not selective in respect to the charge of molecules permeating the channel pore, but have size limiting (∼500 D) restrictions for metabolic communication. Cx30.2 and Cx30.2–EGFP gap junctions showed weak sensitivity to transjunctional voltage (Vj) and a single channel conductance of ∼10 pS, i.e., the lowest among all members of the connexin family. When HeLa cells expressing Cx30.2–GFP were paired with cells expressing Cx40, Cx43 or Cx45 they assembled into heterotypic GJ channels in the form of junctional plaques and functional coupling exhibited asymmetric junctional conductance dependence on Vj. In summary, we demonstrate that Cx30.2, a new member of cardiac connexins, is preferentially expressed in the AV node, forms homo- and heterotypic GJ channels with all principal cardiac connexins and is important in excitation spread at normal conditions and during arrhythmias.
The QT interval as predictor of mortality after myocardial infarction

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Objectives: It was shown recently that prolongation of the QT interval can have prognostic significance in general population and in postinfarction patients. Nevertheless, the role of the corrected QT interval duration (QTc) in predicting of outcomes in patients with acute myocardial infarction (AMI) is finally not determined; purpose of this study was to estimate it.

Design and Methods: 170 patients on the 10–14th day of AMI were examined. The control group included 30 men without heart disease. The QT interval was measured by semi-automatic method on ECG records at rest and corrected using Bazett’s formula. The median follow-up lasted 20.1 months (range: 1.8–36.7). End points included all cases of deaths; sudden (SM), cardiac (CM) and total mortality (TM) was evaluated separately.

Results: QTc was significantly greater in study group than in control group (419.0 ± 31.0 vs 400.5 ± 17.4 ms, \( p < 0.05 \)). During the follow-up 23 patients died, (15 from them – suddenly, 3 more cases were associated with cardiac causes). In the survived patients QTc was significantly less (416.62 ± 30.5 ms), than in the group of SM (434.4 ± 29.9 ms, \( p < 0.05 \)), CM (438.6 ± 29.1 ms, \( p < 0.005 \)) and TM (434.9 ± 30.1 ms, \( p < 0.01 \)). The Kaplan–Meier survival analysis revealed the value of QTc equal to 440 ms as a threshold dividing significantly surviving curves for all end points (\( p < 0.001 \) for TM, \( p < 0.005 \) for CM and \( p < 0.01 \) for SM).

Conclusion: The duration of the corrected QT interval carries prognostic information concerning total, cardiac and sudden mortality, thus this parameter should be considered when estimating the forecast of patients with acute myocardial infarction.
Prognostic value of Duke treadmill score in unstable angina patients


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Objectives: Exercise electrocardiography still remains the corner-stone of non-invasive evaluation of functional state of cardiac patients. The purpose of this study was to evaluate prognostic value of Duke treadmill score in a very early symptom-limited exercise testing in patients admitted to hospital for a suspected unstable angina.

Design and Methods: The treadmill exercise testing (TET) using a modified Bruce protocol was performed on 40 low-risk patients (group I) during 48 h after admission as early as possible but not before 24 h after stabilization of their clinical condition. The low-risk group consisted of patients with no prior history of coronary disease, no abnormal creatine kinase, and the ECG was either normal or had minor non-specific ST-segment and T-wave changes. We compared the data with the results of 167 unstable angina patients with medium or high risk after clinical stabilization (group II). Time from hospital admission to TET was more than 48 h in group II patients.

Results: Mean stress duration showed no significant differences between groups: 7.87 ± 4.7 min in group I and 5.93 ± 3.1 min in group II, but exercise test responses were respectively: heart rate >75% max predicted: 63.0% and 24%, diagnostic ST depression: 27.5% and 44.3%, angina: 30% and 28%, limiting angina: 12.5% and 15.0%, no ischemia: 15.0% and 7.8%. Mean Duke treadmill score was +5.5 in group I and +2.5 in group II. Mean predictive 5 years overall survival was respectively 95% and 90%. The patients of group I had better exercise capacity and ST depression was registered only in 27% of patients as compared with 44.3% of patients of gr. II (p < 0.01). However, there were noted ST elevation episodes with ventricular tachycardia in the patients of group I during further ECG monitoring in hospital.

Conclusion: Duke treadmill score is not predictive in a very early exercise test among low-risk patients with unstable angina.
Quantitative evaluation of hemodynamics during ventricular arrhythmias

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Objectives: To evaluate hemodynamics and impact of ventricular arrhythmias on hemodynamic profile in patients with acute myocardial infarction (AMI) by continuous impedance cardiography (ICG).

Design and Methods: Included 108 patients with AMI, admitted within 12 hours from the onset of pain: 82 (75.9%) were men and 25 (24.1%) women.

The standard 8 electrodes method of ICG registration was used. Hemodynamic indices were evaluated by ICG and transthoracic echocardiography (TTE). Morphological analysis of ICG complexes reflecting systole was performed, including shape, amplitude and area analysis.

Results: Average age was 62.9 ± 11.1 years, body mass index – 28.8 ± 4.2. Stroke volume evaluated by ICG was 80 ± 28.9 ml, by TTE – 44.9 ± 12.2 ml. The other parameters measured by TTE included left ventricular end-diastolic volume – 102.5 ± 31.6 ml, ejection fraction 42.8 ± 10.6%, velocity time integral in the left ventricular outflow tract – 0.18 ± 0.04.

Ventricular extrasystoles were observed for 99 patients (92.5%), coupled extrasystoles – 26 (24.3%), ventricular tachycardias (VT) – 20 (18.7%), ventricular fibrillation – 8 (7.5%).

We found amplitude and area of extrasystoles ICG complexes ranged from 1.3 to 86% (depending on the onset of extrasystoles) of previous complex, but averaged impact on cardiac output (CO) was low (less than 4.5%). While impact of VT, including sustained and nonsustained, on CO was significant: amplitude and area of VT ICG complexes ranged from 0.8 to 47.3% of previous complex and reduction of CO ranged 23–97.2% depending on duration of VT.

Conclusion: ICG allows to evaluate hemodynamic impact of ventricular arrhythmias and changes of patient hemodynamic profile according to changes of ICG complex amplitude, area and shape.
The risk of ventricular arrhythmias in patients with arterial hypertension of different risk extent

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Objectives: There are few definite facts about the state of electrical myocardial activity in patients with arterial hypertension (AH) of different risk extent. We have made an attempt to specify the character of ventricular ectopy, as one of the most probable reasons threatening the patient’s life.

Design and Methods: We have examined 52 persons with AH (10 patients with low-risk AH, 11 patients – average risk, 16 – high risk, 15 – very high risk). Age, sex, average indices of blood pressure (BP) and urea, creatinine, blood glucose levels did not differ between groups.

Daily ECG monitoring with the following estimation of correlation dependences of index mass myocardium of the left ventricle (IMMLV), with a number of ventricular extrasystoles (VE), Lown classification and an average index of VE per 1 hour (VE/per hour).

Results: In low risk AH group, low correlation dependence on the size of IMMLV \( (111.5 \pm 9.2 \text{ g/m}^2) \) \( (r < 0.2) \), as well as the distinct correlation of arrhythmia with sizes of LV (thickness of interventricular septum (IVS) and posterior wall of the left ventricle (PWLV), end-diastolic diameter of left ventricle (EDDLV)) was not exposed. In average AH risk group, positive correlation of supraventricular extrasystoles (SVE) frequency with IVS \( (r = 0.92) \) and PWLV \( (r = 0.68) \) was revealed. The same dependence on IMMLV \( (101.1 \pm 13.3 \text{ g/m}^2) \) and increase of VE frequency were not noted. Group of high-risk AH high was characterized by further increase of myocardial wall thickness. The correlation dependence level of ventricular arrhythmia on IMMLV had no changes and it was rather weak \( (r < 0.25) \); for SVE this index also was within the limits of an average dependence according to the index of IVS and PWLV thickness \( (r = 0.53 \text{ and } r = 0.61; \text{ accordingly}) \). Patients with AH of a very high risk \( (IMMLV 159.3 \pm 39.8 \text{ g/m}^2) \) had a different situation: the class of ventricular arrhythmia according the Lown classification had an average and high correlation dependence on thickness of IVS, PWLV and IMMLV \( (r = 0.76; r = 0.47 \text{ and } r = 0.38; \text{ accordingly}) \). The dependence of VE frequency on IVS thickness as well as on the index of segment myocardial defeat in the zone of coronary supply of an anterior interventricular branch of the left coronary artery (according to the stress-echocardiography results) occurred as an average one \( (r = 0.52 \text{ and } r = 0.35; \text{ accordingly}) \).

Conclusions: The apportionment of risk extent in patients with arterial hypertension (AH) has clinic prognostic significance only with respect to patients with a very high risk, stimulated mainly by the presence of accompanying pathology as coronary artery disease (CAD) addition. CAD plays a leading role, while myocardial hypertrophy in persons with isolated AH is benign.
Idiopathic ventricular tachycardia in infancy

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Objectives: Idiopathic ventricular tachycardia (IVT) in the presence of an apparently normal heart is a rare condition in childhood. But only solitary cases of IVT in infancy are represented in the publications. There are different opinions on the management and prognosis of the infant’s VT. The aim of this study was to represent clinical spectrum and follow-up of all infants with IVT treated in our clinic between January 1996 and December 2003.

Design and Methods: Physical examination, laboratory tests, a twelve lead ECG, Holter monitoring, two-dimensional echocardiography, electrophysiological study were performed to identify IVT.

Results: IVT was diagnosed in five infants (aged 2 weeks to 5 months) presented to our clinic with tachycardia. An ECG showed a right bundle branch block (BBB) pattern in three and left BBB in two patients. The latter patients presented with signs of heart failure and sustained VT (rate > 200 bpm). In both infants VT was triggered by infection. Intravenous amiodarone was effective in terminating VT. Both infants were discharged without antiarythmic drugs. No more episodes of VT arised (follow-up 5.5 and 3 years). The infants with nonsustained VT and right BBB pattern (rate 150–200 bpm) were asymptomatic. VT disappeared in one 5 months old girl after two years (follow-up 6 yrs). The other two show normal development and are asymptomatic (follow-up 1.5 and 1 year, respectively).

Conclusions: In most infants idiopathic ventricular tachycardia has a benign prognosis and requires no treatment.
Data about in-hospital cardiac arrhythmias of patients with acute myocardial infarction

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\textbf{Objectives:} The aim of the study was: (1) to check the cardiac arrhythmias accompanying the admission period of patients with acute myocardial infarction (AMI), (2) to explore links of those arrhythmias with some environmental physical activity – like Geomagnetic Activity (GMA) and related cosmophysical parameters.

\textbf{Design and Methods:} In years 1983–2001, 20665 patients were included in the Kaunas AMI registry. When exclusions for pre-hospital deaths, defects in registration, monitoring was made remained 14529 patients, 8586 men, for the study of arrhythmia and 15765, 9238 men – for conduction defects. Daily cosmophysical activity for years 1983–2001 (6940 d) was obtained from Space Science Institutions in the USA and Russia. The mean age of woman patients was 10 years higher than men (70/60 years).

\textbf{Results:} (1) At all 13.7% men and 14.3% woman had arrhythmia: atrial fibrillation (AF) of new origin – 9.07%: 0.52% AF and ventricular fibrillation (VF) combined. AF combined with bundle brunch block (BBB) (2.4%) was related with high hospital mortality. Conduction defects included: sinus bradycardia – 8.08%; II\textdegree–III\textdegree atrioventricular blocks – 5.5%; left BBB – 7.76%; right BBB – 4.75%.

(2) Arrhythmic events inverse correlated with daily levels of GMA, \( r = -0.98, p = 0.01 \). The ratio of VF versus percent of days of each level of GMA was inverse correlated in men \( r = -0.96, p = 0.035 \). On days of high (IV\textdegree) GMA AMI with VF was in woman twice more frequent as in men (9.09%/4.15%, Chi Squ = 5.179, \( p = 0.02 \)). On days of the lowest (I\textdegree) GMA it was more total arrhythmic events (\( p = 0.0006 \)); new AF – (\( p = 0.039 \)); atrial and ventricular tachycardias – (\( p = 0.01 \)); for VF – nonsignificant, a result of higher rate of events in woman on high GMA.

\textbf{Conclusion:} In 14% of patients admitted for acute myocardial infarction cardiac arrhythmia was registered, with gender differences. Combined atrial fibrillation with bundle brunch block was associated with high hospital mortality. Cardiac arrhythmia in AMI is rising on the lowest GMA, excluding VF in women. Some gender differences can be related to older age of woman suffering AMI.
The influence of pectoral impedance on the results of synchronized cardioversion and its alteration after application of consecutive impulses

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Objectives: The aims of this paper are: (a) to analyze the alterations of pectoral impedance after having applied consecutive cardioversion impulses, (b) to ascertain the influence of pectoral impedance quantity on successful cardioversion or/and the amount of discharge.

Design and Methods: Protocols of synchronized cardioversion of 200 patients (127 males/73 females, age ranging 38–79 years, average age – 64 years) because of sustained/paroxysmal atrial fibrillation/flutter were analyzed. Synchronized cardioversion was applied using monitor-defibrillator “Agilent”. Biphasic synchronized impulses were delivered. Defibrillating paddles were placed over the 2nd intercostal space along the right sternal border and over the 5th or 6th intercostal space at the apex of the heart. Pectoral impedance and the amount of applied energy were automatically measured after each discharge. Intravenous narcosis was used to all pts before cardioversion. Data of 2D+Doppler-Echo of 160 pts (80%) were analyzed. Clinical signs of heart and cerebrovascular failure and angina pectoris were searched and assessed.

Results: Pectoral impedance ranged from 58 ohms to 126 ohms (average – 88.6 ohms). The 1st impulses having been applied, impedance decreased by 6 ohms on average. After the 2nd and consecutive impulses impedance remained stable (±1–2 ohms). Number of impulses applied to each of the pts ranged from 1 to 5 (average 1.8). Sinus rhythm was restored to 190 (95%) patients. Pectoral impedance (88.8 ohms) of 10 patients whose sinus rhythm has not been restored was on average equal to those pts who had the rhythm restored. On average 1.4 impulses were used to restore sinus rhythm in 127 patients (79.4%) with left ventricular ejection fraction (LVEF) > 40% and 2.5 impulses were used in 33 patients (20.6%) with LVEF < 40%. No difference in the number of impulses delivered (1.79/1.75) has been discovered. Meanwhile, 112 patients (56.6%) with impedance larger than average were with/without heart failure compared to 88 patients (44.4%) with impedance less than average (p = 0.17, NS).

Conclusions: (1) Pectoral impedance declined 6 ohms on average after the 1st discharge of cardioversion. No impedance alterations after consecutive discharges have been measured. (2) Pectoral impedance does not have any essential implication for the results of cardioversion and/or number of discharges. (3) It is the size of heart chambers, myocardial and valvular status that have essential implication for successful cardioversion. (4) More discharges have been delivered to patients with fear of the procedures and/or psychologically unstable; as a rule, in such cases more deep intravenous narcosis is used.
Selective preventive therapy of atrial fibrillation in ischemic heart disease patients

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Objectives: The aim of the study was to estimate risk prediction of recurrence of atrial fibrillation (AF) during the first month after cardioversion (Cv), and to evaluate preventive antiarrhythmic therapy (AnT) with amiodarone (Am) according to risk groups.

Design and Methods: Retrospective study of anamnestic, clinical, echocardiographic data and methods of Cv in 294 patients (group I) with no treatment with class I and III antiarrhythmic drugs was performed. Value of risk prediction in the setting of AnT was estimated in control group of 118 patients, treated with Am (group II).

Results: The binary logistic regression model for prediction of early recurrence of ischemic AF was based on the formula: $P(y = 1|x_1, \ldots, x_k) = \frac{e^z}{1 + e^z}$, where $z = b_0 + b_1 \times x_1 + \cdots + b_k \times x_k$. The best sensitivity (0.82) and NPV (0.89) were achieved including patient age, number of AF episodes, mitral valve incompetence and severity of regurgitation, left atrial supero-inferior dimension, thyroid pathology, use of beta-blockers, and method of Cv in the algorithm. Early recurrence of AF occurred in 103 (35%) of group I, and in 44 (37.3%) of group II pts, so preventive treatment with Am showed no benefit in non-selective groups, whereas in high-risk groups patients AnT resulted in significantly lower recurrence rates in group II (46.3% vs 67.7%; $p < 0.01$). According to our prognostic model, “selective” antiarrhythmic approach in the group II (Am in high-risk patients only) would have resulted AnT in 69.5% of patients. The calculated loss of patients who would have been misclassified by the algorithm, and not treated with Am was approximately 3%.

Conclusion: The prognostic model allows identifying prospectively high-risk patients for early atrial fibrillation recurrence. Prophylactic antiarrhythmic therapy with amiodarone in high-risk patients results in significantly lower recurrence rates.
Epidemiological estimation of prevalence of atrial fibrillation and different forms of flutter. Clinical research of the factors determining their onset

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Objectives: The purpose is to analyze the prevalence of paroxysmal, persistent and chronic atrial fibrillation/flutter as well as to research clinically the factors determining their onset in random urban population. To conduct the simultaneous epidemiological study we formed the representative sample of 1200 males aged 20–64 years dwelling in Solomyansky region in Kyiv (250 people from each age decade) according to the voters’ lists by means of random numbers tables. 851 males have been examined (70.8% from the examinees total number).

Design and Methods: (1) questioning and filling in WHO cardiologic form for detecting exertional angina and myocardial infarction in past history; (2) filling in forms for determining cardiac rate and conduction disturbances; (3) monitoring 12-lead ECG at rest; (4) office measurement of blood pressure; (5) Doppler echocardiography.

Results: 150 patients with cardiac rhythm and conduction disturbances have been detected among the examinees (17.6% from the examinees’ total number). Atrial fibrillation/flutter has been documented in 29 people (3.4% from the examinees’ total number); paroxysmal and persistent atrial fibrillation/flutter (75.9%) has been detected in 22 examinees; chronic atrial fibrillation/flutter (24.1%) has been detected in 7 people. The most prevalent atrial fibrillation/flutter has been observed in the group aged 60–64 years (7.6%). Coronary heart disease at different forms of atrial fibrillation/flutter has been diagnosed in 16 cases (57%).

Conclusion: The survey has shown that the atrial fibrillation/flutter prevalence in the population of males of efficient age accounts for 3.4%. The data top the ones generally known in the world to a marked degree (0.4–0.6% in total population) and are evidence of the problem urgency for practical medicine.
Effect of long term oral amiodarone on silent myocardial ischemia

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Objectives: The prognosis of silent myocardial ischemia (SMI) is similar to that of symptomatic ischemia. The aim of our study was to investigate the effect of long-term oral amiodarone administration on SMI. Antiarrhythmic drug amiodarone was synthesized as an antianginal agent.

Design, Methods and Results: Amiodarone was given to 62 patients (28 men and 34 women, mean age 52.77 ± 1.2 years) with varying severity of coronary artery disease to prevent various arrhythmias. After loading dose (1.2 g/d), amiodarone was tapered down to the mean maintenance dose of 1383 ± 81.7 mg/week. The mean duration of therapy was 42.1 ± 4.1 months. Mean total dose of amiodarone was 295.1 ± 32.5 g. Holter studies were obtained at 3–4 month intervals. ST segment depression was defined as horizontal or downsloping ST segment depression of at least 1 mm, occurring 80 ms after the J point, and lasting for 1 min or more. Patients with atrial fibrillation, severe conduction defects, and gross left ventricular hypertrophy were withdrawn for this period. Glyceryl trinitrate only was given for pain. The mean duration of ST segment depression before treatment was 248.3 ± 60.4 (5–1406) min, during treatment 186.4 ± 28.6 (7–1009.8) min, X min 64.8 ± 15.3 min, X max 337.9 ± 51.8 min, X corr 215.8 ± 36.8 min (differences not significant).

Conclusion: Our obtained results did not show reduction of the frequency, duration and magnitude of episodes of SMI in patients with long maintenance dose amiodarone administration.
Registration of patient’s intracranial pressure by invasive and noninvasive methods during transesophageal atrial pacing

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Objectives: We investigated influence of transesophageal atrial pacing (TAP) on unconscious patient’s intracranial pressure (ICP) and arterial blood pressure (ABP).

Design and Methods: Clinical research was approved by Ethics Committee (protocol No. 99127006, AIBS No. 990135, HSSRB log No. A-9676). One patient underwent four series of experiments. ICP was registered invasively using “Microsensor Skull Bold Kit” and “ICP Express Codman” as well as noninvasively, using “VITTAMED” ultrasound sensing elements. Catheter was introduced into the radial artery for ABP registration. ICP systolic (ICPs), diastolic (ICPd), mean (ICPm), ABP systolic (ABPs), diastolic (ABPd) were registered as well as ICP and ABP pulse waves. Parameters were recorded during TAP and after it. The patient’s own heart average rate was 93.4 bpm, TAP rate = 114.5 bpm. The additional experiment was performed while TAP was sharply increased from 96 to 130 bpm.

Results: During TAP the average values of ICPs, ICPd, ICPm, ABPs, ABPd were: 12.76 ± 1.33 (SD) mm Hg, 5.32 ± 1.77, 8.2 ± 73, 153.4 ± 10.27 mm Hg, 57.8 ± 13.13. After TAP corresponding average values of mentioned parameters were: 12.36 ± 1.19, 4.96 ± 1.34, 7.76 ± 1.33, 150.05 ± 7.73, 55.15 ± 11.17. All these data were obtained using invasive recording devices. We obtained that ICPm, ABPs during TAP were higher than ICPm (p = 0.031), ABPs (p = 0.036) after TAP. In case when TAP rate was increased from 96 to 130 bpm, obtained results are shown in Figures 1 and 2. Presented ICP results were received using “VITTAMED”. The values in axes of figures are normalized.

Conclusions: We found that ICPm and ABPs were bigger during TAP when TAP rate is 10–20 bpmc higher than patient’s own heart rate. When pacing rate was 34 bpm higher than patient’s own heart rate, ICPs and ARPs became smaller.
Restoration of sinus rhythm by catheter ablation and cardioversion of atrial flutter

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Objectives: The aim of the study was to evaluate successful restoration of sinus rhythm by catheter ablation and electrical cardioversion in patients with atrial flutter using computerized sinus rhythm analysis.

Design and Methods: Atrial flutter was diagnosed in 25 patients (age 55.44 ± 4.47 years). 500 RR intervals were recorded at rest, during an orthostatic test, standing position, clinostatic test, and again in lying position. The next day after catheter ablation all procedures were repeated. Also, ten patients with atrial flutter and after electrical cardioversion were researched. General heart rate variability and power spectral analysis (very low frequency, low frequency, high frequency) was performed.

Results: Analysis of data showed that the average heart rate frequency before and after catheter ablation in the patients with atrial flutter was similar (RR1 = 0.85 ± 0.11 s; RR2 = 0.83 ± 0.08 s). General heart rate variability before treatment in lying and in standing position was ñ1 = 0.074, ñ2 = 0.068, and after catheter ablation ñ1 = 0.051, ñ2 = 0.041. Also, it was noted improvement of maximal heart rate reaction during the active orthostatic test in the patients after catheter ablation RRB% = 19.3 ± 8.62). Sinus rhythm recovery time after ∆RRB% = 17.53 ± 7.72, ∆ (clinostatic test was better in the patients after catheter ablation (SNRT1 = 23.6 s, SNRT2 = 26.2 s). In ten patients with atrial flutter after electrical cardioversion general rate variability was more stable than in the patients after catheter ablation. Maximal heart rate reaction during the active orthostatic test decreased from 18% to 12.5%. Sinus rhythm the recovery time after clinostatic test was longer (from 35 s to 42.5 s).

Conclusion: In the patients with atrial flutter after recovery of sinus rhythm by catheter ablation in the early stage cardiovascular state and autonomic regulation are better than after treatment by electrical cardioversion.
Surgical treatment of permanent atrial fibrillation

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Objectives: The purpose was to diminish cost of surgical treatment of permanent atrial fibrillation (PAF) with preservation of its efficacy.

Design and Methods: 34 patients with PAF and average daily heart rate more than 90 beats per minute were included in the investigation. Radiofrequency ablation of atrioventricular junction (RFA AVJ) with heart pacemaker implantation had been made to 22 of them. The isolated pacemaker implantation in combination with drug therapy (metoprolol, sotalol, propranolol) was performed to 12 patients. The criterion of efficacy was average heart rate of 60–80 beats per minute. All pacemakers implanted were in VVI and VVIR modes.

Results: The RFA AVJ in the group with PAF was effective in all cases. The pacemaker in VVIR mode was implanted to 7 patients, in VVI mode – to 15 patients. Worsening of heart failure was marked in 2 patients with VVI mode of heart pacing. Isolated pacing was performed in VVI mode. It was possible to obtain normosystolic heart rate in the whole cohort of patients. The deterioration of patients’ feeling and worsening of heart failure have not been marked.

Conclusion: Preservation of atrioventricular conduction in patients with PAF helps to maintain physiological adaptation of heartbeat to physical exertions and implant pacemaker in VVI mode that is less expensive. Pacing in VVIR mode is necessary to preserve growth of heart failure in case of creating artificial atrioventricular block in patients with PAF.
Surgical treatment of paroxysmal atrial fibrillation

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Objectives: The purpose of the study was to access advantages and disadvantages of different kinds of surgical (radiofrequency ablation (RFA) and radiofrequency modulation (RFM) of atrioventricular junction (AVJ)) treatment of patients with paroxysmal atrial fibrillation (AF).

Design and Methods: Surgical treatment was performed in 39 patients with ischemic heart disease and paroxysmal AF: RFM AVJ in combination with drug therapy (amiodarone, propafenone or etacizin) – 14 cases, RFA AVJ and implantation of heart pacemaker – 25 cases. ECG, Holter monitoring and echocardiography were used to control the efficacy of surgical treatment. The criterion of efficacy was the cessation of AF paroxysms.

Results: The effect of treatment was obtained in 24 (96%) of 25 patients after RFA AVJ. There was a recurrence of AF followed by restoration of atrioventricular conduction in 1 patient. The RFM AVJ in combination with further antiarrhythmic therapy was performed to 14 PAF patients and only 6 (43%) of them revealed positive long-term results (period more than 12 months). 8 patients were operated again in 3–10 months. RFA AVJ was performed in 3 patients. Progression to II–III degree atrioventricular block led to the necessity of pacemaker implantation in 5 patients.

Conclusions: High efficacy of RFA AVJ is the most obvious benefit of this operation. Necessity of pacemaker implantation, increase of treatment costs and pacemaker-dependence of patients are shortcomings of this method. RFM AVJ does not require permanent cardiac pacing, that is its benefit. The disadvantage of RFM AVJ is low efficacy and necessity of repeated operations.
Permanent parahisian area pacing – effective and safe treatment for patients with AV junction conduction incompetence

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Objectives: Permanent parahisian area pacing (PHAP), with His–Purkinje system capture, could produce more synchronous ventricular depolarization and improved cardiac function compared to apical pacing. The possibility to transiently pace this area was shown in the electrophysiology laboratory in patients with chronic atrial fibrillation and narrow native QRS complexes. However, the feasibility of PHAP in patients with various degree of atrioventricular junction incompetence has not been widely demonstrated.

Design, Methods and Results: A total of 71 patients (48 males and 23 females) aged 71 ± 14 years, who had a history of AV nodal conduction abnormalities (in 7 patients with chronic atrial fibrillation and fast ventricular response, complete AV block was induced by radiofrequency ablation), were permanently paced in parahisian area using a fixed screw-in ventricular lead. All patients received single or dual chamber rate-responsive pacemakers. Mean acute PHAP thresholds at impulse duration of 0.5 ms was 0.94 V (95% SD 0.44 V; from 0.30 to 2.45 V). In 32 patients with complete AV block and significant bradycardia a temporary right ventricular apex (RVA) pacing was performed before the pacemaker implantation. Comparison of the sinus rhythm 12 lead ECG with same data at the time of RVA and PHAP showed normalization of surface QRS morphology and duration during permanent pacing. Lead complications requiring re-operative adjustment development of exit block in 1 patient and lead dislodgement in 2 PHAP patients was observed.

Conclusions: Ventricular pacing lead localization in parahisian area, allows permanent pacing with narrow and normal morphology QRS. Permanent parahisian area pacing is attainable in most cases and could be used routinely.
Cardiac pacing for right ventricular basal parts in patients with disturbed intraventricular conduction

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Objectives: The aim of this study was to assess the influence of cardiac pacing for right ventricular (RV) basal parts in VVI mode in coronary heart disease (CHD) patients (pts) with III functional class (FC) of severity complicated by bradyarrhythmias and complete left bundle branch block (CLBBB).

Design and Methods: 16 patients with CHD III FC of severity were investigated. All the pts are divided into 2 groups (gr) depending upon CLBBB presence: 5 patients with CLBBB – gr I and 11 pts without CLBBB – gr II. Echocardiography, 6 min walk test were performed in all patients. Observation period was 3 months.

Results: Assessing the influence of cardiac pacing on intracardiac haemodynamics, it is established that no significant changes in left ventricular contractile function (end-diastolic volume, end-systolic volume, end-diastolic diameter, end-systolic diameter) were observed in grs under comparison 1 and 3 months after observation. In gr I mean pulmonary artery pressure (mPAP) has increased insignificantly from 35.1 to 39.6 mm Hg (p = 0.18) one month after and from 35.1 to 39.6 mm Hg (p = 0.18) 3 months after. In gr II mPAP has increased significantly from 37.2 to 42.6 mm Hg (p = 0.04) by the end of first month, and 3 months after, significant increase in mPAP was also observed from 37.2 to 43.4 mm Hg (p = 0.01). Changes in walk duration by 6 min walk test data appeared to be insignificant in both grs.

Conclusion: Cardiac pacing for RV basal parts in patients with CHD III FC of severity complicated by CLBBB does not exert any negative influence on intracardiac haemodynamics.
Comparative effectiveness of right ventricular apical and basal pacing

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Objectives: The aim of the study was to compare effectiveness of the right ventricular (RV) apical pacing and right ventricular basal pacing in VVI mode on intracardiac haemodynamic indices in coronary heart disease (CHD) patients complicated with I–II functional class heart failure and bradyarrhythmias.

Design and Methods: The investigation was performed in 38 patients. Echocardiography, 6 min walk test were performed in all the pts 1, 3 and 6 months after therapy. All the pts are divided into 2 groups (gr): patients with cardiac pacing of RV basal parts in VVI mode – 18 patients – gr I, cardiac apical pacing of RV apex in VVI mode – 20 patients – gr II.

Results: Significant increase in mean pulmonary artery pressure (mean pAP) has been observed in I gr of pts by the end of first month, that is, from 30.5 to 35.7 mm Hg (p=0.015); during the 3 m (mean pAP 33.8 mm Hg, p=0.09); and during the 6 month (mean pAP 34.0 mm Hg, p=0.06). In gr II, significant increase in mean pAP from 30.6 to 38.0 mm Hg (p=0.002) was observed 1 month after observation, these changes have been preserved by the end of third observational month (mean pAP on the average constituted 38.6 mm Hg, p=0.001) and sixth one (mean pAP constituted in average 39.6 mm Hg, p=0.001). Mitral and tricuspid (TR) regurgitation have not changed significantly in gr I. Significant increase in TR from 1.3 to 1.87 (p=0.007) has been observed by the end of 3 month in gr II, by the end of 6 month, TR has increased from 1.3 to 1.8 (p=0.08). Results of 6 min walk test have shown the tendency to increased duration of walk by the end of first month in the gr being investigated, that is, from 316.2 to 356.6 m (p=0.06), by the end of 3 months – from 316.2 to 365.5 m (p=0.03), by the end of 6 months – from 316.2 to 345.0 m (p=0.09). The increase in walk duration was insignificant in gr II.

Conclusion: Cardiac pacing of RV basal parts is more effective from haemodynamic point of view because mean pulmonary artery pressure increases to a less extent because of decreased desynchronization of RV and left ventricle (less QRS widening on ECG), no increment of tricuspidal regurgitation occurs at the same time.
Intra- and interventricular conduction during cardiac pacing of apex and basal parts of the right ventricle

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Objectives: The aim of the study was to compare the influence of right ventricular (RV) apical pacing and of RV basal pacing in VVI mode on intra- and interventricular conduction indices in coronary heart disease (CHD) patients (pts).

Design and Methods: 38 CHD pts were investigated. All the pts are divided into 2 groups (gr): pts with cardiac pacing of RV basal parts in VVI mode – 18 pts – gr I and ones with cardiac apical pacing of RV in VVI mode – 20 pts – gr II. Echocardiography with ECG monitoring was performed in all pts; specific indices for cardiac muscle desynchronization presence were measured as follows: (1) intraventricular conduction index (delayed blood ejection from aorta); (2) one for delayed interventricular conduction.

Results: Pts of both grs initially (without cardiac pacing) did not differ by intraventricular conduction indices (in gr I 104.6 ms, in gr II 101.1 ms, \( p = 0.5 \)) and by interventricular conduction ones (in gr I 19.2 ms, in gr II 24.2 ms, \( p = 0.2 \)). Following cardiac pacing, intraventricular conduction index in I gr was considerably less in comparison with II gr (in I gr 196.5 ms, in II gr 211.7 ms, \( p = 0.005 \)). Interventricular conduction index in I gr was also less in comparison with II gr (in I gr 41.5 ms, in II gr 50.4 ms, \( p = 0.03 \)). Comparison of pts before and after cardiac pacing by intra- and interventricular conduction indices has demonstrated highly significant increase in these indices in both grs: in gr I from 104.6 ms to 196.5 ms (\( p < 0.001 \)) and from 19.2 ms to 41.5 ms (\( p = 0.003 \)); in gr II from 101.1 ms to 211.7 ms (\( p < 0.001 \)) and from 24.2 ms to 50.4 ms (\( p = 0.003 \)).

Conclusion: Cardiac pacing for RV basal parts in comparison with cardiac apical RV pacing reduces desynchronization indices of cardiac muscle.
Left ventricular implantation of pacemaker electrodes: endoscopic extrapleural approach

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Objectives: Our group proposed in 1986 the method of endoscopic implantation of pacemaker electrodes through subxyphoidal approach to the right ventricle and atrium. Our experience now is more than 1000 cases. Implantations of electrodes at the left ventricle (LV) wall began only recently.

Design and Methods: Under general anesthesia the electrode was delivered through subxyphoidal approach using a rigid endoscope with 2 cm diameter. All electrodes were of screw-in type. The ventricular lead was implanted on the lateral walls. Continuous direct visualization of the epicardium provided guidance for lead localization and fixation, including avoidance of complications such as trauma to epicardial coronary vessels. Rotation of a patient on the right side greatly improved LV visualization.

Results: In the group of 18 patients (age 54–76 years) LV stimulation was attempted. 16 patients received primary pacing system (AV block, SSS). In 2 pts LV stimulation was performed in addition to RV stimulation (CRT).

Follow-up examination (9 ± 4 months) demonstrated uncomplicated lead fixation. In the whole group of 18 pts long-term LV stimulation was successful in 17 cases. Capture thresholds were 2.2 ± 0.5 V. There were no complications related with the implantation method.

Conclusions: Using subxyphoidal pericardioscopy, uncomplicated LV epicardial pacing lead implantation can be achieved without thoracotomy. This method could be a reliable alternative for the same purpose endovascular methods.
Pacemaker lead explantation in Kaunas Medical University Hospital

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Objectives: The purpose of the study was to evaluate the data of permanent pacemaker lead explantation between January 1, 2000 and December 31, 2003.

Methods: Case histories were analyzed and data collected in the predesigned forms.

Results: The case histories of 33 patients who underwent pacemaker lead explantation were analyzed, 24 patients having atrial, 7 ventricular and 2 dual chamber cardiac pacing systems. Simple traction method was used for explantation of all pacemaker leads. Pacemaker reimplantation was performed for 30 (90.9%) patients, 23 (76.7%) of them ad hoc, 7 (23.3%) after 2.7 ± 1.9 weeks.

Conclusions: The main reason for pacemaker lead explantation was exit block (48.5%), predominantly in the atrium. 24.2% of the explanted pacemaker leads were extracted because of infection. Total lead removal was obtained in 75.8% of cases.

<table>
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<th>2002 (n = 6)</th>
<th>2003 (n = 3)</th>
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* 7 cases of pocket infection, 1 case of infectious endocarditis, 2 cases of S. aureus in blood culture.
Clinical experience of chronic pacemaker lead removal

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Objectives: Exit block, lead failure and infection are the most common indications for the electrode change. Purpose of the study is to present our experience of the chronic lead extraction over the last four years (2000–2003).

Design and Methods: Chronic pacemaker leads (inserted more than 1 year ago) were removed using manual traction technique. In one patient ventricular lead was attempted to be removed by prolonged (within 72 hrs) traction, however unsuccessfully. Subsequent removal was accomplished via thoracotomy and atriotomy, without the cardiopulmonary bypass.

Results: Atrial double screw-in or anchored leads were removed easily in 24 patients (indications were exit block, lead disintegration or both). Ventricular leads were extracted in 12 patients (sepsis – 3, exit block – 8, lead disintegration – 1). In 15 patients ventricular leads were abandoned after some attempts to extract. Proximal end of these was cut off (incomplete removal). When the reason for the lead replacement was exit block, 28 ventricular leads were abandoned (in situ) without any attempt of removal. No complication related to the extraction procedure was observed. One patient underwent thoracotomy for the final lead removal.

Conclusions: (1) Manual traction is a safe and effective lead removal method. (2) Surgical backup is recommended (if traction technique fails).
Displacement rate of endocardial leads

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Objective: Endocardial lead displacement is a predominant reason of pacing failure in early post implantation period. Purpose of the study was to reveal the incidence rate of lead displacement within the last four year period (2000–2003).

Methods: Data were collected and analyzed from the pacemaker implantation data basis.

Results: There were 1707 primary implantations during study period. Pacemaker with a single atrial lead (AAI, AAIR) was implanted in 400 patients, with a single ventricular lead (VVI, VVIR) – in 1051 patient, dual chamber with a single pass lead (VDD, VDDR) – in 53 patients, and dual chamber pacemakers with both atrial and ventricular leads (DDD, DDDR) – 198. Atrial leads have dislodged in 24 cases, ventricular – in 18. Total displacement rate was 42 (2.46%). The majority of leads – 30 (71.4%) being displaced have had passive fixation, all the rest – 12 (28.6%) active fixation (screw-in type). 35 (83%) of dislodged leads were repositioned and 7 (17%) – replaced. Due to unstable detection of P wave, single-pass lead (VDD system) was repositioned in one patient.

Conclusions: (1) Total incidence rate of endocardial lead displacement is relatively low (2.46%). (2) Displacement rate of active fixation leads is less common than displacement of passive fixation leads (28.6% vs 71.4%). Active fixation leads in atrial position should be used preferably.
Origin and function of intrinsic neural pathways located in the area of pulmonary veins

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Objectives: The aim of the present study was to verify topography of intrinsic nervous pathways (NP) located in the area of pulmonary veins (PV), and to investigate influence to the function and neural control of heart.

Design and Methods: In ten electrophysiological studies with mongrel dogs we bilaterally ligated cervical \textit{n. vagus} trunks, to avoid cerebral influence and control vagal effects. Isolation of NP was performed on the epicardial surface of the heart, in 6 selected zones of PV by using the standard clinical method of radiofrequency ablation. Protocol of investigation included recording of heart rate, sinus node (SN) function recovery time, AV conductivity, effective refractory periods of the atria, AV node and the ventricles before and after isolation.

Results: Isolation in superior right side shows effect of decreased sympathetic tone to all heart parameters with no reliable changes of parasympathetic tone. Isolation in middle right side heightened effects, whereas in inferior right side no changes were observed. Isolation in left superior side shows markedly decreasing or termination of parasympathetic tone, induced by the left \textit{n. vagus} trunk, although parasympathetic action of the right \textit{n. vagus} trunk remains. Isolation of middle/inferior left side produce insignificant diminishing of vagus effect pronounced to function of SN and absent to AV conductivity.

Conclusions:

1. In superior area of the right PV sympathetic NP are localized mainly influencing the AV node and less to the SN function.
2. In superior area of the left PV parasympathetic NP are localized entering from the left cervical \textit{n. vagus} trunk influencing AV conductivity and refractoriness of the ventricles.
3. In inferior area of the left PV possibly mixed vagosympathetic NP or sympathetic branch are localized altering SN function.
Heart electrophysiological parameters after destruction of the epicardial nerves of the right atrium

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Objectives: The aims of present study were to verify the topography of the intracardiac nerve subplexuses (INS) by using electrophysiological methods, its relations with sinoatrial (SA) node function and investigate possibility of selective surgical SA node denervation.

Design, Methods and Results: 32 mongrel dogs were used for electrophysiological studies. Nervus subplexuses destructions were performed by electrocoagulation or cryoablation in three zones located around the right superior vena cava: ventral, lateral and dorsal. The sinus rhythm, SA node function recovery time, AV node conductivity, AV node and atrial effective refractory period were measured. Eight experiments in each of tree zone were performed. The average changes of electrophysiological parameters before and after INS destruction shows that destruction of ventral and lateral zones modify the effects of sympathetic tone to SA node activity. Destruction of dorsal zone modifies the effects of nervus vagus to SA node.

Conclusions: By destruction of ventral, lateral and dorsal zones of the right atrium, the function of SA and AV nodes can be modified. It is necessary to point up that the surgeons while performing interventions and radiofrequency ablations in the zones of nerve plexuses must to be aware of possible changes of sinoatrial node's function because of impairment of these nerve plexuses and, if it is possible, to avoid surgical manipulations in these zones.
Sustained ventricular tachycardia in corrected tetralogy of Fallot. A case report

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Ventricular arrhythmia is a major late complication in adults with repaired tetralogy of Fallot (ToF). Sustained monomorphic ventricular tachycardia (VT) is relatively infrequent and re-entry is the most common pathophysiologic mechanism.

We present 21 years-old female, after radical ToF correction in 1980, muscular ventricular septal defect repair, pulmonary artery comissurotomy and tricuspid valvuloplasty in 1999. Nearly incessant VT was diagnosed in 2003 and has been unsuccessfully treated with amiodarone. The ECG showed wide-QRS complex tachycardia of 125–130 beats per minute, with left bundle branch block morphology and right axis deviation. VT was terminated with intravenous verapamil injection. Therapy with oral verapamil or metoprolol failed to completely suppress the arrhythmia. During intracardiac electrophysiological study double potentials have been found during the VT in the septal part of outflow tract of the right ventricle, and two applications of the radiofrequency energy at that site abolished the tachycardia. Holter ECG monitoring at 5 months of follow-up has shown premature ventricular beats with several different morphologies but no bursts of tachycardia.

In conclusion, this ventricular tachycardia has shown unusual features like sensitivity to verapamil and electrophysiological characteristics typical for re-entry. Late postoperative occurrence of the tachycardia and sensitivity to verapamil may suggest that its mechanism is triggered activity rather than re-entry due to post-operative scar.