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Supraventricular arrhythmias after resection surgery of the lung

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Abstract

Objective: Two hundred consecutive patients undergoing resection surgery of the lung during 1999 were retrospectively reviewed to define prevalence, type, clinical course and risk factors for postoperative supraventricular arrhythmias (SVA) with particular reference to atrial fibrillation or flutter (AF). **Methods**: Records of 200 lung patients were collected and analysed with particular attention to preoperative physiologic values and associated pathologies, lung functional status, electrocardiogram registration, extent of surgical resection of the lung and were also analysed to confirm or exclude correlation between them and postoperative AF; three patients were excluded as they were affected preoperatively by SVA. **Results**: Forty-five episodes of SVA, 41 of AF were identified in 197 patients (22%) and were more prevalent in several groups of patients such as those with increased age, pneumonectomy and superior lobectomy. Rhythm disturbances were most likely to develop on the second day after surgery. Ninety-eight percent of AF disappeared within a day of discharge and sinus rhythm was restored with digitalis or other antiarrhythmic drugs in all patients except one who was discharged with persistent atrial fibrillation. Arrhythmias were not direct causes of any in-hospital deaths. There is a tendency in the difference of the AF rate between pneumonectomy and upper lobectomy patients versus inferior lobectomy ones, probably related to the different anatomic structure of the proximal trunks of the upper and inferior veins of the lung, respectively. **Conclusions**: Statistical analysis revealed that increased age, extent and type of pulmonary resection, such as pneumonectomy and superior lobectomy were significant risk factors. Despite these factors, arrhythmias after lung surgery could be managed easily and were not closely related to higher mortality. Direct cause of AF after lung resection surgery remains unclear; anatomical substrate such as surgical damage to the cardiac plexus or to the proximal trunks of the pulmonary veins covered by myocardial sleeves with electrical properties are to be considered.

Keywords: Thoracic surgery; Cardiac arrhythmias

1. Introduction

Since the 1940s, many studies of patients have been published that document supraventricular arrhythmia (SVA), such as atrial fibrillation and flutter (AF) with heart failure as the most common complication after pulmonary resection, although the reported incidence has varied widely [1–5].

Arrhythmias have been shown to be associated with significantly higher mortality rates, especially in patients undergoing pneumonectomy [6]. The aetiology of these complications is still not clearly understood although several factors are likely to be involved. Few reports analysed for risk factors that were associated with major complications or cardiac arrhythmias.

The purpose of this study was to retrospectively evaluate patients who have undergone a pulmonary resection in an effort to determine the incidence of and factors related to the development of postoperative AF. Our preinvestigation bias was that the incidence of AF increased progressively in patients undergoing pulmonary wedge-resection, lobectomy (inferior versus superior ones) or pneumonectomy.

Specifically we wished to test the following hypothesis: incidence of postoperative AF is dependent on the magnitude of pulmonary resection or the management of the hilar structures of the lung, or both.

2. Materials and methods

The records of 200 patients undergoing pulmonary resection at the Thoracic Surgery Department of Turin, between January 1 and December 31 1999, 191 for malignant and nine for benign diseases of the lung, were reviewed to define the prevalence, associated risk factors and clinical course of

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postoperative arrhythmias. Except for emergency cases, each patient received a routine preoperative check-up including spirometry, blood gases analysis and 12-lead electrocardiogram (ECG).

The patient's history of cardiovascular problems, hypertension, tobacco smoking and pharmacological assumption were carefully noted. No patient received prophylactic digitalis or other antiarrhythmic drugs.

The mode of thoracotomy was not standardized but all our patients reviewed underwent pulmonary surgery and lymph nodal dissection through a postero-lateral thoracotomy and extents of pulmonary resection were carefully recorded. Routine continuous ECG monitoring was conducted in the intensive care unit (ICU) and, if necessary, in the ward during the perioperative period. ECG recording was started immediately after the onset of arrhythmia. A cardiologist consultant interpreted each ECG. All patients, during and after discharge from the ICU, underwent daily serologic laboratory evaluation and arterial oxygen saturation monitoring.

2.1. Statistical analyses

Statistical analyses were performed to identify the significant risk factors for postoperative arrhythmias. The variables included in the analyses were as follows: age, smoking history, preoperative lung functional tests (arterial oxygen and carbon dioxide tensions of blood gases, forced expiratory volume in 1 s and forced vital capacity), ECG abnormalities on preoperative recording, hypertension, diabetes, cardiac history, beta-blockers assumption, pre- and postoperative serologic laboratory values of creatinine and potassium and extent of the surgical resection. Chi-square and Fisher's exact test were used when appropriate (Tables 2–4). Chi-square, Fisher's exact test and Mantel–Haensed Chi-square for the variable smoking history were used in Table 5. Analysis of variance (ANOVA) was used for non-normally distributed data and stepwise logistic regression was performed. Risk factors with P-values less than 0.05 were considered to influence significantly the development of postoperative arrhythmias, P-values greater than 0.05 were indicated with NS (not significant).

3. Results

The study comprised 200 consecutive patients whose age ranged from 38 to 83 years (mean 62.57 ± 9.26 years, median 64 years). There were 140 men and 60 women.

Three patients were found to be affected by SVA in the preoperative period (two were affected by chronic atrial fibrillation and one by atrial flutter) and were excluded from the study; the remaining 197, without preoperative ECG signs of rhythm disturbances, were retrospectively investigated for risk factors which could increase incidence of postoperative arrhythmia. Patients affected by postoperative multiple premature atrial contractions or sinus arrhythmias were excluded.

Forty-five patients out of 197 (23%) underwent pneumonectomy (33 intrapericardial and 12 extrapericardial), 104 (53%) lobectomy or bilobectomy and 48 (24%) wedge-resection. Forty-four (22%) out of 197 patients developed 47 episodes of arrhythmia (Table 1): 45 SVA and two ventricular dysrhythmias; three patients during perioperative period developed two or more different types of arrhythmia (two had atrial fibrillation associated with ventricular tachycardia and one had atrial fibrillation after paroxysmal atrial tachycardia lasting for 6 days). Among the 45 patients suffering from SVA, only 41 affected by atrial fibrillation or flutter (AF) were considered in the present study and four patients affected by paroxysmal atrial tachycardia were excluded.

The incidence of AF in patients having wedge-resection, lobectomy or pneumonectomy was 2, 23 and 35%, respectively ($P < 0.05$ pneumonectomy and lobectomy versus others, no significant difference was noted between pneumonectomy and lobectomy, $P = 0.2$).

Each patient submitted to anatomic resection of the lung (pneumonectomy or lobectomy) underwent hilar and mediastinal nodal dissection: pretracheal, paratracheal, subcarinal, pulmonary ligament and paraoesophageal nodes during right procedures and preaortic, subaortic, subcarinal, pulmonary ligament and paraoesophageal nodes during the left ones were routinely excised.

The incidence of AF with particular reference to the extent of the nodal dissection is illustrated in Table 2. AF related to the extent and type of lung resection is illustrated in Tables 3 and 4; according to our preinvestigation bias of greater incidence of AF in superior versus inferior lobectomy, superior and inferior lobectomies are analysed separately.

No patient revealed pericardial effusion requiring intrapericardial drainage, atrial enlargement, heart insufficiency or failure and pulmonary embolism during the perioperative period. Only three cases of sublobar lung infection were observed after lobectomy; no one experienced AF. The effectiveness of the perioperative analgesia (requiring quantitative evaluation to be analysed) could not be considered because of the aim of the retrospective study.

Thirty-five (85.4%) of the 41 AF patients required pharmacological management, 12 (75%) out of 16 patients underwent pneumonectomy and 23 (92%) of 25 other patients: six patients were not treated because they were not suffering from haemodynamical failure or other major symptoms

Table 1
Arrhythmias after pulmonary resection surgery

	n	%
Supraventricular arrhytmias	45	
Atrial fibrillation or flutter	39	86.7
Atrial flutter	2	4.4
Paroxysmal atrial tachycardia	4	8.9
Ventricular dysrhythmias	2	
Ventricular tachycardia	2	

Table 2
Atrial fibrillation or flutter incidence related to the site and extent of the mediastinal nodal dissection[a]

Side	Surgical resection	*n*	AF (%)	*P*-value
Right (*)	Pneumonectomy	21	8 (38)	0.01
	Upper lobectomy	33	10 (30)	NS
	Middle lobectomy	8	0	NS
	Inferior lobectomy	23	3 (13)	NS
	Total	85	21 (24.7)	NS
Left (^)	Pneumonectomy	24	8 (33.4)	NS
	Upper lobectomy	28	9 (32.1)	NS
	Inferior lobectomy	12	2 (16.7)	NS
	Total	64	19 (29.7)	NS

[a] Right (*), each patient operated on for right anatomic lung resection, underwent systematic dissection and sampling of the pretracheal, paratracheal, subcarinal, pulmonary ligament and paraoesophageal lymph nodes; Left (^), each patient operated on for left anatomic lung resection, underwent systematic dissection and sampling of the preaortic, subaortic, subcarinal, pulmonary ligament and paraoesophageal nodes.

and AF receded spontaneously within 36 h after its onset. All episodes of AF were managed by pharmacological treatment (no patients required electrical cardioversion).

Among the 35 patients requiring pharmacological therapy, 28 (80%) assumed only digitalis, 4 (11.5%) only amiodarone and 3 (8.5%) an association of digitalis and amiodarone. Four patients experienced atrial flutter lasting for less than 24 h during therapy and remission of atrial fibrillation (all had been submitted to digitalis).

The AF lasted from less than 1 to 12 days with an average of 2. The peak for the first occurrence of AF was on postoperative day 2 with a rise in prevalence to 16 (39%) episodes out of 41.

Only three of the 197 patients in the study population experienced the initial onset of AF during the operation; two patients had atrial fibrillation associated with ventricular tachycardia that occurred during the surgical procedure; one patient (2.4%) out of 41 was discharged from hospital with persistent atrial fibrillation.

In none of the cases, the AF determined cardiovascular failure necessitating the death of patients. The perioperative

Table 3
AF incidence related to the extent of the lung resection[a]

	n	AF (%)	*P*-value
Pneumonectomy	45	16 (35)	0.01
Extrapericardial	12	4 (34)	0.01
Intrapericardial	33	12 (36)	NS
Lobectomy	104	24 (23)	NS
RS	33	10 (30)	NS
M	8	0	NS
RI	23	3 (13)	NS
LS	28	9 (32)	NS
LI	12	2 (17)	NS
Wedge-resection	48	1 (2)	0.01

[a] RS, right superior; M, middle lobe; RI, right inferior; LS, left superior; LI, left inferior; AF, atrial fibrillation or flutter; NS, not significant.

Table 4
Incidence of AF related to the type of surgical resection particularly focused to the management of different pulmonary veins[a]

Procedure	*n*	AF	%	*P*-value
Pneumonectomy	45	16	35	0.01
Lobectomy	104	24	23	NS
Superior	61	19	31	0.02
Inferior	35	5	17	NS
Middle lobe	8	0	0	NS

[a] Incidence of AF in pneumonectomy versus superior lobectomy: $P = \text{NS}$; incidence of AF in pneumonectomy versus inferior lobectomy: $P = 0.03$; incidence of AF in superior lobectomy versus inferior lobectomy: $P = 0.07$; AF, atrial fibrillation or flutter; NS, not significant.

mortality rate in this series was 2.3% after pneumonectomy (one patient died from massive pulmonary embolism on postoperative day 3) and 1% after lobectomy (one patient died from acute respiratory insufficiency occurred during pneumonia on postoperative day 8). Overall perioperative mortality rate was 1.2%.

As shown in Tables 5 and 6, numerous preoperative and postoperative clinical and physiological variables were not significantly enhanced with the development of postoperative AF after pulmonary resection. Influence of age and extent of the pulmonary resection are shown in Table 7.

4. Discussion

The goal of thoracic surgical oncology is the extirpation of malignancies with the preservation of the functional status of the patient.

Pneumonectomy was initially performed in all patients affected by non-small cell lung cancer. Later it become apparent that a curative resection could be obtained with lobectomy in many cases, preserving more lung tissue. Pneumonectomy remains useful for patients whose tumour is centrally located, invades across fissures and involves both lobes on the left or the upper and lower lobes on the right. Another actual application of pneumonectomy is in the multidisciplinary management of selected patients with malignant pleural mesothelioma.

Arrhythmias occurring after thoracic operations have different reported prevalence from 3.8 to 37% after non-cardiac thoracic operations or resectional lung operations and 10.3–29.4% after pneumonectomy [2,4,6–10].

Previously stated risk factors for the development of AF after pulmonary resection include malignant disease, sex, preoperative pulmonary functional test, increasing age, side of procedure, extent of resection, postural change, anaesthetic agents, mediastinal dissection and intrapericardial pneumonectomy. Many authors experienced opposite opinions on these factors [2,3,5,10,11].

Some reviewers might suggest a greater incidence of AF with malignant disease because more patients subjected to

Table 5
Parameters analysed as potential predictors for development of AF after pulmonary resection[a]

Parameter	Pne	AF (%)	*P*-value	Lob	AF (%)	*P*-value
Diabetes	4	2 (50)	NS	12	2 (17)	NS
Hypertension	34	8 (25)	NS	47	11 (23)	NS
Cardiac history						
(MI, angina, CAD, ECG+)	3	2 (66)	NS	17	7 (41)	NS
Beta-blocker	1	0	NS	24	5 (21)	NS
Smoking history	35	15 (40)	NS	96	23 (24)	NS
1–10 pack/year	1	1 (100)	NS	9	1 (11)	NS
11–20 pack/year	4	2 (50)	NS	18	4 (22)	NS
21–30 pack/year	7	2 (28)	NS	28	6 (21)	NS
31–40 pack/year	12	5 (45)	NS	27	6 (22)	NS
>40 pack/year	11	5 (45)	NS	13	5 (38)	NS
Hypertrophy on ECG	17	5 (29)	NS	27	6 (22)	NS
PAC on ECG	4	1 (25)	NS	12	1 (8)	NS

[a] Pne, pneumonectomy; Lob, lobectomy; MI, myocardial infarction; CAD, coronary artery disease; ECG, electrocardiogram; PAC, premature atrial contraction; AF, atrial fibrillation or flutter; ECG+, electrocardiographic signs of previous myocardial infarction; NS, not significant.

pneumonectomy have malignant disease and AF which are more common with pneumonectomy.

Overall, sex was not found to be a predictor for the development of arrhythmia after lung resection. Some authors tried to show a correlation between pre- and postoperative blood gases values and pulmonary function tests with the development of postoperative dysrhythmias; this was not proved by any one and we agree with them [4,6]; a weakness of most studies including ours is that arterial blood gases are not always obtained at the time of onset of SVD.

Some authors have shown an increasing incidence of AF with increasing age [4,10]. Older patients had a greater incidence of AF: the incidence of AF in patients older than 64 years, the median age of our studies was 30 of 96 (31.25%) compared with those younger 14 of 101 (13.86%) ($P < 0.01$).

Asamura et al. [2] and Stougard [10] have shown a relationship between the extent of pulmonary resection and the development of postoperative AF. We substantiate this finding in our studies where the incidence of AF was quite null in non-anatomic resection (wedge-resection) and increased in anatomic ones: 23% in lobectomy ($P < 0.05$ versus wedge-resection) and 35% in pneumonectomy ($P < 0.05$ versus wedge-resection).

In some studies, the intrapericardial extent of the procedure in performing pneumonectomy is related with increased development of AF than for extrapleural pneumonectomy [6]; in our study, the incidence of AF is quite similar for both intra- and extrapericadial pneumonectomy.

All anaesthetic agents currently used are potentially arrhythmogenic. Digoxin has been shown to protect from the negative inotropic effects of halothane [12] and a study of propofol has shown no association with arrhythmia [13,14], but the higher incidence of arrhythmia in the postoperative and 24 h postoperative period when anaesthetic agents are still present is significant in pneumonectomy patients and suggests than an association may be important.

Despite many speculations, the direct cause of AF after

Table 6
Continuous variables analysed as potential predictors of development of supraventricular dysrhythmia after pulmonary resection[a]

Variable	AF (+) $n = 45$	AF (−) $n = 152$	*P*-value
FVC (actual) l	3.54 ± 0.95	3.31 ± 0.77	NS
FVC (% predicted)	102.07 ± 19.71	101.87 ± 16.93	NS
FEV1 (actual) l	2.63 ± 0.58	2.41 ± 0.66	NS
FEV1 (% predicted)	90.43 ± 0.17	91.17 ± 20.20	NS
Creatinine (mg/dl)			
Preoperative	0.98 ± 0.17	1.04 ± 0.71	NS
AF onset	0.93 ± 0.18	0.98 ± 0.60	NS
Potassium (mEq/l)			
Preoperative	4.33 ± 0.38	4.26 ± 0.42	NS
AF onset	4.10 ± 0.47	4.09 ± 0.49	NS
Preoperative			
pO_2 (mmHg)	78.52 ± 11.92	80.71 ± 10.70	NS
pCO_2 (mmHg)	36.13 ± 4.65	37.42 ± 3.18	NS
O_2 Sat %	95.56 ± 1.63	95.76 ± 1.42	NS
Postoperative			
O_2 Sat %	94.17 ± 3.63	94.56 ± 2.71	NS

[a] FVC, forced vital capacity (l); FEV1, forced expiratory volume at 1 s, (l); pO_2, partial pressure oxygen; pCO_2, partial pressure carbon dioxide; O_2 Sat %, percent oxygen saturation; AF (+), with episodes of atrial fibrillation or flutter; AF (−), without episodes of atrial fibrillation or flutter; NS, not significant.

Table 7
Age as a predictor for development of supraventricular dysrhythmia after pulmonary resection[a]

Procedure	Average age AF (+)	Average age AF (−)	*P*-value
Pneumonectomy	62.6 ± 10.3	61.6 ± 8.1	NS
Lobectomy	68.5 ± 5.5	62.7 ± 9.8	0.01

[a] AF (+), patients with atrial fibrillation or flutter; AF (−), patients without atrial fibrillation of flutter; NS, not significant.

thoracic operation remains unclear. However, most observers believe that they result from the synergistic action of increased vagal tone, atrial inflammation, pulmonary hypertension, dilation of the right side of the heart and hypoxemia [8,15]. In our studies there were no clinical or instrumental evidences of risk factors like intrapericardial effusion requiring drainage, atrial enlargement, heart insufficiency or failure. Only one episode of pulmonary embolism and one severe pulmonary infection occurred, but they were not associated with rhythm disturbances. Three episodes of sublobar pulmonary infection were referred not associated to AF. The effectiveness of perioperative analgesia was not analysable because the patients' records did not report about quantitative evaluation of this parameter. Other factors such as history of cardiac diseases are probably related with high incidence of postoperative AF, but in our studies they seem not to be significantly associated with the development of rhythm disturbances.

Increased vagal tone in the developing arrhythmias has been evaluated: surgical factors are related to the destruction of cardiac nervous structures. Both sympathetic and parasympathetic cardiac nerves innervate the heart. The vagal and sympathetic fibres emerge, from left and right sides, to form the cardiac plexus located between the aortic arch and the tracheal bifurcation: their filaments accompany the coronary arteries and their branches of division. The extent of pulmonary resection could determine direct damage to the above-mentioned anatomic structures by the dissection of the pulmonary hilum during lung resection or hilar and mediastinal node sampling (in our studies the incidence of AF in patients submitted to wedge-resection is nearly null according to complete respect of the anatomic structures of the pulmonary hilum). The extent of resection (lobectomy versus pneumonectomy) may justify the increased incidence of AF consequently to the management of structures of the hilum by the surgeon and not to the functional impact of the reduction of lung tissue. Dissection of the lymph nodal stations located near the pulmonary hilum seems not to be significantly related with the onset of AF (Table 2; $P = 0.01$) only during right pneumonectomy.

Another factor differentiates the non-anatomic resection of the lung from anatomic ones: the management and ligature before section of the thoracic vessels, such as the pulmonary artery and veins.

In 1966, Nathan and Eliakim [16] reported about the anatomic structure of the junction between the left atrium and the pulmonary veins. Many fibres of the atrial wall, in the immediate vicinity of the pulmonary veins, turn around the opening of these veins forming a sphincter-like structure; some of these fibres may extend to a greater or lesser degree over the vein, contributing to the formation of myocardial sleeves which cover the venous wall to a variable distance [16]. The above-mentioned sphincters around the superior pulmonary veins were in general somewhat thicker and were copious than those around the inferior veins.

Myocardial sleeves extended over the pulmonary vein for a variable distance, which is greater for the superior than for the inferior veins (average 13–18 versus 8–10 mm for the right and left superior versus right and left inferior veins, respectively, as reported by Nathan and Eliakim). In some veins the sleeves extended as far as the hilum of the lung. On the other hand some veins, more often the inferior than superior ones had no myocardial extensions.

During the 1970s some authors reviewed about the recording of spikes during sinus rhythm in the pulmonary veins reflecting the physiologic activation of muscular bands extending from the left atrium to the venous wall confirming an electrical property of the pulmonary veins [17,18]. In 1998, Haissaguerre et al. [19] studied a population of non-surgical patients affected by frequent paroxysms of atrial fibrillation and their electrophysiological study concluded that 94% of the atrial triggers in these patients originated in the pulmonary veins and the earliest activation was found to have occurred 2–4 cm inside the vessels, especially in the superior ones (according to the anatomic observation that the myocardial sleeves is greater in the superior pulmonary vein): pulmonary veins, especially in their proximal tract, are covered by myocardial tissue, with electrical properties which can generate ectopic beats with consequent atrial fibrillation in non-surgical patients.

In our studies, we observed no incidence of AF in wedge-resection patients, 17% AF in inferior lobectomy, 31% AF in superior lobectomy and 35% AF in pneumonectomy (Table 4). Superior lobectomy and pneumonectomy results are significantly related to the onset of postoperative AF.

As reported, there is no statistical difference in the incidence of AF in pneumonectomy versus superior lobectomy (P = NS); pneumonectomy shows significant difference in the incidence of AF versus inferior lobectomy ($P = 0.03$) and superior versus inferior lobectomy patients show a quite significant difference ($P = 0.07$).

Our results indicate a tendency in difference between pneumonectomy or superior lobectomy versus inferior lobectomy patients: the similar rate of AF in pneumonectomy and superior lobectomy, greater than that related to inferior lobectomy is interesting. Does the different anatomic structure of the wall of the upper and inferior vein influence the occurrence of AF after resection surgery of the lung?

During anatomic pulmonary resection after dissection of the main vessels of the pulmonary hilum, the surgeon proceeds to the ligature and sections the proximal trunks of the veins of the lung (one during lobectomy and both superior and inferior during pneumonectomy).

Surgical knots to the wall of the pulmonary veins near the pericardial reflection in lobectomy or extrapericardial pneumonectomy or near the atrial wall in intrapericardial pneumonectomy could probably cause mechanically ischaemic or inflammatory damage to the zone of the venous wall which is often covered by myocardial excitable tissue which could generate ectopic beats conducted to the contiguous atrial myocardium in generating AF.

A prospective study of the risk factors, with particular

focus on an anatomic substrate of arrhythmia after lung resection is mandatory to confirm or exclude this factor in the development of supraventricular disturbances of the cardiac rhythm.

In our studies, prophylaxis on the incidence and clinical outcome of atrial arrhythmias were not carried out. Until a few years ago, the significant effectiveness of antiarrhythmic drugs after thoracic operations in the prophylaxis of the AF was debatable. During the last years, some studies demonstrated the effectiveness of beta-blockers and class III antiarrhythmics (amiodarone and ibutilide), in reducing the AF incidence after cardiac operations such as valvular operations or coronary artery bypass grafting [20–22]. Prophylactic use of these drugs showed significant effect on arrhythmic incidence such as related mortality, hospital stay and cost. In 2000, Amar et al. [23] published the first large, randomised, controlled trial to demonstrate that diltiazem clearly prevents occurrence of AF after major thoracic operations. Prophylactic drugs proved safe and nearly halved the incidence of clinically significant AF in patients known to be at increased risk for this complication.

Other randomised controlled trials to test prophylactic effects of drugs on the incidence of AF are mandatory to confirm these results in thoracic non-cardiac patients.

5. Conclusions

Postoperative AF is a frequent and serious complication in elderly patients undergoing major thoracic operations. In our retrospective studies, AF did not seem to influence postoperative morbidity and mortality but other authors reported AF commonly associated with haemodynamic compromise, greater need for ICU stay, increased hospital stay and readmission and stroke. The effective causes of development of postoperative AF in thoracic surgery is not completely clear, and our present study demonstrates a significant increased incidence of AF in pneumonectomy and upper lobectomy versus inferior lobectomy, which probably could be related to the different anatomic structure of the upper versus inferior pulmonary vein. Since the causes of postoperative rhythm disturbances and their treatment will be completely understood and an anatomic basis of the postoperative development of AF in major pulmonary surgery would be demonstrated, the prophylactic use of cardiac active drugs (demonstrated effective by other authors) should be considered as the only way to secure low-risk surgical procedures, especially in elderly patients.

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