Analysis of Factors leading to a Decline in Renal Function post- Coronary Angiography

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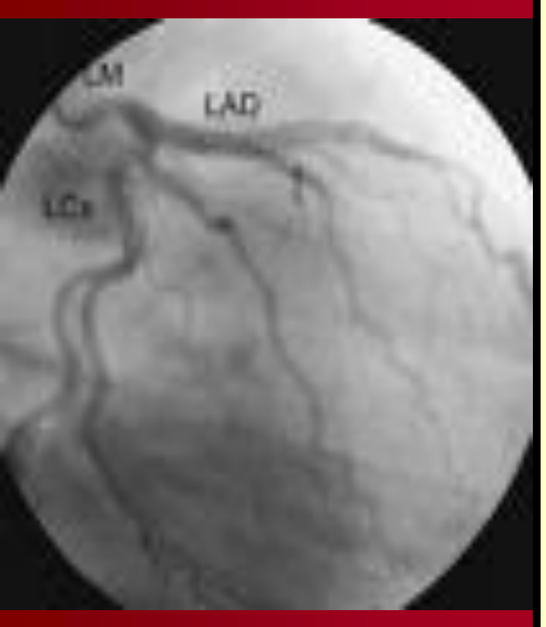

INTRODUCTION

•Contrast-induced nephropathy (CIN) is often a serious adverse event associated with the use of iodinated radiocontrast agents.

•CIN is most commonly defined as acute renal failure occurring within 48-72hr of exposure to intravascular radiographic contrast material that is not attributable to other causes.

•Various independent risk factors have been reported for the development of CIN; however, the underlying pathogenesis is still not fully understood.

OBJECTIVE

To examine the role of:

- Traditional risk factors, mainly diabetes mellitus, advanced age, nephrotoxic heart failure & anaemia;
- New risk factors, including hyperuricaemia, number of diseased coronary vessels, and chronic administration of angiotensin-converting enzyme inhibitors (ACEIs)/ angiotensin receptor blockers (ARBs)

on changes in serum creatinine levels and glomerular filtration rate post- coronary angiography (CA).

METHODS AND MATERIALS

•A prospective cohort study was performed in Caucasian subjects undergoing elective coronary angiography or angioplasty at the Catheterisation Lab, Mater Dei Hospital, Malta.

•Relevant medical and drug history was noted.

•Blood samples for serum creatinine, urea, albumin, fasting plasma glucose, fasting total cholesterol, electrolytes, haemoglobin and eosinophil levels were drawn before coronary angiography. Follow-up serum creatinine, urea, haemoglobin and eosinophil levels were measured 72 hours post-procedure. Baseline estimated glomerular filtration rate (eGFR) was measured using MDRD equation.

•Significance tests were consequently employed to analyse factors that could lead to a decline in renal function following angiography.

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RESULTS

•221 subjects met the inclusion criteria and were included in the analysis. Table 1 shows baseline characteristics of patients studied.

•Univariate analysis of parameters contributing to a rise in serum creatinine post-angiography was performed. Age, male gender, baseline eGFR, FPG, & number of diseased vessels on CA were found to be significant factors (Table 2).

•A multivariate linear regression model was fitted on the decline in renal function after 72 hours. A backward stepwise approach was used; variables with a p value <0.1 in univariate analysis were included in the model. Age (p=0.016, B=0.002), baseline eGFR (p<0.001, B=0.002) and number of diseased vessels (p<0.001, B=0.028) were found to be independent predictors of rise in serum creatinine post-CA.

•12 subjects out of the total had a ≥25% rise in serum creatinine, thus satisfying the arbitrary criteria for CIN. Smoking status, baseline serum sodium, FPG, microalbuminuria, use of diuretics, diabetes mellitus, number of diseased coronary vessels and impairment of left ventricular function were found to be significant contributory factors to 25% rise in serum creatinine (Table 3).

Characteristics	*Study Group*
Age†	62.9 (± 10.2)
Male gender	158 (71%)
Body mass index, kg/m²†	30.3 (± 5.6)
Smokers	14.5%
Systolic blood pressure, mm Hg†	140.7 (± 21.8)
Diastolic blood pressure, mm Hg†	83.6 (± 15.3)
Serum total cholesterol, mmol/L†	4.8 (± 1.1)
Serum LDL-cholesterol, mmol/L†	2.9 (± 1.0)
Serum HDL-cholesterol, mmol/L†	1.2 (± 0.4)
*Serum triglycerides, mmol/L**	1.4 (1.1-1.9)
Baseline serum sodium, mmol/L†	142 ± 2.9
*Fasting plasma glucose, mmol/L**	6.05 (5.44-7.6)
Serum albumin, g/L†	46.3 (± 3.3)
*Haemoglobin, g/dL**	14.3 (13.3-15)
*Serum creatinine, µmol/L**	83 (71-95)
*Serum urea, mmol/L**	7.1 (6-85)
Uric acid, µmol/L†	336.8 (± 86.2)
Estimated glomerular filtration rate, ml/min/1.73m²†	82.6 (± 22.4)
*Microalbumin, mg/L**	5.67 (3-23.82)
Volume of contrast agent, ml†	83.8 (± 22.2)
*Contrast dose/weight (ml/kg)**	1 (0.86-1.29)
*Contrast ratio**	0.19 (0.15-0.27)
Diabetes mellitus	61 (27.6%)
Hypertension	167 (75.6%)
Hypercholesterolaemia	126 (57%)
Gout	5 (2.3%)
Renal impairment	26 (11.8%)
ACE-Is/ ARBs	143 (64.7%)
NSAIDs	1 (0.5%)
Cephalosporins	0 (0%)
Diuretics	63 (28.5%)
Aminoglycosides	1 (0.5%)
Metformin	36 (16.3%)
Coronary Angiogram	159 (72%)
Percutaneous coronary angioplasty	52 (23.6%)
Graft study	5 (2.3%)
Right & Left heart study	4 (1.8%)
Triple chamber pacemaker insertion	1 (0.5%)

Table 1: Baseline characteristics.

Values are expressed as means ± SD†, median (interquartile range)* or number (%) of patients

Parameter	*P value*
Age	**0.03***
Male gender	**0.02***
Body mass index, kg/m²	0.75
Smoking status	0.27
Systolic blood pressure, mm Hg	0.19
Diastolic blood pressure, mm Hg	0.31
Serum total cholesterol, mmol/L	0.8
Serum LDL-cholesterol, mmol/L	0.86
Serum HDL-cholesterol, mmol/L	0.57
Serum triglycerides, mmol/L	0.91
Baseline serum sodium, mmol/L	0.06
Fasting plasma glucose, mmol/L	**0.03***
Serum albumin, g/L	0.39
Haemoglobin, g/dL	0.25
Serum urea, mmol/L	0.63
Uric acid, µmol/L	0.34
Microalbumin, mg/L	0.6
Baseline eGFR, ml/min/1.73m²	**<0.001***
Volume of contrast agent/ weight, ml/kg	0.09
Contrast ratio	0.5
Diabetes mellitus	0.095
Hypertension	0.63
Hypercholesterolaemia	0.61
Gout	0.08
Renal impairment	0.4
ACE-Is/ ARBs	0.78
Diuretics	0.48
Metformin	0.26
Number of diseased coronary vessels	**<0.001***
Left Ventricular Function	0.15

Table 2: Univariate analysis of parameters contributing to rise in serum creatinine post-CA

Parameter	*P value*
Age	0.14
Male gender	0.19
Body mass index, kg/m²	0.19
Smoking status	**0.04***
Systolic blood pressure, mm Hg	0.77
Diastolic blood pressure, mm Hg	0.29
Serum total cholesterol, mmol/L	0.81
Serum LDL-cholesterol, mmol/L	0.76
Serum HDL-cholesterol, mmol/L	0.5
Serum triglycerides, mmol/L	0.3
Baseline serum sodium, mmol/L	0.005*
Fasting plasma glucose, mmol/L	0.02*
Serum albumin, g/L	0.28
Haemoglobin, g/dL	0.15
Serum urea, mmol/L	0.23
Uric acid, µmol/L	0.09
Microalbumin, mg/L	**0.03***
Baseline eGFR, ml/min/1.73m²	0.38
Volume of contrast agent/ weight, ml/kg	0.24
Contrast ratio	0.1
Diabetes mellitus	**0.02***
Hypertension	0.3
Hypercholesterolaemia	0.24
Gout	1.00
Renal impairment	1.00
ACE-Is/ ARBs	0.06
Diuretics	**0.04***
Metformin	0.11
Multivessel Coronary Artery Disease	**0.001***
Left Ventricular Function	**0.004***

Table 3: Univariate analysis of parameters contributing to 25% rise in creatinine post-CA

CONCLUSIONS

CIN is an important complication of procedures involving contrast administration. The number of vessels having significant stenosis on CA is possibly a strong indicator of underlying impairment in renal circulation which in combination with contributing factors, mainly diabetes, microalbuminuria and left ventricular impairment, can lead to a significant decline in renal function. These factors should alert the physician to preventive measures, mainly adequate hydration of the patient at risk.