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A PROSPECTIVE STUDY ON ROLE OF REMOTE ISCHEMIC PRECONDITIONING (RIPC) IN ELECTIVE PCI

Cardiology

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ABSTRACT

Post-procedural myocardial injury occurs in one-third of patients following elective percutaneous coronary interventions (PCI), and worsens their long-term cardiovascular prognosis[1]. The main mechanisms for PCI-related cardiomyocyte necrosis are ischemia-reperfusion injury due to balloon inflation, distal atherosclerotic microembolization, and marginal branch occlusion. Thus, there is a potential role for adjunctive strategies that offer cardioprotection during percutaneous revascularization with the goal of improving outcomes. Myocardial ischemic preconditioning (IP) is a phenomenon in which brief repetitive periods of sub lethal ischemia interrupted by reperfusion, increases myocardial tolerance to subsequent lethal ischemia[2]. Moreover, Remote ischemic preconditioning (RIPC) is a process whereby a brief period of ischemia and reperfusion increases ischemic tolerance of the distal and distant vascular territories to subsequent more prolonged ischemic insults[3]. There is therefore a growing interest in the clinical application of remote ischemic preconditioning as a therapeutic strategy in clinical practice[4]. Ischemic preconditioning has been successfully used to reduce the incidence of myocardial injury in patients undergoing pediatric and adult cardiac surgery and peripheral vascular surgery[5]. A recent clinical study, Hoole and colleagues showed an 18% reduction in the absolute risk of post-PCI myocardial injury in patients with no evidence of pre-procedure myocardial injury who received RIPC through intermittent upper limb tourniquet occlusion suggests that remote IP may offer cardioprotection during elective PCI[6], but the reproducibility and applicability to the broader PCI population remains to be established. The precise mechanism by which IP may occur is unknown, though the current paradigm is that inhibition of the opening of mitochondrial permeability transition pore is the final common pathway our hypothesis was that remote IP reduces myonecrosis during PCI for stable disease or unstable angina. The objective of the present study was to further assess the therapeutic potential of RIPC in reducing post-PCI myocardial injury using a randomized controlled clinical trial.Aim of our study was to determine whether RIPC reduces ischemic chest discomfort during PCI, attenuates procedure-related troponin release, reduces the inflammatory response to PCI (post PCI Hs CRP level) & reduces subsequent cardiovascular events.

KEYWORDS

MATERIAL AND METHODS

Elective PCI patients between March 2011 and June 2012 participated in the study during their attendance in cardiology department DR.R.M.L.HOSPITAL & PGIMER New Delhi. It was a Single center, Randomized, Prospective study. All patients 18 years of age and older (both gender) who were undergoing elective PCI and able to give informed consent were eligible for study. Patient of old/recent (>2 weeks to 30 days) myocardial infarction & Patient of chronic stable and low risk unstable angina (no chest pain in last 4 days) were the inclusion criteria for the study. Exclusion criteria for the study was Emergency PCI, Elevation of troponin before PCI taken at the preadmission clinic, Nicorandil or glibenclamide use (preconditioning -mimetic and preconditioning-blocking medication, respectively), Severe co morbidity (estimated life expectancy <6 months), Presence of an arteriovenous fistula or lymphedema of either arm, Severe endocrine, hepatic, renal, disorders, Inability or unwillingness to provide informed consent. After confirmation of eligibility, patients were randomized to either control or remote IPC group. Randomization was based on patients CR no. last digit even no. to remote IPC and odd digit were enrolled in control arm.

Procedural Interventions

Participants were instructed to avoid any strenuous activity that could provoke angina before their procedure. Those patients randomized to remote IPC had have a blood pressure cuff placed around their non-dominant upper arm. The cuff was inflated to 200-mm Hg pressure for 5 minutes, followed by 5 minutes of deflation, to allow reperfusion. This was repeated 3 times. 3-cycles of cuff inflation (10 mmHg)-deflation was also be performed in the control group for similar durations without inducing ischemia. The decision to proceed with revascularization was based on clinical need. PCI was conducted using techniques, equipment, and practices standard to the cardiology department DR. R.M.L. Hospital New Delhi via the femoral approach. Intravenous weight adjusted unfractionated heparin (50–70 units/kg bolus and additional doses as needed) was administered to maintain the activated clotting time in the therapeutic range (250–300 sec). Use of glycoprotein IIb/IIIa inhibitors was at the operators' discretion. Information about the revascularized territory, number and total length of stents deployed, post-procedural TIMI flow scores were also recorded. All patients received aspirin 325 mg and clopidogrel 300–600 mg at the time or before PCI. After the procedure, all patients continued to receive 325 mg of aspirin, and 150 mg of clopidogrel was added to their medication for at least 12 months.

Biochemistry

Venous blood samples taken at the preadmission clinic (baseline) and again 18-24 hours after PCI for Troponin I (Quantitative estimation via ELISA method) & Hs-CRP (Quantitative Immunoturbidimetry method). Blood samples for Trop I and HsCRP were centrifuged and serum isolated and kept in ependroff vials. Sample storage was done at -20ºC till analysis. cTrop I analysis was done with CALBIOTECH TROP I kit with ELISA Method on EVOLIS TWIN PLUS (biorad) HsCRP analysis was done with Tina-quant C-reactive protein (latex) high sensitive assay on Hitachi analyzer. Normal expected value for cTropI, which is determined to be ≤0.5 ng/ml cTnI, assay range of 0-75 ng/ml.

All routine investigation including Blood sugar, KFT, LFT, etc. was done in the department of biochemistry on fully automated biochemistry analyzer. The patients' demographic details, information about cardiovascular risk factors, previous cardiovascular history, and medications were obtained from medical records. Pre-procedural angina severity was recorded using the NYHA classification system. ECG was compared for ischemic changes before, during and after PCI. Echocardiography was done for LVEF(via modified Simpson method/RWMA(via WMSI) The myocardium at risk during PCI was assessed by reference to the target vessel, and a modified jeopardy score.[21] The jeopardy score is a measure of the burden of coronary disease by assigning disease in a major epicardial vessel (left anterior descending, left circumflex, and right coronary arteries) a score of 4 for proximal disease and 2 for distal disease, with a maximum of 4 in each vessel and a maximum overall total of 12.

METHODS

The primary outcome was whether remote IPC 1 hour before elective PCI reduced troponin I release at 24 hours & Secondary outcomes was the effect of remote IPC on ischemic symptoms, ECG changes during/after coronary balloon Occlusion Creatinine, Hs-CRP and major adverse cardiac and cerebral events (MACCE) at 6 months. Patients were followed up in OPD after 2 weeks than at 3 monthly interval after PCI for 6 month and average MACCE over 6 months recorded.

Adverse events, including hospital admissions with unstable angina/acute coronary syndrome, Myocardial infarction, heart failure, and stroke/transient ischemic attack, were recorded.

Elevations of biomarkers above the 99th percentile URL after PCI, assuming a normal baseline troponin value, are indicative of post-procedural myocardial necrosis. There is currently no definitive scientific basis for defining a biomarker threshold for the diagnosis of peri-procedural myocardial infarction. It is suggested to designate increase more than three times the 99th percentile URL of troponin I as PCI-related myocardial infarction(type 4a).

STATISTICAL METHODS AND ANALYSIS-

Appropriate statistical test were applied. Sample size were based on the assumption of normality for the distribution of mean cTnI, Data were analyzed by categorizing the TnI data into those with a defined MI and those with TnI below the lower limit of detection of the assay. Continuous variables were summarized as mean (SD) or median (quartiles) and compared by use of Student's *t test* .Categorical data were expressed as numbers (percentages) and compared by use of Fisher's exact test/ Chi-square analysis. A value of *P <0.05 is considered significant.* Odds ratios and 95% confidence intervals is calculated. Data is analyzed using SPSS-17 software.

RESULTS

200 patients were recruited and randomized in 1:1 ratio to RIPC arm (n=100) and Control arm (n=100). RIPC successfully applied in all 100 patient without any complication.

Table 1 showing the mean age of study population was 56.97 years (30-78). 86 % of patients were male, 74(37%) patients were diabetic and 75(37.5 %) were hypertensive .147(73.5%) were in AOE II, the most common indication for undergoing elective PCI along with 33(16.5) patients were Low risk unstable angina. Also 6(3%) patients had past history of acute coronary syndrome (ACS).

Baseline antiischemic treatment was similar in both arms except beta blockers were more frequently used in RIPC arm 96 vs. 89 though the p value was not significant (p=.06) The mean LVEF of study group was 55.87 % .4 (2%) patient had history of prior percutaneous coronary angioplasty .Diagnostic coronary angiogram done previously in 186(93%) patients and PTCA and stenting was done electively in them. GPIIb/IIIa inhibitors were used in 74(37 %) patients during PCI .Table 1 show baseline characteristics of total study population and both groups. There were no significant differences between groups in baseline characteristics. Remote IPC was successfully administered to 100 patients without any complication.

Table 2 is showing the angiographic parameters of total study population and both groups .Angiographic parameters were not significantly different between the two groups EXCEPT more patient in RIPC group received LAD stent 70 vs. 56 (p=.04). No significant difference was observed between the studied group in terms of target vessel, coronary artery disease burden, stent length and diameter. LAD was the most common target vessel (63%), followed by RCA 68(34%), and LCX 58(29%). Multivessel stenting was done in 79 (39.5%) patients and 4(2%) patient had angioplasty of all three vessels .Drug eluting stent (DES) was used in majority 188 (94%) of patients. Average length and diameter of stents was 26.85(±6.58) & 2.94(±0.32) respectively. All PCI done through Transfemoral route. Table 3 is showing the clinical and angiographic parameters during PCI of total study population and both study groups. Blood pressure and heart rate during PCI were comparable between both groups. 86(43%) patients had chest pain during PCI. Control patient were more prone for Periprocedure chest pain (RIPC-26 & Control-60) (p=0<.001). Also the average score of chest pain in control arm was significantly higher than RIPC arm (0.99 vs. 2.06; p=0<.001).ECG change were also significantly higher in control arm (15 vs. 3; p=.003). 3 patients in RIPC group had ECG showing ST deviation > 1 mm during PCI as compared to 15 patients in control group (p=0.003) . 2 patients had TIMI flow < 3 during the procedure and 1 belonged to RIPC group (p=0.56). So patients in RIPC group experienced less chest pain and had less ischemic . ECG changes as compared to control group during PCI, & this difference was statistically significant. All the patients in both group had baseline troponin I level comparable. Serum creatinine and HSCRP level were comparable in both groups (Table 4).

Table: 5 is showing the troponin I and HsCRP level at 18-24 hrs after PCI .Mean Troponin level was significantly less in RIPC group as compared to control group at 24 hrs (0.11vs 0.14 ng/ml ,p=0.0.002) . The mean change in cTrop I in RIPC group from baseline was significantly less than control arm (0.027 vs. .052;p=0<.001) The mean Change in HSCRP level was higher in control group indicating more PCI induced inflammatory response in control group as compared to RIPC group but the difference was not significant at 24 hrs (6.39 vs.7.85; p=.21) . Average serum creatinine was similar between both arms (1.26 vs. 1.27; p= 1.0)

Table 6 is showing incidence of MI at 24 hrs in both groups. Incidence of MI was significantly different between both subgroup according to Esc/ACC/AHA definition of a PCI-related MI (MI 4a) and WHO definition for MI (troponin I $\geq$ 0.78 ng/mL) at 24 hrs , & there was trend towards lower incidence of MI in RIPC group (p=.007) The incidence of PCI related MI (MI4a) in RIPC and control group was 0 vs. 7 (p=0.007) at 24 hrs. Table.7 (Fig.1 & 2) is showing Six months follow up results in both groups. MACCE was significantly lower in RIPC group as compared to control arm (13 vs. 30; p=0.003). This difference was mainly because of significantly less hospitalization for heart failure (0 vs. 4; p=.04) and target lesion revascularization (3 vs. 11; p=.05) in RIPC Group as compared to control. There was no difference in unstable angina (8 vs. 12; p=0.34), MI (2vs.3; p=0.65), Cardiac Death (0vs.0), or non target lesion revascularization (3vs.5; p=.47) in RIPC vs. control group respectively.

In one subgroup analysis of patients, it was found that average cTrop I change was significantly lower in patient with DM as compared to patient without DM in RIPC group.

DISCUSSION

Our study demonstrates that RIPC induced by intermittent short durations of upper limb ischemia-reperfusion immediately before PCI does (A) reduce the magnitude or frequency of PCI related myonecrosis, (B) does not modify the inflammatory response, (C) RIPC modify long term prognosis.

The present study was conducted in 200 patient in a single center prospectively randomized 1:1 into RIPC group and control group to evaluate for effect of RIPC on decreasing c Trop I at 24 hr post PCI in patients of stable angina and low risk unstable angina undergoing elective PCI and its effect on 6 month MACCE.

Our study showed that remote IPC, administered by transient upper-limb ischemia, (3 cycles of five minute duration) significantly reduces PCI-related troponin release and incidence of PCI related MI in RIPC group as compared to control group in patients undergoing elective PCI. The change in HsCRP level was not significantly different between RIPC and control group (mean 6.39 vs. 7.85 respectively; p=.21 at 24) indicating inflammatory response is not decreased by RIPC .HsCRP uniformly and consistently increased in both the treatment arm.

The concept of remote IP was initially proposed by Przyklenk et al. who demonstrated in an animal model that short-lived ischemia in myocardium supplied by the circumflex coronary artery reduced infarct size, following subsequent lethal ischemia in the distribution of the left anterior descending artery [7]. The potential for remote IP was further developed in experimental studies showing that transient ischemia of a wide range of organs such as the kidney- and small bowel-induced protection against subsequent MI[8]. Kharbanda et al. were the first to demonstrate that transient limb ischemia could invoke remote IP in humans [9].

Previous study with Gadolinium late enhancement cardiac magnetic resonance has demonstrated that all patients with Post-PCI cTnI elevation at 24 hrs have evidence of new irreversible myocardial injury and magnitude of irreversible injury represented, on average, 5% of total LV mass [10]. A postprocedure increase in cTnI concentration of 5-fold baseline levels is an independent predictor of a composite of death, MI, and revascularization at 1 year (hazard ratio, 2.39; 95% CI, 1.09 to 5.26) [(11)]. The recent redefinition of MI specifically identifies PCI as a cause of MI (MI 4a) when the postprocedure cTnI concentration has risen to 3 times the baseline value [(12)]. Although the magnetic resonance studies suggest that myocardial injury sustained during PCI is the result of more distal and peri-stent microcirculatory obstruction and/or side-branch occlusion, myocyte damage and troponin release also may be associated with a form of ischemia/reperfusion injury during stent deployment. A Doppler flow-wire study reported that the number of microembolic high-intensity signals during PCI correlated with cTnI release [13]. The highest frequency of high-intensity signals is seen during stent deployment, although the background signal is increased throughout PCI.

In the present study, we detect a cardioprotective effect with respect to

myonecrosis but no significant difference was observed in inflammatory levels. Our findings are consistent with efficacy of remote IP reported by Hoole et al. and in contrast with Iliodromitis et al who reported lack of efficacy of RIPC; He performed bilateral upper limb ischemia-reperfusion before PCI [14]. Indeed, in their study, there was an increase in CK-MB, troponin I, and hsCRP levels in the group treated with preconditioning compared to controls suggesting that such interventions may even be harmful. Rational of performing RIPC manoeuvre within 1 hr of PCI came from CRISP STENT study that had shown protection is time dependent and greatest benefit occurred with shorter cuff to balloon time. CRISP STENT study[6] is large prospective randomized controlled study, which concluded that Remote IPC reduces ischemic chest discomfort during PCI, attenuates procedure-related cTnI release, and appears to reduce subsequent cardiovascular events.

In our study we found that in remote IPC group relatively more number of patients had insignificant change in cTnI release at 24 hours and appeared to increase the tolerance of the myocardium to ischemia. Chest discomfort and ECG ST-segment deviation during first coronary balloon occlusion were both significantly improved after remote IPC. Our findings indicate that remote ischemic preconditioning if applied in routine clinical practice can reduce intra-procedural myocardial ischemia and the incidence of procedural myocardial injury in patients undergoing elective percutaneous coronary intervention. Our findings add to the body of evidence suggesting that RICP can be a safe and effective strategy for myocardial protection in commonly encountered clinical circumstances in which the heart is unavoidably but predictably put under strain[15].

Porto and colleagues [(16)]reported that RIPC delivered immediately before PCI, using upper limb, ischemia did not confer cardiac protection. A more recent study by Hoole and colleagues[(6)] demonstrated an 18% reduction in the risk of post-PCI myocardial injury if RIPC was delivered 1 h before the procedure.

The findings of our study agree with those of Hoole and colleagues,[(6)] We in our study used upper limb for RIPC as The upper limb is more accessible and these arteries are less prone to atherosclerotic disease than the lower limb. Its use to deliver RIPC avoids potential complications of distal arterial embolization or venous thromboembolism. What is not clear in this context is whether RIPC is an all-or-none or dose-dependent process. If it is all or none, then the bulk of skeletal muscle used to deliver the RIPC signal is not so important, and the upper limb, being more accessible, should be the preferred site for RIPC. But If RIPC is a dose-dependent phenomenon, and then the lower limb, with its significantly larger bulk of skeletal muscle, may confer maximal cardiac protection. Further studies comparing upper and lower limb RIPC are needed to address this specific question. Our study probably favours that RIPC is all-or-none process as only upper limb ischemia shown significant benefit. A recent randomized controlled trial of patients with suspected myocardial infarction showed that pre-hospital RIPC significantly increased myocardial salvage, and there is increasing recognition that sublethal distant-territory vascular ischemia can confer postconditioning end-organ protection even after an index event has occurred.[(17)] Therefore, our findings extend those already reported suggesting that RIPC can be an effective therapeutic strategy in routine clinical practice.

Importantly Our study also revealed that RIPC is significantly more beneficial in diabetic subgroup of patient in contrast to other study; though the study was not powered for this analysis, this favors humoral factors as a mechanism of beneficial effect of RIPC[18].

One of the limitations of our study was a small number of heterogeneities that were observed despite randomization. For example, significantly more patients in the RIPC group received LAD stent (P=.04), and more patients were on beta blockers although this difference did not reach statistical significance (p=.06). We performed a post-hoc stepwise logistic regression analysis to investigate the potential impact of these heterogeneities, and found that receiving or not receiving RIPC was the only variable that was significantly and independently associated with post-procedure myocardial injury. Another limitation of our study was that frequent sampling for troponin measurement has not been done that may have lowered the chance of detecting highest troponin level. Second, pre and postballon dilatation duration has not been considered in this study that may influence the outcome. Another limitation of our study was that it was powered only in respect of the primary outcome measure though the trend favors better MACCE free survival in RIPC arm (p=.003) Larger multicenter studies are needed to further investigate the utility of RIPC in improving the long-term cardiovascular prognosis of patients after elective PCI.

The data from our study suggest that the noninvasive, physiological, and economic intervention of RIPC can be successfully incorporated into routine clinical care in all subgroup of patient to reduce the intra-procedural myocardial ischemia and the incidence of myocardial injury in patients undergoing elective percutaneous coronary revascularization. Further trials are needed to better determine the optimal method of administration of RIPC and its long-term impact on cardiovascular prognosis.

CONCLUSION

Our study support an adjunctive role for remote IP in low- to moderate-risk patients undergoing PCI, but recent data suggests that remote IP performed prior to PCI may be beneficial in high-risk patients such as those presenting with ST-segment elevation myocardial infarction[17]

In our study Remote ischemic preconditioning significantly reduced troponin-I release at 24 hrs after PCI. We found that in remote IPC group relatively more number of patients had insignificant change in cTnI release at 24 hours and appeared to increase the tolerance of the myocardium to ischemia. Chest discomfort and ECG ST-segment deviation during first coronary balloon occlusion were both significantly improved after remote IPC. RIPC, administered by transient upper-limb ischemia, significantly reduces PCI-related troponin release in patients undergoing PCI, and associated with better outcome at 6 month with statistically significant decrease in MACCE. In the present study, we detect a cardioprotective effect with respect to myonecrosis but no significant difference was observed in inflammatory levels... Our findings are consistent with efficacy of remote IP reported by Hoole et al. and in contrast with Iliodromitis et al[19] who reported lack of efficacy of RIPC.

The data from our study suggest that the noninvasive, physiological, and economic intervention of RIPC can be successfully incorporated into routine clinical care to reduce the duration of intra-procedural myocardial ischemia and the incidence of myocardial injury in patients undergoing elective percutaneous coronary revascularization

Table 1: Baseline Demographic and Clinical profile of patients

Variable	Total (n=200)	RIPC Group (n=100)	Control (n=100)	P value
Age(in Yrs)	56.97(9.7)	56.68 (8.78)	57.27(10.76)	0.67
BMI (kg/square M)	25.92 (5.146)	25.94 (5.186)	25.90 (5.106)	0.94
Male, n (%)	172(86)	87 (87)	85(85)	0.684
Female, n (%)	28(14)	13(13)	15(15)	0.684
DM, n (%)	74(37)	37(37)	37(37)	1.00
Smoker, n (%)	62(31)	32(32)	30(30)	0.76
Hypertension (%)	75(37.5)	38(38)	37(37)	1.00
Dyslipidemia, n (%)	13(6.5)	7(7)	6(6)	0.774
Family H/O CAD, n (%)	8(4)	4(4)	4(4)	1.00
LVEF, %	55.8(7.07)	55.60 (7.25)	56 (6.89)	0.25
Previous ACS, n (%)	6(3)	3(3)	3(3)	1.00
NYHA I/II, n (%)	147(73.5)	74(74)	73(73)	0.8
NYHA III, n (%)	20(10)	9(9)	11(11)	0.8
USA, n (%)	33(16.5)	17	16	0.8
Aspirin, n (%)	200(100)	100	100	1.00
Statins, n (%)	197 (98.5)	97	100	0.08
β-blockers (%)	185(92.5)	96	89	0.06
ACEI/ARB, n (%)	46(23)	23	23	1.00
Clopidogrel n (%)	68(34)	31	37	0.37
GpIIb/IIIa inhibitors, n (%)	74(37)	32	42	0.14
H/o prior PTCA	4(7.4)	1(3.7)	3(11.1)	0.61
Previous coronary artery surgery	0	0	0	

BMI – Body mass index, LVEF, Left ventricle ejection fraction; NYHA - New York Heart Association; ACEI-Angiotensin-converting enzyme inhibitors. ARB- Angiotensin receptor blocker, PTCA-

percutaneous transluminal coronary angioplasty, PCI – percutaneous coronary intervention. Data are mean (SD) when appropriate.

Table 2: Angiographic parameters

Variable	Total (n=200)	RIPC Group(n=100)	Control (n=100)	P value
Target vessel (%)				
LAD n (%)	126(63)	70	56	0.04
LCx n (%)	58(29)	25	33	0.213
RCA n (%)	68(34)	39	29	0.136
CAG jeopardy score	4.85	4.86 (1.42)	4.84 (1.45)	0.42
Single vessel PTCA	121(60.5)	54	67	0.06
Multivessel PTCA	79 (39.5)	46 ()	33	0.76
Stent diameter,mm	2.94(0.32)	2.97 (.33)	2.92 (.32)	0.33
Stent length, mm	26.85 (6.58)	27.46 (6.41)	26.24 (6.75)	0.19
No of stents(per pt)	1.26	1.34	1.18	
No. of stent>1	79	46	33	0.06
2	63	37	26	0.09
3	12	6	6	1.00
4	3	2	1	0.56
5	1	1	0	0.31
DES, n (%)	188 (94)	94	94	1.00
Post PCI complication				
Emergency CABG/PCI	0	0	0	
Arrhythmias	0	0	0	
In hospital death	0	0	0	

LAD, left anterior descending artery; LCX, left circumflex; RCA, right coronary artery; ACC, American college of cardiology; PTCA-percutaneous transluminal coronary angioplasty DES, drug eluting stent; Data are mean (SD) when appropriate.

Table 3: Periprocedure clinical and angiographic parameters

	Total (n=200)	RIPC group (n=100)	Control (n=100)	P value
Chest pain score >1, n (%)	86 (43)	26(26)	60(60)	0<.001
Chest pain average score	1.5	0.99	2.06	0<.001
ECG ST deviation >1mm, n (%)	18	3	15	0.003
TIMI flow grade				
0-2	3	1	2	0.26
3	197	99	98	0.56

TIMI, Thrombolysis in myocardial infarction; Data are mean (SD) when appropriate.

Table 4: Baseline serum cTnI, S. Creatinine and HsCRP

Variable	RIPC group(n=27)	Control(n=27)	P value
cTnI, mean,ng/ml	.083 (.033)	.084(.023)	0.90
Hs HsCRP , mg/dl	2.63(2.20)	3.32 (4.33)	0.16
Serum creatinine,	1.01(.34)	1.08(.35)	1.00

Data are mean (SD)

Table 5: 24 hrs serum troponin I and HSCRP and 24 hrs serum creatinine

Variable	24 hours		
	RIPC group	Control	p value
cTROP I (ng/ml)	.11 (.05)	.14 (.06)	.002
Δ cTROP I(ng/ml)	.027 (.019)	0.052 (.061)	0<.001
HsCRP (mg/dl)	9.03 (7.76)	11.17 (10.96)	.11
Δ HsCRP (mg/dl)	6.39 (6.5)	7.85 (9.6)	0.21
Sr creatinine (mg/dl)	1.26 (.34)	1.27 (.35)	1.0
RIPC GROUP	DM+ve	DM-ve	p value
Δ cTROP I(ng/ml)	0.02	0.03	0.05

Table 6: Incidence of MI at 24 hrs

Variable	24 hours		
Incidence of MI	RIPC group	Control	p value
NO MI	100	93	.007
MI 4a# n %	0	7	.007

Data are mean (SD)

.# The European Society of Cardiology/American College of Cardiology/American Heart Association/World Health Federation definition of a PCI-related MI (MI 4a) was defined as > 0.12 ng/mL (3 times the upper reference limit) .

Table- 7 six month follow up results

Variable	RIPC group(n=27)	Control(n=27)	P value
TVR (ISR)	3	11	0.05
CVA (TIA)	0	1	0.05
Echo EF %	57.15	57.30	.83
1.Hospitalization	10	19	.06
Unstable Angina	8	12	.34
Myocardial Infarction	2	3	.65
Heart Failure	0	4	0.04
2.Cardiac Death	0	0	1.0
3.Target Lesion revascularization	3	11	.05
4.Non Target Lesion revascularization	3	5	.47
MACE (1+2+3)	13	30	.003

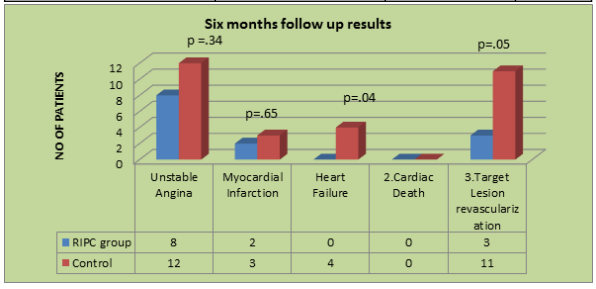

Fig: 1 Bar diagram showing six months follow up results

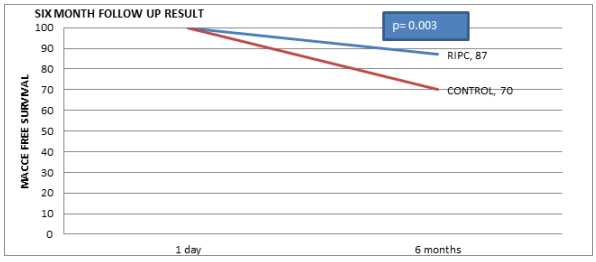

Fig: 2 Kaplein-Meir graph of MACCE rate at 6 months after PCI in 200 patients (100 in RIPC & 100 in control group)

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