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The Role of Prophylactic Intra-Aortic Balloon Pump Counterpulsation (IABP) in Emergency Non-Cardiac Surgery

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Abstract

Patients with recent myocardial infarction (MI), congestive heart failure, severe angina, or uncorrected multivessel coronary artery disease are at increased risk of cardiac complications after urgent major non-cardiac surgery. Although invasive haemodynamic monitoring and preoperative optimization of cardiac status may lead to some reduction in the rate of perioperative cardiac events, the mortality from such events still remains high. The use of an intra-aortic balloon pump (IABP) may play a role in such patients by improving the function of the injured heart. We report our experience with the use of perioperative IABP in a patient with unstable angina and recent MI who underwent urgent cholecystectomy. There were no perioperative cardiac events while the IABP was in place. The anaesthetic concerns, intraoperative and postoperative monitoring and care and usefulness of IABP will be discussed.

Introduction

Patients with recent myocardial infarction, congestive heart failure, severe angina, or uncorrected multivessel coronary artery disease are at an increased risk of cardiac complications during and after undergoing urgent major noncardiac surgery. Invasive haemodynamic monitoring and preoperative optimization of cardiac status may lead to some reduction in the rate of perioperative cardiac events, but the mortality from such events still remains high.¹ The use of an intraaortic balloon pump (IABP) may play a role in such patients by improving the function of the injured heart. We report our experience with the use of perioperative intra-aortic balloon counterpulsation in a patient with unstable angina and recent myocardial infarction who underwent urgent noncardiac surgery. There were no perioperative cardiac events while the IABP was in place. The anaesthetic concerns, intraoperative and postoperative monitoring and care and usefulness of IABP are discussed in the context of anaesthetic management.

Case Report

A 69 years old female was admitted for urgent cholecystectomy due to acute cholecystitis complicated by probable biliary sepsis. Past medical history was significant for

unstable angina, diabetes mellitus and hypertension. She was initially admitted under the surgical service with acute cholecystitis, but developed atrial fibrillation and a rapid ventricular rate of 190 per minute. Intravenous boluses of metoprolol were given to control the heart rate and she was started on 100 milligrams metoprolol eight hourly and nitroglycerin 40 milligram per hour intravenously. Patient was shifted to the Coronary Care Unit with a diagnosis of unstable angina following acute myocardial infarction (MI) and atrial fibrillation. Troponin I was sent which was found to be positive (18.5 i.u.). Ultrasound revealed pus in the gall bladder therefore an urgent open cholecystectomy was planned. In view of her unstable cardiac status, an IABP was inserted by the cardiologist and set at 1:1 augmentation in an attempt to improve oxygen supply and to reduce load on the injured myocardium.

Her preoperative vitals signs were as follows, blood pressure 140/70 mmHg, pulse 70 beat/min, and respiratory rate 16 breaths/min. She was afebrile. After application of routine monitoring, right radial artery was cannulated under local anaesthesia. Fentanyl 2ug/kg, thiopentone sodium 4mg/kg and suxamethonium 1mg/kg were given at induction and tracheal intubation was done with rapid sequence induction and application of cricoid pressure. Swan Ganz catheter sheath was passed after induction for central pressure monitoring and subsequent Swan Ganz catheter insertion if needed. Anaesthesia was maintained with isoflurane 0.6-1%, oxygen and nitrous oxide were used in 50:50 mixture, pancuronium 0.1mg/kg was used for muscle relaxation and end tidal CO₂ was maintained between 30-34mmHg. Glyceryl trinitrate infusion 1-2ug/kg/min was continued throughout surgery. A total dose of 60mg of lasix was given intravenously to maintain urine output.

The patient remained stable during the intraoperative period without pharmacological inotropic support. Postoperative ventilation was planned until she became hemodynamically stable without the support of IABP. Morphine infusion was used to control her pain. IABP was removed after 48 hours. She was extubated on the fourth postoperative day, remained stable and was shifted to the special care unit on the sixth postoperative day and discharged from hospital on the ninth postoperative day.

Discussion

Myocardial ischaemia and perioperative myocardial infarction are the most frequent causes of major morbidity and mortality in patients with ischaemic heart disease undergoing non cardiac surgery.² Newer anaesthetic agents and improvement in invasive monitoring have markedly reduced this percentage from 7.7% to 1.9%.¹ However, myocardial ischaemia can still occur in the perioperative and in the postoperative period because of anaemia, hypothermia and pain. All these factors will activate sympathetic tone with the adverse effects on cardiovascular function and coagulation. The result will be an increase in myocardial oxygen consumption in the presence of decrease in delivery.² Although the risk of myocardial ischaemia appears to be lower when a patient undergoes coronary revascularization before an elective surgery, but situations do arise when this is not feasible, possible or desirable. These clinical situations include coronary artery disease which is not amenable to surgery or coronary angioplasty, multivessel coronary artery disease when emergent noncardiac surgery is needed, severe comorbid diseases, or in a patient who may be a poor candidate for cardiac surgery.

Intra-aortic balloon pump (IABP) support has been suggested to decrease the risk of cardiac complications in patients with ischaemic heart disease who are undergoing noncardiac surgery.³⁻⁶ IABP drive console is a mechanical, circulatory device consisting of a pressurized gas reservoir connected to a slender polyurethane balloon which is controlled electronically. The balloon catheter is inserted into the patient's aorta either surgically or per-cutaneously. The femoral artery is the preferred route for insertion, but alternative routes are via the subclavian or iliac artery. The procedure is usually performed under fluoroscopic guidance to ensure correct placement of IABP so that the tip is about 1cm distal to the origin of the left subclavian artery.

During diastole, the balloon is inflated leading to an increase in the aortic diastolic pressure. This leads to an augmentation of the coronary artery blood flow resulting in an increase in myocardial oxygen supply without an increase in myocardial workload. In systole, the balloon is deflated and this leads to a reduction in aortic root pressure. This produces a reduction in the after load.^{7, 8}

Although the value of prophylactic placement of IABP for high-risk noncardiac surgery remains to be determined, the successful use of IABP to maintain hemodynamic stability has been reported in many high-risk cardiac patients by several authors.⁹ Most of these reported patients had a history of uncontrolled hypertension, congestive heart failure, ventricular ectopy, atrial fibrillation or unstable

angina with diffuse coronary artery disease and recent myocardial infarction at the time of surgery. Georgeson et al. reported the successful prophylactic use of IABP and decision analysis.¹⁰ According to their analysis, patients in Goldman class IV or Detsky class III who were undergoing major surgical procedures may benefit the most from the IABP during surgery.

Our patient came for an urgent open cholecystectomy with the history of unstable angina and recent myocardial infarction (Goldman Class III and Detsky Class III), the rationale for using IABP was to provide haemodynamic stability without inotropic support and at the same time improve the oxygen supply to demand ratio by decreasing the after load, thus preventing myocardial ischemia. With the support of IABP along with aggressive invasive monitoring, we successfully managed the patient perioperatively without any complications.

Conclusion

IABP if available should be considered in the perioperative management of patients with multivessel or left main coronary artery disease, recent MI, severe or unstable angina who must undergo major non-cardiac surgery.

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