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Percutaneous closure of left-to-right shunts in adolescents and adults

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Introduction: Interventional closure of intra- and extracardiac shunts is the treatment of choice in some patients with congenital heart malformations. We present our experience in the treatment of adult and adolescent patients (pts) with atrial septal defects type II (ASD), congenital and acquired ventricular septal defects (VSD) and persistent ductus arteriosus (PDA).

Patients and methods: Between 1992 and 2007, 435 pts were qualified for percutaneous closure of intra- and extracardiac shunts. There were 321 (73.8%) pts with ASD, 84 (19.3%) with PDA, 30 (6.9%) with VSD: 20 with postinfarction VSD (PIVSD), 9 with congenital VSD (2 muscular and 7 perimembranous) and 1 posttraumatic VSD. Their age varied from 15 to 81 years (mean 35.5±17). We applied different Amplatzer devices (380), but also Rashkind umbrellas (8), Cardioseal-Starflex (30), detachable coils (24) and Hellex (2).

Results: Attempted percutaneous closure was successful in 416 (96%) out of 435 pts. In 14 ASD cases the procedure failed (not proper position of the device). In 3 PIVSD pts implantation was abandoned because of technical problems and in 2 pts because of instable position of the device. Six occluders embolized after release (in 4 ASD and 2 VSD pts: 1 muscular and 1 posttraumatic VSD). All were retrieved successfully. Small residual shunts remained in 35 patients after ASD closure (in 34 they disappeared spontaneously during follow-up), in 8 after PDA closure, none after congenital VSD closure. Six patients despite successful PIVSD closure died due to multi-organ failure during early follow-up (hospital stay).

Conclusion: Percutaneous closure of left-to-right shunts is an effective and safe method of treatment in patients with heart defects. Interventional closure of PIVSD is difficult and is followed by a significant percentage of failures. This is a consequence of the bad general condition and specificity of the disease.

Novel 3D Angiographic Reconstruction and Quantification Software (CAAS QCA 3D) in Measuring Intracoronary Length

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Background: Three-dimensional quantitative coronary angiographic analysis (3D QCA) should provide an advantage over two-dimensional (2D) QCA by increasing the accuracy and precision of length measurements through compensating for the foreshortening inherent to 2D images.

Methods: In 13 patients with coronary marker wire in 30 coronary arteries, two angiographic images at least 30 degrees apart were obtained for 3D reconstruction. A total of 240 inter-marker lengths (8/wire, 5-40 mm) were measured with the novel 3D software (CAAS QCA 3D) and standard 2D software (CAAS-II) and were compared to the true lengths of the marker wire. The same frames were used for 3D analysis and the standard 2D QCA.

Results: 2D QCA generally underestimated the true length in comparison to 3D, and the magnitude of the discrepancy increased with the length (medians, CI – see table). In contrast, 3D QCA showed minimal difference from true length regardless of the length measured.

Conclusions: It seems that 3D QCA minimizes errors in length measurements associated with foreshortening. The advantage of 3D QCA is more pronounced at longer lengths.

Table (J. Legutko et al.)

True length	Median Difference between 3D and True Length (mm)	Median Difference between 2D and True Length (mm)	p value
5 mm (n=122)	–0.06 (–0.15, 0.03)	–0,52 (–0.64, –0.4)	<0.001
10 mm (n=126)	0.325 (0.04, 0.61)	–0.86 (–1.32, –0.39)	<0.001
20 mm (n=124)	0.285 (0.003, 0.57)	–1.46 (–2.01, –0.91)	<0.001
25 mm (n=62)	0.22 (–0.15, 0.58)	–1.815 (–2.66, –0.97)	<0.001
40 mm (n=64)	0.69 (0.07, 1.31)	–3.555 (–4.97, –2.14)	<0.001

Table (M. Pieculewicz et al.)

Parameter	Before ASD closure	12 months after ASD closure	p value before vs. 6 months
Time of exercise [min]	9.1±4.1	13.9±5.1	<0.001
VO_2peak [ml/kg/min]	8.2±3.3	13.5±5.1	<0.001
SF36q scale 0-100	21.3±19	85.7±22.7	<0.0001
The right ventricular area [cm^2]	24.8±1.3	17.2±1.2	<0.0001
The right ventricular area [cm^2]	19.5±1.37	12±1.3	<0.0001

Closure of atrial septal defect in elderly patients

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Objective: Closure of atrial septal defect in elderly patients is controversial. The aim of the study was to evaluate the outcomes of transcatheter closure of secundum atrial septal defect (ASD) in elderly patients (pts).

Methods: 25 consecutive adult pts over 60 years (20 females, 5 males) with a mean age of 65.2±15.1 (60-74) with ASD who underwent transcatheter closure were analyzed. All pts had an isolated secundum ASD with pulmonary to systemic blood flow ratio, Qp:Qs: 2.69±1.6 (1.5-3.9).

Quality of life (QoL) was measured using the SF36 questionnaire (SF36q). SF36q were repeated in all pts before the procedure and after 6 months of follow-up as well as symptom-limited treadmill exercise tests with respiratory gas exchange analysis and transthoracic colour Doppler echocardiographic study.

Results: The ASO device was successfully implanted in all pts [procedure time 37.7±4.5 (13-59) minutes, fluoroscopy time 11.2±9.9 (6-40) minutes]. The defect echo diameter was 17.7±5.8 (12-30) mm. The mean balloon stretched diameter of ASD was 22.4±7.9 (14-34) mm. The diameter of the implanted devices was in the range 16-36 mm.

After 6 months of ASD closure, all the pts showed a significant improvement of exercise capacity. Seven QoL parameters (except mental health) improved at 6 months' follow-up compared to their baseline data. The mean SF36q scale increased significantly in 22 (88%) pts of mean 46.2±19.1 (5-69). The right ventricular dimension decreased in 20 (80%) pts (see Table).

Conclusions: Closure of ASD in elderly patients caused significant improvement of exercise capacity as well as improvement of quality of life measured by SF36 questionnaire.

Over 12-month follow-up the right heart dimensions decreased in most of the elderly patients. The elderly patients might benefit from ASD closure.

The influence of reperfusion on follow-up outcome in patients with acute myocardial infarction after primary coronary angioplasty

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Background: Microvasculature damage after myocardial infarction has crucial implications. Myocardial contrast echocardiography (MCE) offers a promising modality for non-invasive evaluation of myocardial perfusion.

Aim: The study aimed to assess the predictive value of myocardial viability detected by contrast echocardiography (MCE) in the follow-up outcome in patients with acute myocardial infarction treated with primary coronary angioplasty.

Methods: Eighty-six patients (68 males, 18 females; mean age 58.4±11.2) underwent primary percutaneous coronary angioplasty (PCI) for acute anterior myocardial infarction. MCE and two--dimensional echocardiography were performed in all patients. Segmental perfusion were estimated in real time before and immediately after PCI using low MI (0.3) after 0.3 ml bolus injection of intravenous Optison. MCE was scored semi-quantitatively as: 1 – homogeneous contrast enhancement, 0.5 – patchy contrast enhancement, 0 – no contrast.

Results: The risk area was defined as the number of segments with no perfusion (minimal/absent opacification) before angioplasty. An MCE perfusion defect size after PCI >25% of the MCE perfusion defect size before PCI was used to define myocardial non-reperfusion. As evidenced by MCE, 54 patients had reperfusion, and 32 had non-reperfusion. During the mean follow-up time of 34 months there were 80% cardiac events (death, restenosis, heart failure).

Conclusion: Absent myocardial viability detected by MCE was a predictor of poor follow-up outcome in patients with acute myocardial infarction after primary coronary angioplasty.

A new option for critically ill patients: high-risk PCI with pLVAD Impella 2.5 LP – first encounter

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A 76-year-old man with arterial hypertension and dyslipidaemia, with a past history of inferior wall myocardial infarction in 1987 and coronary artery bypass grafting procedure in 1992 was admitted to our Department of Invasive Cardiology with aggravation of effort angina despite optimal pharmacotherapy. At the time of admission symptoms and signs of unstable angina with positive troponin I level were obtained as well as ST segment depression in leads I, aVL, V_5 and V_6.

The performed coronary angiography revealed extensive multivessel disease with the last remaining vessel – arterial bypass directly supporting the anterior wall and via collaterals the remaining walls of the left ventricle. Echocardiography revealed compromised left ventricular ejection fraction (LVEF) 35%.

On the basis of general condition and angiographic signs the patient was excluded from surgical revascularization. Also the patient was not eligible for "plain" percutaneous coronary intervention due to the high risk of sudden worsening of cardiac output during inflations in left main artery.

The Impella 2.5 LP cardiac support system was inserted via a right femoral artery puncture. Coronary angioplasty was started. During balloon inflations the patient suffered severe chest pain and the blood pressure dropped to 60/40 mmHg. Supported by the Impella 2.5 LP system arterial blood pressure was maintained at over 120/70 mmHg during the PCI procedure and 3 hours after. With the Impella system we managed to successfully perform DES stenting to the left main and circumflex artery without any adverse events. According to device manual the system was removed 3 hours after patient recovery. The day after the procedure ultrasound examination of the insertion site was performed, revealing a good local result. Echocardiography confirmed sustained LVEF at the initial level. The patient was discharged on the third day after the procedure and since then complains of non-significant symptoms of angina. No MACE was reported during 6 months' follow-up.

Overall, the Impella 2.5 LP system enabled coronary angioplasty to be conducted in the patient with no therapeutic option. It revealed itself as a readily implantable, safe, reliable and user-friendly device which widely extends the possibilities of therapeutic approaches to the group of formerly no-option patients. It also inspires efforts for life-saving procedures in patients with critical cardiac status, giving more chances for recovery.

No-reflow phenomenon after acute myocardial infarction is associated with reduced clot permeability and susceptibility to lysis

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Objective: We assessed the relationship between fibrin clot properties and the no-reflow phenomenon after primary coronary intervention (PCI).

Methods and results: Epicardial blood flow was assessed by TIMI scale and corrected TIMI Frame Count (cTFC), and perfusion by TIMI Myocardial Perfusion Grade (TMPG) after PCI during ST-segment elevation myocardial infarction (STEMI). Fibrin clot permeability (Ks) and susceptibility to lysis in assays using exogenous thrombin (t50%) and without thrombin (tTF) were determined in 30 no-reflow patients (TIMI ≤2) and in 31 controls (TIMI 3) after 6-14 uneventful months from PCI. Patients with TIMI ≤2 had lower Ks by 18% (p <0.0001) and prolonged fibrinolysis by 33% for t50% (p <0.0001) and by 45% for tTF (p <0.0001). The cTFC was correlated with Ks (r=–0.56, p <0.0001), t50% (r=0.49, p <0.001), and tTF (r=0.54, p <0.001). The Ks increased in a stepwise fashion with TIMI flow (p <0.0001) and TMPG (p <0.0001), while both fibrinolysis times decreased with TIMI flow (p <0.0001 for both) and TMPG (p <0.01 for both). Multiple regression models showed that only Ks and fibrinogen were independent predictors of cTFC (p <0.05 for both), TIMI ≤2 flow (p <0.05 for both) and TMPG – 0/1 (p <0.05 for both).

Conclusions: Survivors of myocardial infarction with a history of no-reflow following PCI are characterised by more compact fibrin network and its resistance to lysis.

Long-term mortality of guideline-based early conservative strategy in acute coronary syndrome population

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Objective: Current guidelines for the management of patients (pts) with ST-elevation (STEMI) and non-ST-elevation myocardial infarction (NSTEMI) include recommendations for early invasive and conservative strategy in acute coronary syndromes (ACS).

Aim: To determine long-term mortality and its predictors in pts with ACS primarily not eligible for invasive strategy.

Methods: In the year 2005, 1725 pts were admitted with ACS. Among these, 252 (14.6%) pts with STEMI and 277 (16.1%) pts with NSTEMI were not eligible for percutaneous coronary intervention (PCI). 1072 (62.1%) pts underwent PCI. During a median follow-up time of 24 months (18-30 months) death was recorded in the PCI ACS group, the non-PCI STEMI group and the non-PCI NSTEMI group.

Results: Patients not eligible for PCI were considerably older (64±13 vs. 56±10, p <0.001). The reasons for excluding STEMI pts from invasive treatment were time of ischaemia of >12 h (71%), aborted STEMI (10%), and anticipated transport time of >90 min (8%). These reasons in the NSTEMI population were TIMI risk score of ≤4 (83%), no patient consent (5%) and pulmonary oedema (3%). During hospitalization 64 (12%) pts developed symptoms of acute heart failure (AHF) and 115 (22%) pts underwent delayed PCI within 7 days after index ACS. The mortality rates in all groups are presented in the table. In pts with early conservative strategy for ACS, AHF during index hospitalization (RR 11.3; 95% CI 4.7-27.6; p <0.001), LVEF <35% (RR 13.0; 95% CI 4.2-40.9; p <0.001), lack of delayed PCI (RR 5.2; 95% CI 1.6-18.7; p=0.012) and previous MI (RR 1.9; 95% CI 0.7-3.5; p=0.05) were independent long-term mortality predictors.

Conclusion: Patients with STEMI not eligible for catheter--based reperfusion constitute a population of the highest risk of long-term mortality. The mortality rate in the whole non-PCI ACS population depends on left ventricular function as well as on the performance of delayed PCI.

Table. Mortality rates in the compared groups (J. Zalewski et al.)

	In-hospital	30 days	12 months	24 months
PCI ACS	5.6	6.1	9.5	12.7
non-PCI STEMI	8.1 *	8.8 *	11.7 **	17.2 **
non-PCI NSTEMI	3.3.#	4.0 #	7.3 ##	13.8 ##

**p <0.01 vs. PCI ACS, ** p <0.05 vs. PCI ACS, # p <0.001 vs. non-PCI STEMI, ## p <0.01 vs. non-PCI STEMI*

Peripheral percutaneous interventions in patients with non-ST-elevation acute coronary syndromes by interventional cardiologists: rationale and results

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Objective: To investigate if complex percutaneous cardiovascular interventions for coronary artery disease (CAD) and peripheral artery disease (PAD) may improve prognosis and long-term outcome for this group of patients.

Aim: The coexistence of PAD and presence of multilevel atherosclerosis increases death and stroke rates in patients with CAD. Due to many comorbidities these patients are often treated conservatively without revascularization.

Methods: We included 78 consecutive patients with confirmed CAD. All patients underwent percutaneous coronary intervention (PCI) for non-ST-elevation acute coronary syndrome (Braunwald IIB, IIC) before/after/simultaneously with peripheral angioplasty. Major adverse cardiac and cerebrovascular events (MACCE) during follow-up were defined and assessed: death (cardiac and non-cardiac), urgent/non-urgent revascularization (surgical or repeat PCI, repeat PTA), myocardial infarction (MI), stroke, amputation.

Results: The mean age of patients was 61.5±8.6 years and men constituted 80%. Four (5%) patients had one-stage PCI and PTA procedure. 109 lesions in lower limb arteries were treated and 50% with stent implantation. Mean follow-up time was 18 months (range 2 to 42). There were 4 deaths in observation, 3 myocardial infarctions, 13 repeated PTAs due to restenosis in a previously treated peripheral lesions, 31 elective PTAs of other vessels after the index procedure in different hospitalization, two urgent PCIs and additionally two ischaemic strokes and two TIAs and one amputation.

Conclusions: Patients with concomitant CAD and PAD could safely undergo percutaneous cardiovascular interventions. Multilevel intervention could provide promising long-term follow-up.

Primary coronary angioplasty in elderly patients and the evaluation of risk factors of coronary disease

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Background: The number of elderly patients with acute myocardial infarction (AMI) treated with percutaneous coronary intervention (PCI) is increasing rapidly. Age is strongly related to worse short- and long-term prognosis and a higher rate of complications. On the other hand PCI in the setting of ST-segment elevation myocardial infarction (STEMI) reduces the incidence of death, recurrent myocardial infarction and angina.

Aim: To assess the efficacy of primary PCI in elderly patients with STEMI and frequency of coexisting risk factors of coronary heart disease.

Methods: All consecutive patients with STEMI treated with primary PCI were enrolled in the registry. Early and late (12 months) outcomes were evaluated in 3 age groups: <65 years, 65-74 years and >75 years.

Results: We analyzed 956 consecutive patient who underwent primary PCI. Mean age for consecutive groups was 53.5±0.5 vs. 69.8±0.8 vs. 77.9±1.2 (p <0.001), respectively. Women comprised 22.8, 37.5 and 29.2% of each group (p=NS). In-hospital mortality was low and for each age group was 0.48, 0.96 and 1.9%. Risk factors of coronary heart disease such as hypertension (60.3 vs. 71.4 vs. 75%, p=0.01) and diabetes (15.4 vs. 12.7 vs. 20.8%, p=0.05) were found significantly more frequently in the oldest group. Although percentage of smokers was lower in the elderly patients compared to the youngest group, it was still at a relatively high level (63.4 vs. 25 vs. 31%, p <0.01). There were no significant differences among evaluated groups in history of previous MI, time from onset of symptoms and the use of abciximab, and the max CK level [U/l] ±SD was the lowest in the elderly group (2526.1±178.3 vs. 1933.1±227.8 vs. 1465±435.2, p=0.03). Overall mortality evaluated at one-year follow-up was significantly higher among the oldest patient group than among younger patients (6.5 vs. 8.6 vs. 22.1%, p <0.01).

Conclusions: The results suggest that primary PCI is safe and effective in elderly patients with STEMI in the majority of cases. The frequency of risk factors of coronary heart disease increases with age and requires particular control in the oldest group of patients.

Impact of ICUS on restenosis and stent thrombosis after stent implantation in chronic total occlusions

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Introduction: Implantation of bare metal stents (BMS) and drug-eluting stents (DES) in CTO decreases the rate of restenosis. Available data revealed possible increased rates of death and myocardial infarction after DES implantation, mainly due to late stent thrombosis. In non-CTO angioplasty ICUS and FFR favourably influence outcome and predict event-free survival. There is a lack of data on their role after BMS implantation in CTO. In patients with contraindication to prolonged double antiplatelet therapy optimization of BMS implantation in CTO may play an important role.

Purpose: To assess the role of ICUS and FFR after successful recanalization of CTO and BMS implantation on procedural and long-term result, particularly on restenosis and stent thrombosis.

Methods: The group consisted of 62 pts with CTO. In group A we performed ICUS- and FFR-guided CTO stenting, in group B standard angiography-guided CTO stenting. In group A additional balloon inflation was performed to achieve a larger minimum stent area (MLCSA). By QCA we assessed proximal and average vessel diameter (VD), minimum stent lumen diameter (LD), stent-to-artery

Table (L. Bryniarski et al.)

	Group A (n=43)	Group B (n=19)	p
Stent diameter [mm]	3.58±1.0	3.25±0.7	NS
Minimum stent LD [mm]	3.27±0.52	2.82±0.4	0.05
Stent-to-artery ratio	1.31±0.16	1.08±0.12	NS
Residual stenosis [%]	1.6±13.4	8.9±15.3	NS
MLCSA [mm^2]	8.96±1.65		
FFR	0.84±0.12		

ratio and residual stenosis. ICUS analysis in group A consisted of measurement of the luminal area (LA), the extent of plaque burden at the site proximal and distal to the occlusion, and within the occlusion and the subsequent stent. When optimal ICUS results were achieved FFR were done. Control angio was performed at 6 months. Restenosis occurred in 7 (16.2%) pts in group A and in 4 (26.6%) pts in group B (p=NS), and no stent thrombosis in group A.

Results: see table, p. 244.

Conclusions: ICUS-guided stent implantation after successful recanalization of CTO allows one to achieve larger minimum stent LD, a well known major predictor of angiographic restenosis. ICUS-guided CTO recanalization allows one to achieve a very low rate of restenosis and no stent thrombosis in six-month angiographic follow-up.

The fulfilment of 'aggressive' stent implantation IVUS criteria after successful chronic total occlusion recanalization

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Introduction: Bare metal stent (BMS) after successful recanalization of chronic total occlusion (CTO) diminishes restenosis, reocclusions and all clinical events. However, restenosis rates still remain high. The results of drug-eluting stent (DES) implantation in CTO are promising. But long-term follow-up is necessary to elucidate the possible increased rate of late stent thrombosis. In non-CTO angioplasty intravascular ultrasound (IVUS) favourably influences outcome.

Purpose: To assess the role of IVUS performed after successful recanalization of CTO to improve procedural and long-term result.

Methods: Analysis was performed in a group of 22 patients after IVUS-guided CTO recanalizations (TIMI 0-1, duration of occlusion >15 days, vessel diameter ≥2.5 mm) before and after stent implantation. Additional balloon inflation was performed to achieve larger minimum stent area.

We applied four IVUS criteria for optimal stent implantation:

A. In-stent cross-sectional area (CSA) ≥90% of average lumen CSA in proximal and distal reference segments (MUSIC study criteria).
B. In-stent CSA >80% of average lumen CSA in proximal and distal reference segments (RESIST study criteria).
C. In-stent CSA ≥60% of average lumen CSA in proximal and distal reference segments.
D. Plaque burden at proximal or distal reference segments <60%.

Table (J. Dragan et al.)

Stent diameter [mm]	3.6±1.0
Minimum stent LD [mm]	3.24±0.49
Stent-to-artery ratio	1.29±0.18
Residual stenosis [%]	1.6±13.4
IVUS criteria for optimal stent implantation	A: 4 (18.1%) B: 20 (90.9%) C: 22 (100%) D: 15 (68.1%)

In quantitative angiography we assessed proximal and average vessel diameter (VD), minimum stent lumen diameter (LD), stent-to-artery ratio and residual stenosis.

Quantitative IVUS analysis consisted of measurement of the luminal area (LA), the extent of plaque burden at the site proximal and distal to the occlusion, and within the occlusion and the subsequent stent. Control angiography was performed at 6 months.

Results: See table. Angiographic control after 6 months showed restenosis in 4 (22.7%) pts.

Conclusions:

1. RESIST study IVUS criteria for optimal stent implantation but not MUSIC study criteria could be achieved during IVUS-guided stent implantation after successful recanalization of CTO.
2. Considerable plaque burden at proximal or distal end of stents diminishes the rate of optimal stent implantation in CTO.

Angiographic assessment of coronary artery atherosclerosis progresion in patients with acute myocardial infarction treated with primary angioplasty

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Background: Atherosclerosis progression (AP) might be responsible for a substantial proportion of poor long-term outcomes after acute myocardial infarction (AMI). Data on atherosclerosis progression and factors influencing this process after MI are limited.

Aim: To assess predictors of AP among patients (pts) with AMI treated with angioplasty (PCI) and to estimate the correlation between progression and long-term outcome.

Material and methods: 186 pts with AMI treated with PCI and control angiography performed after 12 months were analyzed. 154 pts were included in the final quantitative coronary angiography (QCA) analysis. All lesions with diameter stenosis (DS) ≥20% or minimal lumen diameter (MLD) <0.4 mm compared to the calculated reference of the coronary segment were estimated. Progression of pre-existing coronary stenosis was defined as a decrease in the MLD of at least 0.4 mm or increase in DS of at least 20%. Similarly, a normal segment had to reveal a new localized narrowing of at least 20%, or with MLD smaller by at least 0.4 mm than the reference diameter, to be accepted as a newly formatted stenosis.

Results: 2096 coronary lesions were analyzed. Of the 1017 pre-existing stenoses, 99 (9.7%) were classified as progressing. Additionally, 62 new lesions were recognized in previously 'normal' coronary segments. Progression found in QCA concerned 93 pts. The remaining 61 pts were classified as pts without progression. On the basis of clinical, laboratory and angiographic data a multivariate analysis of the risk of AP in relation to pts and lesions was performed.

Risk of AP in patients increased with lack of adequate microvascular perfusion (OR 4.13; 95% CI 1.17-14.53), non-smoking status and lower baseline cholesterol value (OR=2.74; 95% CI 1.19-6.31 and OR=1.44; 95% CI 1.04-1.98, respectively).

Frequency of major adverse coronary events was similar in both groups. Composite endpoint occurred in 21 (22.6%) pts with progression and in 11 (18.0%) pts without progression.

Conclusions:

1. Atherosclerosis progression during 12 months after AMI concerns 3/5 of pts.

2. Low baseline cholesterol value and non-smoking status are connected with AP after AMI.
3. Dysfunction of coronary microvasculature after reperfusion therapy is the strongest factor identifying AP among pts.
4. AP does not correlate with frequency of major adverse cardiac events in the analyzed population.

Stable angina and left main stenosis – safety and efficacy of percutaneous coronary intervention, 17-month follow-up

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Background: The presence of left main coronary artery (LM) stenosis is considered as a standard indication for surgical revascularization. However, percutaneous coronary intervention (PCI) in LM stenosis is still a matter of debate. In fact, patients with LM stenosis have varied from those presenting with stable angina to those with acute myocardial infarction and cardiogenic shock.

Aim: To evaluate results of PCI in patients with stable angina at presentation and evidence of at least 50% LM diameter stenosis by visual estimate, suitable for stent placement.

Methods: The total study population comprised 59 patients with LM stenosis and stable angina at presentation, electively treated in the Silesian Centre for Heart Diseases. For baseline characteristics – table 1.

Results: The Euroscore system for cardiac operative risk evaluation was used to stratify the risk of death at 30 days (mean 5.7±3.0 points; high mortality risk score was present in 52.5% of patients). Multivessel artery disease was present in 50 (84.7%) patients; distal LM involvement was present in 39 (66.1%) patients and LM restenosis was the main cause of intervention in 11 (18.6%) cases. During index hospitalization 39 (66.1%) were treated with DES.

One (1.7%) patient died in hospital and the rest were followed up for a mean of 17 months (5-39 months).

Survival during observation was 96.6%. The 17-month incidence was 1.7% for non-fatal myocardial infarction, 10.1% for repeat revascularization (1.7% for repeat LM revascularization).

Conclusion: PCI for left main stenosis has showed satisfactory short- and long-term clinical success rates only in selected patients. The use of PCI for patients with significant LM stenosis seems to be a reasonable method of revascularization, especially in carefully selected and appropriately screened patients.

Table 1. Baseline characteristics

	Stable angina (n=59)
Mean age [years]	65±8.5
Male sex	37 (62.7%)
Diabetes mellitus	23 (39.0%)
Hypertension	46 (77.9%)
Hypercholesterolaemia	34 (42.4%)
Prior myocardial infarction	47 (79.7)
Prior PCI	28 (47.5%)
Prior CABG	19 (32.2%)
Protected LM	12 (20.3%)

Table 2. Angiographic characteristics

	Stable angina (n=59)
Diameter stenosis [%]	77.4±13.9
Pre-intervention [QCA]:	
– MLD [mm]	1.7±0.4
– lesion length [mm]	7.5±4.0
– reference vessel diameter [mm]	3.2±0.5
– diameter stenosis [%]	46.7±13.1
– length of LM [mm]	14.0±4.4
Post-intervention [QCA]:	
– MLD [mm]	2.7±0.2
– lesion length [mm]	3.7±1.6
– reference vessel diameter [mm]	3.3±0.3
– diameter stenosis [%]	18.6±5.8

Proximal neuroprotection as the system of choice in high-risk carotid artery stenting: results from an academic centre registry of 143 proximal and 412 distal neuroprotection CAS

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Background: Recent evidence indicates that the use of embolic protection devices (EPD) increases the safety of carotid artery stenting (CAS). Presently, most CAS procedures are performed with distal EPDs (filters or a distal occlusion balloon) that require unprotected lesion crossing before neuroprotection is implemented. Other disadvantages of distal EPDs include potential incomplete filter apposition, provocation of internal carotid artery spasm or inability to catch and remove the debris completely. Thus the use of distal EPDs can be associated with causing cerebral embolization, particularly in the case of high-risk lesions.

Aim: To evaluate safety and efficacy of the use of proximal protection systems for high-risk lesions/patients.

Material and methods: From Jan 2001 to Sep 2007 we performed 555 CAS procedures in 516 patients (age 38-86 years, 61% symptomatic; all CAS procedures with EPD). For high-risk lesions (in particular, near occlusions and/or thrombus-containing and/or soft long lesions), and also in case of a lack of an optimal 'landing zone' for a distal EPD, proximal EPD was the system of choice. Thus 143 (26%) CAS procedures were performed with cerebral flow reversal (Parodi Anti-Emboli System or GORE NPS, n=103) or proximal flow blockade (Mo.Ma, n=40). Direct stenting was always considered first.

Results: Stenosis severity by QCA was significantly higher in the proximal than distal-EPD-treated lesions (90.2±7.9 vs. 81.8±9.9%, p <0.001). Not unexpectedly, direct stenting was possible in only 42.7% (61/143) of lesions treated under proximal EPD vs. 74.5% (307/412) of lesions treated under distal EPD (p <0.001). The rate of access-site complications was no different between the proximal and distal EPD group (1.6 vs. 1.8%, p=NS) despite the higher profile of proximal EPDs. In the proximal EPD group, during the

peri-procedural period and up to 30 days there were 2 (1.4%) haemorrhagic strokes causing death, 0 (0.0%) minor stroke, 5 (3.5%) TIAs and 1 (0.7%) retinal embolization. In the distal EPD group there was 1 (0.2%) haemorrhagic stroke causing death, 7 (1.7%) minor strokes, 11 (2.7%) TIAs and 1 (0.2%) retinal embolization. Statistical data evaluation for any difference in complication rate between the distal and proximal EPD group showed no significant difference (p=0.82 for TIA and p=0.08 for death and p=0.46 for stroke) despite the significantly higher lesion severity in the proximal EPD group. Analysis of the treatment of high-risk lesions by morphology (n=185) showed proximal EPD use in 131 (70.8%) and closed-cell design stent implantation in 155 (83.7%). This was significantly higher than the proximal EPD use (4.8%, p <0.001) and closed-cell design stent implantation (63%, p <0.01) for other lesions.

Conclusions: The use of a proximal embolic protection system for CAS in patients with high-risk lesions can lead to a peri-procedural and 30-day complication rate that is very low and is similar to that seen with mild-moderate risk lesions stented under distal neuroprotection. Working knowledge of at least one proximal EPD is a must in carotid stenting and needs to be implemented in the training programmes.

Effect of renal artery stenting on renal function and blood pressure in patients with atherosclerotic renovascular disease

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Background: Renal artery stenosis is often related to drug-resistant hypertension, progressive renal failure and flash pulmonary oedema. However, no clear indications and effectiveness of renal artery stenting (RAS) have been established.

Aim: To evaluate the safety and effect of RAS on renal function and blood pressure (BP) control in patients with atherosclerotic renovascular disease (ARVD).

Methods: 63 patients (26 females, 37 males), mean age 63.7±9.3 (47-81) met clinical, angiographic, Duplex ultrasound and/or scintigraphic criteria of significant renal artery stenosis. All had arterial hypertension (HA) and 28 (44%) had impaired baseline renal function (GFR <60 ml/min). Clinical data, renal function and BP were assessed at baseline, 3 months and 6 months after RAS. Renal function was judged by serum creatinine concentration (SCC). GFR was estimated by Cockroft-Gault formula. BP was measured by ambulatory blood pressure monitoring (ABPM). At baseline, mean diameter stenosis was 64.4±14.8% (38-91%), and bilateral stenosis was observed in 14/63 (22%) of pts.

Results: RAS was successfully performed in all 63 pts. Bilateral RAS was performed in 11/63 (15.8%), and RAS of the single functioning kidney was performed in 3/63 (4.7%) pts. RAS was complicated by 2 cases of acute limb ischaemia, treated with vascular surgery – 1 pt died due to multi-organ failure 1 month after operation. In 1 pt minor haematoma after RAS via radial artery was observed. 3 months' follow-up was completed in 40/63 (16 females, 24 males) pts; mean follow-up period was 13.7±7 months (3-31). In the follow-up period, another 3 pts died – all deaths were of cardiovascular causes. Other adverse events were as follows: in 1 pt progressive renal failure requiring dialysis, in 1 pt NSTEMI, in 1 pt stroke, in another 1 pt TIA, in 1 pt pulmonary oedema. In summary, clinical adverse events occurred in 13/63 (20.6%) patients. Clinical restenosis confirmed by angiographic evaluation occured in 4/59 (6.8%) survivours.

Renal function: Mean baseline GFR 63.48±27.6 ml/min increased in the whole group by 19.5% up to75.8±30.4 ml/min (p=0.002) 3 months after RAS. In 21/40 (52.5%) GFR increased >15% (on average by 52%). In 7/40 (17.5%) cases GFR decreased >15% (on average by 46%). In the remaining 12/40 (30%) pts GFR changes did not exceed ±15% of the baseline values. Mean baseline SCC which was 118±41.7 µmol/l, dropped to 97.8±32.9 µmol/l; 3 months after RAS (median decrease by 17%, p=0.007).

ABPM outcome: The 24-hour mean blood pressue values, as well as at night hours, did not differ significantly before and 3 months after RAS (132.5/74 vs. 131.6/74.8 mmHg, p=NS, and 122.7/67.6 vs. 119.8/64.3 mmHg, p=NS). Blood pressure control improved in 11 (27.5%) out of 40 patients with completed 3-month follow-up.

Conclusion: In properly selected patients, PTA is a safe and effective method of treatment of ARVD.

Conquering cardiogenic shock in Cracow – one-year follow-up results

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Background: There was an enormous advance made in the therapy of myocardial infarction (MI) over recent years. However, there is still a high mortality rate in cardiogenic shock. Evaluation of the usefulness of new methods of combined invasive and pharmacological therapy is required.

Aim: To evaluate the results of combined interventional therapy of cardiogenic shock complicating MI during in-hospital and 1-year follow-up.

Methods: 202 patients with cardiogenic shock complicating myocardial infarction treated with early invasive strategy in years 2000-2005 were included in the analysis. Demographic, clinical and angiographic data were analyzed to evaluate their influence on therapy results.

Results: The study group contained 31.7% women and 68.3% men; mean age was 63.66±10.91 years. The direct result of angioplasty was restoration of coronary blood flow in the infarct-related artery (TIMI 2 or 3) and was achieved in 62.37% of patients. Microcirculatory blood flow MPG 2 or 3 was achieved in 36.63% of patients. Total in-hospital mortality rate was 56.43%, whereas 1-year mortality rate was 59.40%. Major adverse cardiac events in 1-year follow-up were: rehospitalization 61.90%, reinfarction 6.97%, rePTCA 7.14%, CABG 4.76% of patients.

Survivors and non-survivors were compared to establish factors influencing the outcome. Patients with worse TIMI flow grade and TIMI microcirculatory perfusion grade, lower pH and altered renal function had higher mortality rate. In cases of full blood flow restoration (TIMI 3) mortality rate was significantly lower and reached 24.36%. When PCI failed to restore proper blood flow (TIMI 0 and 1) mortality rate reached 92-93%. Other important factors influencing outcome are also described in this study.

Conclusion: Despite development of interventional methods mortality remains high in cardiogenic shock. Restoration of TIMI 3 flow is only the first step to lower mortality rate. Preserving renal function in the post-procedural period is essential for better outcome.

Transcatheter closure of persistent foramen ovale in patients with presumed paradoxical embolism

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Objective: To evaluate the outcomes of transcatheter closure of the persistent foramen ovale (PFO) in patients with presumed paradoxical embolism.

Methods: Between December 2001 and December 2006, 49 adult patients (29 females, 20 males) with a mean age of 32.2±12.7 (18-56) years with presumed paradoxical embolism (transient ischaemic attack – 61.2%, stroke – 38.7%), underwent transcatheter device closure of PFO. Various devices were used: Amplatz PFO Occluder (32), Cardia (9), Starflex (8). Transcranial Doppler with a bubble study and saline echocardiographic study were performed on all pts to detect right-to-left shunt before the procedure and after 24 hours, 1 month and 12 months of follow-up.

Results: The devices were successfully implanted in all pts (procedure time 31.1±13.3, fluoroscopy time 7.1±5.3 minutes), with 3 pts with a trivial residual shunt. No predictors for a residual shunt were identified. Procedural complications included right ventricle injury with tamponade (n=1), atrial fibrillation (n=2) and vessel injury (n=1). The follow-up period was 24.1±12.3 (1-60) months. At 1 month of follow-up transthoracic echocardiography showed that the device was correctly positioned in all cases. Residual trivial shunt in 1- and 12-month follow-up was shaded in 1 patient. Two (4.1%) pts had recurrent events – 1 transient ischaemic attack and 1 retinal artery occlusion at mean follow-up of 6.6±3.4 months; none of them had residual shunt.

There were 25 (51%) migraine sufferers before PFO closure, including 10 (20.4%) with aura. After PFO closure a 50% reduction in migraine frequency in pts with aura and 20% reduction in pts without aura was noted.

Conclusions: Transcatheter closure of patent foramen ovale in patients with presumed paradoxical embolism is a safe and effective procedure. It is effective in reducing the frequency of migraine headaches after paradoxical embolism.

Recurrent events may occur in the absence of the residual shunt.

New approach to cardiovascular treatment with personalized medicine

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Background: Structural and functional genomics enable identification of genes involved in incorrect response or resistance to treatment. These techniques improve prevention and specialized treatment in patients with cardiovascular disease (CVD), especially after acute myocardial infarction.

Aim: To summarize and present the most recent information about individual genetic factors involved in treatment failure after acute coronary syndromes (ACS) and describe new frontiers in development of personalized medicine during everyday practice. The molecular basis and prediction value of these studies confirm their importance in the future of invasive cardiology.

Method: Based on a Medline database search of recent studies and trials published between 2000 and 2007 concerning personalized medicine in ACS treatment.

Results: Analyzed literature indicates possibilities of improving effective treatment and prevention of CVD based on study of the structure of the genome, epidemiological factors and implementation of these findings in everyday clinical practice.

Clinical studies concerning ACE polymorphism revealed a significant relationship between the DD allele in the ACE genome and increased mortality or need for heart transplantation. (McNamara). The risk was significantly higher in patients without beta-blocker treatment.

Clopidogrel treatment is proven to be ineffective in 10-30% of patients (PRONTO;Grubel;Lau). Impaired activity of the CYP3A4 enzyme, varying between individuals, is considered to be the reason for inadequate response to clopidogrel treatment. Use of enzyme activators such as rifampicin improves outcomes. New generations of antiplatelet drugs such as AZD6140, which do not need to convert to an active form, are under investigation.

Total resistance to aspirin treatment was proven in 5.5-9.5% of patients, but 23.8% presented suboptimal response to therapy (Gum).

Arterial stiffness, blood pressure, blood viscosity and shear stress among patients with angiographically confirmed three-vessel disease

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Aim: To answer the question whether arterial stiffness is more dependent on blood pressure or rheological factors, i.e. blood viscosity and shear stress.

Methods: In a group of 21 pts, 15 men and 6 women, mean age 60.8±9.8 yrs with severe arterial hypertension and angiographically confirmed three-vessel CAD, with elevated indices of arterial stiffness – carotid-femoral pulse wave velocity (aoPWV) and peripheral (pAI) and aortic (aAI) augmentation indices measured by Complior® and SphygmoCor, respectively – we evaluated arterial ($a\eta$) and venous ($v\eta$) whole blood viscosity (Brookfield DV II+Pro viscometer) and calculated shear stress (τ) from blood viscosity ascending aorta diameter and aortic flow velocity measured ultrasonographically using modified Poiseuille formula.

Results: In the selected group peripheral pSBP/pDBP and pPP averaged 131±16/71±11 and 57.6±17 mmHg while aortic (measured by SphygmoCor) aSBP/aDBP and aPP were 118±15/71±12 and 47±17 mmHg; aoPWV=10.4±2.2 m/s; pAI=85±12%; aAI=27±9%. Arterial blood viscosity was lower than venous $a\eta$=4.6±1.6 vs. $v\eta$=6.0±2.1 cP; p <0.0001. Calculated value of shear stress for ascending aorta was τ=70.6±30 dyne/cm^2. In stepwise regression aoPWV depends on age only. After exclusion of age aoPWV depends on $a\eta$ [regression coefficient (β) –3.34; p=0.0039] and τ (β=0.16; p=0.05) and does not depend on pPP or aPP. In contrast pAI shows dependency on both pPP (β=1.67; p=0.005) and aPP (β=1.87; p=0.05) as well as $a\eta$ (β=–12.3; p=0.001) and τ (β=0.46; p=0.002).

Conclusions: Arterial blood viscosity is significantly lower than venous; thus for calculation of shear stress in the arteries only arterial blood viscosity should be used. The influence of shear stress and blood viscosity on PWV was more pronounced

than blood pressure value. Indices derived from SphygmoCor depend similarly on pressure and rheology.

Comparison of factors determining in-hospital and one-year mortality in women and men with acute myocardial infarction treated with primary percutaneous coronary intervention

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Introduction: There are many factors determining in-hospital and one-year mortality in acute myocardial infarction (AMI). There are contradictory opinions regarding differences in quantity and type of those factors in women and men.

Aim: To compare factors influencing in-hospital and one-year mortality between genders in patients with AMI treated with primary percutaneous coronary intervention.

Method: We examined 2358 consecutive patients with AMI admitted to our Department between 1998 and 2005. Patients were divided into two groups according to gender. For the purpose of this study, selected clinical and angiographic parameters were compared.

Results: 1717 men and 641 women were included in the study. In-hospital mortality was 3.79% in men and 4.99% in women. Multivariate analysis revealed that cardiogenic shock [HR=21.30 (10.86-41.77); p <0.00001], initial flow TIMI 0/1 [HR=3.80 (1.35-10.65); p=0.0113], anterior infarction [HR=3.56 (1.81-7.01); p=0.0002], multi-vessel coronary disease [HR=3.11 (1.50-6.47); p=0.0024], higher blood glucose on admission [per 1 mmol HR=1.11 (1.03-1.19); p=0.0052], older age [per 1 year HR=1.05 (1.02-1.08); p=0.0006] and final flow TIMI 3 [HR=0.29 (0.12-0.69); p=0.0049] were factors influencing in-hospital mortality in males. In comparison, cardiogenic shock [HR=12.08 (4.65-31.37); p <0.00001] and older age [per 1 year HR=1.08 (1.04-1.13); p=0.0001] were independent predictors of in-hospital death in women.

In the analysed population, one-year mortality rate was significantly higher in women (13.88 vs. 10.25%; p=0.0214). In men, cardiogenic shock [HR=7.33 (5.23-10.29); p <0.00001], anterior infarction [HR=1.93 (1.43-2.61); p <0.00001], diabetes [HR=1.74 (1.21-2.49); p=0.0026], multi-vessel coronary disease [HR=1.56 (1.1-2.22); p=0.0122], initial flow TIMI 0/1 [HR=1.54 (1.0-2.36); p=0.049], higher blood glucose on admission [per 1 mmol HR=1.04 (1.01-1.08); p=0,0221], older age [per 1 year HR=1.03 (1.01-1.04); p=0.0007] and final flow TIMI 3 [HR=0.42 (0.27-0.67); p=0.0002] were identified as independent factors determining one-year mortality. Multivariate analysis showed that independent predictors of long-term (1 year observation) mortality in women were cardiogenic shock [HR=2.65 (1.59-4.42); p=0.0002], anterior infarction [HR=2.37 (1.53-3.68); p=0.0001], higher blood glucose on admission [per 1 mmol HR=1.07 (1.03-1.12); p=0.0004], higher creatinine level [per 10 mg% HR=1.05 (1.03-1.08); p=0.0002] and final flow TIMI 3 [HR=0.42 (0.2-0.88); p=0.0212].

Conclusions: There are gender-dependent differences in occurrence of independent factors determining in-hospital and one-year mortality in AMI. In the in-hospital period, only cardiogenic shock and older age were common for both genders. In 1-year follow-up, most factors influencing mortality were common for women and men.

Long-term survival after 'tailored' carotid artery stenting: results from an academic registry of 555 consecutive procedures

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Background: In contrast to the well-known effectiveness of carotid endarterectomy, determinants of long-term mortality after neuroprotected (NP) carotid artery stenting (CAS) are poorly established. Biased CAS data (e.g. 'one for all' NP and stent type in many registries and trials to date with a complication rate higher than considered acceptable according to the current guidelines) have recently influenced the national and international clinical practice and reimbursement policies.

We evaluated short- and long-term effectiveness of CAS with a patient- and lesion-specific choice of the neuroprotection system and stent type.

Material and methods: From January 2001, we performed 555 CAS procedures in 516 patients (age 38-86, mean 64±8.5 years, 61% symptomatic). Prior to CAS, all patients underwent CT angiography and extra- and intracranial duplex Doppler to evaluate plaque content (morphology and the anatomy) function of intracranial circulation to select the most appropriate NP device and stent type. Invasive angiography always included evaluation of the coronary arteries prior to CAS (the presence of at least one ≥50% lesion in a major coronary artery or a history of percutaneous intervention) or CABG defined coronary artery disease (CAD). Our strategy of 'tailored CAS' involved a preferential choice of a proximal NP and a closed-cell design stent for high-risk patients (lesions). In contrast, a distal NP device and an open-cell design stent was preferred for non-critical or highly calcified lesions, particularly in a tortuous vessel. Bilateral or two-level CAS was performed in 39 patients.

Results: Angiographic CAD was diagnosed in 66.3% of patients and peri-CAS (i.e. one stage or within 14 days) percutaneous intervention was performed (the operator's decision) in 11.3% of patients. Distal NP was used in 412 (74%) whereas proximal NP (PAES/Gore NPS, Mo.Ma) was used in 143 (26%) procedures. Stenosis by QCA was 84.9±7.6% before and 10.0±8.5% after CAS (p <0.001). The minimal lumen diameter increased from 1.34±0.58 to 3.85±0.6 mm (p <0.001). Within the 'tailored' CAS strategy, 71.2% of the implanted stents were closed-cell design (this includes the recently introduced hybrid stent 'Cristallo').

In the 30-day period, there were 3 deaths (0.58% of patients, all deaths from intracranial bleeding as a result of haemorrhagic transformation of a prior infarct scar). Clinically manifest hyperperfusion syndrome occurred in 6 (1.08%) procedures, a minor ischaemic stroke in 7 (1.25%) and a limited retinal embolisation in 2 (0.36%). There were 16 (2.88%) TIAs.

Long-term follow-up was up to 5 years (mean 24.6 months). Vital status of all except 2 patients was tracked through the National Residents Registry. There were 29 deaths (26 in CAD patients and 3 in those without CAD). A statistical search for determinants of post-CAS mortality indicated that the risk of death after CAS was not related to the presence of neurological symptoms prior to CAS (p=NS) – fig. In contrast, CAD diagnosed at the time of CAS had a major impact on long-term survival (p=0.008) – fig.

Conclusions: CAS with the NP and stent type tailored by a thorough non-invasive work-up is safe, and has a high procedural success rate and a low complication rate. Total mortality in up to 5 years after CAS is low. The use of tailored NP leads to similar

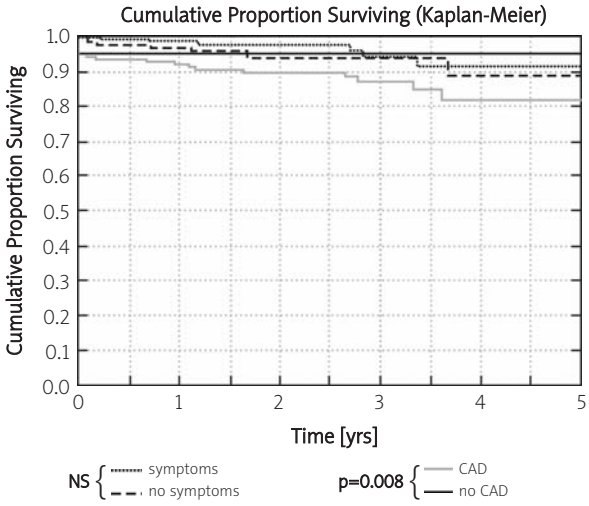

Figure (Ł. Tekieli et al.)

Table. Variables independently related to the end points (P. Jankowski et al.)

Variable	Multivariable HR	95% CI	Wald statistics
Cardiovascular death			
Creatinine level (per 1 mmol/l)	1.05	1.01-1.09	6.48
NYHA class (per class)	2.08	1.12-3.88	5.32
Number of diseased coronary vessels	1.82	1.08-3.05	5.12
Pulsatility index (per 0.1)	1.11	1.00-1.24	3.38
Cardiovascular death or MI or stroke			
Pulsatility index (per 0.1)	1.14	1.05-1.22	11.22
NYHA class (per class)	1.66	1.04-2.64	4.51
Cardiovascular death or MI or stroke or CABG or PCI			
PCI (yes – 1, no – 0)	2.43	1.61-3.67	17.88
Pulsatility index (per 0.1)	1.10	1.04-1.16	12.51

short- and long-term CAS efficacy in (neurologically) symptomatic and asymptomatic patients. Despite revascularisation of significant coronary disease at the time of CAS, long-term mortality after CAS is strongly related to coexisting CAD.

Relative changes of central blood pressure are powerful predictors of event-free survival in patients undergoing coronary revascularization. Results from the Aortic Blood Pressure and Survival Study

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Background: Ascending aortic pulsatility was shown to be related to the risk of MACE in patients with CAD. However, their prognostic significance in patients undergoing coronary revascularization is still unknown. Therefore, the aim of the present study was to evaluate the relationship between baseline aortic blood pressure-derived indices [pulsatility – the ratio of pulse pressure to mean blood pressure (BP); pulsatility index – the ratio of pulse pressure to diastolic BP] and the risk of major cardiovascular (CV) complications.

Methods: The study group consisted of 550 patients (445 men and 105 women; mean age: 57.9±9.6 years) undergoing PCI (n=356) or CABG (n=194). Invasive ascending aortic BP during catheterization was taken at baseline. The duration of follow-up was 53.4±17.1 months. The end-points were defined as shown in the table. Cox proportional hazard regression analysis was used to assess the relation between blood pressure-derived indices and long-term event-free survival.

Results: CV death occurred in 30 (5.5%) patients, CV death or MI or stroke in 66 (12.0%) persons, and CV death or MI or stroke or myocardial revascularization in 138 (25.1%) patients. The independent predictors of the end points are given in the table. When pulsatility was included in the multivariable models instead of pulsatility index the results did not vary significantly.

Adjustments were made for age, gender, ejection fraction, extent of coronary atherosclerosis, NYHA class, heart rate, risk factors and treatment.

Conclusion: Relative changes of central BP are independently related to the risk of CV complications in patients undergoing coronary revascularization. These results should be taken into account in the estimation of CV risk of such patients.

Influence of successful PCI of chronic total occlusion on some non-invasive indices

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Background: The influence of successful recanalization of chronic total occlusion (CTO) on long-term prognosis is disputable. Qualification for these procedures in some cases may be difficult and controversial. Heart rate variability (HRV), left ventricular (LV) parameters and exercise tolerance are important prognostic factors in patients with coronary artery disease.

Aim: To evaluate the effect of PCI in CTO on LV function, exercise tolerance and heart rate variability (HRV).

Material and methods: we included 59 consecutive patients (mean age 59.5±10.3) after successful PCI of CTO (>15 days). For every patient before PCI and after 6 months 24 hour ECG with HRV analysis, echocardiography and exercise treadmill test were performed.

Results: After 6 months we observed significant improvement of HRV and LV parameters, angina class, and trend to improvement in exercise capacity.

Table. Variables independently related to the end points (L. Bryniarski et al.)

Parameter	Baseline	p	After 6 months
LVEF [%]	48.2±10.1	<0.001	52.8±10.8
Wall motion score index (WMSI)	1.56±0.14	<0.01	1.4±0.16
Duration of exercise [s]	484±97	NS	543±102
Max. workload [MET]	8.6±2.4	NS	9.4±2.8
SDNN [ms]	78.6±20.3	<0.001	99.4±21.7
SDANN [ms]	63.4±19.5	<0.001	84.4±26.1
SDNNI [ms]	42.8±11.6	<0.05	53.0±14.6
rMSSD [ms]	21.5±8.5	<0.01	28.4±10.6
pNN50 [%]	4.3±2.0	<0.01	7.8±3.8
Angina class	2.3±.0.7	<0.001	0.61±0.5

Results: See table.

Conclusions: Successful recanalisation of CTO after 6 months' follow-up improves clinical status, LV function and HRV parameters.

A new score for significant renal atherosclerosis in patients with coronary or supraaortic artery atherosclerosis

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Background: Renal atherosclerosis is associated with increased cardiovascular mortality.

Aim: To determine the prevalence and predictors of renal artery stenosis (RAS) in patients with coronary artery disease (CAD) and supraaortic artery (SA) stenosis.

Methods: Renal angiography was performed in 1193 consecutive patients (807 males) referred for coronary or SA angiography. Group I included 296 (136 males, 60.1±9.5 years) patients with no significant (<50%) lesion in a coronary artery or SA; Group II – 706 (526 males, 62.2±9.7 years) with stenosis >50% within a single arterial territory (coronary or SA); Group III – 191 (145 males, 64.9±8.5 years) patients with stenosis >50% in both territories.

Results: RAS was found in 55 (18.6%) in Group I, 250 (35.4%) in Group II and 115 (60.2%) patients in Group III (p <0.001). The proportion of patients with RAS >50% in Group I, II and III was 3.3, 6.2 and 18.3% respectively (p <0.001). RAS prevalence increased with the number of stenosed coronary arteries (38.4% in 1-vessel, 42.1% in 2-vessel, 48.5% in 3-vessel CAD, p <0.001). Independent predictors of RAS >50% identified by logistic regression analysis were: SA stenosis (relative risk, RR=3.28, p <0.001), 2-3-vessel CAD (RR=2.04, p=0.002), creatinine level >1.07 mg/dl (RR=2.95, p <0.001), hypertension (RR=2.97, p=0.012) and body mass index <25 kg/m^2 (RR=1.42, p=0.169). A calculated score for RAS >50% prediction (based on the regression model) was reliable (coefficient of determination, R=0.978) and showed a sensitivity of 77.5% and a specificity of 63.9%.

Conclusion: RAS prevalence and severity increases with the number of arterial territories involved and CAD severity. The following independent predictors of RAS >50% were identified: SA involvement, 2-3-vessel CAD, serum creatinine level and hypertension.

Endovascular therapy of subclavian and innominate artery stenosis: long-term results and factors influencing outcome

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Background: Subclavian and/or innominate artery (SA/IA) angioplasty has become the treatment of choice in selected patients (pts).

Aim: To evaluate the efficacy of percutaneous angioplasty (PTA) on symptoms resolution and factors influencing long-term outcome.

Material and methods: 166 consecutive pts with recognized SA/IA stenosis >50% or occlusion on angiography were analyzed. Of those, 117 pts (67 males, mean age 60.6±8.5 years) were referred for SA/IA angioplasty, including 24 (20.5%) pts with posterior fossa ischaemia, 16 (13.6%) with upper limb claudication, 58 (49.6%) with claudication and ischaemia, 2 (1.7%) with symptomatic coronary--subclavian steal, 8 (6.8%) with bilateral SA/IA disease to enable blood pressure monitoring, and 8 asymptomatic pts with concomitant internal carotid artery occlusion. At least one coronary artery stenosis >50% was found in 53% of patients, PAOD in 50.4%, renal artery stenosis >50% in 8.5%, and concomitant internal/common carotid artery stenosis ≥70% in 35%.

Results: SA/IA PTAs were performed *via* the femoral approach, with a simultaneous radial approach in 11 (10.2%) pts. PTA was successful in 110 (94%) pts: 96/96 (100%) with SA/IA stenosis and 14/21 (66.7%) with occlusion. Mean stenosis grade in successful procedures was reduced from 76.4±16 to 12.3±10.9% (p <0.05). In 100 (91%) patients the lesion was stented; in 90 (81.8%) 1 stent and in 10 (9.1%) 2 stents were implanted. Balloon angioplasty alone was performed in 10 (9.1%) patients. Complete symptom resolution was seen in 91.8% of patients, whereas in 9 (8.2%) dizziness persisted (p <0.05). In 98 pts who completed at least 6-month follow-up (mean 32.9±19.6 months), 3 (3.1%) cardiovascular deaths occurred (2 cardiac and 1 due to cerebral haemorrhage). In 12 (12.2%) patients restenosis occurred, including 11 in-stent restenoses and in 1 after balloon angioplasty. In one patient, symptomatic atherosclerosis progression occurred proximally to the stented lesion. 12 patients with symptom recurrence underwent repeated PTA. Restenosis was noted in 10% of patients after one-stent implantation and in 33% of patients after 2-stent implantation to one SA/IA (p=0.023). Multiple regression analysis revealed that implantation of 2 stents (p=0.039), smaller stent diameter (p=0.01), higher difference in systolic blood pressure after PTA (p=0.008) and younger age (p=0.034) were independent predictors of restenosis.

Conclusion: Angioplasty is an effective method of treatment of SA/IA stenosis, leading to symptoms reversal in the majority of patients. Restenosis is more frequent in younger patients, and is related to the number of implanted stents, stent diameter and post-procedural systolic blood pressure difference between arms.

Left ventricular mass and diastolic function in patients undergoing renal artery stenting

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Background: Renal stenting (RS) is a widely used therapeutic method in patients with secondary hypertension due to renal artery stenosis (RAS); however, its impact on left ventricle (LV) mass and LV diastolic function is unknown.

Aim: To evaluate LV mass and diastolic function in patients undergoing RS.

Methods: We examined 34 patients (21 males; 61.7%) with a mean age of 62.4±9.3 (47-81) years, referred for RS. All patients were hypertensive with a mean number of 3.03±0.9 antihypertensive agents, 12% had a history of hypertension crisis, 38% of pulmonary flash oedema, 56% had renal function impairment. Prior to and 3 months after RS, echocardiography was performed in all patients in standard views with LV mass evaluation, LV mass index in women and men (LVMI), measurements of systolic and diastolic intraventricular septum diameter (IVSs and IVSd), and LV diastolic function: mitral flow velocity ratio (E/A), isovolumetric relaxation time (IVRT) and tissue Doppler imaging of the mitral annulus velocity (E'and A'). 24-hour blood pressure (BP) monitoring was performed in all patients before and 3 months after RS.

Results: RS was technically successful in all patients. Systolic and diastolic BP decrease was observed in 14 (41.2%) patients, no change in 14 (41.2%) and increase in 6 (17.6%). Restenosis was detected in 2 (5.9%) patients at 3-month F-U visit and treated with repeated angioplasty. LV mass before RS correlated significantly with 24-hour systolic BP load (p=0.096, r=0.290), and with E/A ratio (p=0.027, r=0.390). At 3-month F-U visit, a significant reduction in the mean LV mass from 191±43 to 174.5±43.2 g (p=0.005), in IVSd diameter from 12.6±2.2 to 11.5±2.2 mm (p=0.007), IVSs diameter from 18.1±2.5 to 16.2±3.0 mm (p <0.001) and in LVMI in men from 109.1±17.1 to 88.5±18.9 g/m^2 (p=0.017), but not in women (from 99.1±21.3 to 94.7±16.5 g/m^2 (p=0.423) were observed. Diastolic function remained similar before and after RS in relation to E/A ratio (1.05±0.36 vs. 1.08±0.55; p=0.740), E' velocity (5.57±1.4 vs. 5.67±1.4; p=0.71), and A' velocity (8.35±2.3 vs. 8.53±2.1; p=0.598). BP decrease following RS was seen more often in patients with higher initial IVSd diameter (13.6±2.6 vs. 11.9±1.4 mm, p=0.023) and greater diastolic function impairment (IVRT: 124.4±21.2 vs. 104.9±27.0; p=0.019; E/A ratio: 0.89±0.19 vs. 1.14±0.41; p=0.054).

Conclusions: Successful RS causes a significant reduction in LV mass, IVSs and IVSd in a short period of time. No improvement in diastolic function was seen at 3-month F-U. Better BP control was achieved in patients with higher initial IVSd diameter and diastolic dysfunction.

Predictors of cerebral reperfusion injury after carotid stenting: the role of transcranial colour-coded Doppler ultrasonography

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Background: Cerebral reperfusion injury (RI) is a rare but life-threatening complication following carotid endarterectomy and carotid stenting (CS).

Aim: To evaluate the possible role of transcranial colour-coded Doppler ultrasonography (TCCD) in RI prediction in patients undergoing CS for internal carotid artery stenosis (ICAS).

Material and methods: We included 111 (78 males) out of 124 patients, aged 63.6±8.3 (range: 44-82) years with a diagnostic TCCD referred for CS. The mean grade of ICAS subjected to CS was 85.9±9.1%. Contralateral ICA occlusion or near-occlusion (stenosis >90%) was noted in 26 (23.4%) patients, history of stroke/TIA in 72 (64.9%), myocardial infarction in 39 (35.1%). 97 (87.4%) patients were hypertensive, 77 (69.4%) were present or former smokers, 96 (86.5%) had hyperlipidaemia, 34 (30.6%) diabetes. TCCD was performed prior to and during 24 hours after CS with assessment of peak-systolic velocity (PSV) in ipsilateral to CS site – middle cerebral artery (iMCA), as well as contralateral middle cerebral artery (cMCA).

Results: CS was uncomplicated in 106 (95.5%) patients. In these patients CS resulted in significant iMCA PSV increase from 67.5±21 before to 102.1±27 cm/s after CS (p <0.001) as well as in cMCA from 84.9±31.6 to 100.7±29 cm/s (p <0.001). During CS, 2 (1.8%) ischaemic events (1 minor stroke, 1 TIA) occurred, which were related to iMCA PSV decrease after CS. RI occurred in 3 (2.7%) patients during 2-12 hours after CS. All patients with RI were hypertensive with a history of prior TIA or stroke, and they had a contralateral ICA occlusion. In patients with RI, significant PSV increase was noted bilaterally in the range 2.4-2.8-fold in iMCA and 2.5-7.4-fold in cMCA, as compared to values before CS (both p <0.001). The mean iMCA and cMCA PSV increase after CS was 2.66±0.19 and 4.16±2.77 in RI patients, as compared to 1.59±0.56 and 1.26±0.47 in patients who did not develop RI (p=0.001 and p <0.001, respectively). From 19 analysed clinical, angiographic and TCCD variables, the following independent RI risk factors were identified by multiple regression analysis: low initial PSV in iMCA (p=0.025) and cMCA (p=0.031), high cMCA PSV increase after CS (p <0.001), non-functional posterior communicating artery (p=0.037) and bilateral ICAS (p=0.052).

Conclusions: The independent RI risk factors are low initial PSV in MCA bilaterally, a high cMCA PSV increase after CS, lack of posterior communicating artery and contralateral ICA occlusion.

Polish-Italian-Hungarian RAndomized ThrombEctomy Trial (PIHRATE trial)

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Distal embolization during primary percutaneous coronary intervention (PPCI) in ST-segment elevation myocardial infarction (STEMI) may curtail microvascular reperfusion of the infarct region. Our international multi-centre randomized trial investigated whether a new way of PPCI based on simple percutaneous thrombus aspiration followed by direct stenting may reduce distal embolization in arteries with a large thrombus burden and improve microvascular reperfusion.

196 consecutive patients (pts) with STEMI <6 hours and TIMI grade flow 0 to 1 at the baseline angiography were randomized into easy-to-use aspiration thrombectomy (DIVER CE) followed by direct stenting (thrombectomy group) or standard balloon predilatation followed by stent implantation (control group). The study protocol has been registered on the ClinicalTrials.gov website (NCT00377650). The primary end point of the PIHRATE trial was ECG ST-segment elevation resolution (STR) after PPCI. Secondary end points included: angiographic myocardial blush grade (MBG), combination of STR >70% and MBG grade 3 (optimal myocardial reperfusion), TIMI flow, corrected TIMI frame count (cTFC), periprocedural angiographic complications, and in-hospital major adverse cardiac events (MACE).

Finally enrolment of 100 pts in the thrombectomy group and 96 pts in the control group at 10 PPCI centres in Poland, Italy and Hungary was completed in July 2007. Aspiration thrombectomy was successful in 91% of cases (passing lesion with thrombus reduction and restoring flow). Direct stenting was feasible in 75% of cases in the thrombectomy group versus 5.2% in the control group (p <0.0001). STR >70% immediately after PPCI occurred in 41% in the thrombectomy group and 26% in the control group (p <0.05). MBG grade 3 was found in 76 vs. 58% (p <0.05). Optimal myocardial reperfusion (STR >70% after PCI and MBG grade 3) after PPCI was more frequent in the thrombectomy group (35.1% vs. 11.8%, p <0.05). cTFC was significantly better for the thrombectomy group (27.8±15 vs. 33.4±19, p <0.05). Nitroprusside sodium or adenosine was less frequently used in the thrombectomy group (3 vs. 10%, p <0.05) due to the slow/no reflow phenomenon. MACE rates in hospital were 3.0% death, new MI 0% in group 1 vs. death 3.1%, new MI 1% in group 2 (NS).

In patients with STEMI with occluded infarct-related artery simple thrombectomy and direct stenting provides better myocardial reperfusion than standard balloon predilatation followed by stent implantation.

Virtual histology analysis of carotid plaque. Pilot findings from a systematic evaluation

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Background: Current criteria for mechanical stabilization of carotid plaque (carotid artery stenting, CAS) are based exclusively on the degree of stenosis and the presence/absence of neurological symptoms. However, 60-80% of severely disabling strokes occur in the absence of any prodromal symptoms, indicating that, for many patients, mechanical plaque stabilization may be offered already too late. As no current tools can identify which asymptomatic carotid plaque is going to become symptomatic, the number of asymptomatic subjects needed to be treated to prevent one stroke is very high.

Methods: An advanced radiofrequency analysis of intravascular ultrasound signals, virtual histology (VH), has been shown to identify four major histological components of the coronary plaque (fibrous – F, fibro-fatty – FF, necrotic core – NC, and dense calcium – DC). Recently, VH has been validated (against conventional histology) for carotid plaque assessment.

In 33 patients (age 51-82, mean 64±7 years, 21 men), we evaluated with VH 36 angiographically non-critical carotid plaques (19 were associated with a prior cerebral/retinal TIA/stroke ≤6 months – symptomatic, S, and 17 were asymptomatic, aS) that were considered for CAS. Thirty-one (86%) plaques were evaluated under neuroprotection (distal filter in 28 and internal carotid artery flow reversal or clamping in 3). There were no procedure-related complications. Thirty-two plaques (89%) were stented, whereas 4 (11%, large lumen/low plaque burden in all) were left for a tight follow-up.

Results: There was no significant difference in the angiographic stenosis severity between the S and aS plaques (52-84 vs. 49-88%, p=0.37). Plaque ulceration was significantly more prevalent in S (63.2 vs. 29%, p <0.05). In aS, minimal lumen area was significantly larger (7.1 mm^2 vs. 5.8 mm^2, p=0.02) and the plaque burden was significantly lower (76.8 vs. 84.9%, p=0.01). Peak DC was similar in both groups (S vs. aS): 3.3% (0.6-7.2) vs. 4.4% (0.3–18.2). However, peak FF and peak NC tended to be higher in S: 17.7% (4.3–81.7) vs. 15.1% (7.6–32.1) and 10.2% (1.5–29.3) vs. 6.8% (2.0–17.3), but the difference did not reach statistical significance. NC in direct contact with the vessel lumen (indicating a fibrous cap <150 μm) was found more frequently in S (89.5 vs. 52.9%, p=0.01). Macroscopic evidence of embolic plaque debris captured by the neuroprotection device was in 57.9% in S and 35.3% in aS (p=0.07).

Conclusions: Carotid plaque evaluation with IVUS-VH is safe. Plaque ulceration and the thin fibrous cap were significantly more prevalent in the symptomatic carotid plaques. Further work needs to be directed towards identifying those asymptomatic carotid plaques that are liable to rupture and symptomatic embolization.

Comparison of primary balloon angioplasty with bailout stenting strategy to primary coronary stenting strategy for the treatment of patients with ST-segment elevation myocardial infarction (STEMI)

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Background: In recent years significant progress has been made in invasive treatment of patients with acute myocardial infarction (AMI). Primary coronary stenting is currently a routine strategy which replaced primary balloon angioplasty with bailout stenting preferred in the past. Studies comparing these two strategies of stenting in AMI are scarce.

Aim: To compare the immediate and long-term outcomes after primary stent placement strategy versus primary angioplasty with bailout stenting strategy in patients with AMI.

Methods: We used data from a single-centre registry of consecutive patients with STEMI admitted between January 1998 and October 2003. In our centre in years 1998-2000 stenting was used only after failed or non-optimal balloon angioplasty. Starting in year 2001 we used routine stenting. We compare these two terms with application of two patterns of stenting. Patients with cardiogenic shock on admission were excluded.

Results: Out of 1992 hospitalized patients with STEMI, 1778 were treated with immediate coronary angioplasty. After exclusion of patients with cardiogenic shock the final group comprised 1602 patients. Among them, 479 were treated with primary balloon angioplasty with bailout stenting (in years 1998-2000) and 1123 with primary stenting (years 2001-2003). Patients in the balloon angioplasty group were younger, had shorter time from the onset of symptoms to hospital arrival and more frequently underwent rescue coronary intervention after failed thrombolysis. The

in-hospital mortality (2.9% in bailout stenting vs. 2.4% in primary stenting, p=NS) and long-term (24 months) mortality (9.8% in bailout stenting vs. 10.06% in primary stenting, p=NS) were similar in both groups.

Conclusions: The introduction of routine stenting in daily practice for treatment of patients with AMI did not reduce mortality.

Superoxide production in human aortic abdominal aneurysms: sources and relationship to aneurysm diameter

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Increased superoxide (O_2^-) production by vascular cells may play important roles in the pathogenesis of aortic abdominal aneurysms (AAA). However, mechanisms regulating oxidative stress in AAA are unclear. We investigated sources of O_2^- in human AAA, potential role of protein kinase C (PKC) in regulating O_2^- production and the relationship between superoxide production and aneurysm diameter.

Malonylodialdehyde (MDA) level was measured as a marker of oxidative stress from 16 patients with AAA and 16 without AAA. Superoxide production was measured in AAA segments of from 40 patients undergoing AAA repair, using lucigenin enhanced chemiluminescence (5 μM), and visualized by confocal microscopy (dihydroethidium fluorescence). Aneurysm diameter was determined in situ during the surgery.

MDA was higher in patient with AAA (4,87 μM vs. 3,02 μM; p<0.02); Basal superoxide production (O_2^-) was observed in all AAA segments (23.2±1.9 RLU/s/mg) and was significantly higher than in non-AAA segments (vs. 12,9 RLU/s/mg; p <0.001). Increased O_2^- production correlated with aneurysm diameter (R=0.425; p=0.038). O_2^- production was suppressed by preincubation with superoxide scavenger Tiron or the superoxide dismutase (PEG-SOD; 450 U/ml). production was significantly inhibited by iNOS – 1400W (100 μM) to 18% (4,2±2,4 RLU/s/mg). O_2^- production was also significantly inhibited NAD(P)H oxidase inhibitors: diphenyliodonium (DPI; 10 μM) to 16% of control levels or by apocynin (500uM) to 51% of control levels (11.8±1.0 RLU/s/mg). Modest inhibition (to 60% of control levels) was also observed in response to the cyclooxygenase inhibitor indomethacin (10 μM). Inhibitors of other oxidase systems (xanthine oxidase, mitochondrial) did not show significant effects. SOD inhibitable superoxide production in AAA was localised mainly in media and adventitia, as shown by dihydroethidium staining. These data indicate that vascular NAD(P)H oxidase is the predominant source of O_2^- in AAAs. Addition of NADPH (100 μM) to intact AAA segments increased of O_2^- production in AAA 19-fold (to 454±76 RLU/s/mg).

iNOS and vascular NAD(P)H oxidase(s) are the predominant source of superoxide production in AAA. Vascular O_2^- production is correlated with aneurysm diameter, as a measure of disease progression. Antioxidant therapy may be a useful option in AAA.