



Impact of cardiac hybrid imaging-guided patient management on clinical long-term outcome



Dominik C. Benz^{1,2}, Lara Gaemperli^{1,2}, Christoph Gräni², Elia von Felten², Andreas A. Giannopoulos², Michael Messerli², Ronny R. Buechel², Oliver Gaemperli², Aju P. Pazhenkottil^{*,2,3}, Philipp A. Kaufmann^{2,3}

Department of Nuclear Medicine, Cardiac Imaging, University Hospital Zurich, Ramistrasse 100, 8091 Zurich, Switzerland

ARTICLE INFO

Article history:

Received 9 August 2017

Received in revised form 22 December 2017

Accepted 26 January 2018

Keywords:

CCTA
SPECT MPI
Cardiac hybrid imaging
Outcome

ABSTRACT

Background: Although randomized trials have provided evidence for invasive fractional flow reserve to guide revascularization, evidence for non-invasive imaging is less well established. The present study investigated whether hybrid coronary computed tomography (CCTA)/single photon emission computed tomography (SPECT) myocardial perfusion imaging (MPI) can identify patients who benefit from early revascularization compared to medical therapy.

Methods: This retrospective study consists of 414 patients referred for evaluation of known or suspected coronary artery disease (CAD) with CCTA/SPECT hybrid imaging. CCTA categorized patients into no CAD, non-high-risk CAD and high-risk CAD. In patients with CAD ($n = 329$), a matched finding ($n = 75$) was defined as a reversible perfusion defect in a territory subtended by a coronary artery with CAD. All other combinations of pathologic findings were classified as unmatched ($n = 254$). Death, myocardial infarction, unstable angina requiring hospitalization, and late coronary revascularization were defined as major adverse cardiac events (MACE). Cox hazards models included covariates age, male gender, more than two risk factors, previous CABG, high-risk CAD and early revascularization.

Results: During median follow-up of 6.0 years, 112 patients experienced a MACE (27%). Early revascularization ($n = 50$) was independently associated with improved outcome among patients with a matched finding ($p < 0.001$). There was no benefit among patients with an unmatched finding ($p = 0.787$), irrespective of presence ($p = 0.505$) or absence of high-risk CAD ($p = 0.631$).

Conclusions: Early revascularization is associated with an outcome benefit in CAD patients with a matched finding documented by cardiac hybrid imaging while no benefit of revascularization was observed in patients with an unmatched finding.

© 2018 Elsevier B.V. All rights reserved.

1. Introduction

Coronary computed tomography angiography (CCTA) is a non-invasive tool to accurately detect coronary artery disease (CAD) [1,2] and to effectively improve risk-stratification of symptomatic patients [3]. Similarly, reliable diagnostic and prognostic value has been shown for single photon emission computed tomography (SPECT) myocardial perfusion imaging (MPI) in the work-up of patients with suspected or known coronary artery disease [4]. The implementation of cardiac hybrid imaging integrating morphology obtained from CCTA with the functional information from SPECT MPI allowed a comprehensive

non-invasive assessment of CAD [5,6]. Previous studies have demonstrated the added clinical and prognostic value of hybrid imaging [7–9]. Concerns with regard to the relatively high cumulative radiation burden have prevented the widespread use of this promising technique for a long time. Thanks to impressive technological refinements [10,11] and implementation of iterative reconstruction algorithms [12,13] the radiation and contrast agent exposure could be steadily decreased, and cardiac hybrid imaging can now be performed at acceptably low radiation exposure [14].

Since both, revascularization of non-relevant lesions [15] as well as deferring revascularization of hemodynamically relevant lesions, may lead to a less favorable outcome [16,17], physiological assessment of a stenosis has been implemented into guidelines for appropriate clinical decision-making [18]. While large randomized trials have provided a solid body of evidence for the role of invasive fractional flow reserve to guide revascularization, evidence for non-invasive imaging is less well established [19,20]. Nevertheless, observational data from large registries suggest a benefit of revascularization in patients with

* Corresponding author at: Department of Cardiology and Department of Nuclear Medicine, University Hospital Zürich, Ramistrasse 100, CH-8091 Zurich, Switzerland.

E-mail address: aju.pazhenkottil@usz.ch (A.P. Pazhenkottil).

¹ Dominik C. Benz and Lara Gaemperli share first authorship.

² These authors take responsibility for all aspects of the reliability and freedom from bias of the data presented and their discussed interpretation.

³ Aju P. Pazhenkottil and Philipp A. Kaufmann share last authorship.

moderate to large ischemia in SPECT MPI [21] or in patients with high-risk CAD in CCTA [22]. Whether a combination of the two modalities into cardiac hybrid imaging predicts an outcome benefit of early revascularization has not yet been investigated. The aim of the present study was to test the hypothesis that cardiac hybrid imaging can identify patients who benefit from an early revascularization.

2. Methods

2.1. Study population

The present study population consisted of 414 patients who were referred for the evaluation of known or suspected stable CAD by SPECT MPI and CCTA between May 2005 and December 2008 and were entered into the Zurich hybrid cardiac imaging clinical outcome database [8,9]. The study protocol conforms to the ethical guidelines of the 1975 Declaration of Helsinki, was approved by the institutional review board (local ethics committee, KEK-ZH-Nr. 2014-0153) and written informed consent was obtained from each patient.

2.2. CCTA acquisition and interpretation

On a stand-alone 64-slice CT scanner (LightSpeed VCT, GE Healthcare), patients underwent contrast-enhanced CCTA with helical scanning (until 2007; $n = 221$) or prospective ECG-triggering (from 2007; $n = 193$) as previously described in detail [7,8,23,24].

Luminal diameter stenosis severity was scored as 0%, 1–49%, 50–69% and $\geq 70\%$. CAD was defined as any luminal diameter narrowing. For the assessment of the severity of CAD, a modified Duke Index integrating the location and degree of a stenosis was used as previously reported [22]. Accordingly, patients were categorized into no CAD, non-high-risk CAD and high-risk CAD.

2.3. SPECT MPI acquisition and interpretation

All patients underwent a 1-day electrocardiography (ECG)-gated adenosine stress/rest protocol on a dual-head camera (Millenium VG and Hawkeye or Ventri, both GE Healthcare, Milwaukee, WI, USA) as previously reported [9]. Images were attenuation-corrected by unenhanced CT [25] and perfusion defects and reversibility were analyzed visually using a commercially available software package (Cedars QGS/QPS; Cedars-Sinai Medical Center, Los Angeles, CA, USA).

2.4. Hybrid imaging

In order to obtain cardiac hybrid images CCTA and SPECT images were fused on a dedicated workstation (Advantage Workstation 4.3, GE Healthcare) using the CardIQ Fusion software package (GE Healthcare) as previously described in detail [5–9,14]. A matched hybrid imaging finding was defined as a reversible perfusion defect in SPECT MPI subtended by a coronary artery with CAD in CCTA. All other combinations of pathologic findings were classified as unmatched. If no CAD and no perfusion abnormality were present, the finding was classified as normal.

2.5. Outcome data

Follow-up was obtained from standardized telephone interview or from clinical hospital records. All-cause death, non-fatal myocardial infarction (MI) [27], unstable angina requiring hospitalization, and late coronary revascularization (after 90 days) were defined as major adverse cardiac events (MACE). An early revascularization was defined as any coronary revascularization within 90 days after imaging.

The hybrid imaging findings were reported to the referring physician who made a decision towards invasive or conservative patient management based on clinical history, symptoms and hybrid imaging findings.

2.6. Statistical analysis

SPSS 20.0 (IBM Corporation, Armonk, NY) was used for analysis. Quantitative variables were expressed as mean \pm standard deviation (SD) or as median with interquartile range (IQR) if not normally distributed. Categorical variables were expressed as frequencies or percentages. The data were tested for normal distribution using the Kolmogorov-Smirnov test. *P*-values for categorical variables were calculated by the Chi-square test and for continuous variables by *t*-test. Differences in event-free survival over time were analyzed by the Kaplan-Meier method. The survival curves were compared by log-rank test. Univariate and multivariate Cox's proportional hazard regression models were applied to identify independent predictors of cardiac events. Variables were chosen in a stepwise forward selection manner; entry and retention sets with $p < 0.05$ were considered to indicate a significant difference. Variables included in the models were age, male gender, more than two risk factors (i.e. hypertension, dyslipidemia, smoking, diabetes, positive family history for CAD), previous CABG, high-risk CAD and early revascularization. A variable's risk was expressed as hazard ratio with corresponding 95% confidence interval. A *p*-value < 0.05 was considered statistically significant.

3. Results

3.1. Study population

The baseline characteristics of the study population were summarized in Table 1.

Patients with and without early revascularization did not differ in their baseline characteristics, except among patients with a matched finding those with an early revascularization were significantly younger ($t(73) = 2.681$, $p = 0.009$) and had significantly less previous CABG than those without an early revascularization ($\chi^2(1) = 6.350$, $p = 0.012$).

3.2. Imaging findings

CAD was observed in 329 of 414 patients (79%). Among patients with CAD, 75 patients had a matched finding and 254 patients had an unmatched finding. An early revascularization occurred in 37 patients with a matched finding (49%) and in 13 patients with an unmatched

Table 1
Baseline characteristics by findings of hybrid imaging.

	Matched finding			Unmatched finding			No CAD
	Without ER ($n = 38$)	With ER ($n = 37$)	<i>P</i> -value	Without ER ($n = 241$)	With ER ($n = 13$)	<i>P</i> -value	Without ER ($n = 85$)
Male gender, n (%)	30 (79)	28 (76)	0.735	173 (72)	11 (85)	0.313	33 (39)
Age (years)	66 \pm 8	60 \pm 12	0.009	64 \pm 10	63 \pm 7	0.776	55 \pm 11
Body mass index (kg/m ²)	28 \pm 5	28 \pm 5	0.927	27 \pm 4	27 \pm 4	0.884	27 \pm 5
Cardiovascular risk factors, n (%)							
Smoking	14 (37)	18 (49)	0.301	73 (30)	5 (39)	0.534	19 (22)
Diabetes	9 (24)	5 (14)	0.258	37 (15)	1 (8)	0.451	7 (8)
Hypertension	22 (58)	22 (60)	0.891	145 (60)	5 (39)	0.121	48 (57)
Dyslipidaemia	24 (63)	23 (62)	0.929	118 (49)	6 (46)	0.844	30 (35)
Family history of CAD	14 (37)	13 (35)	0.878	79 (33)	6 (46)	0.320	26 (31)
Reason referral, n (%)			0.132			0.585	
Pre-operative evaluation, equivocal/abnormal stress test	16 (42)	8 (22)		115 (48)	4 (31)		18 (21)
Atypical chest pain	9 (24)	16 (43)		69 (29)	6 (46)		29 (34)
Typical angina pectoris	10 (26)	12 (32)		34 (14)	1 (8)		25 (29)
Dyspnea	3 (8)	1 (3)		23 (10)	2 (15)		13 (15)
Cardiac history, n (%)							
Previous myocardial infarction	4 (11)	3 (8)	0.719	14 (6)	1 (8)	0.779	0 (0)
Previous PCI	11 (29)	7 (19)	0.309	29 (12)	2 (15)	0.719	0 (0)
Previous CABG	6 (16)	0 (0)	0.012	12 (5)	0 (0)	0.410	0 (0)

CAD, coronary artery disease. ER, early revascularization. PCI, percutaneous coronary intervention. CABG, coronary artery bypass graft. Mean \pm standard deviation.

Download English Version:

<https://daneshyari.com/en/article/8662085>

Download Persian Version:

<https://daneshyari.com/article/8662085>

[Daneshyari.com](https://daneshyari.com)