

Contrast Induced Renal Dysfunction in Patients Undergoing Percutaneous Coronary Intervention

SYED MUHAMMAD AFTAB SHAH, TANVIR AHMAD BHATTI, WASIM ASHRAF, SAQIB SHAFI SH.

ABSTRACT

Background: Contrast-induced nephropathy remains a common complication of radiographic procedures. However, ionic contrast media cause more renal insufficiency than non ionic one due having low osmolality and chemotoxicity.

Aim: To examine the contrast induced renal dysfunction in patients undergoing percutaneous coronary intervention.

Methods: A prospective, single-center, randomized trial conducted for six months, between January & July 2007, of 100 patients. Serum creatinine levels were measured at baseline and 1 and 2 days after contrast. Patients received median dose of non ionic contrast 101±16.64 ml and 110±12.9 ml of ionic contrast.

Results: There were no significant group differences in age, but significant difference was seen in sex (P=0.01). The incidence of renal insufficiency (RI) was more in patients suffering from and hypertension and diabetes mellitus. Out of 100 (78 male and 22 female) patients only 18(18%) developed RI. Out of 78 male patients, 12(15%) male and of 22 female patients, 6(27%) showed RI.

Conclusion: Non ionic contrast media is safe to use for angiography in spite of predisposing factors like hypertension and diabetes mellitus

Keywords: Angiography, Ionic contrast, Non Ionic Contrast, Renal Insufficiency, Percutaneous coronary intervention

INTRODUCTION

Iodinated contrast (IC) is widely used in both diagnostic as well as therapeutic cardiovascular procedures. The risk of contrast induced renal dysfunction is low in general population but in certain subsets of patients it may be very high^{1,2,3,4,5}.

Cardiovascular disease is the leading cause of death among patients with renal failure. Mild to moderate renal insufficiency (RI) is also associated with increased cardiovascular morbidity and mortality in patients with hypertension, heart failure, coronary artery disease, and acute coronary syndromes and in those undergoing percutaneous or surgical revascularization^{6,7,8}.

Contrast induced nephropathy(CIN) is rare in patients with normal renal function in the absence of diabetes mellitus^{6,9}. Low dose and nonionic iodinated contrast is associated with less incidence of CIN. Risk of CIN is significantly proportional to the severity of baseline renal disease. A higher risk of CIN is seen in patients with diabetes and hypertension^{6,10}. The pathogenesis of CIN is not completely understood. However disturbance in renal hemodynamics and direct cytotoxicity have been proposed as possible mechanisms^{10,11,12,13}.

Department of Cardiology, Mayo Hospital, Lahore
Correspondence to Dr. Syed Muhammad Aftab Shah Email: draftabshah15@gmail.com, Cell: 03008438314

This study was conducted to see the impact of iodinated contrast induced nephropathy (CIN) in patients undergoing Percutaneous Coronary Intervention (PCI) who do not have any preexistent renal failure.

MATERIAL AND METHODS

It was a cross-sectional and analytical study. It was conducted in the cardiology department, Punjab Institute of cardiology Lahore for six months on one hundred consecutive patients undergoing Percutaneous Coronary Intervention (PCI). All the samples were purposive non probability sampling. Samples were collected by an inclusive and exclusive criteria.

Inclusion criteria

1. No known renal impairment before PCI.
2. Undergoing percutaneous coronary intervention
3. Hemodynamically stable patients.

Exclusion criteria

1. Pre procedure serum creatinine (SCr) > 2.0 mg/dl.
2. Hypersensitivity to contrast.
3. Sepsis.
4. Pre Percutaneous Coronary Intervention (PCI) hypotension.

Statistical Analysis: Data were expressed as mean ±SD. Comparisons between groups of RI was analyzed by Fisher's exact test. Statistical significance was assumed if a null hypothesis (2-tailed) could be rejected at P=0.05

RESULTS

The two groups appeared to be clinically similar with regard to demographic and other base line characteristics. Procedural success was defined as a residual stenosis < 50%, TIMI – 3 flow and absence of major adverse cardiac events (MACE) within 48 hours. Baseline SCr levels were obtained before angioplasty in all patients. Estimated creatinine clearance (CrCl) was calculated by correction factor of 0.85 in women.

A CrCl <60ml/min was chosen to define at least moderate RI. Outcome as a function of RI were further assessed by examining CrCl strata of > 60, 50-60, 40-49, 30-39, 20-29 and < 20ml/min. SCr levels were assessed at admission, 48 hours after PCI. Contrast induced nephropathy (CIN) was defined as an SCr increase by > 0.5mg / dl within the index hospitalization (1+ 2.5 days).

Between January 2007 & July 2007, 100 PCI patients were included in the study including 78 males and 22 females with average age 51±9.02 years. All 100 patients in whom the protocol was followed and who were evaluated for renal outcomes received average dose of 101.66±16.64 ml of ionic and 110±12.9 ml of nonionic dye (Table 1, 2, 3).

Out of 22 females 17 were hypertensive with average BP 131.2±22.88 mm of Hg and 05 non hypertensive with average BP 114±5.47 mmHg. 12 were diabetic, 03 smoker, 05 with hyperlipidaemia and 13 were having family history of cardiac problem. Most of these female patients (16) were suffering from ACS while one came with acute myocardial infraction and 05 with stable angina.

Out of 78 males 43 were hypertensive with average BP 137.2±16 mm of Hg and 35 non hypertensive with average BP 117±13 mm of Hg. 27 were diabetic, 46 smoker, 09 with hyperlipidaemia

and 28 were having family history of cardiac problem. Most of these male patients (40) were suffering from ACS while 23 came with acute myocardial infraction, 11 with stable angina and remaining 07 patients with some other kind of cardiac problem.

Out of 78 males 12(15%) showed RI, while out of 22(27%) females 06 showed RI. At least moderate RI based on CrCl cutoff < 60ml/min was present in 12 males (15%) with mean PSC 1.5±0.18 mg/dl and PSCC 51±8.15ml/min and 06 females (27%) patients with mean PSC 2.3±1.45 mg/dl and PSCC 36.58±17.27 ml/min. (P=0.01) Base line characteristics of patients with and with out RI are shown in (table 1, 2, 3). Our findings are different from that of Merten et all (2004) who found that there were no significant group differences in age, sex, incidence of diabetes mellitus, ethnicity, or contrast volume because in our study females developed more RI as compared to males (P=0.01), however there was no statistical difference regarding the age of the patients and volume of the contrast.¹⁷

The mean age was 60.91±9.93 years of male patients and 63±6.96 years in females. Out of 12 males with RI, 10 were hypertensive, 04 were smokers, 07 were diabetics and 05 with family history of heart attacks. Regarding the females all were hypertensive and diabetics, while only 02 were with hyperlipidaemia (Table 1, 2, 3, graph 1, 2).

The median amount of nonionic contrast median administered was 142.5±85.38 ml in males 95±5.77 ml in females while the median amount of ionic contrast used was 115±7.07ml in males and 215±120.20 ml in female in patients with RI.

Non ionic contrast was given to 93 patients and 14(15%) showed RI while ionic contrast was given to 7 patients. Out of these 07 patients receiving ionic contrast, 4(53%) patients showed RI.

Table 1: RI < 60mg/dl in hypertensive Patients in males

Age	Sex	Blood pressure		Hyperten sion	Smo ker	DM	HL	FH	SC BPCI	SCC BPCI	SC APCI	SCC APCI	Non Ionic	ion ic
		Sys	dias											
55	M	160	90	Y	N	Y	N	N	0.9	99.6	1.8	35.5	300	
69	M	160	90	Y	Y	Y	N	Y	1.2	65.7	1.5	52.5	95	
60	M	120	70	Y	N	N	N	N	1.2	72.22	1.5	57.7	70	
75	M	150	80	Y	N	N	N	Y	1.2	61	1.2	52.2	100	
71	M	120	70	N	N	N	N	Y	1.2	58.3	1.2	58.3	95	
52	M	110	70	N	N	Y	N	Y	1	73.33	1.4	45.7		110
42	M	120	80	Y	N	Ad	N	N	0.8	122.5	1.4	59.3		120
53	M	140	90	Y	Y	Y	N	N	0.7	124.2	1.5	52.5	150	
55	M	160	90	Y	N	Y	N	N	0.9	99.6	1.8	35.5	300	
69	M	160	90	Y	Y	Y	N	Y	1.2	65.7	1.5	52.5	95	
70	M	150	90	Y	Y	Y	N	N	1.1	69.8	1.4	52.6	110	
60	M	120	70	Y	N	N	N	N	1.2	72.22	1.5	57.7	110	
Totals	12	139 ±19.75	92 ±9.37	Yes=10 No=02	Yes=4 No=8	Yes=8 No=4	No=12	Yes=5 No=7	1.05±0.18	82±23.33	1.5±0.18	51± 8.15	142.5 ±85.38	115± 7.07

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Table 2: RI < 60mg/dl in hypertensive Patients in females

Age	Sex	Blood pressure		Hypertension	Smoker	DM	HL	FH	SC BPCI	SCC BPCI	SC APCI	SCC APCI	Non Ionic	Ionic
		Sys	dias											
55	F	130	90	Y	N	Y	N	N	1.1	100.3	1.5	54.3		300
62	F	180	85	Y	N	Y	Y	N	3.2	21	4.2	16	100	
72	F	130	80	Y	N	Y	N	N	1.2	39.46	1.2	39.46	90	
62	F	180	85	Y	N	Y	Y	N	3.2	21	4.2	16	100	
72	F	130	80	Y	N	Y	N	N	1.2	39.46	1.2	39.46	90	
55	F	130	90	Y	N	Y	N	N	1.1	100.3	1.7	54.3		130
Total	6	146±2	95±4.4	Yes=6	No=6	Yes=8	Yes=2 N0=4	No=6	1.83± 1.05	53.58± 37.11	2.3± 1.45	36.58± 17.27	95± 5.77	215± 120.20

Table 3: Comparison of RI in various risk factors

Sex	Mean Age Range	Hypertensive		Smokers	DM	HL	FH	PP SC	PPS CC	PSC	PSCC	Contrast	
		Yes	No									Non Ionic	Ionic
Male n=12	60.91± 9.93	10	02	04	07	Nil	05	1.05± 0.18	82± 23.33	1.5± 0.18	51± 8.15	142.5± 85.38	115± 7.07
Female n=06	63± 6.97	6	0	0	6	02	0	1.83± 1.05	53.58± 37.11	2.3± 1.45	36.58± 17.27	95± 5.77	215± 120.20

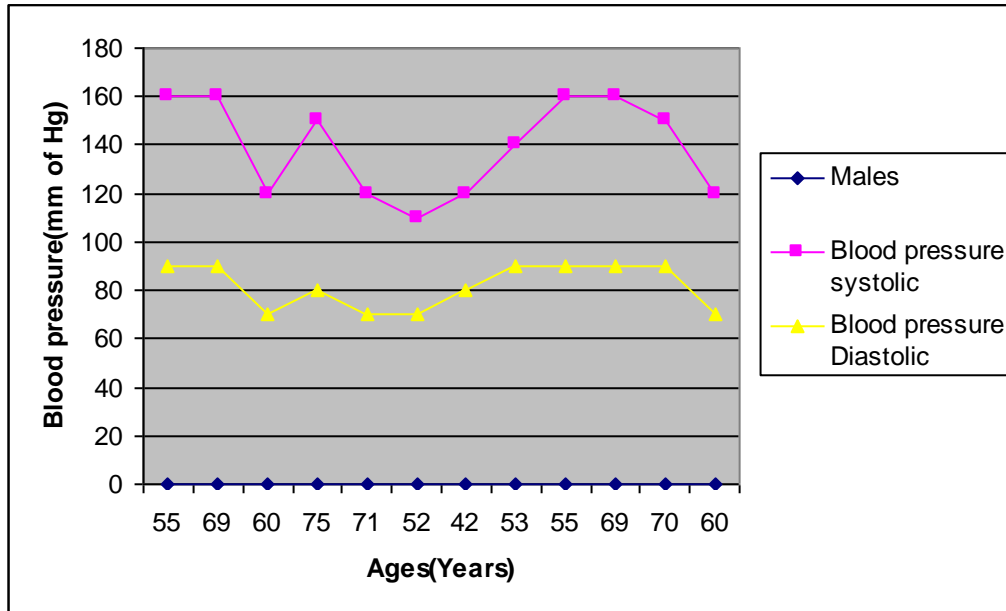
Table 4: Difference of RI with non ionic contrast and ionic contrast medium

Contrast (n=100)	With RI	With out RI	
Ionic	04(57%)	03(43%)	07
Non Ionic	14(15%)	79(85%)	93
P=0.01	18	82	100

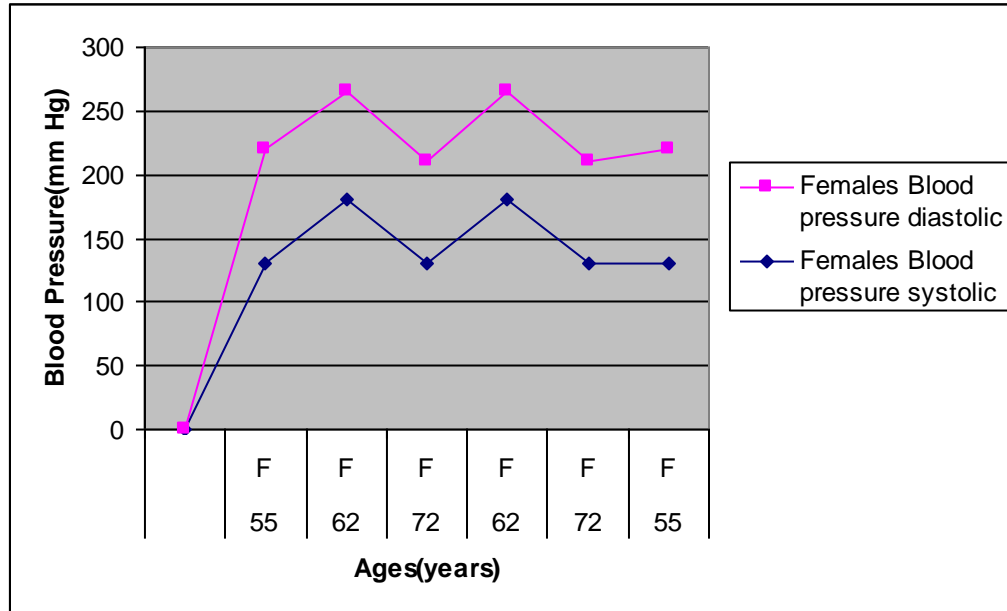
Table 5: Difference of RI in males and females

	With RI	With out RI	
Male	12 (15.38%)	66 (84.62)	78
Female	06 (27%)	16 (73)	22
P=0.02	18	82	100

Graph 1: Record of blood pressure of male patients with Renal Insufficiency



Graph 2: Record of blood pressure of female patients with Renal Insufficiency



DISCUSSION

Our study found that the rise of serum creatinine concentration between day 0 and day 2 was significantly lower in the Non-ionic group than in the Ionic group. The incidence of contrast – medium induced nephropathy, defined as an increase in the serum creatinine concentration of 0.5mg per deciliter or more, was 15% in the non-ionic dye and 53 % in ionic dye group. The difference was statistically significant ($P=0.01$) (Table 4). These findings suggest that non ionic contrast is safer than ionic contrast. The difference might be explained by differences in either the osmolality or the chemotoxicity of the ionic contrast medium. The median amount of non ionic contrast administered was 142.5 ± 85.38 ml in males 95 ± 5.77 ml in females while the median amount of ionic contrast was 115 ± 7.07 ml in males and 215 ± 120.20 ml in female patients with RI. These differences are non specific ($P=0.1$) (Table 1,2). Our findings are not consistent with Kielpinska et al (2002)¹⁴ while consistent with Davidson et al (2000)¹⁵ and Mchran et al (2004)¹. In a study, Beyer-Enke and Zeitler showed that non ionic contrast media were more toxic as compare to ionic media but they also agreed that these adverse reactions after (non-ionic) contrast media were due to the underlying disease and that a (clinically latent) impairment of renal function can be assumed¹⁶.

In our study out of 78 males 12 (15%) showed RI, while out of 22 (27%) females 06 showed RI. Female showed more RI as compared to males. This could be due to precipitation factors for RI because all 6 females showing RI were diabetic and

hypertensive. This RI difference regarding the sex was statistically significant $P=0.02$ (table 5).

In this study the mean age of males was 60.91 ± 9.93 years and that of female was 63 ± 6.96 years. While out of 12 males with RI, 10 were hypertensive, 04 were smokers, 07 were diabetics and 05 with family history of heart attacks. Regarding the female all were hypertensive and diabetic, whereas only 02 were having hyperlipidaemia. In our study hypertension and diabetes mellitus were the main risk factors for the development of RI. These findings are consistent with that of world wide data (Table 1, 2, 3, graph 1, 2).

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