

EXTRA CARPORATED CIRCULATIONS INPRESENCE OF SEPRIS THE MANAGEMENT STRATAGE

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Cardiopulmonary bypass (CPB) is known to be a key factor in the development of cardiac surgery since its early application in clinical practice around fifty years ago. Its purposes are to provide a bloodless and motionless field for the operating surgeon and to provide blood flow to the organ systems. Technological advances in CPB have standardized its use leading it to be employed routinely in cardiac surgery today, however, managing CPB requires a specific knowledge of circulatory and pulmonary physiology to address gas exchange, rheology and fluid behavior to make the procedure safe and effective. On the other hand, CPB because of its non-physiological status enhances a global body response being the so-called systemic inflammatory response, the paradigm of global aggression. It is therefore of utmost importance to have appropriate knowledge of organ function to understand abnormalities caused by different situations. As CPB is nowadays widely used not only in conventional cardiac surgical patients suffering from coronary or valvular heart disease, the need for a global understanding of CPB in specific morbid conditions is an important asset for any perfusionist participating in these complex surgical procedures.

Currently, a significant proportion of patients undergoing cardiac surgery with CPB have comorbidities that may eventually influence their final outcome. Advanced average age, previous surgical procedures, renal impairment, lung dysfunction are common difficulties that need to be tackled by the perfusionist in today's surgical population. It has also been noticed that ageing patients suffering from comorbidities need additional allocation of resources due to more complex surgical procedures, more complicated postoperative periods that eventually result in prolonged hospital stay.

Sepsis is a serious disease caused by the invasion of the blood stream by toxin-producing microorganisms. Sepsis and septic shock are the major causes of morbidity and mortality in critically ill patients. Patients suffering from infective endocarditis (IE) often present for surgery in a serious condition mainly due to congestive heart failure or persistent sepsis. This is particularly seen with Staphylococcal infections. A massive inflammatory reaction that involves mediators such as cytokines and inflammatory cells (polymorphonuclear neutrophils and macrophages) develops during sepsis. Clinically a decrease in vasomotor tone and peripheral vascular resistance is detected. The therapeutic approach is based on epidemiology, clinical, microbiological and echocardiographic diagnosis and the combined medical and surgical therapy.

THE CLINICAL SITUATION

On the average, patients suffering from IE will present for consultation with a clinical picture of fever in about 80% of cases as the main symptom. Malaise, anorexia and sweating are present between 25 and 40% of the cases together with cough. Dyspnoea also appears in 25-40% of the cases and, more importantly, a cerebrovascular embolic event may be seen in about 15% of cases. Fever is usually absent or minimal when the patient is in congestive heart failure.

The clinical pattern will be more or less dramatic depending upon the aggressiveness of the pathogen involved and previous use of antibiotics. Surgery has favored radical treatment of valve lesions and has helped to eradicate infection. The advantages of surgery in the treatment of IE can be summarized as follows:

- Local treatment with a degree of radicalism.
- Excision and reconstruction.
- Reduction in mortality.
- Eradication of infection

These can be considered the basic principles of surgical treatment. Reduction of mortality

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related to IE has been one of the most significant developments noticed over the last few years. However not all cases or valve positions are the same and not all the patients present in the same way for surgery. There are many factors that influence on the results of surgery such as:

- Preoperative condition of the patient.
- Time interval from diagnosis to the operation.
- Antimicrobial treatment.
- Indications for surgery.
- Associated conditions.
- Extension of local lesions.
- Intra- and postoperative management.

The indications for surgery are CHF, persistent sepsis, recurrent embolic phenomena, periannular complications and new conduction defects.

CONDUCT OF OPERATION

Before surgery, medical treatment according to antibiotic sensitivity is always necessary. The clinical evolution of the disease will dictate the need for an operation according to the above mentioned indications. Once the indication for an operation has been established, intra-operative treatment plays a fundamental role in establishing patient outcome. On the average 20-30% of the patients with acute native valve IE and 40-50% with prosthetic valve IE will need an operation before one week of treatment.

1. ANESTHETIC MANAGEMENT

Vasopressors and inotropes are required to maintain a mean blood pressure above 70 mmHg. Acidosis must be avoided whenever possible. Phenylephrine is widely used as it usually it increases blood pressure without affecting distribution of blood flow. Hyperglycemia is carefully managed and the aim is to keep glycemia below 120 mg/dl, as persistent hyperglycemia is a poor prognostic factor.

2. CONDUCT OF PERFUSION

Perfusion is conducted to maintain a cardiac index around 2.2 - 2.4 l/min/m². Strategy used is alpha-stat control. Intraoperative vasopressors are used in cases of vasoplegia or established shock. Phenylephrine is the drug of choice for this purpose. It is advisable to run bypass using biocompatible heparin-coated CPB circuits. Care has to be taken to avoid hypotension as low output and suboptimal perfusion may induce splanchnic ischemia

and organ failure. Myocardial protection is achieved with antegrade and retrograde cold blood cardioplegia. A significant proportion of acute patients will present with preoperative renal failure. High creatinine level (>2 mg/dl) and hypervolemic state associated to CHF are indications for intraoperative hemofiltration. An average volume of 1000-1500 ml can be filtered but this amount may be modified according to the status of the patient.

A leukocyte filter with mixed coating is used. A standard 40N pore size is routinely used. Aprotinin is routinely used in acute IE and as all patients with prosthetic valve IE are reoperations, this is an attempt to further reduce blood loss and blood product transfusion requirements. The potential role of aprotinin in stabilizing the microcirculation and influencing the systemic inflammatory response has to be taken into account.

3. COMING OFF BYPASS

There is no evidence that NO is useful for routine application. However, it is used when there is PAH. It is well known that NO significantly reduces pulmonary vascular resistance. However, there are also toxic effects of NO that are related to high doses (>10 ppm) and therefore this should also be considered in view of vasoplegic states.

A vasoplegic syndrome has been found to be associated with systemic inflammatory response and sepsis. Post-CPB vaso-dilatory shock may develop in the absence of sepsis. In cases of patients with preoperative sepsis, this may eventually be an aggravating factor. Refractory vasoplegia can be managed with methylene blue as there is currently some information suggesting clinical relevance at doses of 0.5mcg/kg⁻¹/min⁻¹.

Low cardiac output. Patients with preoperative sepsis and impaired left ventricular function may present with compromised weaning from CPB. In the case of patients with IE, long aortic cross-clamping and CPB times are to be expected. Therefore, the chances of support therapies after CPB are high. As inotropes and vasodilators may not be enough cardiac support, mechanical support with an Intra Aortic Balloon Pump might be necessary. Very recently, Levosimendan, a calcium sensitizer, is emerging as promising pharmacological therapy. This exerts a potent dose-dependent inotropic activity. There is no real or

clear evidence to support its routine use, nevertheless its preliminary experience in cardiac surgery confirms an enhancement in cardiac performance.

Long aortic cross-clamp and CPB times are to be expected when there are periannular complications. This is especially critical in the aortic position as reconstruction of the complicated aortic root requires time. In one series of 191 patients, average cross-clamp and CPB times were 103.86 and 160.38 minutes, for 48 patients requiring a homograft repair of the aortic root. These are particularly long times when compared to average cross-clamp and CPB times of 76.28 and 115.02 minutes respectively for the entire cohort of patients operated on for IE. Despite excellent myocardial protection in these patients, about 10%

required IABP support. As the life saving role of IABP has been established over the last two decades, there should be no hesitation in providing mechanical support even in patients with an aortic homograft in place.

CONCLUSION

Patients suffering from IE are the paradigm of the septic patient. An aggressive intraoperative management must be established. Vasoconstrictors and inotropes before, during and after the operation are often the rule to counteract vasoplegia together with more recent therapies like methylene blue or eventually Levosimendan. Hemofiltration is useful during CPB as hypervolemia and edema are frequently present. Biocompatible heparin-coated circuits are suggested on a routine basis.

REFERENCES

1. Solina AR, Ginsberg SH, Papp D, Grubb WR, Scholz PM, Pantin EJ, Cody RP, Krause TJ. Dose response to nitric oxide in adult cardiac surgery patients. *J Clin Anesth* 2001; 13:281-286.
2. Tetta C, Bellomo R, Ronco C. Artificial treatment for multiple organ failure, acute renal failure and sepsis: Recent new trends. *Artif Org* 2003; 27:202-213
3. Shanmugam G. Vasoplegic syndrome - the role of methylene blue. *Eur J Cardio-thorac Surg* 2005; 28:705-710.
4. Krejci V, Hildebrand LB, Sigurdsson GH. Effects of epinephrine, norepinephrine and phenylephrine on microcirculatory blood flow in the gastrointestinal tract in sepsis. *Crit Care Med* 2006; 34:1456-1463
5. Raja SG, Rayen BS. Levosimendan in cardiac surgery: Current best available evidence. *Ann Thorac Surg* 2006; 81:1536-1546