Renal Impairment After Valvular Heart Surgery in Adult

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ABSTRACT:

BACKGROUND:

Cardiac surgery can either induce acute renal failure or improve GFR by improving the cardiac performance. Acute renal shutdown (urine output <0.5ml/kg/hr.) is an uncommon but fatal complication which occurs in cases of insufficient cardiac function and may be accompanied with multi-organ failure. Acute renal failure (ARF) after open heart valve surgery occurs in about 8% of adult cardiac surgical patients with some preoperative renal impairment and in about 3-4% of patients with normal preoperative renal function test. This study was done to determine the frequency of acute renal shutdown after valvular open heart surgery and to detect any suggestive risk factors.

METHODS:

90 patients undergoing valve replacement (mitral and/ or aortic) were prospectively evaluated in three time periods: before, 24 hours after surgery and 48 hours after surgery. The association between preoperative, intra-operative and postoperative variables and the development of ARF was assessed thoroughly.

RESULTS:

Of the 90 consecutive patients 3 (3.49%) patients developed acute renal failure (serum creatinine>2.5 mg/dl) and 16 (18.6%) patients developed acute renal dysfunction (serum creatinine 1.6-2.4 mg/dl). The risk factors that were noted in the development of ARF were age, raised preoperative blood urea and creatinine, low cardiac output state, diabetes mellitus, oligurea, total cross clamp time total CPB time, and significant hypotension during the procedure or during intensive care unit (ICU) stay. Mortality rate for established ARF was extremely poor (50 %).

CONCLUSION:

Avoidance of this dangerous outcome looks better than trying to treat once it is fully established.

KEY WORDS: Acute renal failure, acute renal shutdown, cardiopulmonary bypass surgery, valve replacement.

INTRODUCTION:

Acute renal failure (ARF) is an unusual and severe complication which may occur in patients following cardiac surgery. The incidence of ARF is from 1% to 15% (according to some authors up to 40%) [1,2]. It is more common in old age people and in those who are preoperatively suffer from oligurea or renal dysfunction, low cardiac output [3,4]. Low cardiac output is thought to be the primary cause of renal failure after open heart surgery [5]. Measures that elevate cardiac output generally improve renal blood flow. If urine output exceeds 0.5 ml/kg/hr after cardiac surgery and cardiac output is 2.4 L/m^2 / min or more, renal function is probably sufficient [6,7]. Acute tubular necrosis is a serious complication of cardiopulmonary bypass and is associated with increased morbidity and mortality [8]. A prolonged hypotension is the usual cause that results in nephron ischemia and reduced renal cortical blood flow. During bypass, renal blood flow may be reduced by periods of low perfusion flow, hypotension, vasoconstriction (e.g., dopamine etc.) and micro emboli [6]. Excessive plasma hemoglobin filtered by the glomeruli precipitates in the renal tubules when the urine is acid [9,10,11]. The major concern is that occurrence of postoperative ARF is still associated with a high mortality rate ranging from 24% to 70%. The multifactorial nature of the postoperative ARF and its independent ability as a predictor of mortality is also well recognized [12]. This study was undertaken to evaluate the proportion of patients developing postoperative ARF, their mortality and morbidity with a view to aid in subsequent patient management.

MATERIAL AND METHODS:

This study was carried out at Ibn Al Bitar cardiac hospital / Baghdad / Iraq, from January 2006 to April 2008 which is a referral hospital, dedicated to the treatment of cardiac diseases. We studied 90

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consecutive adult patients who underwent valve replacement operation with cardiopulmonary bypass. Patients who died within the first twenty-four hours after the operation (minimum time required for laboratory assessment of renal function) were excluded from the study. The data were recorded in a data sheet.

Preoperative: Age, body weight, height, hemodynamic state, blood urea & creatinine.

Intraoperative: Duration of CPB, mean CPB flows, perfusion pressures (mean), volume of urine output during CPB, inotropic support.

Postoperative: Inotropic support, Intra-aortic balloon pump (IABP) used, blood urea and creatinine, urine output, need of dialysis, days on ventilator, ICU stay, dead or discharged.

During operation, three limb leads I, II, III were continuously monitored and invasive arterial blood pressure monitoring continuously done through a peripheral arterial cannula either in the radial or femoral artery. Central venous catheter was inserted after induction except when required otherwise. Cardiopulmonary bypass was managed with non-pulsatile perfusion. A crystalloid priming solution was used (25ml / kg) with mannitol (0.5 mg / kg) supplementation. Systemic flow was targeted at 2.2 L / min / m^2 and was varied according to venous return to maintain a mean arterial pressure of about 60 $\pm$ 10 mmHg. These variables were recorded every 20 minutes during CPB. Diuretic drugs were given whenever urinary output fell below 0.5 ml/kg/hr. In the postoperative period patients with urinary output below 0.5 ml/kg/hr. for three hours or more were considered oliguric and diuretic therapy followed optimization of cardiac output and filling pressures. The general condition of the patients was evaluated on the basis of inotropic drug administration. Patients who received dopamine more than 10 µg / kg / min or adrenaline more than 0.03 µg / kg / min were considered to be in low cardiac output state. Intra Aortic Balloon therapy was required when the pharmacologic treatment failed to restore a satisfactory cardiac performance. Antibiotic prophylaxis was used in all patients. Cefotaxime 1 gm I.V. was given at induction, and then every eight hours for 7 days beside metronidazol 500mg I.V. every eight hours for 7 days postoperatively. Postoperative renal function was defined as normal if peak postoperative creatinine remained below 1.5 mg/dl, renal dysfunction if creatinine was 1.6-2.5 mg/dl and ARF when creatinine was more than 2.5 mg/dl. In patients with renal dysfunction (creatinine 1.6-2.5 mg/dl) creatinine clearance was calculated. Each variable was compared among the three classes of renal function by the X^2 test for homogeneity and the one-way analysis of variance with significance at p=0.05. The variables that attained significance were then included in further analysis [13,14,15].

RESULT:

Of the 90 patients, 86 (95.56%) patients had normal preoperative creatinine and 4 patients (4.44%) had impaired renal function. Among the patients with normal preoperative renal function, 19 (22.09%) patients developed postoperative renal complications. 16 (18.6%) patients had renal dysfunction (creatinine 1.6-2.4) and 3 (3.49%) had ARF (table-1).

Table-1: Renal complications after CPB

	Normal renal parameters		Raised renal parameters		Total	
	No.	%	No.	%	No.	%
No renal dysfunction	67	84.7	0	0.0	67	74.45
Renal dysfunction	16	18.6	3	75	19	21.11
Acute renal failure	3	3.49	1	25	4	4.44
Total	86	95.56	4	4.44	90	100

The patients (without preoperative renal impairment) were classified according to their ages into 5 groups. The risk of renal impairment is increased with age of the patients 0% in age below 20 years to 33.3% in patients above 50 years (table-2).

Table-2: The number of cases with elevated serum creatinine in relation to the age of the patients.

Age (years)	No.	Raised Creatinine (no.)	Raised Creatinine (%)
< 25	4	0	0
25- 35	20	3	15
35- 44	31	6	19.35
45- 54	28	9	32.14
> 55	3	1	33.3
Total	86	19	22.09

replacement was 19.15%, while in aortic valve replacement was 21.74%, but in cases of double valve surgery it rose to31.25% (table-3). Renal impairment in cases of mitral valve

Table-3: Type of surgery.

Type of surgery	No.	Raised Creatinine (no.)	Raised Creatinine (%)
Mitral valve replacement	47	9	19.15 %
Aortic valve replacement	23	5	21.74 %
Double valve replacement	16	5	31.25 %
Total	86	19	22.09 %

The overall mortality rate was 7.78% and was rose from 2.33 % in patients without any renal problems to 15.79% with postoperative renal impairment. In patients with preoperative renal impairment and worsening after the operation, mortality rose to 50% (table-4).

Table-4: Mortality.

Patients	No.	%
No renal impairment	2	2.33 %
Postoperative renal impairment	3	15.79 %
Preoperative renal impairment	2	50 %
Total	7	7.78 %

DISCUSSION:

Depending on the basis that each year about 600,000 cardiac surgeries (coronary and valve) had been done throughout the world, and if the incidence of ARF is 7.7%, Chew and colleagues estimated that approximately 46,000 patients will end with renal impairment postoperatively and that 8000 of these patients will need dialysis [8]. It is obvious that postoperative renal impairment is relatively common and dangerous. As we know, there are no local studies to be compared with (no such work has been done before in Iraq for acute renal failure after cardiac surgery), may be due to the lack of registration or the short number of cardiac centers that dedicated to do such surgeries, In this study, the ARF prevalence and mortality were not different from the generally reported values of 5-8% for ARF and 25-70% for the mortality associated with it [12]. however many studies outside Iraq gave results similar to our study in spite of the big gab our clinical facilities and that of the global centers ([6,7,16]).

In our study, low urine output during cardiopulmonary bypass was one of the earliest clinical clew for patients at risk of developing postoperative renal impairment. Slogoff and associates evaluated the incidence of oligurea (output less than O.5 ml/kg/hr) during cardiopulmonary bypass, they failed to demonstrate any statistical correlation with postoperative renal outcome [17]. Lombardi and colleagues registered a lower diuresis before cardiac surgery in patients with postoperative renal impairment whereas urine output during and after the operation was not different [18]. Relationship of age to the outcome is also controversial. Although in the older age renal functional capacity reduction is proved, some investigators have found no significant statistical relationship between age and renal outcome [3,11]. A strong correlation between the preoperative renal impairment and the increased risk of postoperative renal impairment, this is proved by our study, and in spite of the small number of the data, but this has been documented by Balogun and colleagues [1].

So, in the present study the proportion of patients developing postoperative acute renal failure and the mortality related to it has been found to be consistent with the current opinion worldwide.

Suen and colleagues showed that most patients who are at increased risk for postoperative renal

dysfunction can be identified before their surgical procedures. This include patients with advanced age, a previous coronary artery bypass graft, type 1 diabetes mellitus, preoperative hyperglycemia or preexisting renal disease (as manifested by an elevated serum creatinine level) have an increased risk for postoperative renal impairment [19].

The results of our study may not be generalizable to all cardiac centers. Also they are limited with respect to exploring other potential causes of renal impairment especially injury caused by nephrotoxic agents or dyes and exploring the temporal relation between renal dysfunction and other relevant comorbid events.

CONCLUSION:

Avoidance of this dangerous outcome looks better than trying to treat once it is fully established.

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