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Abstracts of original contributions

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1-P

Assessment of percutaneous coronary interventions among seniors

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Background: In recent years, the percentage of elderly patients has been increased, which means that this group of patients requires individualized treatment.

Aim: To assess the effectiveness of percutaneous coronary interventions (PCI) among seniors.

Methods: 3188 of invasive procedures performed among patients over 75 years old in 2008–2013 met inclusion criteria. Demographical data, comorbidities, type and method of procedure were analyzed. Total mortality was estimated on 20.03.2018.

Results: In the study group 79.5% of procedures were performed in stable coronary artery disease (CAD), 30.5% in acute coronary syndrome (ACS). Post-PCI stroke occurred in 0.9% of the subjects. Local complications were more frequent among women (4.3% vs. 1.6%, $p < 0.001$) and ACS group (4.4% vs. 1.8%, $p < 0.001$). In-hospital mortality rate was 5.4%. Risk factors increasing in-hospital mortality were: cardiac shock RR 0.95 (95% CI: 0.94–0.97), post-PCI creatinine level elevation RR 1.36 (95% CI: 1.03–1.77), and elevated INR RR – 1.57 (95% CI: 1.05–2.36). 10-year survival prognosis for post-PCI patients was 33.9%. Factors resulting in decreased long-term survival were: age RR = 1.07 (95% CI: 1.05–1.08), gender RR = 1.38 (95% CI: 1.23–1.57), prior ACS RR = 1.13 (95% CI: 1.01–1.29), kidney failure RR = 1.15 (95% CI: 1.03–1.28).

Conclusions: Prognosis of seniors, who underwent PCI is good. After considering contraindications, invasive procedures in this group of patients should be performed both in stable CAD and ACS.

2-P

The hybrid algorithm in coronary chronic total occlusions treatment – MSWiA Lublin CTO 5-year registry

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Background: Treatment of chronic total occlusions (CTO) despite improvement in techniques and results over the last years still seems to be limited to the small number of centers and operators. Application of the hybrid strategy in procedure planning may support further spread of the percutaneous CTO treatment in community.

Aim: Our single center registry aims to provide details and results of recanalizations of coronary CTO performed according to the hybrid algorithm in consecutive patients.

Methods: Between January 2015 and September 2019 clinical and procedural data of consecutive CTO procedures on unselected patients were collected. Lesion complexity was assessed according to Multicenter CTO Registry of Japan (J-CTO) score: 0 – easy, 1 – intermediate, 2 – difficult, ≥ 3 – very difficult. Strategies applied were classified as: anterior wire escalation (AWE), anterior dissection and reentry (ADR), reverse wire escalation (RWE) and RDR (reverse wire escalation, mainly rCART). Angiographic success was defined as < 30% residual stenosis wit TIMI grade 3. Angiographic and clinical complications were reported.

Results: 266 patients were included and 285 procedures were performed in total. Success rate was 92.5% (calculated per patient) and 87.7% (calculated per procedure). Four patients underwent successful staged double CTO recanalization. Fifteen patients out of 31 primary failures underwent second attempt with 73% success rate (11/15). 52 patients (18.2%) were referred for second attempt from other institutions. Mean J-CTO score was 2.6 (0 – n = 13, 1 – n = 41, 2 – n = 80, ≥ 3 – n = 151) and success rate was accordingly: 91.7%, 92.7%, 91.3% and 84.1%). Higher complexity of occlusion required higher number of applied strategies including retrograde access in over a quarter of cases (Table I). Complete revascularizations were obtained in 215 cases (75.4%). One patient died due to acute renal failure complications. Among complications we report 10 (3.5%) myocardial infarctions (1 STEMI due to side branch occlusion), 7 perforations (2.4%) all treated conservatively and 10 cases (3.5%) of acute kidney injury (one dialysis).

Conclusions: Application of the hybrid algorithm in unselected population of patients with CTO is a success-

Table I

J-CTO	Number of strategies applied			Successful strategy			
	1	2	3	AWE	ADR	RWE	RDR
0	13 (100%)	0	0	12 (100%)			
1	36 (87.8%)	4 (9.8%)	1 (2.4%)	34 (89.5%)	1 (2.6%)	3 (7.9%)	
2	49 (61.2%)	19 (23.8%)	12 (15%)	51 (69.9%)	1 (1.3%)	7 (9.6%)	14 (19.2%)
≥ 3	80 (53%)	47 (31.1%)	24 (15.9%)	59 (46.5%)	21 (16.5%)	11 (8.7%)	36 (28.3%)
All	178 (62.5%)	70 (24.6%)	37 (12.9%)	156 (62.4%)	23 (9.2%)	21 (8.4%)	50 (20%)

ful strategy with low rate of complications. Higher complexity of CTO requires more procedural strategies with significantly low success rate in very difficult cases.

3-P

Importance of the hyperemic and non-hyperemic pressure gradients in complex physiological evaluation of coronary vessels

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Background: FFR is considered as an appropriate tool for the selection of intermediate epicardial coronary lesions for stenting, while coronary flow reserve (CFR) was proposed as the true indicator of myocardial ischemia. Recently, non-hyperemic pressure ratios (RPR: resting pressure ratios and iFR: instantaneous flow reserve) challenged the need for vasodilatation for clinical decision making. We aimed to calculate CFR on the basis of fluid dynamic equations using 3D coronary angiography parameters and measured pressure gradients. We also aimed to compare FFR and RPR values with regard to calculated CFR ones.

Methods: FFR measurements were performed on 32 coronary arteries. The lumen of the interrogated vessel segments was reconstructed in 3D. The components of the pressure gradients due to laminar and "turbulent" flow were modelled by classic fluid dynamic equations, CFR was defined as the ratio between hyperaemic and resting flows.

Results: A good correlation was found between FFR and RPR values ($r = 0.91$, $p < 0.001$), however 8/32 cases demonstrated discordant results. There were significant correlations between FFR and CFR values as well as between RPR and CFR parameters, but the latter demonstrated stronger relation ($r = 0.33$, $p = 0.066$ and $r = 0.52$, $p = 0.002$, respectively). The CFR was calculated to be higher in the discordant 5 cases with RPR > 0.90 and FFR < 0.80 than that in the 3 cases with RPR < 0.90 and FFR > 0.80 (2.50 ±0.71 vs. 1.30 ±0.07, $p = 0.05$).

Conclusions: Our results support the importance of the evaluation of the RPR being in close relation with the CFR. Supplementing FFR with RPR can help the appropriate classification of the functional state of coronary vessel.

4-P

Safety and efficacy of embolic protection devices in saphenous vein graft interventions: a propensity score analysis – multicenter SVG PCI PROTECTA study

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Background: Data regarding the efficacy of the embolic protection devices (EPD) in saphenous vein graft (SVG) PCI is controversial.

Aim: The primary objective of the study was to compare 1-year clinical outcomes of SVG PCI with and without EPD in the all-comer population.

Methods: A multi-center registry comparing PCI with and without EPD in consecutive patients undergoing PCI of SVG. The group consisted of 792 patients including 266 (33.6%) patients with MI. The primary composite endpoint was MACCE defined as death, myocardial infarction (MI), target lesion revascularization, and stroke assessed at 1 year.

Results: In an unmatched cohort of patients, there were no significant differences in MACCE (20.5% vs. 26.4%; HR = 0.75, 95% CI: 0.53–1.06, p = 0.105) between EPDs and non-EPD. A trend towards lower risk of death in EPD group (4.2% vs. 7.8%; HR = 0.53, 95% CI: 0.25–1.12, p = 0.094) was present at 1-year, but after propensity score matching no significant differences were observed. No difference in MACCE between PCI SVG with and without EPDs was also found in MI subgroup. In a subanalysis comparing PCI with Spider-EPDs showed a trend towards lower risk of death in the device group vs. no-EPDs (2.1% vs. 7.8%, HR = 0.26, 95% CI: 0.06–1.07, p = 0.062). Also in the MI subgroup, there was a trend towards lower MACCE in patients treated with the support of Spider-EPDs as compared with no EPD (18.7% vs. 34.6%, HR = 0.50, 95% CI: 0.22–1.14, p = 0.099).

Conclusions: SVG PCI using EPDs showed favourable clinical outcomes at 1-year follow-up. There was no statistically significant clinical benefit of routine use of EPD in this all-comer population.

5-P

Prevalence, characteristics and long-term mortality of patients with valvular heart disease in Podlaskie Voivodeship (BIA-WAD2 Registry)

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Background: Population of patients with valvular heart disease (VHD) has changed in recent years along with diagnostic and treatment management.

Aim: To evaluate prevalence, characteristics and long-term prognosis of patients with VHD.

Methods: Medical records of 36941 patients treated in the Department of Invasive Cardiology of the Medical University of Bialystok in 2006–2016 were retrospectively analyzed. Assessed variables included: angiography characteristics, echocardiography imaging and medical history. Type of treatment and total mortality on 16.05.2019 were estimated. Mean observation time was 1865 days (SD = 1249).

Results: 2661 patients met inclusion criteria with mean age 69.55 (SD = 10.71), men 56.63% (n = 1507). The most frequent VHD were: moderate mitral valve insufficiency (MVI, n = 1082) and severe aortic valve stenosis (AVS, n = 728). Comorbidities with the highest prevalence were: coronary artery disease (CAD) 81.17% (single-vessel 17.25%, multi-vessel 21.8%) and arterial hypertension (70.31%, n = 1871). During follow-up PCI was performed in 28.49% (n = 758), TAVI in 3.58%

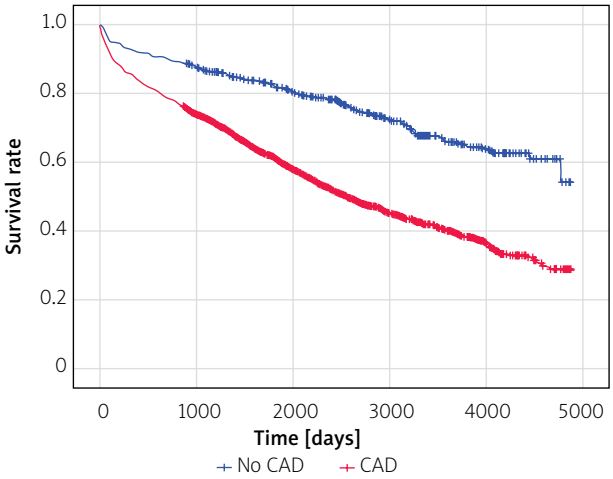

Figure 1. Kaplan-Meier survival curve for patients with VHD depending on CAD

(n = 93), 44.3% (n = 1170) of subjects underwent cardiac surgery. During 14 years observation time 44.08% (n = 1173) of subjects died, with the worst prognosis in moderate AVS group (52.31%, n = 147). In patients with CAD mortality rate was 47.87% (n = 1034) vs. 27.74% (n = 139), $p < 0.001$. The most significant death risk factors were: AVS (severe RR = 2.825, 95% CI: 1.922–4.153, moderate RR = 2.486, 95% CI: 1.681–3.677), chronic pulmonary obstructive disease (RR = 2.512, 95% CI: 1.595–3.956) and CAD (RR = 1.611, 95% CI: 1.142–2.271) (Figure 1).

Conclusions: The most frequent VHD was moderate MVI. Patients with moderate AVS were related with the worst long-term prognosis. CAD is one of the most significant factors worsening the prognosis of patients with VHD.

6-P

Evaluation of the air pollution effect on frequency of admissions for acute coronary syndromes and cardiovascular diseases mortality

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Background: Cardiovascular diseases (CVD) are the biggest threat and the most common cause of death in Poland. Air quality is a well-known risk factor in the development of these diseases.

Aim: Evaluation of the air pollution effect on frequency of admissions for acute coronary syndromes (ACS) and CVD mortality.

Methods: Inhabitants of Bialystok treated for ACS in 2008–2017 met inclusion criteria. Mortality statistics were achieved from Statistical Office for the same time. Concentrations of SO_2, NO_2, PM2.5, PM10 and weather conditions were analyzed. Multivariate Poisson regression test was used for statistical analysis ($p < 0.05$).

Results: In analyzed period of time 2645 patients with ACS and 16370 CVD deaths among inhabitants of Bialystok were reported. After excluding seasonal changes in NSTEMI group there was a greater number of hospitalizations related with increased NO_2 (RR = 1.19, 95% CI: 1.01–1.41, p = 0.04) and PM2.5 concentration (RR = 1.10, 95% CI: 1.01–1.21; p = 0.04). Increased SO_2 concertation by 10 µg/m^3 was connected with higher mortality for cardiovascular reasons (RR = 1.05, 95% CI: 1.01–1.09; p = 0.02). Temperature drop by 10°°C resulted in 11% increase in number of admissions for STEMI (RR = 1.11, 95% CI: 1.01–1.21; p = 0.01) and increased cardiac mortality by 5% (RR = 1.05, 95% CI: 1.02–1.09; $p < 0.001$).

Conclusions: An elevation of PM2.5 concentration increases the risk of NSTEMI. The main air pollutant affecting cardiovascular mortality is SO_2. Temperature drop is related to increased mortality and admissions for STEMI.

7-P

Safety and feasibility of early one-day-discharge after intracoronary imaging

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Background: Intracoronary imaging in recent years become mandatory tool in the diagnostics of coronary and stent pathology. Nevertheless, the intracoronary imaging could lead to serious consequences like plaque or wall injury, dissections, acute artery occlusions and myocardial infarction or perforation.

Aim: To assess the safety and feasibility of one day discharge after intracoronary imaging.

Methods: This study was a prospective multicenter single arm clinical trial conducted in 2 sites of American Heart of Poland. We included patients with stable angina who underwent planned angiography with intracoronary imaging. Optical coherence tomography (OCT DragonFly®, Abbot) and intravascular ultrasound both mechanical and electronical (IVUS, Volcano- Revolution® and Eagel Eye® catheters, IVUS-NIRS, TVC Imaging System) and planned to be discharged same day after procedure.

Results: Forty patients were included. Mean age was 65.53 ±9.53 years and 24 (60%) were male. The diabetes melitus and hypertension were present, in 14% (6) and 53% (21) patients, respectively. Left radial was chosen more frequent than right one (40% (16) vs. 60% (24), p = 0.11) OCT was used in 40% (16), IVUS Revolution 10% (4) and Eagle Eye 22.5% (9). Whereas TVC IVUS-NIRS system was used in 27.5% (11). Thirty-five (87.5%) subjects were discharged home during same day after procedure. The mean time to discharge after procedure was 3.7 ±0.8 h. There were no any adverse events before discharge and in 24 h phone follow up. Two patients were left overnight due to stent implantation and 3 due to unsuccessful radial access.

Conclusion: One day discharge after intracoronary imaging is safe and feasible.

8-P

Short-term healing response after implantation of thin strut, fast releasing sirolimus-eluting biodegradable polymer-coated stent: preliminary results of an optical coherence tomography study

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Background: Bioresorbable polymer drug eluting stent (DES) technologies promise to enhance vascular healing by reducing polymer exposure to the vessel wall potentially allowing the earlier discontinuation of dual anti-platelet therapy. Experimental data suggest that the early phases of strut healing determines the long-term healing response of DES.

Aim: The present study assessed vessel healing response after implantation of a thin strut (71 µm), fast releasing sirolimus-eluting biodegradable polymer-coated stent (BP-SES, Alex, Balton, Poland) at 30-day follow-up by optical coherence tomography (OCT) imaging.

Methods: Up to date nine patients underwent OCT guided percutaneous coronary intervention (PCI) in *de novo* coronary lesions with implantation of 9 BP-SES (we plan to include total of n = 15 patients). All patients underwent follow-up OCT imaging at 4-weeks following implantation.

Results: A total of 209 cross sections and 1984 struts were included in the final analysis. Mean patient age was 72 ±7 years (67% males). The clinical presentation consisted of acute coronary syndromes (22%) and stable coronary disease (78%). Almost half of the patients (~45%) had a history of previous PCI. All patients received dual anti-platelet therapy during the entire duration of the study. The mean stent diameter and length were 3.25 ±0.46 mm and 20.5 ±3.21 mm respectively. Reference vessel area evaluated by OCT was 8.59 ±3.45 mm^2. Mean minimal lumen area and percent of area stenosis before stent implantation was respectively 1.66 ±0.51 mm^2 and 75.23 ±14.09%. Average lesion length was 24.5 ±5.28 mm. At 4-weeks following stent implantation almost all analyzed struts (89.8%) had evidence of tissue coverage. The percentage of fully embedded struts was 69.92% and protruding covered struts was 19.89%. The percentage area stenosis based on reference was 8.84 ±16.69% at follow-up and no stents had > 30% area stenosis.

Conclusions: The preliminary results of this ongoing study demonstrated favorable vessel healing at 4-weeks OCT follow-up after implantation of a thin strut, fast releasing sirolimus-eluting biodegradable polymer-coated stent. However, results from a larger group of patients are required to consider shorter dual-antiplateled regimens for the studied device.

9-P

In vitro mechanical behavior and in vivo healing response of a new generation biodegradable-polymer coated thin strut sirolimus eluting stent

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Background: Recent advancements in drug-eluting stents (DES) technologies reduced the rate of repeat revascularization. However, treatment complex lesions still remain challenging.

Aim: To evaluate the biomechanical behavior and vascular healing profile of a new generation biodegradable-polymer coated thin strut sirolimus-eluting stent (Alex NG, Balton, Poland).

Methods: *In vitro* biomechanical testing was performed under static conditions. We compared Alex NG with the commercially available previous generation platform (Alex Plus, Balton, Poland) and the leading DES (Orsiro, Biotronik, Germany). We investigated the difference in stent designs and the results obtained after post-expansion with larger balloon sizes. A total of 6 domestic swines were implanted with Alex NG (n = 12) and Alex Plus (n = 6) for healing evaluation at 30 days

Results: With overexpansion 1mm above nominal diameter no fractures or significant deformations were observed in the light microscopy in all studied groups. Furthermore, postdilatation 1.5 mm above the nominal diameter revealed no fractures in Alex NG and Orsiro. Also, the largest cell opening diameter was observed in the Alex NG both at the nominal and upsized diameters. Optical coherence tomography analysis demonstrated comparable neoinitimal thickness at 30 days in Alex NG when compared to Alex Plus (respectively: 0.14 ±0.03 vs. 0.14 ±0.05, p = 0.887). Histology evaluation is pending, and the results will be presented at the meeting.

Conclusions: The new-generation Alex NG demonstrated improved biomechanical behavior to the previous generation platform (Alex Plus) with the results similar

to the Orsiro stent. Furthermore, Alex NG demonstrated favorable healing profile in the imaging in vivo study.

10-P

Transradial and transfemoral approach in patients with prior coronary artery bypass grafting and treated with percutaneous coronary interventions

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Background: The relationship between periprocedural complications and the type of vascular access in patients with prior history of coronary artery bypass grafting (CABG) and treated with percutaneous coronary intervention (PCI) is less investigated than in the overall group of patients treated with PCI.

Aim*:* To assess the relationship between type of vascular access and selected periprocedural complications in the group of patients with prior history of CABG treated with PCIs.

Methods: Based on the nationwide registry (ORPKI) we analysed 536,826 patients treated with PCI between 2014 and 2018. We extracted 32,225 with prior history of CABG. Then we compared patients with femoral and radial access as well as with right and left radial access. The comparison was proceeded by propensity score matching (PSM).

Results: After PSM, the multifactorial analysis revealed that patients treated with PCI from femoral access were significantly more often related to periprocedural deaths (odds ratio (OR) = 1.79; 95% confidence interval (CI): 1.1–3.0, p = 0.02) and cardiac arrests (OR = 1.98; 95% CI: 1.38–2.87, p < 0.001). Following adjusting for Killip class grade and the occurrence of cardiac arrests before PCI the significance remained for procedural related cardiac arrests (OR = 1.59; 95% CI: 1.09–2.35, p = 0.01). While the comparison of right and left radial access showed no significant differences between procedural related complications.

Conclusions: Femoral access in comparison to the radial is related to higher rate of periprocedural cardiac arrests in patients with prior history of CABG treated with PCI.

11-P

Prognostic model for paravalvular leakage prediction after transcatheter aortic valve replacement based on non-standard computed tomography analysis

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Background: Paravalvular leakage (PVL) is one of the most common complications of transcatheter aortic valve replacement (TAVR), affecting short- and long-term outcomes.

Aim: To identify imaging biomarkers to predict complications of TAVR, with emphasis on the PVL occurrence.

Methods: We analyzed CT scans of 45 TAVR patients with our newly developed software and defined a list of unique quantitative parameters that describe aortic valve calcifications (AVC) in two ways: as a whole stenotic mass and as a local AVC amount in each of three section of stenotic aortic valve (radial presentation). We confronted these parameters with data of baseline characteristic, procedural and long-term outcomes after TAVR.

Results: We found a correlation between the volume of the largest calcium block, calcium perimeter and calcium Feret's diameter in analyzing AVC mass and PVL occurrence after TAVR (p = 0.012, p = 0.001 and p = 0.045, respectively). Local AVC analysis in radial presentation showed that AVC amount is an independent predictor of PVL. Moreover, a 100 mm increase in local AVC amount in each section was associated with 16.1% (95% CI: 4.5–29.1; p < 0.01) increase in the risk of PVL in the corresponding area. Bootstrap validation with 1000 simu-

lations was performed on the multivariable model with C-statistics as a measure of goodness of fit. ROC analysis revealed the cut-off point of 909.187 mm of AVC amount considered in radial presentation. Kaplan-Meier curves showed (p = 0.003; log-rank) worst PVL-free survival in patients with more than 909.187 mm of calcium.

Conclusions: Quantitative AVC assessment for PVL prediction may play an important role in TAVR patients' selection.

12-P

Automatic arrhythmia detection form two-channel ambulatory ECG recordings using Shannon Information Theory-based algorithms

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Background: Cardiovascular disease (CVD) accounts for about 45% of deaths in Europe. Development of effective tools for automatic arrhythmia detection from electrocardiogram (ECG) is important, especially in early prevention and diagnosis.

Aim: Designing and implementation of new classification algorithms based on Information Theory concepts for quantifying the irregularity of physiological time series. Entropy, Mutual Information, and complexity are the essence of the approach proposed. The advantage of these indicators is that they take into account inner structures in the sequences of symbols (digitalized signals).

Methods: In this study, we considered a group of subjects healthy individuals (MIT-BIH Normal Sinus Rhythm Database, 18 individuals) and patients with arrhythmias (MIT-BIH Arrhythmia Database, 47 subjects). Before applying the Information Theory-based tools, bio-signals have to be digitalized. Here, the binary sequence conversion was proposed, using the encoding fluctuation addressing method, which strongly exploits the variability of bio-signals by taking into account oscillations of consecutive ECG values around the signal average.

Results: It turned out that normalized Lempel-Ziv complexity (LZC) values were significantly lower for patients with arrhythmias aginst control group (AVR_{ar} = 0.38 vs. AVR_{contr} = 0.86). This means, due to the essence of LZC, that healthy individuals signals exhibit much more patterns than subjects with arrhythmias. Consequently, arrhythmias group signals have LZC much lower (Figure 1). The proposed classifier provided arrhythmias diagnostics with a sensitivity of 90.00 and specificity of 92.00%.

Conclusions: Results obtained support the hypothesis that Information Theory tools can be successfully applied to classified biomedical signals addressing biological systems physiological states and can improve diagnostic speed, accuracy, and reliability.

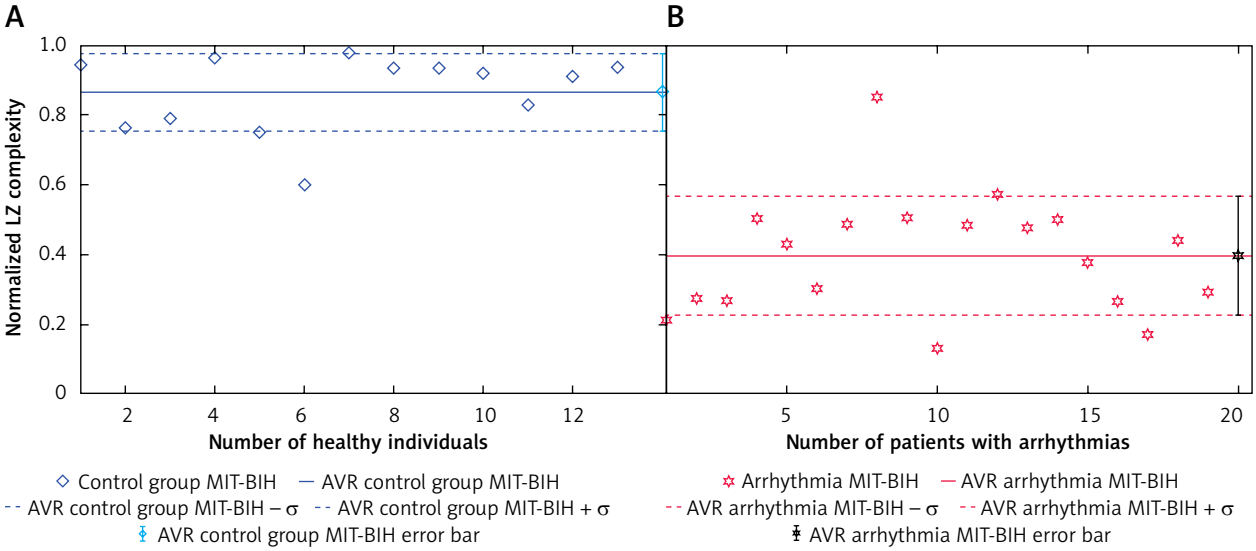

Figure 1. Normalized Lempel-Ziv complexity of ECG, for MIT-BIT control group (blue) (**A**), and for MIT-BIT arrhythmias patients (red) (**B**). The average values and standard deviations within groups are also shown. An important observation is that the intervals with the spread σ around averages do not completely overlap what was illustrated in the middle vertical axis

13-P

Augmented reality as a doctor support to meet the General Data Protection Regulation in Europe

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Background: General Data Protection Regulation (GSPR) created by the European Nation aims to harmonize data protection rules and everyone in Europe is obligated to follow it. Unfortunately, one can still find, doctors who have on their desk subjects documentation from the current and sometimes even the previous day. On the other hand, display data using PC/Laptops are limited to a few rigorous conditions like the location of the power socket, free space on table/desk, and the display angle.

Aim: This paper aims to develop an Augmented Reality (AR) based application using an advanced technology device – Microsoft's Azure Kinect DK camera and HoloLens glasses.

Methods and results: The scheme of the proposed support systems is presented in Figure 1. Rooms where doctors work, such as a doctor's office, an exam room, an operating room, and a treatment room will be transferred to the digital form in real-time. The proposed solution will give new possibilities and enable additional support in the clinical diagnosis process, during medical procedures and the preview of the procedure from a different non-standard location without spatial restrictions related to the perspective of the Operator. A remote person could mark on his screen or AR device place, on which he/she wants to show, mark or point. The same information can be displayed on surgery glasses as a hint, it does not disturb his/her activities performed. Moreover, the proposed doctors' support tool allows also greater flexibility to learn and interact inside the worldwide medical community.

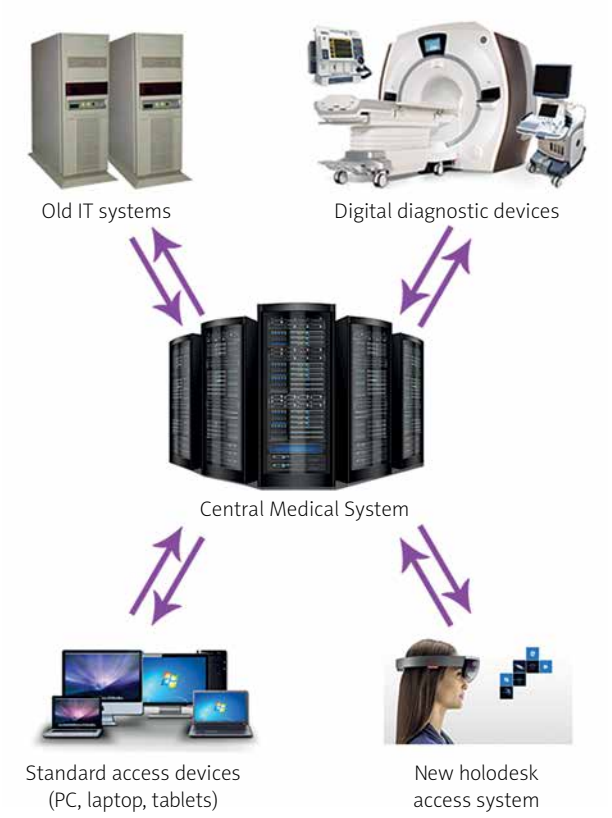

Figure 1. The scheme of the holographic system of the doctors supports