Role of Gated SPECT MPI in Follow-up of Patients after Coronary Revascularization

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ABSTRACT

Objective: **Gated SPECT myocardial perfusion imaging (GSMPI) is a preferred modality for non invasive assessment following coronary revascularization (CR) of both symptomatic and asymptomatic patients. This study was conducted to observe the impact of GSMPI results on further management of patients who after CR had underwent GSMPI at National Institute of Nuclear Medicine and Allied Sciences (NINMAS).**

Patients and methods: **Record files of GSMPI of all patients who underwent GSMPI over a period of 31 months from June 2011 to December 2013 at NINMAS for assessment of perfusion after CR were selected from the Nuclear Cardiology Divisional archive of patient studies in order to retrieve their clinical and demographic data including the contact numbers. The results of GSMPI scan were categorized as normal scan (NS) and perfusion defect (PD) which included reversible and/or fixed PD. All the contact numbers were called up by a nuclear medicine physician who conducted a semi-structured telephonic interview either with the patients or with a concerned family member. Management strategies adopted after GSMPI were categorized as conservative (CM) and interventional (IM).Cramer's V (φc) test were done to find strength of relation among patients' symptoms, scan findings and management strategies.**

Results: **Follow up data of 55 patients (54M, 1F) among 68 (66M, 2F) were available who underwent MPI for the purpose of post CR assessment. MPI was performed in between six months to 13 years after CR (mean 43.8 ± 48.2 months). Categorically 33 patients had percutaneous transluminal coronary angioplasty (PTCA) with stent, 16 patients had coronary artery by-pass grafting (CABG) and 6 patients had both CABG & PTCA. There were 38 PD (27symptomatic) and 17 NS (12 symptomatic). Since all patients (n=12) who had fixed PD were symptomatic, a strong relation was found between being symptomatic and fixed perfusion defect (φc> 0.3). Symptoms were found to be weakly related with reversible PD i.e. ischemia (φc< 0.2). Management strategies were conservative in 44 (30 symptomatic and 28 PD) and interventional in 11 (nine symptomatic and 10 PD). Management strategies were found to be weakly related with symptoms (φc< 0.2) but moderately related with perfusion status (φc = 0.24).**

Conclusions: **While symptoms were observed to be poorly related with perfusion status following CR, GSMPI guided to choose further interventional management strategies with rationality in lower proportion of patients.**

Key Words: **Gated SPECT, Myocardial Perfusion Imaging (MPI), Coronary revascularization.**

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INTRODUCTION

While the sentinel role of gated SPECT myocardial perfusion imaging (GSMPI) to guide coronary revascularization (CR) is established during past 40 years (1), restenosis has remained the Achilles hill of CR. Restenosis can be asymptomatic posing athreat to timely interventionor can be symptomatic with a long list of non-cardiac etiology to exclude (2-4). In both the cases GSMPI is recommended as a tool for detection (5, 6) by virtue of its higher accuracy in comparison to exercise electrocardiogram (7, 8). GSMPI has been an associate to management of ischemic heart disease (IHD) in Bangladesh for past 20 years (9). It has been a general observation that the proportion of post CR patient referred for GSMPI has been progressively increasing at National Institute of Nuclear Medicine and Allied Sciences (NINMAS).This study was therefore conducted to observe the impact of GSMPI results on further management of patients who after CR had underwent GSMPI.

PATIENTS AND METHODS

Subjects

This is a cross sectional retrospective study conducted in August, 2016 on a group of patients who had underwent CR previously and then were referred to Nuclear Cardiology Division of NINMAS for assessment of post CR myocardial perfusion status from June of 2011 to December of 2013. Of the total number of selected patients fulfilling above criteria, the proportion whose responses were available during follow-up were included in the final analysis.

Procedure of follow-up

Patient data was obtained from the Nuclear Cardiology Divisional archive of patient studies. Status of

revascularization was noted for each patient. The image and clinical record files of all patients who underwent GSMPI for post CR assessment within the defined study period were then selected and their contact information was retrieved. The contact numbers of patients were called up by a nuclear medicine physician in order to conduct a semi structured interview over telephone with either directly with the patients or with a concerned family member. Information regarding patient's health status as well as further management strategies adopted or advised by the cardiologist or cardiac surgeon within this duration was enquired.

Categorization of variables and response

The results of GSMPI scan retrieved from image archive were categorized as normal scan (NS) and perfusion defect (PD) which included reversible and/or fixed PD. Management strategies after GSMPI were categorized as conservative and interventional.

Descriptions of variables and analytic method

Continuous data were presented as means and standard deviations (SD) and value ranges. Categorical data were presented as frequencies and percentages. For test of association between patients' symptoms with scan findings and management strategies Chi-square test could not be adopted because there was no asymptomatic patient with fixed perfusion defect leaving count zero in a two by two table. This is why, Cramér's V (φ_c) test was done to find strength of relation among patients' symptoms with scan findings and management strategies, where a φ_c values of ≤ 0.2, > 0.2 to 0.3 and > 0.3 were considered as weak, moderately strong and strong relation among the variables.

SPSS software version 20 (SPSS Inc., Chicago, IL, USA) was used for the statistical analyses. Two-sided p values <0.05 were considered statistically significant.

RESULTS

Demographic and background clinical characteristics

Sixty eight patients (two female) with mean age of 56.9 ± 8.1 (38 to 77) years underwent MPI for the purpose of post CR assessment. Follow up data of 55 patients (one female) with mean age of 59.6 ± 8.6 (38 to 77) were available. MPI was performed in between six months to 13 years after CR (mean 43.8 ± 48.2 months). Categorically 33 patients had PTCA with stent, 16 patients had coronary artery bypass grafting (CABG) and six patients had both CABG & PTCA. Among the patients, 39 gave history of cardiac symptoms in their post CR period while 16 were asymptomatic.

All patients underwent one day stress-rest MPI; treadmill exercise stress was done in 19 patients, pharmacological stress with dobutamine infusion was done in 32 patients and adenosine stress was done in four patients.

Perfusion status and association with symptoms

MPI results revealed 38 PD and 17 NS. Figure 1 shows representative GSMPI images of each category of perfusion. As shown in Figure 2, among the patients having PD, 19 had reversible defects in revascularized

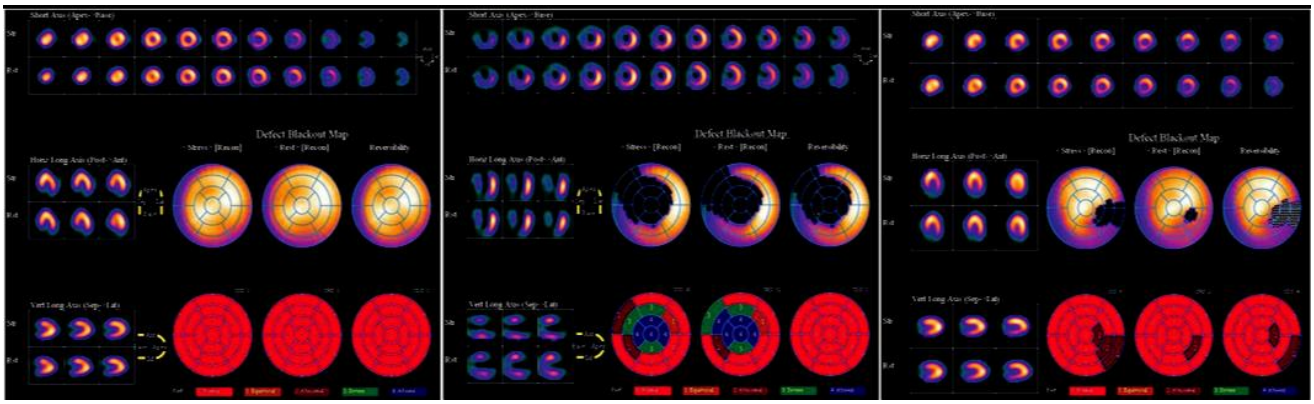

Figure 1: Representative post-stress and rest GS MPI images in post CR patients. There is (a) normal myocardial perfusion in a 67 years old male; (b) extensive fixed perfusion defect in LAD territory in a 50 years old male and (c) reversible perfusion defect in LCX territory in a 68 years old male. LV slices are displayed in three standard axes; perfusion map in 17 LV segments with perfusion scores displayed using 4DMSPECT

territories, 10 had fixed defects in revascularized territories, seven had ischemia in previously non revascularized territories and two patients had fixed defect in previously non revascularized territory. Thus, as showed in Table 1, among the 38 patients with PD, the proportion of symptomatic versus asymptomatic was 27/11. Similarly among the 17 patients with NS the proportion of symptomatic versus asymptomatic was 12/5. Since all patients (n=12) who had fixed PD were symptomatic, as showed in Table 2, being symptomatic was rather strongly related with finding of fixed PD (φ_c> 0.3) than NS or reversible PD. Conversely, being symptomatic was rather weakly related with finding of reversible PD i.e. ischemia (φ_c< 0.2) than NS.

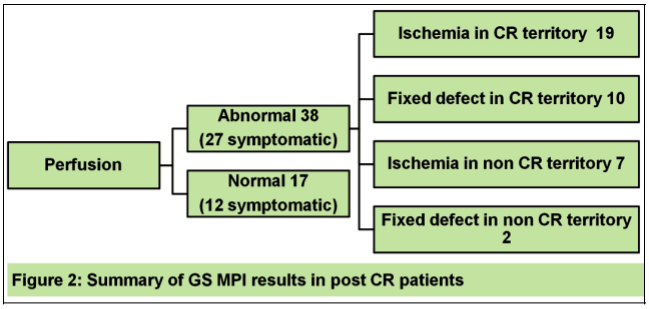

Figure 2: Summary of GS MPI results in post CR patients

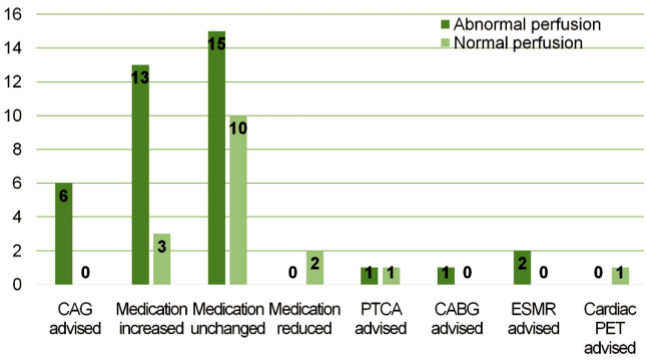

Figure 3: Follow up status of post CR patients after GS MPI

Management strategies and association with symptoms or perfusion status

Among the strategies undertaken by the clinicians (Figure 3) those categorized as conservative (n=44) in this study were, regimen was kept unchanged in 25 (PD/NS= 15/10), extension or maximization of medication regimen was done in 16 (PD/NS= 13/3), reduction of medication regimen in two, both having NS (Table 3) and further work up advised with cardiac PET in one (NS). Management strategies, categorized as interventional (n=11)were advise for coronary angiogram (CAG) to six (all PD), advise for extracorporeal shock wave myocardial revascularization (ESMR) to two (both PD), advise for further PTCA to two (PD/NS= 1/1) and advise for CABG to one (PD) Thus among the 44 patients whose management strategies were conservative, the proportion of symptomatic versus asymptomatic was 30/14 (Table 4a) whereas proportion of PD versus NS and 28/16 (Table 4b). Similarly, among the 11 patients whose management strategies were interventional, the proportion of symptomatic versus asymptomatic was 9/2 whereas proportion of PD versus NS was 10/1. The proportion of NS versus PD in patients who after GSMPI were advised with unchanged regimen were 10/15, curtailed regimen 2/0 and extended regimen 3/13. Table 5 shows φ_c values representing moderate to strong relation of change of medication regimen with perfusion status.

Finally, Table 6 shows that the management strategies were found to be weakly related with symptoms (φ_c< 0.2) but moderately related with perfusion status (φ_c = 0.24).

Table 1: Distribution of perfusion status according to presence of symptoms

	Symptomatic	Asymptomatic	% of patients
Normal perfusion	**12**	**5**	**0.71**
Total abnormal perfusion	**27**	**11**	**0.71**
Fixed perfusion defect	**12**	**0**	**1.00**
Reversible perfusion defect	**15**	**11**	**0.58**

Table 2: Measure of association of perfusion status and symptoms

Comparison	Cramer's V measure of association	p value
Normal vs fixed perfusion defect	**0.38**	**0.039**
Reversible vs fixed perfusion defect	**0.43**	**0.008**
Normal vs reversible perfusion defect	0.13	0.392
Normal vs total abnormal perfusion defect	0.01	0.97

Table 3: Distribution of change of medication regimen according to perfusion status

	Normal Perfusion	Perfusion Defect
Unchanged regimen	**10**	**15**
Curtailed regimen	**2**	**0**
Extended regimen	**3**	**13**

Table 4 (a): Distribution of management strategies according to symptoms

	Symptomatic	Asymptomatic
Conservative management	30	14
Interventional management	9	2

Table 4 (b): Distribution of management strategies according to perfusion status

	Normal perfusion	Perfusion defect
Conservative management	16	28
Interventional management	1	10

Table 5: Measure of association of medication regimen according to perfusion status

Comparison	Cramer's V measure of association	p value
Unchanged vs curtailed	0.32	0.1
Unchanged vs extended	0.22	0.1
Curtailedvs extended	0.57	0.01

Table 6: Measure of association of management strategy with symptoms and perfusion status

Comparison	Cramer's V measure of association	p value
Symptom vs management	0.12	0.37
Perfusion status (PD/NS) vs management	0.24	0.08

DISCUSSION

Outcome of CR can be jeopardized by restenosis or in-stent restenosis following a percutaneous coronary intervention (PCI) due to neointimal proliferation as a result of neoatherosclerosis (2). Similarly, following a CABG, there can be endothelial damage within the venous grafts by the operative procedure and by the pulsatile high-pressure arterial flow, necessitating platelet deposition and thrombus formation (3).The reported incidences of re-stenosis after PTCA used to be 32-55% in the pre-stent era, dropping to 17-41% in the bare metal stent era followed by a further drop to<10% with the advent of drug eluting stent (2). Post CABG patency at 10 years is reported to be 61% for venous grafts and 85% for arterial grafts (10).

Recurrent angina is a manifestation of restenosis or in-stent restenosis, which can arise from stretch pain, in-stent thrombosis, incomplete revascularization, progression of coronary atherosclerosis, coronary micro-vascular dysfunction, epicardial coronary spasm or even from a wide confounding array of non-cardiac causes (4,5). Seminal investigators (11-16) have shown that chest pain following PCI is a poor indicator of ischemia or restenosis and does not risk stratify patients whereas GSMPI does. Approximately 50% of patients remain asymptomatic when restenosis occurs (11-15). Conversely, up to 45% of patients developing chest pain after PCI do not have angiographic restenosis (7, 13, 17-24). A large trial reported in 2005 finds that 42% of patients in the stent group and 22% in the CABG group have recurrence of symptoms requiring repeat revascularization after 5 years from an initial CR (25). In our series, proportion of symptomatic patient in groups with normal perfusion, fixed PD and reversible PD were 71%, 100% and 58% leading to the finding that symptoms were weakly related with scan finding of reversible PD i.e. ischemia ($\varphi c < 0.2$).

Current guidelines recognize that myocardial ischemia whether manifest or asymptomatic have a deleterious effect on prognosis (26-28). GSMPI out performs exercise electrocardiography for diagnosis of >70% stenosis of aorto-coronary bypass grafts (8) as well as for the diagnosis of restenosis after coronary stenting (7, 16, 27).Sensitivity and specificity of MPI, performed at varying times after PCI range from 39% to 100% and 46% to 100% respectively (7, 13, 17-24), improving with time since revascularization (7, 13, 18, 20-24). Giedd and Bergmann recommend MPI in asymptomatic patients at six to nine months following PCI and propose to limit angiography in patients who will have medium or large defects or scan feature of stress induced left ventricular failure (29). Zellweger et al recommend post CABG follow-up with GSMPI in patients with symptoms before

5 years of CR and in all patients irrespective of symptoms after 5 years CR. (6)

Limitations of the study

Association of post CR perfusion status with gender and with patients' compliance to medical treatment and/or advice to lifestyle modification could not be statistically analyzed. Rationality of variation of medical management strategy in response to GSMPI findings was not addressed.

CONCLUSIONS

This study could find poor relation between cardiac symptoms and myocardial perfusion status in patients following CR where GSMPI could guide a rational choice between conservative management in greater proportion of patients while directing the smaller proportion of patients towards further interventional management. Thus it may be permitted to assume that GSMPI in this series played an extended role as a gate keeper to invasive management in status post CR patients, in addition to its otherwise popular role of guiding initiation of CR.

DISCLOSURE

No competing financial interests exist

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