

Renal insufficiency after infrarenal abdominal aortic aneurysm reconstruction: An analysis of this risk factor in 45 patients

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Abstract

Background: Renal insufficiency is a potential complication after infrarenal abdominal aortic aneurysm repair and is a significant risk factor for postoperative mortality and morbidity. The aim of this study was to analyze the effect of this risk factor, before and during operation.

Methods: In this prospective study, between 2003 and 2006, 45 patients underwent repair of an infrarenal abdominal aortic aneurysm. Elective surgical repair was performed in 34 patients and 11 patients underwent immediate surgical repair of ruptured aneurysms. There were 41 males and 4 females. The mean age was 68 years. The patients were divided into four groups depending on their preoperative serum creatinine (Scr), group I, serum creatinine less than 1.4 mg/dl, group II $1.4 \leq \text{Scr} < 2$ mg/dl, group III $2 \leq \text{Scr} < 2.5$ mg/dl and group IV $\text{Scr} \geq 2.5$ mg/dl. In each group postoperative changes in renal function were analyzed.

Results: Several factors significantly influenced postoperative serum creatinine concentration and BUN level. These factors were: previous renal disease (diabetic nephropathy and renal artery stenosis), ruptured aneurysm and profound shock, blood transfusion greater than 4 units, duration of clamping time (greater than 2 hrs and 10 min), and age over 65 years.

The postoperative rise in serum creatinine level was noted in 33 patients (73.3%) and BUN increased in 27 cases (60%), but only 2 patients out of these 33 patients required hemodialysis. Renal function recovery occurred after several days of surgery (3 to 5 days).

Conclusion: The cause of renal dysfunction after elective or emergency repair of an infrarenal abdominal aortic aneurysm is multifactorial and the most important predictor is preoperative renal insufficiency, so special precautions are appropriate in such patients for prevention of this complication. Decreasing the aortic clamp time, operative time and blood loss, and administration of optimal volume loading seems to be essential.

Keywords: renal insufficiency, infrarenal abdominal aortic aneurysm, hemodialysis

Introduction

Renal insufficiency is the second most frequent complication (the most common is myocardial ischemia), and occurs following 6% of elective aneurysm repairs and is more com-

monly encountered in ruptured cases [1,2].

Renal failure can occur for several reasons, the most common being inadequate volume replacement and hypoperfusion [3]. Other factors causing renal failure are elevated preoperative creatinine concentration, contrast administration, amount of blood loss and blood transfusion

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Baseline Scr	Number (%)	Scr (rise) (%)	Scr (decrease) (%)	Without significant change (%)
Group I: Scr<1.4mg/dl	31 (68.8%)	23 (1.1%)	4 (8.8%)	4 (8.8%)
Group II: $1.4 \leq \text{Scr} < 2$ mg/dl	9 (20%)	7 (15.5%)	1 (2.2%)	1 (2.2%)
Group III: $2 \leq \text{Scr} < 2.5$ mg/dl	2 (4.4%)	1 (2.2%)	1 (2.2%)	--
Group IV: Scr ≥ 2.5 mg/dl	3 (6.6%)	2 (4.4%)	1 (2.2%)	--
Total	45	33 (73.3%)	7 (15.5%)	5 (11.2%)

Table 1. Baseline serum creatinine and serum creatinine changes after operation (Scr = serum creatinine).

[5,6].

Renal function assessment preoperatively via serum electrolytes, blood urea nitrogen and creatinine measurement and accurate information regarding baseline renal function has important therapeutic and prognostic implications. Patients with severely impaired renal function frequently require at least temporary hemodialysis after surgery; these patients also have a significantly higher mortality and morbidity rate [7,8,9].

The aim of this study is to analyze the effect of major risk factors on renal function.

Methods

Between April 2003 and July 2006, 45 patients underwent Dacron graft replacement of the infrarenal abdominal aortic aneurysm. Elective surgical repair was performed in 34 patients and 11 patients underwent emergency

surgical repair (ruptured aneurysms). There were 41 males and 4 females and the mean age was 68 years. The hospital stay was between 7 to 45 days.

All of the patients were heavy smokers, and 41 patients had a history of hypertension. All operations were performed through a standard transperitoneal median laparotomy.

Type of anastomosis in 34 cases was aortoiliac bypass, in 9 cases aorto-aortic with tubular graft and in two cases aortobifemoral bypass.

Baseline serum creatinine (Scr) was divided into four groups: less than 1.4 mg/dL, $1.4 \leq \text{Scr} < 2$ mg/dL, $2 \leq \text{Scr} < 2.5$ mg/dL and Scr ≥ 2.5 mg/dL. The postoperative changes in renal function were analyzed, after repair, during hospitalization period and before discharge. Renal insufficiency was defined as an increase in serum creatinine greater than 30% from a preoperative value, any serum creatinine con-

Number of patients	BUN increase	BUN decrease	Without significant change in BUN level
45	27 (60%)	17 (37.7%)	1 (2.3%)

(A)

BUN increase > 10mg/dl	BUN increase < 10mg/dl
9 (33.3%)	18 (66.7%)

(B)

Table 2. (A) BUN level changes after surgery - (B) BUN rise divided into two groups: Less than 10 mg/dl and greater than 10 mg/dl.

Baseline Serum creatinine	Mild to moderate rise in Scr (%)	severe rise in Scr (%)
Group I	16 (48.4%)	7 (21.2%)
Group II	4(12.2%)	3(9%)
Group III	--	1(3.1%)
Group IV	--	2(2.6%)
Total	20(60.6%)	13(39.4%)

Table 3. Classification of patients who had serum creatinine rise after surgery depending on their preoperative creatinine.

centration in excess of 2 mg/dL or any need for hemodialysis.

Previous renal disease and preoperative renal dysfunction, duration of aortic clamping, amount of blood transfusion, profound shock (ruptured aneurysm), and age over 65 years, were the major risk factors assessed.

Results

The significant risk factors were assessed in this study and the effect of each of them on renal function are discussed in the following:

Serum creatinine and BUN levels

In 33 cases (73.3%) a rise in serum creatinine concentration occurred.

In 7 cases (15.5%) serum creatinine level decreased postoperatively and in 5 patients (11.2%) serum creatinine level did not have any change (Table 1). In 27 cases (60%) BUN levels increased, in 17 cases (37.7%) BUN levels decreased, and in one case (2.3%) BUN levels didn't change (Table 2).

In 22 cases (48.8%) elevation of BUN level was parallel to the rise of serum creatinine concentration. In group IV, one patient underwent temporary hemodialysis (he had renal artery stenosis and baseline serum creatinine level was 3.6 mg/dL), but he was discharged without further need for hemodialysis, and one patient required hemodialysis during hospital stay and after discharge, because of severe renal insufficiency (he had diabetic nephropathy and baseline serum creatinine level was 4mg/dL).

Most patients (60.6%) demonstrated limited to moderate increase in serum creatinine concentration and renal function recovery occurred after 3 to 5 days (Table 3 and Fig. 1).

Associated renal disease (e.g. diabetic nephropathy and renal artery occlusive disease) influ-

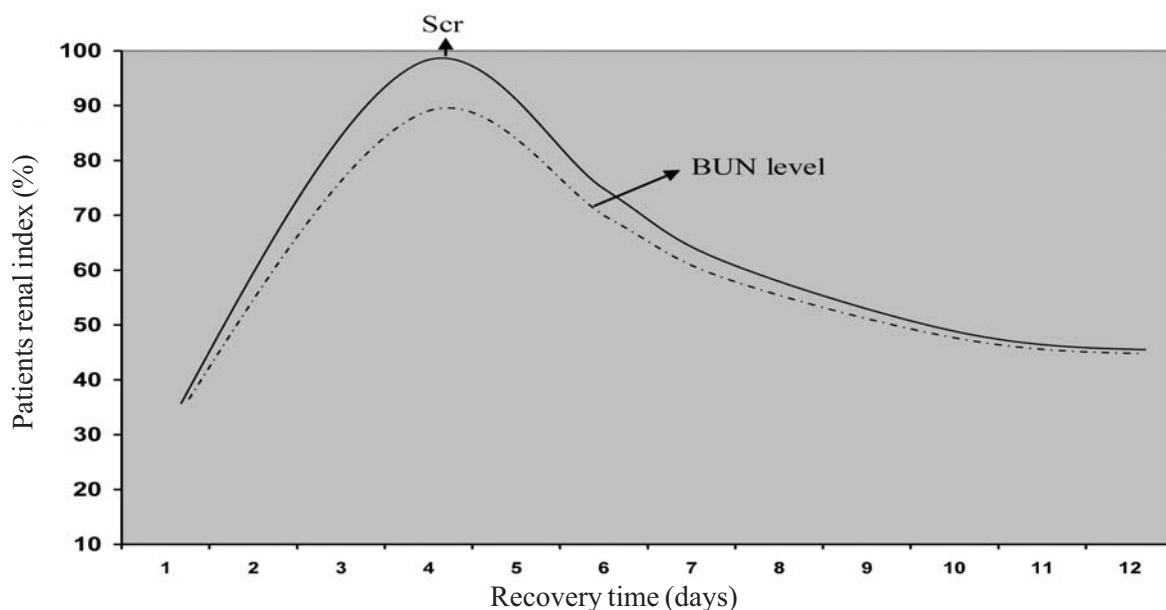


Fig. 1. Renal insufficiency and recovery time.

Clamping time	Severe rise in Scr (%)	Mild to moderate rise in Scr (%)	Without significant change in Scr (%)
≥ 130 min N=25	10 (22.3%)	13 (28.8%)	1 (2.3%)
< 130 min N=21	3 (6.7%)	7 (15.5%)	11 (24.4%)

Table 4. Clamping time and serum creatinine change. (N=number of patients, Scr=serum creatinine).

ences renal function, as mentioned above and in the two cases that underwent hemodialysis, one patient had diabetic nephropathy and another one had renal artery stenosis.

Aortic clamping time

The postoperative rise in the serum creatinine concentration after cross-clamping for 2 hrs and 10 min was significantly higher than that after cross clamping for < 2 hrs and 10 min (Table 4). The increase in serum creatinine and blood urea nitrogen levels were correlated positively with the duration of aortic clamping time and this time was greater in the patients who needed aortobifemoral and aortoiliac bypass graft, rather than those patients who underwent aorto-aortic tubular graft insertion. Thus, careful attention must be paid to decreasing the aortic clamping time.

Hypotension and profound shock

In patients with a ruptured abdominal aortic aneurysm, preoperative oliguria may lead to a complete renal shutdown lasting several days to several weeks postoperatively. In this study, most of our 9 patients with ruptured aneurysm

demonstrated a moderate to severe increase in serum creatinine concentration. In 7 patients, serum creatinine doubled and peaked above 2 mg/dL, but returned to baseline levels within several days, and they required close monitoring and prolonged hospital care during the post-operative period.

Blood transfusion

Patients who required packed red blood cells more than 4 units (excluding those who had hypotension) showed a rise in serum creatinine concentration between 0.3 – 0.5 mg/dL greater than in those patients who were administered less than 4 units packed RBC (Table 5).

Age

This study showed that age over 65 years is an independent factor and may influence renal function recovery. In most patients who were under 65 years, serum creatinine level returned to baseline after 3 to 5 days, but in patients over 65 years, serum creatinine returned to baseline after five days and hospital stay was longer.

Need for blood transfusion (%)	Severe rise in Scr (%)	Mild to moderate rise in Scr (%)	Without significant change in Scr (%)
≥ 4 units N=27	9(20%)	16(35.5%)	2(4.4%)
< 4 units N=18	4(8.8%)	4(8.8%)	10(22.2%)

Table 5. Amount of blood transfusion and serum creatinine changes (N=number of patients, Scr= serum creatinine).

Conclusion

The present study demonstrates that renal dysfunction after elective or emergency infrarenal abdominal aortic aneurysm repair is multifactorial, and preoperative renal function is an important predictor of postoperative renal insufficiency. This study found that age over 65 years, clamping time over 2 hrs and 10 min, amount of blood transfusion, dehydration, and/or shock before surgery, influences renal function.

Previous renal disease is a more important risk factor, and when other risk factors add to it, severe renal insufficiency may occur [9,10, 11,12]. Thus, because preoperative renal insufficiency is the best predictor of postoperative renal failure, special precautions such as decreasing the aortic clamp time, operative time and blood loss, are appropriate in these patients [13].

Because of the renal toxicity of intravenous contrast material, it is prudent to delay abdominal aortic aneurysm repair after arteriography or contrast-enhanced CT, to be certain that renal dysfunction has not been induced.

If renal dysfunction becomes evident, volume expansion, blood pressure support, or treatment of heart failure may result in reversal of renal insufficiency following repletion of intravascular volume. Diuretic administration may convert oliguric to nonoliguric renal failure, which facilitates management and perhaps improves the prognosis [14,15,16].

References

1. Zarins CK, Heikkinen MA. Aneurysmal Vascular Disease. In: Townsend CM, Beauchamp RD. Sabiston Text Book of Surgery. 17th ed. Philadelphia: WB. Saunders Co; 2004.pp.1965-1987.
2. Haimovici H. Abdominal aortic aneurysm. In: Haimovici H. Vascular surgery; Principles and Techniques. 2nd ed. East Norwalk: Appleton – Century-Crofts; 1984. pp. 709- 710.
3. Arok FR, Zarins CK. Repair of infraabdominal aortic aneurysms. In: Wilmore DW. ACS surgery: principles and practice. New York: Web MD Corporation; 2002.pp. 937- 947.
4. Lumsden AB, Lin PH, et al. Arterial Disease. In: Brunicaudi F.C. Schwartz's principles of surgery. 8th ed. New York: Mc Graw- Hill Co; 2005.pp. 732- 759.
5. McCombs PR, Roberts B. Acute renal failure following resection of abdominal aortic aneurysm. Surg Gynecol Obstet 1979; 148: 179.
6. Chawla SK, Najafi H, et al. Acute renal failure complicating ruptured abdominal aortic aneurysm. Arch Surg 1975; 110: 521.
7. Diehl JT, Cali RF, Hertzner NR, Beven EG. Complications of abdominal aortic reconstruction, An analysis of perioperative risk factors in 557 patients. Ann Surg 1983; 197: 49-56.
8. Sever K, Kiziltan F, et al. The surgical treatment of abdominal aortic aneurysm in patients with light to moderate renal dysfunction. Acta chir Belg 2004; 104 (6): 695-670.
9. Norwood MG, Polimenov NM, et al. Abdominal aortic aneurysm in patients with chronic renal disease. Eur J vasc surg; 2004; 27 (3): 287- 91.
10. Umeda Y, Mori Y, Takagi H, et al. Surgical outcome of abdominal aortic aneurysm repair in patients undergoing chronic hemodialysis. Heart Vessels 2003; 18 (1): 7-11.
11. Godet G, Fleron MH, et al: Risk factors for acute postoperative renal failure in thoracic or thoraco-abdominal aortic surgery: a prospective study. Anesth Analg 1997; 85 (6): 1227- 32.
12. Cohen JR, Mannick JA, Couch NP, et al. Abdominal aortic aneurysm repair in patients with preoperative renal failure. J Vasc Surg 1986; 3(6): 867-70.
13. Bush HL, et al. Prevention of renal insufficiency, after abdominal aortic aneurysm resection by optimal volume loading. Arch surg 1981; 116 (12): 1517-24.
14. Carroccio A, Hollier LH. Abdominal aortic aneurysm. In: Ascher E. Haimovici's vascular surgery. 5th ed. Massachusetts: Blackwell Publishing; 2004. pp. 726-729.
15. Stokes J, Butcher HR. Abdominal aortic aneurysms: factors influencing operative mortality and criteria of operability. Arch Surg 1973; 107: 297.
16. Crawford ES, Saleh SA, Babb JW, et al. Infrarenal abdominal aortic aneurysms after operation. Performed over a 25- year period. Ann Surg 1981; 193: 699-709.