CASE REPORTS

Intra-Aortic Balloon Counterpulsation in High-Risk Cardiac Patients Undergoing Noncardiac Surgery: A Case Series

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HEART DISEASE is a potential source of complications during surgery, and risk depends on the performance status, the prevalence of comorbidities, and the urgency, magnitude, duration, and type of surgical procedure.[1] The number of patients affected with severe cardiac disease needing noncardiac surgery has been increasing and likely will become an emergent and diffuse problem in light of the increasing prevalence of ischemic heart disease, heart failure, and cardiovascular risk factors in the elderly population.[2,3]

The group of patients at increased perioperative cardiac risk is vast[4] and includes those with untreated coronary artery disease (CAD), congestive heart failure, severe valvular heart disease, and patients in work-up for heart transplantation or ventricular assist device (VAD) placement who, for several reasons (eg, characterization of suspected lesions or intercurrent diseases), may need surgery.

The authors' institute has adopted the latest European Society of Cardiology/European Society of Anesthesia guidelines on noncardiac surgery as their patient care protocol.[5,6] In treating patients on the waiting list for heart transplantation and also undergoing noncardiac surgery, the authors realized that the guidelines did not offer clear recommendations for managing this group of patients. Based on pathopyhsiologic concepts, the authors use an intra-aortic balloon pump (IABP) to support patients at higher risk when undergoing noncardiac surgery.[7]

The use of an IABP in noncardiac surgery is founded on case reports and small case series.[8–11] The balance between risks and benefits of its use remains controversial, and the guidelines do not mention the IABP as a tool for reducing mortality, cardiac events, or general complications in the perioperative period.

The authors present a report of 14 noncardiac surgery patients in whom hemodynamic management included an IABP during surgery or in the early postoperative period.

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CASE SERIES

A retrospective analysis was done in the authors' 78-bed institute of solid organ transplantation; abdominal, thoracic, and cardiac surgery; and general support of end-stage organ failure patients. The study was carried out in accordance with the principles of the Declaration of Helsinki, was approved by the authors' Institutional Research Review Board (IRRB/15/14), and consisted of a series of 14 abdominal and thoracic surgery patients with severe cardiac comorbidities between November 2010 and November 2014. In 11 patients surgery was performed with IABP support as elective management, in 1 patient the IABP was placed as rescue support in the early postoperative period, and in 2 patients an IABP was already in place while they were waiting for heart transplantation and VAD placement, respectively.

Patients were defined as being at high cardiac risk if they had 1 or more of the following: class 3/4 Lee Revised Cardiac Risk Index, New York Heart Association (NYHA) class 2 to 4, unstable angina, multivessel or untreatable left main CAD, inducible ischemia (impossible to postpone surgery), or severely compromised ejection fraction.

All patients were assessed by a multidisciplinary team composed of anesthesiologists, surgeons, and cardiologists/cardiac surgeons, who optimized preoperative treatment, evaluated timing for surgery, and implemented perioperative care. Patients were supported with a Linear® 7.5-Fr intra-aortic balloon (MAQUET, Getinge Group, Rastatt, Germany). Percutaneous catheterization was performed 9 times in the operating room, whereas in 2 cases, because of known severe peripheral vascular disease, the IABP was placed in the catheterization laboratory. In 1 patient, the IABP was placed postoperatively upon admission to the ICU. In 2 patients, it was already in place.

Anesthesia was general or combined epidural/general if not contraindicated. Monitoring included invasive arterial pressure measurements before anesthesia and transesophageal echocardiography (TEE) during surgery. A pulmonary artery catheter was placed in 6 patients. Peripheral perfusion was assessed by clinical examination, diuresis, and lactate variation, as per protocol. All patients were followed postoperatively with cardiac enzyme curves every 8 hours. In 6 patients, monitoring involved preoperative and postoperative measurement of pro-Brain Natriuretic Peptide.

The goals for anesthetic management were avoidance of drug-induced myocardial depression and excessive vasodilation, maintenance of normovolemia, and prevention of increased ventricular afterload. Target hemoglobin during

Table 1. Patient Characteristics, Surgical Procedure, and Anesthesia

Pt	M/F	Age (y)	LEE Ind	NYHA	EF	H tx VAD List	Cardiac Disease	Intervention	Anesthesia Mode
1	F	69	4	2	45		CAD	Gastrectomy for bleeding AC	General
2	M	60	4	3	25	X	Postischemic cardiomyopathy	Thoracoscopic lung nodule atypical resection	General
3	M	72	4	2	60		Severe aortic stenosis, CAD	Subtotal gastrectomy for ulcerated bleeding cancer	Combined
4	M	71	4	3	20		Postischemic cardiomyopathy	Hemicolectomy	Combined
5	M	53	4	2	14	X	Postischemic cardiomyopathy	Nephrectomy, Cholecystectomy	General
6	M	53	4	2	18	X	Postischemic cardiomyopathy	Cholecystectomy	General
7	M	73	3	2	40		CAD	Sup lung Rx lobectomy	General
8	M	70	3	2	40		Postischemic cardiomyopathy	Rectal resection	General
9	M	76	3	2	50		CAD	Laparoscopic surrenectomy	Combined
10	M	76	4	3	50		CAD	Colostomy for colic perforation	General
11	M	76	4	3	50		CAD	Lx hemicolectomy for perforation/ ischemia	General
12	M	71	3	2	50		CAD	Rx Nephrectomy	Combined
13	M	58	4	3	18	X	Postischemic cardiomyopathy	Cholecystectomy	General
14	M	69	4	3	25	X	Postischemic cardiomyopathy	Urgent cholecystectomy	General

Abbreviations: AC, adenocarcinoma; CAD, coronary artery disease; EF, ejection fraction; F, female; H tx, Heart Transplant; Lee Ind, Lee Index; M, male; NYHA, New York Heart Association; Pt, patient; Rx, right; VAD, ventricular assist device.

surgery was kept at about 10 mg/dL. Weaning of the IABP was achieved in the postoperative period when hemodynamic status was stable, and no metabolic impairment was detected. Postoperative cardiac events were defined as any of the following: death from cardiac cause, myocardial infarction, unstable angina or acute decompensated heart failure, or major arrhythmia with hemodynamic impairment.

Complications were considered early and correlated with perioperative management if they occurred within the first 7 postoperative days (PODs). Major complications of an IABP (balloon membrane perforation, limb ischemia, bleeding at the insertion site, infection, thrombocytopenia, arterial dissection or aneurysm, thrombosis) were evaluated up to POD 7. Secondary complications were the need for rescue inotropes and vasopressors in the operating room and continued in the postoperative period, increased level of lactates, and relevant and sustained acute kidney injury.

Patient characteristics and interventions are listed in Table 1. The high-risk group was characterized by age (67.6 ± 7.8 y), Revised Lee Cardiac Index Risk (10 Lee class IV and 4 in Lee class III), and NYHA stage (NYHA 2 in 8 cases, and 3 in 6 cases). Five patients were in workup or already listed for heart transplantation or VAD placement.

The rationale for the use and management of an IABP is summarized in Table 2 and outcomes in Table 3. No cardiac death occurred. One patient did not survive the hospital stay because of a late infectious complication of evisceration after 2 months of hospitalization. One patient on the waiting list for heart transplant experienced intraoperative cardiac decompensation during cholecystectomy. After treating with rescue inotropes, the authors inserted the IABP on the patient's arrival in the ICU, with a complete recovery of general conditions within 5 days.

No relevant cardiac enzyme increase was registered in the first PODs. Hemoglobin was maintained at approximately 10 mg/dL by transfusion in 6 of 14 patients. Acute kidney injury developed in 3 (23%) patients, according to the Risk, Injury, Failure, Loss, End Stage Score for Acute Kidney Injury classification. Preoperative and POD 1 creatinine levels are reported in Table 4, as well as creatinine clearance calculated by Modification of Diet in Renal Disease Study equation for glomerular filtration estimation, and intraoperative diuresis.

The IABP was weaned successfully on POD 1 in 9 patients (69%). In 4 patients, weaning of mechanical support lasted longer because of a cardiac event in 1. In 2 patients, because of hemorrhage and sepsis, the IABP was kept in place until recovery; in 2 patients, IABP support was not weaned and cardiac support was continued until VAD placement. There were no complications related to the IABP.

Table 2. Rationale for IABP Use, Management and Complications.

Pt	IABP Rationale	IABP Preop	IABP Vaso/ Inotr Rescue	IABP Days	IABP Compl
1	3-vessel disease needing treatment	X		1	0
2	Very low EF	X		1	0
3	Critical stenosis Cdx and inducible ischemia	X		1	0
4	Diffuse CAD, very low EF	X		1	0
5	Very low EF	X		1	0
6	Very low EF		X	5	0
7	Complex lesion Cdx, OM	X		1	0
8	Aortic stenosis, CAD	X		5	0
9	Cdx stenosis 60-90%	X		1	0
10	Cdx stenosis 60-90%	X		1	0
11	Cdx stenosis 60-90%	X		7	0
12	3-vessel disease, inducible ischemia	X		1	0
13	Very low EF, reconditioning	X		NA	0
14	Very low EF, recent pulmonary edema	X		NA	0

NOTE. Not applicable because in both patients IABP subsequently was replaced in the left subclavian artery to allow complete mobilization while awaiting heart transplant or VAD.

Abbreviations: CAD, coronary artery disease; Cdx, Right Coronary Artery Cx, ; EF, ejection fraction; IABP, intra-aortic balloon pump; OM, Obtuse Marginal Coronary; Pt, patient; VAD, ventricular assist device.