Is angiographic perfusion score assessed in patients with acute myocardial infarction correlated with cardiac magnetic resonance infarct size and N-terminal pro-brain natriuretic peptide in 6-month follow-up

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Purpose

• The aim of this study was to analyze the correlation between Cardio MR infarct size and left ventricular function parameters in long-term follow-up and Angiographic Perfusion Score (APS)

Methods and Materials

• Angiographic Perfusion Score (APS) proposed as a simple, angiographic score linking epicardial and myocardial perfusion parameters before and after percutaneous coronary intervention (PCI) is a predictor of shortterm outcome in patients with ST-segment elevation myocardial infarction (STEMI) treated with PCI.

• Primary percutaneus coronary intervention (PCI) is a preferred method of reperfusion for ST-segment Elevation Myocardial Infarction (STEMI). Assessment of reperfusion plays an important role in the treatment strategy planning and it is a well known predictor of patient outcome;

• We analysed a cohort of 68 patients with STEMI treated with PCI APS. The inclusion criteria were age > 18 years and acute STEMI (chest pain > 30 min, ST segment elevation > 0.2 mV in at least two contiguous leads), presenting within 6 h from chest pain onset;

• The exclusion criteria were: previous myocardial infarction, contraindications to lytics or abciximab, contraindications to PCI, previous PCI or CABG, cardiogenic shock, left bundle branch block or pacemaker rhythm in the ECG,

participation in another clinical study, neoplastic diseases, pregnancy, low-molecular weight heparin usage during previous 24 h.

• All patients received aspirin (300-500 mg), loading dose of clopidogrel (#300 mg), and a bolus of unfractionated heparin (60-100 U/kg).

• Tenecteplase (TNK) was given in a weight adjusted standard dose in patients with long anticipated delay to PCI. • Abciximab was given in standard dose as intravenous bolus (0.25 mg/kg) and infusion (0.125 lg/kg/min). Before PCI activated clotting time was monitored in all patients and heparin was added if necessary to maintain optimal anticoagulation. • Bare metal stents were used during primary PCI.

In patients with multivessel disease PCI was performed only in the infarctrelated artery

• Angiographic parameters were analyzed using the NewQuant32 software (Sanders Data Systems, Palo Alto, CA, USA) by analysts blinded to clinical and treatment data. • Patency of the infarct-related artery was determined by TIMI classification (TIMI flow grade-TFG).
• Myocardial perfusion was expressed by the TIMI myocardial perfusion grade (TMPG).

• All measurements were performed in a standard fashion.

• APS was calculated for infarct-related artery based on angiographic parameters and was defined as the sum of the Thrombolysis in Myocardial Infarction (TIMI) flow grade (0-3 points) and the TIMI myocardial perfusion grade (0-3 points) before and after PCI (range of points from 0 to 12).

• Sum of the TFG (0-3 points) and the TMPG (0-3 points) before and TFG, TMPG after PCI in infarct-related artery area was calculated (total range of points from 0 to 12). Full perfusion was defined as an APS # 10.

• Cardiac magnetic resonance (CMR) study was performed on 1.5T scanner (GE Signa EXCITE) with TORSOPA coil. Dedicated software was used for post-processing (MASS, Medis).

• Left ventricle volumes, ejection fraction and infarct size in one study per patient, minimum 6 months after index myocardial infarction were analyzed.

• The end-diastolic and end-systolic volume indices were obtained after dividing volume by body surface area according to the DuBois formula.

• Left ventricular volumes and ejection fraction were assessed with cine-CMR using a steady-state free-precession technique (FIESTA) with the following imaging parameters:

  • 20 phases per slice location, FOV 32 9 32 cm; TR 1.6 ms; TE 2.8 ms; FA 20-30; matrix 256 9 160; NEX 1.

  • 10-14 consecutive slices of 8 mm were planned in short axis view.

  • Also one horizontal long axis view (fourchamber) was obtained.

• Delayed enhancement images were acquired 15-20 min after a double bolus of gadolinium (0.2 mmol/kg) using inversion recovery gradientecho sequence with the following imaging parameters:

  • FOV 42 9 42 cm; TR 8 ms; TE 3.8 ms; FA 40-50, NEX 2; slice thickness 8 mm.

  • The inversion time was adjusted individually to null normal myocardium.

• Slice locations of the delayed enhancement images were copied from the cine images to ensure registration between cine-CMR and infarct measurements. The volume of delayed enhancement was quantified manually from consecutive short axis slices and was multiplied by 1.05 g/ml to obtain myocardial infarct mass (1 ml = 1.05 g).

• Papillary muscles were not included into the delineations of hyperenhanced area.
• Infarct size was expressed as percentage of total left ventricular mass.

• Blood samples were collected from patients at 6-month follow-up visit.

• NT pro-BNP concentrations were measured using automated electrochemoluminescent method (ECLIA) on a Modular Analytics E170;

• Results were expressed as medians with interquartile range (IQR) or percentages of patients.

• Correlations were calculated using Spearman method.

Differences between continuous variables were assessed by the Mann-Whitney U-test

• Receiver-operating characteristic (ROC) curve analysis was performed to calculate sensitivity and specificity of APS scale in predicting CMR infarct size and NT pro-BNP after 6 months.

• A P value of <0.05 was considered statistically significant.

Results

• A total of 68 patients with STEMI treated with PCI entered the study.

• Baseline characteristics and angiographic characteristics are shown in Table 1.

• In 26 patients (38.2%) lytic therapy was administered before transfer to cathlab due to long anticipated delay to PCI.

• The median of APS was 7.5 [6-11] points and full perfusion (APS # 10) was present in 42% of patients.

• The CMR study showed infarct size of 8.5 (4-16.7)%, left ventricular ejection fraction of 42.4 (38-50)%, left ventricular end-diastolic volume index of 80.6 (64.7-97.6) ml/m² and left ventricular end-systolic volume index of 43.3 (31.2-57) ml/m² (all medians with IQR).

RESULTS Tab. 1 - 1
Characteristics of the study population. Angiography and PCI characteristics (n = 68):

• Age (years, median IQR) - 58 (54-67)

• Male (%) - 79.4
• Diabetes (%) - 6
• Hypertension (%) - 50
• Dyslipidemia (%) - 36.8
• History of smoking (%) - 58.8
• Killip Class>1 (%) - 13.2
• Time from chest pain onset to PCI (minutes, median IQR) - 234 (184-300)
• Infarct related artery (%):
  • LAD - 54.4
  • Cx - 5.9
  • RCA - 39.7

• TIMI before PCI:
  • 0 + 1 flow grade (%) - 42.6
  • 2 flow grade (%) - 16.2
  • 3 flow grade (%) - 41.2

• TIMI after PCI:
  • 0 + 1 flow grade (%) - 0
  • 2 flow grade (%) - 8.8
  • 3 flow grade (%) - 91.2

• TMPG before PCI:
  • 0 + 1 grade (%) - 50
  • 2 grade (%) - 19.1
  • 3 grade (%) - 30.9

• TMPG after PCI:
•0 + 1 grade (%) - 19.1
•2 grade (%) - 16.2
•3 grade (%) - 64.7

•Multivessel disease (%) - 35.3
•Lytics (%) - 38.2
•Abciximab (%) - 55.9
•Stent implantation (%) - 94.1

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•Cx circumflex artery, IRA infarct related artery, LAD left anterior descending artery,
PCI percutaneous coronary intervention, RCA right coronary artery, TIMI thrombolysis
in myocardial infarction

•The median of NT pro-BNP after 6 months was 242 (111-355) pg/ml.

•APS was analyzed based on previously described criteria of full perfusion (APS # 10)
and was a good predictor of CMR results and NT pro-BNP after 6 months (Table 2).

•Table 2.: CMR left ventricular function and NT pro-BNP at 6-month according to APS
value. Full perfusion defined as APS C 10 points (median, IQR)

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•CMR infarct size (%) 13.3 (7.6-22.6); 5.5 (3.5-10.9); 0.001
•CMR EF (%) 40.9 (33.5-46.5); 47.9 (41.6-55.9); 0.001
•CMR EDVI (ml/m2): 83.6 (76.8-102.1); 70.5 (61.6-92.6); 0.005

•CMR ESVI (ml/m2): 50.9 (36.9-63.4); 37.9 (29.4-43.2); 0.004

•NT pro-BNP (pg/ml): 354.1(202.4-565.8); 133.8 (96.6-265.5); 0.002

•There was a significant correlation of

•APS and CMR parameters and NT pro-BNP after 6 months (Table 3).

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•Table 3. Spearman correlation between APS and 6-month CMR results and NT pro-BNP.

•APS angiographic perfusion score, CMR cardiac magnetic resonance, NT pro-BNP N-terminal pro-brain natriuretic peptide;

•Parameter r P

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•APS and NT pro-BNP -0.5; 0.02

•APS and CMR infarct size -0.48; 0.0001

•APS and CMR ejection fraction 0.5; 0.002

•APS and end-diastolic volume index -0.37; 0.004

•APS and end-systolic volume index -0.41; 0.001

•In receiver-operating characteristic (ROC) curve analysis, the optimal APS cut-off point was>7.5 with 69% sensitivity and 68.8% specificity (AUC = 0.73) for predicting CMR infarct size <8.5% at 6-month and >9.5 points, with 75% sensitivity and 66.7% specificity (AUC = 0.72) for predicting NT pro-BNP <242 pg/ml after 6 months (Fig. 1 i 2).

RESULTS - Figur 1 i 2:

•Angiographic Perfusion Score (APS). Receiver-operating characteristic (ROC) curve analysis for predicting CMR infarct size<8.5% at 6-month (Fig.1) and for predicting NTpro-BNP<242 pg/ml after 6 months (Fig. 2);
When analyzing final TIMI flow grade and final TMPG as independent parameters we did not find significant correlation with CMR infarct size and NT pro-BNP.

**Images for this section:**

**Fig. 1:** Angiographic Perfusion Score (APS). Receiver-operating characteristic (ROC) curve analysis for predicting CMR infarct size.
Fig. 2: ROC curve analysis for predicting CMR infarct size
Fig. 3: DE - 4CH view - scar formation after 6 months from MI
Conclusion

• APS assessed in patients with STEMI treated with PCI is a good predictor of infarct size and left ventricular function in 6-month follow-up.

• There was a significant correlation of APS and CMR parameters and NT pro-BNP after 6 months.

References


Personal Information