

# Application of Intra-Aortic Balloon Pump in Resection and Anastomosis of Trachea

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The intra-aortic balloon pump (IABP) is a mechanical device used to assist cardiac circulatory function in patients suffering from cardiogenic shock, congestive heart failure, refractory angina and complications of myocardial infarction. While using IABP in cardiac surgery is well established, there are few studies on the utility of IABP support in high-risk cardiac patients undergoing non-cardiac surgery. Major non-cardiac surgeries are associated with high rates of cardiac complications in patients with advanced coronary disease. Recent case studies have reported favorable outcomes with the use of IABP support in non-cardiac surgery in patients with severe cardiac compromise. Using IABP may reduce cardiac complications by providing hemodynamic stability.

Here, we present five cases of IABP use in high-risk cardiac patients undergoing resection and anastomosis of the trachea. IABP was inserted prior to induction of anesthesia in four of the cases, while IABP insertion was withheld in one case. In the four cases where IABP support was utilized, the IABP was removed between 6-48 hours postoperatively with no complications. The patient who did not undergo IABP insertion died on the 8th postoperative day due to uncontrollable pulmonary edema and progressive myocardial infarction.

We also review the literature and discuss the role of IABP use in non-cardiac surgery.

**Key words:** Intra-Aortic Balloon Pump, Heart Failure, Resection and Anastomosis of Trachea

## INTRODUCTION

The intra-aortic balloon pump (IABP) is a widely used circulatory assist device inserted percutaneously via the femoral artery (alternatively, the subclavian, axillary or iliac arteries) into the descending thoracic aorta (1, 2). The balloon inflates during diastole, leading to an increasing diastolic pressure, thereby enhancing coronary artery blood flow and augmenting myocardial perfusion. The balloon deflates during systole, reducing after load,

decreasing myocardial oxygen demand and increasing myocardial oxygen reserve (1-3).

The IABP has been used since the late 1960's and is commonly used perioperatively in high-risk cardiac surgery (surgeries on patients with pre-operative left ventricular ejection fraction  $\leq 40\%$ , left main coronary artery stenosis  $\geq 70\%$ , reoperation and/or unstable angina) (4). Pre-operative IABP use in high-risk cardiac patients

has been shown to reduce hospital deaths and shorten ICU stay (5).

Despite IABP complications such as aortic dissection, arterial perforation, limb ischemia, hematoma and sepsis, (3, 6) indications for IABP utilization continue to evolve (1, 2).

While there are currently no case-control studies or randomized controlled trials investigating IABP use in non-cardiac surgery, recent case reports of IABP use in urgent esophagogastrectomy (7), thoracotomy and lobectomy (2), laparotomy (1), cholecystectomy (8), hepatic resection (4), and maxillofacial surgery (9) and in patients with ischemic heart disease suggest that IABP may reduce perioperative cardiac events in high-risk patients undergoing non-cardiac surgery.

This study presents the outcomes of five cases of IABP use in high-risk patients undergoing tracheal resection and discusses the role of IABP use in non-cardiac surgery.

## CASE SUMMARIES

### Case 1

A 64-year-old man was admitted with distress due to post-intubation tracheal stenosis after hospitalization for myocardial infarction (MI) 6 months prior to admission. Echocardiography revealed an enlarged left ventricle (LV) and ejection fraction (EF) of 20%.

The patient was determined to be a candidate for tracheal resection and anastomosis. Immediately after induction of anesthesia, the patient's blood pressure dropped and his condition deteriorated. It was decided to insert an IABP in order to stabilize the patient. The surgery was performed with no complications and the IABP device was removed 6 hours postoperatively. The patient was discharged with no complications.

### Case 2

A 48-year-old man was referred to the center for post-intubation tracheal stenosis after myocardial infarction 3.5 months prior to admission. Echocardiography showed dilated LV with an EF of 25%, trivial mitral regurgitation, and akinesia of apex and the inferoposterior and lateral

walls of the LV. Due to the very low EF and his high-risk status, an IABP was inserted just before induction of anesthesia. The patient had an uneventful intraoperative course and the IABP was removed 10 hours postoperatively in the ICU and the patient was discharged with no complications.

### Case 3

A 42-year-old man was referred to ER of a center in another city with shortness of breath. In the ER, the patient suddenly developed cardiac arrest. After resuscitation, he was transferred to the ICU. Extubation was not possible after a couple of weeks. Workups revealed poststenotic dilatation. The patient's echocardiogram revealed poor LV function with an EF of 20% and akinesia in the anterior and apical portions of the heart. Single photon emission computed tomography (SPECT) imaging of the heart showed many areas with no perfusion, and revascularization was not considered beneficial for the patient. It was decided to insert an IABP just before the induction of anesthesia. All phases of the operation were performed with no difficulty. The IABP was removed 24 hours postoperatively with no complications. The patient left the hospital on the 11<sup>th</sup> postoperative day.

### Case 4

A 74-year-old woman was admitted due to post-intubation tracheal stenosis after prolonged intubation because of myocardial infarction and cardiopulmonary resuscitation 4 months prior to admission. Echocardiography showed poor LV systolic function, anteroseptal akinesia and EF of 20% prior to surgery; IABP was inserted. Anesthesia was performed smoothly with no difficulty. Resection and anastomosis of the trachea were done. The IABP was removed 48 hours post-operatively with no complications. The patient was discharged on the 7<sup>th</sup> postoperative day.

### Case 5

A 62 year-old man was referred to the center for tracheal resection and anastomosis due to tracheal stenosis after a 35-day intubation period following MI and cardiopulmonary arrest 3 months prior to admission.

Echocardiography revealed apical and lateral wall hypokinesia and an enlarged LV. The EF was 20%. The coronary angiogram showed diffuse triple vessel disease. But the patient did not consent for coronary revascularization. She was considered a candidate for IABP insertion. After the insertion of IABP, general anesthesia was induced, resection and anastomosis of the trachea were done properly and after 48 hours the IABP was removed. The patient was discharged on the 10<sup>th</sup> postoperative day.

### Case 6

A 68 year-old male was referred to the center as a case of post intubation stenosis after CABG. He had undergone CABG in another center, during which he had developed cardiac arrest, which improved after resuscitation. Tracheostomy was done for him, but he had shortness of breath. Trans thoracic echocardiography (TTE) showed EF=25%. Dobutamine stress echocardiogram showed no increase in EF of the patient. Thus, no other workups were done. The IABP was inserted just before the induction of anesthesia, and then resection and anastomosis of the trachea were done without any problem. The IABP was removed 24 hours after the operation. The patient was discharged on the 12<sup>th</sup> postoperative day.

## DISCUSSION

Indications for IABP use have continued to evolve since its introduction in 1962. It is the most widely used mechanical circulatory assist device in clinical practice (5). Currently, the IABP is mainly used preoperatively or operatively in high-risk patients undergoing emergent cardiac surgery for multi-vessel coronary artery disease, recent MI, severe angina, and congestive heart failure (1, 8, 10).

General anesthesia and major surgeries are associated with higher mortality rates in patients suffering from advanced coronary disease, ischemic heart disease, left ventricular failure and irritability (11- 13). Operative and preoperative IABP use in such patients may improve postoperative prognosis and survival, reduce cardiac

complications (12-14), and reduce the length of hospital stay. Additionally, the device has been shown to be safe and cost-effective (15).

There are few reports of intraoperative deaths while the IABP has been *in situ*. However, complications have been reported upon removal of the device (1,2). The optimal removal time is undetermined, but removal at 5-6 days has been suggested as appropriate due to persistent MI risk until the fifth or sixth postoperative day (1,2).

Recent studies have reported the utility of IABP support in non-cardiac surgeries. Millat and Cameron suggested a valuable role for IABP in esophagogastrectomy for esophageal carcinoma in patients with ischemic heart disease (7). Beneficial outcomes have also been reported in cases of IABP use in cholecystectomy (8), thoracotomy (2), hepatic resection (4), and maxillofacial surgery (9). Khan et al. have also reported on IABP use in emergent laparotomy in three patients suffering from hernia incarceration, small bowel obstruction and ischemic bowel disease (1).

All patients in this study who underwent IABP insertion, were cases with advanced ischemic cardiomyopathy and revascularization had no benefit for them. The IABP was inserted via the left or right groin area, by closed method. The duration of operation in all patients was about 4 hours, and there was no hemodynamic instability during the operation. No heparin was given during the operation or when the IABP was within the aorta. There were no definite criteria for withdrawal of IABP. But, when the blood pressure of the patient was stable with no inotropic drugs, there was no arrhythmia, urine output was adequate and arterial blood gases were within the normal range, (all suggestive of adequate cardiac output) then the balloon was removed. After the operation, routine prophylactic doses of Deep Vein Thrombosis prophylaxis were given. No complications of IABP occurred in our patients. These outcomes suggest a beneficial role for IABP support in patients with poor cardiovascular status undergoing non-cardiac surgery.

The limitations of this study included the small number of cases; although we planned to perform a randomized clinical trial for these patients, but due to the definite benefit of IABP in low EF patients, such study design seemed unethical. Further studies on this area are vital to determine whether IABP support should become commonplace in high-risk patients undergoing non-cardiac surgery. Despite these limitations, the successful use of IABP, as reported in the recent literature and supported by this study, urges serious consideration of IABP support where available in patients with severe cardiac compromise who require non-cardiac surgery.

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