Adenosine in Port-Access Surgery: A Means for Stabilizing the Endoaortic Clamp

(#2001-5341 … January 8, 2002)

Fadi Farhat, MD,[1] José Coddens, MD,[2] Hugo Vanermen, MD,[3] Philippe Mikaeloff, MD,[1] Olivier Jegaden, MD[1]

[1]Department of Cardiovascular Surgery, Unité 31, Hôpital Cardiologique, Lyon, France
[2]Department of Anesthesiology, Onze-Lieve-Vrouw Ziekenhuis, Aalst, Belgium
[3]Department of Thoracic and Cardiovascular Surgery, Onze-Lieve-Vrouw Ziekenhuis, Aalst, Belgium

ABSTRACT

Port-Access™ surgery at its inception presented difficulties that have been progressively resolved as surgeons have gained additional experience with the technique. The migration of the Endoaortic clamp™ during balloon inflation and the subsequent need for frequent repositioning is one such problem that has not been solved. We describe the use of adenosine as a means of stabilizing the Endoaortic clamp™ to address the migration problem.

BACKGROUND

Minimally invasive Port-Access™ surgery with the help of the Heartport Endo-CPB® system (Ethicon, Inc., Somerville, NJ) may offer advantages over operations done through conventional sternotomy incisions [Glower 1998]. Animal studies have suggested that excellent myocardial preservation can be provided in near-closed chest models by means of intra-aortic balloon occlusions and antegrade cardioplegia [Pompili 1996]. In 1996, the Stanford group performed four minimally invasive mitral valve replacements by minithoracotomy in humans using a comparable technique [Schwartz 1996]. Nevertheless, the positioning of the endoaortic clamp before aortic occlusion remains one of the major pitfalls of the technique and may discourage inexperienced surgeons. When inflated, and before cardioplegic arrest, this balloon is mobilized even by the cardiac output or the retrograde arterial flow provided by the femoral Y-arm cannula. Thus, successive deflation and re-inflation of the balloon were frequently needed for repositioning, resulting in coronary reperfusion during antegrade cardioplegia delivery. Vanermen et al. described the use of a rapid injection of 0.5 mg of potassium chloride at the balloon's tip before inflation in order to obtain an immediate cardiac arrest and to avoid balloon migration during inflation [Vanermen 2000]. Nevertheless, this technique presents the disadvantage of potassium overload and provides very short cardioplegic arrest that often results in cardiac restart before cardioplegic action. Adenosine has been previously used for pharmacological preconditioning and for cardioplegic induction [Chauhan 2000]. Adenosine also allows a 15-20 second cardiac arrest when injected intravenously. For this reason, we used it as a complement to crystalloid cardioplegia in Port-Access™ surgery. Adenosine was first tested for Port-Access™ surgery in the OLV clinic (Aalst, Belgium, Dr. Vanermen) in preliminary studies.

MATERIALS AND METHODS

From September 2000 to January 2001, 18 patients underwent Port-Access™ mitral valve surgery (n = 8, 2 repair, 6 replacements, including 3 redo) or coronary surgery (n = 10, mean grafts per patient = 1.2 ± 0.4) in our institution using the Heartport cardiopulmonary bypass (CPB) system (See Table 1,). Patients were intubated selectively. A vent was positioned through the right jugular vein into the pulmonary artery root under transesophageal echocardiography (TEE) in order to avoid excessive backbleeding [Blanc 1999]. After general heparinization, arterial and venous cannulations were performed in the right groin. A needle was introduced using the Seldinger technique in the middle of two overlapping U stitches of PTFE material placed on the anterior wall of the artery. The gentle passage of the soft-tip guide wire and its advancement into the descending aorta gave the image of a free-floating guide on TEE. Arterial cannulas were introduced over the guide wire after using a dilator. The Y-arm cannula allowed a safe introduction of the Endo-Aortic Clamp™ (Ethicon, Inc., Somerville, NJ). The venous cannulation was performed the same way, and a double stage cannula was placed into the right atrium under control of TEE. The Endo-Aortic Clamp™ positioning initially required fluoroscopic control but completely relied on TEE for the rest of the series. The diameter of the ascending aorta was measured to determine the correct balloon inflation. CPB was then started and general cooling was performed to 35°C. When the balloon was half inflated, a rapid injection of

Submitted January 2, 2002; accepted January 8, 2002.

Address correspondence and reprint requests to: Fadi Farhat, MD, Department of Cardiovascular Surgery, Unité 31, Professeur Mikaeloff. Hôpital Cardiologique et Pneumologique, 28, avenue du doyen Lepine, BP Lyon-Monchat, 69394, Lyon, France, Phone: 33 4 72 35 75 28, Fax: 33 4 72 35 75 32, Email: farhatfadi@hotmail.com

Table 1. General Data for Patients Who Had Port-Access™ Surgery

Characteristics	Data
Age (range) in years	54 ± 12 (23-78)
Gender	14M/4F
LVEF (%)	64 ± 11
NYHA class	1.9 ± 1.2
Aortic cross-clamping time (min.)	63 ± 31
CPB time (min.)	83 ± 38
Operative time (hours)	3.1 ± 0.5
Intubation time (hours)	9.0 ± 7.9
Postoperative bleeding at 24 hours (ml)	422 ± 304
Troponin (ng/ml)	3.9 ± 3.4
ICU stay (days)	2.6 ± 3.0
Postoperative hospital stay (days)	8.1 ± 3.5

M = male; F = female; LVEF = left ventricular ejection fraction; NYHA = New York Heart Association; CPB = cardiopulmonary bypass; ICU = intensive care unit. Results are in mean ± standard deviation.

250 µg/kg of adenosine 5-triphosphate (Stryadine®, Wyeth-Lederle, Inc., Puteaux, France) diluted into 10 ml of saline solution was made at the balloon's tip. Cardiac arrest was obtained after an interval of 3-5 seconds for a duration of 15-20 seconds, consequently avoiding balloon migration during inflation. After complete aortic occlusion (balloon pressure = 280-340 mmHg), antegrade cold crystalloid cardioplegia (St. Thomas solution, 1 liter) was delivered at the balloon tip in order to achieve myocardial protection. After cardiac surgery was completed through a 5-cm left or right incision of the fourth intercostal space, the balloon was deflated as aortic venting continued. A routine procedure for weaning from CPB was then performed.

RESULTS

In this short series, no cardiac electrical activity was noticed after adenosine delivery. No balloon repositioning was needed after inflation, and no patient needed complementary cardioplegia or had postoperative ischemic injury at twenty-four hour troponin analysis.

CONCLUSION

Adenosine provides a safe and reproducible complement to crystalloid cardioplegia. Moreover, it facilitates Port-Access™ procedures by avoiding intra-aortic balloon migration during inflation.

REFERENCES

1. Blanc P, Aouifi A, Chiari P, et al. Minimally invasive cardiac surgery: surgical techniques and anesthetic problems. Ann Fr Anesth Reanim 18:748-71, 1999.
2. Chauhan S, Wasir HS, Bhan A, et al. Adenosine for cardioplegic induction: a comparison with St. Thomas solution. J Cardiothorac Vasc Anesth 14: 21-4, 2000.
3. Glower DD, Landolfo KP, Clements F, et al. Mitral valve operation via Port-Access versus median sternotomy. Eur J Cardiothorac Surg 14(suppl I):S143-7, 1998.
4. Pompili MF, Stevens JH, Burdon TA, et al. Port-Access mitral valve replacement in dogs. J Thorac Cardiovasc Surg 112:1268-74, 1996.
5. Schwartz D, Ribakove GH, Grossi EA, et al. Minimally invasive cardiopulmonary bypass with cardioplegic arrest: a closed chest technique with equivalent myocardial protection. J Thorac Cardiovasc Surg 111:556-66, 1996.
6. Vanermen H, Farhat F, Wellens F, et al. Minimally invasive video-assisted mitral valve surgery: from port-access towards a totally endoscopic procedure. J Card Surg 15:51-60, 2000.