

# Relation between Preoperative Mild Increased in Serum Creatinine Level and Early Outcomes after Coronary Artery Bypass Grafting

Hassan Radmehr<sup>1</sup>, Seyed Khalil Forouzannia<sup>2</sup>, Ali Reza Bakhshandeh<sup>1</sup>, and Mehdi Sanatkar<sup>1</sup>

<sup>1</sup> Cardiovascular Surgery Department, Imam Khomeini Medical Center, Tehran University of Medical Sciences, Tehran, Iran

<sup>2</sup> Cardiovascular Research Center, Afshar Hospital, Shahid Sadooghi University of Medical Sciences, Yazd, Iran

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**Abstract-** This study evaluates the effect of preoperative increased level of serum creatinine (Cr) on early outcomes after coronary artery bypass graft surgery (CABG). 1140 patients who underwent CABG in our center were studied. Patients with Cr >2.25 mg/dl or preoperative dialysis and who had off-pump operations were excluded. Group 1 consisted of 892 patients with normal Cr (0.5-1.2 mg/dl) and group 2 consisted of 248 (21.8%) patients with mild increased level of serum Cr (1.3-2.2 mg/dl). Patients in group 1 were younger than group 2. There were more patients with hypertension in group 2, but there were not statistically significant difference between two groups in terms of the frequency of diabetes, smoking, cerebrovascular disease and New York Heart Association (NYHA) class. Left ventricular ejection fraction (LVEF) was lower in group 2. Cardiopulmonary bypass time (CPB) was longer in group 2. Early mortality was 3.2% in group 1 and 8.4% in group 2 ( $P < 0.001$ ). Prolonged ICU stay, low cardiac output, prolonged mechanical ventilation, postoperative atrial fibrillation, postoperative re-exploration and sepsis were more frequent in group 2. Mild increase in serum Cr level preoperatively is a marker of increased early mortality and outcome after CABG.

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**Keywords:** Serum creatinine; Coronary artery bypass graft surgery; Early mortality

## Introduction

Preoperative renal failure is a documented predisposing factor for morbidity and mortality after coronary artery bypass graft surgery (CABG) (1,2). In patients with mild decrease in renal function there is little known about the outcome after CABG. Previous studies showed that higher preoperative levels of Cr were associated with increased one year mortality (3,4). Another study demonstrated that higher absolute changes in Cr were associated with a significant increase in 3 years mortality (5, 6). A similar study showed that patients with increased Cr levels after cardiac surgery had higher long term mortality (7).

Patients with preoperative serum Cr level higher than 2.25 mg/dl were excluded from this study and defined as patients with renal insufficiency. The aim of this study was to compare early mortality and outcomes between patients with normal preoperative Cr and patients with mild rise in Cr level under 2.25 mg/dl who have not been diagnosed with renal insufficiency.

## Patients and Methods

We studied 1280 patients in our center that underwent CABG from July 2008 till May 2010, and evaluated preoperative Cr levels. Patients with Cr >2.25 mg/dl or preoperative dialysis and who had off-pump operations were excluded leaving 1140 patients in our study. Patients were stratified by the level of Cr: patients with normal Cr (0.5-1.2 mg/dl) (n=892) as group 1 and patients with mild increased level of serum Cr (1.3-2.2 mg/dl) as group 2 (n=248, 21.8%). Postoperative renal insufficiency was defined as Cr >2.2 mg/dl after CABG or the need for dialysis support. Our study was approved by the ethical committee of our center. All patients were operated using standard median sternotomy, cardiopulmonary bypass and cardioplegic arrest. All patients underwent CABG in moderate hypothermia and perfusion pressure was kept between 60 and 70 mmHg. For myocardial protection we used cold blood antegrade and retrograde cardioplegia.

**Corresponding Author:** Mehdi Sanatkar

Cardiovascular Surgery Department, Imam Khomeini Medical Center, Tehran University of Medical Sciences, Tehran, Iran.  
Tel: +98 21 66925901, Fax: +98 21 6929977, E-mail: mehdi\_sanatkar@yahoo.com

**Table 1.** Comparison of study characteristics in patients with normal renal function and patients with mild renal dysfunction

| Study characteristics | Normal renal function | Increase in preoperative creatinine | P value |
|-----------------------|-----------------------|-------------------------------------|---------|
| Age (mean)            | 57.8                  | 62.2                                | <0.01   |
| Sex (male %)          | 65                    | 68                                  | 0.4     |
| DM (%)                | 45.8                  | 48.6                                | 0.65    |
| HTN (%)               | 40.5                  | 59.2                                | 0.01    |
| CVA (%)               | 1.6                   | 5.2                                 | 0.08    |
| PVD (%)               | 0.97                  | 2.6                                 | 0.2     |
| Smoke (%)             | 22.8                  | 21                                  | 0.73    |
| NYHA 4                | 8.73                  | 9.2                                 | 0.89    |
| EF <40%               | 10.2                  | 21.1                                | 0.01    |
| CPB (min)             | 100                   | 116                                 | <0.001  |

DM: diabetes mellitus, HTN: hypertension, CVA: cerebrovascular accident, PVD: peripheral vascular disease, NYHA: New York Heart Association classification, EF: ejection fraction, CPB: cardiopulmonary bypass time.

We assessed early postoperative mortality and outcomes in both groups. Variables were tested for their associations with serum Cr level by using student t tests, chi-square test or logistic regression as appropriate. Variables that compared between two groups were New York Heart Association (NYHA) classification, hypertension, diabetes, ejection fraction, cerebrovascular events and cardiopulmonary bypass time. Outcomes included operative mortality and 30-day mortality, prolonged mechanical ventilation, postoperative atrial fibrillation, low cardiac output, infection, re-exploration and ICU stay.

## Results

Patients in group 1 were younger than group 2 ( $P<0.01$ ), but two groups were almost identical based on gender distribution ( $P=0.4$ ). There were more patients with hypertension in group 2, but there were not statistically significant difference between two groups for diabetes, smoking, cerebrovascular disease and NYHA classes. Left ventricular ejection fraction (LVEF) was lower in

Group 2 ( $P=0.01$ ). Demographic data are summarized in Table 1.

All patients in both groups underwent CABG, and cardiopulmonary bypass time (CPB) was longer in group 2 ( $P<0.001$ ). Operative mortality was not significantly different between two groups, however early mortality was 3.2% in group 1 and 8.4% in group 2 ( $P<0.001$ ). There were more patients requiring prolonged ICU stay in group 2 ( $P=0.04$ ).

Low cardiac output (LCO) and need to intra aortic balloon pump (IABP) was lower in group 1 in comparison with group 2 ( $P=0.03$ ). Prolonged mechanical ventilation was more frequent in group 2 ( $P<0.001$ ) and postoperative atrial fibrillation (AF) was less frequent in group 1 ( $P<0.01$ ). Moreover, re-exploration as a result of bleeding and sepsis was more often in group 2 ( $P<0.01$ ). Early outcomes of both groups are summarized in Table 2.

The present study is a retrospective study and has the limitations of other retrospective studies carried out in a single referral unit.

**Table 2.** Comparison of post-operative outcomes between patients with normal renal function and patients with mild renal dysfunction

| Post-operative outcomes      | Normal renal function | Increase in preoperative creatinine | P value |
|------------------------------|-----------------------|-------------------------------------|---------|
| Early Death (%)              | 3.2                   | 8.4                                 | <0.001  |
| Post operative AF (%)        | 4.2                   | 20                                  | 0.001   |
| Re-exploration (%)           | 4.61                  | 11.8                                | <0.01   |
| IABP (%)                     | 3.39                  | 6.8                                 | 0.03    |
| Sepsis (%)                   | 2.9                   | 7.8                                 | <0.01   |
| ICU stay (days)              | 2.4                   | 4.7                                 | 0.04    |
| Mechanical ventilation (hrs) | 16.8                  | 28.2                                | <0.001  |

AF: atrial fibrillation, IABP: intra aortic balloon pump.

## Discussion

Slightly high preoperative Cr level without renal failure was common among patients underwent CABG in our study (n=248, 21.8%). The frequency of patients with impaired renal function among the CABG candidates is rising due to increasing prevalence of diabetes, hypertension, congestive heart failure and arteriosclerotic disease (9). Previous studies have shown that preoperative mild renal failure has significant impact on early and late outcomes in patients underwent CABG surgery (10-12). In present study two groups were separated based on serum Cr levels. Measurement of serum Cr is readily available and is a sensitive indicator for renal impairment. However, serum Cr level does not assess renal failure due to age and gender and other issues. Previous studies showed that patients with preoperative renal failure have higher mortality compared with patients with normal renal function (13, 14). Previous studies have shown that in-hospital mortality has been associated with high preoperative Cr (15), postoperative Cr (16) and preoperative-to-postoperative increases in Cr (17). Patients with preoperative mild renal impairment (without renal failure) are also reported to have higher early mortality (18). We found that operative mortality was not significantly different between two groups, but early mortality was significantly higher in group 2. Aarne Jyrälä *et al.* showed that operative mortality was similar in patients with normal renal function and mild increased Cr level but hospital mortality was higher in second group (9). In this mentioned study low cardiac output and infection were more frequent in group 2. Brown *et al.* discovered distinct associations between elevated serum Cr levels, low cardiac output syndrome and infection (6). These associations may suggest that these clinical manifestations could present prior to the elevation in serum Cr levels and might result in damage to the kidneys (6). In our study CPB time, prolonged ICU stay, prolonged mechanical ventilation, postoperative atrial fibrillation and re-exploration were more common in group 2. LVEF was also lower in patients with higher Cr levels. We assume that impaired cardiac function may predispose patients to renal dysfunction and increase in preoperative serum Cr level. Patients with mild renal impairment and elevated serum Cr level have a much higher incidence of hypertension than control group and this risk factor may have an impact on renal function and increase in the likelihood of late renal failure. Patients in group 1 were younger in comparison with group 2. This may also lead to renal

impairment due to increased incidence of arteriosclerotic diseases in older population. In conclusion, elevated serum Cr level is a reliable indicator for increased early mortality and other morbidities such as prolonged ICU stay, LCO, prolonged mechanical ventilation support, postoperative atrial fibrillation, re-exploration and sepsis after CABG. We recommend that all modifiable risk factors should be optimized preoperatively in these patients who undergo CABG surgery.

## References

1. Devbhandari MP, Duncan AJ, Grayson AD, Fabri BM, Keenan DJ, Bridgewater B, Jones MT, Au J; North West Quality Improvement Programme in Cardiac Interventions. Effect of risk-adjusted, non-dialysis-dependent renal dysfunction on mortality and morbidity following coronary artery bypass surgery: a multi-centre study. *Eur J Cardiothorac Surg* 2006;29(6):964-70.
2. Hirose H, Amano A, Takahashi A, Nagano N. Coronary artery bypass grafting for patients with non-dialysis-dependent renal dysfunction (serum creatinine  $\geq$  2.0 mg/dl). *Eur J Cardiothorac Surg* 2001;20(3):565-72.
3. Lok CE, Austin PC, Wang H, Tu JV. Impact of renal insufficiency on short- and long-term outcomes after cardiac surgery. *Am Heart J* 2004;148(3):430-8.
4. Dacey LJ, Liu JY, Braxton JH, Weintraub RM, DeSimone J, Charlesworth DC, Lahey SJ, Ross CS, Hernandez F Jr, Leavitt BJ, O'Connor GT; Northern New England Cardiovascular Disease Study Group. Long-term survival of dialysis patients after coronary bypass grafting. *Ann Thorac Surg* 2002;74(2):458-62.
5. Lassnigg A, Schmidlin D, Mouhieddine M, Bachmann LM, Druml W, Bauer P, Hiesmayr M. Minimal changes of serum creatinine predict prognosis in patients after cardiothoracic surgery: a prospective cohort study. *J Am Soc Nephrol* 2004;15(6):1597-605.
6. Brown JR, Cochran RP, Dacey LJ, Ross CS, Kunzelman KS, Dunton RF, Braxton JH, Charlesworth DC, Clough RA, Helm RE, Leavitt BJ, MacKenzie TA, O'Connor GT. Northern New England Cardiovascular Disease Study Group. Perioperative increases in serum creatinine are predictive of increased 90-day mortality after coronary artery bypass graft surgery. *Circulation* 2006;114(1 Suppl):I409-13.
7. Loeff BG, Epema AH, Smilde TD, Henning RH, Ebels T, Navis G, Stegeman CA. Immediate postoperative renal function deterioration in cardiac surgical patients predicts in-hospital mortality and long-term survival. *J Am Soc Nephrol* 2005;16(1):195-200.

8. Provenchère S, Plantefève G, Hufnagel G, Vicaut E, De Vaumas C, Lecharny JB, Depoix JP, Vrtovsnik F, Desmonts JM, Philip I. Renal dysfunction after cardiac surgery with normothermic cardiopulmonary bypass: incidence, risk factors, and effect on clinical outcome. *Anesth Analg* 2003;96(5):1258-64.
9. Jyralaa A, Weissb RE, Jeffriesb RA, Kaya GL. Effect of mild renal dysfunction (s-crea 1.2–2.2 mg/dl) on presentation characteristics and short- and long-term outcomes of on-pump cardiac surgery patients. *Interact CardioVasc Thorac Surg* 2010;10:777-82.
10. Simon C, Luciani R, Capuano F, Miceli A, Roscitano A, Tonelli E, Sinatra R. Mild and moderate renal dysfunction: impact on short-term outcome. *Eur J Cardiothorac Surg* 2007;32(2):286-90.
11. Zakeri R, Freemantle N, Barnett V, Lipkin GW, Bonser RS, Graham TR, Rooney SJ, Wilson IC, Cramb R, Keogh BE, Pagano D. Relation between mild renal dysfunction and outcomes after coronary artery bypass grafting. *Circulation* 2005;112(9 Suppl):I270-5.
12. Filsoufi F, Rahmanian PB, Castillo JG, Chikwe J, Carpentier A, Adams DH. Early and late outcomes of cardiac surgery in patients with moderate to severe preoperative renal dysfunction without dialysis. *Interact CardioVasc Thorac Surg* 2008;7(1):90-5.
13. Cooper WA, O'Brien SM, Thourani VH, Guyton RA, Bridges CR, Szczech LA, Petersen R, Peterson ED. Impact of renal dysfunction on outcomes of coronary artery bypass surgery: results from the Society of Thoracic Surgeons National Adult Cardiac Database. *Circulation* 2006;113(8):1063-70.
14. Howell NJ, Keogh BE, Bonser RS, Graham TR, Mascaro J, Rooney SJ, Wilson IC, Pagano D. Mild renal dysfunction predicts in-hospital mortality and post-discharge survival following cardiac surgery. *Eur J Cardiothorac Surg* 2008;34(2):390-5.
15. Weerasinghe A, Hornick P, Smith P, Taylor K, Ratnatunga C. Coronary artery bypass grafting in non-dialysis-dependent mild-to-moderate renal dysfunction. *J Thorac Cardiovasc Surg* 2001;121(6):1083-9.
16. Zanardo G, Michielon P, Paccagnella A, Rosi P, Caló M, Salandin V, Da Ros A, Michieletto F, Simini G. Acute renal failure in the patient undergoing cardiac operation. Prevalence, mortality rate, and main risk factors. *J Thorac Cardiovasc Surg* 1994;107(6):1489-95.
17. Stafford-Smith M, Reddan DN, Phillips-Bute B, Newman MF, Winn MP. Association of perioperative creatinine-derived variables with mortality and other outcomes after coronary bypass surgery. *Anesth Analg* 2001;92(Suppl):SCA28.
18. Kilo J, Margreiter JE, Ruttman E, Laufer G, Bonatti JO. Slightly elevated serum creatinine predicts renal failure requiring hemofiltration after cardiac surgery. *Heart Surg Forum* 2005;8(1):E34-8.