

Repercussions of Atrial Fibrillation in Cardiac Surgery

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ABSTRACT

Introduction: Atrial fibrillation is a well-tolerated complication in most individuals, being a temporary problem associated with cardiac surgery. However, it can be life threatening in elderly patients and/or patients with left ventricular dysfunction.

Materials and methods: This is a retrospective cross-sectional study with the objective of investigating the repercussions of atrial fibrillation in patients during the postoperative period of cardiac surgery at a hospital in Maranhao, Brazil. The sample was composed of 29 medical records of adult patients undergoing valve replacement and/or myocardial revascularization who developed atrial fibrillation in the postoperative period between the years 2016 to 2017.

Results and discussion: The project was sent to the Research Ethics Committee of the university hospital that hosted the study, and was granted the favourable Opinion ne 2855350. Atrial fibrillation had an incidence of 13.3%. Valve replacement surgery (62.1%) was the most prevalent. In myocardial revascularization (34.5%) the prevalent duration was of 3 to 4 hours (41.4%), with extracorporeal circulation (96.6%) lasting 81 to 120 minutes (62.1%). The prevalent length of hospital stay was more than 40 days (27.6%), and the length of stay in the Cardiac ICU, 6 to 14 days (44.9%). Hemodynamic instability (34.5%) and increased bleeding (17.2%) were the main complications. Beta-blockers (27, 93.1%), heparin/enoxaparin (26, 89.7%) and vasoactive drugs (20, 69%) were the most used. More than half of the patients had atrial valve fibrillation (65.5%), in the mediate postoperative period (65.5%), of paroxysmal type (72.5%), with rapid ventricular response (79.3%), and 2 or 3 episodes (55.2%). All episodes of

atrial fibrillation developed within the first seven days of hospitalization.

Conclusion: The prevalent treatment was drug therapy with amiodarone (86.2%) and beta-blockers (93.1). Electrical cardioversion (17.2%) and electrical defibrillation (10.3%) were also used, with low incidence (13.3%). The repercussions of atrial fibrillation were longer hospital stay, increased number of complications and prolonged drug therapy.

INTRODUCTION

According to the World Health Organization (WHO), cardiovascular diseases are the main cause of death in the world. These diseases affect the heart, blood vessels, or both and it is estimated that 17.7 million people died from cardiovascular diseases in 2015. This number represents of total deaths worldwide 31%, and at least three quarters of deaths for cardiovascular diseases occur in low and middle income countries. In Brazil, about 300 thousand deaths per year are due to this cause^[1].

The prevalence of atrial fibrillation (AF) in the general population is 0.5% to 1%, and this number may be much higher because 10% to 25% of cases are asymptomatic and progressively increase with aging. Men are more susceptible to developing such an arrhythmia, but there are more women affected, a fact that can be explained by the greater survival of women^[2]. It is recognized that the incidence of AF has had a steady increase in recent decades worldwide, especially due to the higher prevalence of older people undergoing cardiac surgery. The high incidence of AF in the postoperative period of cardiac surgery calls attention to the importance of identifying patients at risk for the development of this arrhythmia^[3].

The symptomatology of AF vary according to the irregularity of the rhythm, myocardial functional status, duration of the AF episode in which complaints of palpitations are common, chest pain, dyspnoea, fatigue, dizziness and, in unusual cases, syncope, and bradycardia after reversion of arrhythmia^[4]. Amiodarone is very effective in reversing and maintaining sinus rhythm. In some cases it is necessary to use invasive procedures to reverse the condition. Ablation is widely used; tissue triggering or sustaining the abnormal heart rhythm is cauterized, with eventual three-dimensional mapping support to increase effectiveness. But in some cases, not even radiofrequency catheter ablation of atrial arrhythmias is effective. In these cases, Cox/Maze III procedure is considered the gold standard, in which incisions in the right and left atrium are constructed to interrupt the disorganized multiple re-entrant circuits that characterize FA^[2-5]. This study aimed to identify the repercussions of AF in patients in the post-operative period of cardiac surgery.

MATERIALS AND METHODS

Retrospective, cross-sectional study performed at the Cardiac Surgery Service of a University Hospital (UH) of federal public nature, the Hospital of the Federal University of Maranhao (HUUFMA). This is a tertiary care institution considered a reference in the state of Maranhao for highly complex procedures in cardiology. Initially, a survey of cardiac surgeries performed in the period 2016 to 2017 was carried out in the database of the Cardiac Surgery Service of the UH. Then the medical records were sought in the Medical and Statistical Archive (SAME) of the institution. The study population comprised 218 medical records of patients of both sexes who underwent cardiac surgery from January 1, 2016, to December 31, 2017. The sample consisted of 29 medical records. The inclusion criteria were medical records of adult patients who underwent coronary artery bypass graft surgery and/or valve replacement surgery in the period from 2016 to 2017. Patients under 18 years of age who had undergone previous cardiac surgery and/or had another cardiac arrhythmia were excluded. Data collection was carried out from September to October 2018 at the SAME of the UH. The sample was represented by 29 records of patients submitted coronary artery bypass graft surgery and/or valve replacement for the first time and who developed AF in the postoperative period.

RESULTS

Of the 29 medical records of patients who developed AF in the postoperative period of valve repair/replacement surgery and/or myocardial revascularization, with 5.0% in 2016 and 8.2% in 2017, the incidence was of 13.3%.

Table 1. Frequency distribution of surgical and hospitalization data of patients with atrial fibrillation (AF) in cardiac surgery.

Variables	N	%
Type of Surgery		
Myocardial revascularization (MR)	10	34.5
Mitral valve replacement/repair (MVRR)	8	27.5
Aortic valve replacement/repair (AVRR)	5	17.2
Double mitral + aortic valve replacement	2	6.9
Aortic valve re-replacement	2	6.9
Mitral valve re-replacement	1	3.5
MVRR + MR	1	3.5
Number of vein grafts (MR)		
One	1	9.1
Two	4	36.4
Three	6	54.5
Surgery time		
Less than 3 hours	3	10.4
3 to 4 hours	12	41.4
4 to 5 hours	9	31
More than 5 hours	5	17.2
Left atrial exclusion		
Yes	6	20.7
No	23	79.3
Extracorporeal circulation (ECC)		
Yes	28	96.6
No	1	3.4
ECC time		
< 40 minutes	1	3.4
41 - 80 minutes	2	7
81 - 120 minutes	18	62.1
121 - 160 minutes	6	20.7
> 160 minutes	1	3.4
Length of hospital stay (mean = 32.9 years)		
Up to 15 days	5	20.8
16 to 20 days	5	17.2
21 to 30 days	5	17.2

31 to 40 days	5	17.2
More than 40 days	8	27.6
Length of Cardiac ICU stay (mean = 13.2 years)		
Up to 5 days	8	27.6
6 to 14 days	13	44.9
15 to 25 days	3	10.3
More than 25 days	5	17.2
Length of stay in the infirmary (mean = 19.7 years)		
Up to 10 days	8	27.6
10 to 20 days	10	34.5
21 to 30 days	7	24.1
More than 30 days	4	13.8
Complications in the Cardiac ICU		
Haemodynamic instability	10	34.5
Increased bleeding	5	17.2
Atrioventricular block	4	13.8
Embolic stroke	1	3.4
Cardiogenic shock	1	3.4
Other arrhythmias	5	17.2
None	5	17.2
Drug Therapy II		
Beta-blockers	27	93.1
Heparin and enoxaparin	26	89.7
Vasoactive drugs	20	69
ACE* Inhibitors	13	44.8
Warfarin	12	41.4
Diuretics	10	34.5
Calcium channel blockers	8	27.6
Magnesium sulfate	7	24.1
Source: prepared by the author (2019).		
*Angiotensin-converting enzyme.		

According to **Table 1**, valve replacement/repair totaled 19 (65.5%) cases, with a highlight on MVRR 8 (27.5%) followed by AVRR 5 (17.2%). In myocardial revascularization surgery 10 (34.5%), three vein grafts 6 (54.5%) were frequent. The most prevalent surgery time was 3 to 4 hours 12 (41.4%) and almost all used ECC 28 (96.6%) for 81 to 120 minutes 18 (62.1%). The prevalent length of stay in the hospital was more than 40 days 8 (27.6%) with an average time of 32.9 days; in the Cardiac ICU was 6 to 14 days 13 (44.9%) with an average time of 13.2 days; and in the infirmary was 10 to 20 days 10 (34.5%) with an average time of 19.7 days. Hemodynamic instability 10 (34.5%), increased bleeding 5 (17.2%), and drug

therapy with beta-blockers 27 (93.1%), heparin/enoxaparin 26 (89.7%) and vasoactive drugs 20 (69%) such as dobutamine, noradrenaline and sodium nitroprusside stood out as complications in the Cardiac ICU.

Table 2. Frequency distribution of atrial fibrillation (AF) variables of patients undergoing cardiac surgery.

Variables	N	%
Etiology of AF		
Valve surgery	19	65.5
MR surgery	10	34.5
Occurrence of AF		
Cardiac ICU	24	82.8
Surgical center	5	17.2
AF type		
Paroxysmal	21	72.5
Persistent	5	17.2
Permanent	3	10.3
AF intensity		
AF with rapid ventricular response	23	79.3
AF with slow ventricular response	6	20.7
Episodes of AF with rapid ventricular response		
1 episode	6	20.7
2 to 3 episodes	16	55.2
4 to 6 episodes	1	3.4
Episodes of AF with slow ventricular response		
1 episode	6	20.7

As shown in **Table 2**, most patients had AF of valve etiology 19 (65.5%), of paroxysmal type 21 (72.5%), with rapid ventricular response 23 (79.3%), and 2 or 3 episodes 16 (55.2%). Six (20.7%) patients had one AF episode with slow ventricular response. It is noteworthy that all AF episodes were developed in the first seven days of hospitalization, with 24 (82.8%) occurring in the Cardiac ICU and 5 (17.2%) at the end of ECC, in the Surgical Center. In addition to AF, other arrhythmias associated with AF were identified such as atrial flutter 1 (3.4%) and supraventricular paroxysmal tachycardia 2 (6.8%).

Table 3. Frequency distribution of drug and invasive therapy used in patients with atrial fibrillation (AF) in cardiac surgery.

Variables	N	%
Drug treatment of AF		
Beta-blockers	27	93.1
Antiarrhythmic drugs	25	86.2
Injectable amiodarone (loading dose)		
1 dose	14	48.3

2 doses	10	34.5
3 doses	0	0
Injectable amiodarone (maintenance dose)		
1 dose	13	44.8
2 to 3 doses	9	31
4 to 5 doses	1	3.4
Oral amiodarone (dose)		
1 to 15 doses	7	24.1
16 to 30 doses	2	6.8
30 to 45 doses	8	27.5
More than 45 doses	2	6.8
Use of oral amiodarone		
Up to 15 days	15	51.7
16 to 29 days	3	10.3
More than 30 days	3	10.3
Invasive treatment of AF		
Electric cardioversion	5	17.2
Temporary pacemaker	3	10.3
Electrical defibrillation	1	3.4
Source: prepared by the author (2019).		

Table 3 shows that the prevalent treatment of AF involved the use of beta-blockers 27 (93.1%) followed by amiodarone 25 (86.2%). The most used injectable loading 14 (48.3%) and maintenance 13 (44.8%) dose of amiodarone was one dose, and in the case of oral amiodarone was 30 to 45 doses 8 (27.5%). Oral amiodarone was used for up to 15 days 15 (51.7%). The invasive treatments were electrical cardioversion 5 (17.2%) and temporary pacemaker 3 (10.3%). Only one patient underwent electrical defibrillation 1 (3.4%) and there was no ablation or surgical treatment for AF.

DISCUSSION

Surgeries that lasted longer are those related to the greater number of vein grafts and coronary artery bypass surgery combined with valve replacement, significantly increasing the risk of AF [3]. Myocardial revascularization surgery lasts an average of four hours depending on the number of vein grafts, presence of complications, among other factors. In the present study, the number of vein grafts inserted was within the expected range, but the ECC time was greater than the average time of 60 to 90 minutes or up to 85 minutes [6]. Longer ECC time can bring several complications such as increased systemic inflammatory response. However, there are still controversies regarding the relationship between ECC time and the occurrence of AF. It is recognized that the prolonged ECC time favors patient's vulnerability, but in many cases the combination of the patient's risk factors seems to have a greater influence on complications than length of CCE time per se [7,8].

In this research, cardiac surgery time of up to four hours, three vein grafts and relatively high ECC time (81 to 120 minutes) were predominant. No direct relation was seen between advanced age and longer surgery time. On the other hand, type of surgery and number of vein grafts influenced the length of stay. Surgeries that lasted longer were those related to a greater number of vein grafts, and coronary artery bypass surgery combined with valve replacement significantly increased the risk of AF [3].

Myocardial revascularization surgery lasts an average of four hours depending on the number of vein grafts inserted, complications presented, among other factors. In the present study, the number of vein grafts inserted was within the

expected range, but the ECC time was greater than the average time of 60 to 90 minutes or up to 85 minutes^[6]. Longer ECC time can bring several complications such as increased systemic inflammatory response. However, there are still controversies regarding the relationship between ECC time and the occurrence of AF. It is recognized that the prolonged ECC time favors patient's vulnerability, but in many cases the combination of the patient's risk factors seems to have a greater influence on complications than length of CCE time^[7,8].

In the present study, six patients who underwent mitral valve replacement/repair had left atrial exclusion. It is noteworthy that this procedure is done, often, in an attempt to reduce the incidence of thromboembolic phenomena, common in patients with AF. The exclusion seeks to reestablish the outflow of blood, avoiding embolism/thrombosis, although in rare cases, the flow continues reduced by residual tissues even after this procedure^[9].

The majority of patients in the study had a long hospital stay, especially in the Cardiac ICU (6 to 14 days), with double or even triple of the time expected for hospital discharge in patients without AF or other complications. Atrial fibrillation is indicated as one of the main factors increasing the length of hospital stay, because of its short to long-term consequences. It is known that more complications imply changes and prolongation of drug therapy and in some cases more invasive procedures, which is directly linked to longer hospital stay and consequent lower bed turnover and higher costs to the hospital^[10-13].

Studies highlight the occurrence of AF in the first postoperative days of cardiac surgery with great chances of a second episode, with the most critical period being the first 24 hours. There are, however, other factors associated with the occurrence of AF between 36 and 48 h after surgery, namely, advanced age, overweight, Caucasian ethnicity, and mitral valve surgery. This is in line with the results presented in this research, with the only difference being the aspect of ethnicity, as the brown skin color prevailed in the present study. The main AF episodes tend to occur within the first 72 hours and may also occur during the first week, but then the chances decrease significantly from the second postoperative week onwards^[14,15].

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In this research, all patients (n = 29) developed AF in the Cardiac ICU and more than half had 2 or 3 recurrent episodes. Studies highlight the occurrence of AF in the first postoperative days of cardiac surgery with great chances of a second episode, with the most critical period being the first 24 hours. There are, however, other factors associated with the occurrence of AF between 36 and 48 h after surgery, namely, advanced age, overweight, Caucasian ethnicity, and mitral valve surgery. This is in line with the results presented in this research, with the only difference being the aspect of ethnicity, as the brown skin color prevailed in the present study. The main AF episodes tend to occur within the first 72 hours and may also occur during the first week, but then the chances decrease significantly from the second postoperative week onwards^[14,15].

In AF with slow ventricular response, studies indicate that drug therapy is not instituted in 80% of the situations, and the self-limited character of the AF is awaited, that is, the return to spontaneous sinus rhythm. This diverges from the present study; some type of treatment was used in all patients, as for example drug therapy with the use of beta-blockers or amiodarone^[4]. Amiodarone and beta-blockers are still considered first-line medications in the treatment and prevention of AF. Acute episodes, which are rapid and present rapid ventricular response, were the most prevalent and obviously the most worrisome, requiring, in most cases, immediate management and reversal to sinus rhythm^[14-16].

Although there is no consensus on the use of beta-blockers as prophylaxis for AF (depending on the methodology of approach and limitations of the study), this therapy is still widely adopted throughout the hospitalization period, and this was no different in the present study^[3-8-14]. Beta-blockers and anticoagulants were the most used drugs, followed by amiodarone. The drug approach to AF will never be directed only to the arrhythmia, but rather to all the repercussions and risks that it may cause in the body^[17]. Besides the most commonly used anticoagulants, as heparin and acetyl salicylic acid, warfarin is used and it is very effective in preventing embolic events. Studies show the effectiveness of warfarin in reducing the risk of stroke by 68%, indicated in patients with AF and with valve prostheses^[18].

However, some complications may be linked the use of warfarin, and for this reason, constant monitoring of the International Normalized Ratio (INR) is necessary to ensure control and prevention of bleeding and hemorrhage. Warfarin also requires good adherence to treatment and control of lifestyle. Restriction of vitamin K and alcohol intake allows the assessment of anticoagulant therapy in a more appropriate way. The time of use of warfarin by patients was not long (7 to 15 days) in most cases, because treatment for no more than 30 days is recommended. Increased bleeding was the second

most frequent complication in the study, and then hemodynamic instability, thus clearly indicating the importance of assessing the risk/benefit of treatment of AF and prevention of thrombus formation [19,20].

A study showed that magnesium supplementation caused an increase in the risk of developing AF in patients undergoing myocardial revascularization and valve replacement, gradually putting the immediate ion replacement into contradiction [3]. It is noteworthy that apart from beta-blockers, the most widely used medication for AF is amiodarone, a broad-spectrum antiarrhythmic agent that is the most effective for maintenance of sinus rhythm, and undoubtedly of great importance for reducing mortality in cases that need reversion [17-21]. Despite absence of interaction with warfarin [22], amiodarone can bring some complications that deserve attention, due to its vasodilator effect. Thus, vasoactive support may be needed in the case of patients in intensive care. The amiodarone therapy used is related to AF episodes and has major importance in reversing the response of each patient [21].

In the present study, the loading dose was used in the first 24 hours, with an infusion speed of 11 ml/h and the maintenance dose was used after the loading dose, in case the patient continued with fibrillation, with an infusion varying around 10 ml/h. It appears that the injectable doses used in this study were compatible with what values reported in the literature as the most effective approach: 300 mg intravenously, followed by 20 mg/kg in 24 hours. In the case of oral amiodarone, the dose used was of one 200 mg tablet every 8/8 h, 12/12 h, or one tablet per day [17].

In patients with AF episodes with rapid ventricular response, amiodarone was adopted in an equivalent way, as 24 patients used at least one loading dose of this drug [17,22,23]. There was a prevalence of 2 to 3 AF episodes with rapid ventricular response per patient. When the patient does not respond to any drug therapy instituted for reversal of AF and presents hemodynamic disorder or low cardiac output, electrical cardioversion may be indicated. In this study, electrical cardioversion was carried out in five patients, three of them with hemodynamic instability. Atrial fibrillation is the most frequent arrhythmia in the postoperative period of cardiac surgery. More studies are necessary, particularly on important clinical situations such as cerebrovascular accident, increased costs, length of hospital stay and mortality [24,25].

In AF with slow ventricular response, studies indicate that in 80% of the situations, drug therapy is not instituted, and one can wait for the self-limited character (spontaneous return to sinus rhythm) of AF, which differed from the present study, that is, in all patients used some type of treatment, such as drug therapy with the use of beta-blockers or amiodarone [14]. Amiodarone and beta-blockers are still considered first-line medications in the treatment and prevention of AF. Acute episodes, which are fast and present rapid ventricular response, were the most prevalent and obviously the most worrisome, requiring, in most cases, immediate management and reversal therapy for sinus rhythm [14-16].

Although there is no consensus on the use of beta-blockers as prophylaxis for AF, this therapy is still widely adopted throughout the hospitalization period, and it was no different in the present study [3,8-14]. Beta-blockers and anticoagulants were the most used drugs, followed by amiodarone. The drug approach to AF is never directed only to the arrhythmia itself, but to all the repercussions and risks that the episode can cause in the body [17]. In addition to the most commonly used anticoagulants such as heparin and acetyl salicylic acid, there is warfarin, which is very effective in preventing embolic events. Studies show the effectiveness of warfarin in reducing the risk of stroke by 68%, indicated in patients with AF and with valve prostheses [18]. However, there are complications that may be linked to its use, which requires constant monitoring of the International Standard Ratio (INR) to ensure control and prevention of bleeding and bleeding. Increased bleeding was the second most frequent complication in the study after hemodynamic instability, which seems clear the importance of assessing the risk/benefit in the treatment of AF and prevention of thrombus formation [19,20].

A study showed that magnesium supplementation caused an increase in the risk of developing AF in patients undergoing myocardial revascularization and valve replacement, gradually putting the immediate ion replacement into contradiction [3]. It is noteworthy that apart from beta-blockers, the most widely used medication for AF is amiodarone, a broad-spectrum antiarrhythmic agent that is the most effective for maintenance of sinus rhythm, and undoubtedly of great importance for reducing mortality in cases that need reversion [17-21]. It appears that the injectable doses of amiodarone used in the study were compatible with what the literature shows as the most effective approach: 300 mg intravenously, followed by 20 mg/kg in 24 hours [17].

Despite absence of interaction with warfarin [26] amiodarone can bring some complications that deserve attention, due to its vasodilator effect. Thus, vasoactive support may be needed in the case of patients in intensive care. It is noteworthy that the amiodarone therapy used is related to AF episodes and has major importance for reversing the response of each patient [21]. In the present study, more than half (69%) of the patients used amiodarone in addition to vasoactive drugs. The AF episodes were compatible with the recommended therapy, that is, proportional to the number of injected doses administered. Therefore, the therapy with amiodarone and beta-blockers proved to be effective, and there was only one death in the sample. In all cases the arrhythmia was reversed while the patient was still in the Cardiac ICU, even though the length of hospital stay was prolonged.

In patients with AF episodes with rapid ventricular response, amiodarone was adopted in an equivalent way, as 24 patients used at least one loading dose of this drug [22,23]. There was a prevalence of 2 to 3 AF episodes with rapid

ventricular response per patient. When the patient does not respond to any drug therapy instituted for reversal of AF and presents hemodynamic disorder or low cardiac output, electrical cardioversion may be indicated. In this study, electrical cardioversion was carried out in five patients, three of them with hemodynamic instability. Atrial fibrillation is the most frequent arrhythmia in the postoperative period of cardiac surgery. More studies are necessary, particularly on important clinical situations such as cerebrovascular accident, increased costs, length of hospital stay and mortality^[24-26].

CONCLUSION

The incidence of AF was 13.3%, which is considered low. Valve replacement/repair totaled 19 (65.5%) cases and myocardial revascularization surgery, 10 (34.5%), with mostly three vein grafts 6 (54.5%). The prevalent time of surgery was 3 to 4 hours 12 (41.4%) and length of hospital stay, more than 40 days 8 (27.6%). Length of stay in the Cardiac ICU was from 6 to 14 days 13 (44.9%), and in the infirmary, 10 to 20 days 10 (34.5%). Hemodynamic instability 10 (34.5%) and increased bleeding 5 (17.2%) stood out as complications in the Cardiac ICU, and beta-blockers 27 (93.1%), heparin/enoxaparin 26 (89.7%), vasoactive drugs 20 (69%) as drug therapy. Almost the whole sample used ECC 28 (96.6%), with a time of 81 to 120 minutes 18 (62.1%).

Most patients had AF of valve etiology 19 (65.5%), of paroxysmal type 21 (72.5%), with rapid ventricular response 23 (79.3%), and 2 or 3 episodes 16 (55.2%). All AF episodes were developed in the first seven days of hospitalization, with 24 (82.8%) occurring in the Cardiac ICU and 5 (17.2%) at the end of ECC, in the Surgical Center. Treatment of AF predominantly involved beta-blockers 27 (93.1%) followed by amiodarone 25 (86.2%) and the invasive treatments (unstable AF) were electrical cardioversion 5 (17.2%), temporary pacemaker 3 (10.3%), and electrical defibrillation 1 (3.4%) for unstable AF. All episodes of AF, regardless of intensity or duration, had a drug or invasive approach; wait for spontaneous reversal was not adopted in any of the cases.

There was no direct relation between advanced age and longer surgery time, but type of surgery and number of vein grafts influenced the length of stay. The repercussions of AF were longest length of hospitalization, greater number of complications and prolongation of drug therapy.

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