

# POSTOPERATIVE ATRIAL FIBRILLATION AFTER ON PUMP TOTAL ENDOSCOPIC CORONARY ARTERY BYPASS GRAFTING: A PRELIMINARY REPORT

Mirela Scherer, Abdul Sami Sirat, Selami Dogan, Tayfun Aybek, Anton Moritz, Gerhard Wimmer-Greinecker

## REZUMAT

**Introducere și obiective:** Incidența fibrilației atriale după intervențiile de bypass coronarian variază foarte mult, în literatura de specialitate fiind citate rate cuprinse între 10% și 40%. În ciuda incidenței crescute și a relevanței clinice, etiologia sa rămâne puțin cunoscută. S-a emis ipoteza că inflamația ar putea avea un rol în dezvoltarea fibrilației atriale postoperatorii; reducerea răspunsului inflamator prin minimizarea traumatizării chirurgicale este unul din motivele pentru care sunt utilizate metode minim invazive. Scopul acestui studiu a fost de a evalua incidența fibrilației atriale postoperatorii la pacienții supuși bypass-ului coronarian complet endoscopic cu circulație extracorporeală. **Material și metode:** A fost efectuată o analiză retrospectivă a 46 de pacienți supuși revascularizării miocardice complet endoscopice cu circulație extracorporeală. Incidența fibrilației atriale postoperatorii timpurii, caracteristicile clinice și demografice ale pacienților, datele intraoperatorii și postoperatorii, precum și durata spitalizării postoperatorii au fost luate în considerare. **Rezultate:** Cinci dintre pacienți au dezvoltat fibrilație atrială postoperator, corespunzător unui procent de 10,4% din totalul pacienților evaluați. Din evaluarea datelor demografice, intraoperatorii și postoperatorii a pacienților nu a rezultat nici o diferență statistică semnificativă între pacienții cu fibrilație atrială și cei fără fibrilație. Durata spitalizării postoperatorii a fost de  $9 \pm 2$  zile la pacienții cu fibrilație atrială, față de  $10 \pm 2$  zile la cei cu ritm sinusal ( $p = 0,44$ ). **Concluzii:** Aceste date preliminare sugerează că incidența fibrilației atriale postoperatorii poate fi mai redusă la pacienții supuși bypass-ului coronarian complet endoscopic.

**Cuvinte cheie:** fibrilație atrială postoperatorie, bypass coronarian complet endoscopic

## ABSTRACT

**Background:** The occurrence rate of atrial fibrillation (AF) after coronary artery bypass grafting, quoted in the literature, is wide ranging, from 10% to over 40%. Despite its high incidence and clinical relevance, its etiology remains obscure. It has been hypothesized that inflammation can have a role in the development of postoperative AF. To potentially reduce inflammatory response by minimizing surgical trauma is one reason why minimally invasive techniques are performed. The aim of this study was to evaluate the incidence of postoperative AF in patients undergoing on pump total endoscopic coronary artery bypass grafting (TECAB). **Material and methods:** A retrospective analysis of 46 patients undergoing on pump total endoscopic myocardial revascularization was performed. Early postoperative incidence of atrial fibrillation, clinical and demographic patient characteristics, operative and postoperative patient characteristics, and postoperative length of stay were evaluated. **Results:** Five patients developed postoperative atrial fibrillation (10.4%). Patient's demographics as well as evaluation of operative and postoperative patient characteristics showed no statistical difference between patients with postoperative AF and patients without postoperative AF. Postoperative length of stay in patients with AF was  $9 \pm 2$  days versus  $10 \pm 2$  ( $p = 0.44$ ) days in those with normal sinus rhythm. **Conclusion:** These preliminary data show that the incidence of postoperative atrial fibrillation may be lower in patients undergoing total endoscopic coronary artery bypass grafting.

**Key Words:** postoperative atrial fibrillation, total endoscopic coronary artery bypass grafting

## BACKGROUND

Atrial fibrillation is one of the most common arrhythmias to occur after conventional coronary artery bypass grafting with a reported prevalence of 10% to 65%, depending on patient profile, type of surgery,

method of arrhythmia surveillance, and definition of arrhythmia.<sup>1,2</sup> Usually atrial fibrillation occurs on the second or third postoperative day. Postoperative AF increases health care resource utilization and is associated with other serious adverse events such as congestive heart failure and perioperative stroke.<sup>1-3</sup> The aetiology of this arrhythmia is not known with certainty, but has been related to instrumentation required for cardiopulmonary bypass, including atrial cannulation, and to myocardial ischemia and protection required during these procedures.<sup>2,3</sup> Imbalance in the autonomic nervous system may cause changes in atrial conduction and refractoriness previously shown to be related to the propensity for AF.<sup>4</sup> Surgical trauma associated with increased sympathetic stimulation may trigger the onset of atrial fibrillation.<sup>5</sup>

Department of Thoracic and Cardiovascular Surgery, J. W. Goethe University, Frankfurt am Main, Germany

Correspondence to:

Mirela Scherer, Department of Thoracic and Cardiovascular Surgery, J. W. Goethe University, Theodor-Stern-Kai 7, 60590 Frankfurt am Main, Germany, Tel. +49-69-6301-5850, Fax: +49-69-6301-5849  
Email: M.Scherer@em.uni-frankfurt.de

Received for publication: Sep. 5, 2005. Revised: Nov. 1, 2005.

Generally lower incidence of postoperative atrial fibrillation is expected after operations without atrial cannulation, and with minimally surgical trauma. The incidence of postoperative AF in patients after minimally invasive heart surgery using the Port-Access system has been described to be lower with an occurrence rate from 13 % to 14.4 %.<sup>6,7</sup>

Recently, total endoscopic computer enhanced technology was developed to minimize access in coronary artery bypass surgery.<sup>8,9</sup> The occurrence of postoperative AF in patients after totally endoscopic coronary artery bypass grafting has not been described before. The total endoscopic coronary artery bypass grafting (TECAB) technique leads to less manipulation on the heart avoids direct atrial cannulation and reduces surgical trauma. It may thereby decrease the occurrence of postoperative atrial fibrillation.

The aim of this study was to evaluate the incidence of postoperative AF after total endoscopic computer enhanced coronary artery bypass grafting.

## **MATERIAL AND METHODS**

All patients undergoing total endoscopic coronary artery bypass grafting from June 1999 through October 2003 were evaluated for the occurrence of in-hospital postoperative atrial fibrillation. Patients with preoperative AF and patients who had to be converted to a standard procedure were excluded. A total of 46 patients were retrospectively analyzed. The frequency of AF occurrence was estimated retrospectively by reviewing the noted onset episodes in the patient records. According to our clinical routine, each kind of rhythm disturbance was evaluated by the examining physician and noted in the patient record. During the first 3 postoperative days rhythm disturbances were evaluated by the physician at our intensive and intermediate care unit, using a continuous monitoring ECG system (Hellige Marquette Solar 8000 Patient Monitor, Marquette Medical Systems, Milwaukee, WI). Thereafter, until discharge, pulse control was performed by the physician twice daily. A 12-lead ECG recording was also performed 3 and 6 days postoperatively, and in each case of clinical symptoms of rhythm disturbances.

### **Surgical Technique**

The surgical technique was performed using the Da Vinci Surgical System (Intuitive Surgical, Inc, Mountain View, CA), as described by Dogan et al.<sup>10</sup>

Anesthesia was induced in a standard fashion, except for a double lumen tube for single lung

ventilation. A pulmonary artery vent catheter (Heartport Inc, Redwood City, CA) was introduced percutaneously for left heart decompression. After heparinization, cardiopulmonary bypass (CPB) was established under TEE guidance by way of cannulation of the left femoral vessels using the Port Access EndoCPB system (Heartport Inc). Starting CPB, the heart was decompressed. Cardioplegic arrest was achieved by antegrade crystalloid cardioplegia delivered to the aortic root by way of the Port Access aortic endoclamp.

### **Statistical analysis**

Data are presented as mean  $\pm$  standard deviation of the mean. Continuous variables were tested with the Mann-Whitney test for unpaired data, and categorical data were tested with Fisher's exact test. A *p* value less than 0.05 indicated statistical significance.

## **RESULTS**

During the study period, 5 of the 46 patients (10.4%) who underwent on pump TECAB, developed postoperative AF.

Table 1 shows the performed operations. In most cases a single arterial bypass with either the left ITA to LAD or right ITA to RCA was performed (*n* = 32). In 14 patients more complex double-vessel bypass procedures were carried out.

**Table 1.** Total endoscopic procedures.

<b>Procedure</b>	<b>No. of patients with AF</b>	<b>No. of patients without AF</b>
LITA - LAD	2	26
RITA - RCA	1	3
LITA - DB - LAD	2	9
LITA - LAD, RITA - RCA		2
LITA - LAD, RITA - RCX		1

LITA: Left internal thoracic artery, LAD: left anterior descending coronary artery, RITA: right internal thoracic artery, DB: diagonal branch, RCA: right coronary artery, RCX: right circumflex

Baseline demographic characteristics are summarized in Table 2. There were no statistical differences between patients with and patients without postoperative AF. The intraoperative and postoperative variables are summarized in Table 3, and none of these variables resulted in a significant difference between patients with and patients without postoperative AF.

No differences of blood electrolyte measurements were found in patients with or without AF. Arrhythmia prophylaxis with preoperative and postoperative  $\beta$ -blockers therapy was conducted in 32 patients. The 5

patients who developed postoperative AF were pre- and postoperatively under  $\beta$ -blockers therapy.

**Table 2.** Clinical and demographic patient characteristics.

	Atrial fibrillation	No atrial fibrillation	p
Number of patients	5	41	
Male	4	26	0.64
Female	1	15	0.64
Mean age (y)	65 $\pm$ 7	57 $\pm$ 10	0.09
Age > 70 yrs	2	4	0.19
EF %	65 $\pm$ 9	67 $\pm$ 6	0.49
Diabetes	0	5	0.5
Hypertension	2	17	0.5
History of COPD	0	2	0.5
Preoperative $\beta$ blockers	5	32	0.5

**Table 3.** Operative and postoperative patient characteristics.

	Atrial fibrillation	No Atrial fibrillation	p
Operating time (min)	303 $\pm$ 77	301 $\pm$ 80	0.51
CPB time (min)	142 $\pm$ 69	137 $\pm$ 44	0.44
Crossclamp time (min)	68 $\pm$ 32	67 $\pm$ 32	0.50
Postoperative length of stay	9 $\pm$ 2	10 $\pm$ 2	0.44
Serum Potassium level (mg/dl)	4.32 $\pm$ 0.11	4.18 $\pm$ 0.24	0.71
Serum Magnesium level (mg/dl)	0.8 $\pm$ 0.1	0.8 $\pm$ 0.07	0.43

CPB = cardiopulmonary bypass

## DISCUSSION

The incidence of postoperative AF, as quoted in the literature, is wide ranging, from 10% to 65%.<sup>1-3</sup> Postoperative AF is usually well tolerated but tachycardia and loss of organized atrial contraction may result in hypotension and congestive heart failure in some patients. The risk for perioperative stroke has been shown to be nearly threefold higher for patients with postoperative AF especially for those with low cardiac output.<sup>1,2</sup> Patients developing postoperative AF are hospitalized 3 to 4 days longer leading to increased hospital cost.<sup>1-3</sup> Postoperative AF usually occurs 1-5 days after surgical procedure with a peak incidence on day 2. Usually, it has a self-limited course.<sup>10,11</sup>

Several preoperative factors are associated with the incidence of atrial fibrillation after cardiac surgery. Older age has consistently predicted a higher incidence of postoperative AF; incidence is increased by at least 50% per decade.<sup>2,3,12</sup> Men appear more likely than women to develop postoperative AF.<sup>2,13</sup> Previous atrial fibrillation and congestive heart failure are also predictors of postoperative AF.<sup>3</sup> Hypertension appears to also predict atrial fibrillation after cardiac surgery.<sup>2</sup>

Different mechanisms have been proposed to explain the high incidence of AF after cardiac surgery, including withdrawal of  $\beta$ -blockers administered preoperatively, increased sympathetic activation, structural changes in the heart such as those related to age, the effects of cardiopulmonary bypass, atrial cannulation technique and myocardial preservation, as well as the effects of postoperative hypoxia, hypovolemia, and electrolyte imbalance.<sup>2,14</sup> Respiratory compromise and prolonged ventilation are also associated with post cardiac surgery atrial fibrillation.<sup>2</sup>

The autonomic nervous system has previously been implicated in the initiation and perpetuation of atrial fibrillation.<sup>4</sup> Surgical trauma associated with increased sympathetic stimulation may trigger the onset of AF. Thoracic epidural anesthesia reduces sympathetic activity but does not influence the incidence of postoperative AF in conventional and beating-heart coronary artery bypass graft surgery.<sup>5,15</sup>

Minimally invasive coronary artery bypass grafting surgery using the Port-Access system does not require direct atrial cannulation. The surgical trauma is minimal. The incidence of postoperative arrhythmia in such patients appears to be lower than in patients after conventional coronary artery bypass grafting (CABG).<sup>6,7</sup>

If direct atrial cannulation, heart manipulation, and surgical trauma are factors having influence on postoperative atrial fibrillation, a surgical technique without direct atrial cannulation, and with less heart manipulation and surgical trauma may thereby decrease the occurrence of postoperative atrial fibrillation.

In an effort to minimize access in coronary artery bypass surgery, a totally endoscopic approach using computer enhanced technology has been developed. On-pump TECAB does not require direct atrial cannulation or heart manipulation and surgical trauma is minimal. Our hypothesis, that this technique would therefore reduce the incidence of postoperative AF can be supported with this study.

Importantly, this study addresses a specific patient group among the CABG population. Patients with multiple CABGs present a more extensive disease, which has been shown to be a determinant of postoperative AF. This difference could explain our prevalence of postoperative AF, which is in the lower range of that reported in the literature.<sup>1-3</sup>

The small number of patients and the lack of telemetric monitoring once the patients were transferred out of the ICU represent a limitation of this study.

With these limitations in mind, these preliminary

data suggest, that postoperative atrial fibrillation may be reduced by using totally endoscopic coronary artery bypass grafting technique.

## **REFERENCES**

1. Cressler LL, Scheussler RB, Rosenbloom M, et al. Hazards of postoperative atrial arrhythmias. *Ann Thorac Surg* 1993;56:539-49.
2. Aranki SF, Shaw DP, Adams DH, et al. Predictors of atrial fibrillation after coronary artery surgery: current trends and impact on hospital resources. *Circulation* 1996;94:390-7.
3. Mathew JP, Parks R, Savino JS, et al. Atrial fibrillation following coronary artery bypass graft surgery. Predictors, outcome, and resource utilization. *JAMA* 1996;276:300-6.
4. Kalman J, Munavar M, Howes LG, et al. Atrial fibrillation after coronary artery bypass grafting is associated with sympathetic activation. *Ann Thorac Surg* 1995;60:1709-15.
5. Jideus L, Joachimsson PO, Stridsberg M, et al. Thoracic epidural anesthesia does not influence the occurrence of postoperative sustained atrial fibrillation. *Ann Thorac Surg* 2001;72:65-71.
6. Groh MA, Sutherland SE, Burton HG, et al. Port-access coronary artery bypass grafting: technique and comparative results. *Ann Thorac Surg* 1999;68:1506-8.
7. Zapolanski A, Kover K, Pliam MB, et al. Multiple coronary artery bypass via mini left thoracotomy with conventional aortic occlusion. *Heart Surg Forum* 2001;4(2):109-11.
8. Mohr FW, Falk V, Diegeler A, et al. Computer enhanced coronary artery bypass surgery. *J Thorac Cardiovasc Surg* 1999;117:1212-3.
9. Dogan S, Aybek T, Andressen E et al. Totally endoscopic coronary artery bypass grafting on cardiopulmonary bypass with robotically enhanced telemanipulation: Report of forty-five cases. *J Thorac Cardiovasc Surg* 2002;123:1125-31.
10. Landymore RW, Howell F. Recurrent atrial arrhythmias following treatment for postoperative atrial fibrillation after coronary bypass operations. *Eur J Cardiothor Surg* 1991;5:436-9.
11. Matangi MF, Neutze JM, Graham KJ, et al. Arrhythmia prophylaxis after aorta-coronary bypass: the effect of minidose propranolol. *J Thorac Cardiovasc Surg* 1985;89:439-43.
12. Fuller JA, Adams GG, Buxton B. Atrial fibrillation after coronary artery bypass grafting. Is it a disorder of the elderly? *J Thorac Cardiovasc Surg* 1989;97:821-5.
13. Almassi GH, Schowalter T, Nicolosi AC, et al. Atrial fibrillation after cardiac surgery: a major morbid event? *Ann Surg* 1997;226:501-11.
14. Hohnloser SH. Can we predict atrial fibrillation after coronary surgery and why should we? *Eur Heart J* 1998;19:684-5.
15. Scherer M, Sirat AS, Aybek T, et al. Thoracic epidural anesthesia does not influence the incidence of postoperative atrial fibrillation after beating heart surgery. *J Thorac Cardiovasc Surg* 2003;51:8-10.