



ORIGINAL RESEARCH ARTICLE

IS SERUM CREATININE MANDATORY PRIOR TO CONTRAST ENHANCED COMPUTED TOMOGRAPHY?

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ABSTRACT

Introduction: Contrast-enhanced Computed Tomography (CECT) is an imaging technique to diagnose many clinical manifestations. Contrast media used in CECT can lead to contrast induced nephropathy (CIN). Hence, screening of serum creatinine (SCr) level prior to CECT is commonly practiced as it is considered to be an indicator for the risk of Contrast Induced Nephropathy (CIN). But, it adds up extra cost and also increases duration for investigation. The purpose of this study is to find out, if SCr screening can be skipped among certain group by medical history related to risk factors of CIN.

Methodology: A total 250 patient SCr were obtained prior to CECT over period of 4 months between June 2016 to September 2016. Duplication in the samples was avoided. A survey of medical history regarding risk factors for CIN was taken in each case. Chi square test and odds ratio was applied for data analysis.

Results: In this study 68% of total (250) patients were found to have normal SCr level without any risk factors for CIN and among 3% abnormal categorized patients (SCr ≥ 1.5 mg/dl) 71% (5 of 7) were identified with risk factors.

Conclusions: The data suggests that screening SCr prior to CECT is significant only to those patients who acquire any of the identifiable risk factors for CIN. Those patients who are not identified with any of the associated risk factors, especially for renal disease, are not mandatory to obtain SCr value. This can reduce many challenges while checking patient's creatinine status, such as patient's booking delays, extra cost and time, additional pricking while taking blood sample. This practice can also increase the departmental throughput and efficiency of service.

Key words: Contrast-induced Nephropathy (CIN), Serum creatinine level, Risk factors

INTRODUCTION

CT examinations are often done using contrast media (CM). Such examinations are called contrast-enhanced CT (CECT).¹ Contrast media are diagnostic agents used to enhance or create the necessary visual contrast in an image between the organs, vessels, or tracts in which they are present and the surrounding tissue in the body. Therefore, it is possible to visualize difference between normal and pathologic conditions.²

Commonly barium or iodine is used as positive CM due to their high density. Barium is used only for gastrointestinal (GI) system while iodine can be used for all other system including GI system also.³

ICM are excreted unmetabolized by glomerular filtration through kidneys. Approximately 12%

of injected dose is found in urine at 10 minutes, 50% at one hour, 83% at 3 hours and about 100% within 24 hours. Less than 1% of the injected dose is excreted through other routes such as liver and small bowel.⁴ Non-idiosyncratic or non-anaphylactic reactions are usually dose dependent and specific for any substance. This type of reaction also includes contrast-media induced nephropathy (CIN).^{5,6}

Most of the medical institutions advise routine screening of serum creatinine (SCr) prior to CECT examinations in order to check the functional status of kidney so that incidence of non-idiosyncratic CIN can be minimized.⁷ The normal range of creatinine may vary among laboratories. Elevated creatinine level may indicate that the kidney is not functioning properly or may be damaged.^{8,9} Routine SCr test is not required for all patients undergoing CECT,

considering the fact that contrast is not always the factor responsible for creatinine elevation.¹⁰ CECT examinations are done for critical diagnostic study which should not be delayed due to excessive concern regarding the possibility of contrast induced nephropathy.¹¹ Major risk factors should be screened out properly and if creatinine testing is required, a creatinine level obtained prior 6 weeks is sufficient for most examinations.¹²

Moreover, Patients may get annoyed due to extra prick while taking sample again. The laboratory cost of obtaining a creatinine level at our institution is significant for poor nepalese and it takes about 2 hours for receiving the lab report. Though the cost and time of reporting may vary among different institutions, this can cause delay in the examination as well as reporting of the examination. Eventually, it is inconvenient for the patient for another laboratory test and there is loss of lots of time. So, we are in need to ask “Are screening serum creatinine levels necessary for all patients prior to contrast enhanced CT examinations?”

MATERIALS AND METHODS

Descriptive cross-sectional study design was used over 250 samples (59% female and 41% male) undergoing contrast enhanced computed tomography in Chitwan Medical College over 2 months of time between June 2016 to September 2016. Age of patients varied from 10 years to 92 years. All the cases were included except for non-contrast CT scans and emergency CT scan. Pre-scan serum creatinine (SCr) level of each patient undergoing CECT examination was obtained and, survey of medical history regarding risk factors for CIN was also taken in each case where investigator was directly involved in data collection. Individuals having SCr level below 1.5 mg/dl (133µmol/L) were categorized to be normal and above that were categorised to be abnormal. Likewise, risk factors included in study were renal diseases, Diabetes, Chemotherapy, Hypertension, Chemotherapy + Diabetes, Diabetes + Hypertension, Renal disease + Hypertension.

Data was entered into a computer analyzed by IBM SPSS 20 after due reviewing of accuracy and completeness in terms of descriptive statistics. MS-Excel was also used for minor calculations and chart

designing

RESULTS

Table1: Age

Age Group	Number of patients	Percentage (%)
10-19	17	6.8
20-29	32	12.8
30-39	39	15.6
40-49	27	10.8
50-59	41	16.4
60-69	55	22.0
70-79	27	10.8
80-89	11	4.4
90-99	1	0.4
Total	250	100

Table 1 shows range of ages varying from 10-99 years. However, Mean age is 49 year which is also mean for females but the mean age of males is 50 years.

Distribution of patients by pre-scan serum creatinine level suggests that 97% of samples were under “Normal group (SCr<1.5 mg/dl)” and 3% were under “Abnormal group (SCr>1.5 mg/dl). Mean level of Scr was 0.8mg/dl but highest and lowest SCr level noted was 7.2 mg/dl and 0.4 mg/dl respectively.

Similarly, association of sex with SCr was tested by Fishers’ exact test and it was found that according to odd ratio, males were 9.188 times (OR=9.188, 95% CI: 1.089-77.51) more likely to have abnormal SCr or elevated SCr as compared to those of females.

Likewise, there was association between risk factors and abnormal SCr level. Calculation of odd ratio (OR=5.938, 95% CI: 1.126-31.314) suggests that patients with risk factors present were 5.938 times more likely to have abnormal SCr or elevated SCr as compared to those without any risk factors present.

Table 2: Distribution of patients with each category of creatinine values and various risk factors:

n=250

Risk factors	Normal		Abnormal	
	N	%	N	%

Renal diseases	54	21.6	3	1.2
Diabetes	3	1.2	0	0
Chemotherapy	9	3.6	0	0
Hypertension	3	1.2	0	0
Chemotherapy + Diabetes	1	0.4	0	0
Diabetes + Hypertension	1	0.4	1	0.4
Renal disease + Hypertension	1	0.4	1	0.4

Table 2 illustrates patients with one or more risk factors categorised under normal and abnormal group. Normal category includes patients having one or more risk factor with creatinine level below 1.5mg/dl and patients with creatinine above 1.5mg/dl is under abnormal.

Association of SCr with various risk factors were also calculated on the basis of odd ratio, and it was that patients with renal disease were 4.558 times more likely to have abnormal SCr or elevated SCr as compared to those without renal disease. Similarly, diabetic patients were 0.158 times more likely to have abnormal SCr or elevated SCr as compared to non-diabetic patients. Likewise, hypertensive patients were 19 times more likely to have abnormal SCr or elevated SCr as compared to non-hypertensive patients. In contrast to the pattern, the test shows no association between chemotherapy and elevated SCr level, may be due to small sample size. However, clinically there is significant association between chemotherapy and elevated SCr.

DISCUSSION

In the study, it was found that 243(97%) of the patients had normal SCr i.e in the range of 0.4 to 1.4 mg/dl. Among the normal 243 respondents, 171(70%) had no risk factors which represent 68% of the total number (250) of patients. This is similar to the finding in the research done by Chyoke et al¹¹, who found 450 of 673 i.e., 67% of patients had normal SCr values with no risk factors present. Also, the research by Tippins RB et al⁷ found that 163 of 240 i.e., 68% had no risk factors present with normal SCr values. This shows that the patients having no any identifiable risk factors do not require undergoing routine SCr test prior to CECT.

Only 3% (7 of 250) patients who underwent CECT had abnormal SCr level ($\geq 1.5\text{mg/dl}$). 71% i.e., 5 of these patients having elevated sCr were identified with risk factors and 57% i.e., 4 of abnormal patients had renal disease. Tippins RB et al⁷ also found that 3.2% (66 of 2034) had elevated SCr level and risk factors were present in 64 of the 66 (97%) and 63 of the 66 i.e., 94% had renal diseases.

The study found the association with elevated SCr values pertained to preexisting renal insufficiency or disease (OR 4.6), hypertension (OR 19.0), chemotherapy (OR 1.03) and diabetes (OR 7.9). Chyoke et al¹¹ found that there is strong association of SCr with preexisting renal disease (OR 13.6), proteinuria (OR 8.7), prior kidney surgery (OR 8.1), hypertension (OR 5.4), gout (4.6), and diabetes (OR 3.2).

However, using Fishers' exact test, it was found that there was no significant association of SCr values with renal disease, diabetes and chemotherapy. The significance of SCr was found only with hypertension. The result might have occurred since the sample size is small and done within short period of time compared to other research articles. Tippins RB et al⁷ had found by using chi square test that the difference was significance ($P < .001$) for renal insufficiency and diabetes with elevated SCr values. Melo J¹³ has found cancer as non-significant risk factor and safe to use contrast media. However, ACR Manual¹⁴ has mentioned renal cancer as risk factor.

There was significant difference in the number of male and female when abnormal SCr category was compared with normal SCr category. Male were 9.188 times more likely to have abnormal SCr as compared to female (OR=9.188, 95% CI: 1.089-77.51). Similarly, Tippins RB et al⁷ also found significant difference in the number of male and female patients when compared between abnormal and normal categories.

CONCLUSION

In this study 68% of total (250) patients were found normal SCr level without any risk factors for CIN and among 3% abnormal categorized patients (SCr $\geq 1.5\text{mg/dl}$) 71% (5 of 7) were identified with risk factors. Among the patients with risk factor which were 76 in number, 5 patients (6.5%) were found to be abnormal with elevated sCr where those having

renal disease was predominant with 3 patients (~4%) while hypertension with diabetes was just single (1.3%) and hypertension with renal disease was also one (1.3%). This suggests that screening of baseline SCr level should be prescribed only to those patients who acquire any of the identifiable risk factors for CIN. Those patients, who are not identified with any of the associated risk factors, can be administered with contrast media without screening for SCr level. This can reduce many challenges while checking patient's creatinine status, such as patient's booking delays, extra cost and time, additional pricking while taking blood sample. This practice can also increase the departmental throughput and efficiency of service.

RECOMMENDATIONS

The following would be recommendations to the CT department:

1. The patients scheduled for CECT should be properly surveyed with following risk factors:
 - a. Renal disease/insufficiency
 - b. Diabetes
 - c. Hypertension
 - d. Chemotherapy
2. If any of the above risk factors are not present, contrast media can be administered without screening for serum creatinine level.

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