Literature Reviews

Coronary artery bypass grafting with or without cardiopulmonary bypass in patients with preoperative non-dialysis dependent renal nsufficiency: a randomized study.

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Abstract Excerpt

The purpose of this study was to examine patients with non-dialysis dependent renal insufficiency undergoing coronary artery bypass graft surgery (CABG) with either the use of cardiopulmonary bypass (CPB), commonly referred to as: "on-pump" or without CPB ("off-pump"). From August 2004 to October 2005, 116 consecutive patients undergoing primary CABG surgery were randomized to either on–pump or off-pump CABG. All of these patients had been diagnosed preoperatively with non-dialysis dependent renal insufficiency by the Modification of Diet in Renal Disease (MDRD) equation (glomerular filtration rate [GFR] of: ≤ 60 mL/min · 1.73/m2). Preoperative characteristics between the two groups were comparable. Patients who had on-pump surgery had worsening of renal function with respect to both creatinine levels and GFR. Three patients in the on-pump group ended up requiring dialysis, while none in the off-pump group did. Further analysis of patients with diabetes, hypertension, or both also showed significant deterioration in renal function in the on-pump group versus the off-pump group. Covariate analysis demonstrated that the presence of diabetes was a significant covariate for serum creatinine levels in determining renal dysfunction while compromised left ventricular (LV) function emerged as a significant covariate for renal dysfunction by GFR criteria. Mean number of grafts was significantly increased in the on-pump group, but indices of completeness of revascularization were similar between the two groups. The authors concluded that on-pump surgery in patients with underlying renal insufficiency is more deleterious than off-pump CABG. Patients with diabetes, hypertension or compromised LV function may be at even higher risk with on-pump CABG.

Reviewer's Comments

Cardiac surgery and the use of CPB have long been associated with potential organ dysfunction perioperatively. Specifically, renal dysfunction in the perioperative period after CABG is known to increase morbidity and mortality. Factors associated with CPB such as nonpulsatile perfusion, renal hypoperfusion, hypothermia, and increased cytokines/activation of the inflammatory response are thought to be especially deleterious to renal function. Interest in off-pump CABG increased in the 1990's and advocates of this surgical technique argued that by avoiding CPB, one could potentially reduce the incidence of renal dysfunction in the perioperative period. Data to this effect however, have been lacking, with some conflicting studies being published, and no clear conclusion has been identified.

This study was the first time a patient population with non-dialysis dependent renal dysfunction was examined in a randomized, controlled manner. Previous observational studies had demonstrated off-pump CABG patients had improved outcomes versus those who had CABG with CPB. Results of the study were statistically significant with respect to demonstrating the benefits of off-pump CABG in this patient population. The only patients who required dialysis in the postoperative period were patients who had CPB and the only deaths were in patients who required CPB.

There are multiple factors involved in the development of renal dysfunction in the perioperative period in CABG patients. The authors did a good job in controlling for some of these, including not using nephrotoxic antibiotics, and aprotinin was only used in two patients (both in the CPB group). However, with respect to the maintenance of mean pressures, the authors stated that mean arterial pressure (MAP) in the on-pump group was kept between 65-70 mmHg and off-pump group the MAP was kept between 70-75 mmHg most of the time. Why is this important? If the nonpulsatile flow of CPB is contributing to its deleterious effects, and hypertensive patients were at increased risk (they presumably have kidneys that are used to higher pressures and therefore their autoregulation may be shifted to higher pressures), perhaps this difference may have contributed to the outcomes observed. In other words, were these outcomes pressure related or CPB related? It would have been interesting what the outcomes would have been if the MAPs had been the same between the two groups or if the CPB group had been maintained at higher MAPs. Additionally, more detailed analysis on diabetic and hypertensive patients revealed these patients were even more susceptible to the detrimental effects of CPB when compared to patients who did not have these comorbidities. This is important clinically, as many patients we anesthetize for cardiac surgery have these comorbidities present. Also, the authors did not discuss intraoperative glucose levels in either patient population. As there continues to be evidence that increased glucose levels in the perioperative period are associated with increased morbidity (including renal dysfunction), it would have been interesting to see if there was a difference between the two groups with respect to this variable. Finally, any discussion involving off-pump CABG needs to include surgical aspects as well. While the techniques were described, and the authors state that off-pump CABG has been employed since 1996 at their institution with a 'standardized' technique, it should be noted that not all surgeons are comfortable with this approach and not all patients may be candidates for it. The study did not comment on which surgeons performed which operation (on-pump or off-pump). These benefits may not have been demonstrated in centers where off-pump CABG is not routinely performed. Besides this being a single-center study with only 116 patients, all patients were undergoing primary CABG operations (a further limitation of their study population).

Overall, while this study demonstrated some potential benefit for patients with renal insufficiency to have CABG performed off-pump versus on-pump, more randomized controlled trials are needed with larger numbers of patients and multiple centers/surgeons in order to better delineate a clear advantage to off-pump CABG in this patient population.