

Retrospective Evaluation of Impact of Radio Contrast Enhanced Computed Tomography of the Renal System in Diabetic Patients: A Comparative Study

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ABSTRACT

Background: In the field of imaging and diagnosis, Contrast media (CM) are becoming increasingly used. This results in the rising incidence of iatrogenic renal function impairment caused by the exposure to CM, a condition known as contrast induced nephropathy (CIN). There has been increase in usage of contrast media and computed tomography (CT) scan of renal system in diabetic patients. Hence; we planned the present study to assess the effect of radio contrast enhanced CT of renal system in diabetic patients and compare it with non-diabetic subjects.

Materials & Methods: The present study included retrospective assessment of effect of radio contrast enhanced CT of renal system in diabetic and non-diabetic subjects. A total of 40 subjects were included in the present study, out of which 20 were diabetic and 20 were non-diabetic. Patient details were obtained from the archives of the data records of the department of radio-diagnosis. Investigation records of all the patients were obtained for the assessment of contrast induced nephropathy and before the procedure blood urea levels and serum creatinine levels were measured. Data records of repeat creatinine and creatinine clearance post-procedure after 48 hours were obtained and assessed. All the results were assessed by SPSS software.

Results: A total of 40 patients were included in the present study. Mean pre-operative and post-operative value of plasma creatinine levels in non-diabetic patients was 0.75 and 0.95

mg/dl respectively. In the diabetic group, mean pre-operative and post-operative value of plasma creatinine levels was 0.79 and 1.10 mg/dl respectively. Significant results were obtained while comparing the preoperative and postoperative mean plasma creatinine values in both the study groups. No-significant results were obtained while comparing the mean post-operative plasma creatinine values in between both the study groups.

Conclusion: Transient increase in plasma creatinine of all patients does occur while utilizing the contrast medium in all patients.

Key words: Computed topography, Diabetic, Renal.

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INTRODUCTION

Contrast media (CM) are increasingly used in diagnostic imaging procedures. This results in the rising incidence of iatrogenic renal function impairment caused by the exposure to CM, a condition known as contrast induced nephropathy (CIN).¹⁻³ In patients without risk factors, the incidence may be as low as 2%. With the introduction of risk factors, like diabetes, the number rises to 9%, with incidences being as high as 90% in diabetics with chronic kidney disease (CKD).⁴

Results from the past literature show that there is an increase in usage of contrast media and computed tomography (CT) scan of renal system as well as more and more patients with diabetes undergoing for the procedure there is a need to study the effect of contrast media on renal function.⁵ Hence; we planned the present

study to assess the effect of radio contrast enhanced CT of renal system in diabetic patients and compare it with non-diabetic subjects.

MATERIALS & METHODS

The present study was conducted in the department of radio-diagnosis and included retrospective assessment of effect of radio contrast enhanced CT of renal system in diabetic and non-diabetic subjects. Ethical approval was taken from the institutional ethical committee for the present retrospective study. A total of 40 subjects were included in the present study, out of which 20 were diabetic and 20 were non-diabetic. Patient details were obtained from the archives of the data records of the department of

radio-diagnosis. After assessing the past records, following criteria were established for including patients of the diabetic group:

- Patients with history of diabetes for a minimum of 10 years,
- Patients with negative history of any other systemic illness,
- Patients with negative history of any drug allergy,

Exclusion criteria for including the subjects in the diabetic group included:

- Patients allergic to contrast media,
- Patients with pre-existing renal disease if creatinine more than 1.6 mg%.
- Patients with presence of any pathology or drug treatment affecting renal function.

Total of 20 patient's data was included into the diabetic group after meeting the inclusion and the exclusion criteria. Investigation records of all the patients were obtained for the assessment of contrast induced nephropathy and before the procedure blood urea levels and serum creatinine levels were measured. Data records of repeat creatinine and creatinine clearance post-procedure after 48 hours were obtained and assessed. Data of the patients who serum creatinine were found to increase more than 25 percent were categorized under CIN. All the results were assessed by SPSS software. Chi- square test and student t test were used for assessment of level of significance. P- value of less than 0.05 was taken as significant.

Table 1: Demographic details of the patients

Parameter	Diabetic group	Non-diabetic group
No. of patients	20	20
Mean age (years)	55.5	51.2
Males	12	11
Females	8	9

Table 2: Comparison of mean plasma creatinine values within individual groups

Group	Mean plasma creatinine value (mg/dl)		P- value
	Pre-operative	Post-operative	
Non- Diabetic	0.75	0.95	0.01*
Diabetic	0.79	1.10	0.03*

*: Significant

Graph 1: Comparison of mean plasma creatinine values within individual groups

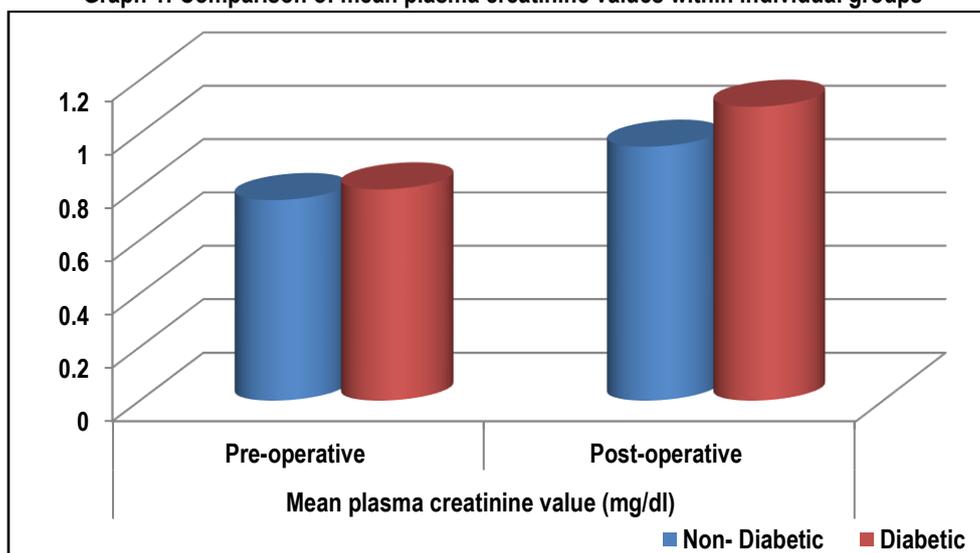


Table 3: Comparison of postoperative mean plasma creatinine values in between individual groups

Group	Mean postoperative plasma creatinine value (mg/dl)	P- value
Non-diabetic	0.95	0.58
Diabetic	1.10	

RESULTS

A total of 40 patients were included in the present study. 20 out of these 40 patients were diabetic, while the remaining 20 were non-diabetic (Table 1). Mean age of the subjects of the diabetic and non-diabetic group was 55.5 and 51.2 years respectively. 12 patients in diabetic group were males while remaining 8 were

females. 11 patients in the diabetic group were males while remaining 9 were females. Table 2 shows the comparison of mean plasma creatinine values within individual groups. Mean pre-operative and post-operative value of plasma creatinine levels in non-diabetic patients was 0.75 and 0.95 mg/dl respectively. In the diabetic group, mean pre-operative and post-operative value

of plasma creatinine levels was 0.79 and 1.10 mg/dl respectively. Significant results were obtained while comparing the preoperative and postoperative mean plasma creatinine values in both the study groups (P- value < 0.05).

Table 3 shows the comparison of postoperative mean plasma creatinine values in between individual groups. No-significant results were obtained while comparing the mean post-operative plasma creatinine values in between both the study groups (P-value > 0.05).

DISCUSSION

Various degrees of renal dysfunction are frequently encountered in patients undergoing coronary angiography and other diagnostic procedures that utilize various radiographic contrast agents. The association is not by chance alone, for some risk factors that contribute to coronary artery disease are also frequently implicated in renal vascular disease.^{6,7} Mechanisms of contrast nephropathy, and various techniques and medications utilized to achieve such a goal will be discussed. Contrast agents will lead to an increase in osmolality. These increases may reflexively cause vasoconstriction of the afferent arterioles and subsequently medullary ischemia. These effects may be caused by calcium channels and are mediated by adenosine release. The ischemia's will likely cause damage to the kidney, and that damage is mediated by oxygen free radicals.^{8,9} Hence; we planned the present study to assess the effect of radio contrast enhanced CT of renal system in diabetic patients and compare it with non-diabetic subjects.

In the present study, we observed a significant rise in the value of plasma creatinine postoperatively in both the study groups (P-value < 0.05) (Table 2). However; while comparing the postoperative plasma creatinine values in between the study groups, we didn't observe any significant results (P- value > 0.05) (Table 3).

Barbieri et al studied a total of 1324 patients without diabetes, undergoing elective/urgent coronary angiography/ angioplasty were divided according to quartiles of baseline glycated-haemoglobin. CIN was defined as an absolute ≥ 0.5 mg/dL or a relative $\geq 25\%$ increase in creatinine level at 24–48 h after the procedure. Patients with elevated glycated-haemoglobin were older, with hypertension, metabolic syndromes, and previous history of AMI, PCI and CABG. They had higher glycaemia, fasting-glycaemia and triglycerides but lower HDL-cholesterol. Patients with higher glycated-haemoglobin were more often on therapy with statins, diuretics and calcium-antagonist at admission, had higher basal, 24 and 48 h creatinine, lower creatinine clearance and lower ejection fraction. They had the highest incidence of PCI and contrast volume-eGFR rate. CIN occurred in 10.6% of patients with a linear association with glycated-haemoglobin ($p = 0.001$). No relationship was found between glycaemia/fasting glycaemia at admission and CIN. The multivariate analysis confirmed the association between elevated glycated hemoglobin (above the median value 5.7%) and the risk of CIN after adjustment for baseline confounding factors. In fact, the results were consistent in major high-risk subgroups.¹⁰

Manske et al evaluated the incidence of, risk factors for, and outcome of contrast nephropathy in azotemic diabetic patients undergoing coronary angiography. Fifty-nine insulin-dependent diabetics with a mean serum creatinine level of 522 $\mu\text{mol/L}$ (5.9

mg/dL) underwent coronary angiography as part of a pre transplant evaluation. Twenty-four azotemic diabetics undergoing inpatient evaluation not including angiography for transplantation formed the control group. Serum creatinine measurements obtained at baseline and after radiocontrast exposure were compared in patients and control subjects. Risk factors for contrast nephropathy were evaluated in patients with a 25% or greater increase in serum creatinine. Serum creatinine was significantly elevated 24 hours after radiocontrast exposure in patients ($557 \pm 141 \mu\text{mol/L}$ versus $522 \pm 141 \mu\text{mol/L}$, mean \pm SD; $p < 0.001$) but not in controls. Seven patients required dialysis within 6 days of coronary angiography and two additional patients required dialysis within 14 days. Contrast nephropathy, defined as a serum creatinine increase of greater than 25% when measured 48 hours after radiocontrast exposure, occurred in 50% of patients and no controls. Univariate analysis of risk factors for contrast nephropathy revealed a significant association with dye quantity ($p = 0.002$), mean arterial pressure less than 100 mm Hg ($p = 0.02$), and ejection fraction less than 50% ($p = 0.04$). Stepwise logistic regression verified the independence of dye quantity and low mean arterial pressure but not low ejection fraction as risk factors for contrast nephropathy. Follow-up serum creatinine values were not significantly different in patients and control subjects. Authors concluded that azotemic patients with diabetes are at high risk of developing contrast nephropathy even when less than 100 mL of radiocontrast agent is used. The acute renal failure is reversible but precipitates the need for short-term dialysis in some patients. Radiocontrast quantity is an important risk factor not previously noted. The incidence of contrast nephropathy can be minimized by using less than 30 mL of radiocontrast agent.¹¹ In the review of prediction of risk of CIN, McCulloch et al identified hypertension as one of the important risk factors.³⁰ Hypertension is a common feature of chronic kidney disease and is present in approximately 80% of patients with diabetic nephropathy. Thus co-presence of all these factors or individual factors are considered as important risk factors for CIN.¹²

CONCLUSION

Under the lights of the above results, the authors conclude that Diabetes might be associated with increased risk of contrast nephropathy. Transient increase in plasma creatinine of all patients does occur while utilizing the contrast medium in all patients. However; future research is recommended.

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